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# Principles of MACROECONOMICS

## An Open Text

by Douglas Curtis and Ian Irvine

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Douglas Curtis and Ian Irvine

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# Table of Contents

# About the Authors

**Doug Curtis** is a specialist in macroeconomics. He is the author of numerous research papers on fiscal policy, monetary policy, and economic growth and structural change. He has also prepared research reports for Canadian industry and government agencies and authored numerous working papers. He completed his PhD at McGill University, and has held visiting appointments at the University of Cambridge and the University of York in the United Kingdom. His current research interests are monetary and fiscal policy rules, and the relationship between economic growth and structural change. He is Professor Emeritus of Economics at Trent University in Peterborough, Ontario, and also held an appointment as Sessional Adjunct Professor in the Department of Economics at Queen's University in Kingston, Ontario from 2003 until 2013.

**Ian Irvine** is a specialist in microeconomics, public economics, economic inequality and health economics. He is the author of numerous research papers in these fields. He completed his PhD at the University of Western Ontario, has been a visitor at the London School of Economics, the University of Sydney, the University of Colorado, University College Dublin and the Economic and Social Research Institute. His current research interests are in tobacco use and taxation, and Canada's Employment Insurance and Welfare systems. He has done numerous studies for the Government of Canada, and is currently a Professor of Economics at Concordia University in Montreal.

## Our Philosophy

*Principles of Macroeconomics* is focused on the material that students need to cover in a first introductory course. It is slightly more compact than the majority of introductory macroeconomics books in the Canadian marketplace. Decades of teaching experience and textbook writing has led the authors to avoid the encyclopedic approach that characterizes the recent trends in textbooks.

Consistent with this approach, there are no appendices or 'afterthought' chapters. If important material is challenging then it is still included in the main body of the text; it is not relegated elsewhere for a limited audience; the text makes choices on what issues and topics are important in an introductory course. This philosophy has resulted in a Macro book of just 13 chapters, with three introductory chapters common to both our *Principles of Microeconomics* and *Principles of Macroeconomics* books.

Examples are domestic and international in their subject matter and are of the modern era – financial markets, monetary and fiscal policies aimed at inflation and debt control, globalization and the importance of trade flows in economic structure and concerns about slow growth and the risk of deflation are included.

The title is intended to be informative. Students are introduced to the concepts of models early, and the working of such models is illustrated in every chapter. While this book avoids calculus and uses algebra sparingly, it still aims to be rigorous. In contrast to many books on the market that simply insert diagrams and discuss concepts in a diagrammatic framework, our books develop and analyze key concepts and relations by introducing numerical and empirical examples at the outset. Students are introduced immediately to the practice of taking a set of data, examining it numerically, plotting it and thinking about how it illustrates a concept or relationship. The process is not difficult but it is rigorous and stresses the link between empirical observation, economic theory, models and policy. Hence numerical examples, diagrams, and straight line equations and are introduced early and are used throughout.

## Structure of the Text

*Principles of Macroeconomics* provides complete, concise coverage of introductory macroeconomic theory and policy. It examines the Canadian economy as an economic system, and embeds current Canadian institutions and approaches to monetary policy and fiscal policy within that system. Particular attention is given to the recent structure, performance, and evolution of the Canadian economy, and to the current targets and instruments of Canadian monetary and fiscal policy.

These are exciting and challenging times in which to study macroeconomics. We focus on short-run macroeconomic performance, analysis, and policy motivated by the recessions of the early 1980s and 1990s, the financial crisis and recession of 2008-2009, and the prolonged recovery that is still incomplete in most industrial countries in 2015. To that end, the text examines macroeconomic institutions, performance, and policies in ways that help students understand and evaluate critically the news media coverage and broader public discussion of:

- Recessions and recoveries, unemployment, inflation, deflation and conditions in financial markets—topics of ongoing reporting, discussion, and debate.
- Monetary and fiscal policy announcements and discussions focused on inflation targets, interest rate settings, budget balances, tax rates, expenditures, and public debt targets as these affect economic performance.
- Exports, imports, international capital flows, foreign exchange rates, commodity prices and the importance of the international sector of the Canadian economy.
- Economic growth, productivity growth, and the importance of productivity growth for standards of living in Canada and other countries.

A basic modern Aggregate Demand and Supply model of real GDP and the *inflation rate* is developed based on:

- Expenditure decisions by households and businesses in an open economy.
- Government sector expenditures, taxes and budgets.
  - Current Canadian monetary policy based on inflation targets, interest rate policy in-

struments, and current Bank of Canada operating techniques, including the potential for quantitative or credit easing.

– Current Canadian fiscal policy based on deficit and debt control targets, the government's budget function, the temporary shift to fiscal stimulus in 2009, the subsequent fiscal austerity designed to achieve a balanced budget by 2015 and the implications for economic performance and the public debt.

Numerical examples, diagrams, and basic arithmetic are used in combination to illustrate and explain economic relationships. Students learn about: The importance of consumption, capital expenditures, and government budgets; money supply; financial asset prices, yields, and interest rates; employment and unemployment; and other key relationships in the economy. Canadian and selected international data are used to provide real world examples and comparisons.

# Part One

## The Building Blocks



Economics is a social science; it analyzes human interactions in a scientific manner. We begin by defining the central aspects of this social science – trading, the marketplace, opportunity cost and resources. We explore how producers and consumers interact in society. Trade is central to improving the living standards of individuals. This material forms the subject matter of Chapter 1.

Methods of analysis are central to any science. Consequently we explore how data can be displayed and analyzed in order to better understand the economy around us in Chapter 2. Understanding the world is facilitated by the development of theories and models and then testing such theories with the use of data-driven models.

Trade is critical to individual well-being, whether domestically or internationally. To understand this trading process we analyze the behaviour of suppliers and buyers in the marketplace. Markets are formed by suppliers and demanders coming together for the purpose of trading. Thus, demand and supply are examined in Chapter 3 in tabular, graphical and mathematical form.

# Chapter 1

## Introduction to key ideas

**In this chapter we will explore:**



## 1.1 What's it all about?

### The big issues

Economics is the study of human behaviour. Since it uses scientific methods it is called a social science. We study human behaviour to better understand and improve our world. During his acceptance speech, a recent Nobel Laureate in Economics suggested:

> *Economics, at its best, is a set of ideas and methods for the improvement of society. It is not, as so often seems the case today, a set of ideological rules for asserting why we cannot face the challenges of stagnation, job loss and widening inequality.*
>
> Christopher Sims, Nobel Laureate in Economics 2011

This is an elegant definition of economics and serves as a timely caution about the perils of ideology. Economics evolves continuously as current observations and experience provide new evidence about economic behaviour and relationships. Inference and policy recommendations based on earlier theories, observations and institutional structures require constant analysis and updating if they are to furnish valuable responses to changing conditions and problems.

Much of today's developed world faces severe challenges as a result of the financial crisis that began in 2008. Unemployment rates among young people are at historically high levels in several economies, government balance sheets are in disarray, and inequality is on the rise. In addition to the challenges posed by this severe economic cycle, the world simultaneously faces structural upheaval: Overpopulation, climate change, political instability and globalization challenge us to understand and modify our behaviour.

These challenges do not imply that our world is deteriorating. Literacy rates have been rising dramatically in the developing world for decades; child mortality has plummeted; family size is a fraction of what it was 50 years ago; prosperity is on the rise in much of Asia; life expectancy is increasing universally and deaths through wars are in a state of long-term decline.

These developments, good and bad, have a universal character and affect billions of individuals. They involve an understanding of economies as large organisms with interactive components. The study of economies as large interactive systems is called **macroeconomics**. Technically, macroeconomics approaches the economy as a complete system with interactions and feedback effects among sectors that determine national economic performance. These interactions and feedbacks within the system mean that the operation of the macro-economy is more complex than the operation of the sum of its parts.

Application Box 1.1 gives an example.

> **Macroeconomics**: the study of the economy as a system in which interactions and feedbacks among sectors determine national output, employment and prices.

## Individual behaviours

Economic actions, at the level of the person or organization, form the subject matter of microeconomics. Formally, **microeconomics** is the study of individual behaviour in the context of scarcity. Not all individual behaviours are motivated by self-interest; many are motivated by a concern for the well being of society-at-large. Philanthropic societies are goal-oriented and seek to attain their objectives in an efficient manner.

> **Microeconomics**: the study of individual behaviour in the context of scarcity.

Individual economic decisions need not be world-changing events, or motivated by a search for profit. Microeconomics is also about how we choose to spend our time and money. There are quite a few options to choose from: Sleep, work, study, food, shelter, transportation, entertainment, recreation and so forth. Because both time and income are limited we cannot do all things all the time. Many choices are routine or are driven by necessity. You have to eat and you need a place to live. If you have a job you have committed some of your time to work, or if you are a student some of your time is committed to lectures and study. There is more flexibility in other choices. Critically, microeconomics seeks to understand and explain how we make choices and how those choices affect our behaviour in the workplace, the marketplace, and society more generally.

A critical element in making choices is that there exists a *scarcity* of time, or income or productive resources. Decisions are invariably subject to limits or constraints, and it is these constraints that make decisions both challenging and scientific.

Microeconomics also concerns business choices. How does a business use its funds and management skill to produce goods and services? The individual business operator or firm has to decide what to produce, how to produce it, how to sell it and in many cases, how to price it. To make and sell pizza, for example, the pizza parlour needs, in addition to a source of pizza ingredients, a store location (land), a pizza oven (capital), a cook and a sales person (labour). Payments for the use of these inputs generate income to those supplying them. If revenue from the sale of pizzas is greater than the costs of production, the business earns a profit for the owner. A business fails if it cannot cover its costs.

In these micro-level behaviours the decision makers have a common goal: To do as well as they can, *given the constraints imposed by the operating environment*. The individual wants to mix work and leisure in a way that makes her as happy or contented as possible. The entrepreneur aims at making a profit. These actors, or agents as we sometimes call them, are *maximizing*. Such maximizing behaviour is a central theme in this book and in economics at large.

**Application Box 1.1: Macroeconomic interactions – the paradox of thrift**

Finance Minister Jim Flaherty and Bank of Canada Governor Mark Carney in 2011 urged Canadian households to increase their savings in order to reduce their record high debt-to-income ratio. On an individual level this makes obvious sense. If you could save more and spend less you could pay down the balances on credit cards, your line of credit, mortgage and other debts.

But one household's spending is another household's income. For the economy as a system, an increase in households' saving from say 5 percent of income to 10 percent reduces spending accordingly. But lower spending by all households will reduce the purchases of goods and services produced in the economy, and therefore has the potential to reduce national incomes. Furthermore, with lower income the troublesome debt-to-income ratio will not fall, as originally intended. Hence, while higher saving may work for one household in isolation, higher saving by all households may not. The interactions and feedbacks in the economic system create a '**paradox of thrift**'.

The paradox can also create problems for government finances and debt. Following the recession that began in 2008/09, many European economies with high debt loads cut spending and increased taxes to in order to balance their fiscal accounts. But this fiscal austerity reduced the national incomes on which government tax revenues are based, making deficit and debt problems even more problematic. Feedback effects, within and across economies, meant that European Union members could not all cut deficits and debt simultaneously.

## Markets and government

Markets play a key role in coordinating the choices of individuals with the decisions of business. In modern market economies goods and services are supplied by both business and government. Hence we call them **mixed economies**. Some products or services are available through the marketplace to those who wish to buy them and have the necessary income—as in cases like coffee and wireless services. Other services are provided to all people through government programs like law enforcement and health care.

> **Mixed economy**: goods and services are supplied both by private suppliers and government.

Markets offer the choice of a wide range of goods and services at various prices. Individuals can use their incomes to decide the pattern of expenditures and the bundle of goods and services they prefer. Businesses sell goods and services in the expectation that the market price will cover costs and yield a profit.

The market also allows for specialization and separation between production and use. Rather than each individual growing her own food, for example, she can sell her time or labour to employers in return for income. That income can then support her desired purchases. If businesses can produce food more cheaply than individuals the individual obviously gains from using the market – by both having the food to consume, and additional income with which to buy other goods and services. Economics seeks to explain how markets and specialization might yield such gains for individuals and society.

We will represent individuals and firms by envisaging that they have explicit objectives – to maximize their happiness or profit. However, this does not imply that individuals and firms are concerned only with such objectives. On the contrary, much of microeconomics and macroeconomics focuses upon the role of government: How it manages the economy through fiscal and monetary policy, how it redistributes through the tax-transfer system, how it supplies information to buyers and sets safety standards for products.

Since governments perform all of these society-enhancing functions, in large measure governments reflect the social ethos of voters. So, while these voters may be maximizing at the individual level in their everyday lives, and our models of human behaviour in microeconomics certainly emphasize this optimization, economics does not see individuals and corporations as being devoid of civic virtue or compassion, nor does it assume that only market-based activity is important. Governments play a central role in modern economies, to the point where they account for more than one third of all economic activity in the modern mixed economy.

Governments supply goods and services in many spheres, for example, health and education. The provision of public education is motivated both by a concern for equality and a realization that an educated labour force increases the productivity of an economy. Likewise, the provision of law and order, through our legal system broadly defined, represents more than a commitment to a just society at the individual level; without a legal system that enforces contracts and respects property rights, the private sector of the economy would diminish dramatically as a result of corruption, uncertainty and insecurity. It is the lack of such a secure environment in many of the world's economies that inhibits their growth and prosperity.

Let us consider now the methods of economics, methods that are common to science-based disciplines.

## 1.2 Understanding through the use of models

Most students have seen an image of Ptolemy's concept of our Universe. Planet Earth forms the centre, with the other planets and our sun revolving around it. The ancients' anthropocentric view of the universe necessarily placed their planet at the centre. Despite being false, this view of our world worked reasonably well – in the sense that the ancients could predict celestial motions, lunar patterns and the seasons quite accurately.

More than one Greek astronomer believed that it was more natural for smaller objects such as the earth to revolve around larger objects such as the sun, and they knew that the sun had to be larger as a result of having studied eclipses of the moon and sun. Nonetheless, the Ptolemaic description of the universe persisted until Copernicus wrote his treatise "On the Revolutions of the Celestial Spheres" in the early sixteenth century. And it was another hundred years before the Church accepted that our corner of the universe is heliocentric. During this time evidence accumulated as a result of the work of Brahe, Kepler and Galileo. The time had come for the Ptolemaic *model* of the universe to be supplanted with a better *model*.

All disciplines progress and develop and explain themselves using models of reality. A **model** is a formalization of theory that facilitates scientific inquiry. Any history or philosophy of science book will describe the essential features of a model. First, it is a stripped down, or reduced, version of the phenomenon that is under study. It incorporates the key elements while disregarding what are considered to be secondary elements. Second, it should accord with reality. Third, it should be able to make meaningful predictions. Ptolemy's model of the known universe met these criteria: It was not excessively complicated (for example distant stars were considered as secondary elements in the universe and were excluded); it corresponded to the known reality of the day, and made pretty good predictions. Evidently not all models are correct and this was the case here.

> **Model**: a formalization of theory that facilitates scientific inquiry.

In short, models are frameworks we use to organize how we think about a problem. Economists sometimes interchange the terms theories and models, though they are conceptually distinct. A **theory** is a logical view of how things work, and is frequently formulated on the basis of observation. A model is a formalization of the essential elements of a theory, and has the characteristics we described above. As an example of an economic model, suppose we theorize that a household's expenditure depends on its key characteristics: A corresponding model might specify that wealth, income, and household size determine its expenditures, while it might ignore other, less important, traits such as the household's neighbourhood or its religious beliefs. The model reduces and simplifies the theory to manageable dimensions. From such a reduced picture of reality we develop an analysis of how an economy and its components work.

> **Theory**: a logical view of how things work, and is frequently formulated on the basis of observation.

An economist uses a model as a tourist uses a map. Any city map misses out some detail—traffic lights and speed bumps, for example. But with careful study you can get a good idea of the best route to take. Economists are not alone in this approach; astronomers, meteorologists, physicists, and genetic scientists operate similarly. Meteorologists disregard weather conditions in South Africa when predicting tomorrow's conditions in Winnipeg. Genetic scientists concentrate on the interactions of limited subsets of genes that they believe are the most important for their purpose. Even with huge computers, all of these scientists build *models* that concentrate on the essentials.

## 1.3 Opportunity cost and the market

Individuals face choices at every turn: In deciding to go to the hockey game tonight, you may have to forgo a concert; or you will have to forgo some leisure time this week in order to earn additional income for the hockey game ticket. Indeed, there is no such thing as a free lunch, a free hockey game or a free concert. In economics we say that these limits or constraints reflect opportunity cost. The **opportunity cost** of a choice is what must be sacrificed when a choice is made. That cost may be financial; it may be measured in time, or simply the alternative foregone.

> **Opportunity cost**: what must be sacrificed when a choice is made.

Opportunity costs play a determining role in markets. It is precisely because individuals and organizations have different opportunity costs that they enter into exchange agreements. If you are a skilled plumber and an unskilled gardener, while your neighbour is a skilled gardener and an unskilled plumber, then you and your neighbour not only have different capabilities, you also have different opportunity costs, and *you could gain by trading your skills*. Here's why. Fixing a leaking pipe has a low opportunity cost for you in terms of time: You can do it quickly. But pruning your apple trees will be costly because you must first learn how to avoid killing them and this may require many hours. Your neighbour has exactly the same problem, with the tasks in reverse positions. In a sensible world you would fix your own pipes *and* your neighbour's pipes, and she would ensure the health of the apple trees in both backyards.

If you reflect upon this 'sensible' solution—one that involves each of you achieving your objectives while minimizing the time input—you will quickly realize that it resembles the solution provided by the marketplace. You may not have a gardener as a neighbour, so you buy the services of a gardener in the marketplace. Likewise, your immediate neighbour may not need a leaking pipe repaired, but many others in your neighbourhood do, so you sell your service to them. You each specialize in the performance of specific tasks as a result of having different opportunity costs or different efficiencies. Let us now develop a model of exchange to illustrate the advantages of specialization and trade, and hence the markets that facilitate these activities. This model is developed with the help of some two-dimensional graphics.

## 1.4 A model of exchange and specialization

### Production and specialization

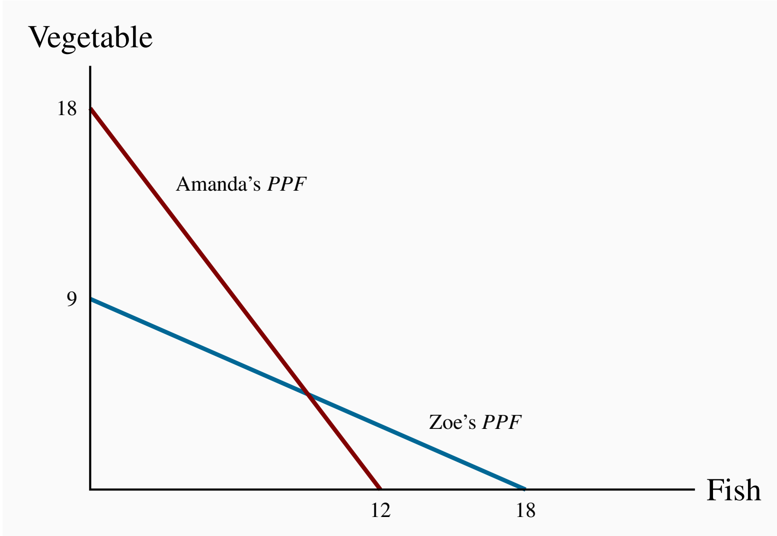
We have two producers and two goods: Amanda and Zoe produce vegetables ($V$) and or fish ($F$). Their production capabilities are defined in Table 1.1 and in Figure 1.1, where the quantity of $V$ appears on the vertical axis and the quantity of $F$ on the horizontal axis. Zoe and Amanda each have 36-hour weeks and they devote that time to producing the two goods. But their efficiencies differ: Amanda requires two hours to produce a unit of $V$ and three hours for a unit of $F$. As a consequence, if she devotes all of her time to $V$ she can produce 18 units, or if she devotes all of her time to $F$ she can produce 12 units. Or, she could share her time between the two. This environment can also be illustrated and analyzed graphically, as in Figure 1.1.

**Table 1.1: Production possibilities in a two-person economy**

| | Hours/ fish | Hours/ vegetable | Fish specialization | Vegetable specialization |
|---|---|---|---|---|
| **Amanda** | 3 | 2 | 12 | 18 |
| **Zoe** | 2 | 4 | 18 | 9 |

Each producer has a time allocation of 36 hours. By allocating total time to one activity, Amanda can produce $12F$ or $18V$, Zoe can produce $18F$ or $9V$. By splitting their time each person can also produce a combination of the two.

**Figure 1.1: Absolute advantage – production**




Amanda's $PPF$ indicates that she can produce either $18V$ (and zero $F$), or $12F$ (and zero $V$), or some combination. Zoe's $PPF$ indicates she can produce either $9V$ (and zero $F$), or $18F$ (and zero $V$), or some combination. Amanda is more efficient in producing $V$ and Zoe is more efficient at producing $F$.

Two-dimensional graphics are a means of portraying the operation of a model, as defined above. We will use these graphical representations throughout the text. In this case, Amanda's production capability is represented by the line that meets the vertical axis at 18 and the horizontal axis at 12. The vertical point indicates that she can produce 18 units of $V$ if she produces zero units of $F$ – keep in mind that where $V$ has a value of 18, Amanda has no time left for fish production. Likewise, if she devotes all of her time to fish she can produce 12 units, since each unit requires 3 of her 36 hours. The point $F = 12$ is thus another possibility for her. In addition to these two possibilities, which we can term 'specialization', she could allocate her time to producing some of each good. For example, by dividing her 36 hours equally she could produce 6 units of $F$ and 9 units of $V$. A little computation will quickly convince us that different allocations of her time will lead to combinations of the two goods that lie along a straight line joining the specialization points. We will call this straight line Amanda's **production possibility frontier** (*PPF*): It is the combination of goods she can produce while using all of her resources – time. She could not produce combinations of goods represented by points beyond this line (to the top right). She could indeed produce combinations below it (lower left) – for example, a combination of 4 units of $V$ and 4 units of $F$; but such points would not require all of her time. The $(4,4)$ combination would require just 20 hours. In sum, points beyond this line are not feasible, and points within it do not require all of her time resources.

**Production possibility frontier (PPF)**: the combination of goods that can be produced using all of the resources available.

Having developed Amanda's *PPF*, it is straightforward to develop a corresponding set of possibilities for Zoe. If she requires 4 hours to produce a unit of $V$ and 2 hours to produce a unit of $F$, then her 36 hours will enable her to specialize in 9 units of $V$ or 18 units of $F$; or she could produce a combination represented by the straight line that joins these two specialty extremes.

Consider now the opportunity costs for each person. Suppose Amanda is currently producing 18 $V$ and zero $F$, and considers producing some $F$ and less $V$. For each unit of $F$ she wishes to produce, it is evident from her PPF that she must sacrifice 1.5 units of $V$. This is because $F$ requires 50% more hours than $V$. Her trade-off is 1.5 : 1.0. The additional time requirement is also expressed in the intercept values: She could give up 18 units of $V$ and produce 12 units of $F$ instead; this again is a ratio of 1.5 : 1.0. This ratio defines her opportunity cost: The cost of an additional unit of $F$ is that 1.5 units of $V$ must be 'sacrificed'.

Applying the same reasoning to Zoe's *PPF*, her opportunity cost is 0.5 : 1; she must sacrifice one half of a unit of $V$ to free up enough time to produce one unit of $F$.

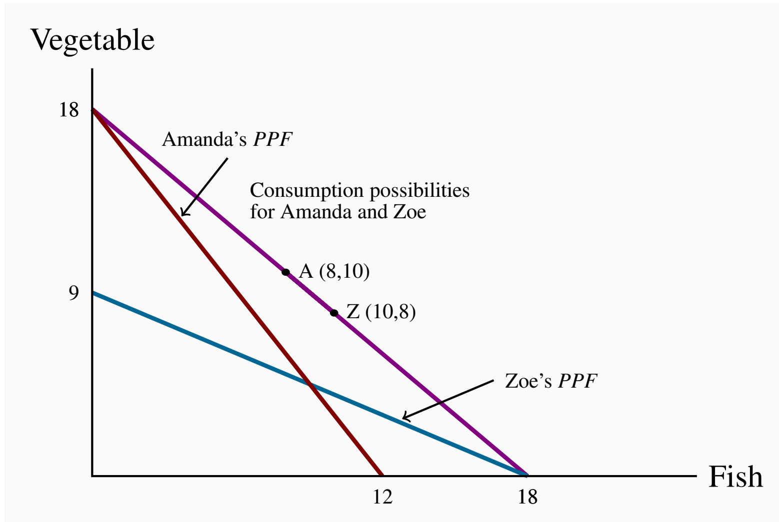
So we have established two things about Amanda and Zoe's production possibilities. First, if Amanda specializes in $V$ she can produce more than Zoe, just as Zoe can produce more than Amanda if Zoe specializes in $F$. Second, their opportunity costs are different: Amanda must sacrifice more $V$ than Zoe in producing one more unit of $F$. The different opportunity costs translate into potential gains for each individual.

## The gains from exchange

We shall illustrate the gains that arise from specialization and exchange graphically. Note first that if these individuals are self-sufficient, in the sense that they consume their own production, each individual's consumption combination will lie on their own *PPF*. For example, Amanda could allocate half of her time to each good, and produce (and consume) $6F$ and $9V$. Such a point necessarily lies on her *PPF*. Likewise for Zoe. So, *in the absence of exchange*, each individual's *PPF* is also her **consumption possibility frontier** (*CPF*). In Figure 1.1 the *PPF* for each individual is thus also her *CPF*.

> **Consumption possibility frontier (CPF)**: the combination of goods that can be consumed as a result of a given production choice.

**Figure 1.2: Absolute advantage – consumption**




With specialization and trade at a rate of 1 : 1 they consume along the line joining the specialization points. If Amanda trades $8V$ to Zoe in return for $8F$, Amanda moves to the point A(8,10) and Zoe to Z(10,8). Each can consume more after specialization than before specialization.

Upon realizing that they are not equally efficient in producing the two goods, they decide to specialize completely in producing just the single good where they are most efficient. Amanda specializes in $V$ and Zoe in $F$. Next they must agree to a rate at which to exchange $V$ for $F$. Since Amanda's opportunity cost is 1.5 : 1 and Zoe's is 0.5 : 1, suppose they agree to exchange $V$ for $F$ at an intermediate rate of 1 : 1. There are many trading, or exchange, rates possible; our purpose is to illustrate that gains are possible for *both* individuals at some exchange rate. The choice of this rate also makes the graphic as simple as possible. At this exchange rate, $18V$ must exchange for $18F$. In Figure 1.2, this means that each individual is now able to consume along the line joining the coordinates $(0,18)$ and $(18,0)$.[1] This is because Amanda produces $18V$ and she can trade at a rate of 1 : 1, while Zoe produces $18F$ and trades at the same rate of 1 : 1.

The fundamental result illustrated in Figure 1.2 is that, as a result of specialization and trade, each individual can consume combinations of goods that lie on a line beyond her initial consumption possibilities. Their consumption well-being has thus improved. For example, suppose Amanda trades away $8V$ to Zoe and obtains $8F$ in return. The points '$A$' and '$Z$' with coordinates $(8,10)$ and $(10,8)$ respectively define their final consumption. Pre-specialization, if Amanda wished to consume $8F$ she would have been constrained to consume $6V$ rather than the $10V$ now possible. Zoe benefits correspondingly.[2]

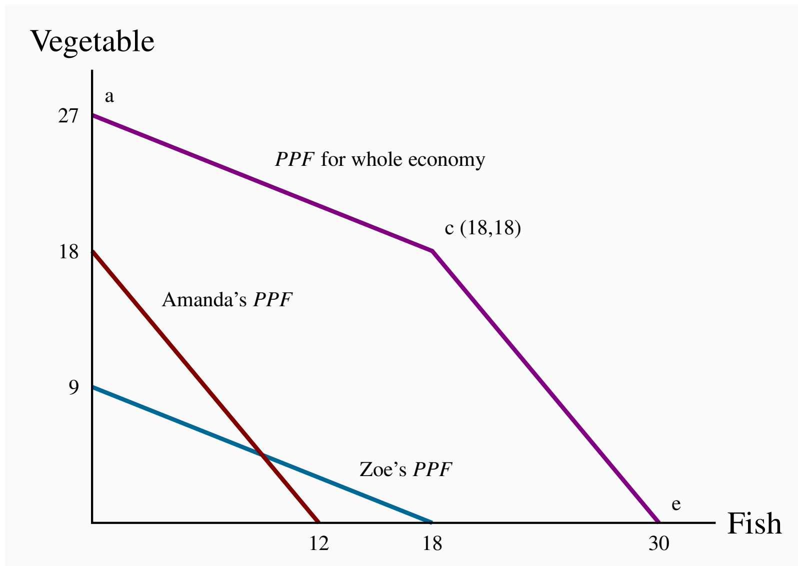
[1] When two values, separated by a comma, appear in parentheses, the first value refers to the horizontal-axis variable, and the second to the vertical-axis variable.

[2] In the situation we describe above one individual is absolutely more efficient in producing one of the goods and absolutely less efficient in the other. We will return to this model in *Principles of Microeconomics* Chapter 15 and illustrate that consumption gains of the type that arise here can also result if one of the individuals is absolutely more

## 1.5 Economy-wide production possibilities

The *PPF*s in Figures 1.1 and 1.2 define the amounts of the goods that each *individual* can produce while using all of their productive capacity—time in this instance. The national, or economy-wide, *PPF* for this two-person economy reflects these individual possibilities combined. Such a frontier can be constructed using the individual frontiers as the component blocks.

**Figure 1.3: Economy-wide PPF**




From a, to produce Fish it is more efficient to use Zoe because her opportunity cost is less (segment ac). When Zoe is completely specialized, Amanda produces (ce). With complete specialization this economy can produce $27V$ or $30F$.

First let us define this economy-wide frontier precisely. The **economy-wide** *PPF* is the set of goods and services combinations that can be produced in the economy when all available productive resources are in use. Figure 1.3 contains both of the individual frontiers plus the aggregate of these, represented by the kinked line *ace*. The point on the $V$ axis, $a = 27$, represents the total amount of $V$ that could be produced if both individuals devoted all of their time to it. The point $e = 30$ on the horizontal axis is the corresponding total for fish.

> **Economy-wide PPF**: the set of goods and services combinations that can be produced in the economy when all available productive resources are in use.

To understand the point $c$, imagine initially that all resources are devoted to $V$. From such a point, $a$, consider a reduction in $V$ and an increase in $F$. The most efficient way of increasing $F$ production at the point $a$ is to use the individual whose opportunity cost is lower. Zoe can produce one unit

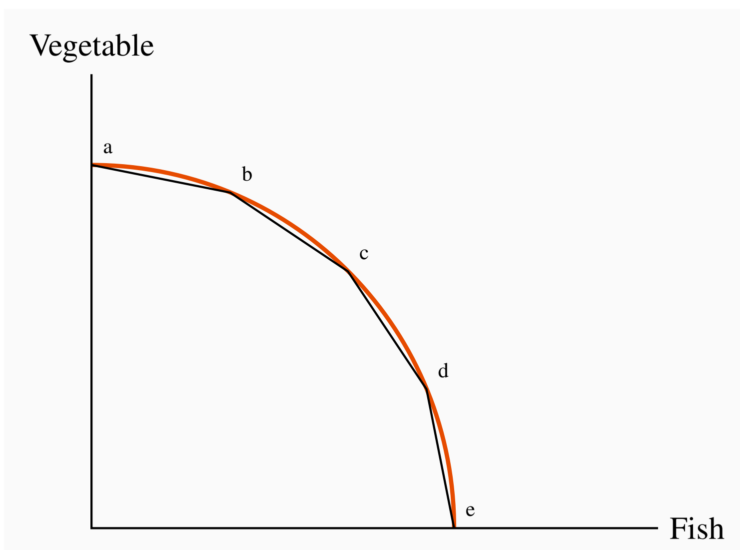
efficient in producing both goods, but that the degree of such advantage differs across goods.

of $F$ by sacrificing just 0.5 units of $V$, whereas Amanda must sacrifice 1.5 units of $V$ to produce 1 unit of $F$. Hence, at this stage Amanda should stick to $V$ and Zoe should devote some time to fish. In fact as long as we want to produce more fish Zoe should be the one to do it, until she has exhausted her time resource. This occurs after she has produced $18F$ and has ceased producing $V$. At this point the economy will be producing $18V$ and $18F$ – the point *c*.

From this combination, if the economy wishes to produce more fish Amanda must become involved. Since her opportunity cost is 1.5 units of $V$ for each unit of $F$, the next segment of the economy-wide *PPF* must see a reduction of 1.5 units of $V$ for each additional unit of $F$. This is reflected in the segment *ce*. When both producers allocate all of their time to $F$ the economy can produce 30 units. Hence the economy's *PPF* is the two-segment line *ace*. Since this has an outward kink, we call it concave (rather than convex).

As a final step consider what this *PPF* would resemble if the economy were composed of many persons with differing efficiencies. A little imagination suggests (correctly) that it will have a segment for each individual and continue to have its outward concave form. Hence, a four-person economy in which each person had a different opportunity cost could be represented by the segmented line *abcde*, in Figure 1.4. Furthermore, we could represent the *PPF* of an economy with a very large number of such individuals by a somewhat smooth *PPF* that accompanies the 4-person *PPF*. The logic for its shape continues to be the same: As we produce less $V$ and more $F$ we progressively bring into play resources, or individuals, whose opportunity cost, in terms of reduced $V$ is higher.

**Figure 1.4: A multi-person PPF**




The PPF for the whole economy, abcde, is obtained by allocating productive resources most efficiently. With many individuals we can think of the PPF as the *concave envelope* of the individual capabilities.

The outputs $V$ and $F$ in our economic model require just one input – time, but if other productive resources were required the result would be still a concave $PPF$. Furthermore, we generally interpret the $PPF$ to define the output possibilities *when the economy is running at its normal capacity*. In this example, we consider a work week of 36 hours to be the 'norm'. Yet it is still possible that the economy's producers might work some additional time in exceptional circumstances, and this would increase total production possibilities. This event would be represented by an outward movement of the $PPF$.

## 1.6 Aggregate output, growth and business cycles

The $PPF$ can be used to illustrate several aspects of macroeconomics: In particular, the level of an economy's output, the growth of national and per capita output over time, and short-run business-cycle fluctuations in national output and employment.

### Aggregate output

An economy's capacity to produce goods and services depends on its endowment of resources and the productivity of those resources. The two-person, two-product examples in the previous section reflect this.

The **productivity of labour**, defined as output per worker or per hour, depends on:

- Skill, knowledge and experience of the labour force;
- **Capital stock**: Buildings, machinery, equipment, and software the labour force has to work with; and
- Current state of technology.

> The **productivity of labour** is the output of goods and services per worker.
>
> An economy's **capital stock** is the buildings, machinery, equipment and software used in producing goods and services.

The economy's output, which we define by $Y$, can be defined as the output per worker times the number of workers; hence, we can write:

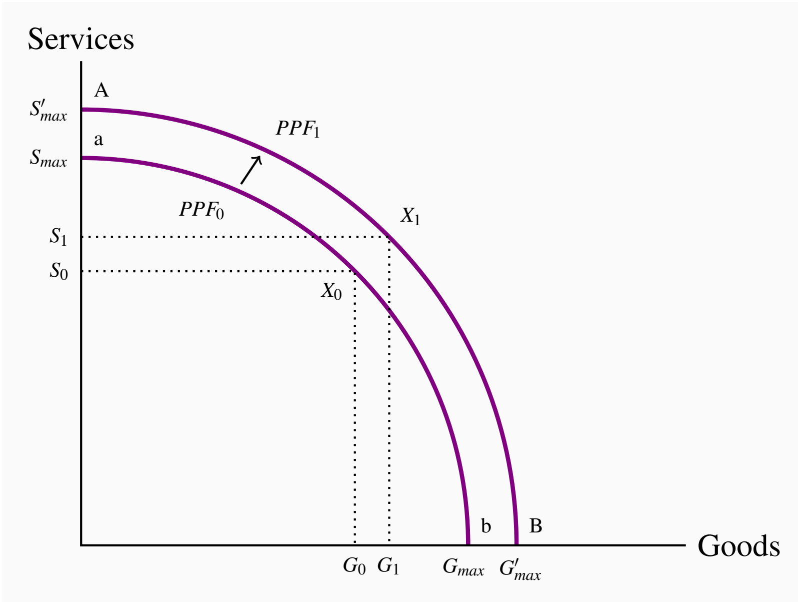
$$Y = (\text{number of workers employed}) \times (\text{output per worker}).$$

When the employment of labour corresponds to 'full employment' in the sense that everyone willing to work at current wage rates and normal hours of work is working, the economy's actual output is also its capacity output $Y_c$. We also term this capacity output as **full employment output**:

**Full employment output** $Y_c$ = (number of workers at full employment) × (output per worker).

Suppose the economy is operating with full employment of resources producing outputs of two types: Goods and services. In Figure 1.5, $PPF_0$ shows the different combinations of goods and services that the economy can produce in a particular year using all its labour, capital and the best technology available at the time.

**Figure 1.5: Growth and the PPF**




Economic growth or an increase in the available resources can be envisioned as an outward shift in the $PPF$ from $PPF_0$ to $PPF_1$. With $PPF_1$ the economy can produce more in both sectors than with $PPF_0$.

An aggregate economy produces a large variety of outputs in two broad categories. Goods are the products of the agriculture, forestry, mining, manufacturing and construction industries. Services are provided by the wholesale and retail trade, transportation, hospitality, finance, health care, education, legal and other service sectors. As in the two-product examples used earlier, the shape of the $PPF$ illustrates the opportunity cost of increasing the output of either product type. We are not concerned with who supplies the products for the moment: It may be the private sector or the government.

Point $X_0$ on $PPF_0$ shows one possible structure of capacity output. This combination may reflect the pattern of demand and hence expenditures in this economy. Output structures differ among economies with different income levels. High-income economies spend more on services than goods and produce higher ratios of services to goods. Middle income countries produce lower ratios of services to goods, and low income countries much lower ratios of services to goods. Different countries also have different $PPF$s and different output structures, depending on their labour forces, labour productivity and expenditure patterns.

## Economic growth

Three things contribute to growth in the economy. The labour supply grows as the population expands; the stock of capital grows as spending by business (and government) on buildings, machinery, information technology and so forth increases; and labour-force productivity grows as a result of experience, the development of scientific knowledge combined with product and process innovations, and advances in the technology of production. Combined, these developments expand capacity output over time. In Figure 1.5 economic growth shifts the $PPF$ out from $PPF_0$ to $PPF_1$.

This basic description covers the key sources of growth in total output. Economies differ in their rates of overall economic growth as a result of different rates of growth in labour force, in capital stock, and improvements in technology. But improvements in standards of living require more than growth in total output. Increases in output *per worker* and *per person* are necessary. Sustained increases in living standards require sustained growth in labour productivity, which in turn is based on advances in the technology along with the amount of capital each worker has to work with.

## Recessions and booms

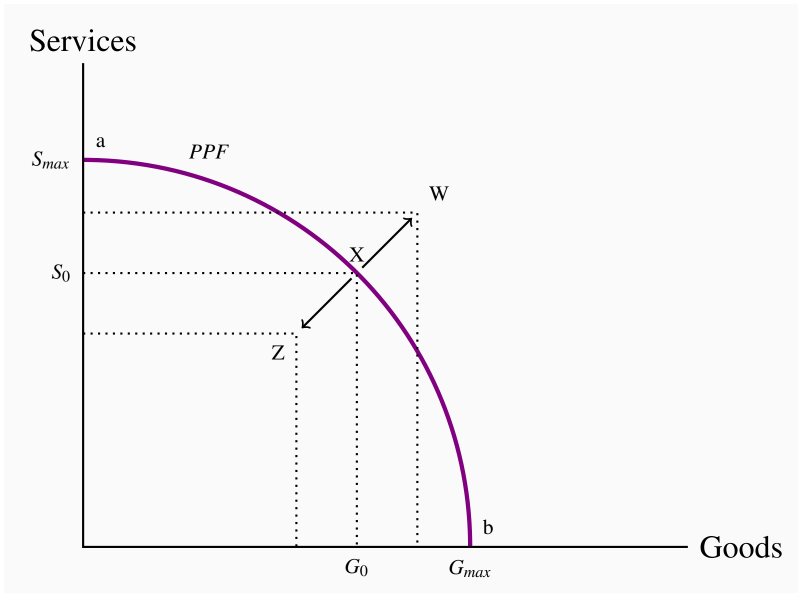
A prime objective of economic policy is to ensure that the economy operates on or near the $PPF$ – it should use its resources to capacity and have minimal unemployment. However, economic conditions are seldom tranquil for long periods of time. Unpredictable changes in business expectations of future profits, in consumer confidence, in financial markets, in commodity and energy prices, in the demand conditions in major trading partners, in government policy and many other events disrupt patterns of expenditure and output. Some of these changes disturb the level of total expenditure and thus the demand for total output. Others disturb the conditions of production and thus the economy's production capacity. Whatever the exact cause, the economy may be pushed off its current $PPF$. If expenditures on goods and services decline, the economy may experience a **recession**. Output would fall short of capacity output and unemployment would rise. Alternatively, times of rapidly growing expenditure and output may result in an economic **boom**: Output and employment expand beyond capacity levels.

> An **economic recession** occurs when output falls below the economy's capacity output.
>
> A **boom** is a period of high growth that raises output above normal capacity output.

Recent history provides examples. Following the financial crisis of 2008-09 that hit the US and many other developed economies, many economies were pushed into recessions. Expenditure on new residential construction collapsed for lack of income and secure financing, as did business investment, consumption spending and exports. Lower expenditures reduced producers' revenues, forcing cuts in output and employment and reducing household incomes. Lower incomes led to further cutbacks in spending. In Canada in 2009 aggregate output declined by 2.9 percent, employment declined by 1.6 percent and the unemployment rate rose from 6.1 percent in 2008 to

8.3 percent by 2010. The world's economies have been slow to recover, and even by 2015 the output in several developed economies was no higher than it was in 2008. Canada's recession was not nearly as severe as the recessions in economies such as Spain and Italy; but output between 2009 and 2015 has been far below the potential of the Canadian economy. The unemployment rate in 2015 still stood at 7.0%.

**Figure 1.6: Booms and recessions**




Economic recessions leave the economy below its normal capacity; the economy might be driven to a point such as Z. Economic expansions, or booms, may drive capacity above its normal level, to a point such as W.

An economy in a recession is operating inside its $PPF$. The fall in output from $X$ to $Z$ in Figure 1.6 illustrates the effect of a recession. Expenditures on goods and services have declined. Output is less than capacity output, unemployment is up and some plant capacity is idle. Labour income and business profits are lower. More people would like to work and business would like to produce and sell more output, but it takes time for interdependent product, labour and financial markets in the economy to adjust and increase employment and output. Monetary and fiscal policy may be productive in specific circumstances, to stimulate demand, increase output and employment and move the economy back to capacity output and full employment. The development and implementation of such policies form the core of macroeconomics.

Alternatively, an unexpected increase in demand for exports would increase output and employment. Higher employment and output would increase incomes and expenditure, and in the process spread the effects of higher output sales to other sectors of the economy. The economy would move outside its $PPF$, for example to $W$ in Figure 1.6, by using its resources more intensively than normal. Unemployment would fall and overtime work would increase. Extra production shifts would run plant and equipment for longer hours and work days than were planned when it was designed and installed. Output at this level may not be sustainable, because shortages of labour and materials along with excessive rates of equipment wear and tear would push costs and prices up. Again, we will examine how the economy reacts to such a state in our macroeconomic analysis.

Output and employment in the Canadian economy over the past twenty years fluctuated about growth trend in the way Figure 1.6 illustrates. For several years prior to 2008 the Canadian economy operated slightly above its capacity; but once the recession arrived monetary and fiscal policy were used to fight it – to bring the economy back from a point such as $Z$ towards a point such as $X$ on the $PPF$.

### Macroeconomic models and policy

The *PPF* diagrams illustrate the main dimensions of macroeconomics: Capacity output, growth in capacity output and business cycle fluctuations in actual output relative to capacity. But these diagrams do not offer explanations and analysis of macroeconomic activity. We need a macroeconomic *model* to understand and evaluate the causes and consequences of business cycle fluctuations. As we shall see, these models are based on explanations of expenditure decisions by households and business, financial market conditions, production costs and producer pricing decisions at different levels of output. Models also capture the objectives of fiscal and monetary policies and provide a framework for policy evaluation. A full macroeconomic model integrates different sector behaviours and the feedbacks across sectors that can moderate or amplify the effects of changes in one sector on national output and employment.

## Conclusion

We have covered a lot of ground in this introductory chapter. It is intended to open up the vista of economics to the new student in the discipline. Economics is powerful and challenging, and the ideas we have developed here will serve as conceptual foundations for our exploration of the subject.

## Key Terms

**Macroeconomics** studies the economy as system in which feedback among sectors determine national output, employment and prices.

**Microeconomics** is the study of individual behaviour in the context of scarcity.

**Mixed economy**: goods and services are supplied both by private suppliers and government.

**Model** is a formalization of theory that facilitates scientific inquiry.

**Theory** is a logical view of how things work, and is frequently formulated on the basis of observation.

**Opportunity cost** of a choice is what must be sacrificed when a choice is made.

**Production possibility frontier (PPF)** defines the combination of goods that can be produced using all of the resources available.

**Consumption possibility frontier (CPF)**: the combination of goods that can be consumed as a result of a given production choice.

**Economy-wide PPF** is the set of goods combinations that can be produced in the economy when all available productive resources are in use.

**Productivity of labour** is the output of goods and services per worker.

**Capital stock**: the buildings, machinery, equipment and software used in producing goods and services.

**Full employment output** $Y_c$ = (number of workers at full employment) $\times$ (output per worker).

**Recession**: when output falls below the economy's capacity output.

**Boom**: a period of high growth that raises output above normal capacity output.

## Exercises for Chapter 1

**Exercise 1.1** An economy has 100 identical workers. Each one can produce four cakes or three shirts, regardless of the number of other individuals producing each good.

(a) How many cakes can be produced in this economy when all the workers are cooking?

(b) How many shirts can be produced in this economy when all the workers are sewing?

(c) On a diagram with cakes on the vertical axis, and shirts on the horizontal axis, join these points with a straight line to form the *PPF*.

(d) Label the inefficient and unattainable regions on the diagram.

**Exercise 1.2** In the table below are listed a series of points that define an economy's production possibility frontier for goods $Y$ and $X$.

| $Y$ | 1000 | 900 | 800 | 700 | 600 | 500 | 400 | 300 | 200 | 100 | 0 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| $X$ | 0 | 1600 | 2500 | 3300 | 4000 | 4600 | 5100 | 5500 | 5750 | 5900 | 6000 |

(a) Plot these pairs of points to scale, on graph paper, or with the help of a spreadsheet.

(b) Given the shape of this *PPF* is the economy made up of individuals who are similar or different in their production capabilities?

(c) What is the opportunity cost of producing 100 more $Y$ at the combination $(X = 5500, Y = 300)$.

(d) Suppose next there is technological change so that at every output level of good $Y$ the economy can produce 20 percent more $X$. Enter a new row in the table containing the new values, and plot the new *PPF*.

**Exercise 1.3** Using the *PPF* that you have graphed using the data in Exercise 1.2, determine if the following combinations are attainable or not: $(X = 3000, Y = 720)$, $(X = 4800, Y = 480)$.

**Exercise 1.4** You and your partner are highly efficient people. You can earn $20 per hour in the workplace; your partner can earn $30 per hour.

(a) What is the opportunity cost of one hour of leisure for you?

(b) What is the opportunity cost of one hour of leisure for your partner?

(c) Now consider what a *PPF* would look like: You can produce/consume two things, leisure and income. Since income buys things you can think of the *PPF* as having these two 'products' – leisure and consumption goods/services. So, with leisure on the horizontal axis and income in dollars is on the vertical axis, plot your *PPF*. You can assume that you have 12 hours per day to allocate to either leisure or income. [*Hint*: the leisure axis will have an intercept of 12 hours. The income intercept will have a dollar value corresponding to where all hours are devoted to work.]

(d) Draw the *PPF* for your partner.

**Exercise 1.5** Louis and Carrie Anne are students who have set up a summer business in their neighbourhood. They cut lawns and clean cars. Louis is particularly efficient at cutting the grass – he requires one hour to cut a typical lawn, while Carrie Anne needs one and one half hours. In contrast, Carrie Anne can wash a car in a half hour, while Louis requires three quarters of an hour.

(a) If they decide to specialize in the tasks, who should cut the grass and who should wash cars?

(b) If they each work a twelve hour day, how many lawns can they cut and how many cars can they wash if they each specialize in performing the task where they are most efficient?

(c) Illustrate the *PPF* for each individual where lawns are on the horizontal axis and car washes on the vertical axis.

**Exercise 1.6** Continuing with the same data set, suppose Carrie Anne's productivity improves so that she can now cut grass as efficiently as Louis; that is, she can cut grass in one hour, and can still wash a car in one half of an hour.

(a) In a new diagram draw the *PPF* for each individual.

(b) In this case does specialization matter if they are to be as productive as possible as a team?

(c) Draw the PPF for the whole economy, labelling the intercepts and the 'kink' point coordinates.

**Exercise 1.7** Going back to the simple *PPF* plotted for Exercise 1.1 where each of 100 workers can produce either four cakes or three shirts, suppose a recession reduces demand for the outputs to 220 cakes and 129 shirts.

(a) Plot this combination of outputs in the diagram that also shows the *PPF*.

(b) How many workers are needed to produce this output of cakes and shirts?

(c) What percentage of the 100 worker labour force is unemployed?

# Chapter 2

## Theories, data and beliefs

**In this chapter we will explore:**



Economists, like other scientists and social scientists, observe and analyze behaviour and events. Economists are concerned primarily with the economic causes and consequences of what they observe. They want to understand an extensive range of human experience, including: money, government finances, industrial production, household consumption, inequality in income distribution, war, monopoly power, professional and amateur sports, pollution, marriage, music, art, and much more.

Economists approach these issues using theories and models. To present, explain, illustrate and evaluate their theories and models they have developed a set of techniques or tools. These involve verbal descriptions and explanations, diagrams, algebraic equations, data tables and charts and statistical tests of economic relationships.

This chapter covers some of these basic techniques of analysis.

## 2.1 Data analysis

The analysis of behaviour necessarily involves data. Data may serve to validate or contradict a theory. Data analysis, even without being motivated by economic theory, frequently displays patterns of behaviour that merit examination. The terms *variables* and *data* are related. **Variables** are measures that can take on different magnitudes. The interest rate on a student loan, for example, is a variable with a certain value at a point in time but perhaps a different value at an earlier or later date. Economic theories and models explain the causal relationships between variables. In contrast, **Data** are the recorded values of variables. Sets of data provide specific values for the variables we want to study and analyze. Knowing that gross domestic product (a variable) declined in 2009 is just a partial description of events. If the data indicate that it decreased by exactly 3%, we know a great deal more – we know that the decline was significantly large.

**Variables**: measures that can take on different values.

**Data**: recorded values of variables.

Sets of data help us to test our models or theories, but first we need to pay attention to the economic logic involved in observations and modelling. For example, if sunspots or baggy pants were found to be correlated with economic expansion, would we consider these events a coincidence or a key to understanding economic growth? The observation is based on facts or data, but it need not have any economic content. The economist's task is to distinguish between coincidence and economic causation.

While the more frequent wearing of loose clothing in the past may have been associated with economic growth because they both occurred at the same time (correlation), one could not argue on a logical basis that this behaviour causes good economic times. Therefore, the past association of these variables should be considered as no more than a coincidence. Once specified on the basis of economic logic, a model must be tested to determine its usefulness in explaining observed economic events.

**Table 2.1: House prices and price indexes**

| Year | House prices in dollars ($P_H$) | Percentage change in $P_H$ | Percentage change in consumer prices | Real percentage change in $P_H$ | Index for price of housing | 5-year mortgage rate |
|---|---|---|---|---|---|---|
| 2001 | 350,000 | | | | 100 | 7.75 |
| 2002 | 360,000 | | | | 102.9 | 6.85 |
| 2003 | 395,000 | 35,000/360,000=9.7% | 3% | 6.7% | 112.9 | 6.6 |
| 2004 | 434,000 | | | | 124.0 | 5.8 |
| 2005 | 477,000 | | | | 136.3 | 6.1 |
| 2006 | 580,000 | | | | 165.7 | 6.3 |
| 2007 | 630,000 | | | | 180.0 | 6.65 |
| 2008 | 710,000 | | | | 202.9 | 7.3 |
| 2009 | 605,000 | -105,000/710,000=-14.8% | 1.6% | -16.4% | 172.9 | 5.8 |
| 2010 | 740,000 | | | | 211.4 | 5.4 |
| 2011 | 800,000 | | | | 228.6 | 5.2 |

*Note*: Data on changes in consumer prices come from Statistics Canada, CANSIM series V41692930; data on house prices are for N. Vancouver from *Royal Le Page*; data on mortgage rates from `www.ratehub.ca`. Index for house prices obtained by scaling each entry in column 2 by 100/350,000. The real percentage change in the price of housing is: The percentage change in the price of housing minus the percentage change in consumer prices.

## Data types

Data come in several forms. One form is **time-series**, which reflects a set of measurements made in sequence at different points in time. The first column in Table 2.1 reports the values for house prices in North Vancouver for the first quarter of each year, between 2001 and 2011. Evidently this is a time series. Annual data report one observation per year. We could, alternatively, have presented the data in monthly, weekly, or even daily form. The frequency we use depends on the purpose: If we are interested in the longer-term trend in house prices, then the annual form suffices. In contrast, financial economists, who study the behaviour of stock prices, might not be content with daily or even hourly prices; they may need prices minute-by-minute. Such data are called **high-frequency** data, whereas annual data are **low-frequency** data.

**Table 2.2: Unemployment rates, Canada and Provinces, monthly 2012, seasonally adjusted**

| | Jan | Feb | Mar | Apr | May | Jun |
|---|---|---|---|---|---|---|
| **CANADA** | 7.6 | 7.4 | 7.2 | 7.3 | 7.3 | 7.2 |
| **NFLD** | 13.5 | 12.9 | 13.0 | 12.3 | 12.0 | 13.0 |
| **PEI** | 12.2 | 10.5 | 11.3 | 11.0 | 11.3 | 11.3 |
| **NS** | 8.4 | 8.2 | 8.3 | 9.0 | 9.2 | 9.6 |
| **NB** | 9.5 | 10.1 | 12.2 | 9.8 | 9.4 | 9.5 |
| **QUE** | 8.4 | 8.4 | 7.9 | 8.0 | 7.8 | 7.7 |
| **ONT** | 8.1 | 7.6 | 7.4 | 7.8 | 7.8 | 7.8 |
| **MAN** | 5.4 | 5.6 | 5.3 | 5.3 | 5.1 | 5.2 |
| **SASK** | 5.0 | 5.0 | 4.8 | 4.9 | 4.5 | 4.9 |
| **ALTA** | 4.9 | 5.0 | 5.3 | 4.9 | 4.5 | 4.6 |
| **BC** | 6.9 | 6.9 | 7.0 | 6.2 | 7.4 | 6.6 |

*Source*: Statistics Canada CANSIM Table 282-0087.

> **Time-series**: a set of measurements made sequentially at different points in time.
>
> **High (low) frequency data**: series with short (long) intervals between observations.

In contrast to time-series data, **cross-section** data record the values of different variables at a point in time. Table 2.2 contains a cross-section of unemployment rates for Canada and Canadian provinces economies. For January 2012 we have a snapshot of the provincial economies at that point in time, likewise for the months until June. This table therefore contains **repeated cross-sections**.

When the unit of observation is the same over time such repeated cross sections are called longitudinal data. For example, a health survey that followed and interviewed the same individuals over time would yield longitudinal data. If the individuals differ each time the survey is conducted, the data are repeated cross sections. **Longitudinal data** therefore follow the same units of observation through time.

> **Cross-section data**: values for different variables recorded at a point in time.
>
> **Repeated cross-section data**: cross-section data recorded at regular or irregular intervals.
>
> **Longitudinal data**: follow the same units of observation through time.

## Graphing the data

Data can be presented in graphical as well as tabular form. Figure 2.1 plots the house price data from the second column of Table 2.1. Each asterisk in the figure represents a price value and a corresponding time period. The horizontal axis reflects time, the vertical axis price in dollars. The graphical presentation of data simply provides a visual rather than numeric perspective. It is immediately evident that house prices increased consistently during this 11-year period, with a single downward 'correction' in 2009. We have plotted the data a second time in Figure 2.2 to illustrate the need to read graphs carefully. The greater *apparent* slope in Figure 2.1 might easily be interpreted to mean that prices increased more steeply than suggested in Figure 2.2. But a careful reading of the axes reveals that this is not so; using different scales when plotting data or constructing diagrams can mislead the unaware viewer.

**Figure 2.1: House prices in dollars 1999-2012**

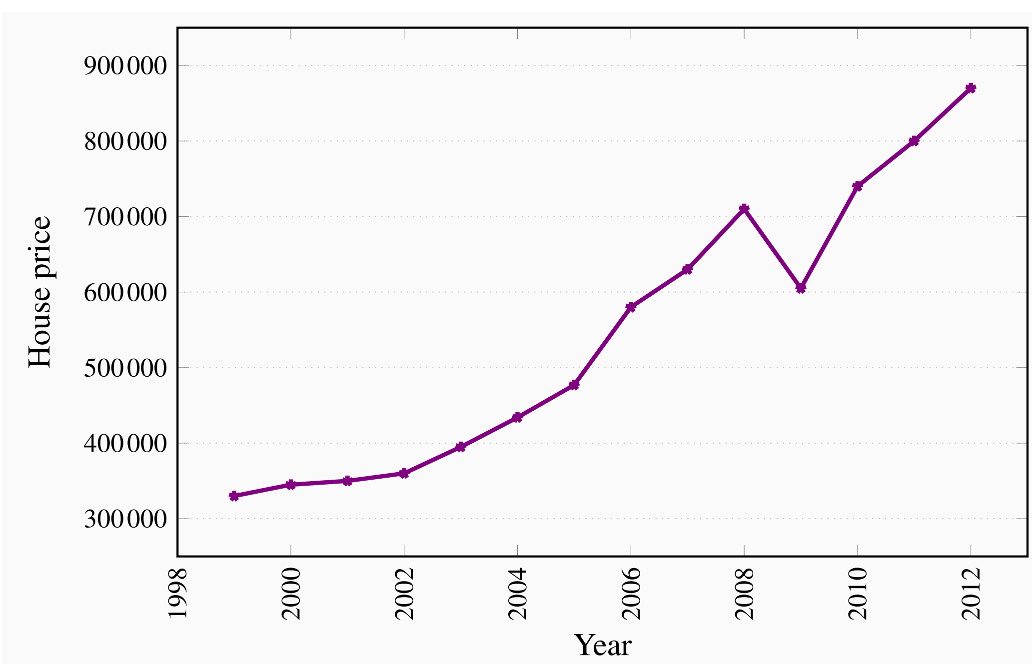
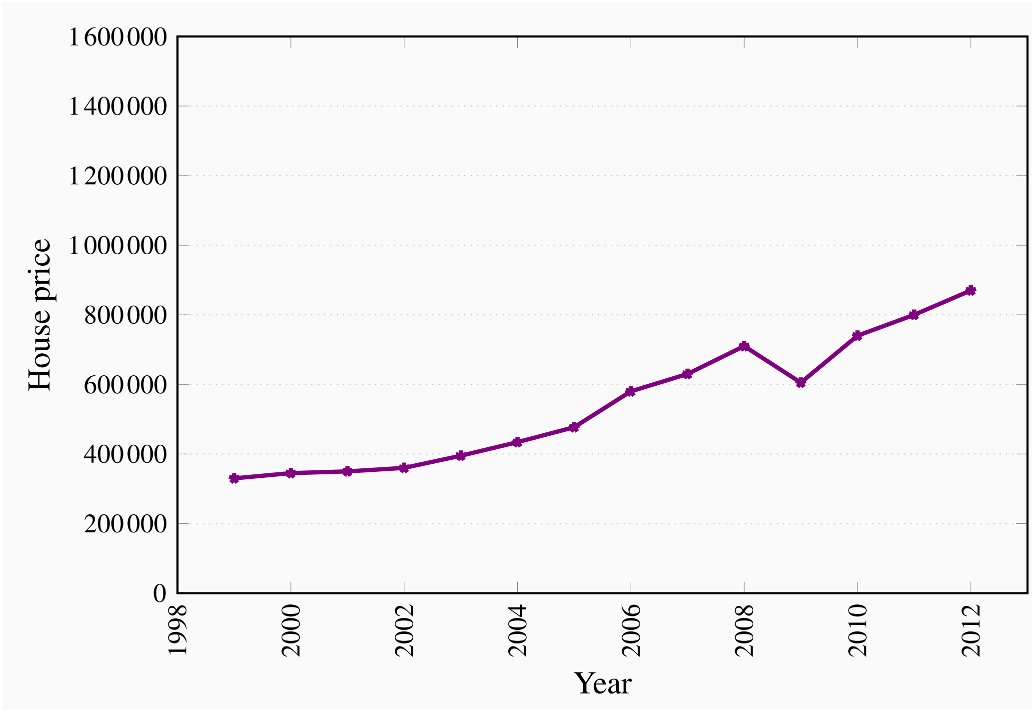


**Figure 2.2: House prices in dollars 1999-2012**




## Percentage changes

The use of percentages makes the analysis of data particularly simple. Suppose we wanted to compare the prices of New York luxury condominiums with the prices of homes in rural Mississippi. In the latter case, a change in average prices of $10,000 might be considered enormous, whereas a change of one million dollars in New York might be pretty normal – because the average price in New York is so much higher than in Mississippi. To make comparisons between the two markets, we can use the concept of a **percentage change**. This is defined as the change in the value of the variable, relative to its initial value, multiplied by 100.

**Percentage change** = [(change in values)/(original value)] × 100.

The third column of Table 2.1 contains the values of the percentage change in house prices for two pairs of years. Between 2002 and 2003 the price change was $35,000. Relative to the price in the first of these two years this change was the fraction $35,000/395,000 = 0.097$. If we multiply this fraction by 100 we obtain a percentage price change of 9.7%. Evidently we could calculate the percentage price changes for all pairs of years. A second price change is calculated for the 2008-2009 pair of years. Here price declined and the result is thus a negative percentage change.

## Consumer prices

Most variables in economics are averages of the components that go into them. When variables are denominated in dollar terms it is important to be able to interpret them correctly. While the house price series above indicates a strong pattern of price increases, it is vital to know if the price of housing increased more or less rapidly that other prices in the economy. If all prices in the economy were increasing in line with house prices there would be no special information in the house price series. However, if house prices increased more rapidly than prices in general, then the data indicate that something special took place in the housing market during the decade in question. To determine an answer to this we need to know the degree to which the general price level changed each year.

*Statistics Canada* regularly surveys the price of virtually every product produced in the economy. One such survey records the prices of goods and services purchased by consumers. Statistics Canada then computes an average price level for all of these goods combined for each time period the survey is carried out (monthly). Once Statistics Canada has computed the average consumer price, it can compute the change in the price level from one period to the next. In Table 2.1 two such values are entered in the following data column: Consumer prices increased by 3% between 2002 and 2003, and by 1.6% between 2008 and 2009. These percentage changes in the general price level represent **inflation** if prices increase, and **deflation** if prices decline.

In this market it is clear that housing price changes were substantially larger than the changes in consumer prices for these two pairs of years. The next column provides information on the difference between the house price changes and changes in the general consumer price level, in percentage terms. This is (approximately) the change in the relative price of housing, or what economists call the **real price** of housing.

**Consumer price index**: the average price level for consumer goods and services.

**Inflation (deflation) rate**: the annual percentage increase (decrease) in the level of consumer prices.

**Real price**: the actual price adjusted by the general (consumer) price level in the economy.

## Index numbers

Statistics Canada and other statistical agencies frequently present data in **index number** form. An index number provides an easy way to read the data. For example, suppose we wanted to compute the percentage change in the price of housing between 2001 and 2007. We could do this by entering the two data points in a spreadsheet or calculator and do the computation. But suppose the prices were entered in another form. In particular, by dividing each price value by the first year value and multipling the result by 100 we obtain a series of prices that are all relative to the initial year – which we call the base year. The resulting series in column 6 is an index of house price values. Each entry is the corresponding value in column 2, divided by the first entry in column 2. The key characteristics of indexes are that they are *not dependent upon the units of measurement of the data in question*, and they are interpretable easily with reference to a given base value. To illustrate, suppose we wish to know how prices behaved between 2001 and 2007. The index number column immediately tells us that prices increased by 80%, because relative to 2001, the 2007 value is 80% higher.

> **Index number**: value for a variable, or an average of a set of variables, expressed relative to a given base value.

Furthermore, index numbers enable us to make *comparisons with the price patterns for other goods* much more easily. If we had constructed a price index for automobiles, which also had a base value of 100 in 2001, we could make immediate comparisons without having to compare one set of numbers defined in thousands of dollars with another defined in hundreds of thousands of dollars. In short, index numbers simplify the interpretation of data.

## 2.2 Data, theory and economic models

Let us now investigate the interplay between economic theories on the one hand and data on the other. We will develop two examples. The first will be based upon the data on house prices, the second upon a new data set.

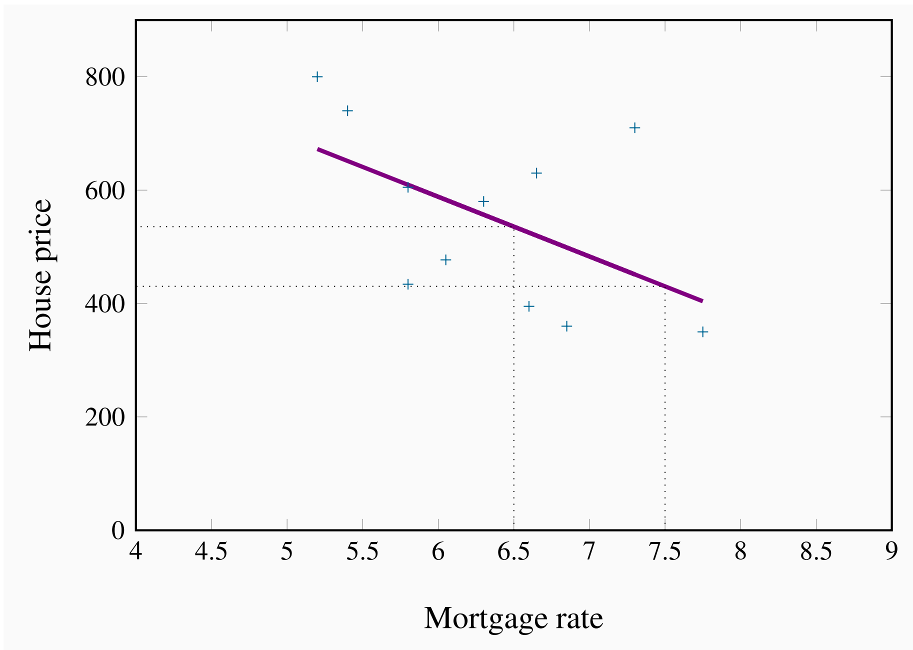
### House prices – theory

Remember from Chapter 1 that a theory is a logical argument regarding economic relationships. A theory of house prices would propose that the price of housing depends upon a number of elements in the economy. In particular, if borrowing costs are low then buyers are able to afford the interest costs on larger borrowings. This in turn might mean they are willing to pay higher prices. Conversely, if borrowing rates are higher. Consequently, the borrowing rate, or mortgage rate, is a variable for an economic model of house prices. A second variable might be available space for development: If space in a given metropolitan area is tight then the land value will reflect this, and consequently the higher land price should be reflected in higher house prices. A third variable would be the business climate: If there is a high volume of high-value business transacted in a given area then buildings will be more in demand, and that in turn should be reflected in higher prices. For example, both business and residential properties are more highly priced in San Francisco and New York than in Moncton, New Brunswick. A fourth variable might be environmental attractiveness: Vancouver may be more enticing than other towns in Canada. A fifth variable might be the climate.

### House prices – evidence

These and other variables could form the basis of a *theory* of house prices. A *model* of house prices, as explained in Chapter 1, focuses upon what we would consider to be the most important subset of these variables. In the limit, we could have an extremely simple model that specified a dependence between the price of housing and the mortgage rate alone. To test such a simple model we need data on house prices and mortgage rates. The final column of Table 2.1 contains data on the 5-year fixed-rate mortgage for the period in question. Since our simple model proposes that prices depend (primarily) upon mortgage rates, in Figure 2.3 we plot the house price series on the vertical axis, and the mortgage rate on the horizontal axis, for each year from 2001 to 2011. As before, each point (shown as a '+') represents a pair of price and mortgage rate values.

**Figure 2.3: Price of housing**




The resulting plot (called a scatter diagram) suggests that there is a negative relationship between these two variables. That is, higher prices are correlated with lower mortgage rates. Such a correlation is consistent with our theory of house prices, and so we might conclude that changes in mortgage rates *cause* changes in house prices. Or at least the data suggest that we should not reject the idea that such causation is in the data.

## House prices – inference

To summarize the relationship between these variables, the pattern suggests that a straight line through the scatter plot would provide a reasonably good description of the relationship between these variables. Obviously it is important to define the most appropriate line – one that 'fits' the data well.[1] The line we have drawn through the data points is informative, because it relates the two variables in a *quantitative manner*. It is called a **regression line**. It predicts that, on average, if the mortgage rate increases, the price of housing will respond in the downward direction. This

[1]This task is the job of econometricians, who practice econometrics. Econometrics is the science of examining and quantifying relationships between economic variables. It attempts to determine the separate influences of each variable, in an environment where many things move simultaneously. Computer algorithms that do this are plentiful. Computers can also work in many dimensions in order to capture the influences of *several variables simultaneously* if the model requires that.

particular line states that a one point change in the mortgage rate will move prices in the opposing direction by $105,000. This is easily verified by considering the dollar value corresponding to say a mortgage value of 6.5, and then the value corresponding to a mortgage value of 7.5. Projecting vertically to the regression line from each of these points on the horizontal axis, and from there across to the vertical axis will produce a change in price of $105,000.

Note that the line is not at all a 'perfect' fit. For example, the mortgage rate declined between 2008 and 2009, but the price declined also – contrary to our theory. The model is not a perfect predictor; it states that *on average* a change in the magnitude of the x-axis variable leads to a change of a specific amount in the magnitude of the y-axis variable.

In this instance the slope of the line is given by -105,000/1, which is the vertical distance divided by the corresponding horizontal distance. Since the line is straight, this slope is unchanging.

> **Regression line**: representation of the average relationship between two variables in a scatter diagram.

## Road fatalities – theory, evidence and inference

Table 2.3 contains data on annual road fatalities per 100,000 drivers for various age groups. In the background, we have a *theory*, proposing that driver fatalities depend upon the age of the driver, the quality of roads and signage, speed limits, the age of the automobile stock and perhaps some other variables. Our model focuses upon a subset of these variables, and in order to present the example in graphical terms we specify fatalities as being dependent upon a single variable – age of driver.

**Table 2.3: Non-linearity: Driver fatality rates Canada, 2009**

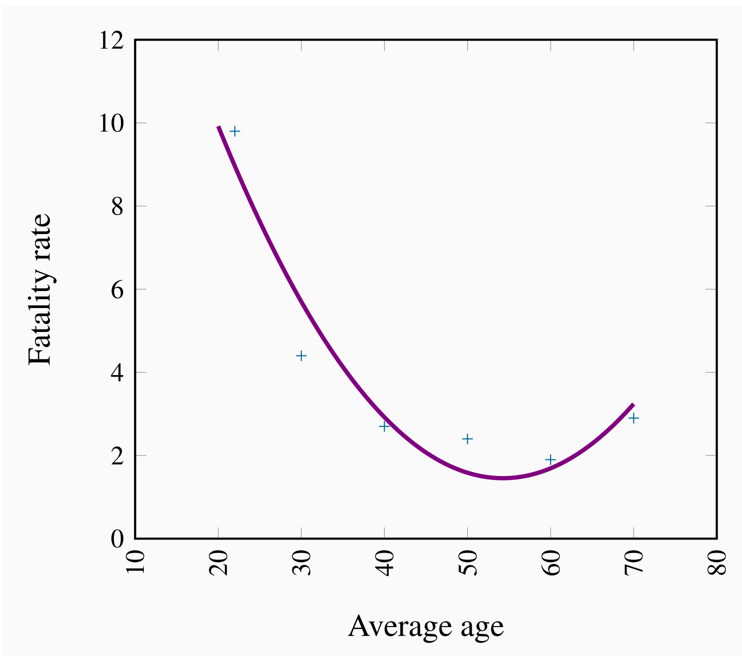
| Age of driver | Fatality rate per 100,000 drivers |
|---|---|
| 20-24 | 9.8 |
| 25-34 | 4.4 |
| 35-44 | 2.7 |
| 45-54 | 2.4 |
| 55-64 | 1.9 |
| 65+ | 2.9 |

*Source*: Transport Canada, Canadian motor vehicle traffic collision statistics, 2009.

The scatter diagram is presented in Figure 2.4. Two aspects of this plot stand out. First, there is an exceedingly steep decline in the fatality rate when we go from the youngest age group to the next two age groups. The decline in fatalities between the youngest and second youngest groups is about 20 points, whereas the decline between the third and fourth age groups is less than 2 points. This suggests that behaviour is not the same throughout the age distribution. Second, we notice that fatalities increase for the oldest age group, perhaps indicating that the oldest drivers are not as good as middle-aged drivers.

These two features suggest that the relationship between fatalities and age differs across the age spectrum. Accordingly, a straightline would not be an accurate way of representing the behaviours in these data. A straight line through the plot implies that a given change in age should have a similar impact on fatalities, no matter the age group. Accordingly we have an example of a *non-linear relationship*. Such a non-linear relationship might be represented by the curve going through the plot. Clearly the slope of this line varies as we move from one age category to another.

**Figure 2.4: Non-linearity: Driver fatality rates Canada, 2009**




Fatality rates vary non-linearly with age: At first they decline, then increase again, relative to the youngest age group.

## 2.3 Ethics, efficiency and beliefs

**Positive economics** studies objective or scientific explanations of how the economy functions. Its aim is to understand and generate predictions about how the economy may respond to changes and policy initiatives. In this effort economists strive to act as detached scientists, regardless of political sympathies or ethical code. Personal judgments and preferences are (ideally) kept apart. In this particular sense, economics is similar to the natural sciences such as physics or biology. To date in this chapter we have been exploring economics primarily from a positive standpoint.

In contrast, **normative economics** offers recommendations based partly on value judgments. While economists of different political persuasions can agree that raising the income tax rate would lead to some reduction in the number of hours worked, they may yet differ in their views on the advisability of such a rise. One economist may believe that the additional revenue that may come in to government coffers is not worth the disincentives to work; another may think that, if such monies can be redistributed to benefit the needy, or provide valuable infrastructure, the negative impact on the workers paying the income tax is worth it.

> **Positive economics** studies objective or scientific explanations of how the economy functions.
>
> **Normative economics** offers recommendations that incorporate value judgments.

Scientific research can frequently resolve differences that arise in positive economics—not so in normative economics. For example, if we claim that "the elderly have high medical bills, and the government should cover all of the bills", we are making both a positive and a normative statement. The first part is positive, and its truth is easily established. The latter part is normative, and individuals of different beliefs may reasonably differ. Some people may believe that the money would be better spent on the environment and have the aged cover at least part of their own medical costs. Positive economics does not attempt to show that one of these views is correct and the other false. The views are based on value judgments, and are motivated by a concern for **equity**. Equity is a vital guiding principle in the formation of policy and is frequently, though not always, seen as being in competition with the drive for economic growth. Equity is driven primarily by normative considerations. Few economists would disagree with the assertion that a government should implement policies that improve the lot of the poor—but to what degree?

> **Economic equity** is concerned with the distribution of well-being among members of the economy.

Most economists hold normative views, sometimes very strongly. They frequently see themselves, not just as cold hearted scientists, but as champions for their (normative) cause in addition. Conservative economists see a smaller role for government than left-leaning economists.

Many economists see a conflict between equity and the efficiency considerations that we developed in Chapter 1. For example, high taxes may provide disincentives to work in the marketplace and therefore reduce the efficiency of the economy: Plumbers and gardeners may decide to do their own gardening and their own plumbing because, by staying out of the marketplace where monetary transactions are taxed, they can avoid the taxes. And avoiding the taxes may turn out to be as valuable as the efficiency gains they forgo.

In other areas the equity-efficiency trade-off is not so obvious: If taxes (that may have disincentive effects) are used to educate individuals who otherwise would not develop the skills that follow education, then economic growth may be higher as a result of the intervention.

## Revisiting the definition of economics – core beliefs

This is an appropriate point at which to return to the definition of economics in Chapter 1 that we borrowed from Nobel Laureate Christopher Sims: Economics is a set of ideas and methods for the betterment of society.

If economics is concerned about the betterment of society, clearly there are ethical as well as efficiency considerations at play. And given the philosophical differences among scientists (including economists), can we define an approach to economics that is shared by the economics profession at large? Most economists would answer that the profession shares a set of beliefs, and that differences refer to the extent to which one consideration may collide with another.

- First of all we believe that *markets are critical* because they facilitate exchange and therefore encourage efficiency. Specialization and trade creates benefits for the trading parties. For example, Canada has not the appropriate climate for growing coffee beans, and Colombia has not the terrain for wheat. If Canada had to be self-sufficient, we might have to grow coffee beans in green-houses—a costly proposition. But with trade we can specialize, and then exchange some of our wheat for Colombian coffee. Similar benefits arise for the Colombians.

  A frequent complaint against trade is that its modern-day form (globalization) does not benefit the poor. For example, workers in the Philippines may earn only a few dollars per day manufacturing clothing for Western markets. From this perspective, most of the gains from trade go to the Western consumers and capitalists, come at the expense of jobs to western workers, and provide Asian workers with meagre rewards.

- A corollary of the centrality of markets is *that incentives matter*. If the price of business class seats on your favourite airline is reduced, you may consider upgrading. Economists believe strongly that the price mechanism influences behaviour, and therefore favour the use of price incentives in the marketplace and public policy more generally. Environmental economists, for example, advocate the use of pollution permits that can be traded at a price between users, or carbon taxes on the emission of greenhouse gases. We will develop such ideas in *Principles of Microeconomics* Chapter 5 more fully.

- In saying that economists believe in incentives, we are not proposing that human beings are purely mercenary. People have many motivations: Self-interest, a sense of public duty, kindness, etc. Acting out of a sense of self-interest does not imply that people are morally empty or have no altruistic sense.

- Economists believe universally in the *importance of the rule of law*, no matter where they sit on the political spectrum. Legal institutions that govern contracts are critical to the functioning of an economy. If goods and services are to be supplied in a market economy, the suppliers must be guaranteed that they will be remunerated. And this requires a developed legal structure with penalties imposed on individuals or groups who violate contracts. Markets alone will not function efficiently.

  Modern development economics sees the implementation of the rule of law as perhaps the central challenge facing poorer economies. There is a strong correlation between economic growth and national wealth on the one hand, and an effective judical and policing system on the other. The consequence on the world stage is that numerous 'economic' development projects now focus upon training jurists, police officers and bureaucrats in the rule of law!

- Finally, economists believe in the centrality of government. Governments can solve a number of problems that arise in market economies that cannot be addressed by the private market place. For example, governments can best address the potential abuses of monopoly power. Monopoly power, as we shall see in *Principles of Microeconomics* Chapter 10, not only has equity impacts it may also reduce economic efficiency. Governments are also best positioned to deal with environmental or other types of externalities – the impact of economic activity on sectors of the economy that are not directly involved in the activity under consideration.

In summary, governments have a variety of roles to play in the economy. These roles involve making the economy more equitable and more efficient by using their many powers.

## KEY TERMS

**Variables**: measures that can take on different sizes.

**Data**: recorded values of variables.

**Time series data**: a set of measurements made sequentially at different points in time.

**High (low) frequency data** series have short (long) intervals between observations.

**Cross-section data**: values for different variables recorded at a point in time.

**Repeated cross-section data**: cross-section data recorded at regular or irregular intervals.

**Longitudinal data** follow the same units of observation through time.

**Percentage change**$=$ (change in values)/original value $\times$ 100.

**Consumer price index**: the average price level for consumer goods and services.

**Inflation (deflation) rate**: the annual percentage increase (decrease) in the level of consumer prices.

**Real price**: the actual price adjusted by the general (consumer) price level in the economy.

**Index number**: value for a variable, or an average of a set of variables, expressed relative to a given base value.

**Regression line**: representation of the average relationship between two variables in a scatter diagram.

**Positive economics** studies objective or scientific explanations of how the economy functions.

**Normative economics** offers recommendations that incorporate value judgments.

**Economic equity** is concerned with the distribution of well-being among members of the economy.

## EXERCISES FOR CHAPTER 2

**Exercise 2.1** An examination of a country's recent international trade flows yields the data in the table below.

| Year | National Income ($b) | Imports ($b) |
|---|---|---|
| 2011 | 1,500 | 550 |
| 2012 | 1,575 | 573 |
| 2013 | 1,701 | 610 |
| 2014 | 1,531 | 560 |
| 2015 | 1,638 | 591 |

(a) Based on an examination of these data do you think the national income and imports are not related, positively related, or negatively related?

(b) Plot each pair of observations in a two-dimensional line diagram to illustrate your view of the import/income relationship. Measure income on the horizontal axis and imports on the vertical axis. This can be done using graph paper or a spreadsheet-cum-graphics software.

**Exercise 2.2** The average price of a medium coffee at *Wakeup Coffee Shop* in each of the past ten years is given in the table below.

| 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|
| $1.05 | $1.10 | $1.14 | $1.20 | $1.25 | $1.25 | $1.33 | $1.35 | $1.45 | $1.49 |

(a) Construct an annual 'coffee price index' for this time period using 2005 as the base year. [*Hint*: follow the procedure detailed in the chapter – divide each yearly price by the base year price.]

(b) Based on your price index, what was the percentage change in the price of a medium coffee from 2005 to 2012?

(c) Based on your index, what was the average annual percentage change in the price of coffee from 2005 to 2010?

(d) Assuming the inflation rate in this economy was 2% every year, what was the real change in the price of coffee between 2007 and 2008; and between 2009 and 2010?

**Exercise 2.3** The following table shows hypothetical consumption spending by households and income of households in billions of dollars.

| Year | Income | Consumption |
|---|---|---|
| 2006 | 476 | 434 |
| 2007 | 482 | 447 |
| 2008 | 495 | 454 |
| 2009 | 505 | 471 |
| 2010 | 525 | 489 |
| 2011 | 539 | 509 |
| 2012 | 550 | 530 |
| 2013 | 567 | 548 |

(a) Plot the scatter diagram with consumption on the vertical axis and income on the horizontal axis.

(b) Fit a line through these points.

(c) Does the line indicate that these two variables are related to each other?

(d) How would you describe the *causal relationship* between income and consumption?

**Exercise 2.4** Using the data from Exercise 2.3, compute the percentage change in consumption and the percentage change in income for each pair of adjoining years between 2006 and 2013.

**Exercise 2.5** You are told that the relationship between two variables, $X$ and $Y$, has the form $Y = 10 + 2X$. By trying different values for $X$ you can obtain the corresponding predicted value for $Y$ (e.g., if $X = 3$, then $Y = 10 + 2 \times 3 = 16$). For values of $X$ between 0 and 12, compute the matching value of $Y$ and plot the scatter diagram.

**Exercise 2.6** For the data below, plot a scatter diagram with variable $Y$ on the vertical axis and variable $X$ on the horizontal axis.

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Y** | 40 | 33 | 29 | 56 | 81 | 19 | 20 |
| **X** | 5 | 7 | 9 | 3 | 1 | 11 | 10 |

(a) Is the relationship between the variables positive or negative?

(b) Do you think that a linear or non-linear line better describes the relationship?

# Chapter 3

# The classical marketplace – demand and supply

**In this chapter we will explore:**



## 3.1 The marketplace – trading

The marketplace in today's economy has evolved from earlier times. It no longer has a unique form – one where buyers and sellers physically come together for the purpose of exchange. Indeed, supermarkets require individuals to be physically present to make their purchases. But when purchasing an airline ticket, individuals simply go online and interact with perhaps a number of different airlines (suppliers) simultaneously. Or again, individuals may simply give an instruction to their stock broker, who will execute a purchase on their behalf – the broker performs the role of a middleman, who may additionally give advice to the purchaser. Or a marketing agency may decide to subcontract work to a translator or graphic artist who resides in Mumbai. In pure auctions (where a single work of art or a single residence is offered for sale) buyers compete one against the other for the single item supplied. Accomodations in private homes are supplied to potential visitors (buyers) through *Airbnb*. Taxi rides are mediated through *Lyft* or *Uber*. These institutions are all different types of markets; they serve the purpose of facilitating exchange and trade.

Not all goods and services in the modern economy are obtained through the marketplace. Schooling and health care are allocated in Canada primarily by government decree. In some instances the market plays a supporting role: Universities and colleges may levy fees, and most individuals must pay, at least in part, for their pharmaceuticals. In contrast, broadcasting services may carry a price of zero – as with the Canadian Broadcasting Corporation.

The importance of the marketplace springs from its role as an allocating mechanism. Elevated prices effectively send a signal to suppliers that the buyers in the market place a high value on the product being traded; conversely when prices are low. Accordingly, suppliers may decide to cease supplying markets where prices do not remunerate them sufficiently, and redirect their energies and the productive resources under their control to other markets – markets where the product being traded is more highly valued, and where the buyer is willing to pay more.

Whatever their form, the marketplace is central to the economy we live in. Not only does it facilitate trade, it also provides a means of earning a livelihood. Suppliers must hire resources – human and non-human in order to bring their supplies to market and these resources must be paid a return – income is generated.

In this chapter we will examine the process of price formation – how the prices that we observe in the marketplace come to be what they are. We will illustrate that the price for a good is inevitably linked to the quantity of a good; price and quantity are different sides of the same coin and cannot generally be analyzed separately. To understand this process more fully, we need to *model* a typical market. The essentials are demand and supply.

## 3.2 The market's building blocks

In economics we use the terminology that describes trade in a particular manner. Non-economists frequently describe microeconomics by saying "it's all about supply and demand". While this is largely true we need to define exactly what we mean by these two central words. **Demand** is the quantity of a good or service that buyers wish to purchase at each conceivable price, with all other influences on demand remaining unchanged. It reflects a multitude of values, not a single value. It is not a single or unique quantity such as two cell phones, but rather a full description of the quantity of a good or service that buyers would purchase at various prices.

> **Demand** is the quantity of a good or service that buyers wish to purchase at each possible price, with all other influences on demand remaining unchanged.

As a hypothetical example, the first column of Table 3.1 shows the price of natural gas per cubic foot. The second column shows the quantity that would be purchased in a given time period at each price. It is therefore a schedule of quantities demanded at various prices. For example, at a price $6 per unit, buyers would like to purchase 4 units, whereas at the lower price of $3 buyers would like to purchase 7 units. Note also that this is a homogeneous good. A cubit foot of natural gas is considered to be the same product no matter which supplier brings it to the market. In contrast, accomodations supplied through *Airbnb* are heterogeneous – they vary in size and quality.

**Table 3.1: Demand and supply for natural gas**

| Price ($) | Demand (thousands of cu feet) | Supply (thousands of cu feet) | Excess |
|---|---|---|---|
| 10 | 0 | 18 | |
| 9 | 1 | 16 | |
| 8 | 2 | 14 | **Excess Supply** |
| 7 | 3 | 12 | |
| 6 | 4 | 10 | |
| 5 | 5 | 8 | |
| 4 | 6 | 6 | **Equilibrium** |
| 3 | 7 | 4 | |
| 2 | 8 | 2 | **Excess Demand** |
| 1 | 9 | 0 | |
| 0 | 10 | 0 | |

Supply is interpreted in a similar manner. It is not a single value; we say that **supply** is the quantity of a good or service that sellers are willing to sell at each possible price, with all other influences on supply remaining unchanged. Such a supply schedule is defined in the third column of the table. It is assumed that no supplier can make a profit (on account of their costs) unless the price is at least $2 per unit, and therefore a zero quantity is supplied below that price. The higher price is more profitable, and therefore induces a greater quantity supplied, perhaps by attracting more suppliers. This is reflected in the data. For example, at a price of $3 suppliers are willing to supply 4 units, whereas with a price of $7 they are willing to supply 12 units. There is thus a positive relationship between price and quantity for the supplier – a higher price induces a greater quantity; whereas on the demand side of the market a higher price induces a lower quantity demanded – a negative relationship.

> **Supply** is the quantity of a good or service that sellers are willing to sell at each possible price, with all other influences on supply remaining unchanged.

We can now identify a key difference in terminology – between the words demand and quantity demanded, and between supply and quantity supplied. While the words demand and supply refer to the complete schedules of demand and supply, the terms **quantity demanded** and **quantity supplied** each define a single value of demand or supply at a particular price.

> **Quantity demanded** defines the amount purchased at a particular price.

**Quantity supplied** refers to the amount supplied at a particular price.

Thus while the non-economist may say that when some fans did not get tickets to the Stanley Cup it was a case of demand exceeding supply, as economists we say that the quantity demanded exceeded the quantity supplied *at the going price of tickets*. In this instance, had every ticket been offered at a sufficiently high price, the market could have generated an excess supply rather than an excess demand. A higher ticket price would reduce the *quantity demanded*; yet would not change *demand*, because demand refers to the whole schedule of possible quantities demanded at different prices.

## Other things equal – ceteris paribus

The demand and supply schedules rest on the assumption that all other influences on supply and demand remain the same as we move up and down the possible price values. The expression *other things being equal*, or its Latin counterpart *ceteris paribus*, describes this constancy of other influences. For example, we assume on the demand side that the prices of other goods remain constant, and that tastes and incomes are unchanging. On the supply side we assume, for example, that there is no technological change in production methods. If any of these elements change then the market supply or demand schedules will reflect such changes. For example, if coal or oil prices increase (decline) then some buyers may switch to (away from) gas. This will be reflected in the data: At any given price more (or less) will be demanded. We will illustrate this in graphic form presently.

## Market equilibrium

Let us now bring the demand and supply schedules together in an attempt to analyze what the marketplace will produce – will a single price emerge that will equate supply and demand? We will keep other things constant for the moment, and explore what materializes at different prices. At low prices, the data in Table 3.1 indicate that the quantity demanded exceeds the quantity supplied – for example, verify what happens when the price is $3 per unit. The opposite occurs when the price is high – what would happen if the price were $8? Evidently, there exists an intermediate price, where the quantity demanded equals the quantity supplied. At this point we say that the market is in equilibrium. The **equilibrium price** equates demand and supply – it clears the market.

The **equilibrium price** equilibrates the market. It is the price at which quantity demanded equals the quantity supplied.

In Table 3.1 the equilibrium price is $4, and the equilibrium quantity is 6 thousand cubic feet of gas (we will use the notation 'k' to denote thousands). At higher prices there is an **excess supply**—suppliers wish to sell more than buyers wish to buy. Conversely, at lower prices there is an **excess demand**. Only at the equilibrium price is the quantity supplied equal to the quantity demanded.

**Excess supply** exists when the quantity supplied exceeds the quantity demanded at the going price.

> **Excess demand** exists when the quantity demanded exceeds the quantity supplied at the going price.

Does the market automatically reach equilibrium? To answer this question, suppose initially that the sellers choose a price of $10. Here suppliers would like to supply 18k cubic feet, but there are no buyers—a situation of extreme excess supply. At the price of $7 the excess supply is reduced to 9k, because both the quantity demanded is now higher at 3k units, and the quantity supplied is lower at 12k. But excess supply means that there are suppliers willing to supply at a lower price, and this willingness exerts continual downward pressure on any price above the price that equates demand and supply.

At prices below the equilibrium there is, conversely, an excess demand. In this situation, suppliers could force the price upward, knowing that buyers will continue to buy at a price at which the suppliers are willing to sell. Such upward pressure would continue until the excess demand is eliminated.

In general then, above the equilibrium price excess supply exerts downward pressure on price, and below the equilibrium excess demand exerts upward pressure on price. This process implies that the buyers and sellers have information on the various elements that make up the marketplace.

We will explore later in this chapter some specific circumstances in which trading could take place at prices above or below the equilibrium price. In such situations the quantity actually traded always corresponds to the short side of the market: At high prices the quantity demanded is less than the quantity supplied, and it is the quantity demanded that is traded because buyers will not buy the amount suppliers would like to supply. At low prices the quantity demanded exceeds quantity supplied, and it is the amount that suppliers are willing to sell that is traded. In sum, when trading takes place at prices other than the equilibrium price it is always the lesser of the quantity demanded or supplied that is traded. Hence we say that at non-equilibrium prices the **short side** dominates. We will return to this in a series of examples later in this chapter.

> The **short side of the market** determines outcomes at prices other than the equilibrium.

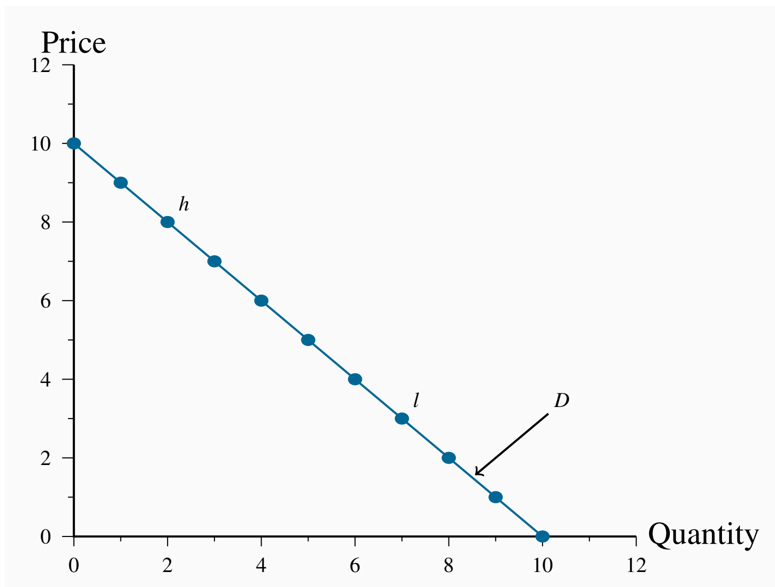
## Supply and the nature of costs

Before progressing to a graphical analysis, we should add a word about costs. The supply schedules are based primarily on the cost of producing the product in question, and we frequently assume that all of the costs associated with supply are incorporated in the supply schedules. In *Principles of Microeconomics* Chapter 6 we will explore cases where costs additional to those incurred by producers may be relevant. For example, coal burning power plants emit pollutants into the atmosphere; but the individual supplier may not take account of these pollutants, which are costs to society at large, in deciding how much to supply at different prices. Stated another way, the private costs of production would not reflect the total, or full social costs of production. For the moment the assumption is that no such additional costs are associated with the markets we analyze.

## 3.3 Demand and supply curves

The **demand curve** is a graphical expression of the relationship between price and quantity demanded, holding other things constant. Figure 3.1 measures price on the vertical axis and quantity on the horizontal axis. The curve $D$ represents the data from the first two columns of Table 3.1. Each combination of price and quantity demanded lies on the curve. In this case the curve is *linear*—it is a straight line. The demand curve slopes downward (technically we say that its slope is negative), reflecting the fact that buyers wish to purchase more when the price is less.

**Figure 3.1: Measuring price & quantity**



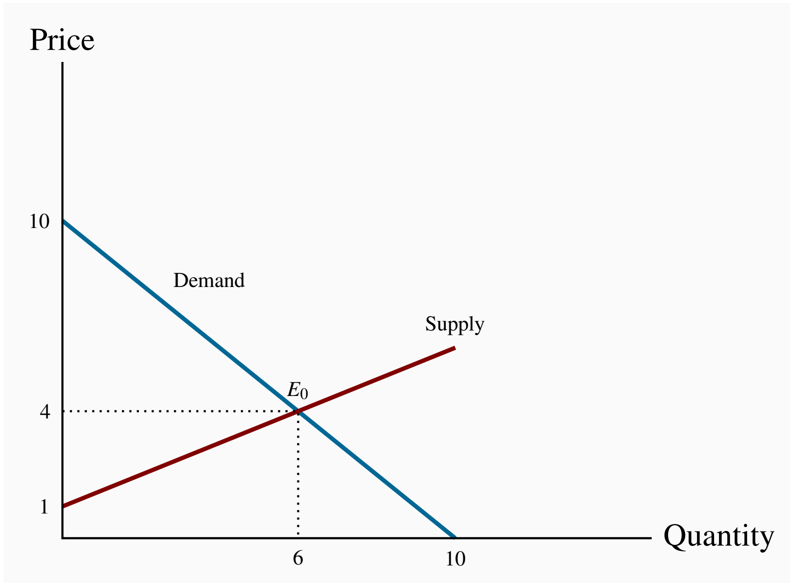

To derive this demand curve we take each price-quantity combination from the demand schedule in Table 3.1 and insert a point that corresponds to those combinations. For example, point $h$ defines the combination $\{P = \$8, Q_d = 2\}$, the point $l$ denotes the combination $\{P = \$3, Q_d = 7\}$. If we join all such points we obtain the demand curve in Figure 3.2. In this particular case the demand schedule results in a straight-line, or linear, demand curve. The same process yields the supply curve in Figure 3.2.

> The **demand curve** is a graphical expression of the relationship between price and quantity demanded, with other influences remaining unchanged.

The **supply curve** is a graphical representation of the relationship between price and quantity supplied, holding other things constant. The supply curve $S$ in Figure 3.2 is based on the data from columns 1 and 3 in Table 3.1. It, too, is linear, but has a positive slope indicating that suppliers wish to supply more at higher prices.

The **supply curve** is a graphical expression of the relationship between price and quantity supplied, with other influences remaining unchanged.

**Figure 3.2: Supply, demand, equilibrium**




The demand and supply curves intersect at point $E_0$, corresponding to a price of $4 which, as illustrated above, is the equilibrium price for this market. At any price below this the horizontal distance between the supply and demand curves represents excess demand, because demand exceeds supply. Conversely, at any price above $4 there is an excess supply that is again measured by the horizontal distance between the two curves. Market forces tend to eliminate excess demand and excess supply as we explained above. In the final section of the chapter we illustrate how the supply and demand curves can be 'solved' for the equilibrium price and quantity.

## 3.4 Non-price influences on demand

We have emphasized several times the importance of the *ceteris paribus* assumption when exploring the impact of different prices on the quantity demanded: We assume all other influences on the purchase decision are unchanged (at least momentarily). These other influences fall into several broad categories: The prices of related goods; the incomes of buyers; buyer tastes; and expectations about the future. Before proceeding, note that we are dealing with *market* demand rather than demand by one *individual* (the precise relationship between the two is developed later in this chapter).

### The prices of related goods – oil and gas, Kindle and paperbacks

We expect that the price of other forms of energy would impact the price of natural gas. For example, if electricity, oil or coal becomes less expensive we would expect some buyers to switch to these other products. Alternatively, if gas-burning furnaces experience a technological break-through that makes them more efficient and cheaper we would expect some users of other fuels to move to gas. Among these examples, it is clear that oil and electricity are substitute fuels for gas; in contrast the efficient new gas furnace complements the use of gas. We use these terms, **substitutes** and **complements**, to describe products that influence the demand for the primary good.

> **Substitute goods**: when a price reduction (rise) for a related product reduces (increases) the demand for a primary product, it is a substitute for the primary product.
>
> **Complementary goods**: when a price reduction (rise) for a related product increases (reduces) the demand for a primary product, it is a complement for the primary product.

Clearly electricity is a substitute for gas in the power market, whereas a gas furnace is a complement for gas as a fuel. The words substitutes and complements immediately suggest the nature of the relationships. Every product has complements and substitutes. As another example: Electronic readers such as Kindle, Nook and Kobo are substitutes for paper-form books; a rise in the price of paper books should increase the demand for electronic readers at any given price for electronic readers. In graphical terms, the demand curve *shifts* in response to changes in the prices of other goods – an increase in the price of paper-form books will shift the demand for electronic readers outward, because more electronic readers will be demanded at any price.

## Buyer incomes – which goods to buy

The demand for most goods increases in response to income increases. Given this, the demand curve for gas will shift outward if household incomes in the economy increase. Household incomes may increase either because there are more households in the economy or because the incomes of the existing households grow.

Most goods are demanded in greater quantity in response to higher incomes at any given price. But there are exceptions. For example, public transit demand may decline at any price when household incomes rise, because some individuals move to cars. Or the demand for laundromats may decline in response to higher incomes, as households purchase more of their own consumer durables – washers and driers. We use the term **inferior good** to define these cases: An inferior good is one whose demand declines in response to increasing incomes, whereas a **normal good** experiences an increase in demand in response to rising incomes.

> An **inferior good** is one whose demand falls in response to higher incomes.
>
> A **normal good** is one whose demand increases in response to higher incomes.

There is a further sense in which consumer incomes influence demand, and this relates to how the incomes are *distributed* in the economy. In the discussion above we stated that higher total incomes shift demand curves outwards when goods are normal. But think of the difference in the demand for electronic readers between Portugal and Saudi Arabia. These economies have roughly the same average per-person income, but incomes are distributed more unequally in Saudi Arabia. It does not have a large middle class that can afford electronic readers or *iPads*, despite the huge wealth held by the elite. In contrast, Portugal has a relatively larger middle class that can afford such goods. Consequently, the *distribution of income* can be an important determinant of the demand for many commodities and services.

## Tastes and networks – hemlines and homogeneity

While demand functions are drawn on the assumption that tastes are constant, in an evolving world they are not. We are all subject to peer pressure, the fashion industry, marketing, and a desire to maintain our image. If the fashion industry dictates that lapels or long skirts are *de rigueur* for the coming season, some fashion-conscious individuals will discard a large segment of their wardrobe, even though the clothes may be in perfectly good condition: Their demand is influenced by the dictates of current fashion.

Correspondingly, the items that other individuals buy or use frequently determine our own purchases. Businesses frequently decide that all of their employees will have the same type of computer and software on account of *network economies*: It is easier to communicate if equipment is compatible, and it is less costly to maintain infrastructure where the variety is less.

## Expectations – betting on the future

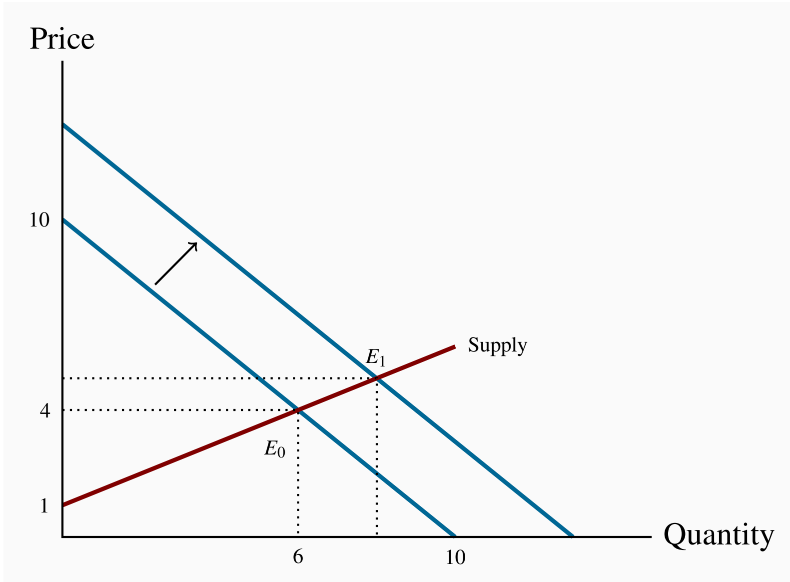
In our natural gas example, if households expected that the price of natural gas was going to stay relatively low for many years – perhaps on account of the discovery of large deposits – then they would be tempted to purchase a gas burning furnace rather than an oil burning furnace. In this example, it is more than the current price that determines choices; *the prices that are expected to prevail in the future* also determine current demand.

Expectations are particularly important in stock markets. When investors anticipate that corporations will earn high rewards in the future they will buy a stock today. If enough people believe this, the price of the stock will be driven upward on the market, even before profitable earnings are registered.

## Shifts in demand

The demand curve in Figure 3.2 is drawn for a given level of other prices, incomes, tastes, and expectations. Movements along the demand curve reflect solely the impact of different prices for the good in question, holding other influences constant. But changes in any of these other factors will change the position of the demand curve. Figure 3.3 illustrates a shift in the demand curve. This shift could result from a rise in household incomes that increase the quantity demanded *at every price*. This is illustrated by an outward shift in the demand curve. With supply conditions unchanged, there is a new equilibrium at $E_1$, indicating a greater quantity of purchases accompanied by a higher price. The new equilibrium reflects a *change in quantity supplied and a change in demand*.

**Figure 3.3: Demand shift and new equilibrium**




The outward shift in demand leads to a new equilibrium $E_1$.

We may well ask why so much emphasis in our diagrams and analysis is placed on the relationship between *price* and quantity, rather than on the relationship between quantity and its other determinants. The answer is that we could indeed draw diagrams with quantity on the horizontal axis and a measure of one of these other influences on the vertical axis. But the price mechanism plays a very important role. *Variations in price are what equilibrate the market.* By focusing primarily upon the price, we see the self-correcting mechanism by which the market reacts to excess supply or excess demand.

In addition, this analysis illustrates the method of **comparative statics**—examining the impact of changing one of the other things that are assumed constant in the supply and demand diagrams.

> **Comparative static analysis** compares an initial equilibrium with a new equilibrium, where the difference is due to a change in one of the other things that lie behind the demand curve or the supply curve.

'Comparative' obviously denotes the idea of a comparison, and static means that we are not in a state of motion. Hence we use these words in conjunction to indicate that we compare one outcome with another, without being concerned too much about the transition from an initial equilibrium to a new equilibrium. The transition would be concerned with dynamics rather than statics. In Figure 3.3 we explain the difference between the points $E_0$ and $E_1$ by indicating that there has been a change in incomes or in the price of a substitute good. We do not attempt to analyze the details of this move or the exact path from $E_0$ to $E_1$.

**Application Box 3.1: Corn prices and demand shifts**

In the middle of its second mandate, the Bush Administration in the US decided to encourage the production of ethanol – a fuel that is less polluting than gasoline. The target production was 35 billion for 2017 – from a base of 1 billion gallons in 2000. Corn is the principal input in ethanol production. It is also used as animal feed, as a sweetener and as a food for humans. The target was to be met with the help of a subsidy to producers and a tariff on imports of Brazil's sugar-cane based ethanol.

The impact on corn prices was immediate; from a farm-gate price of $2 per bushel in 2005, the price reached the $4 range two years later, despite a significant increase in production. In 2012 the price was $7. While other factors, such as growing incomes, have stimulated the demand for corn; ethanol is seen as the main price driver.

The wider impact of these developments was that the prices of virtually all grains increased in tandem with corn. For example, the prices of sorghum and barley increased because of a switch in land use towards corn. Corn was seen as more profitable, less acreage was allocated to other grains, and the supply of these other grains fell.

While producers benefited from the price rise, consumers – particularly those in less developed economies – experienced a dramatic increase in their basic living costs. Visit the site of the United Nations' Food and Agricultural Organization for an assessment.

In terms of supply and demand shifts, the demand side has dominated. The ethanol drive, combined with secular growth in the demand for food, means that the demand for grains shifted outward faster than the supply.

## 3.5 Non-price influences on supply

To date we have drawn supply curves with an upward slope. Is this a reasonable representation of supply in view of what is frequently observed in markets? We suggested earlier that the various producers of a particular good or service may have different levels of efficiency. If so, only the more efficient producers can make a profit at a low price, whereas at higher prices more producers or suppliers enter the market – producers who may not be as lean and efficient as those who can survive in a lower-price environment. This view of the world yields a positively-sloping supply curve.

As a second example, consider *Uber* taxi drivers. Some drivers may be in serious need of income and may be willing to drive for a low hourly rate. For other individuals driving may be a secondary source of income, and such drivers are less likely to want to drive unless the hourly wage is higher. Consequently if *Uber* needs a large number of drivers at any one time it may be necessary to pay a higher wage – *and charge a higher fare to passengers*, to induce more drivers to take their taxis onto the road. This phenomenon corresponds to a positively-sloped supply curve.

In contrast to these two examples, some suppliers simply choose a unique price and let buyers purchase as much as they want at that price. This is the practice of most retailers. For example, the price of *Samsung's Galaxy* is typically fixed, no matter how many are purchased – and tens of millions are sold at a fixed price when a new model is launched. *Apple* also sets a price, and buyers purchase as many as they desire at that price. This practice corresponds to a horizontal supply cuve: The price does not vary and the market equilibrium occurs where the demand curve intersects this supply curve.

In yet other situations supply is fixed. This happens in auctions. Bidders at the auction simply determine the price to be paid. At a real estate auction a given property is put on the market and the price is determined by the bidding process. In this case the supply of a single property is represented by a vertical supply at a quantity of 1 unit.

Regardless of the type of market we encounter, however, it is safe to assume that supply curves do not slope downward. So, for the moment, we adopt the stance that supply curves are generally upward sloping – somewhere between the extremes of being vertical or horizontal – as we have drawn them to this point.

Next, we examine those other influences that underlie supply curves. Technology, input costs, the prices of competing goods, expectations and the number of suppliers are the most important.

## Technology – computers and fracking

A technological advance may involve an idea that allows more output to be produced with the same inputs, or an equal output with fewer inputs. A good example is *just-in-time* technology. Before the modern era, auto manufacturers kept large stocks of components in their production facilities, but developments in communications and computers at that time made it possible for manufacturers to link directly with their input suppliers. Nowadays assembly plants place their order for, say, seat delivery to their local seat supplier well ahead of assembly time. The seats swing into the assembly area hours or minutes before assembly—just in time. The result is that the assembler reduces his seat inventory (an input) and thereby reduces production cost.

Such a technology-induced cost saving is represented by moving the supply curve downward or outward: The supplier is now able and willing to supply the same quantity at a lower price because of the technological innovation. Or, saying the same thing slightly differently, suppliers will supply more at a given price than before.

A second example relates to the extraction of natural gas. The development of 'fracking' means that companies involved in gas recovery can now do so at a lower cost. Hence they are willing to supply any given quantity at a lower price.

## Input costs – green power

Input costs can vary independently of technology. For example, a wage negotiation that grants workers a substantial pay raise will increase the cost of production. This is reflected in a leftward, or upward, supply shift: Any quantity supplied is now priced higher; alternatively, suppliers are willing to supply less at the going price.

As a further example, suppose the government decrees that power-generating companies must provide a certain percentage of their power using 'green' sources – from solar power or windmills. Since such sources are not yet as cost efficient as more conventional power sources, the electricity they generate comes at a higher cost.

## Competing products – Airbnb versus hotels

If competing products improve in quality or fall in price, a supplier may be forced to follow suit. For example, *Asus* and *Dell* are constantly watching each other's pricing policies. If *Dell* brings out a new generation of computers at a lower price, *Asus* may lower its prices in turn—which is to say that Asus' supply curve will shift downward. Likewise, *Samsung* and *Apple* each responds to the other's pricing and technology behaviours. The arrival of new products in the marketplace also impacts the willingness of suppliers to supply goods at a given price. New intermediaries such as *Airbnb* and *Vacation Rentals by Owner* have shifted the supply curves of hotel rooms downward.

These are some of the many factors that influence the position of the supply curve in a given market.

**Application Box 3.2: The price of light**

Technological developments have had a staggering impact on many price declines. Professor William Nordhaus of Yale University is an expert on measuring technological change. He has examined the trend in the real price of lighting. Originally, light was provided by whale oil and gas lamps and these sources of lumens (the scientific measure of the amount of light produced) were costly. In his research, Professor Nordhaus pieced together evidence on the actual historic cost of light produced at various times, going all the way back to 1800. He found that light in 1800 cost about 100 times more than in 1900, and light in the year 2000 was a fraction of its cost in 1900. A rough calculation suggests that light was five hundred times more expensive at the start of this 200-year period than at the end, and this was before the arrival of LEDs.

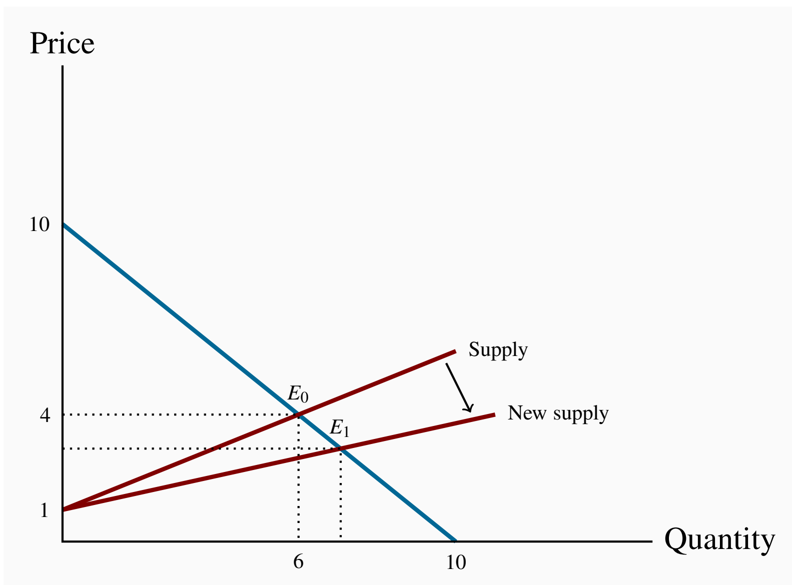
In terms of supply and demand analysis, light has been subject to very substantial downward supply shifts. Despite the long-term growth in demand, the technologically-induced supply changes have been the dominant factor in its price determination.

For further information, visit Professor Nordhaus's website in the Department of Economics at Yale University.

## Shifts in supply

Whenever technology changes, or the costs of production change, or the prices of competing products adjust, then one of our *ceteris paribus* assumptions is violated. Such changes are generally reflected by shifting the supply curve. Figure 3.4 illustrates the impact of the arrival of just-in-time technology. The supply curve shifts, reflecting the ability of suppliers to supply the same output at a reduced price. The resulting new equilibrium price is lower, since production costs have fallen. At this reduced price more gas is traded at a lower price.

**Figure 3.4: Supply shift and new equilibrium**




The supply curve shifts due to lower production costs. A new equilibrium $E_1$ is attained in the market at a lower price.

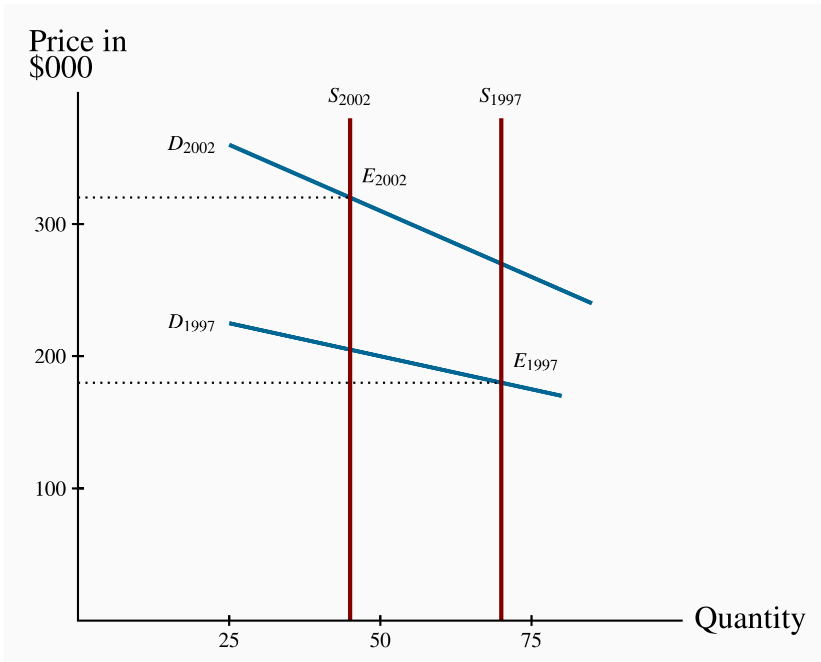
# 3.6 Simultaneous supply and demand impacts

In the real world, demand and supply frequently shift at the same time. We present such a case in Figure 3.5. It is based upon real estate data describing the housing market in a small Montreal municipality. Vertical curves define the supply side of the market. Such vertical curves mean that a fixed number of homeowners decide to put their homes on the market, and these suppliers just take whatever price results in the market. In this example, fewer houses were offered for sale in 2002 (less than 50) than in 1997 (more than 70). We are assuming in this market that the houses traded were similar; that is, we are not lumping together mansions with row houses.

During this time period household incomes increased substantially and, also, mortgage rates fell. Both of these developments shifted the demand curve upward/outward: Buyers were willing to pay more for housing in 2002 than in 1997, both because their incomes were on average higher and because they could borrow more cheaply.

The shifts on both sides of the market resulted in a higher average price. And each of these shifts compounded the other: The outward shift in demand would lead to a higher price on its own, and a reduction in supply would do likewise. Hence both forces acted to push up the price in 2002. If, instead, the supply had been greater in 2002 than in 1997 this would have acted to reduce the equilibrium price. And with the demand and supply shifts operating in opposing directions, it is not possible to say in general whether the price would increase or decrease. If the demand shift were strong and the supply shift weak then the demand forces would have dominated and led to a higher price. Conversely, if the supply forces were stronger than the demand forces.

**Figure 3.5: A model of the housing market with shifts in demand and supply**




The vertical supply denotes a fixed number of houses supplied each year. Demand was stronger in 2002 than in 1997 both on account of higher incomes and lower mortgage rates. Thus the higher price in 2002 is due to both a reduction in supply and an increase in demand.

## 3.7 Market interventions – governments and interest groups

The freely functioning markets that we have developed certainly do not describe all markets. For example, minimum wages characterize the labour market, most agricultural markets have supply restrictions, apartments are subject to rent controls, and blood is not a freely traded market commodity in Canada. In short, price controls and quotas characterize many markets. **Price controls** are government rules or laws that inhibit the formation of market-determined prices. **Quotas** are physical restrictions on how much output can be brought to the market.

**Price controls** are government rules or laws that inhibit the formation of market-determined prices.

**Quotas** are physical restrictions on output.

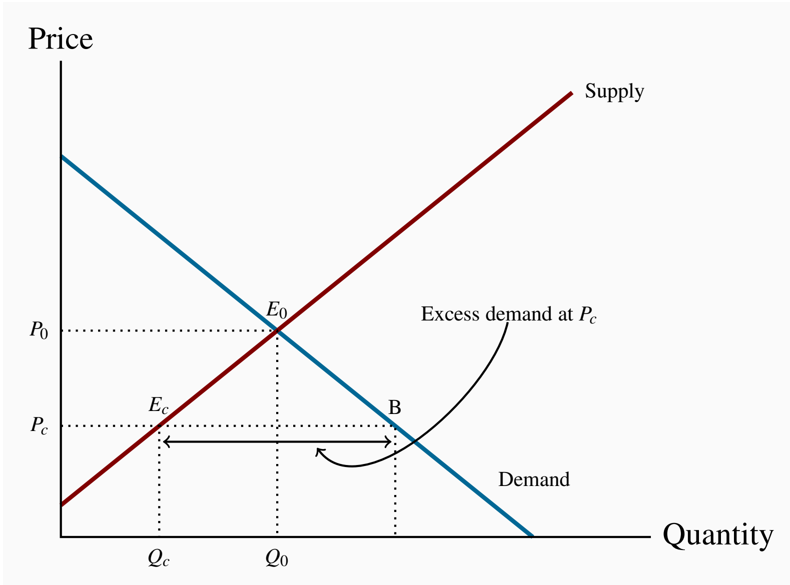
Price controls come in the form of either *floors* or *ceilings*. Price floors are frequently accompanied by *marketing boards*.

## Price ceilings – rental boards

Ceilings mean that suppliers cannot legally charge more than a specific price. Limits on apartment rents are one form of ceiling. In times of emergency – such as flooding or famine, price controls are frequently imposed on foodstuffs, in conjunction with rationing, to ensure that access is not determined by who has the most income. The problem with price ceilings, however, is that they leave demand unsatisfied, and therefore they must be accompanied by some other allocation mechanism.

Consider an environment where, for some reason – perhaps a sudden and unanticipated growth in population – rents increase. Let the resulting equilibrium be defined by the point $E_0$ in Figure 3.6. If the government were to decide that this is an unfair price because it places hardships on low- and middle-income households, it might impose a price limit, or ceiling, of $P_c$. The problem with such a limit is that excess demand results: Individuals want to rent more apartments than are available in the city. In a free market the price would adjust upward to eliminate the excess demand, but in this controlled environment it cannot. So some other way of allocating the available supply between demanders must evolve.

**Figure 3.6: The effect of a price ceiling**




The free market equilibrium occurs at $E_0$. A price ceiling at $P_c$ holds down the price but leads to excess demand $E_c$B, because $Q_c$ is the quantity traded. A price ceiling above $P_0$ is irrelevant since the free market equilibrium $E_0$ can still be attained.

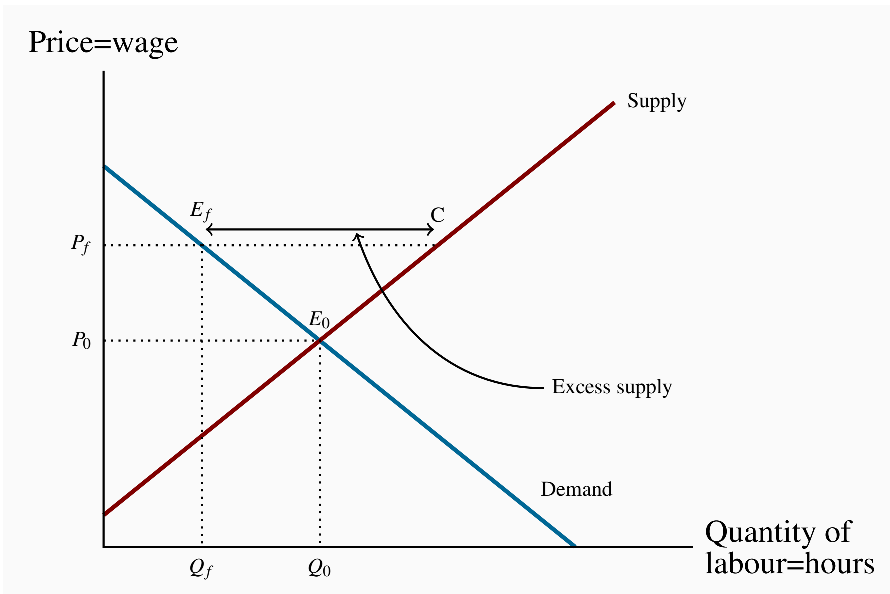
In reality, most apartments are allocated to those households already occupying them. But what happens when such a resident household decides to purchase a home or move to another city? In a free market, the landlord could increase the rent in accordance with market pressures. But in a controlled market a city's rental tribunal may restrict the annual rent increase to just a couple of percent and the demand may continue to outstrip supply. So how does the stock of apartments get allocated between the potential renters? One allocation method is well known: The existing tenant informs her friends of her plan to move, and the friends are the first to apply to the landlord to occupy the apartment. But that still leaves much unmet demand. If this is a student rental market, students whose parents live nearby may simply return 'home'. Others may chose to move to a part of the city where rents are more affordable.

However, rent controls sometimes yield undesirable outcomes. Rent controls are widely studied in economics, and the consequences are well understood: Landlords tend not to repair or maintain their rental units in good condition if they cannot obtain the rent they believe they are entitled to. Accordingly, the residential rental stock deteriorates. In addition, builders realize that more money is to be made in building condominium units than rental units, or in *converting rental units to condominiums*. The frequent consequence is thus a *reduction* in supply and a reduced quality. Market forces are hard to circumvent because, as we emphasized in Chapter 1, economic players react to the incentives they face. These outcomes are examples of what we call the *law of unintended consequences*.

## Price floors – minimum wages

An effective price floor sets the price *above* the market-clearing price. A minimum wage is the most widespread example in the Canadian economy. Provinces each set their own minimum, and it is seen as a way of protecting the well-being of low-skill workers. Such a floor is illustrated in Figure 3.7. The free-market equilibrium is again $E_0$, but the effective market outcome is the combination of price and quantity corresponding to the point $E_f$ at the price floor, $P_f$. In this instance, there is excess supply equal to the amount $E_f$C.

**Figure 3.7: Price floor – minimum wage**




In a free market the equilibrium is $E_0$. A minimum wage of $P_f$ raises the hourly wage, but reduces the hours demanded to $Q_f$. Thus $E_f$C is the excess supply.

Note that there is a similarity between the outcomes defined in the floor and ceiling cases: The quantity actually traded is *the lesser of the supply quantity and demand quantity at the going price: The short side dominates.*

If price floors, in the form of minimum wages, result in some workers going unemployed, why do governments choose to put them in place? The excess supply in this case corresponds to unemployment – more individuals are willing to work for the going wage than buyers (employers) wish to employ. The answer really depends upon the magnitude of the excess supply. In particular, suppose, in Figure 3.7 that the supply and demand curves going through the equilibrium $E_0$ were more 'vertical'. This would result in a smaller excess supply than is represented with the existing supply and demand curves. This would mean in practice that a higher wage could go to workers, making them better off, without causing substantial unemployment. This is the tradeoff that governments face: With a view to increasing the purchasing power of generally lower-skill individuals, a minimum wage is set, hoping that the negative impact on employment will be small. We will return to this in the next chapter, where we examine the responsiveness of supply and demand curves to different prices.

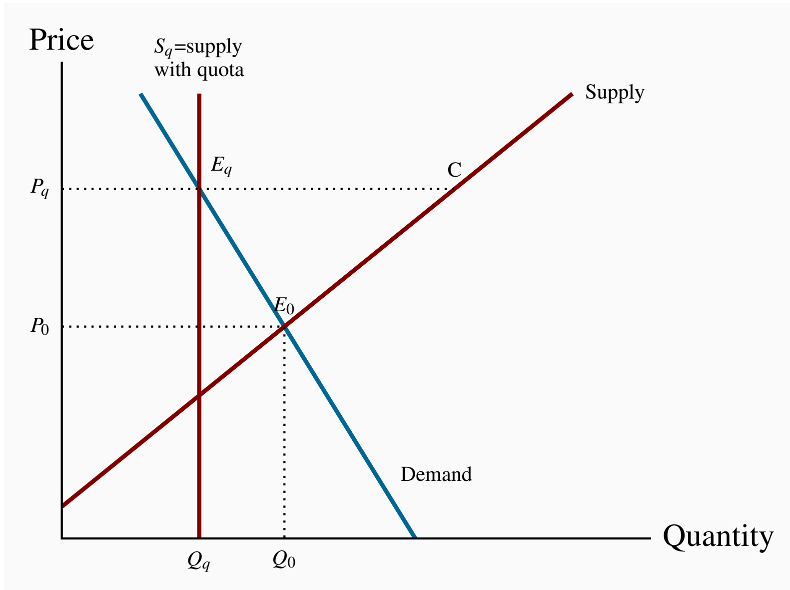
## Quotas – agricultural supply

A quota represents the right to supply a specified quantity of a good to the market. It is a means of keeping prices higher than the free-market equilibrium price. As an alternative to imposing a price floor, the government can generate a high price by restricting supply.

Agricultural markets abound with examples. In these markets, farmers can supply only what they are permitted by the quota they hold, and there is usually a market for these quotas. For example, in several Canadian provinces it currently costs in the region of $30,000 to purchase a quota granting the right to sell the milk of one cow. The cost of purchasing quotas can thus easily outstrip the cost of a farm and herd. Canadian cheese importers must pay for the right to import cheese from abroad. Restrictions also apply to poultry. The impact of all of these restrictions is to raise the domestic price above the free market price.

In Figure 3.8, the free-market equilibrium is at $E_0$. In order to raise the price above $P_0$, the government restricts supply to $Q_q$ by granting quotas, which permit producers to supply a limited amount of the good in question. This supply is purchased at the price equal to $P_q$. From the standpoint of farmers, a higher price might be beneficial, even if they get to supply a smaller quantity, provided the amount of revenue they get as a result is as great as the revenue in the free market.

**Figure 3.8: The effect of a quota**




The government decides that the equilibrium price $P_0$ is too low. It decides to boost price by reducing supply from $Q_0$ to $Q_q$. It achieves this by requiring producers to have a production quota. This is equivalent to fixing supply at $S_q$.

## Marketing boards – milk and maple syrup

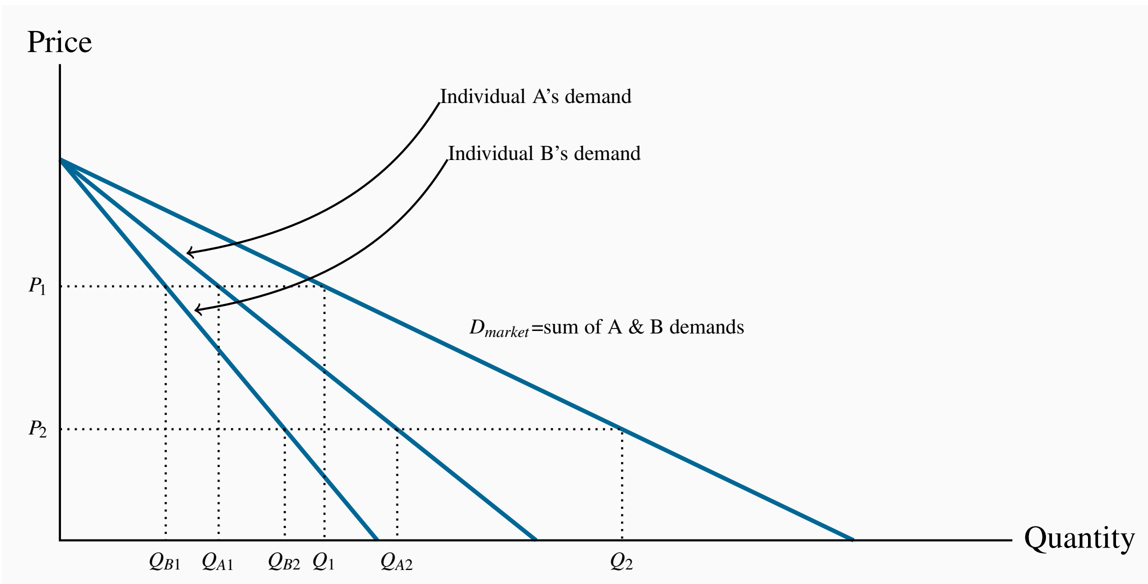
A marketing board is a means of insuring that a quota or price floor can be maintained. Quotas are frequent in the agriculture sector of the economy. One example is maple syrup in Quebec. The Federation of Maple Syrup Producers of Quebec has the sole right to market maple syrup. All producers must sell their syrup through this marketing board. It is a *de facto* monopoly. The Federation increases the total revenue going to producers by artificially restricting the supply to the market. The Federation calculates that by reducing supply and selling it at a higher price, more revenue will accrue to the producers. This is illustrated in Figure 3.8. The market equilibrium is given by $E_0$, but the Federation restricts supply to the quantity $Q_q$, which is sold to buyers at price $P_q$. To make this possible the total supply must be restricted; otherwise producers would supply the amount given by the point C on the supply curve, and this would result in excess supply in the amount $E_q$C. In order to restrict supply to $Q_q$ in total, individual producers are limited in what they can sell to the Federation; they have a quota, which gives them the right to produce and sell no more than a specific limited amount. This system of quotas is necessary to eliminate the excess supply that would emerge at the above-equilibrium price $P_q$.

We will return to this topic in *Principles of Microeconomics* Chapter 4. For the moment, to see that this type of revenue-increasing outcome is possible, examine Table 3.1 again. At this equilibrium price of \$4 the quantity traded is 6 units, yielding a total expenditure by buyers (revenue to suppliers) of \$24. However, if the supply were restricted and a price of \$5 were set, the expenditure by buyers (revenue to suppliers) would rise to $25.

## 3.8 Individual and market functions

Markets are made up of many individual participants on the demand and supply side. The supply and demand functions that we have worked with in this chapter are those for the total of all participants on each side of the market. But how do we arrive at such market functions when the economy is composed of individuals? We can illustrate how, with the help of Figure 3.9.

**Figure 3.9: Summing individual demands**




At $P_1$ individual A purchases $Q_{A1}$ and B purchases $Q_{B1}$. The total demand is the sum of these individual demands at this price ($Q_1$). At $P_2$ individual demands are summed to $Q_2$. Since the points $Q_1$ and $Q_2$ define the demands of the market participants it follows that market demand is the horizontal sum of these curves.

To concentrate on the essentials, imagine that there are just two buyers of chocolate cookies in the economy. A has a stronger preference for cookies than B, so his demand is greater. To simplify, let the two demands have the same intercept on the vertical axis. The curves $D_A$ and $D_B$ indicate how many cookies A and B, respectively, will buy at each price. The market demand indicates how much they buy *together* at any price. Accordingly, at $P_1$, A and B purchase the quantities $Q_{A1}$ and $Q_{B1}$ respectively. Thus $Q_1 = Q_{A1} + Q_{B1}$. At a price $P_2$, they purchase $Q_{A2}$ and $Q_{B2}$. Thus $Q_2 = Q_{A2} + Q_{B2}$. The **market demand** is therefore the horizontal sum of the individual demands at these prices. In the figure this is defined by $D_{market}$.

**Market demand**: the horizontal sum of individual demands.

## 3.9 Useful techniques – demand and supply equations

The supply and demand functions, or equations, underlying Table 3.1 and Figure 3.2 can be written in their mathematical form:

$$\text{Demand: } P = 10 - Q$$

$$\text{Supply: } P = 1 + (1/2)Q$$

A straight line is represented completely by the intercept and slope. In particular, if the variable $P$ is on the vertical axis and $Q$ on the horizontal axis, the straight-line equation relating $P$ and $Q$ is defined by $P = a + bQ$. Where the line is negatively sloped, as in the demand equation, the parameter $b$ must take a negative value. By observing either the data in Table 3.1 or Figure 3.2 it is clear that the vertical intercept, $a$, takes a value of \$10. The vertical intercept corresponds to a zero-value for the $Q$ variable. Next we can see from Figure 3.2 that the slope (given by the rise over the run) is 10/10 and hence has a value of $-1$. Accordingly the demand equation takes the form $P = 10 - Q$.

On the supply side the price-axis intercept, from either the figure or the table, is clearly 1. The slope is one half, because a two-unit change in quantity is associated with a one-unit change in price. This is a positive relationship obviously so the supply curve can be written as $P = 1 + (1/2)Q$.

Where the supply and demand curves intersect is the market equilibrium; that is, the price-quantity combination is the same for both supply and demand where the supply curve takes on the same values as the demand curve. This unique price-quantity combination is obtained by equating the two curves: If Demand=Supply, then

$$10 - Q = 1 + (1/2)Q.$$

Gathering the terms involving $Q$ to one side and the numerical terms to the other side of the equation results in $9 = 1.5Q$. This implies that the equilibrium quantity must be 6 units. And this quantity must trade at a price of \$4. That is, when the price is \$4 both the quantity demanded and the quantity supplied take a value of 6 units.

### Modelling market interventions using equations

To illustrate the impact of market interventions examined in Section 3.7 on our numerical market model for natural gas, suppose that the government imposes a minimum price of \$6 – above the equilibrium price obviously. We can easily determine the quantity supplied and demanded at such a price. Given the supply equation

$$P = 1 + (1/2)Q,$$

it follows that at $P = 6$ the quantity supplied is 10. This follows by solving the relationship $6 = 1 + (1/2)Q$ for the value of $Q$. Accordingly, suppliers *would like to supply* 10 units at this price.

Correspondingly on the demand side, given the demand curve

$$P = 10 - Q,$$

with a price given by $P = \$6$, it must be the case that $Q = 4$. So buyers *would like to buy* 4 units at that price: There is excess supply. But we know that the short side of the market will win out, and so the actual amount traded at this restricted price will be 4 units.

## CONCLUSION

We have covered a lot of ground in this chapter. It is intended to open up the vista of economics to the new student in the discipline. Economics is powerful and challenging, and the ideas we have developed here will serve as conceptual foundations for our exploration of the subject. Our next chapter deals with measurement and responsiveness.

## Key Terms

**Demand** is the quantity of a good or service that buyers wish to purchase at each possible price, with all other influences on demand remaining unchanged.

**Supply** is the quantity of a good or service that sellers are willing to sell at each possible price, with all other influences on supply remaining unchanged.

**Quantity demanded** defines the amount purchased at a particular price.

**Quantity supplied** refers to the amount supplied at a particular price.

**Equilibrium price**: equilibrates the market. It is the price at which quantity demanded equals the quantity supplied.

**Excess supply** exists when the quantity supplied exceeds the quantity demanded at the going price.

**Excess demand** exists when the quantity demanded exceeds quantity supplied at the going price.

**Short side of the market** determines outcomes at prices other than the equilibrium.

**Demand curve** is a graphical expression of the relationship between price and quantity demanded, with other influences remaining unchanged.

**Supply curve** is a graphical expression of the relationship between price and quantity supplied, with other influences remaining unchanged.

**Substitute goods**: when a price reduction (rise) for a related product reduces (increases) the demand for a primary product, it is a substitute for the primary product.

**Complementary goods**: when a price reduction (rise) for a related product increases (reduces) the demand for a primary product, it is a complement for the primary product.

**Inferior good** is one whose demand falls in response to higher incomes.

**Normal good** is one whose demand increases in response to higher incomes.

**Comparative static analysis** compares an initial equilibrium with a new equilibrium, where the difference is due to a change in one of the other things that lie behind the demand curve or the supply curve.

**Price controls** are government rules or laws that inhibit the formation of market-determined prices.

**Quotas** are physical restrictions on output.

**Market demand**: the horizontal sum of individual demands.

## Exercises for Chapter 3

**Exercise 3.1** The supply and demand for concert tickets are given in the table below.

| Price ($) | 0 | 4 | 8 | 12 | 16 | 20 | 24 | 28 | 32 | 36 | 40 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Quantity demanded | 15 | 14 | 13 | 12 | 11 | 10 | 9 | 8 | 7 | 6 | 5 |
| Quantity supplied | 0 | 0 | 0 | 0 | 0 | 1 | 3 | 5 | 7 | 9 | 11 |

(a) Plot the supply and demand curves to scale and establish the equilibrium price and quantity.

(b) What is the excess supply or demand when price is $24? When price is $36?

(c) Describe the market adjustments in price induced by these two prices.

(d) *Optional*: The functions underlying the example in the table are linear and can be presented as $P = 18 + 2Q$ (supply) and $P = 60 - 4Q$ (demand). Solve the two equations for the equilibrium price and quantity values.

**Exercise 3.2** Illustrate in a supply/demand diagram, by shifting the demand curve appropriately, the effect on the demand for flights between Calgary and Winnipeg as a result of:

(a) Increasing the annual government subsidy to *Via Rail*.

(b) Improving the Trans-Canada highway between the two cities.

(c) The arrival of a new budget airline on the scene.

**Exercise 3.3** A new trend in US high schools is the widespread use of chewing tobacco. A recent survey indicates that 15 percent of males in upper grades now use it – a figure not far below the use rate for cigarettes. This development came about in response to the widespread implementation by schools of regulations that forbade cigarette smoking on and around school property. Draw a supply-demand equilibrium for each of the cigarette and chewing tobacco markets before and after the introduction of the regulations.

**Exercise 3.4** The following table describes the demand and supply conditions for labour.

| Price ($) = wage rate | 0 | 10 | 20 | 30 | 40 | 50 | 60 | 70 | 80 | 90 | 100 | 110 | 120 | 130 | 140 | 150 | 160 | 170 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Quantity demanded | 1020 | 960 | 900 | 840 | 780 | 720 | 660 | 600 | 540 | 480 | 420 | 360 | 300 | 240 | 180 | 120 | 60 | 0 |
| Quantity supplied | 0 | 0 | 0 | 0 | 0 | 0 | 30 | 60 | 90 | 120 | 150 | 180 | 210 | 240 | 270 | 300 | 330 | 360 |

(a) Graph the functions and find the equilibrium price and quantity by equating demand and supply.

(b) Suppose a price ceiling is established by the government at a price of \$120. This price is below the equilibrium price that you have obtained in part (a). Calculate the amount that would be demanded and supplied and then calculate the excess demand.

**Exercise 3.5** In Exercise 3.4, suppose that the supply and demand describe an agricultural market rather than a labour market, and the government implements a price floor of \$140. This is greater than the equilibrium price.

(a) Estimate the quantity supplied and the quantity demanded at this price, and calculate the excess supply.

(b) Suppose the government instead chose to maintain a price of \$140 by implementing a system of quotas. What quantity of quotas should the government make available to the suppliers?

**Exercise 3.6** In Exercise 3.5, suppose that, at the minimum price, the government buys up all of the supply that is not demanded, and exports it at a price of \$80 per unit. Compute the cost to the government of this operation.

**Exercise 3.7** Let us sum two demand curves to obtain a 'market' demand curve. We will suppose there are just two buyers in the market. Each of the individual demand curves has a price intercept of \$42. One has a quantity intercept of 126, the other 84.

(a) Draw the demands either to scale or in an Excel spreadsheet, and label the intercepts on both the price and quantity axes.

(b) Determine how much would be purchased in the market at prices \$10, \$20, and \$30.

(c) *Optional*: Since you know the intercepts of the market (total) demand curve, can you write an equation for it?

**Exercise 3.8** In Exercise 3.7 the demand curves had the same price intercept. Suppose instead that the first demand curve has a price intercept of \$36 and a quantity intercept of 126; the other individual has a demand curve defined by a price intercept of \$42 and a quantity intercept of 84. Graph these curves and illustrate the market demand curve.

**Exercise 3.9** Here is an example of a demand curve that is not linear:

| Price (\$) | 4 | 3 | 2 | 1 | 0 |
|---|---|---|---|---|---|
| Quantity demanded | 25 | 100 | 225 | 400 | 625 |

(a) Plot this demand curve to scale or in Excel.

(b) If the supply function in this market is $P = 2$, plot this function in the same diagram.

(c) Determine the equilibrium quantity traded in this market.

**Exercise 3.10** The football stadium of the University of the North West Territories has 30 seats. The demand curve for tickets has a price intercept of \$36 and a quantity intercept of 72.

(a) Draw the supply and demand curves to scale in a graph or in Excel. (This demand curve has the form $P = 36 - 0.5 \times Q$.)

(b) Determine the equilibrium admission price, and the amount of revenue generated from ticket sales for each game.

(c) A local alumnus and benefactor offers to install 6 more seats at no cost to the University. Compute the price that would be charged with this new supply and compute the revenue that would accrue at this new equilibrium price. Should the University accept the offer to install the seats?

(d) Redo the previous part of this question, assuming that the initial number of seats is 40, and the University has the option to increase capacity to 46 at no cost to itself. Should the University accept the offer in this case?

**Exercise 3.11** Suppose farm workers in Mexico are successful in obtaining a substantial wage increase. Illustrate the effect of this on the price of lettuce in the Canadian winter, using a supply and demand diagram, on the assumption that all lettuce in Canada is imported during its winter.

# Part Two

## Introduction to Macroeconomics



The four chapters in this part of the text introduce and develop the expenditure side of a basic traditional macroeconomic model. Chapter 4 explains the measurement of macroeconomic activity and performance. Then Chapter 5 introduces an aggregate demand and supply model of national output, the general price level and business cycles. Market based aggregate expenditure components that determine aggregate demand, when prices, interest rates and exchange rates are constant, are modelled in Chapter 6. Chapter 7 extends the expenditure model to include Government expenditure, taxes, budgets, public debt and basic fiscal policy.

# Chapter 4

## Economic activity & performance

**In this chapter we will explore:**



Macroeconomics is focused on three key indicators of the economy's performance and the underlying explanations for their behaviour. The indicators are:

1. The rate of growth of real national income.
2. The rate of inflation.
3. The rate of unemployment.

Other aspects of the economy like interest rates, foreign exchange rates, wage rates, government budgets, capital investment, commodity prices, housing and so forth are important to macroeconomic analysis because they work to determine performance as measured by these three indicators.

Macroeconomics involves complex linkage and feedback effects that tie economic conditions and economic policy to economic performance. Macroeconomic theories and models attempt to capture this complexity. They seek to understand and explain the causes of changes in economic performance and the role for economic policy.

Internationally the persistent effects of what seemed to be a local crisis in the US housing market triggered the Great Recession of 2009. International linkages among financial markets spread the effects across European and other financial markets. Government bailouts of major banks and monetary and fiscal stimulus to fight falling output and employment resulted in unprecedented government deficits and historically low interest rates. International financial and fiscal linkages were much stronger than expected initially.

In Canada, the interest rates set by the Bank of Canada were reduced to the lowest historical level. Governments continue to focus their budget policies on reducing or eliminating budget deficits caused by earlier economic conditions and policy decisions, despite pressing needs for infrastructure investment. The recent collapse in crude oil and other commodity prices raise new concerns for domestic economic growth and employment.

Macroeconomic theory and models emerged from an earlier major financial collapse and crisis followed by the depression years of the 1930s. Although today's economies are larger and more complex they still behave by the same basic principles.

To understand the different dimensions of economic activity, economic conditions and macroeconomic policies, we need a framework that captures how they are related and how they interact. Macroeconomics provides that framework, using consistent and comprehensive system of definitions for the measurement of economic activity provided by the national accounts.

## 4.1 Macroeconomic performance

Output, price, and employment are three key dimensions of macroeconomic activity. Output is a measure of the total quantity of goods and services produced in the economy. It is also a measure of the incomes generated by that production. Price or the price level in macroeconomics is the weighted average of the market prices of all final goods and services produced. The price level reflects the costs of production in the economy. Employment is a measure of the number of jobs involved in the production of goods and services, or, in more refined terms, the number of hours of labour input required to produce the economy's output. Economic performance is judged by how these measures change over time.

Output and its rate of growth are measured in terms of **real gross domestic product (real GDP)**. It is the quantity of final goods and services produced in the economy in a specific time period, such as one year, measured in the market prices of a base year, 2007 for example. (It may also be called GDP in constant 2007 dollars). The production of goods and services generates incomes equal to the value of those goods and services. As a result, real GDP is also the real income in the economy and the quantity of goods and services the economy can afford to buy.

> **Real GDP**: the quantity of final goods and services produced by the economy in a specified time period.

In an economy with a growing population and labour force, growth in real GDP is necessary to maintain standards of living. In the Canadian economy, real GDP changes from year to year. By measuring real GDP in the prices of a base year, the changes seen in real GDP are the result of changes in the quantities of goods and services produced, and not the result of changes in prices. This distinction is important: Increased quantities of goods and services provide for increased standards of living in the economy, increases in prices do not. As a result, **economic growth** is defined as an increase in real GDP, and the annual **rate of economic growth** is the annual percentage change in real GDP. This is the first key indicator of economic performance.

The rate of growth in real GDP is calculated as follows:

$$\text{Rate of growth of real GDP} = \frac{\text{Real GDP}_{\text{year 2}} - \text{Real GDP}_{\text{year 1}}}{\text{Real GDP}_{\text{year 1}}} \times 100 \tag{4.1}$$

**Economic growth**: an increase in real GDP.

**Rate of economic growth**: the annual percentage change in real GDP.

Recent measures of real GDP in Canada provide an example of economic growth and the calculation of the rate of economic growth. In the year 2013, real GDP in Canada measured in 2007 dollars was $1,681 billion. In 2012, real GDP in 2007 dollars was $1,654 billion. Using these data:

$$\text{Rate of growth of real GDP in 2013} = \frac{\$1,681 - \$1,654}{\$1,654} \times 100 = 1.6\%$$

The **price level** in the economy is a measure of the weighted average of prices of a wide variety of goods and services. The **Consumer Price Index (CPI)**, for example, compares the cost of a fixed basket of goods and services bought by the typical household at a specific time with the cost of that same basket of goods and services in the base year. It is the most widely used indicator of prices in Canada and is often referred to as the "cost of living."

**Price level**: a measure of the average prices of all goods and services produced in the economy.

**Price index**: a measure of the price level in one year compared with prices in a base year.

**Consumer Price Index (CPI)**: a measure of the cost of living in any one year compared to the cost of living in a base year.

The Consumer Price Index is a more comprehensive measure of the change in prices from one year to the next, but the simple example in Example Box 4.1 illustrates the how such an index is constructed and what it tells us.

**Example Box 4.1: Constructing a price index**

A simple example illustrates the construction of a price index. Suppose a survey of expenditures by university students in the year 2006 gives the information reported in the first three columns in the following table:

**University student weekly expenditure basket (Base year 2006)**

| | Quantity | 2006 Price | 2006 Cost | 2011 Price | 2011 Cost |
|---|---|---|---|---|---|
| Pizza | 5 | $7.50 | $37.50 | $8.50 | $42.50 |
| Hamburger | 5 | $2.50 | $12.50 | $2.25 | $11.25 |
| Coffee | 10 | $1.00 | $10.00 | $1.25 | $12.50 |
| Movies | 1 | $10.00 | $10.00 | $8.00 | $8.00 |
| Bus fare | 7 | $1.50 | $10.50 | $1.85 | $12.95 |
| Total | | | $80.50 | | $87.20 |

This table gives us the cost of weekly expenditures on a basket of five items and the weight of each item in the total expenditure. If we choose 2006 as our base year then the cost of the basket in 2006 prices, $80.50, has an index value of 100 [($80.50/80.50) × 100]. In other words we have a Student Price Index:

$$\text{SPI}_{2006} = 100.0$$

Now we see in the last two columns of the table that this same basket of goods and services in *the prices of 2011* would cost $87.20. Then our SPI in 2011 would be:

$$(\text{Cost of basket in 2011})/(\text{Cost of basket in 2006}) \times 100 = (\$87.20)/(\$80.50) \times 100 = 108.3$$

The index tells us that even though the prices of some things went up and others went down the Student Price Index increased by 8.3%. This was the weighted average increase in prices and the increase in the cost of student expenditures.

Today, the base year for the consumer price index is 2002 with a value of 100. Statistics Canada uses a fixed basket classified under eight consumer expenditure categories. The weight or importance of each category is its share of expenditure as determined by consumer expenditure surveys. By visiting the Statistics Canada website, `www.statcan.gc.ca`, and selecting Consumer Price Index in the *Latest Indicators* table on the right side of the home page, you can scroll down to a table showing the components of the CPI.

For 2012 Statistics Canada reported a CPI of 121.7 compared to a CPI of 100.0 in 2002. That meant the cost of the basket of goods in 2012 was 21.7 per cent higher than it was in 2002. Prices and the cost of living increased over the 10-year period. At the end of 2013 the CPI was 122.8. Prices had increased again. **Inflation** is defined as a persistent rise in the general price level as indicated by these increases taking the change, as a percentage, in the price level the previous year.

> **Inflation**: a persistent rise in the general price level.

The inflation rate is calculated using the same method used for calculating the growth rate in real GDP. For example:

$$\text{Inflation rate for 2013} = \frac{\text{CPI}_{2013} - \text{CPI}_{2012}}{\text{CPI}_{2012}} \times 100 \tag{4.2}$$

Statistics Canada reported the 2013 CPI at 122.8 and the 2012 CPI at 121.7. The inflation rate for 2011 was:

$$\text{Inflation rate for 2013} = \frac{122.8 - 121.7}{121.7} \times 100 = 0.9$$

Statistics Canada also collects and publishes information on the Canadian labour market. It uses a monthly Labour Force Survey of approximately 50,000 Canadian individuals 15 years of age or over living in the provinces of Canada, excluding full-time members of the armed forces, those persons living on Indian reserves, and those in institutions such as penal institutions, hospitals, and nursing homes. The survey provides the data used to estimate the size of the labour force, employment, and unemployment.

**Employment** is defined as the number of adults (15 years of age and older) employed full-time and part-time and self-employed. **Unemployment** covers those not working but available for and *seeking work*. The civilian **labour force** is those adults who are employed plus those not employed but actively looking for jobs. Based on these concepts, and data on the surveyed population, Statistics Canada reports three key labour market indicators, namely: The participation rate, the unemployment rate, and the employment rate. Employment and unemployment receive most of the media attention and have become familiar indicators of economic conditions. There are, however, two other underlying labour market measures that deserve attention when interpreting the employment and unemployment rates.

> **Labour force**: adults employed plus those not employed but actively looking for work.
>
> **Employment**: number of adults employed full-time and part-time and self-employed.
>
> **Unemployment**: number of adults not working but actively looking for work.

The **participation rate** is the proportion of the surveyed population that is either working or unemployed. It measures the size of the labour force relative to the surveyed population. The participation rate changes as people become more optimistic about finding employment, or discouraged by periods without employment. Discouraged workers want to work but are no longer looking for work because they believe suitable work is not available. As a result they are excluded from the measurement of the labour force and reduce the participation rate. *Changes in the participation rate change the size of the labour force and the unemployment rate even if employment and the population are constant.*

> **Participation rate**: percent of the population that is either working or unemployed.

$$\text{Participation Rate} = \frac{\text{Labour force}}{\text{Population 15+ yrs}} \times 100 \tag{4.3}$$

In Canada in 2013 Statistics Canada reported the population 15 years and older was 28.690 million persons and the labour force was 19.079 million persons. These data give:

$$\text{Participation rate in 2013} = \frac{19.079}{28.690} \times 100 = 66.5\%$$

The **unemployment rate** is the number of unemployed persons as a percentage of the labour force. The size of the labour force depends on the participation rate, which reflects the choices people make about looking for work. The unemployment rate will rise if people become more optimistic about job prospects and begin to look for work, increasing the participation rate and the labour force. On the other hand, the unemployment rate will decline if some people become discouraged and give up looking for work, reducing the participation rate and the labour force.

> **Unemployment rate**: the number of unemployed persons as a percentage of the labour force.

The unemployment rate is calculated as follows:

$$\text{Unemployment Rate} = \frac{\text{Labour force} - \text{employment}}{\text{Labour force}} \times 100 \tag{4.4}$$

Statistics Canada reported labour force participation rate of 66.5 percent, a labour force of 19.079 million persons in 2013 and total employment of 17.731 million persons. In that year, 1.348 million persons were unemployed and the unemployment rate was:

$$\text{Unemployment rate for 2013} = \frac{19.079 - 17.731}{19.079} \times 100 = 7.1\%$$

Unemployment as measured by the broad unemployment rate has three important components. **Cyclical unemployment** is unemployment that would be eliminated by a higher level of economic activity without putting increased pressure on wage rates and inflation. **Frictional unemployment** comes from the dynamics of the labour market as changing labour force participation and employment opportunities mean that it takes time to match job openings with job candidates. **Structural unemployment** reflects differences in labour force characteristics and employment opportunities as the structure of the economy changes. In combination, frictional and structural unemployment make up the "full employment" level of unemployment. The corresponding unemployment rate is defined as the **natural unemployment rate**. In recent years in Canada, estimates of frictional and structural unemployment suggest a natural unemployment rate of about 6.0 percent. An unemployment rate persistently below 6.0 percent would create inflationary pressure in the labour market and the economy.

**Cyclical unemployment**: would be eliminated by higher levels of economic activity.

**Frictional unemployment**: a result of the time involved in adjusting to changing labour force and employment opportunities.

**Structural unemployment**: caused by changes in economic structure relative to labour characteristics.

**Natural unemployment rate**: the unemployment rate at "full employment".

The **employment rate** is the percentage of the population 15 years of age and over that is employed. Employment rates provide a different perspective on labour market conditions because they are not affected by changes in the participation rate, which can change unemployment rates. If some people become discouraged and stop looking for work the participation rate, the labour force and the unemployment rate decline, but the employment rate is unchanged. The employment rate is calculated as:

$$\text{Employment Rate} = \frac{\text{Employment}}{\text{Population 15+ yrs}} \times 100 \tag{4.5}$$

**Employment rate**: percent of the population 15 years of age and over that is employed.

In 2013 the population 15 years of age and over was 28.111 million and employment was 17.327 million and the employment rate was:

$$\text{Employment rate in 2013} = \frac{17.731}{28.690} \times 100 = 61.8\%$$

The employment rate was lower than the participation rate because some members of the labour force were unemployed.

Table 4.1 gives recent data on the Canadian labour force and labour market conditions using these concepts.

**Table 4.1: The Canadian labour market, February 2014 (thousands of persons and percent)**

| | |
|---|---|
| 1. Non-institutional population 15+ yrs | 28,894 |
| 2. Labour force | 19,133 |
| 3. Employment | 17,790 |
| | |
| 4. Unemployment $[(2)-(3)]$ | 1,343 |
| 5. Participation rate $[(2)/(1)\times 100]$ | 66.2% |
| 6. Employment rate $[(3)/(1)\times 100]$ | 61.6% |
| 7. Unemployment rate $[(4)/(2)\times 100]$ | 7.0% |

*Source:* Statistics Canada, Labour Force Characteristics, Seasonally Adjusted, by Province. Table 282-0087.

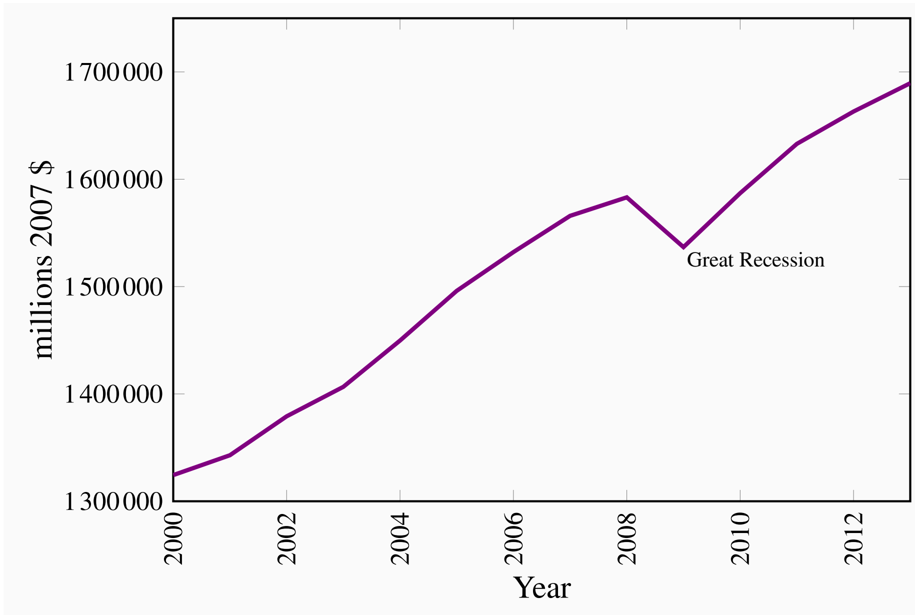
Almost every day the media discuss some aspects of economic growth, inflation, and employment. Often these discussions ignore the requirement that employment must grow faster than the growth in the labour force if unemployment is to decline. Good news about 'job creation' needs to be tempered by news on labour force growth. These issues often play large roles in elections and discussions of economic policy. In the chapters that follow, we will study causes of changes in output, income, prices and inflation, and employment and unemployment. As a background to that work, consider recent Canadian economic performance.

## 4.2 Canadian economic performance

The positive relationship between economic performance and standards of living motivates the study of macroeconomics and macroeconomic policy. The ideal would be an economy in which, starting with full employment of labour and capital equipment, the rate of growth of real GDP matched the rate of growth of the labour force and growth in labour productivity, at a low and stable rate of inflation. This is sometimes referred to as a 'Goldilocks Economy' – neither too hot nor too cold, just right.

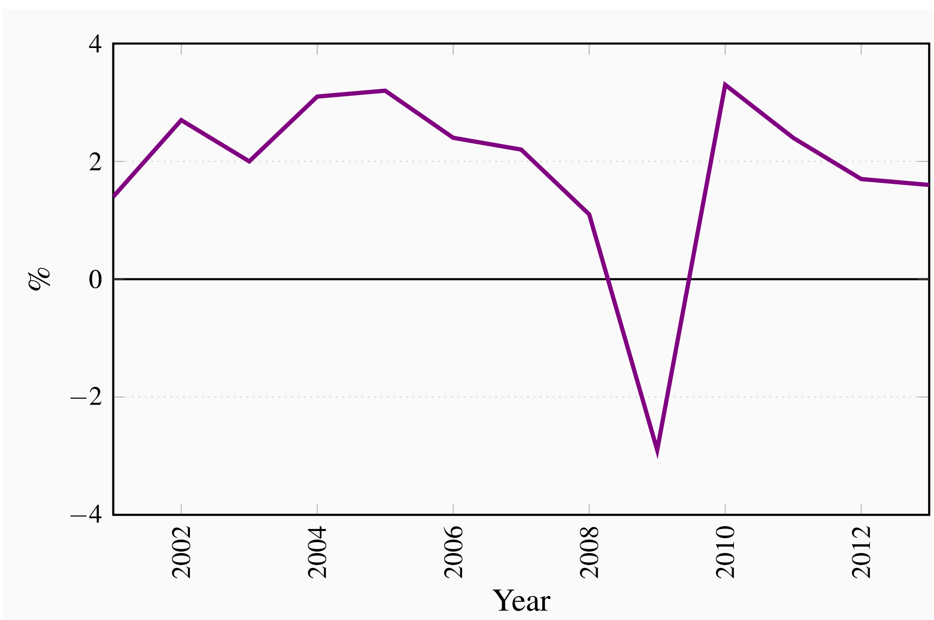
Figures 4.1 to 4.4 provide a more detailed look at the actual rate of growth of real GDP, the rate of inflation, and unemployment rate in Canada over the 2000-2013 time period. They show the trends and annual variations in these measures of economic performance. Understanding the causes of these short-term fluctuations in economic performance, their effects on standards of living and the economic policy questions they raise, are major reasons for studying macroeconomics.

**Figure 4.1: Real GDP in Canada 2000-2013**




*Source*: CANSIM Table 380-0106

**Figure 4.2: Annual real GDP growth in Canada, 2001-2013**




*Source*: CANSIM Table 380-0106 and author's calculations.

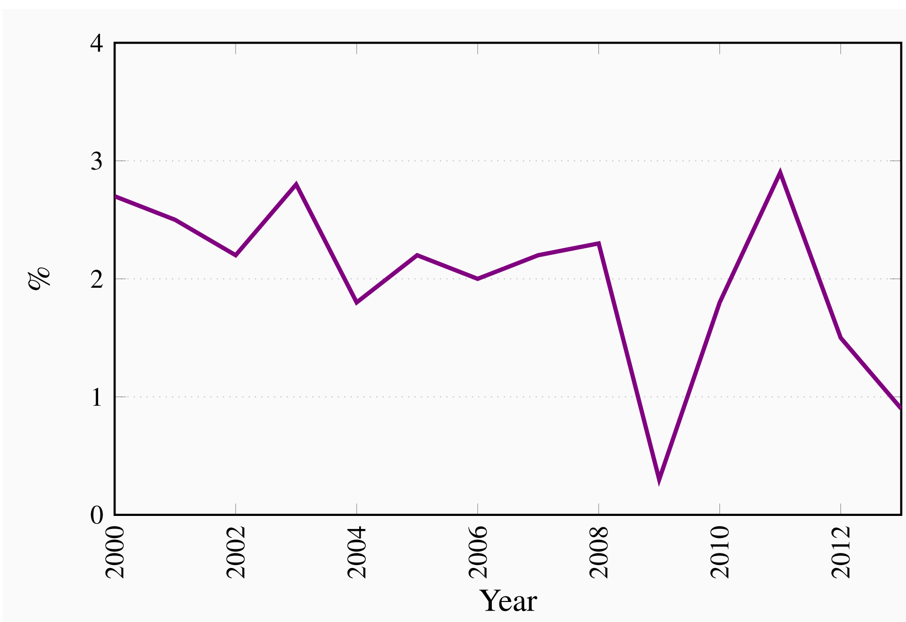
Figure 4.1 shows the substantial growth in real GDP over the 2000-2013 period. It also shows that growth was not steady. Real GDP did increase from 2000-2008 with annual growth rates ranging from 1.5-3.0. Then the real GDP declined sharply by 3.0 percent in 2009. This and other times of negative growth in real GDP are called **recessions**. Indeed the fall in real GDP in 2009, the largest since such decline since the 1930s, is now called the 'Great Recession'.

> **Recession**: decline in economic activity, often defined as two consecutive quarters of negative growth in real GDP.

Figure 4.2 shows more clearly the considerable fluctuations in real GDP annual growth rates and the negative growth rate of the Great Recession. Even when the trend in growth is positive, fluctuations in growth rates can have negative effects on standards of living. They are reflected in changes in employment, changes in incomes and changes in markets that can make life difficult for those affected. We study macroeconomics to find explanations for the causes and effects of these fluctuations in economic activity that will guide stabilization policies.

Figure 4.3 shows annual inflation rates in Canada since 2000. These show the relative stability of Canadian inflation in the years leading up to the Great Recession. That pattern changed after 2008 with the effects of lower output growth and higher unemployment on prices and wage rates.

**Figure 4.3: Annual inflation rates in Canada, 2000-2013**

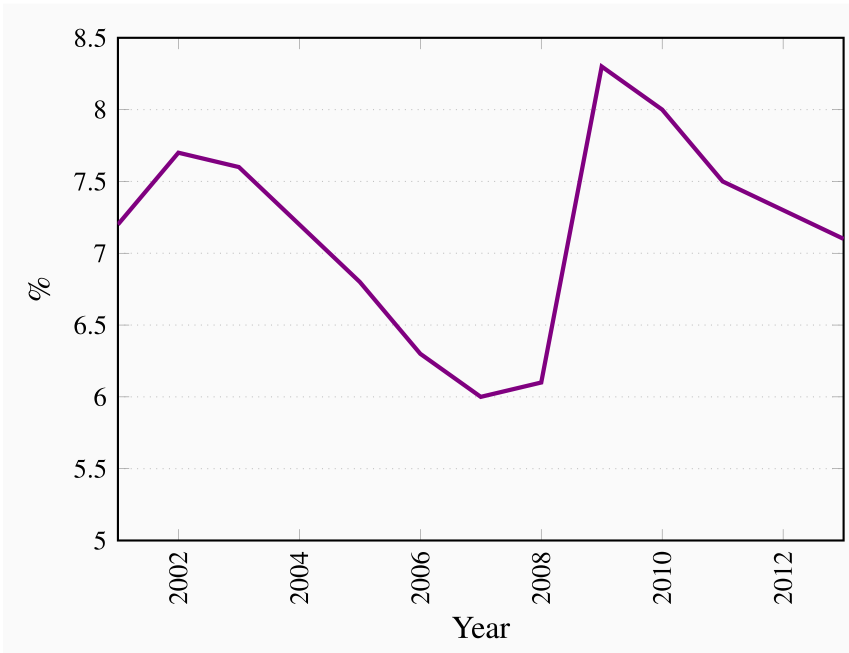



*Source*: Statistics Canada, CANSIM series V41690914

Our recent experience with low and stable inflation rates in the 2000-2014 period is quite different from past experience. In the late 1980s and early 1990s annual inflation rates were at times higher than 10 percent. We will examine the roles that monetary policies and recessions played in these changes in inflation rates.

Fluctuations in growth rates and inflation rates are also accompanied by fluctuations in unemployment rates. Annual unemployment rates plotted in Figure 4.4 have fluctuated between 6 percent and 8.3 percent. Although employment has grown over time, when job creation has at times fallen short of the growth in the labour force, unemployment rates rise. At other times, strong real GDP growth and job creation have lowered the unemployment rate. The falling unemployment rates from 2002 to 2007 coincided in time with the continuous growth in real GDP we saw in Figure 4.1.

**Figure 4.4: Annual unemployment rates in Canada 2001-2013**




*Source*: Statistics Canada CANSIM series V2062815

The sharp rise in unemployment in 2009 and the persistence of unemployment rates higher than those in earlier years give us an example of the way growth in real GDP and employment are tied together. The recovery of GDP growth after the Great Recession has not been strong enough to offset modest growth in the labour force and lower unemployment rates to pre-recession levels.

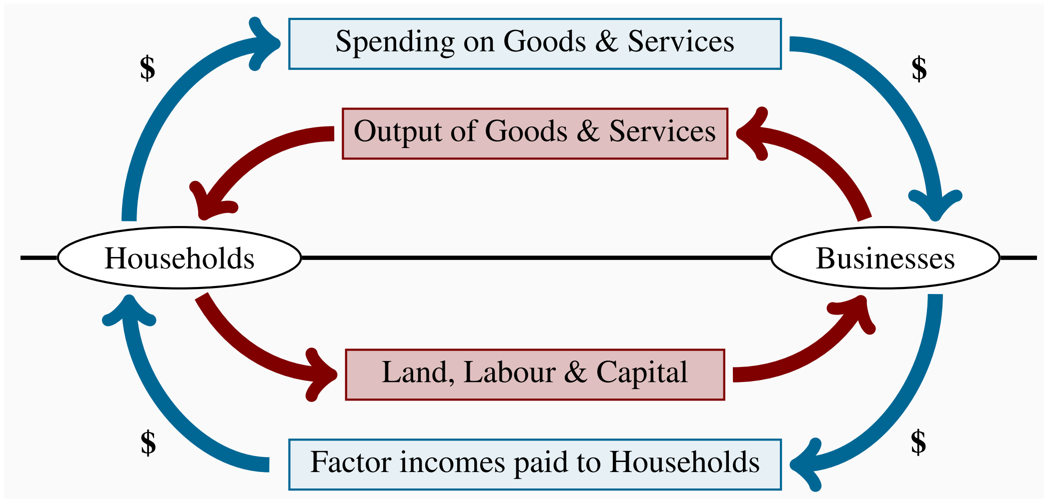
## 4.3 National accounts

National accounts provide the framework that is essential for consistent definitions and measurement of spending, output, and incomes. However, it is important to recognize that this is an accounting system that *describes* the economy, not an economic model that *explains* the economy's behaviour. That comes later.

The national economy involves all households, businesses, and governments that make decisions about employment, output and expenditures. The results of individual decisions made by these economic units are measured by the economy's total spending, output, and income. The **circular flow diagram** in Figure 4.5 shows the relationship between spending, output, and income.

**Circular flow diagrams**: show the flows of money payments, real resources, and goods and services between households and businesses.

**Figure 4.5: Circular flows in the economy**




We start with the simplest of economies. There are only households and businesses; no government and no trade with other countries. Households own the factors of production: Labour, land, capital, and entrepreneurship. Businesses use these factors of production to produce outputs of goods and services. Businesses pay households for the factor services they use and recover these costs by selling their output to the households.

Figure 4.5 shows the circular flow of inputs to production, outputs of goods and services, costs of the inputs to production, and receipts from sales. The upper half of the diagram, above the horizontal line, shows the outputs of goods and services supplied by business to households and household expenditures on those goods and services. The lower half of the diagram shows the factor services of labour, land capital, and entrepreneurship supplied by households to business in exchange for the factor incomes: wages, rent, interest, and profit.

The figure also suggests an alternative way to look at activity in the aggregate economy. The inner loop in the diagram shows the *flows of real factor services* between households and businesses. Households provide factor services to business and get goods and services in return. In modern economies this exchange of factor services for goods and services is facilitated by the use of money as a means of payment. The outer loop in the diagram illustrates the *flows of money payments* made by business to buy factor services, and by households to buy goods and services produced by business. Business pays wages, rent, interest, and profits to households and finances those costs with their receipts from sales to households. To keep the example simple, we assume that households spend all the income they receive from the business sector on goods and services produced by the business sector.

Figure 4.5 illustrates four ways to measure economic activity, namely:

1. the output of goods and services at market prices;
2. the total expenditure on goods and services at market prices;
3. the inputs to the production of goods and services costed at market prices; and
4. the incomes received by households for providing factor inputs to production.

The four rectangles in the diagram show these four alternative but equal measurements.

The accounting framework gives the same measure of total economic activity whether we use the market value of output, total spending on that output, inputs to production, or the factor incomes received by households in return for those inputs.

This circular flow model is kept very simple to illustrate the basic accounting principle:

$$\begin{aligned}\text{Market value of output} &= \text{total expenditure}\\ &= \text{market value of factor services}\\ &= \text{household income.}\end{aligned}$$

While the principle illustrated by the circular flow is sound, the economy in Figure 4.5 is too simple. It does not allow households to save or businesses to invest. It leaves out government expenditures and taxes, and transactions between households and businesses with the rest of the world. Including those aspects of economic activity would make our model more complex, and we would need a comprehensive system of national accounts to describe and measure it. But the basic accounting principle would be the same: the four ways to measure total activity in the economy give, *by definition*, the same answer.

## 4.4 Measuring GDP

Nominal GDP is measured using market prices and a specific time period. It is not possible to add up the final physical outputs of many different businesses and arrive at a meaningful result. Instead, because we have a 'money economy', we let current market prices determine the money values of these different outputs. Then the total market value can be found by adding up the money values. Nominal GDP is the market value at current prices of all final goods and services.

Furthermore, the outputs of goods and services occur over time, not all at once. They flow over time and must be measured relative to time. GDP measured over three-month and one-year time periods are reported as quarterly GDP and annual GDP. Annual nominal GDP for any year is the value of the **final goods and services** produced in that year at the prices of that year.

**Final goods and services**: goods and services are purchased by the ultimate users.

In Canada, Statistics Canada uses the Canadian System of National Accounts (CSNA) to measure GDP. This framework is based on the circular flow concept we have discussed, but is applied to the complexity of the actual economy.

Although earlier in this chapter we defined and discussed *real GDP*, measured at prices of a base year national accounting measures **nominal GDP** at current prices. The CSNA produces three measurements of nominal GDP:

1. *Output-based GDP* is the sum of value added (output less the cost of goods and services purchased from other business) by all industries in Canada;
2. *Income-based GDP* records the earnings generated by the production of goods and services; and
3. *Expenditure-based GDP* is equal to expenditure on final goods and services produced.

> **Nominal GDP**: the output of final goods and services, the money incomes generated by the production of that output, and expenditure on the sale of that output in a specific time period.

These three alternative measures of GDP provide importantly different perspectives on the level of national economic activity. The output and income measures describe the *supply side* of the economy in terms of goods and services produced, and cost of production. The expenditure measure of GDP describes the *demand side* of the economy.

## Output-based GDP

To measure output in the economy, and the contribution of particular businesses or industries to that output, we use the **value-added** approach to GDP. Value added measures the *net* output of each industry. To find the value added (net output) of a particular business or industry, the costs of the goods and services purchased from other businesses and industries are deducted from the value of the final product. National, or all-industry GDP, is then the sum of GDP by industry.

> **Value added**: the difference between the market value of the output of the business and the cost of inputs purchased from other businesses.

This method recognizes that businesses buy inputs to production from other businesses as well as from households. Automakers like General Motors and Honda buy parts and components like tires and windshields from other businesses, and include the costs of those inputs in the prices of the finished cars they sell. They also buy services like accounting, advertising, and transportation from service producers. Similarly, pizza makers buy cheese and pepperoni from cheese factories and meat processors. If we were to add up the outputs of auto parts manufacturers, cheese makers, meat processors, pizza makers, General Motors, and Honda in our measurement of nominal GDP, we would overstate GDP by *double counting*. The cheese would be counted once at the cheese factory and again in the pizza. The same applies to the tires and windshields of the new cars. To avoid double counting, we use value added, the increase in the value of goods and services as measured by the difference between market value of output and the cost of **intermediate inputs** bought from other businesses. Or we could count only the outputs sold to *final* users. Notice that total GDP by our definition measures the output of final goods and services.

> **Intermediate inputs**: services, materials, and components purchased from other businesses and used in the production of final goods.

Consider a simple example. A coffee shop sells 100 cups of coffee an hour at a price, before tax, of \$1.50. To make 100 cups of coffee the shop uses 2 kilos of ground coffee costing \$10.00 per kilo, 25 litres of pure spring water costing \$0.40 a litre, and electricity and dairy products costing, in total \$20. The coffee shop's sales per hour are \$150 using inputs costing \$50. Its value added is $\$150 - \$50 = \$100$. As we will see shortly, this value added, or \$100, covers the labour costs, rent, interest expenses, and management costs of the business, for producing 100 cups of coffee an hour.

**Table 4.2: Outputs of selected industries in GDP, Canada 2013 (percent shares)**

| | |
|---|---|
| **All industries** | 100.0 |
| Goods producing industries | 29.9 |
| Service producing industries | 70.1 |
| | |
| Agriculture, forestry, fishing, etc. | 1.8 |
| Mining, oil and gas extraction | 8.3 |
| Construction | 7.0 |
| Manufacturing | 10.3 |
| Wholesale and retail trade | 10.8 |
| Transportation | 4.2 |
| Finance, insurance and real estate | 19.5 |
| Professional and educational | 10.6 |
| Health and social assistance | 6.8 |
| Public administration | 6.9 |
| All other | 13.9 |

*Source*: Statistics Canada, CANSIM Table 379-0031 and author's calculations.

Table 4.2 shows the industrial structure of output in Canada in 2013, based on the percentage shares of selected industries in Canadian GDP. Industry outputs are measured by value added. The data illustrate the importance of service-producing industries to economic activity in Canada. This industrial structure is typical of today's high-income economies and raises many interesting questions about the relationship between economic structure, performance, and growth. However, when our main interest is in the total level of economic activity rather than its industrial structure, the expenditure-based and income-based measures of GDP are used.

## Expenditure-based GDP and income-based GDP

In the national accounts, expenditure based GDP and income based GDP are equal by definition. Table 4.3 provides an example using the actual accounts for Canada in 2013. Expenditure categories and their shares in total expenditure are recorded in the left hand side of Table 4.3. Income categories and indirect taxes shares and their shares are recorded on the right-hand side.

**Table 4.3: Canadian national accounts 2013 (billions \$ at current prices and % GDP)**

| **Expenditure measures** | | | **Incomes measures** | | |
|---|---|---|---|---|---|
| **At market price** | \$ | % | **Income source** | \$ | % |
| *C* by households[1] | 1,045.9 | 56.7 | Employee compensation | 956.8 | 50.9 |
| *I* by business[2] | 380.0 | 20.2 | Net corporate surplus | 239.5 | 12.7 |
| *G* by government | 485.6 | 25.8 | Net mixed income | 167.7 | 8.9 |
| *X* exports | 565.7 | 30.1 | Capital consumption | 325.0 | 17.3 |
| *IM* imports | −597.6 | −31.8 | Net indirect taxes | 190.3 | 10.1 |
| Statistical discrepancy | −0.2 | 0.0 | Statistical discrepancy | 0.2 | 0.0 |
| | | | | | |
| **GDP at market price** | **1,879.5** | 100.0 | **GDP at market price** | **1,879.5** | 100.0 |

1. Includes expenditure by non-profit institutions serving households
2. Includes investment in inventories

*Source*: Based on Statistics Canada CANSIM Tables 380-0063 and 380-0064 and author's calculations.

**Expenditure-based nominal GDP** adds up the market value of all the final goods and services bought in a given time period, say one year. The national accounts classify this final expenditure into five main categories: Consumption, investment, government expenditure, exports, and imports.

For expenditure, the national accounts classification system is essential for our study of macroeconomic activity for two reasons. First, the classification scheme covers final expenditure in the economy completely; nothing is omitted. Second, the categories represent expenditure decisions made for different reasons in different parts of the economy and the percentage share or importance of each in final expenditure. Understanding expenditure decisions is critical to the work that lies ahead. Defining the *expenditure* categories is the first step.

Applying a name to each expenditure category in the table and using the notation attached gives:

$$\text{GDP} = \text{consumption} + \text{investment} + \text{government expenditure} + \text{exports} - \text{imports}$$

or

$$\text{GDP} = C + I + G + X - IM \tag{4.6}$$

For macroeconomic theory and models, this expenditure GDP is the foundation of theory of aggregate demand introduced in Chapter 5 and developed in detail in later chapters.

**Income-based GDP** adds up the factor costs of production of all goods and services plus the net in direct taxes included in market price. The national accounts classifications of factor incomes correspond to labour income, corporate profit, unincorporated business income plus investment income, and depreciation. The table also shows the percentage share of each category in GDP and thus the relative importance of each in income or cost respectively. The income categories are: Employment compensation ($W$), net corporate surplus (profit) ($NCS$), net mixed income (unincorporated business income plus investment income) ($NMI$), capital consumption allowance ($CCA$) and net indirect taxes ($T_{IN}$). Then GDP at market price is:

$$\text{GDP} = W + NCS + NMI + CCA + T_{IN} \tag{4.7}$$

This income based GDP measures total cost of production. The first three components $W$, $NCS$ and $NMI$ are factor costs of production; $CCA$ is the depreciation of capital equipment used in production. Net indirect tax $T_{IN}$ is the revenue generated by taxes applied to goods and services and included in final price. An aggregate supply function for the economy involves these costs of production in relation to total output. Aggregate expenditure at market prices is the revenue that producers receive to cover these costs.

To construct a macroeconomic theory and model of the economy we must explain the linkages, feedbacks and interactions among the elements of the economy defined by national accounting conventions. These linkages, feedbacks and interactions are the important relationships that work together to explain how this economic system determines GDP, business cycle fluctuations in GDP, inflation, and employment.

## 4.5 Nominal GDP, real GDP & the GDP deflator

We have used *real GDP* to measure growth and the growth rate in the beginning of this chapter, and then *nominal GDP* as recorded in the National Accounts. Now we need to look carefully at both concepts and the relationship between them, which is the GDP deflator, a measure of the general price level. *Nominal GDP* measures output and incomes based on *current market prices* for goods and services and factors of production. As a result, changes in nominal GDP from one period to the next might be the result of changes in prices of final outputs and factor inputs, or the result of changes in the quantities of final outputs and factor inputs, or some combination of the two. Since it is physical quantities of goods and services that yield satisfaction or utility, it can be misleading to judge the economy's performance by looking at nominal GDP. For that purpose we need real GDP, as we discussed earlier in this chapter. *Real GDP*, or *GDP in constant prices*, measures the value of goods and services produced in any given year using the prices of a base year. In this way, real GDP adjusts changes in GDP for changes in prices by measuring GDP in different years in constant prices.

**Table 4.4: Nominal and real GDP**

| | | 2000 | 2014 | % change |
|---|---|---|---|---|
| **Quantity** | blue jeans | 4,000 | 5,000 | 25 |
| | solar panels | 2,000 | 4,000 | 100 |
| **Price in $** | blue jeans | 25 | 50 | 100 |
| | solar panels | 100 | 80 | −20 |
| **Current value** | blue jeans | 100,000 | 250,000 | 150 |
| | solar panels | 200,000 | 320,000 | 60 |
| **Nominal GDP** | | 300,000 | 570,000 | **90** |
| **Value in 2000 $** | blue jeans | 100,000 | 125,000 | 25 |
| | solar panels | 200,000 | 400,000 | 100 |
| **Real GDP** | | **300,000** | **525,000** | **75** |
| **GDP deflator** | | **100** | **108.6** | **8.6** |

To illustrate this important point, Table 4.4 shows a simple economy that produces both consumer goods, blue jeans, and capital goods, solar panels. In this economy nominal GDP rises from $300,000 to $570,000 between 2000 and 2014, a 90 percent increase measured in current prices as a result of changes in both quantities and prices. If we take 2000 as the base year, we can measure *real GDP* in 2014 by valuing output quantities in 2014 using 2000 prices. This gives real GDP in 2014 of $525,000 in prices of the base year. In the example in the table, quantities of both products rise over the period but the price of blue jeans rises while the price of solar panels falls. As a result the rise of about 75 percent in real GDP gives a truer picture of the extra quantity of goods available in the economy in 2014 compared with 2000. It eliminates the change in GDP that was the result of the changes in prices by 8.6 percent between 2000 and 2011.

## The GDP deflator

The Canadian economy is obviously more complex than this economy. We have seen that GDP includes expenditures by households, governments, businesses, and residents of other countries who supply us with imports and buy our exports. To convert nominal GDP to real GDP we need to use an index that includes what is happening to the prices of all these different goods and services. This index is called the **GDP deflator**.

**GDP deflator**: index of current final output prices relative to base year prices.

If we have data for both nominal and real GDP, we can calculate the GDP deflator as the ratio of nominal GDP to real GDP expressed as an index with a value of 100 in the base year.

$$\text{GDP deflator} = \frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100 \tag{4.8}$$

The GDP deflator differs from the consumer price index (CPI) illustrated in Example Box 4.1 and used to measure inflation in consumer prices and the cost of living. First, the CPI is based on a "representative basket" of goods and services that consumers buy, while the GDP deflator is comprehensive and covers all the goods and services included in national accounts. Second, the CPI changes over time with changes in the prices of the basket of consumer goods and services. The GDP deflator, by contrast, is built on the base year prices. It changes over time as the current prices change relative to base year prices. In other words the GDP deflator is used to "deflate" the dollar value of current 2011 output to what value it would be in 2000 prices, while the CPI measures the *increase in the cost* of the "basket" of consumer goods and services.

But why does the GDP deflator change over time? From our earlier discussion of the national income accounting framework, we can see that *costs of production* and *net indirect taxes* are included in the general level of market prices measured by the GDP deflator. Nominal GDP measured by the income approach is reported in Table 4.3. It is the sum of incomes paid to factor inputs to production, plus depreciation allowances and net indirect taxes. These components of nominal GDP are the costs of production, gross profits, and taxes that are built into the market prices of the goods and services.

The general price level in the economy is the dollar amount paid for a 'unit of output' and, subtracting indirect taxes, the revenue received by producers for the sale of 'unit of output'. Revenue per unit of output must cover costs per unit of output, including expected profit, for producers to be willing to continue operations. Changes in costs must be covered eventually by changes in prices. Or if market conditions raise prices—think about crude oil production or lumber production—producers will increase output,as long as higher prices cover higher costs.

Summarizing from the national accounts gives three components of cost per unit of output:

1. employee compensation per unit of output, $W/Y$;
2. gross business income per unit of output, $(NCS + NMI + CCA)/Y$; and
3. net indirect tax per unit of output, $T_{IN}/Y$.

Changes in the sum of these three components of the price level must change *both* price and nominal GDP, whether we measure nominal GDP by the income or the expenditure approach. The GDP deflator is an index of this price level in any particular year relative to a chosen base year. However, the accounting framework does not explain the causes of change in the price level. That requires explanations of changes in unit labour costs, of producer output and pricing decisions and information on the net indirect tax rate. Those explanations are parts of an economic model of the supply side of the economy.

To show the empirical importance of the distinction between real and nominal GDP, Table 4.5 gives Canadian data over the period 2001 to 2013. Nominal GDP rose from $1,134.8 billion in 2001 to $1,879.5 billion in 2013. Without knowing what happened to prices of goods and services in general, we cannot judge what happened to the quantity of output over that period. To answer this question we use the GDP deflator to convert nominal GDP to real GDP in the prices of the base year 2007 as follows:

$$\text{Real GDP}_{\text{year } t} = \frac{\text{GDP}_{\text{year } t}}{\text{GDP deflator}} \times 100 \tag{4.9}$$

**Table 4.5: Canadian nominal and real GDP 2001-2013**

| | 2001 | 2005 | 2009 | 2013 |
|---|---|---|---|---|
| Nominal GDP (billions $) | 1,134.8 | 1,410.7 | 1,567.0 | 1,879.5 |
| GDP deflator (2007=100) | 84.6 | 94.3 | 101.6 | 110.9 |
| Real GDP (billions 2007 $) | 1,341.5 | 1,496.0 | 1,542.3 | 1,694.8 |

*Source:* Statistics Canada CANSIM Tables 380-0064 and 380-0066 and author's calculations.

For example, in 2013, nominal GDP was $1,879.5 billion and the GDP deflator (2007=100) was 110.9. Real GDP measured in constant 2007 dollars was then:

$$\text{Real GDP}_{2013} = \frac{1879.5}{110.9} \times 100 = 1694.8 \text{ in 2007 dollars}$$

When converted to constant dollars, the change in real GDP is much smaller than the change in nominal GDP. Over the 2001-2013 period, real GDP increased by 26.3 percent compared to a 65.6 percent increase in nominal GDP. On average, prices in 2013 were 31.1 percent higher than in 2001. Clearly, it is important to distinguish between nominal and real GDP.

## 4.6 Per capita real GDP

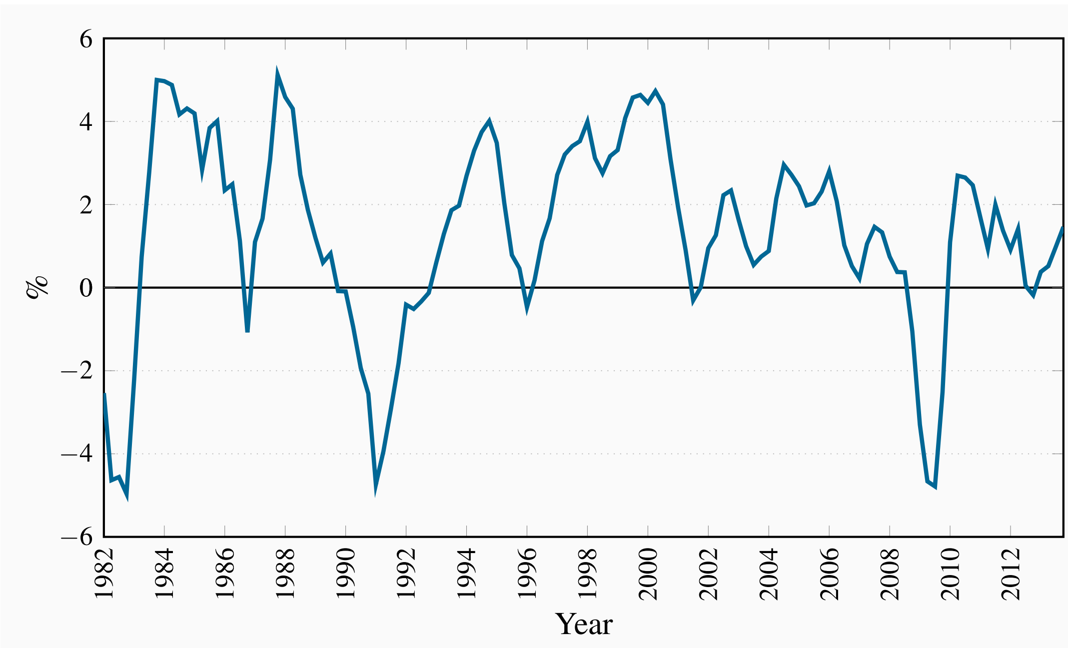
Real GDP is a simple measure of the total real income and output of an economy. The percentage change in real GDP we saw in Figures 4.1, 4.2 and 4.3 shows how fast the economy is growing. But we are also interested in what is happening to *productivity*, the *standard of living* in the economy and how they change over time. For a given real GDP, the larger the population, the lower is productivity and the smaller is the quantity of goods and services per person. To get a simple measure of the standard of living enjoyed by a person in the economy it is better to look at **per capita real GDP**, which adjusts for population. Whether or not growth in total GDP improves standards of living depends also on what is happening to the size of the population. To find per capita real GDP for a country, which is real GDP per person, we simply divide real GDP by population.

> **Per capita real GDP**: real GDP per person.

$$\text{Per capita real GDP} = \frac{\text{Real GDP}}{\text{Population}} \tag{4.10}$$

The study of short-run macroeconomics is strongly motivated by the negative effects of recessions on national standards of living. Figure 4.6 shows the negative effects of recessions on per capita GDP in 1982, 1991, and 2009.

**Figure 4.6: Quarterly rates of growth in per capita real GDP in Canada, 1982-2013**




*Source*: Statistics Canada, CANSIM Table 380-0064 and Series V1

Macroeconomic models are built to help us understand the causes of fluctuations in real GDP, employment, and the price level. Understanding the workings of the economy is essential for the design and implementation of monetary and fiscal policies that contribute to economic stability and protect standards of living.

In longer time horizons macroeconomics seeks to understand and explain the growth of real GDP that is essential to protect and improve standards of living as population grows. Growth also increases the capacity of the economy to direct its resources to a wider range of activities that may include improvements in the quality of goods and services produced or reductions in the effects of growth on social and environmental conditions.

## Limitations of real GDP

Because we use GDP to measure the output and income of an economy, the coverage should be as comprehensive as possible. We should also recognize that the composition of GDP and the distribution of income are important to a country's standard of living.

In practice, we encounter several problems when including all production in GDP. First, some production causes noise, pollution, and congestion, which do not contribute to economic welfare. Current national and international concern about greenhouse gases and climate change is a clear and obvious example of the issues involved. We should adjust GDP for these costs to evaluate standards of living more accurately. This is sensible but difficult to do. Recent policy changes by governments to impose carbon taxes on fuels and fuel efficiency targets for automobiles aim to reduce some greenhouse gases. But most such nuisance goods are not traded through markets, so it is hard to quantify their output or decide how to value their costs to society.

Similarly, many valuable goods and services are excluded from GDP because they are not marketed and therefore are hard to measure. These include the home cleaning, maintenance, and improvements households carry out for themselves, and any unreported jobs and incomes in the economy. Deducting nuisance outputs and adding the value of unreported and non-marketed incomes would make GDP a more accurate measure of the economy's production of goods and services.

Furthermore, high GDP and even high per capita GDP are not necessarily good measures of economic well-being. The composition of that output also affects standards of living. Health care services are likely to have different effects than military expenditures. The United Nations prepares an annual Human Development Index (HDI) to provide a more comprehensive measure of a country's achievements. The HDI provides a summary measure based on life expectancy, adult literacy, and real GDP per capita.

Table 4.6 shows HDIs for the top ten countries in 2011, according to the *Human Development Report, 2011*. The second last and last columns in the table are of particular interest. The second last column shows the HDI adjusted for national inequalities in the distributions of income, life expectancy and education on country standards of living. The underlying argument is that more equal distributions of income, life expectancy and education contribute to higher standards of living. The last column in the table records the effects of inequality on a country's ranking according to the HDI. By these data, distributional inequalities reduce the ranks of three countries: the Netherlands by 1 place, Canada by 7 places and United States by 19 places. By Inequality Adjusted HDI's the Netherlands would rank $4^{th}$ in 2011, Canada would rank $13^{th}$ and the United States would rank $23^{rd}$. Clearly per capita real GDP is not the only indicator of standard of living.

**Table 4.6: Top ten countries based on the United Nations human development index**

| Country ranked by 2011 HDI | 2000 Index | 2005 Index | 2011 Index | 2011 HDI inequality adjusted index | Change in HDI rank* |
|---|---|---|---|---|---|
| **1. Norway** | 0.893 | 0.938 | 0.943 | 0.890 | 0 |
| **2. Australia** | 0.906 | 0.918 | 0.929 | 0.856 | 0 |
| **3. Netherlands** | 0.882 | 0.890 | 0.910 | 0.846 | −1 |
| **4. United States** | 0.897 | 0.902 | 0.910 | 0.771 | −19 |
| **5. New Zealand** | 0.878 | 0.899 | 0.908 | – | – |
| **6. Canada** | 0.879 | 0.892 | 0.908 | 0.829 | −7 |
| **7. Ireland** | 0.869 | 0.898 | 0.908 | 0.843 | 0 |
| **8. Germany** | 0.864 | 0.895 | 0.905 | 0.842 | 0 |
| **9. Sweden** | 0.894 | 0.896 | 0.904 | 0.851 | 5 |
| **10. Switzerland** | – | – | 0.903 | – | – |

* A positive value indicates a country HDI rank higher than its per capita GDP rank.

*Source:* Human Development Report 2011, Statistical Tables, Table 3, p. 135. New York: United Nations Development Programme, hdr.undp.org/en/reports/global/hdr2011/, and *Regional and National trends in Human Development Indicators* 1980-2011.

Do these limitations of GDP matter for our study of macroeconomics? Probably not. We will be examining changes in real GDP from year to year, for the most part. As long as the importance of nuisance and non-marketed outputs, life expectancy, literacy and inequalities do not change dramatically in that time frame, changes in measured real GDP will provide good measures of changes in economic activity and performance. Changes in per capita real GDP will also provide measures of changes in standards of living.

## Conclusion

In this chapter we have looked at indicators of macroeconomic activity and performance, and the measurement of macroeconomic activity using the national accounts. We have not examined the conditions that determine the level of economic activity and fluctuations in that level. An economic model is required for that work. In the next chapter we introduce the framework of a basic macroeconomic model.

## Key Concepts

**Macroeconomics** studies the whole national economy as a system. It examines expenditure decisions by households, businesses, and governments, and the total flows of goods and services produced and incomes earned.

**Real Gross Domestic Product (GDP)**, prices and **inflation rates**, and employment and **unemployment rates** are indicators of macroeconomic activity and performance.

**Fluctuations** in the growth rate of real GDP, in inflation rates, and in unemployment rates are important aspects of recent economic performance in Canada.

The expenditures by households, production of goods and services by business, and the incomes that result are illustrated by the **circular flow** of real resources and money payments.

The **National Accounts** provide a framework for the measurement of the output of the economy and the incomes earned in the economy.

**Nominal GDP** measures the output of final goods and services at market prices in the economy, and the money incomes earned by the factors of production.

**Real GDP** measures the output of final goods and services produced, and incomes earned at constant prices.

The **GDP deflator** is a measure of the price level for all final goods and services in the economy.

**Real GDP** and **per capita real GDP** are crude measures of national and individual welfare. They ignore non-market activities, the composition of output, and the distribution of income among industries and households.

## Exercises for Chapter 4

**Exercise 4.1** You have the following annual data for an economy:

| Year | Real GDP (2007 $) | Consumer price index (2007=100) | Labour force (000) | Employment (000) |
|---|---|---|---|---|
| 2012 | 1,282 | 109.1 | 17.593 | 16.537 |
| 2013 | 1,307 | 111.9 | 17.857 | 16.696 |
| 2014 | 1,288 | 138.9 | 18.125 | 16.856 |

(a) What was the rate of growth of real GDP from 2012 to 2013, and 2013 to 2014?

(b) What was the rate of inflation in 2013 and in 2014?

(c) What were the rates of growth of the labour force and employment from 2012 to 2013, and 2013 to 2014?

(d) What happened to the unemployment rate between 2012 and 2013, and between 2013 and 2014?

**Exercise 4.2** Suppose the economy represented by the table in Exercise 4.1 above had a population of 27.885 thousand in 2014.

(a) What were the participation and employment rates in the economy in that year?

(b) Suppose a mild recession in that year discouraged some unemployed workers and they stop looking for work. As a result the participation rate fell to 64.5 per cent. How would the unemployment rate and the employment rate be affected? Why?

**Exercise 4.3** If brewers buy barley and hops from agricultural producers, natural gas to fire their brew kettles from gas companies and bottles from glass manufacturers as in the following table, what is the value added of the brewing industry? If brewers also wholesale some of their output to pubs, is that output counted in GDP? Explain your answer.

| | Costs (millions of current $) of: | | |
|---|---|---|---|
| Brewery retail sales | Barley and hops | Natural gas | Bottles |
| 1000 | 350 | 125 | 150 |

**Exercise 4.4** The economy has two main industries. One produces services and the other produces goods. The services industries produce services for households and businesses with a total market

value of $10,000. The goods industries produce goods for the use of both households and businesses with a total market value of $5,000. The service industries spend $1,000 on computers and paper and envelopes supplied by the goods industries. The goods industries spend $1,000 to buy financial, insurance, advertising and custodial services supplied by the service industries. Explain how you measure nominal GDP in this economy and the value of output you find?

**Exercise 4.5** Suppose you are given the following data on incomes and expenditures for the economy of Westland, in current prices for factors of production and outputs.

| | |
|---|---|
| Consumption expenditures | 2,500 |
| Employment compensation | 2,800 |
| Government expenditure | 800 |
| Net indirect taxes | 150 |
| Exports | 1,200 |
| Net corporate surplus and mixed income | 850 |
| Capital consumption allowance | 200 |
| Investment expenditure | 600 |
| Imports | 1,100 |

(a) What is the value of nominal GDP measured by expenditures?
(b) What is net domestic income?
(c) What is the value of nominal GDP measured by the income approach?

**Exercise 4.6** Suppose GDP is $2,000, consumption expenditure is $1,700, government expenditure is $50, and net exports are $40.

(a) What is business investment expenditure?
(b) If exports are $350, what are imports?
(c) In this example, net exports are positive. Could they be negative?

**Exercise 4.7** Consider the following information about a hypothetical economy:

| **Year** | **Nominal GDP (billions $)** | **GDP deflator** (2000 = 100) | **Population (millions $)** |
|---|---|---|---|
| 2012 | 750 | 104.0 | 25.0 |
| 2013 | 825 | 112.0 | 30.0 |

(a) Calculate the growth (percentage change) in nominal GDP from 2012 to 2013.

(b) What was real GDP in 2012 and 2013? How much did real GDP grow?

(c) If changes in the standard of living can be measured by changes in real per capita GDP, did growth in nominal and real GDP raise the standard of living in this economy from 2012 to 2013?

(d) Explain the reasons for the change in standard of living that you have found.

# Chapter 5

## Output, business cycles, growth & employment

**In this chapter we will explore:**



Many economic events seem simple and limited in their effects on rates of growth of output, rates of inflation and rates of unemployment. A housing market collapse in the US in 2008 was seen, at first as just a collapse in prices in an overheated market. A sharp drop in crude oil prices in early 2015 was seen as a benefit to households that would reduce their driving costs and allow for higher expenditure in other areas. Fiscal austerity aimed at achieving balance government budgets in Europe seemed an obvious way to reduce high government debt to GDP ratios. But none of these initial judgements worked out. In each case, ignoring the complexity of the macro economy led to large errors in early forecasts and persistent, widespread problems with economic performance.

An aggregate demand and aggregate supply model is the workhorse of macroeconomics. It integrates the effects of economic disturbances, economic decisions, relationships and linkages that determine real GDP and the GDP deflator. Analyzing events like financial shocks, commodity price shocks and government policy shifts using a full macroeconomic model provides a better understanding of their effects on rates of growth of GDP, rates of unemployment and rates of inflation. In this chapter we introduce a basic concepts of an aggregate demand and supply model and use it to illustrate the causes and effects of business cycle fluctuations in real output and prices. The objective is to provide the framework for the economic theory on which aggregate demand and supply are based.

## 5.1 Aggregate demand & aggregate supply

The **short run** in macroeconomics is defined by assuming a specific set of conditions in the economy. These are:

1. There are constant prices for factors of production, especially money wage rates for labour.

2. The supply of labour, the stock of capital, and the state of technology are fixed.

> **Short run**: a time frame in which factor prices, supplies of factors of production, and technology are fixed by assumption.

In the short run, changes in output involve changes in the employment of labour and in the use of plant and equipment, but these changes are not sustainable over longer time periods. Furthermore, because supplies of factor inputs and technology are fixed, there is no sustained growth in real GDP. We leave that topic for a later chapter.

The national accounts we studied in Chapter 4 describe and measure economic activity in terms of an accounting framework used to measure aggregate expenditures, outputs, and incomes. But the accounting framework simply measures what has happened in the recent past. It does not *explain* the level of economic activity and prices or the reasons for changes in output and prices from time to time.

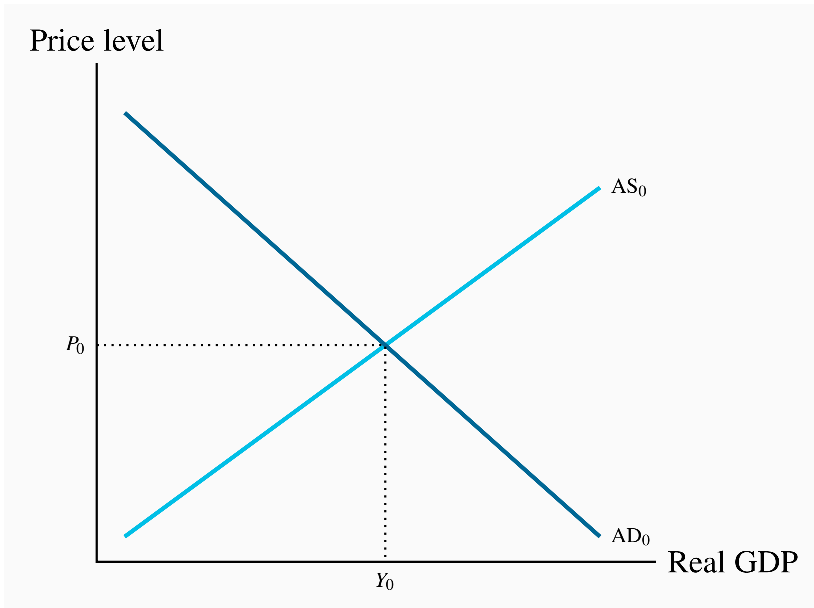
For that we need an analytical framework that looks at cause and effect. An **aggregate demand (AD)** and **aggregate supply (AS) model** is such an analytical framework. It helps us understand the conditions that determine output and prices, and changes in output and prices over time.

> **AD/AS model**: a framework used to explain the behaviour of real output and prices in the national economy.

The short-run AD/AS model builds on the national accounts framework. Aggregate demand is the relationship between aggregate expenditure on final goods and services and the general price level. Real GDP by the expenditure approach measures this expenditure at the price level given by the GDP deflator. Aggregate supply is the relationship between the output of goods and services produced by business and the general price level. Real GDP by the income approach measures this output, and the corresponding real incomes. The price level is again the GDP deflator. National accounts tell us that, by definition, these *measured* outputs and incomes are equal. AD and AS functions describe *expenditure plans, outputs, and prices* using the national accounts framework. This distinction between measured and planned expenditure and output is important. Planned expenditure is the current output households and businesses would *want to buy* at different levels of income and price. Output is what businesses actually produce. Planned expenditure and the actual output produced by business may not be the same.

Figure 5.1 gives us a first look at output, real income, and prices for a specific year using an aggregate demand and aggregate supply diagram. The price level as measured by the GDP deflator is measured on the vertical axis. Real output and income are measured on the horizontal axis. The point of intersection of the AD and AS lines shows that real output by the expenditure approach, $Y_0$, is equal to real income by the income approach at the price level $P_0$, as required by national accounts. It also shows planned aggregate expenditures equal to the current output of goods and services. However, we need to explain the aggregate demand and aggregate supply relationships indicated by the slopes and positions of the AD and AS lines in the diagram before we use the model to study output and prices.

**Figure 5.1: A basic aggregate demand and supply model**




The AD and AS lines show planned expenditures on and output of final goods and services at different aggregate price levels *all other conditions held constant*. At the intersection of $AD_0$ and $AS_0$ planned expenditures on final goods and services are equal to real GDP at $P_0$.

> **Equilibrium GDP**: AD=AS, planned expenditure equals current output and provides business revenues that cover current costs including expected profit.

**Aggregate demand** (AD) is **planned aggregate expenditure** on final goods and services at different price levels when all other conditions are constant. This relationship is examined in detail in the chapters that follow. A downward sloping AD curve means the relationship between planned aggregate expenditure and the general price level is negative. A higher price level reduces the expenditures planned by households, businesses, and residents of other countries. Lower price levels increase those expenditure plans.

> **Aggregate demand**: **planned aggregate expenditure** on final goods and services at different price levels, all other conditions remaining constant.

**Aggregate Supply (AS)** is the output of final goods and services business produces at different price levels when other conditions are constant. The upward sloping AS curve in Figure 5.1 assumes that the relationship between the quantity of goods and services produced and the price level is positive. Prices and output rise or fall together. We will examine this relationship in more detail below and in later chapters.

As we can see in the diagram, changes in either AD or AS would result in changes in the point of intersection of AD and AS and in equilibrium $P$ and $Y$. But the important question is: What economic conditions and events determine the positions and slopes of AD and AS? The model is a tool for economic analysis that will only be useful when we know how it works and how to operate it.

> **Aggregate supply**: the output of final goods and services businesses would produce at different price levels, all other conditions held constant.

## Aggregate demand

Aggregate Demand and the market demand for an individual product are different. In our discussion of the market for an individual product in Chapter 3, demand is based on the assumptions that incomes and prices of other products are constant. Then a rise in the price of the product makes the product more expensive relative to income and relative to other products. As a result, people buy less of the product. Alternatively, if price falls people buy more.

The link between the *general* price level and aggregate demand is different. We cannot assume constant incomes and prices of other products. In the aggregate economy a rise in the price level raises money incomes by an equal amount. A 10 percent rise in the general price level is also a 10 percent rise in money incomes. Changes in the price level do not make goods and services either more or less affordable, *in terms of incomes*. There is no direct price incentive to change aggregate expenditure.

Furthermore, if prices of individual goods and services do not rise or fall in the same proportion as the general price level, the distribution of aggregate expenditure among goods and services may change without a change in aggregate expenditure. If, for example, the general price level is pushed up because oil and commodity prices rise, and expenditure on those products rises in the short run because there are no alternatives, expenditures on other goods and services fall. Aggregate expenditure is unchanged.

As a result, we cannot explain the negative relationship between the general price level and aggregate expenditure as we would explain demand for an individual good or service. Nor can we simply add up all the demands for individual products and services to get aggregate demand. The assumptions of constant incomes and other product prices that underlie market demand do not hold in the aggregate. Different explanations are needed.

*Money and financial markets* play key roles in the explanation of the price-quantity relationship in aggregate demand and the negative *slope of AD* as follows:

- Changes in the price level ($P$) change demand and supply conditions in financial markets. Higher prices raise interest rates and lower prices lower interest rates.
- Interest rates determine costs of credit and foreign exchange rates. Higher interest rates reduce expenditures on goods and services, lower interest rates stimulate expenditure.

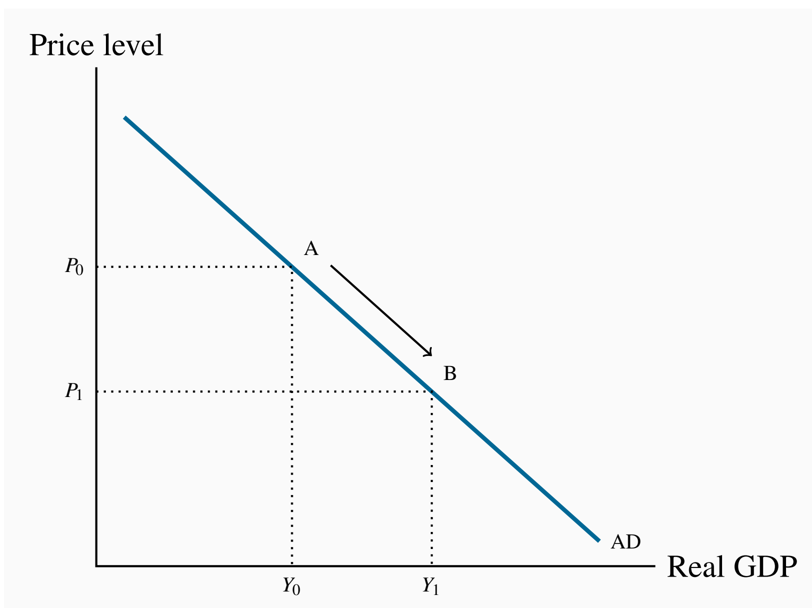
- The responsiveness of expenditures to changes in interest rates determines the extent of the change in expenditure ($Y$) as a result of a change in the price level ($P$).
- Changes in expenditure then feed back to offset some of the change in financial conditions.

Chapters 8, 9 and 10 examine these financial markets and their effects on expenditure.

The result is a negative relationship between the price level and aggregate expenditure and a negatively sloped AD curve.

In Figure 5.2, the negatively sloped AD line shows planned aggregate expenditures at different price levels, on the assumption that the money supply and anything other than price that might affect expenditure plans are held constant. If the price level falls from $P_0$ to $P_1$, the movement along AD from A to B shows the negative relationship between planned aggregate expenditure and price. A rise in price would reduce planned expenditure as shown by moving up the AD curve.

**Figure 5.2: The aggregate demand curve**




The AD curve shows planned expenditures at different aggregate price levels all things other than price held constant. *A change in the price level causes movement along the AD curve* as from A to B if price falls from $P_0$ to $P_1$.

The *position of the AD curve* depends on all the conditions other than price that affect aggregate expenditure plans. We study these other conditions in detail in later Chapters 6 and 7.

## Aggregate supply

Aggregate Supply (AS) is the output of final goods and services businesses would produce at different price levels. The aggregate supply curve is based on the following key assumptions:

1. Prices of the factors of production—the money wage rate for labour in particular—are constant.
2. The stock of capital equipment—the buildings and equipment used in the production process—and the technology of production are constant.

From national accounts we know that the costs of production include labour costs, business and investment incomes and depreciation. Market prices depend on those *costs per unit of output* and the output and price setting decisions by producers. Aggregate supply is usually described as a positive relationship between quantities of goods and services businesses are willing to produce and prices. Higher outputs of final goods and services and higher prices go together.

This relationship between aggregate output, costs and prices reflects two different market conditions on the supply side. In some markets, particularly those for commodities and standardized products, supply and demand in international markets establish price. Producers of those products are price takers. They decide how much labour and plant capacity to employ to produce based on market price.

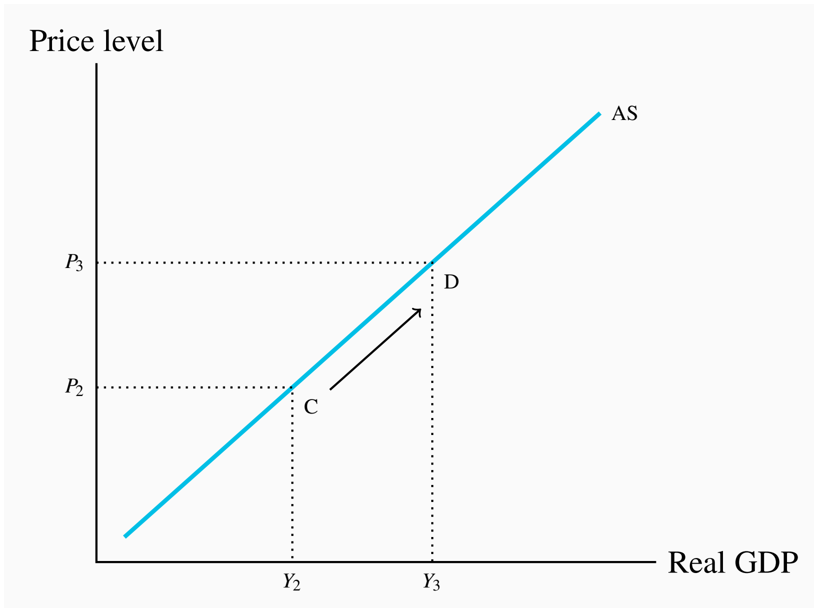
Broadly speaking, in these industries cost per unit of output are increasing with increasing output. Employing more labour and plant capacity means expanding into less productive land and natural resource inputs. Mining gold or extracting bitumen from oil sands are good examples. A rise in price justifies expanding the output of higher cost mines and oil wells. However, many raw material markets are like this including those for agricultural products, forestry products, base metals and natural gas. When market price changes these producers respond by changing their outputs.

In other parts of the economy producers are price setters. Major manufacturing and service industries like auto producers, banks and wireless phone companies face market conditions that are different from those of commodity producers. They set prices based on costs of production and sales and profit targets, and supply the number of cars or bank services or cell phone accounts that are in demand at those prices.

In these industries costs per unit of output are constant over a wide range of current outputs. Money wage rates are fixed, the capacity to produce output is flexible and productivity is constant. If demand for their product or service increases they can supply more by hiring more employees at existing wage rates and selling more output at existing prices. Industries like major manufacturing, retail services, financial services, hospitality services, and professional services are some examples. Output and changes in output are determined by demand.

The upward-sloping aggregate supply curve in Figure 5.3 captures both market conditions to show the output producers are willing to produce and the price level. The aggregate supply curve is drawn based on the assumptions that money wage rates and all other conditions except price that might affect output decisions are constant. As we will see in later chapters, money wage rates and productivity are the most important of these conditions. They determine the *position* of the AS curve.

**Figure 5.3: The aggregate supply curve**




The AS curve shows the relationship between price level and real GDP, assuming the prices of factors of production are constant. The position of the curve is determined by factor prices and productivity. The slope is determined by changes in costs of production and producer price decisions as output changes.

The *slope* of the AS curve depends on changes in cost per unit of output and price changes if aggregate output changes. As a result it reflects the structure of industry. In Canada, for example Table 4.2 shows that about 70 percent of real GDP comes from service producing industries. Consequently we would expect a smaller positive slope in the AS curve than in Figure 5.3.

In Figure 5.3, if price were $P_2$ the AS curve shows that business would be willing to produce aggregate output $Y_2$, which would generate an equal flow of real income. A rise in aggregate output from $Y_2$ to $Y_3$ would mean a rise in price to $P_3$ to meet the increased costs and profits associated with output at this level. Changes in output or price, holding all other conditions constant, move the economy along the AS curve. Moving from point C to point D in the diagram shows this relationship.

On the other hand, a change in any of the conditions assumed to be constant will shift the entire AS curve. A rise in money wage rates, for example, would increase labour costs per unit of output $(W/Y)$ at every level of output. The AS curve would shift up vertically as prices rose in order to cover the increased unit labour costs.

## 5.2 Equilibrium output and potential output

The distinction between equilibrium output and **potential output** is very important to our study of the economy. In the short run, AD and AS determine *equilibrium output*. *Potential output* is determined by the size of the labour force, the stock of capital, and the state of technology. The general level of prices and short-run aggregate demand and supply conditions do not affect potential output.

> **Potential output**: the real GDP the economy can produce on a sustained basis with current labour force, capital and technology without generating inflationary pressure on prices.

Short-run equilibrium real GDP is determined by AD and AS conditions. Fluctuations in real GDP and price are a result of short-run changes in economic conditions. To evaluate the economy's performance and understand how it behaves over time, we need a benchmark. Potential output is the output the economy can produce on a sustained basis using the current labour force, capital, and technology without putting continuous upward pressure on the price level or the inflation rate.

In the short run, the labour force, the capital stock, and technology are fixed by assumption. Potential output is the economy's output based on "full employment" of these inputs, but it is not the maximum output an economy can conceivably make. For short periods of time we could make more by using labour for longer hours and factories for extra production shifts. Just as a marathon runner can sprint from time to time but cannot sustain the sprint over the whole race, the economy can operate for short time periods at levels of output above potential. Potential output is the output the economy can produce on a sustained basis.

When the economy is at potential output, every worker wanting a job at the equilibrium wage rate can find a job, and every machine that can be profitably used at the equilibrium cost for capital is in use. Thus, potential output includes an allowance for "equilibrium unemployment" or structural unemployment and some excess capacity. Some people, who would work at higher wage rates, do not want to work at the equilibrium wage rate. Moreover, in a constantly changing economy, some people are joining the labour force, others are leaving, and still others are temporarily between jobs. Today, Canadian potential output means an unemployment rate of about 6 to 7 percent. This is usually called the **natural unemployment rate**.

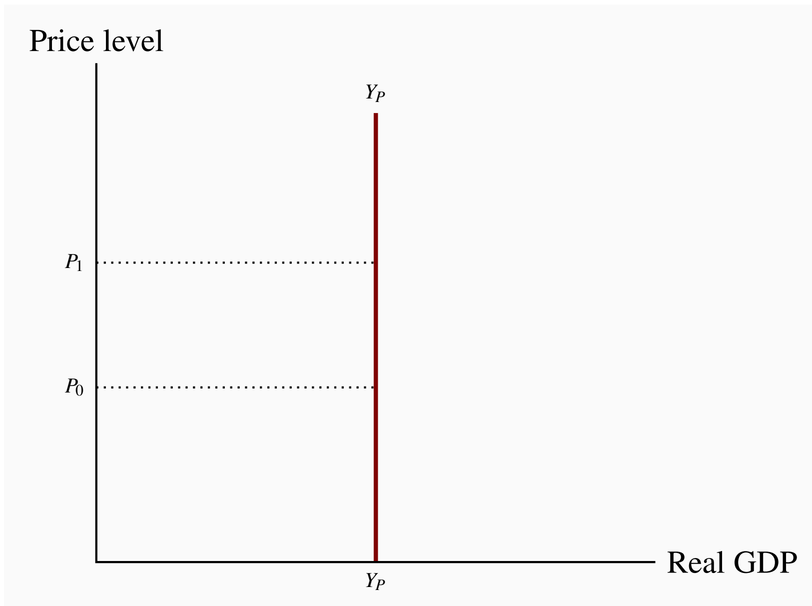
> **Natural unemployment rate**: the unemployment rate that corresponds to potential GDP.

Actual output can also fall below potential output. Workers who want jobs may be unemployed, and producers may have idle plant and equipment or excess capacity. The unemployment rate rises above the 6 percent "full employment" rate.

A key issue in macroeconomics is the way differences between actual output and potential output affect unemployment rates, wage rates, and inflation rates. These effects are important to how the economy provides the standard of living and the way it might adjust equilibrium output to potential output without policy intervention.

Figure 5.4 illustrates potential real GDP ($Y_P$) with a vertical line. Changes in price from $P_0$ to $P_1$, for example, have no effect on $Y_P$. Changes in the supply of labour, the stock of capital, or the state of technology would increase potential output and shift the vertical $Y_P$ line to the right or to the left.

**Figure 5.4: Potential GDP**

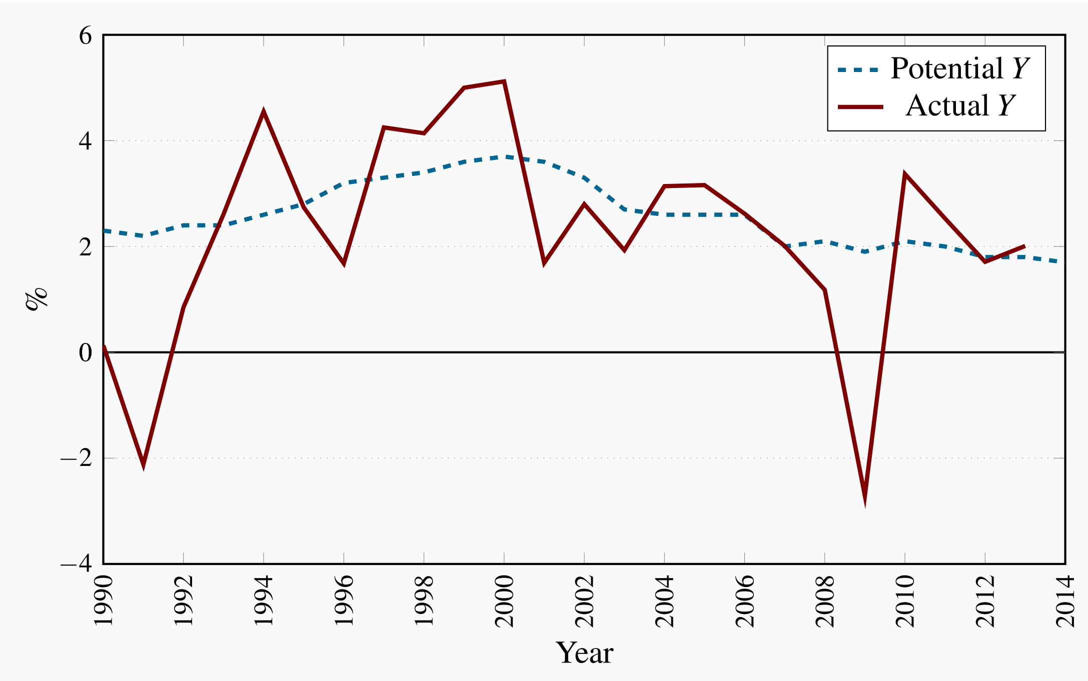



Potential GDP ($Y_P$) is the real GDP the economy could produce on a sustained basis without putting pressure on costs and prices. $Y_P$ is independent of $P$.

## 5.3 Growth in potential output

Growth in the labour force and improvements in labour productivity increase the economy's potential output over time. Labour productivity grows as a result of advances in technology and knowledge coming from investments in capital equipment, education and training. Figure 5.5 shows growth rates for potential and actual real GDP each year in Canada over the period from 1990 to 2011. Potential GDP grew over this period, reflecting the underlying growth in labour force, the stock of capital, and improved technology. But annual growth rates were not constant and in the period since 2000 have tended to decline. Part of this decline is attributed to lower rates of productivity growth in recent years as compared to earlier periods.

**Figure 5.5: Annual growth in potential and actual real GDP in Canada, 1990-2014**




*Sources*: Statistics Canada, CANSIM Table 380-0064, Office of the Parliamentary Budget Officer and author's calculations.

Growth rates in actual GDP were more volatile relative to growth rates in potential output. The negative growth rates in 1991 and 2009 mark the recessions of those years. Fluctuations in AD and AS cause business cycles in real GDP and employment. Unemployment rises when output growth is less than the growth in potential output and falls when it is greater.

## 5.4 Business cycles and output gaps

In some years GDP grows very rapidly, and in other years it actually falls. Growth of potential GDP is also variable but it is consistently positive. These up and down fluctuations in the growth of real GDP are described as **business cycles** in economic activity.

**Business cycles**: short-term fluctuations of actual real GDP.

Business cycles cause differences between actual and potential GDP. **Output gaps** measure these differences. In a short-run aggregate demand and supply model with a constant potential output, the gap is:

$$\text{Output Gap} = Y - Y_P \tag{5.1}$$

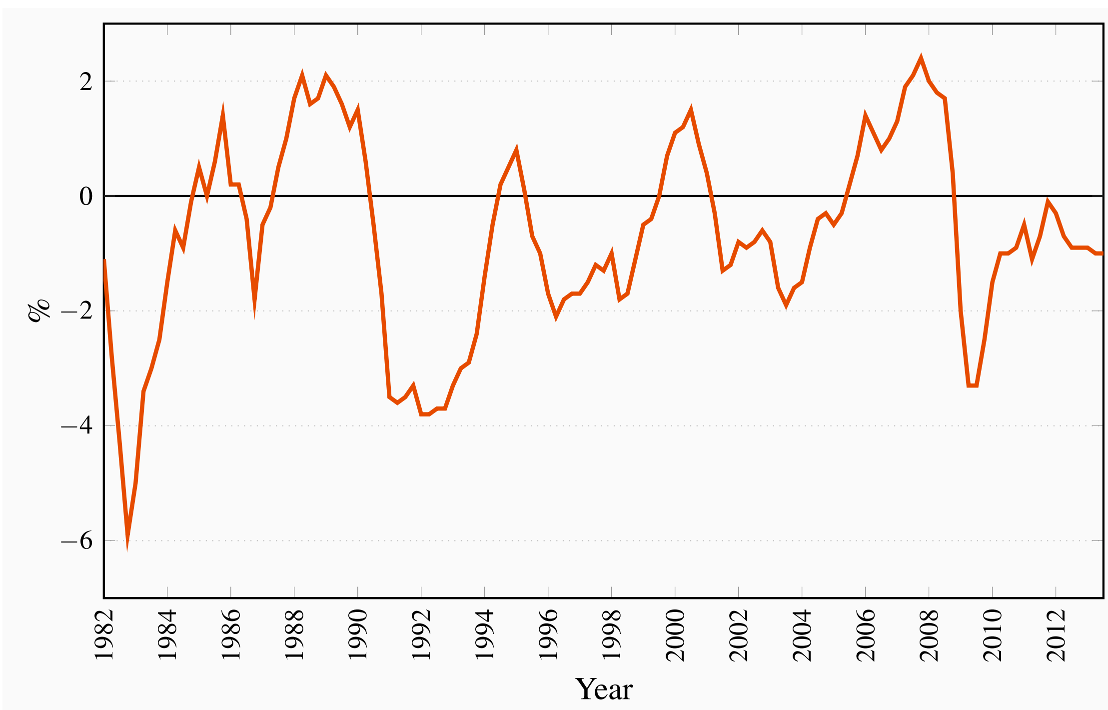
**Output gap**: the difference between actual output and potential output.

In an economy that grows over time the absolute output gap $Y - Y_P$ is usually measured relative to potential output. This recognizes that a gap of $10 million is a more serious matter in an economy with a potential output of $1,000 million than in an economy with a potential output of $5,000 million.

Figure 5.6 plots the Bank of Canada's estimates of the differences between actual and potential GDP for Canada for each year from 1990 to 2013, expressed as a percentage of potential GDP, calculated as:

$$\text{Output Gap}(\%) = \frac{Y - Y_P}{Y_P} \times 100 \tag{5.2}$$

**Figure 5.6: The output gap in Canada, 1982-2013**




*Source*: Bank of Canada, Indicators of Capacity and Inflation Pressures for Canada, www.bankofcanada.ca.

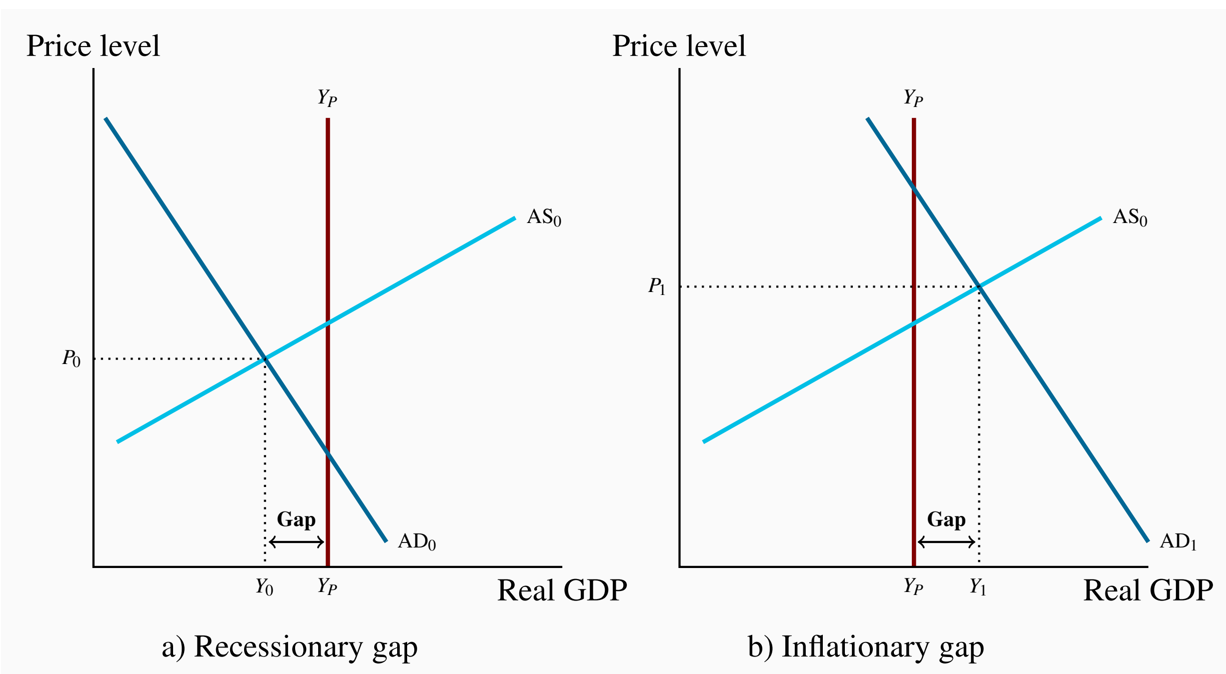
When we compare growth in actual real GDP and potential GDP in Canada from 2007 to 2013 in Figure 5.5, we see an example of the business cycle caused by the 2008-2009 financial crisis. Real GDP growth declined in 2008 to less than growth potential GDP and turned negative in 2009. This was a *recession*. It created the negative output gap in Figure 5.6 that starts in the first quarter of 2009 and persists in the most recent data for the second quarter of 2015.

Output gaps describe and measure the short-run economic conditions, and indicate the strength or weakness of the economy's performance. High growth rates in the boom phase of the cycle create positive output gaps, which are called **inflationary gaps** because they put upward pressure on costs and prices. Low or negative growth rates that result in negative output gaps and rising unemployment rate are called **recessionary gaps**. They put downward pressure on costs and prices. As economic conditions change over time, business cycle fluctuations move the economy through recessionary and inflationary gaps. However, you will notice in Figure 5.6 that recessionary gaps in Canada have been deeper and more persistent than inflationary gaps over the past 30 years.

> **Inflationary gap**: a measure of the amount by which actual GDP is greater than potential GDP.
>
> **Recessionary gap**: a measure of the amount by which actual GDP is less than potential GDP.

We can show output gaps in diagrams using the aggregate demand and supply curves and the potential output line. Figure 5.7 provides an example. Panel a) illustrates a recessionary gap. Panel b) shows an inflationary gap.

**Figure 5.7: Output gap**




a) AD is too weak to support equilibrium at $Y_P$. b) AD is too strong and pushes equilibrium past $Y_P$.

The AD and AS model provides a basic explanation of the differences we see between actual real GDP and potential real GDP. Short-run AD and AS conditions determine equilibrium real GDP, which may be either greater or less than potential GDP. Furthermore, the business cycles are the results of changes in the short-run AD and AS conditions.

Introduction to the AD/AS model is an important first step in the study of the performance of the macro economy. But there are more questions:

1. What is the relationship between output gaps and unemployment?
2. How would the economy react to a persistent output gap?
3. Why do short-run AD and AS conditions change from time to time?

The first two questions are considered in the remainder of this chapter. Chapter 6 starts on the third question.

## 5.5 Output gaps and unemployment rates

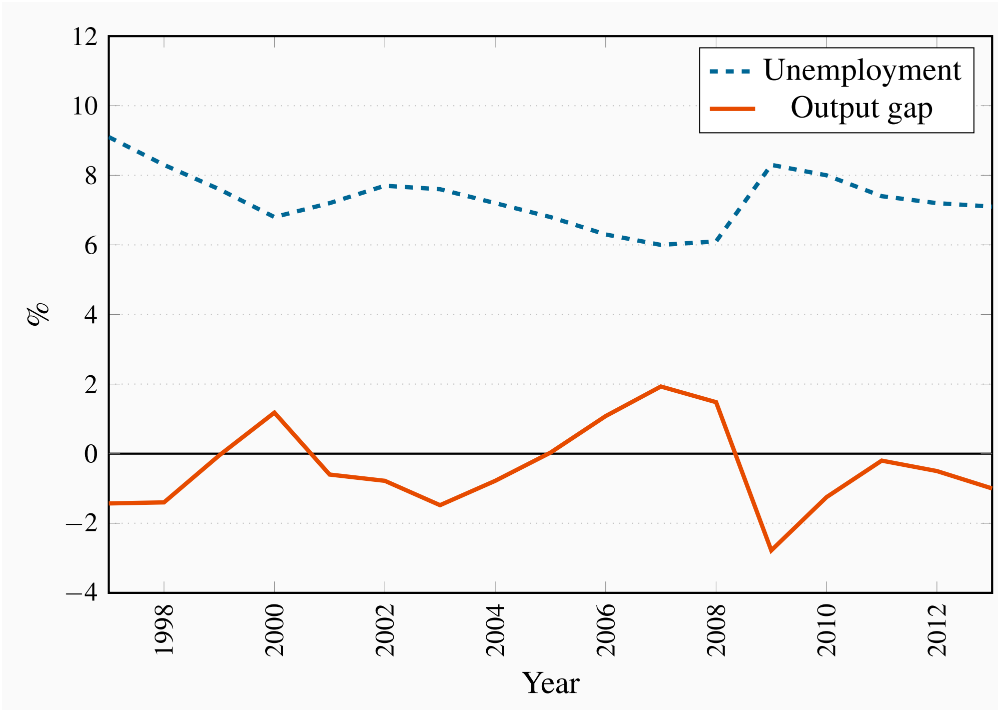
Output gaps and unemployment rates are tied together. Output gaps measure the difference between actual real GDP and potential GDP. When the economy is producing potential output, employment is at the 'natural employment' rate. Any output other than potential output therefore involves an employment rate other than the full employment rate and a corresponding level of unemployment that differs from the approximately 6 to 7 percent natural unemployment rate.

Figures 5.5 and 5.6 show the relationship between growth rates in actual and potential GDP and the output gap. Negative growth rates in actual GDP in recessions, while potential GDP continues to grow, create recessionary gaps. Indeed any time *growth* in actual GDP differs from *growth* in potential GDP the output gap changes and the unemployment rate changes.

Differences between the rates of growth in actual and potential output explain the persistence of high rates of unemployment in western industrial countries in the years since the 2008 financial crisis. Real GDP and employment in both Canada and the United States have been growing since 2009. However, potential output has been growing at the same time. As a result, growth in actual GDP has not been strong enough to eliminate output gaps and restore full employment.

Figure 5.8 shows the relationship between output gaps and unemployment rates in Canada. Clearly, a rise in the output gap also involves a fall in the unemployment rate, and vice versa. Business cycle fluctuations in actual output result in predictable changes in output gaps and unemployment rates.

**Figure 5.8: Output gaps and unemployment rates in Canada, 1997-2013**




*Source*: Bank of Canada, Indicators of Capacity and Inflation Pressures for Canada. Statistics Canada, CANSIM series V2062815 and author's calculations.

## 5.6 Adjustments to output gaps?

Potential output is real GDP when all markets are in equilibrium. Output gaps indicate disequilibrium in some markets. If we leave the short run and drop the assumption that factor prices are constant, we can ask:

How does the economy react to persistent output gaps?

The answer to this question depends in part on the *flexibility of wage rates and prices* and in part on how *planned expenditure* responds to the flexibility in wage rates and prices.

Figure 5.8 shows that the labour market is one of the markets not in equilibrium when there is an output gap. We also know from national accounts that labour costs are the largest part of factor costs of production, and labour costs per unit of output are the largest part of prices. If the labour market is not in equilibrium—which means unemployment rates not equal to the natural rate—this results in changes in money wage rates. Persistent output gaps will change wage rates and other factor prices and costs. Changes in costs will change prices, shifting the short-run AS curve. The economy may have an adjustment mechanism that tries to eliminate output gaps over time.

*This adjustment process assumes that the AD curve is not changed by the fall in wage rates that shifts the AS curve*. There are good reasons for skepticism here. In a money economy, with debt and financial contracts denominated in nominal terms, a general fall in money incomes can cause financial distress, extensive insolvencies and reductions in AD. As a result, economists generally agree that *deflation*, a persistent fall in the general *price level*, is *contractionary*, not expansionary as the simple adjustment process suggests. This is reflected in the current concerns that deflation may return to Japan and emerge in Europe as growth stagnates and inflation rates have fallen persistently below 1 percent.

## 5.7 The role of macroeconomic policy

In Chapter 4, performance of the economy was evaluated based on the standard of living, measured as the real GDP per capita, it provided. Recessionary gaps reduce the standard of living in the economy by reducing employment, real GDP, and per capita real GDP.

Inflationary gaps reduce standards of living in more subtle ways. They push up the price level, raising the cost of living. But the rise in the cost of living affects different people in different ways. Those on fixed money incomes suffer a reduction in their standards of living. People holding their wealth in fixed price financial assets like bank deposits and bonds suffer a loss in their real wealth. On the other hand, inflation reduces the real value of debt, whether it is mortgage debt used to finance the purchase of a house, or a student loan used to finance education. The money repaid in the future has a lower purchasing power than the money borrowed. In these and other ways, the costs of inflation are distributed unevenly in the economy, making decisions about employment, household expenditure, and investment more difficult.

We have also seen, in Figure 5.6, that output gaps have been persistent in the Canadian economy despite the possibility that flexible wages and prices might automatically eliminate gaps. These observations raise two questions:

1. Why are output gaps, especially recessionary gaps, persistent?
2. Can government policy work to eliminate output gaps?

To answer the first question, we need to think about two issues. The first is the *flexibility or rigidity of wages and prices* both up and down. The second is the strong possibility of asymmetry between adjustment effects of absolute increases and absolute decreases in wages and prices. These are topics for later discussion.

The important immediate policy question is: When wages and prices are sticky, should government wait for the self-adjustment process to work, accepting the costs of high unemployment or rising inflation that it produces? This was a very serious and widely debated question since 2008 in the face of growing international recessions as a consequence of serious government debt problems and continued international financial market uncertainty.

Government has policies it can use to reduce or eliminate output gaps. In Chapter 7 we will examine **fiscal policy**, the government expenditures and tax policy that establish the government's budget and its effect on aggregate demand. Government can use its fiscal policy to change the AD curve and eliminate an output gap without waiting for the economy to adjust itself. Chapters 9 and 10 discuss **monetary policy**, actions by the monetary authorities designed to change aggregate demand and eliminate output gaps by changing interest rates, money supply, and the availability of credit. Both fiscal and monetary policy work to change aggregate demand and eliminate output gaps, which reduce the standard of living the national economy provides for its citizens.

> **Fiscal policy**: government expenditure and tax changes designed to influence AD.
>
> **Monetary policy**: changes in interest rates and money supply designed to influence AD.

# Key Concepts

The **Aggregate demand and supply** model provides a framework for our study of the operation of the economy.

**Aggregate demand** is the negative relationship between planned aggregate expenditure on final goods and services and the price level, assuming all other conditions in the economy are constant.

**Aggregate supply** is the positive relationship between outputs of goods and services and the price level, assuming factor prices, capital stock, and technology are constant.

**Short-run equilibrium real GDP and price** are determined by short-run aggregate demand and aggregate supply, illustrated by the intersection of the AD and AS curves.

**Potential output** is the output the economy can produce on an ongoing basis with given labour, capital, and technology without putting persistent upward pressure on prices or inflation rates.

The **Natural unemployment rate** is the 'full employment' unemployment rate observed when the economy is in equilibrium at potential output.

**Growth in potential output** comes from growth in the labour force and growth in labour productivity coming from improvements in technology as a result of investment in fixed and human capital.

**Business cycles** are the short-run fluctuations in real GDP and employment relative to Potential Output (GDP) and full employment caused by short-run changes in aggregate demand and supply.

**Output gaps** are the differences between actual real GDP and potential GDP that occur during business cycles.

**Unemployment rates** fluctuate with output gaps.

**Inflationary gaps and recessionary gaps** are the terms used to describe positive and negative output gaps based on the effects the gaps have on factor prices.

**Actual output adjusts to potential output** over time *if factor input and final output prices are flexible* and changes in prices shift the aggregate supply curve to equilibrium with aggregate demand at $Y_P$.

**Fiscal and monetary policy** are tools governments and monetary authorities can use to stabilize real output and employment or speed up the economy's adjustment to output gaps.

## Exercises for Chapter 5

**Exercise 5.1** Suppose we have the following information for an economy:

| GDP deflator | Planned aggregate expenditure | Planned aggregate output |
|---|---|---|
| 90 | 550 | 150 |
| 100 | 500 | 300 |
| 110 | 450 | 450 |
| 120 | 400 | 600 |
| 130 | 350 | 750 |

(a) Plot the AD and AS curves in a carefully labeled diagram.

(b) What are the short-run equilibrium values of real GDP and the price level?

**Exercise 5.2** Suppose we learn that potential output is 500 for the economy in Exercise 5.1.

(a) Add a line to your diagram for Exercise 5.1 to illustrate potential GDP.

(b) What is the size of any output gap you see in the diagram?

**Exercise 5.3** Potential GDP is determined by the size of the labour force, the stock of capital and the state of technology used in the production process. Assume the labour force grows over time, and research and development lead to improvements in technology, and productivity. Use an AD/AS diagram to illustrate potential GDP both before and after the growth in labour force and the improvement in technology.

**Exercise 5.4** Growth in potential output is determined by growth in the labour force and growth in labour productivity. Suppose the labour force grows by 1.5 percent a year and labour productivity, based on increased capital and improved technology, grows by 1.0 percent a year.

(a) What is the annual growth in potential output?

(b) Illustrate the growth in potential output in an AD/AS diagram.

(c) Aggregate demand is not changed by the change in potential output. Indicate any output gap caused by the change in potential output.

**Exercise 5.5** Suppose we have the following data for an economy:

| Year | Potential output (billions 2007$) | Real GDP (billions 2007$) |
|---|---|---|
| 2006 | 1,038 | 1,017 |
| 2007 | 1,069 | 1,030 |
| 2008 | 1,101 | 1,101 |
| 2009 | 1,134 | 1,160 |
| 2010 | 1,168 | 1,139 |
| 2011 | 1,203 | 1,130 |
| 2012 | 1,240 | 1,187 |
| 2013 | 1,277 | 1,163 |

Calculate the output gap for each year in this economy. Plot the output gap in a time series diagram. Date the timing of the phases of any business cycles you see in your plot of the output gap.

**Exercise 5.6** Draw an AD/AS diagram that shows an economy called Westland in short-run equilibrium with GDP equal to potential GDP.

(a) Suppose a slowdown in the rate of growth of GDP in China cuts Chinese imports of primary products from Westland. Using your AD/AS diagram illustrate and explain your forecast for the effects of this change on the equilibrium GDP and price level in Westland.

(b) What effect, if any, would a slowdown in GDP growth in China have on employment and unemployment rates in Westland? Explain why.

**Exercise 5.7** *Optional*: Consider an economy described by the following: AD: $Y = 2250 - 10P$, AS: $P = 125 + 0.1Y$.

(a) What are the short-run equilibrium values for real GDP and the price level?

(b) Assume potential output is 500 and draw an AD/AS/$Y_P$ diagram to show the initial short-run equilibrium real GDP, price level and potential output.

(c) Changes in international market conditions drive up prices for crude oil and base metals. Increased production costs driven by these higher input prices raise the general price level by 5 at every level of output. Write the equation of the new AS curve. What are the new short-run equilibrium real GDP and price level?

(d) Draw the new AS curve in your diagram for (b). What is the size of the output gap?

# Chapter 6

## Aggregate expenditure & aggregate demand

**This chapter explains a basic model of the economy:**



The state of the Canadian economy was very much in the news in the early summer of 2015. Economic growth in the first quarter of the year was negative and, by early estimates, was negative again in the second quarter. Some commentators said the economy was in 'recession' as defined by two consecutive quarters of negative growth. Others were more positive. Earlier forecasts had called for a short drop in growth after the fall in crude oil prices, offset shortly by increased consumer spending. Lower gasoline prices were expected to reduce household travel expenses and support higher consumption expenditure in other areas. Things had not yet worked out that way.

Economic forecasting is complicated by the complex system of interdependencies and feedback effects in the macro economy. In Chapter 5, differences in output, employment and prices were the results of different aggregate demand and supply conditions. The challenge is to sort out how an event like a change in a commodity price or a shift in household expectation of future employment prospects or a change in business expectations of future markets would affect aggregate demand and supply conditions.

This chapter introduces a basic short-run model of the economy as a first step in explaining changes in aggregate demand that can change economic performance.

## 6.1 Short-run aggregate demand and output

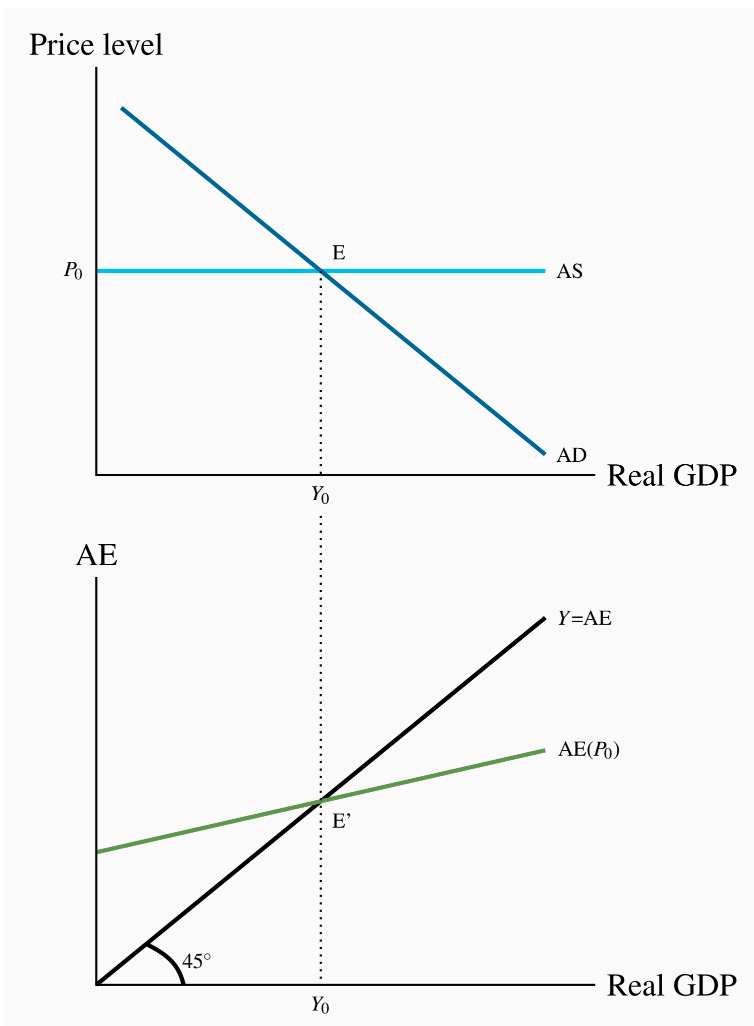
Consider first just the private market sector. Assume there are households and businesses in this simple economy, but no government and no financial markets. The households and businesses buy domestically produced and imported goods and services. Businesses also sell some output in export markets to residents of other countries. This basic model offers a simple but useful example of how the actual economy works.

This initial *short-run* model is based on the following assumptions:

- All prices and wages are fixed at a given level.
- At these prices and wages, businesses produce the output that is demanded and labour accepts opportunities to work.
- Money supply, interest rates and foreign exchange rates are fixed because at this stage we ignore the financial sector.

With constant prices **aggregate demand** determines total output, real GDP. Figure 6.1 uses an AD/AS diagram like those developed in Chapter 5 to illustrate these conditions and develop an aggregate expenditure function.

**Figure 6.1: Aggregate demand, aggregate expenditure and output when the price level is constant**



**Aggregate demand** determines total output, real GDP.

The horizontal AS curve in the upper part of Figure 6.1 shows that the price level is fixed at $P_0$. As a result, the equilibrium real GDP in this example is determined by the *position of the AD curve*. Changes in the position of the AD curve would cause changes in real output and real income, and corresponding changes in employment.

The position of the AD curve in the diagram is determined by things, *other than price*, that affect expenditure decisions. Understanding these expenditure decisions and their effects are the focus of this and the next several chapters.

The lower part of Figure 6.1 shows the relationship between planned aggregate expenditure and *income as measured by real GDP(Y)* when the price level is fixed. It also shows that, if the aggregate expenditure function (AE) has the right position and slope, there is a level of output at which planned expenditure and output are equal ($Y = \text{AE}$). Then revenue the business sector receives from sales of current output just covers the costs of production including expected profit. Planned expenditure and planned output are in equilibrium.

**Aggregate demand** is determined by equality between **aggregate expenditure (AE)** and real GDP.

This equality between planned expenditure and output determines the position of the AD curve, as shown in the upper part of the diagram.

The interactions of expenditure, output, and income shown in the lower part of Figure 6.1 define a basic macroeconomic model.

## 6.2 Aggregate expenditure

The model starts with the expenditure categories defined and measured in national accounts and described in Chapter 4. By the expenditure approach, GDP ($Y$) is the sum of consumption ($C$), investment ($I$), and exports ($X$), minus imports ($IM$). Then we can write:

$$\text{GDP}(Y) = C + I + X - IM \tag{6.1}$$

Expenditure as measured by national accounts is the sum of actual expenditures by business and households.

**GDP($Y$)** is the national accounts measure of the sum of *actual expenditure in the economy*.

**Aggregate expenditure (AE)** is planned expenditure by business and households. The distinction between planned and actual expenditures is a key factor in explaining how the national income and employment are determined.

> **Aggregate expenditure (AE)** is *planned expenditure* by business and households.

## Induced expenditure

A simple short-run model of the economy builds on two key aspects of planned expenditure, namely *induced* expenditure and *autonomous* expenditure. First, an important part of the expenditure in the economy is directly related to GDP and changes when GDP changes. This is defined as **induced expenditure**. It is mainly a result of household expenditure plans and expenditure on imported goods and services embodied in those plans.

> **Induced expenditure** is planned expenditure that is determined by current income and changes when income changes.

The largest part of consumption expenditure by households is *induced expenditure*, closely linked to current income. This expenditure changes when income changes, changing in the same direction as income changes but changing by less than income changes. The **marginal propensity to consume ($mpc = c$)** defines this link between changes in income and the changes in consumption they induce. The *mpc* is a positive fraction.

> **Marginal propensity to consume ($mpc = c = \Delta C/\Delta Y$)** is the change in consumption expenditure *caused by* a change in income.

Household's expenditures on imports are at least partly induced expenditures that change as income and consumption expenditure changes. The **marginal propensity to import ($mpm = m$)** defines this link between changes in income and the changes in imports. The *mpm* is also a positive fraction because changes in income induce changes in imports in the same direction but by a smaller amount.

> **Marginal propensity to import ($mpm = m = \Delta IM/\Delta Y$)** is the change in imports caused by a change in income.

Because expenditure on imports is not demand for domestic output aggregate **induced expenditure** for the economy is determined by *subtracting* induced import expenditure from induced consumption expenditure to get induced expenditure on domestic output.

> **Induced expenditure** $(c - m)Y$ is planned consumption expenditures net of imports that changes when income changes.

The relationship between expenditures and national income (GDP) is illustrated in Table 6.1 using a simple numerical example and then in Figure 6.2 using a diagram.

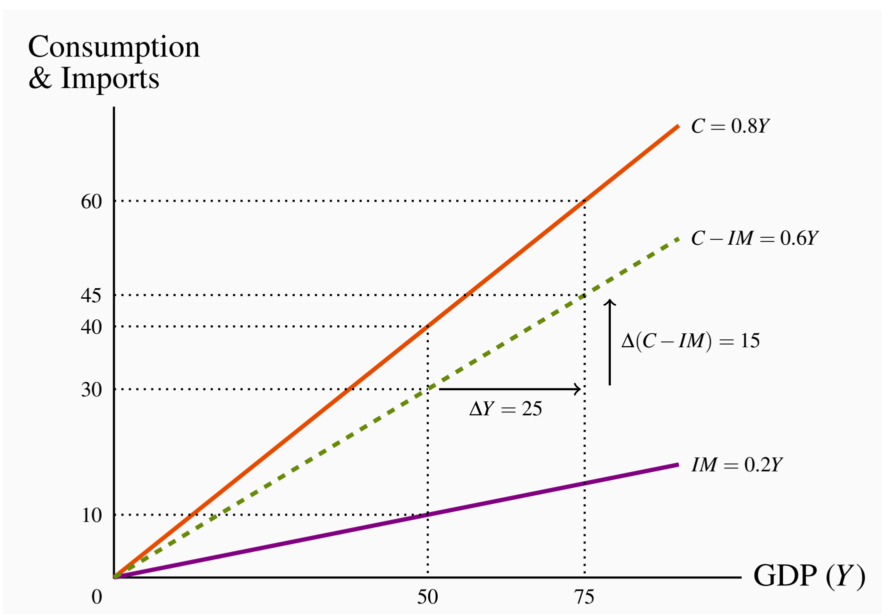
**Table 6.1: The effects of changes in GDP on consumption, imports and expenditure.**

| Consumption function: | $C = 0.8Y$ | | |
|---|---|---|---|
| Imports function: | $IM = 0.2Y$ | | |
| $Y$ | Induced $C = \Delta C/\Delta Y$ | Induced $IM = \Delta IM/\Delta Y$ | Induced expenditure $(\Delta C - \Delta IM)/\Delta Y$ |
| 0 | 0 | 0 | 0 |
| 50 | 40 | 10 | 30 |
| 100 | 80 | 20 | 60 |
| 75 | 60 | 15 | 45 |

The first row of the table illustrates clearly that if there were no income there would be no induced expenditure. The next two rows show that positive and increased incomes causes (induces) increased expenditure. The final row shows that a fall in income reduces expenditure. The induced expenditure relationship causes both increases and decrease in expenditure as income increases or decreases.

Figure 6.2 shows the same induced expenditure relationships in a diagram.

**Figure 6.2: Induced expenditures**



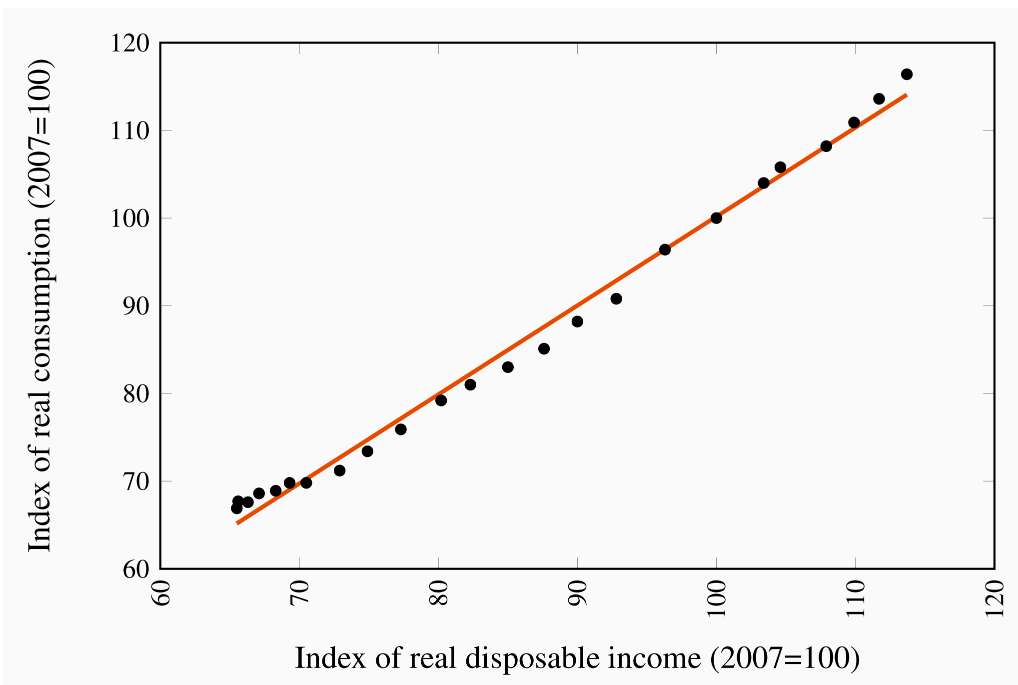

The slope of the $C - IM$ line is $\Delta(C - M)/\Delta Y = 15/25 = 3/5 = 0.6$.

The positive slopes of the consumption and import lines in the diagram show the positive relationship between income and expenditure. A rise in income from 0 to 50 induces a rise in national expenditure from 0 to 30 because consumption expenditure increases by 40 of which 10 is expenditure on imports. If income were to decline induced expenditure would decline, illustrated by movements to the left and down the expenditure lines.

The marginal propensities to spend are the slopes of the expenditure lines. If, for example, GDP increased from 50 to 75 in the diagram, consumption expenditure on domestic goods and services $C - IM$ would increase by 15. The slope of the $C - IM$ line is defined as rise/run which is $15/25 = 0.6$. By similar observations and calculations the slopes of the $C$ line and the $IM$ line are $\Delta C/\Delta Y = 0.8$ and $\Delta IM/\Delta Y = 0.2$.

These induced expenditure relationships are fundamentals of a basic macro model. The numerical values used here are chosen just to illustrate the relationships. Values used in the model of an actual economy, like the Canadian economy, would be estimated by econometric analysis of Canadian data. It is important that these relationships remain stable even as economic conditions change. The close statistical relationship between income and consumption in Figure 6.3 and size and stability of consumption share in expenditure GDP are strong evidence in support of that stability.

**Figure 6.3: A consumption function for Canada, 1990-2013**




*Source*: Statistics Canada, CANSIM Tables 380-0064 and 380-0065.

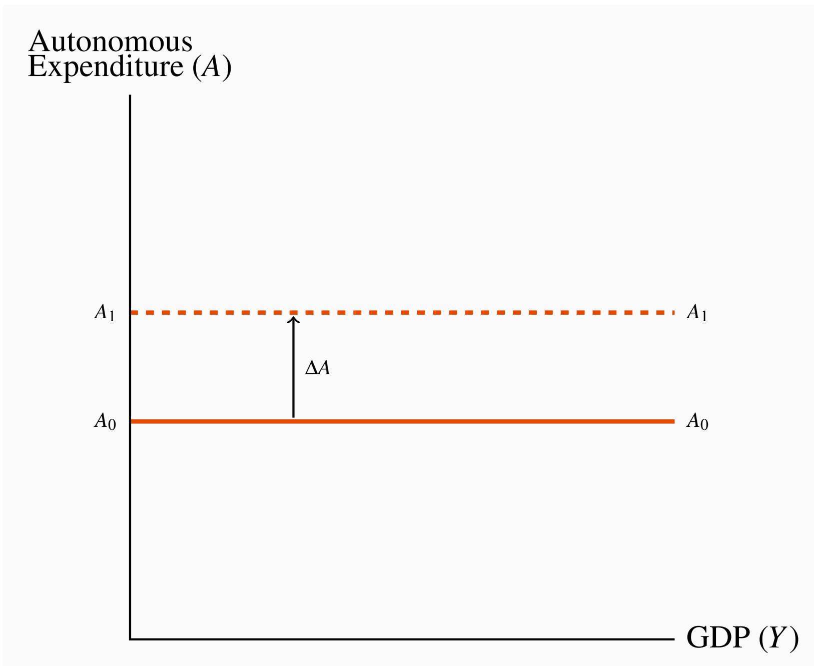
## Autonomous expenditure

The second part of GDP expenditure is where the real action lies. It covers the important changes in expenditure that drive the business cycles in economic activity. **Autonomous expenditure** ($A$), is the planned expenditure that is not determined by current income. It is determined instead by a wide range of economic, financial, external and psychological conditions that affect decisions to make expenditures on current output.

> **Autonomous expenditure** ($A$) is planned expenditure that is not determined by current income.

Consumption and imports have an autonomous component in addition to the induced component. But investment ($I$) and exports ($X$) are the major autonomous expenditures. Figure 6.4 shows the independence of autonomous expenditure from income. Unlike induced expenditure, autonomous expenditure does not change as a result of changes in GDP. The slope of the $A$ line in the diagram is zero $(\Delta A/\Delta Y = 0)$. However, a change in autonomous expenditure would cause a parallel shift in the $A$ line either up or down. An increase in $A$ is shown.

**Figure 6.4: Autonomous expenditure**



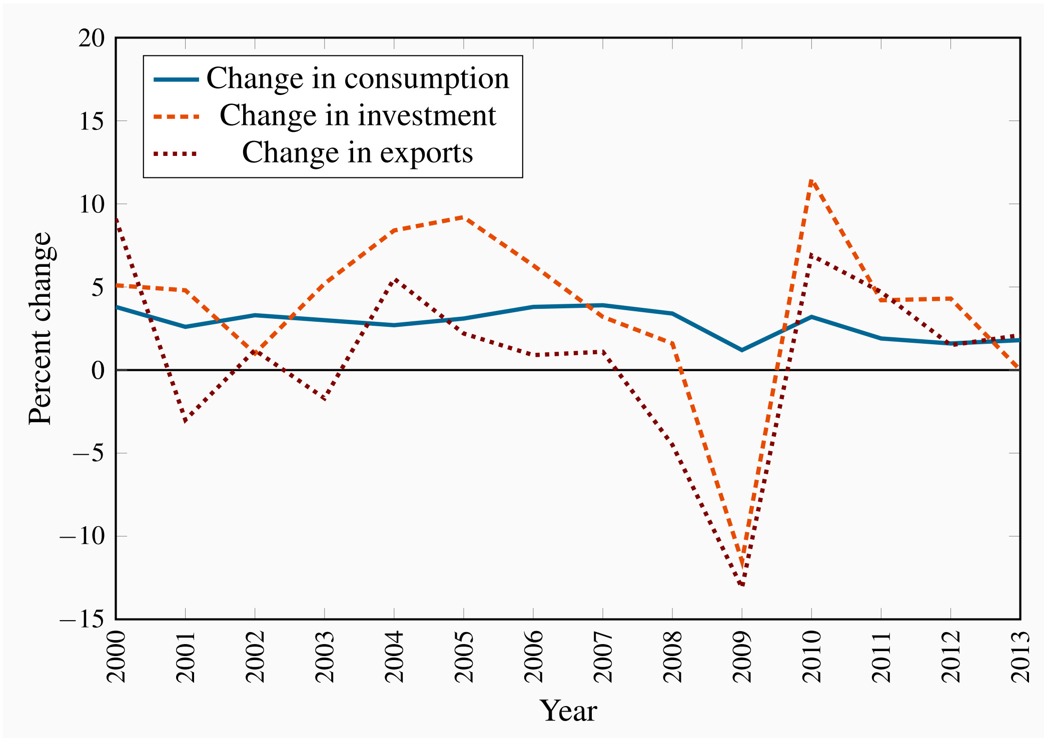

Investment expenditure ($I$) is one volatile part of aggregate expenditure. It is expenditure by business intended to change the fixed capital stock, buildings, machinery, equipment and inventories they use to produce goods and services. In 2014 investment expenditures were about 21 percent of GDP. Business capacity to produce goods and services depends on the numbers and sizes of factories and machinery they operate and the technology embodied in that capital. Inventories of raw materials, component inputs, and final goods for sale allow firms to maintain a steady flow of output and supply of goods to customers.

Firms' investment expenditure on fixed capital depends chiefly on their current expectations about how fast the demand for their output will increase and the expected profitability of higher future output. Sometimes output is high and rising; sometimes it is high and falling. Business expectations about changes in demand for their output depend on many factors that are not clearly linked to current income. As a result we treat investment expenditure as autonomous, independent of current income but potentially volatile as financial conditions and economic forecasts fluctuate. For example, the sharp drop in crude oil prices in late 2014 changed market and profit expectations dramatically for petroleum producers and for a wide range of suppliers to the industry. Investment and exploration projects were cut back sharply, reducing investment expenditure.

Exports ($X$), like investment, can be a volatile component of aggregate expenditure. Changes in economic conditions in other countries, changes in tastes and preferences across countries, changes in trade policies, and the emergence of new national competitors in world markets all impact on the demand for domestic exports.

To illustrate this volatility in exports and in investment, Figure 6.5 shows the year-to-year changes in investment, exports, and consumption expenditures in Canada from 1987 to 2012. You can see how changes in investment and exports were much larger than those in consumption. This volatility in investment and exports causes short-term shifts in aggregate expenditure which cause business cycle fluctuations in GDP and employment. More specifically, the data show the sharp declines in investment and exports that caused the Great Recession in 2009 and even though these autonomous expenditures increased in 2010 those increases were not large or persistent enough to restore pre-recession levels of autonomous expenditure.

**Figure 6.5: Annual percent change in real consumption, investment and exports, Canada 2000-2013**




*Source*: Statistics Canada, CANSIM Table 380-0064

## The aggregate expenditure function

The **aggregate expenditure function (AE)** is the sum of *planned* induced expenditure and planned autonomous expenditure. The emphasis on 'planned' expenditure is important. Aggregate expenditure is the expenditure households and businesses want to make based on current income and expectations of future economic conditions. Expenditure based GDP in national accounts measures, after the fact, the expenditures that were made. These may not be the same as planned expenditure. Some plans may not work out.

> **Aggregate expenditure (AE)** is the sum of *planned induced* and *autonomous expenditure* in the economy.

Aggregate expenditure (AE) equals the sum of a specific level of autonomous expenditure ($A_0$) and induced expenditure $[(c-m)Y]$ or in the simple notation introduced above:

$$\text{AE} = A_0 + (c-m)Y \tag{6.2}$$

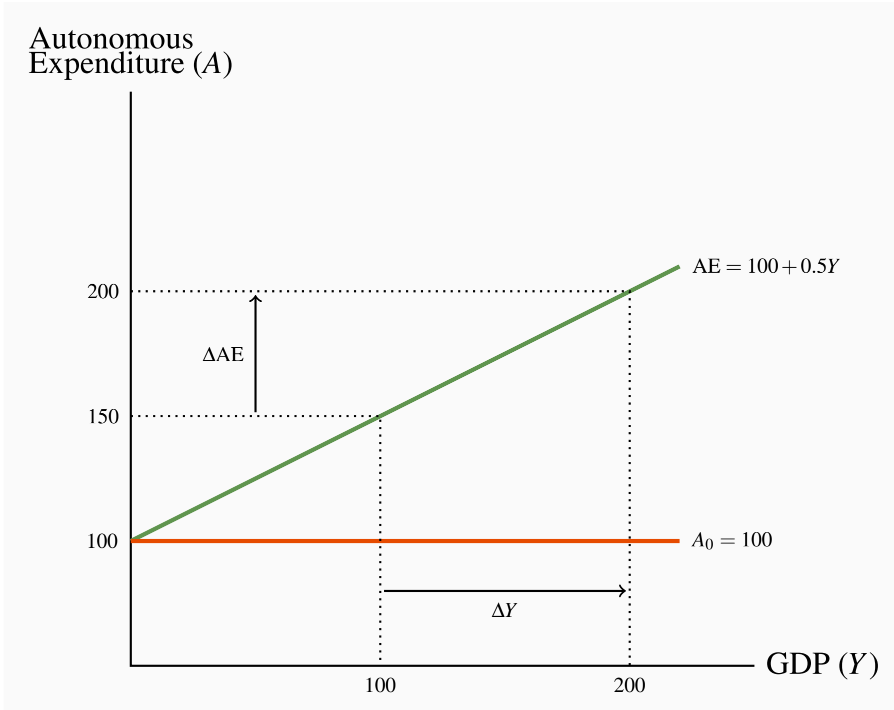
Table 6.2 gives a numerical example of the aggregate expenditure function, assuming the marginal propensity to spend on domestic output $(c-m)=0.5$. It shows constant autonomous expenditure at each level of GDP, induced expenditure changing as GDP changes and aggregate expenditure as the sum of autonomous and induced expenditure at each level of GDP. Induced expenditure changes in the same direction as GDP which raises aggregate expenditure in rows 3 to 5 in the table but lowers aggregate expenditure in the last row when GDP falls.

**Table 6.2: An aggregate expenditure function.**

| **GDP ($Y$)** | **Autonomous Expenditure ($A_0 = 100$)** | **Induced Expenditure** $(c-m)Y = 0.5Y$ | **Aggregate Expenditure AE**$= 100 + 0.5Y$ |
|---|---|---|---|
| 0 | 100 | 0 | 100 |
| 50 | 100 | 25 | 125 |
| 100 | 100 | 50 | 150 |
| 175 | 100 | 87.5 | 187.5 |
| 200 | 100 | 100 | 200 |
| 150 | 100 | 75 | 175 |

Figure 6.6 shows this aggregate expenditure function with a positive intercept on the vertical axis and positive slope. The positive intercept measures autonomous expenditure. The slope measures induced expenditure. Changes in autonomous expenditure would shift the AE function vertically, up for an increase or down for a decrease. Induced expenditures are usually assumed to be stable in the short run but if they were to change, as a result of change in marginal propensity to import for example, the slope of the AE function would change in the same way.

**Figure 6.6: An aggregate expenditure function**




The AE function has a vertical intercept equal to autonomous expenditure 100 and a slope of $\Delta AE/\Delta Y = 0.5$ equal to the changes in expenditure induced by changes in $Y$.

## 6.3 Aggregate expenditure and equilibrium output in the short run

National Accounts as in Chapter 4 measure actual expenditure, output and national income and GDP($Y$). The Aggregate Expenditure function gives *planned* expenditure (AE). In a modern industrial economy actual output and income may differ from what was planned, either on the output side or on the purchase and sales side. A simple example of the time sequence of output and sales shows why.

In most cases business install capacity and produce output in anticipation of sales in the near future. This is apparent from the stocks of goods offered in most retail outlets or online. Auto manufacturers, for example like to have an inventory of 30 to 60 days of finished vehicle sales available for retail buyers. Coffee and donut shops have coffee and snacks available to customers when they walk in. Even service industries like cell phone companies try to have staff and product on hand and ready to serve customers on demand. In these and other cases producers incur costs that they expect to recover from later sales. If sales don't match expectations some inventories of products build up or fall short, capacity is not matched to demand and some sales opportunities are lost or costs are not recovered.

As a result, if planned expenditure (AE) and GDP are different then plans in some part of the economy have not been realized and there is an incentive to change output. However, when actual output (GDP) is equal to planned expenditure (AE) expenditure and output plans are successful and, unless underlying conditions change there is no incentive to change output.

### Equilibrium output

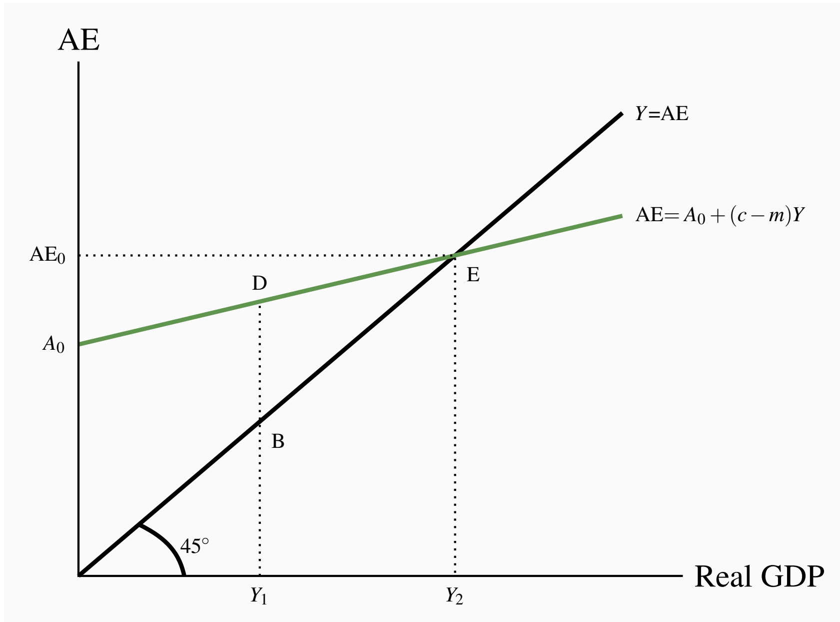
Output is said to be in **short-run equilibrium** when the current output of goods and services equals planned aggregate expenditure:

$$Y = A_0 + (c - m)Y \tag{6.2}$$

Then spending plans are not frustrated by a shortage of goods and services. Nor do business firms make more output than they can sell. In short-run equilibrium, output equals the total of goods and services households, businesses, and residents of other countries want to buy. Real GDP is determined by aggregate expenditure.

> **Short-run equilibrium output**: Aggregate expenditure and current output are equal ($Y = \text{AE}$).

**Figure 6.7: The 45° diagram and equilibrium GDP**




The 45° line gives $Y = \text{AE}$ the equilibrium condition. At point E the AE line crosses the 45° line and $\text{AE}_0 = Y_2$. This is the equilibrium. At $Y_1$, AE$> Y$ and unplanned reductions in inventories provide the incentive to increase $Y$.

In Figure 6.7 real GDP is measured on the horizontal axis and aggregate spending on the vertical axis. The 45° line labeled $Y = \text{AE}$, illustrates the equilibrium condition. At every point on the 45° line, AE measured on the vertical axis equals current output, $Y$, measured on the horizontal axis. This 45° line has a slope of 1.

The AE function in Figure 6.7 starts from a positive intercept on the vertical axis to show autonomous aggregate expenditure $A_0$, and has a slope equal to $(c-m)$ which is less than one. The 45° line has a slope equal to one. At every point on the 45° line, the value of output (and income) measured on the horizontal axis equals the value of expenditure on the vertical axis. With a positive vertical intercept and slope less than 1 the AE line crosses the 45° line at E. Since E is the only point on the AE line also on the 45° line, it is the only point at which output and planned expenditure are equal. It is the equilibrium point.

Income $Y_2$ is the only income at which aggregate expenditure just buys all current output. For example, assume as shown in the diagram, that output and incomes are only $Y_1$. Aggregate expenditure at D is not equal to output as measured at B. Planned expenditure is greater than current output. Aggregate spending plans cannot all be fulfilled at this current output level. Consumption and export plans will be realized only if business fails to meet its investment plans as a result of an unplanned fall in inventories of goods.

In Figure 6.7 all outputs less than the equilibrium output $Y_2$, are too low to satisfy planned aggregate expenditure. The AE line is above the 45° line along which expenditure and output are equal. Conversely, if real GDP is greater than $Y_2$ aggregate expenditure is not high enough to buy all current output produced. Businesses have unwanted and unplanned increases in inventories of unsold goods.

Table 6.3 extends the numerical example in Table 6.2 to show equilibrium when GDP($Y$) is 200 and the unwanted inventory changes at other income levels. When GDP in column (1) is less than AE in column (4) current output does not cover current planned expenditure. Inventories fall and producers can't meet their inventory targets. The unwanted change in inventories in column (5) is negative.

**Table 6.3: Equilibrium GDP: $Y = \text{AE}$.**

| **GDP ($Y$)** (1) | **Autonomous Expenditure** ($A_0 = 100$) (2) | **Induced Expenditure** $(c-m)Y = 0.5Y$ (3) | **Aggregate Expenditure** $\text{AE} = 100 + 0.5Y$ (4) | **Unplanned Δ Inventory** $(Y - \text{AE})$ (5) |
|---|---|---|---|---|
| 0 | 100 | 0 | 100 | -100 |
| 50 | 100 | 25 | 125 | -75 |
| 100 | 100 | 50 | 150 | -50 |
| 175 | 100 | 87.5 | 187.5 | 12.5 |
| 200 | 100 | 100 | 200 | 0 |
| 250 | 100 | 125 | 225 | +25 |
| 300 | 100 | 150 | 250 | +50 |

You can construct a diagram like Figure 6.7 using the numerical values for GDP and aggregate expenditure in Table 6.3 and a 45° line to show equilibrium $Y_e = 200$. Example Box 6.1 at the end of the chapter illustrates equilibrium for this basic model using simple algebra.

## Adjustment towards equilibrium

**Unplanned changes in business inventories** cause adjustments in output that move the economy to equilibrium output. Suppose in Figure 6.7 the economy begins with an output $Y_1$, below equilibrium output $Y_e$. Aggregate expenditure is greater than output $Y_1$. If firms have inventories from previous production, they can sell more than they have produced by running down inventories for a while. Note that this fall in inventories is unplanned. Planned changes in inventories are already included in planned investment and aggregate expenditure.

> **Unplanned changes in business inventories**: indicators of disequilibrium between planned and actual expenditures – incentives for businesses to adjust levels of employment and output ($Y$).

If firms cannot meet planned aggregate expenditure by unplanned inventory reductions, they must turn away customers. Either response—unplanned inventory reductions or turning away customers—is a signal to firms that aggregate expenditure is greater than current output, markets are strong, and output and sales can be increased profitably. Hence, at any output below $Y_e$, aggregate expenditure exceeds output and firms get signals from unwanted inventory reductions to raise output.

Conversely, if output is initially above the equilibrium level, Figure 6.7 shows that output will exceed aggregate expenditure. Producers cannot sell all their current output. Unplanned and unwanted additions to inventories result, and firms respond by cutting output. In the last few years, producers of commodities including iron ore, copper, metallurgical coal, base metals, natural gas, and crude oil have faced declining demand for their products and lower prices and rising inventories. Producers responded by lowering production to try to reduce excess inventory. In general terms, when the economy is producing more than current aggregate expenditure, unwanted inventories build up and output is cut back.

Hence, when output is below the equilibrium level, firms raise output. When output is above the equilibrium level, firms reduce output. At the equilibrium output $Y_e$, firms sell their current output and there are no unplanned changes to their inventories. Firms have no incentive to change output.

### Equilibrium output and employment

In the examples of short-run equilibrium we have discussed, output is at $Y_e$ with output equal to planned expenditure. Firms sell all they produce, and households and firms buy all they plan to buy. But it is important to note that nothing guarantees that equilibrium output $Y_e$ is the level of potential output $Y_P$. When wages and prices are fixed, the economy can end up at a short-run equilibrium below potential output with no forces present to move output to potential output. Furthermore, we know that, when output is below potential output, employment is less than full and the unemployment rate $u$ is higher than the natural rate $u_n$. The economy is in recession and by our current assumptions neither price flexibility nor government policy action can affect these conditions.

## 6.4 The multiplier: Changes in aggregate expenditure and equilibrium output

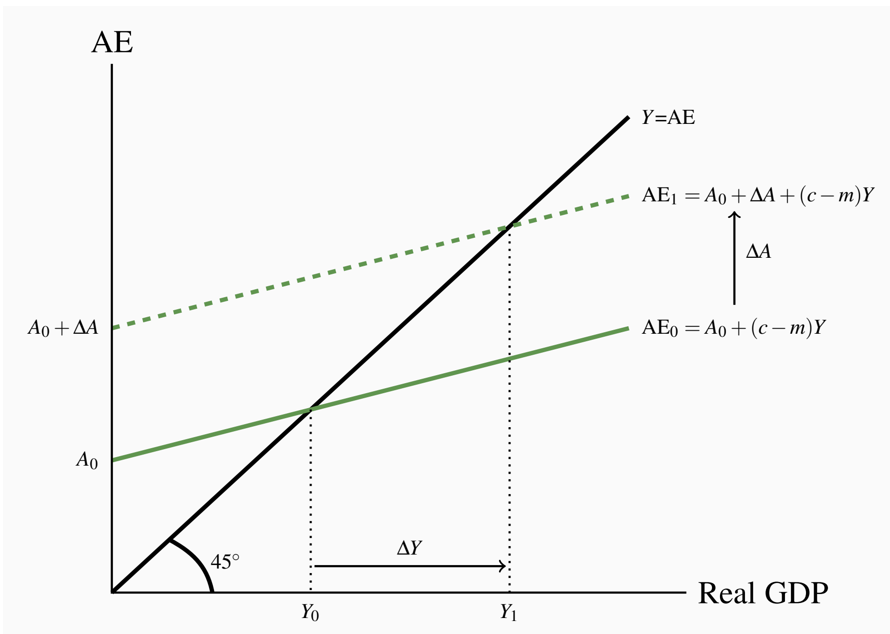
In our model the slope of the AE line depends on the marginal propensity to consume and the marginal propensity to import. For any given *mpc* and *mpm*, the level of autonomous expenditure ($A_0$) determines *the height of the AE* line. Recall that autonomous expenditure is expenditure that is not related to national income.

In a diagram, changes in autonomous expenditure cause parallel vertical shifts in the AE function.

Autonomous expenditure depends chiefly on current expectations about future domestic and foreign demand for output, future prices and future profits. These expectations about the size and strength of future markets can fluctuate significantly, influenced by current pessimism or optimism about the future. We saw this volatility in investment in Figure 6.6. Similarly, changes in conditions in export markets change exports and changes in consumer confidence change autonomous consumption expenditure.

Suppose firms become very optimistic about future demand for their output. They want to expand their factories and add new equipment to meet this future demand. Autonomous expenditure rises. If other components of aggregate expenditure are unaffected, AE will be higher at each income than before. Figure 6.8 shows this upward shift in AE to $\text{AE}_1$. Before we go into detail, think about what is likely to happen to output. It will rise, but by how much?

**Figure 6.8: The effect of a rise in autonomous expenditure**




A rise in autonomous expenditure $\Delta A$ shifts AE up to $\text{AE}_1$. Equilibrium GDP rises by a larger amount from $Y_0$ to $Y_1$.

When autonomous expenditure rises, firms increase output, increasing their payments for factor inputs to production. Households have higher income and increase their consumption expenditure ($cY$) and imports ($m\Delta Y$). Firms increase output again to meet this increased demand, further increasing household incomes. Consumption and imports rise further. This is a first and important example of interdependency and feedback in a basic model. A change in autonomous expenditure, either positive or negative, changes income which in turn causes a change in induced expenditure. Equilibrium income changes by the change in autonomous expenditure plus the change in induced expenditure.

Figure 6.8 shows that an upward shift in the AE function increases equilibrium income by a finite amount, but by a larger amount than the vertical rise in the AE line. This is because $(c-m)$, the slope of AE, is less than unity, giving the AE line a lower slope than the 45° line. Households increase their expenditure when incomes rise, but they increase expenditure by less than the rise in income. Equilibrium moves from $Y_0$ to $Y_1$. Equilibrium output rises more than the original rise in investment, $\Delta Y_e > \Delta A$, but does not rise without limit.

A fall in autonomous expenditure would have the opposite effect. AE would shift down and equilibrium income would decline by more than the fall in $A$.

The **multiplier** is a concept used to define the change in equilibrium output and income *caused* by a change in autonomous expenditure. If $A$ is autonomous expenditure:

$$\text{The multiplier} = \frac{\Delta Y}{\Delta A} \tag{6.3}$$

**Multiplier** $(\Delta Y/\Delta A)$: the ratio of the change in equilibrium income $Y$ to the change in autonomous expenditure $A$ that caused it.

We can also show the change in equilibrium output caused by a rise in autonomous investment expenditure using the earlier simple numerical example we used earlier. In Table 6.4 initial autonomous expenditure is 100, induced expenditure is $0.5Y$ and initial equilibrium is $Y = 200$. Then autonomous expenditure increases, as in column (3) by 25 to a new level of 125. Induced expenditure is still $0.5Y$. Aggregate expenditure in column (6) rises as a result of increase in both autonomous and induced expenditure.

**Table 6.4: The effect of a rise in autonomous expenditure on equilibrium GDP**

| **GDP** ($Y$) **(1)** | **Initial Autonomous Expenditure** ($A_0 = 100$) **(2)** | **New Autonomous Expenditure** ($A_1 = 125$) **(3)** | **Induced Expenditure** $(c-m)Y = 0.5Y$ **(4)** | **Initial Aggregate Expenditure** $(\text{AE} = 100 + 0.5Y)$ **(5)** | **New Aggregate Expenditure** $(\text{AE}_1 = 120 + 0.5Y)$ **(6)** |
|---|---|---|---|---|---|
| 175 | 100 | - | 87.5 | 187.5 | 187.5 |
| 200 | 100 | - | 100 | 200 | 200 |
| 225 | | 125 | 112.5 | | 237.5 |
| 237.5 | | 125 | 118.75 | | 243.5 |
| 243.5 | | 125 | 121.75 | | 246.75 |
| 246.75 | | 125 | | | |
| – | | 125 | | | |
| 250 | | 125 | 125 | | 250 |
| 300 | | 125 | 150 | | 275 |

The initial increase in aggregate expenditure illustrated is from 200 to 237.5 made up of an increase in autonomous expenditure of 25 and in induced expenditure of $0.5 \times 25 = 12.5$. However GDP($Y$) is only 225 and planned expenditure is accommodated by a decrease in inventories of 12.5. This unintended fall in inventories is an incentive to increase production to take advantage of higher than expected sales. The incentive exists until producers increase output and income to 250. Aggregate expenditure rises as income increases until equilibrium is reached at $Y = 250$. At that point actual inventory investment meets producer plans.

The change in autonomous expenditure by 25 caused an increase in equilibrium income by 50. The multiplier, defined as the change in equilibrium income caused by a change in autonomous expenditure $\Delta Y / \Delta A = 2$.

You can construct a diagram like Figure 6.8 using the numerical values for GDP and aggregate expenditure in Table 6.4 and a 45° line to show equilibrium $Y_e = 200$. Example Box 6.2 at the end of the chapter illustrates the multiplier effect of a change in autonomous expenditure on equilibrium income using simple algebra.

## The size of the multiplier

The multiplier is a number that tells us how much equilibrium output changes as a result of a change in autonomous expenditure. The multiplier is bigger than 1 because a change in autonomous expenditure changes income and sets off further changes in induced expenditure. The marginal propensity to spend on domestic output $(c-m)$ determines the induced expenditure.

In more general terms, because $mpc - mpm = c - m$ is the slope of the AE function, we can write:

$$\text{Multiplier} = \frac{1}{(1 - \text{slope of AE})} \tag{6.4}$$

In the example in Table 6.4 with a induced expenditure $(c - m)Y = 0.5$ wbich also the slope of AE the multiplier is:

$$\frac{\Delta Y}{\Delta A} = \frac{1}{(1 - \text{slope of AE})} = \frac{1}{(1 - 0.5)} = 2.0$$

But at a different time or in a different economy the marginal propensity to consume might be higher and the marginal propensity to import might be lower, for example let $c_1 = 0.85$ and $m_1 = 0.10$. Then induced expenditure on domestic output would be $(c_1 - m_1) = (0.85 - 0.10) = 0.75$ as would the slope of $\text{AE}_1$. Now a change in autonomous expenditure raises income and causes a higher change in induced expenditure. As a result the multiplier for this economy would be:

$$\frac{\Delta Y}{\Delta A} = \frac{1}{(1 - \text{slope of AE})} = \frac{1}{(1 - 0.75)} = \frac{1}{0.25} = 4.0$$

As a result, national incomes in economies with higher rates of induced expenditure on domestic output will fluctuate more; experience stronger business cycles, as a result of changes in autonomous expenditure like investment and exports.

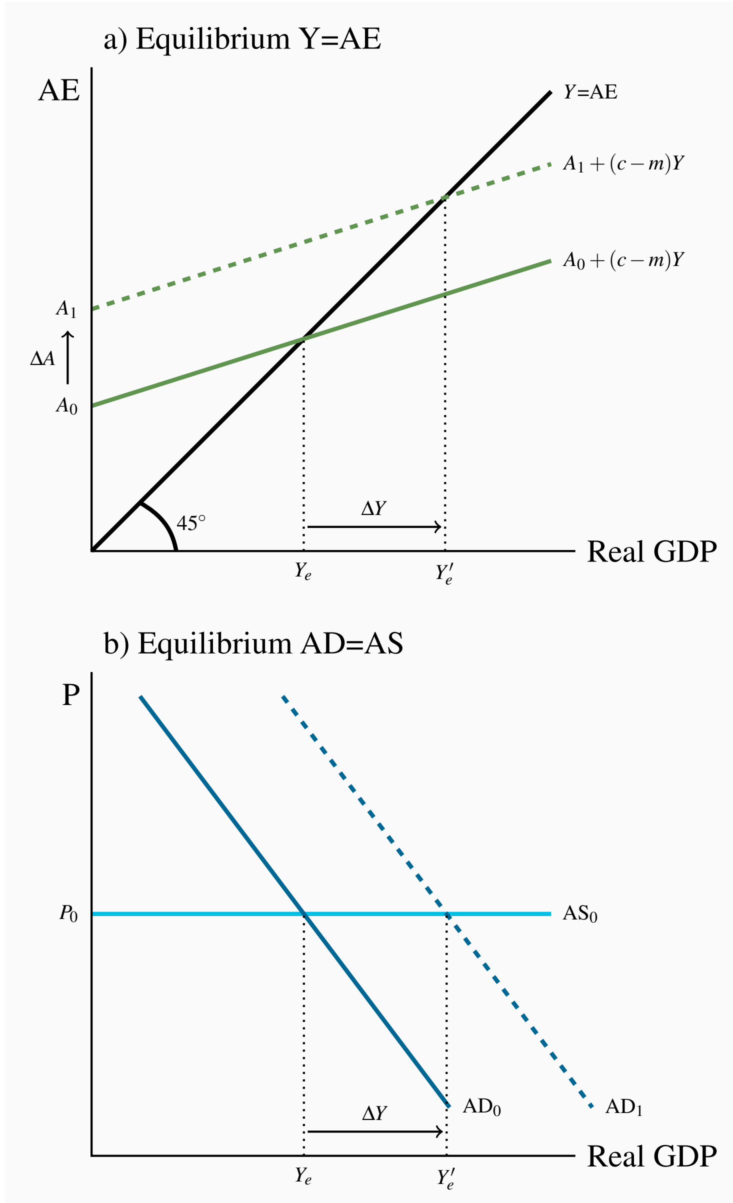
In the basic model we have here, the slope of AE is $(mpc - mpm)$, but this simple formula for the multiplier will still be useful when we introduce the tax system in the government sector in Chapter 7.

## 6.5 Equilibrium output and the AD curve

In Chapter 5 and at the beginning of this chapter, we used an aggregate demand and aggregate supply model to explain business cycle fluctuations in real GDP and employment. In this chapter we have developed a basic explanation for the shifts in AD that cause changes in real output. In the short run:

- wages, prices, money supply, interest rates and exchange rates are assumed to be constant;
- distinction between autonomous and induced expenditures is important; and
- equilibrium real GDP requires output equal to planned aggregate expenditure.

**Figure 6.9: Equilibrium GDP and aggregate demand**




Equilibrium in a) determined the *position* of the AD curve in b). A *change in autonomous* expenditure in a) changes equilibrium $Y$ and *shifts* AD by the change in autonomous expenditure times the multiplier.

In this model, investment and exports are the main sources of fluctuations in autonomous expenditures. The marginal propensities to consume and import describe the changes in aggregate expenditure caused by changes in income. These induced expenditures are the source of the multiplier. When business changes its investment plans in response to predictions and expectations about future markets and profits, or exports change in response to international trade conditions, the multiplier translates these changes in autonomous expenditure into shifts in the AD curve.

Shifts in the AD curve cause changes in equilibrium output and employment.

Figure 6.9 shows how this works. Equilibrium real GDP in the upper panel determines the position of the AD curve in the lower panel.

Initially, equilibrium real GDP at the price level $P_0$ is determined by the equilibrium condition $Y_e = A_0 + (c - m)Y$ in the upper panel and by the equilibrium condition $\text{AD}_0 = \text{AS}_0$ in the lower panel.

Changes in autonomous expenditure shift the AD curve. If autonomous expenditure increased from $A_0$ to $A_1$ as shown in panel (a), equilibrium output would increase from $Y_0$ to $Y_{e1}$. The change in equilibrium output would be ($\Delta A \times$ multiplier). The AD curve would shift to the right to $\text{AD}_1$ as a result of the increase in autonomous expenditure. The size of the horizontal shift would be ($\Delta A \times$ multiplier).

This model provides an important first insight into the sources of business cycles in the economy. However, it is a pure private household/private business sector economy. Autonomous consumption, investment, exports and imports, and the multiplier drive real GDP and income and fluctuations in those measures of economic activity. There is no government, and thus no way for government policy to affect real output and employment. There is no financial sector to explain the interest rates and foreign exchange rates that affect expenditure decisions, and thus no monetary policy. In the next few chapters we extend our discussion of aggregate expenditure and aggregate demand to include the government sector and financial sectors, as well as fiscal and monetary policy. The framework becomes a bit more complicated and realistic, but the basic mechanics are still those we have developed in this chapter.

Nonetheless, this basic model explains why, in the first half of 2015 both Steven Poloz, the Governor of the Bank of Canada and Joe Oliver, the Minister of Finance are both counting on a strong rise in exports to move the Canadian economy from a recession to growth in the second and third quarters of 2015.

**Example Box 6.1: The algebra of the basic income – expenditure model.**

The basic model has two components:

1. Aggregate expenditure = Autonomous expenditure plus induced expenditure:

$$\text{AE} = A_0 + (c - m)Y \tag{6.2}$$

2. Equilibrium condition: GDP = Aggregate expenditure

$$Y = \text{AE}$$

Then equilibrium $Y$ is found by substituting 1 into 2:

$$\begin{aligned} Y &= A_0 + (c - m)Y \\ Y - (c - m)Y &= A_0 \\ Y[1 - (c - m)] &= A_0 \\ Y &= A_0/[1 - (c - m)] \end{aligned}$$

Recall that $(c - m)$ is the slope of the AE function (i.e. $\Delta\text{AE}/\Delta Y$). Then in equilibrium:

$$Y = A/(1 - \text{slope of AE})$$

Using the numbers in the example in Table 6.3 $\text{AE} = 100 + 0.5Y$ and for equilibrium:

$$\begin{aligned} Y &= 100 + 0.5Y \\ Y - 0.5Y &= 100 \\ Y &= 100/(1 - 0.5) \\ Y &= 200 \end{aligned}$$

**Example Box 6.2: The multiplier in a basic algebraic model.**

Initial conditions in a basic model:

$$\begin{aligned}\text{Aggregate expenditure}: \ & \text{AE} = 100 + 0.5Y \\ \text{Equilibrium condition}: \ & Y = \text{AE}\end{aligned}$$

Then equilibrium national income is:

$$\begin{aligned} Y &= 100 + 0.5Y \\ 0.5Y &= 100 \\ Y &= 200 \end{aligned}$$

Suppose autonomous expenditure increases by 25 to $A_1 = 125$:

$$\begin{aligned}\text{Aggregate expenditure}: \ & \text{AE}_1 = 125 + 0.5Y \\ \text{Equilibrium condition}: \ & Y = \text{AE}_1\end{aligned}$$

Then the new equilibrium national income is:

$$\begin{aligned} Y &= 125 + 0.5Y \\ 0.5Y &= 125 \\ Y_1 &= 250 \end{aligned}$$

The change in autonomous expenditure by 25 increased equilibrium national income by 50.

The **Multiplier** is defined as the change in national income $(\Delta Y)$ divided by the change in autonomous expenditure $(\Delta A)$ that caused it. In this example the multiplier is:

$$\Delta Y/\Delta A = 50/25 = 2.$$

Notice the multiplier is also equal to $1/(1-\text{slope of AE})$. In this example the slope of AE is the marginal propensity to spend on domestic output $(c-m) = 0.5$. The multiplier is:

$$\Delta Y/\Delta A = 1/(1-\text{slope of AE}) = 1/(1-0.5) = 1/0.5 = 2.$$

## Key Concepts

**Aggregate demand** determines real output ($Y$) and national income in the short run when prices are constant.

**Aggregate demand**: aggregate expenditure (AE) at different price levels when all other conditions are constant.

**GDP($Y$)**: the national accounts measure of the sum of actual expenditure and income in the economy.

**Aggregate expenditure (AE)**: planned expenditure by business and households.

**Induced expenditure**: planned expenditure that is determined by current income and changes when income changes.

**Marginal propensity to consume ($mpc = c = \Delta C/\Delta Y$)**: the change in consumption expenditure caused by a change in income.

**Marginal propensity to import** ($mpm = m = \Delta IM/\Delta Y$): the change in imports caused by a change in income.

**Induced expenditure** $(c - m)Y$: planned consumption and imports expenditures that change when income changes.

**Autonomous expenditure ($A$)**: planned expenditure that is not determined by current income.

**Aggregate expenditure (AE)**: the sum of planned induced and autonomous expenditure in the economy.

**Short-run equilibrium output**: Aggregate expenditure current output are equal ($Y =$ AE).

**Unplanned changes in business inventories**: indicators of disequilibrium between planned and actual expenditures – incentives for businesses to adjust levels of employment and output ($Y$).

**Multiplier** $(\Delta Y/\Delta A)$: the ratio of the change in equilibrium income $Y$ to the change in autonomous expenditure $A$ that caused it.

## Exercises for Chapter 6

**Exercise 6.1** Suppose that in an economy with no government the aggregate expenditure function is: $\text{AE} = 50 + 0.75Y$.

(a) Draw a diagram showing the aggregate expenditure function, and indicate the level of planned expenditure when income is 150.

(b) In this same diagram, show what would happen to aggregate expenditure if income increased to 200.

(c) What are the levels of autonomous expenditure and induced expenditure at income levels of 150 and 200.

(d) In this same diagram show what would happen if autonomous expenditure increased by 20.

**Exercise 6.2** Suppose the media predicts a deep and persistent economic recession. Households expect their future income and employment prospects to fall. They cut back on expenditure, reducing autonomous expenditure from 50 to 30.

(a) Re-draw the aggregate expenditure functions you have drawn in your diagrams for Exercise 6.1 to show the effects, if any, of this change in household behaviour.

(b) Suppose the negative economic forecast also reduces induced expenditure in the economy from $0.75Y$ to $0.5Y$. In a diagram show the effect would this have on the aggregate expenditure functions you have drawn.

**Exercise 6.3** Construct a table showing autonomous, induced and aggregate expenditure at different income levels ($Y$) for an economy with autonomous expenditure of 105 and induced expenditure of $0.5Y$.

(a) Using numbers from your table draw a diagram showing the aggregate expenditure function AE. What is the intercept of this function on the vertical axis?

(b) What is the slope of the AE function, and what does the slope measure?

(c) Write the equation for the aggregate expenditure function for this economy.

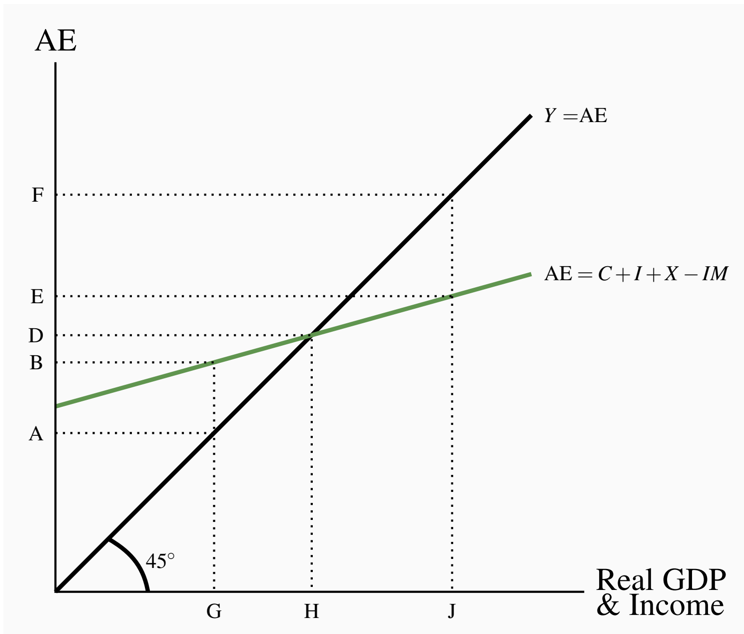
**Exercise 6.4** Output and income are in equilibrium when planned expenditures AE are equal to national income, $Y$, in other words, meaning $Y = \text{AE}$.

(a) Suppose the AE function is $\text{AE} = 175 + 0.75Y$. Draw a diagram showing the aggregate expenditure function.

(b) In your diagram draw the 45° line that shows all points at which national income and aggregate expenditures are equal ($Y = \text{AE}$).

(c) Using your diagram, or a numerical example, or an algebraic solution, find equilibrium output and income in this example and show it in the diagram.

**Exercise 6.5** The diagram below shows the aggregate expenditure schedule for the economy and the equilibrium condition on the 45° line.




(a) Suppose output is 0G. What is the level of planned aggregate expenditure? Is planned expenditure greater or less than output?

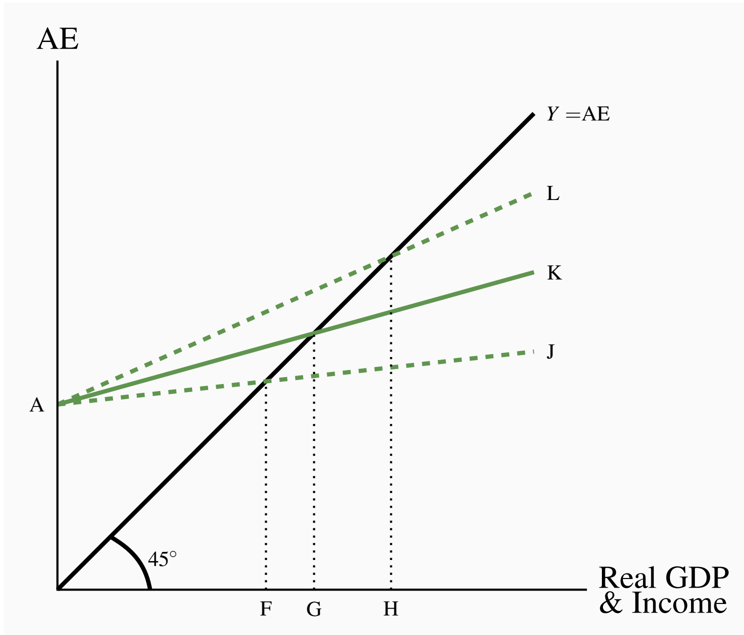
(b) What is the size of the unplanned change in inventories at output 0G?

(c) How will business firms respond to this situation?

(d) What is the equilibrium income and expenditure?

(e) Suppose output is at 0J: What is there an unplanned change in inventories?

**Exercise 6.6** The following diagram shows an economy that initially has an aggregate expenditure function AK.




(a) What is the initial equilibrium real GDP?

(b) Suppose there is an increase in the marginal propensity to import. What is the new aggregate expenditure function?

(c) What is the new equilibrium real GDP and income?

(d) Suppose, instead, the marginal propensity to consume has increased. What is the new aggregate expenditure function? What is the new equilibrium real GDP and income?

**Exercise 6.7** The distinction between autonomous and induced expenditure is important for the determination of equilibrium real GDP. Assume that the marginal propensity spend on domestic output is 0.70 and autonomous aggregate expenditure is zero.

(a) What is the equation for the aggregate expenditure function under these assumptions?

(b) Draw the aggregate expenditure function in an income-expenditure 45° line diagram.

(c) What is the equilibrium level of real GDP illustrated by your diagram?

(d) Explain why this is the equilibrium level of real GDP.

**Exercise 6.8** Suppose the slope of the AE function is 0.6. Starting from equilibrium, suppose planned investment increases by 10.

(a) By how much and in what direction does equilibrium income change?

(b) How much of that change in equilibrium income is the result of the change in induced expenditure?

(c) How would your answers to (b) differ if the slope of the AE function was 0.8?

**Exercise 6.9** Suppose autonomous expenditure is 100 and there is no induced expenditure in the economy.

(a) Write the aggregate expenditure function for this economy.

(b) Draw the aggregate expenditure function and the 45° line in a diagram.

(c) What is the equilibrium level of real output and income?

(d) By how much would equilibrium real output change if autonomous expenditure increased to 125? Show the change in expenditure and equilibrium in your diagram for part (b).

(e) What is the size of the multiplier? Explain your answer.

# Chapter 7

## The government sector

**In this chapter we will explore:**



The federal government in Canada and its budget policies generated a lot of media coverage and public debate in 2015. The Minister of Finance in his April 2015 Budget delivered on the Harper Government's promise to balance the budget in 2015. But politics aside there really is no magic to a balanced budget. A balanced budget does not reduce the public debt. Nor does a balanced budget directly increase economic activity in an economy operating with a recessionary gap. Perhaps more interestingly, the government's actual budget balance at the end of its budget year depends importantly on the level of national income. By July 2015, it seemed clear that the negative growth in national income in the first two quarters would cause a government budget deficit rather than the projected surplus. Actual budget balances depend on budget plans and the level on national income. This chapter explains these issues and the role of government in the economy.

A government sector adds important new linkages and feedback effects to the basic model of Chapter 6. Government expenditures on goods and services ($G$), determined by government policy, are added to other autonomous expenditures. They affect AE and equilibrium income through the multiplier. Government revenue collected by a net tax rate ($t$) applied to national income reduces the income households have to spend on consumption and reduces induced consumption expenditure. The multiplier is reduced, reducing equilibrium national income and the effects of changes in autonomous expenditure on equilibrium national income.

The linkages and feedbacks work in both directions. Changes in government expenditures and taxes have effects on equilibrium national income. Government can use these effects to manage aggregate expenditure and equilibrium income. However, changes in equilibrium national income caused by changes in expenditure in other parts of the economy changes incomes, government revenues and budget balances. As a result, changing economic conditions often lead to government budget outcomes that differ from initial targets and projections as in 2015.

Furthermore, over time governments must manage their budgets in ways that control the size of their debt relative to GDP. The fiscal policy governments implement through their budgets has dual objectives: Manage aggregate demand and, over time, manage the size of the public debt relative to national income. Recently, Canadian governments have been more concerned about government budget surpluses, deficits, and debt than about demand management when designing fiscal policy.

To explain the role of government in macroeconomic analysis and policy, we start with a brief look at the data on the size of the government sector in Canada.

## 7.1 Government in Canada

The total government sector in Canada includes the federal, provincial, and municipal governments, as well as hospitals. Table 7.1 shows total outlays by the government sector in 2013. These totaled $758 billion. Of this total, 31.2 percent was expenditure on government employees and 22.4 percent for the goods and services that provided government services to Canadians. The remaining 46.1 percent was transfer payments to persons, business, and non-residents, and interest paid on the outstanding public debt.

**Table 7.1: Total government expense in Canada, 2013**

| Total Expense (millions $) | Compensatio employees % | Use of Good & Services % | Consumptio of Fixed Capital % | Subsidies & Grants % | Social Benefits % | Other Expense % | Interest % |
|---|---|---|---|---|---|---|---|
| 758 | 31.2 | 22.4 | 8.4 | 3.5 | 20.1 | 6.0 | 8.1 |

*Source:* Department of Finance, *Fiscal Reference Tables, 2014*, Table 34.

To provide some perspective, Table 7.2 compares the size of the government sector in Canada, relative to GDP, with the average for the G7 group of industrial countries (Canada, the United States, Japan, the United Kingdom, Germany, France, and Italy) in 2007 and 2013. These data illustrate two aspects of recent government budget activity that are of particular interest. The first is the size of the government sector in each country as measured by revenue, expenditure, budget balance and net public debt, all reported as a percent of GDP. The second is the change in government sector finances from 2007 to 2013, the period of the financial crisis, recession and prolonged recovery.

On the first point the 2007 data show expenditures by Canada's government sector—the combined federal, provincial, and local governments—on goods, services, and transfers were 38.6 percent of GDP. This was less than the average for G7 countries. The difference reflects national political choices about the role the government sector plays in the economy.

**Table 7.2: The general government sector in Canada vs. the G7 countries**

| | Total Revenues % GDP | | Total Outlays % GDP | | Budget Balance % GDP | | Net Public Debt % GDP | |
|---|---|---|---|---|---|---|---|---|
| | **2007** | **2013** | **2007** | **2013** | **2007** | **2013** | **2007** | **2013** |
| **Canada** | 40.1 | 38.1 | 38.6 | 41.1 | 1.5 | −3.0 | 27.0 | 40.4 |
| **G7 Average** | 37.3 | 37.3 | 39.9 | 42.9 | −2.6 | −5.6 | 49.7 | 84.3 |

*Source:* Canada: Department of Finance, *Fiscal Reference Tables, 2014*, Tables 51-54.

In 2007, Canada differed from the G7 average in terms of their government sector budget balances. Canada operated with a budget surplus (revenues were greater than expenditures), while the other countries had budget deficits. Canada's budget surplus was the latest in a series of annual government-sector budget surpluses over the period from 1997 to 2007. These budget surpluses reduced the outstanding public debt and reduced Canada's ratio of net public debt to GDP well below the average to the lowest in the G7.

The shift in fiscal conditions in the G7 from 2007 to 2013 was dramatic. The recession that followed the financial crisis of 2008 reduced employment and incomes in all countries. Government revenue in Canada fell relative to GDP but not in the G7. At the same time governments increased expenditures to stimulate demand and some provided financial bailouts to banks to limit the impact of the financial crisis on bank balance sheets. In combination, these fiscal policy actions increased average G7 government outlays by about 2 percent of GDP, pushed budget deficits up to 5.6 percent of GDP and, combined with slow growth in GDP, raised the average net public debt ratio more than 30 percentage points. Canada also experienced a rise in the net public debt ratio although to a less extent than other countries. The government debt crisis that followed in several countries has dominated European economic conditions and policy debates and remained unsolved in 2015.

## 7.2 Government expenditure & taxes

A basic government budget has two components:

1. A plan for *government expenditures* on goods and services, $G$.
2. A *net tax rate* on income, $t$, set to generate revenue to finance expenditure.

When added to the definition of autonomous expenditure, $A$ is expanded to include **government expenditure** $G$.

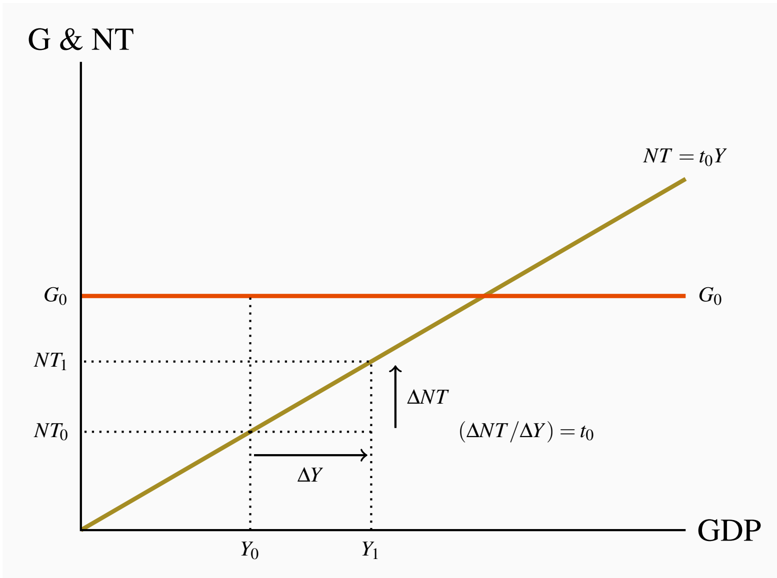
> **Government expenditure** ($G$): government spending on currently produced goods and services.

We illustrate *autonomous* government expenditure in the same way we did with other autonomous expenditures, using a simple equation. For a specific level of government expenditure:

$$G = G_0 \tag{7.1}$$

In Figure 7.1 with income on the horizontal axis and government expenditure and net tax revenue on the vertical axis, a horizontal line intersecting the vertical axis at $G_0$ illustrates a particular level of government expenditure. Any change in government expenditure would shift this line up or down in a parallel way.

**Figure 7.1: Government expenditure and net tax revenue function**




The government raises revenue by levying direct taxes on incomes and pays out transfer payments such as old age security, employment insurance benefits, social assistance and interest on the public debt. The difference between taxes collected and transfers paid is **net taxes ($NT$)**, the net revenue collected by government from households.

**Net taxes**: taxes on incomes minus transfer payments.

Net taxes revenues relative to national income are also illustrated in Figure 7.1. With no autonomous net taxes and a tax rate $t_0$, the tax revenue line starts at the origin, $NT = 0$ when $Y = 0$, and rises as income rises, moving to the right in the diagram. The slope of the $NT$ line is the net tax rate: $\Delta NT/\Delta Y = t$.

Figure 7.1 illustrates another important point. It shows that for a given level of planned government expenditure and a given tax rate, government expenditure will be greater than tax revenue at lower income levels and lower than tax revenue at higher income levels. There is a strong direct linkage between government finances and national income.

There is another but slightly more complex link between government taxes and non-government expenditures. The net tax rate on income reduces *induced* consumption. Net taxes reduce **disposable income**—the amount available to households for spending or saving—relative to national income. If $YD$ **is disposable income**, $Y$ national income and output, and $NT$ net taxes:

$$\text{Disposable income} = \text{national income minus net tax revenue}$$

$$YD = Y - NT \tag{7.2}$$

**Disposable income ($YD$):** national income minus net taxes.

Suppose taxes net of transfers are about 15 percent of national income. The net tax rate $t = 0.15$. If national income $Y$ increases by \$1, net tax revenue will increase by \$0.15, but household disposable income will increase by only \$0.85.

For simplicity, suppose the marginal propensity to consume ($mpc = c$) out of disposable income is 0.8. The consumption function is:

$$\text{Consumption} = \text{autonomous consumption} + \text{induced consumption based on disposable income.}$$

Then if:

$$C = 20 + 0.8YD$$

And the net tax rate is $t = 0.15$, disposable income is $(1 - 0.15) = 0.85$ times national income. Thus, consumption expenditure based on national income is:

$$C = 20 + 0.8 \times 0.85Y$$
$$C = 20 + 0.68Y$$

A change in national income of \$1 changes consumption expenditure by only 0.8 times $(1 - t)$ of a dollar. If the net tax rate is 0.15, consumption expenditure changes by only $\$1 \times (0.8 \times 0.85) = \$0.68$. Each extra dollar of national income increases disposable income by \$0.85, out of which households plan to spend 68 cents and save 17 cents. Table 7.3 gives a numerical example.

**Table 7.3: A numerical example**

| | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| a) | $C = 20 + 0.8YD$ | | | | b) | $C = 20 + 0.8YD$ | | | |
| | $NT = 0$ | | | | | $NT = 0.15Y$ | | | |
| | $YD = Y$ | | | | | $YD = (1 - 0.15)Y$ | | | |
| | | | | | | $C = 20 + 0.8(1 - 0.15)Y$ | | | |
| a) | $Y$ | $NT$ | $YD$ | $C_1$ | b) | $Y$ | $NT$ | $YD$ | $C_2$ |
| | 100 | 0 | 100 | 100 | | 100 | 15 | 85 | 88 |
| | 300 | 0 | 300 | 260 | | 300 | 45 | 255 | 224 |
| | 500 | 0 | 500 | 420 | | 500 | 75 | 425 | 360 |

In the absence of taxation, in part (a) of the table, national income $Y$ and disposable income $YD$ are the same. The consumption function $C_1$ shows how much households wish to consume at each level of national income, based on the numerical example.

With a proportional net tax rate of 0.15, households still consume \$0.80 of each dollar of disposable income. Now part (b) shows $YD$ is now only 0.85 of $Y$ when the net tax rate is 0.15. Households consume only $0.8 \times 0.85 = 0.68$ of each extra dollar of national income.

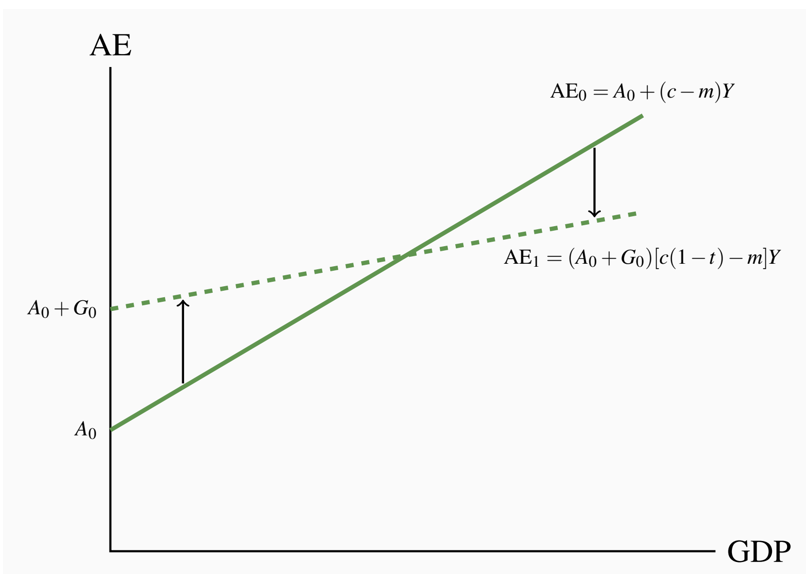
## The effects of both government expenditure and taxation

Aggregate expenditure includes both autonomous and induced expenditure. The net tax rate diverts some of national income to the government budget and lowers the disposable income on which induced expenditure is based. Net Taxes and imports both lower the marginal propensity to spend on domestic output. With the marginal propensity to consume out of disposable income ($mpc$), the marginal propensity to import ($mpm$) and the net tax rate ($t$), the slope of the AE function, the marginal propensity to spend on domestic output is:

Slope of AE = marginal propensity to consume disposable income − marginal propensity to import

$$\frac{\Delta \text{AE}}{\Delta Y} = c(1-t) - m \tag{7.3}$$

**Figure 7.2: The effect of G and NT on AE**

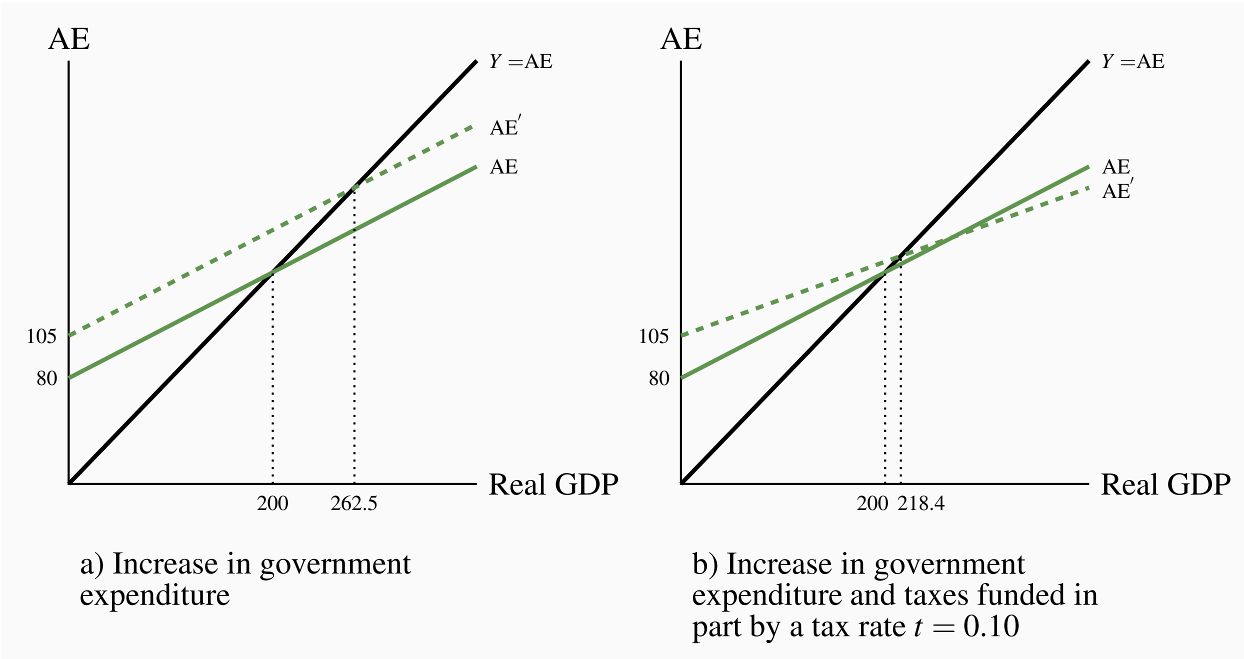



New government expenditure and taxes shift the AE function up by $G_0$ and lower its slope from $(c-m)$ to $c(1-t)-m$. A change in $G$ shifts AE vertically. A change in $t$ changes the slope of AE.

Figure 7.2 shows the combined effect of government expenditure and net taxes on the aggregate expenditure function.

As in the basic model, equilibrium real GDP equals autonomous aggregate expenditure multiplied by the multiplier. The government sector adds a new autonomous expenditure component $G_0$ that shifts the AE function, and a new induced expenditure factor, the net tax rate ($t$), which lowers the slope of the AE function. Figure 7.3 illustrates the effects on equilibrium GDP and the multiplier.

**Figure 7.3: Government expenditure, taxes, and equilibrium real GDP**




a) An increase in $G$ of 25 with a multiplier of 2.5 increases equilibrium GDP by 62.5. b) With $G = 25$ funded by a tax rate $t = 0.10$ the multiplier is reduced from 2.5 to 2.08 and equilibrium GDP is 218.4. $t = 0.10$ lowers slope of the AE.

Part a) of Figure 7.3 shows the effect of adding government expenditure to aggregate expenditure in the basic model. Government expenditure $G = 25$ is autonomous and shifts the AE curve up to a new intercept at 105. With $mpc = 0.8$ and $mpm = 0.2$ the slope of AE is 0.6 and the multiplier is 2.5. Equilibrium $Y$ increases by $25 \times 2.5 = 62.5$ to the new equilibrium 262.5. An increase in autonomous government expenditure increased equilibrium GDP. A cut in government expenditure would reduce it. In this example, since the government has not introduced a tax system the government expenditure is financed by borrowing money through the sale of bonds.

Part b) shows the effect of government expenditure finance by net taxes on income. Government expenditure is 25 and tax revenues are raised by a net tax rate of 10 percent, $t = 0.10$ and $NT = 0.10Y$. Higher autonomous government expenditure raises the intercept of the AE function by 25 to 105. The net tax rate lowers the slope of the AE function and reduces the size of the multiplier from 2.5 to 2.08. Equilibrium GDP does increase to 218.4 because the government expenditure of 25 is greater than the net tax revenue $(0.10 \times 218.4)$ of 21.84. The government's budget is in deficit.

Example Box 7.1 at the end of the chapter gives the basic algebra of Figure 7.3.

## The multiplier revisited

The multiplier relates changes in equilibrium national income to the changes in autonomous expenditures that cause them. The formula in Chapter 6 still applies.

$$\text{The multiplier} = \frac{1}{1 - \text{slope of AE}}$$

Without government and taxes, disposable income and national income are the same. With induced expenditure based on the marginal propensity to consume ($mpc = c$) and the marginal propensity to import ($mpm = m$) the multiplier is:

$$\frac{\Delta Y}{\Delta A} = \frac{1}{1 - c + m}$$

With government net taxes proportional to income, $NT = tY$, disposable income is less than national income namely $Y - tY$. This reduces the marginal propensity to consume out of national to $c(1 - t)$, reducing the slope of the AE function.

$$\frac{\Delta \text{AE}}{\Delta Y} = c(1 - t) - m$$

As a result, the multiplier, which is $1/(1 - \text{slope AE})$ is smaller:

$$\frac{\Delta Y}{\Delta A} = \frac{1}{1 - c(1 - t) + m} \tag{7.4}$$

The numerical values in Figure 7.3 provide one example of this change in the multiplier.

Now that we have seen that government expenditure and net tax taxes have effects on aggregate expenditure and equilibrium income, it is time to examine the effects of government budgets on AE, AD, and real GDP. The government implements fiscal policy through its budget.

**Application Box 7.1: The multiplier in Canada**

The multiplier plays a key role in the AE and AD/AS model of the economy. But what is the size of the multiplier in Canada? A simple statistical estimate, using Statistics Canada annual data for real GDP and consumption expenditures, gives a Canadian marginal propensity to consume out of national income $c(1-t) = 0.54$, and marginal propensity to import $m = 0.34$. Using these estimates, we get a multiplier for Canada:

$$\Delta Y/\Delta A = 1/(1-0.54+0.34) = 1/(1-0.2) = 1.25$$

Recent data gives an estimate of the Canadian marginal propensity to consume out of disposable income of $mpc = 0.88$. If there were no taxes or imports, an $mpc = 0.88$ would mean a multiplier of about 8.33. The difference between the multipliers 1.25 and 8.33 shows clearly the automatic stabilization coming from the net tax rate and marginal propensity to import.

## 7.3 The government's budget function

It is important to make a clear distinction between a government budget as it affects and is affected by national income and an individual or household budget. The large size of the government sector relative to the economy (see Table 7.2) means any change in government expenditure or taxes also changes national income and government tax revenue. An increase in government expenditure also increases its tax revenue by increasing national income. A cut in government expenditure reduces national income and tax revenue. A household can improve its budget balance by cutting its expenditure without affecting its income. A government cannot. Recent experience in many countries provides a record of the difficulties governments have in trying to reduce budget deficits by cutting government expenditures.

The government budget function provides a useful tool for the discussion of these questions. It illustrates two-way linkages between the government budget and national income and the internal feedback within the government budget.

Think of a budget as the revenue and spending plan of an individual, a company, or a government. The government budget describes what goods and services the government will buy during the coming year, what transfer payments it will make, and how it will pay for them. Most spending is financed by taxes, but some revenue comes from charges for services. A balanced budget has revenues equal to spending. When revenues exceed spending, there is a budget surplus. When revenues fall short of spending, there is a budget deficit, which is financed by borrowing through the sale of government bonds to the public.

**Government budget**: planned government spending and revenue.

**Balanced budget**: revenues are equal to expenditures.

**Budget surplus**: revenues are greater than expenditures.

**Budget deficit**: revenues are less than expenditures.

Continuing to use $G$ for government expenditure on goods and services, and $NT$ for net tax revenue or taxes minus transfer payments (ignoring other sources of revenue, for simplicity):

$$\text{Government budget balance } (BB) = \text{Net tax revenue } (tY) - \text{government expenditure } (G)$$

$$BB = tY - G \tag{7.5}$$

The budget balance, whether deficit, surplus or zero, is determined by three things:

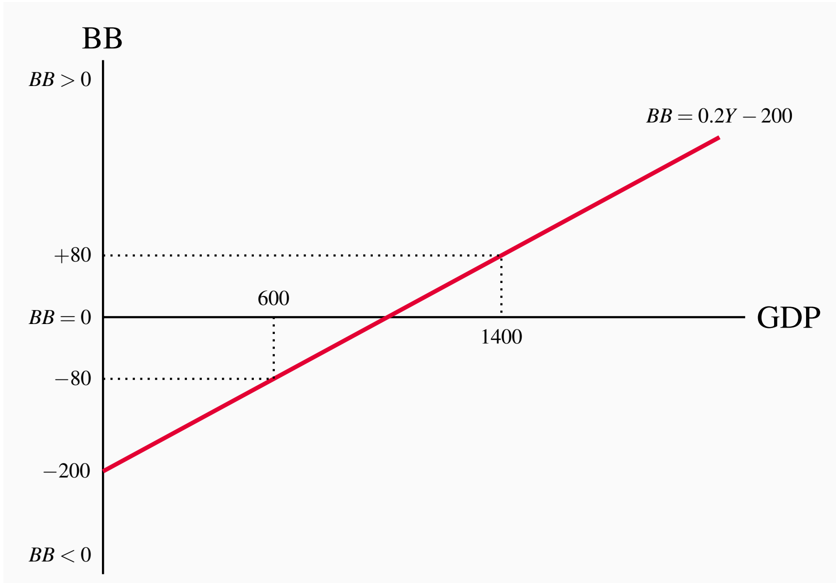
1. the *net tax rate* $t$ set by the government;
2. the level of *expenditure* $G$ set by the government; and
3. the level of *output* $Y$ determined by AE and AD.

We can summarize the relationship between national income and the government's budget balance in a way we will find useful for discussing a government's budget and fiscal policies. Figure 7.4 shows a **budget function**. This budget function assumes $t_0 = 0.20$ and $G_0 = 200$. This is a specific fiscal program and budget plan, namely $BB_0$.

$$BB_0 = 0.2Y - 200$$

**Budget function**: the relationship between the budget balance and the level of national income for a specific budget program.

**Figure 7.4: The government budget function**




The budget function is positioned by $G = 200$ with a slope $\Delta BB/\Delta Y = t = 0.2$. The budget balance depends on the equilibrium level of GDP determined by AE.

A budget function is a simple illustration of the way the budget balance for one fiscal policy program depends on levels of national income.

In Figure 7.4, if national income $Y$ were 600 the budget $BB_0$ would be in deficit by 80. If a rise in autonomous aggregate expenditure increased equilibrium national income to 1400 the budget $BB_0$ would be in surplus. Changes in national income induce changes in the revenues generated by the tax rate $t = 0.2$ and automatically change the government's budget balance. The fiscal program and budget plan have not changed.

Once that fiscal program is set, the budget function is set, but the budget balance is not. The budget balance depends on the performance of the economy in terms of national income. In presenting the budget, the Minister of Finance gives a forecast of the budget balance based on a forecast of national income. If the income forecast is wrong, the budget program will result in either a larger or smaller budget balance than initially predicted.

Recent experience illustrates this relationship. In April of 2015 the Minister of Finance, Joe Oliver, tabled a government budget plan that was intended to result in a balanced budget ($BB = 0$) in 2015. That budget plan was based on the assumption the GDP in Canada would grow at an annual rate of 2 per cent in 2015 and generate corresponding government tax revenue. However, by mid-July 2015 there were serious questions about that growth rate assumption. The Parliamentary Budget Office in a Budget Update that used the Bank of Canada's latest forecasts for real GDP growth at an annual rate of 1 percent estimated a budget deficit of $1.5 billion for 2015-16. The promised balanced budget was at risk as real GDP would be less by the end of the budget year. The finance minister makes a budget plan but the performance of the economy determines the budget outcome.

This recent experience is not anomalous. For many years before the financial crisis of 2008 and the recession that followed the Canadian federal government ran budget surpluses that frequently exceeded predictions, while many provincial government budget deficits were smaller than predicted. Economic growth during those years was stronger than forecast when the budgets were designed. Clearly the difficulties in making accurate income forecasts have important effects on the actual government budget balances.

Finally, notice that because a budget function describes one fiscal plan, any change in the fiscal plan will change the *BB* line to show a new budget function.

## 7.4 Fiscal policy & government budget balances

**Fiscal policy** is the government's use of its taxing and spending powers to affect aggregate expenditure and equilibrium real GDP. The main objective of fiscal policy is to stabilize output by managing aggregate demand, keeping output close to potential output, and reducing the size and duration of business cycle fluctuations. This requires changes in the government's expenditure plans and tax policy to offset changes in autonomous expenditures that would otherwise push the economy away from equilibrium at potential output.

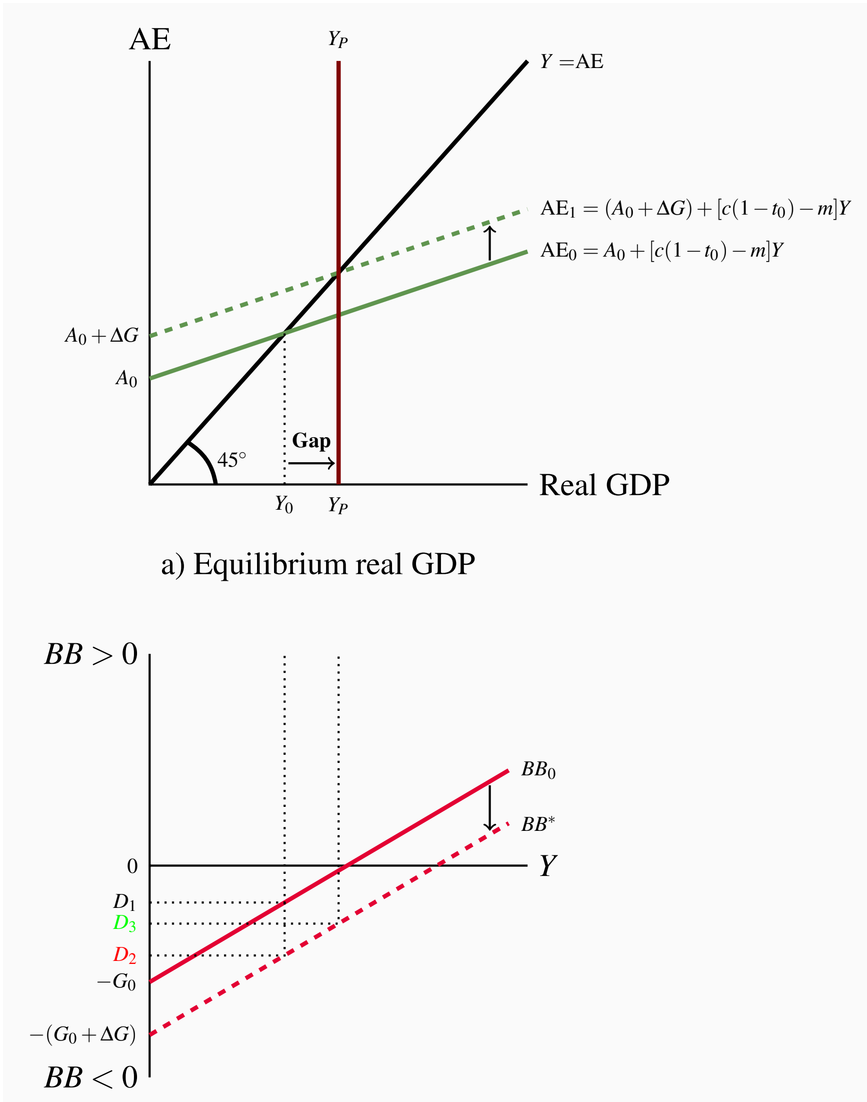
> **Fiscal policy**: government use of taxes and spending to affect equilibrium GDP.

In 2008 and 2009, for example, the international financial crises and the recession that followed led to fiscal stimulus programs in most industrial countries, like Canada's federal '*Economic Action Plan*', and calls for international coordination of fiscal stimulus. This fiscal stimulus led in turn to increased budget deficits and national debts and, especially in Europe, to national or sovereign debt crises.

### Fiscal stimulus

Figure 7.5 illustrates the use of fiscal policy to eliminate an output gap. In the Part a) of the diagram the economy has a recessionary gap at equilibrium $Y_0 < Y_P$ because aggregate expenditure, AE, is not high enough to give equilibrium at $Y_P$.

**Figure 7.5: Fiscal policies to eliminate an output gap**




An increase in $G$ reduces the budget balance and $BB$ drops to $BB^*$, increasing the deficit from $D_1$ to $D_2$. The higher autonomous $G$ increases AE to $\text{AE}_1$ and real GDP increases to $Y_P$, eliminating the output gap. That increase in $Y$ increases tax revenue and offsets some of the initial increase in the deficit such that the final budget deficit is $D_3$.

Government can intervene to raise AE to $\text{AE}_1$ by increasing government expenditures or by lowering the net tax rate or a combination of the two. In this case, the government chooses to increase $G$ from $G_0$ to $G_0 + \Delta G$. The increase in $G$, working through the multiplier raises equilibrium real GDP to potential output.

Part b) of the diagram shows the change in the fiscal program used to provide fiscal stimulus and expand AE and equilibrium real GDP. Increased $G$ lowers the budget function at every income level by $\Delta G$ to the new function $BB^*$.

Before the increase in $G$ the budget had a small deficit $D_1$. The deficit rises initially to $D_2$ as a result of higher government expenditure and as yet no increase in income. Then, as the increased government expenditure raises AE and real GDP, the economy moves to the right along the budget function $BB^*$ and higher national income generates higher tax revenue. Higher revenue offsets some of the increase in the deficit caused by $\Delta G$ leaving deficit $D_3$, larger than the deficit $D_1$ but less than the increase in spending and deficit used to stimulate the economy.

Fiscal policy makes changes in net tax rates and government spending that are intended to change aggregate expenditure and aggregate demand and stabilize equilibrium output at potential output. These changes change the government's budget function and the budget balance. In the case of fiscal expansion in Figure 7.5 the increase in equilibrium income means the fiscal stimulus is partly self-financed by the increase in equilibrium income.

## Fiscal austerity

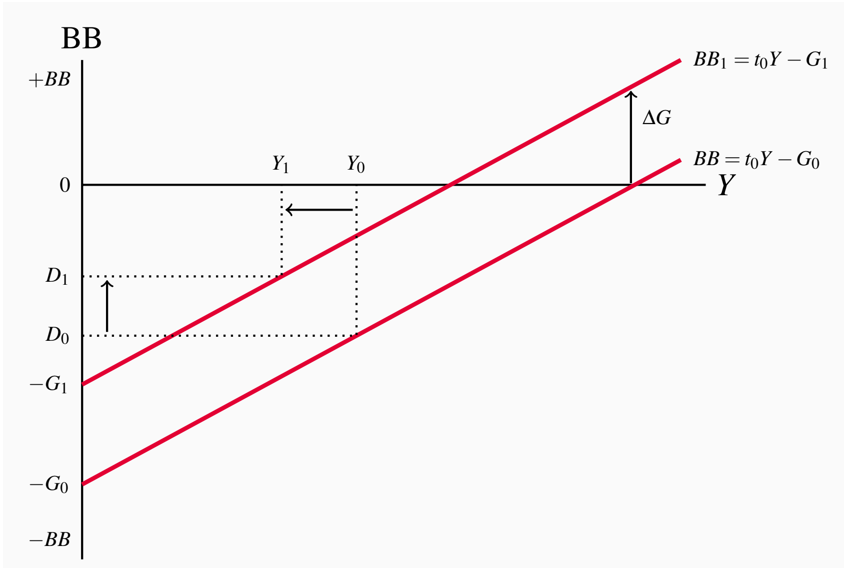
At times government directs fiscal policy not to the level of economic activity but to state of the government budget balance and public debt ratio. A balanced budget $(BB = 0)$ is often the target of a fiscal plan that involves some combination of cuts in government expenditure and tax increases. This is fiscal austerity. Recent federal government fiscal policy in Canada is a good example.

> **Fiscal austerity**: cuts in government expenditure and/or increases in taxes aimed at improving the government's budget balance.

But the same linkage and feedback effects that work to finance part of a fiscal expansion work to opposite effect in the case of fiscal austerity. If a government cuts expenditures in trying to reduce a budget deficit, some of the initial effect on the budget balance is lost to falling tax revenue. Lower $G$ lowers equilibrium income and lower income lowers tax revenues. Larger budget expenditure cuts to make up for lost revenues make matters worse. This was the experience of many European countries in the years following the recession of 2008. Greece is the extreme case.

Figure 7.6 illustrates the effects of a cut in $G$ designed to reduce a budget deficit.

**Figure 7.6: The fiscal policy to reduce a budget deficit**




A cut in government expenditure to reduce the budget deficit $D_0$ at $Y_0$ shifts the $BB$ line up to $BB_1$. The deficit is reduced but the austerity policy lowers autonomous aggregate expenditure and equilibrium national income from $Y_0$ to $Y_1$. The net reduction in the deficit is less than the cut in $G$.

Because the observed budget balance combines autonomous ($G$) and induced ($NT$) components it is important to consider if the *observed budget balance*—whether surplus, balanced, or deficit—is a good measure of the government's policy action or fiscal stance.

Does the budget balance show whether fiscal policy is *expansionary*, aiming to raise national income, or *contractionary*, aimed at deficit control and reduction?

In itself, the budget balance may be a poor measure of the government's fiscal stance, because the budget balance can change for reasons unconnected to fiscal policy. Even if $G$ and $t$ are unaltered, a fall in investment or exports will reduce national income and output. In turn, this reduces net tax revenue and reduces the budget balance. Indeed, any change in non-government autonomous expenditure changes equilibrium income, net tax revenue, and the government's budget balance. Recent experience in Canada with oil prices and lower growth is a good illustration.

The *structural budget balance* provides a fiscal indicator that helps to solve this problem.

## The structural budget balance

The **structural budget balance** (*SBB*) is an estimate of what the budget balance would be if the economy were operating at potential output. By evaluating the budget at a fixed level of income, namely potential GDP, the structural budget balance does not change as a result of business cycle fluctuations in output. In terms of the budget function we used above, the structural balance is:

$$SBB = tY_p - G \tag{7.6}$$

**Structural budget balance (SBB)**: the government budget balance at potential output.

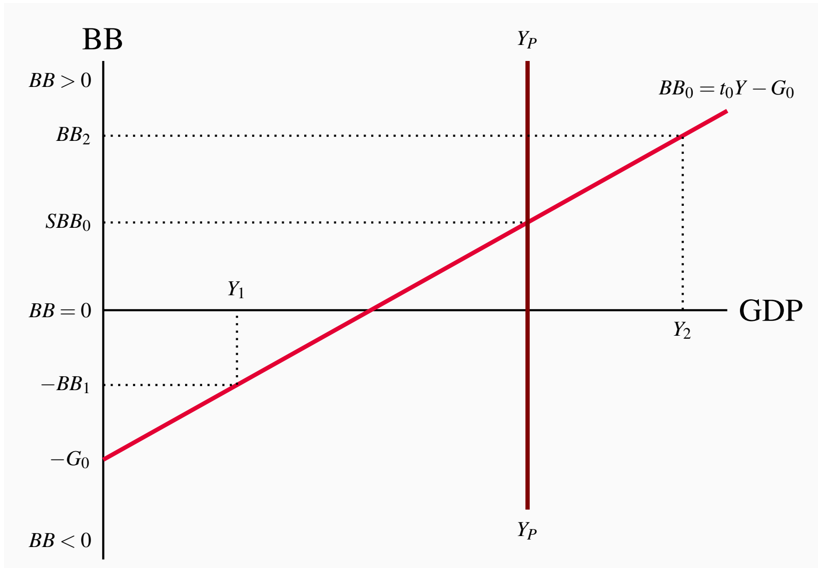
Notice that this structural budget function differs from the general budget function of Equation 7.5 by calculating net tax revenue at $Y_P$ rather than at any $Y$.

Using the previous numerical example, suppose government expenditure is 200 and the tax rate is 0.20. Holding these terms of the fiscal plan constant, as in Figure 7.4, the budget balance is a deficit at any income below 1000 and a surplus at any income above 1000. If, given other components of aggregate expenditure, the equilibrium output is 800, the actual budget balance will be a deficit. Net tax revenue will be $NT = 0.2 \times 800 = 160$. With government expenditure of $G = 200$, $BB = 160 - 200 = -40$.

Conversely, suppose higher AE makes equilibrium output 1200. With a tax rate of 0.20 and government expenditure of 200, the budget balance would be a surplus of 40. The important point of these examples is that we cannot tell the stance of fiscal policy, or a change in the stance of fiscal policy, by looking at the budget balance reported by the Department of Finance and published in the media. We need to look at a *structural budget balance*, calculated at potential output ($Y_P$) that is not changed by business fluctuations in actual output around potential output. Estimates of structural budget balances in Canada are published by the Department of Finance in *Fiscal Reference Tables*, `http://www.fin.gc.ca/frt-trf/2014/frt-trf-14-eng.asp`, Tables 17 and 46, as 'cyclically adjusted budget balances'.

Figure 7.7 illustrates the concept of the structural budget deficit as compared to the actual budget deficit. The fiscal policy program is $BB_0 = t_0Y - G_0$. If the economy were operating at potential output $Y_P$ the budget balance would be $SBB_0$, the structural balance. At any other level of income, resulting for example from cyclical changes in autonomous investment or exports, the actual budget balance would be different from the structural budget balance. A fall in autonomous expenditure that lowered equilibrium GDP to $Y_1$ would result in a budget deficit – $BB_1$ in the diagram. There has been no change in fiscal policy – just a change in the actual budget caused by a business cycle change in national income.

**Figure 7.7: Actual and structural budget balances**




Structural budget balance $SBB_0 = t_0 Y_P - G_0$. Actual budget balance $BB_1 = tY_1 - G_0$.

A change in the fiscal plan that changed the net tax rate or a change in planned government expenditure would change the budget function and the structural budget balance. There would be a different budget function line in the diagram. The slope of the line would increase with an increase in the tax rate or fall with a cut in the tax rate. A change in planned government expenditure would change the position of the line. In either case the new structural budget balance would indicate that fiscal policy had changed. The change in fiscal policy would increase or decrease aggregate expenditure.

## 7.5 Automatic and discretionary fiscal policy

### Automatic fiscal policy

**Automatic stabilizers** have a great advantage. They are built into the budget program by setting the net tax rate, and work automatically. There is no need to determine if the shift in autonomous expenditure is transitory or persistent. By reducing the sensitivity of the economy to expenditure shocks, automatic stabilizers are always at work reducing the size of output and employment fluctuations.

> **Automatic stabilizers**: tax and transfer programs that reduce the size of the multiplier and the effects of *transitory* fluctuations in autonomous expenditures on equilibrium GDP.

Income taxes and transfers, such as unemployment benefits, are important automatic stabilizers. At given net tax rates, a fall in national income, output, and employment raises payments of unemployment benefits and reduces tax collections. Both effects mean that disposable income changes by less than the change in national income. The slope of the aggregate expenditure function $(c(1-t)-m)$ is lower, and so is the multiplier. Conversely, in a boom, net tax revenues rise and disposable income rises by less than the rise in national income, which helps dampen the boom.

However, automatic stabilizers only serve to moderate the fluctuations in real GDP caused by fluctuations in autonomous expenditure. They do not offset those autonomous expenditure disturbances. There is no automatic change in autonomous government expenditure or tax rates. Those changes usually come from discretionary fiscal policy.

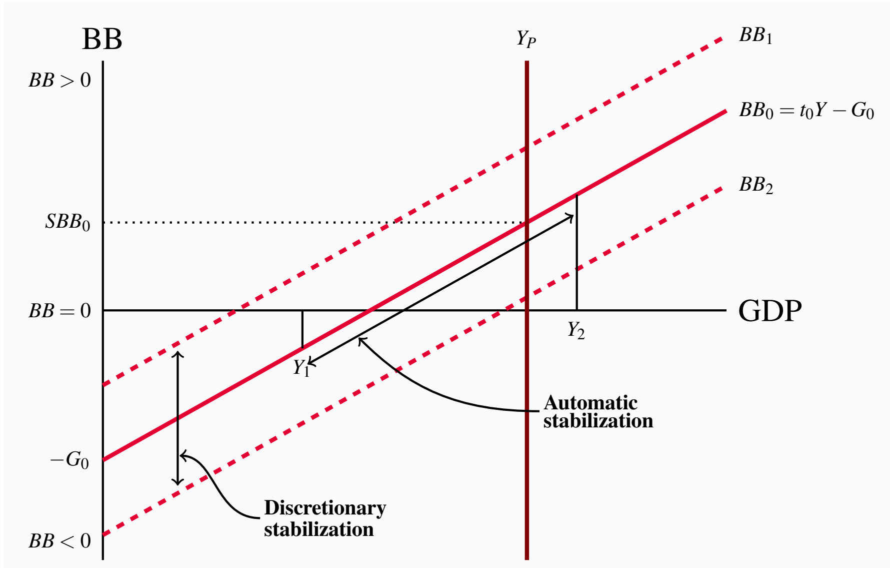
## Discretionary fiscal policy

Governments use **discretionary fiscal policies** to offset *persistent* changes in autonomous expenditures. A persistent drop in investment or exports would be offset by an increase in government spending and by cutting taxes, or both as for example the Canadian government's *Economic Action Plan* in response to the recession of 2009. Alternatively an export or investment boom might be offset by higher tax rates or reduced government expenditures.

> **Discretionary fiscal policy**: changes in net tax rates and government expenditure intended to offset *persistent* autonomous expenditure shocks and stabilize aggregate expenditure and output.

The budget function and the structural budget balance we discussed earlier provide a good illustration of automatic and discretionary fiscal policy. Figure 7.8 shows a government budget function $BB_0 = t_0Y - G_0$ and a structural budget balance $SBB_0$ at potential output $Y_P$. This budget function represents a fiscal program designed by the Minister of Finance and approved by parliament.

**Figure 7.8: Automatic and discretionary fiscal policies**




*Automatic stabilization* comes from changes in the budget balance along the $BB_0$ line as $Y$ fluctuates between $Y_1$ and $Y_2$. *Discretionary stabilization* shifts the budget function as a result of changes in government expenditure or taxes.

Discretionary fiscal policy sets both the position and slope of the budget function. A change in discretionary policy would *change the entire budget line*. Figure 7.8 illustrates discretionary policy as shifting the $BB$ line up to $BB_1$, in the case of restraint or austerity, or down to $BB_2$ to provide fiscal stimulus. Automatic stabilization is a part of all these programs. It comes from *the slope of the budget function*, the net tax rate $t_0$ in this case. Any fluctuations in private sector autonomous expenditures cause changes in income $Y$. These changes in $Y$ for example, down to $Y_1$ or up to $Y_2$, cause *movements along the budget function* and a change in the budget balance, as shown in Figure 7.8. The effect of the change in the budget balance is stabilizing. A larger net tax rate would mean larger automatic changes in the budget balance in response to changes in income and more automatic stabilization.

When we use the budget function to show fiscal policy changes, we can also consider more complex programs that change both the slope of the function and the structural balance.

It is quite easy to present fiscal policy in theory and illustrate it in diagrams but does it work in the real world? Why, if governments have fiscal tools to stabilize and offset fluctuations in aggregate expenditure and demand do we still experience business cycles, including the recession of 2009 and the prolonged recovery?

The answer has several dimensions. While automatic stabilizers moderate the severity of fluctuations in autonomous expenditures they do not offset those fluctuations. That calls for discretionary fiscal policy, namely a change in the budget plan involving changes in autonomous government expenditures and net tax rates. The process is partly economic and partly political and can take time.

The timelines involved are frequently defined in terms of recognition lags, decision lags, implementation lags and impact lags. It takes time to recognize a *persistent* shift in aggregate expenditure and identify its source. This involves the availability of economic data and economic analysis to establish the size and source of shift in economic conditions. That in turn provides the basis for the design of the new budget program required. The implementation of the new budget is a political process. It may involve substantial time and changes to the budget before it passes. Once the budget passes and new expenditure plans and tax rate are in effect it takes time for them to work through the economy and have their full impact on aggregate expenditure and national income. As a result, economic fluctuations are well underway before discretionary fiscal policies can shift to offset them. Discretionary policies may still provide stabilization but they do not completely eliminate business cycle fluctuations.

## 7.6 The public debt and the budget balance

Budget balances and outstanding debt are closely related. A student's debt at the time of graduation is the sum of her budget balances during years of study. In any year in which her income is less than her expenses, she finances the difference by borrowing. In another year, if income is greater than expenses, she can repay some previous borrowing. In the end, the sum of borrowings minus the sum of repayments is her outstanding student debt (loan). This debt is a result of borrowing to finance investment in education.

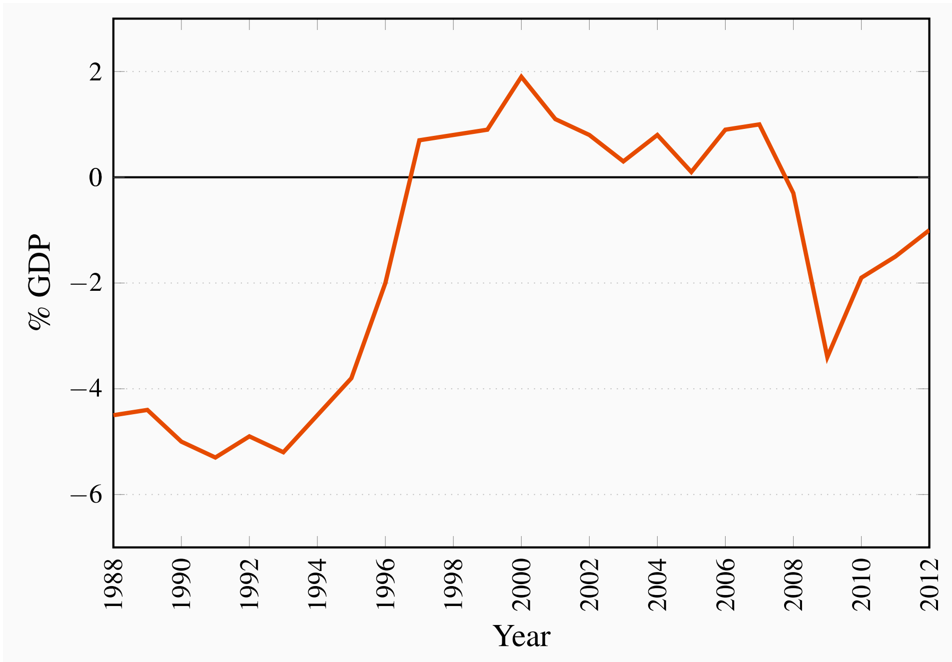
Similarly, the outstanding **public debt (*PD*)** at any point in time is simply the sum of past government budget balances. Governments borrow to finance budget deficits by selling government bonds to households and businesses. Budget surpluses reduce the government's financing requirements. Some bonds previously issued mature without being refinanced. In simple terms, the budget balance in any year changes the outstanding public debt by an equal amount but with the opposite sign. A positive balance, a surplus ($BB > 0$), reduces the public debt ($\Delta PD < 0$). A negative balance, a deficit ($BB < 0$), increases the public debt ($\Delta PD > 0$). Using $PD$ to represent the outstanding public debt, we can express the link between the public debt and the government's budget balance as:

$$\Delta PD = -BB \tag{7.7}$$

> **Public debt (*PD*)**: the outstanding stock of government bonds issued to finance government budget deficits.

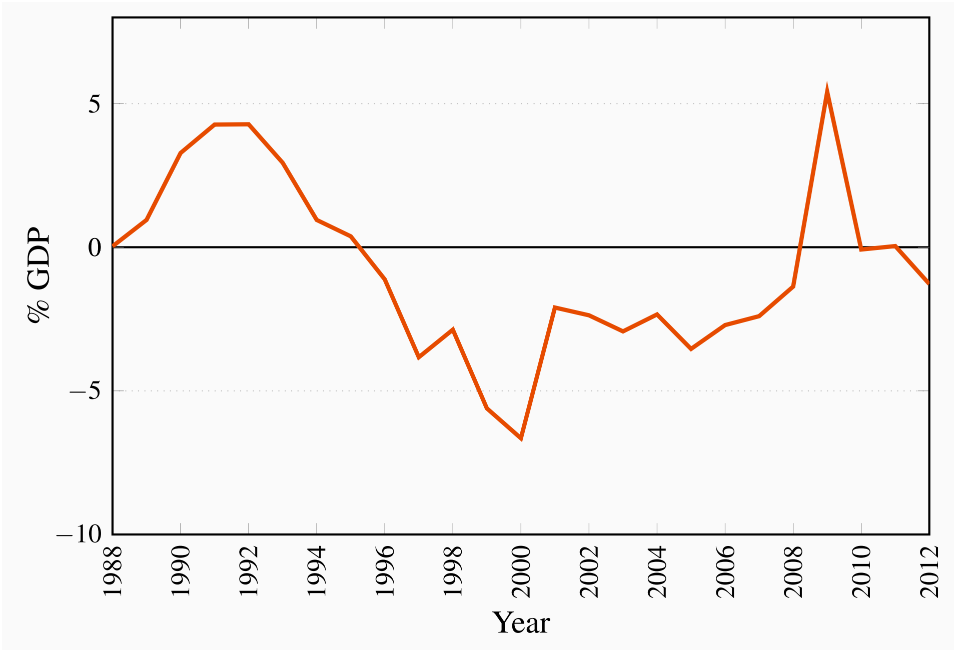
Figures 7.9 and 7.10 show the relationship between the government budget balance and the change in the public debt relative to GDP based on Canadian data for the 1988-2012 period. Recognizing that growth in the economy makes absolute numbers for deficits and debt hard to evaluate, the budget balance and the change public debt are presented as percentages of nominal GDP. The effects of budget balances on the public debt are illustrated clearly in the diagrams.

**Figure 7.9: Canadian federal government BB % GDP**




*Source*: Department of Finance, Fiscal Reference Tables 2013.

**Figure 7.10: Change in federal government public debt ratio**




*Source*: Department of Finance, Fiscal Reference Tables 2013. Bank of Canada, Banking and Financial Statistics Feb 2014 and author's calculations.

In the years from 1995 to 2007 the Government of Canada had budget surpluses. Things were different in the years before 1995. Large budget deficits, averaging more than 5 percent of GDP, were the norm in the late 1980s and early 1990s. As a result, the outstanding federal government public debt increased, and increased faster than GDP, pushing the ratio of public debt to GDP up from 38 percent of GDP in 1983 to 68 percent of GDP in 1996. The cost of the interest payments the government had to make to the holders of its bonds increased from $3.9 billion to $42.4 billion. These costs accounted for almost 30 percent of budgetary expenses in 1995.

As a result, Canadian fiscal and budgetary policy shifted in 1995 to focus much more on deficit and debt control than on income stabilization. As Figure 7.9 shows, the federal budget was in surplus from 1997 until 2007. This reduced the debt to GDP ratio each year until 2008 as in Figure 7.10.

The financial crisis and recession of 2008-2009 and the federal government's *Economic Action Plan* changed this focus and pattern of fiscal policy. Fiscal stimulus through increased government expenditures and modest tax credits together with the recession in income created budget deficits in 2008-2013. These deficits added directly to the federal government debt. Larger debt combined with little or no growth in nominal GDP in 2009 and 2010 caused a sharp increase in the debt ratio shown in Figure 7.10. The focus of Federal Budget plans for recent years, as the recovery from recession seems to be underway, has shifted back to budget deficit control and reduction and a return to lower public debt ratios.

Although cumulative deficits can raise the public debt dramatically, it is not the absolute value of the outstanding debt that should be of interest or concern. If, at the same time as the debt is rising, the economy is growing and tax revenues are rising as a result of a growing tax base, the government may be able to service a growing debt without having to raise taxes. The **public debt ratio ($PD/Y$)** is then the appropriate measure of the debt situation. A rise in the outstanding debt is not in itself a source of concern. However, the government cannot allow the debt ratio to rise without limit.

> **Public debt ratio ($PD/Y$)**: the ratio of outstanding government debt to GDP.

Recent sovereign debt crises in Portugal, Ireland, Greece and Spain provide clear examples of the difficulties high and rising public debt ratios cause. In those countries and others in Europe, and in the US, the government costs of rescuing banks in financial distress after 2008 combined in many cases with already large budget deficits, compounded by the recession in economic growth raised public debt ratios sharply. Table 7.2 shows the early stages of these increases in public debt ratios from 2007 to 2013. The consequence was a loss of financial market confidence in the ability of some of these countries to pay interest on and subsequently retire outstanding government bonds, let alone service new bond issues to finance current deficits. Interest rates for new bond issues increased sharply and Greece and Ireland needed financial bailouts from joint EU rescue funds. This has provided time for fiscal adjustment but the economic growth required to solve sovereign debt issues remains elusive.

We will return to the relationship between fiscal policy and the public debt and examine the dynamics of the public debt ratio in Chapter 11.

This completes our introduction to the government budget, fiscal policy, aggregate expenditure, and the economy. It recognizes the importance of another set of linkages and feedback effects within the macro economy. We have seen two ways in which the government sector affects aggregate expenditure and output. Government expenditure is a part of autonomous aggregate expenditure. It affects the position of the AE function, equilibrium output, and the aggregate demand curve. The net tax rate diverts income from the household sector to government revenue and reduces induced expenditures. It changes the slope of the AE function, the size of the multiplier. Together the change in autonomous government expenditure and the effect of the net tax rate on induced expenditure change equilibrium income, and the AD curve. The size and direction of the change depends on the government's actual budget balance.

At the same time, conditions in the economy have significant effects on the government's budget. Recessions cause induced budget deficits and booms generate budget surpluses, both of which complicate the evaluation of the government's policy stance. Furthermore feedback effects within the government budget provide revenue support for fiscal expansion and revenue resistance to fiscal restraint or austerity. These effects mean government budget cannot be judged in the same way a private or household budget might be.

## 7.7 Aggregate demand & equilibrium output

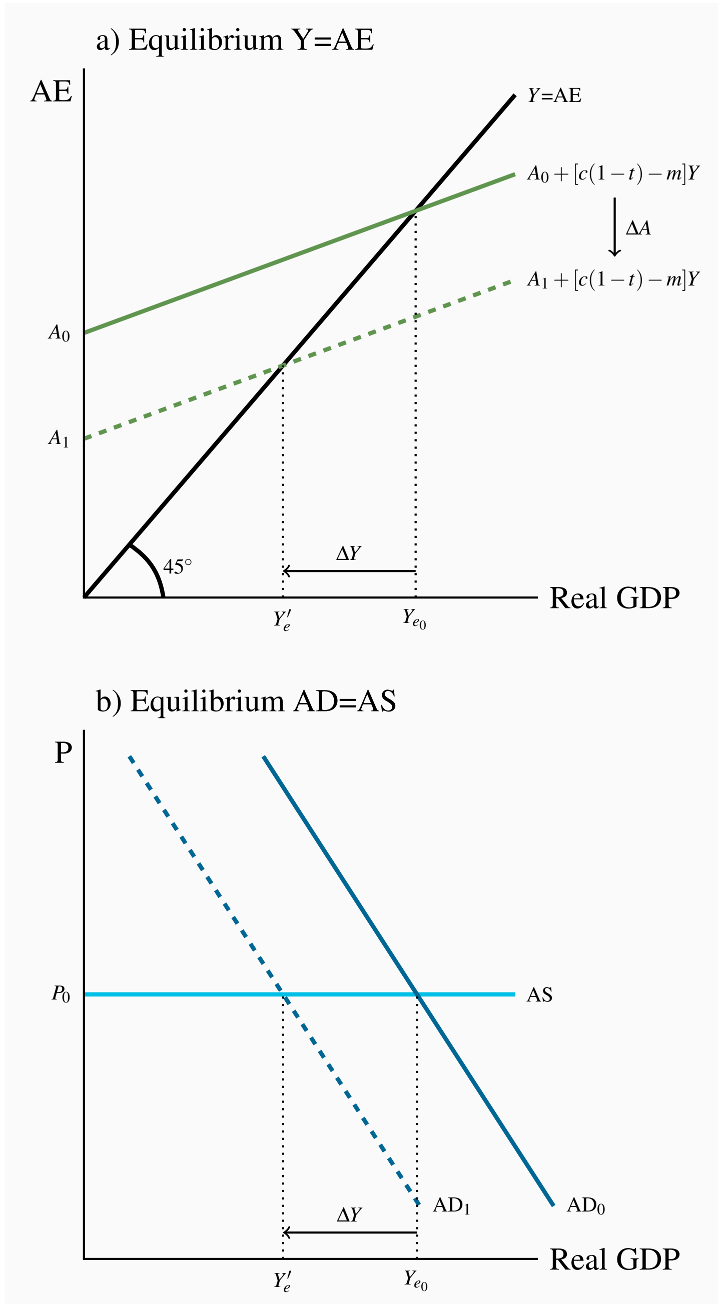
Our objective in this chapter was to extend the model of Chapter 6 to include a government sector and fiscal policy in aggregate demand. To do this we continued to assume that *wages, prices, money supply, interest rates, and foreign exchange rates are constant*. We also continued to make the important distinction between *autonomous* expenditure and *induced* expenditure, which leads to the existence of a multiplier. The equilibrium condition is still $Y$ =AE and AD=AS, output and income equal to planned expenditure. Even though the model is more complex, it still shows us that fluctuations in autonomous expenditures, working through the multiplier, cause fluctuations in Aggregate Demand, output, income, and employment.

Changes in autonomous expenditures are still the sources of business cycles. If business changes planned investment expenditure in response to changed expectations about future markets, or if changes in economic conditions in other countries change exports or imports, the multiplier translates these changes into larger changes or fluctuations in income and employment. Government expenditure plans and net tax rates are fiscal policy tools that could be used to moderate or offset these fluctuations through a combination of automatic and discretionary fiscal policy.

Figure 7.11 shows the relationship between equilibrium income and output, and the link between changes in aggregate expenditure, aggregate demand, and equilibrium income. In the upper diagram a fall in autonomous expenditure from $A_0$ to $A_1$ reduces AE and equilibrium $Y$ from $Y_{e_0}$ to $Y_e^{'}$, which is the fall in $A$ times the multiplier.

The fall in autonomous expenditure and equilibrium is a leftward shift in the AD curve in the lower diagram. The size of that shift in AD is the change in equilibrium income in the upper diagram, namely the fall in $A$ times the multiplier. Because the price level is constant, giving a horizontal AS curve at $P_0$, the fall in equilibrium determined by AD/AS is the same as the horizontal shift in AD.

**Figure 7.11: AE, AD and equilibrium output**



**Example Box 7.1: The effect of the government sector on equilibrium income**

**a) Equilibrium with no Government**

| | | | |
|---|---|---|---|
| Autonomous expenditure | $= A_0$ | Autonomous expenditure | $= 80$ |
| Induced expenditure | $= (c-m)Y$ | Induced expenditure | $= (0.8-0.2)Y = 0.6Y$ |
| Aggregate expenditure | $= A_0 + (c-m)Y$ | Aggregate expenditure | $= 80 + 0.6Y$ |
| Equilibrium income: | $Y = \text{AE}$ | Equilibrium income: | $Y = \text{AE}$ |
| | $Y = A_0 + (c-m)Y$ | | $Y = 80 + 0.6Y$ |
| | $Y[1-(c-m)] = A_0$ | | $Y[1-0.6] = 80$ |
| | $Y = A_0/[1-c+m]$ | | $Y = 80 \times 1/[1-0.6] = 80 \times 2.5$ |
| | | | $Y = 200$ |

**b) Equilibrium with added government sector:** $G = 25$, $NT = 0.10Y$

| | | | |
|---|---|---|---|
| Autonomous expenditure | $= A_0 + G_0$ | Autonomous expenditure | $= 105$ |
| Induced expenditure | $= c(1-t) - m$ | Induced expenditure | $= [0.8(1-0.1) - 0.2]Y = 0.52Y$ |
| Aggregate expenditure | $= A_0 + G_0 + [c(1-t)-m]Y$ | Aggregate expenditure | $= 105 + 0.52Y$ |
| Equilibrium income: | $Y = \text{AE}$ | Equilibrium income: | $Y = \text{AE}$ |
| | $Y = A_0 + G_0 + [c(1-t)-m]Y$ | | $Y = 105 + 0.52Y$ |
| | $Y[1-[c(1-t)-m]] = A_0 + G_0$ | | $Y(1-0.52) = 105$ |
| | $Y = [A_0 + G_0]/[1-[c(1-t)-m]]$ | | $Y = 105/(1-0.52) = 105 \times 2.08$ |
| | | | $Y = 218.4$ |

In this example adding government expenditure $G = 25$ financed in part by a net tax rate $t = 0.10$ raised autonomous expenditure by 25 but lowered the multiplier from 2.5 to 2.08 with the result that equilibrium income increased by 18.4. Equilibrium income increased because the government sector ran a budget deficit. $G$ was 25 but net tax revenue was only $0.10 \times 218.4 = 21.84$.

# KEY CONCEPTS

**Canadian governments** directly buy about 25 percent of GDP according to the national accounts data. They also spend about 17 percent on transfer payments to persons and business, including interest payments to holders of government bonds.

**Government expenditure** $G$ on goods and services, including the public services provided to households and business is a policy variable and an autonomous component of aggregate expenditure.

**Net taxes** $(NT = tY)$, the revenue collected by government from households, are difference between taxes collected and transfers paid.

**Disposable income** is national income minus net taxes. Changes in disposable income cause changes in household consumption expenditure based on the $MPC$.

The **net tax rate** $(t)$ reduces changes in disposable income relative to national income and reduces the marginal propensity to consume out of national income to $c(1-t)$. This lowers the slope of AE and the size of the multiplier.

**Government expenditure and net taxes** affect equilibrium national income by changing both autonomous expenditure and the multiplier.

The **government budget** describes what goods and services the government plans to buy during the coming year, what transfer payments it will make, and how it will pay for them. Most spending is financed by taxes, but some revenue comes from charges for services.

The **government budget balance** is the difference between net revenues and government expenditures. Because net tax revenues depend on national income $(NT = tY)$ the **actual budget balance** is determined by the government's budget plan and the level of national income. The actual budget balance will change with changes in national income.

A **balanced budget** has revenues equal to expenditures.

A **budget surplus** means revenues are greater than expenditures.

A **budget deficit** means revenues are less than expenditures.

**Fiscal policy** is the government's use of its taxing and spending powers to affect aggregate demand and equilibrium GDP.

The **structural budget balance** $(SBB)$ is an estimate of what the budget balance would be if the economy were operating at potential output. *Changes in the structural budget balance* are indicators of changes in fiscal policy because they measure changes in expenditure and tax programs at a standardized income level.

The government's tax and transfer programs are **automatic (fiscal) stabilizers** that reduce the size of the multiplier and the effects of *transitory* fluctuations in autonomous expenditures on equilibrium GDP.

**Discretionary fiscal policies** are changes in net tax rates and government's expenditure intended to offset *persistent* autonomous expenditure shocks and stabilize aggregate demand and equilibrium output at potential output.

**Public debt** $(PD)$ is the outstanding stock of government bonds issued to finance past government budget deficits minus the retirement of government bonds in times of past government budget surpluses. The annual change in the public debt is $\Delta PB = -BB$.

**Public debt ratio** $(PD/Y)$ is the ratio of outstanding government debt to GDP, $PD/Y$.

Recent **sovereign debt crises** in Portugal, Ireland, Greece and Spain provide clear examples of the difficulties high and rising public debt ratios cause.

The **government sector and fiscal policy** are important determinates of aggregate demand and equilibrium GDP. Government expenditures are an autonomous policy variable. Net tax rates and policy affect the size of the multiplier. Changes in government expenditure and tax programs through the setting of the government's budget affect AE, AD and equilibrium GDP.

## Exercises for Chapter 7

**Exercise 7.1** Suppose a government is established in a country where none previously existed. The government spends 100, financed by borrowing, to provide public services. If autonomous expenditure before government is set up is 200 and induced expenditure is $0.6Y$ (based on $mpc = 0.75$ and $mpm = 0.15$) what is the equilibrium value of real GDP before the government is established and what would equilibrium GDP be after government is established?

**Exercise 7.2** If the government expenditure in Exercise 7.1 were financed by imposing a net tax rate on income of $t = 0.10$:

(a) Calculate and compare the slopes of the AE functions in Exercises 7.1 and 7.2.

(b) Calculate and compare the multipliers in Exercises 7.1 and 7.2.

(c) What is the equilibrium real GDP in Exercise 7.2 compared to Exercise 7.1?

**Exercise 7.3** If government expenditure is 100 and the net tax rate is $t = 0.20$:

(a) Complete the following table:

| $Y$ | $NT = tY$ | $G$ | $BB = NT - G$ |
|---|---|---|---|
| 100 | | | |
| 200 | | | |
| 300 | | | |
| 400 | | | |
| 500 | | | |
| 600 | | | |
| 700 | | | |

(b) In a diagram with national income $Y$ on the horizontal axis and government revenue and expenditure on the vertical axis, draw the government expenditure and net tax functions. Explain the intercept on the vertical axis, and the slope you have given to the $NT$ and $G$ functions in your diagram.

(c) Suppose the government cuts the tax rate to $t = 0.15$. Show the effects in your diagram.

**Exercise 7.4** Using diagrams illustrate an initial equilibrium national income, the effect of the increase in government expenditure on that equilibrium national income, and the government's budget functions and balances before and after the increase in government expenditure.

**Exercise 7.5** Suppose the government raises its revenue by a net tax of 25 percent on income, $t = 0.25$. Further suppose that induced expenditure is $0.45Y$ (based on $c = 0.8$, $t = 0.25$ and $m = 0.15$).

(a) What is the slope of the AE function? What is the size of the multiplier?

(b) Autonomous expenditure by the non-government sectors $(A_0)$ is 300 and government expenditure is 400. What is the equilibrium income and output? What is the government's budget balance?

(c) Now assume the government increases its expenditures by 100 to provide additional funding for national defense. What is the effect on equilibrium income and output? What is the effect on the government's budget balance?

**Exercise 7.6** An economy is in equilibrium at a real GDP of 750, but current estimates put potential output at $Y_P = 850$.

(a) Is there an inflationary or a recessionary gap, and, if there is either, what is its size?

(b) Research suggests that induced expenditure is $0.5Y$ (based on $c = 0.75$, $m = 0.10$, and $t = 0.20$). If there is a gap, what change in government expenditure would eliminate the gap?

(c) If the government preferred to change its net tax rate to eliminate the gap, and not change government expenditure, what new tax rate would be required to eliminate the gap?

**Exercise 7.7**

(a) Draw a diagram that shows the government's budget balance relative to national income. Explain briefly the vertical intercept of the budget function and its slope.

(b) Using your diagram from (a), show the structural budget balance and a situation in which the actual balance is different from the structural balance.

(c) Based on this diagram, show and explain the difference between the budget effects of automatic stabilization and discretionary fiscal policy.

**Exercise 7.8** Suppose as in Exercise 7.5 the government raises its revenue by a net tax of 25 percent on income, $t = 0.25$. Further suppose that induced expenditure is $0.45Y$ (based on $c = 0.8$, $t = 0.25$ and $m = 0.15$), autonomous private expenditure is 300 and government expenditure is 400.

(a) What is the government's budget balance?

(b) If the government has outstanding public debt equal to 500 what is the public debt to GDP ratio?

(c) Suppose the government increases its expenditure by 100 without any increase in the tax rate. What are the new equilibrium GDP and the new budget balance? Explain why the change in the government's budget balance is different than the change in government expenditure.

(d) What is the outstanding public debt and the public debt ratio in the new equilibrium, assuming the economy has reached its new equilibrium national income in one year?

# Part Three
## Financial Markets & Economic Activity



Three chapters in this part examine the financial sector of the economy and the important role it has in the determination of output and employment. They cover money, banks and banking, financial markets, asset prices and foreign exchange rates. When integrated, these parts of the economy provide the 'monetary transmission mechanism' and a framework for the design and implementation of central bank monetary policy. Moreover, the financial sector is the key to price level and inflation rate elasticities in the aggregate demand functions derived in later chapters.

# Chapter 8

## Money, banking & money supply

**In this chapter we will explore:**



Banks are the front line of the financial system. Bank deposits are a form in which people hold their wealth and they are also the main means of payment, making them the main component of the money supply in the economy. Furthermore banks are the major sources of credit for households and businesses, either directly through bank loans or indirectly through the credit card systems they own.

The financial sector provides the important link between and aggregate expenditure and aggregate demand. *It is the key to understanding the slope and position of the AD curve*. It also creates the framework for central bank *monetary policy*.

## 8.1 Money and the functions of money

You can see the variety of things that have been used as money in Canada in James Powell's *A History of the Canadian Dollar*, available at the Bank of Canada's website: `http://goo.gl/BnIgpK`.

Our money in the seventeenth and eighteenth centuries was silver and gold coins from many countries, and playing cards. The British pound sterling, the Spanish silver dollar, and the US dollar were the main moneys in Canada in the nineteenth century, followed by paper currencies issued by banks and by the government since the late nineteenth century.

It is not the commodity or token used as money that matters, but the social convention that it is accepted without question as a means of payment. Money makes it easier for everyone to buy and sell goods and services and economize on the use of scarce resources.

Money is defined by four important functions. It provides:

1. A means of payment as a medium of exchange

2. A unit of account
3. A store of value
4. A standard of deferred payments

As a **means of payment** money is involved in most exchanges. We use money to pay for the goods and services – from food and clothing to transportation, to rent, to fees and taxes. People receive wages and salaries and other types of income in money. Money is not consumed in these transactions. It is used as a medium of exchange.

> **Means of payment**: a commodity or token generally accepted in payment for goods and services or the repayment of debt.

Exchange transactions without money are **barter exchanges**, a direct exchange of one good for another. These exchanges depend on a *double coincidence of wants*. Each party to the exchange has a good the other party wants and is willing to trade one good for another. This means exchange transactions are expensive as people must find others who have what they want and want what they have. Using a money as a medium of exchange dramatically lowers the cost and increases the ease and efficiency of trade.

> **Barter exchanges**: direct exchanges of goods or services for goods or services without the use of money.

Money also serves as a **unit of account**. Prices in Canada are quoted in Canadian dollars. Similarly in other countries prices are quoted in domestic currency. In much of Europe prices are in euros, in the United States in US dollars and in Japan in yen. This reflects the convenience of using the same units for the means of payment and the unit of account. However, there are exceptions. Historically, in Canada, during the time of the fur trade, books were kept in "currency" but actual currency never changed hands in the barter of trade goods for furs.

> **Unit of account**: the standard in which prices are quoted and accounts are kept.

To serve as a medium of exchange, money *must also be* a **store of value**. Money works as a time machine allowing people to separate the timing of their expenditures from the timing of their incomes. Money is accepted today with confidence that it can be used some time in the future to make payments when buying goods and services. You would not accept money today that you thought would be unacceptable when you offered it in payment at some later date.

> **Store of value**: an asset that carries purchasing power forward in time for future purchases.

Money is not a unique store of value. Other assets including real estate, financial assets like corporate and government bonds, fine art and antiques all serve as stores of value. These may be better ways to store value, but people still choose to hold some of their wealth as money. This choice to hold money balances is very important to the effects money balances have on financial markets and aggregate expenditure. Chapter 9 examines it in detail.

Money provides a **standard for deferred payments**. If you take out a student loan the amounts you will repay in the future are measured in dollars. Similarly, servicing and retiring a mortgage on a property or a loan on a car calls for future payments specified in dollars. Domestic money is not essential for this function. Individuals, businesses and governments often borrow or lend in the money of other countries. In those cases the currency in which the loan transaction takes place is usually the standard for payments to settle the debt. The essential attribute of money is its general acceptance as a means of payment. For this money must also be a store of value. This works well when money is also a unit of account and a standard of deferred payments.

> **Standard of deferred payments**: the units in which future financial obligations are measured.

## The development of money

The money we use today is the product of a long and continuing evolution in the financial services industry. It is a testament to the ingenuity of people and society seeking to reduce the costs and increase the volume of trade in goods and services.

Historically, there were no banks. Money was a commodity. Gold and silver bullion are two commodities that came to be used extensively because of their relative scarcity and durability. Concerns about the purity of these metals and the inconvenience of weighing out small quantities to make payments led to coinage. The minting of gold and silver coins by heads of state offered a solution to these problems. The 'monarch' certified the purity and quantity of the metal in the coin by having his or her likeness stamped into the metal.

Unfortunately, coinage did not completely solve the concerns about the quantity and quality of gold and silver money. The quantity of gold in a coin could be reduced by clipping its edges, or by rubbing the surfaces of the coin to wear some of the metal away. "Sweating" coins by placing them in a leather bag and shaking them was one technique used to remove some of their precious metal. The edge designs, millings, or facets that we still see on coins today were introduced to combat clipping, and wear on the heads and tails stamped into coins provided evidence of sweating. Coins that were worn or clipped were not accepted at full value in exchange for goods and services.

A second difficulty with precious metal coinage came from the sovereign who controlled the minting process. Adding a little base metal to the gold or silver being minted resulted in coins with less precious metal content than their face value certified. A little of the precious metal was withheld and could be used to mint more coin, which was, in effect, free money for the sovereign. This "debasing" of the coinage was a serious problem at times and, like clipping and sweating, reduced the acceptability of precious metal coinage as money.

The emergence of banks and paper money was a response to the problems with gold and silver commodity money. The first banks were goldsmiths who used gold in the production of jewelry and ornaments. They were accustomed to buying and selling gold bullion, and holding stocks of gold bullion. It was a natural extension of their business to offer to hold gold for safekeeping. Those who stored their gold with goldsmiths were given paper claims or receipts (IOUs), which were convertible back into gold on demand.

When people began to use gold receipts to make payments, gold receipts became a means of payment. They were **token money**, representing a fixed amount of the precious metal.

> **Token money**: convertible claims on commodity money.

Goldsmiths became bankers when they realized that not all their customers would show up at the same time and want their gold back. The convertibility of gold receipts made them acceptable as a medium of exchange. Gold merchants could make loans by issuing more gold receipts than they had gold in their storage vaults. They only needed gold holdings equal to a fraction of the gold receipts they had issued, as long as people used the receipts as a medium of exchange.

Banks as we know them grew out of this acceptance by society of credit (IOU) money as a medium of exchange. Banks began to accept customer deposits of token money and to issue their own bank notes (credits) as receipts. People liked the convenience and safety of storing some of their wealth with banks. As society became more comfortable with banks and confident in the safety of banks, bank deposits, which could be transferred by cheque, became widely accepted as the medium of exchange. Bank notes and deposits were no longer convertible into gold or commodity money, but they were convertible into **legal tender**. Governments established central banks to control the supply of legal tender, bank notes, or cash. Bank notes now serve as both a medium of exchange and as the **reserves** banks hold to ensure the convertibility of their customers' deposits.

> **Legal tender**: money that by law must be accepted as a means of payment.
>
> **Bank reserves**: cash (legal tender) held by banks to meet possible withdrawals by depositors.

Unlike other financial institutions, such as pension funds and insurance companies, the key aspect of banks is that some of their liabilities are used as the medium of exchange; cheques and debit cards allow their deposits to be used as money to make payments. Bank deposits are credit money.

In Canada today, as in most industrial countries, we use a combination of **fiat money** and **credit money**. Fiat money, in contrast to commodity or token money is money that the government has declared to be legal tender. Coins and paper bank notes are fiat money in Canada. If you look carefully at a $5, $10, or $20 Bank of Canada bill you will find the statement: "This note is legal tender." By law it must be accepted as a means of payment for goods and services bought or debts repaid.

> **Fiat money**: money the government has declared as legal tender.

**Credit money**: the debt of a private business or individual.

Our fiat money is supplemented by credit money. A bank deposit is credit money, and is redeemable in fiat money on demand, or in the case of some savings and time deposits, after a short waiting period. Furthermore, the bank is obliged to pay when your cheque is presented, or when you use your debit card. Bank deposits are a medium of exchange because they are generally accepted as a means of payment, even though they are not legal tender. The sum of bank deposits and fiat money in circulation outside the banks at any time is the stock of medium of exchange and the economy's **money supply**.

**Money supply**: the means of payment in the economy, namely currency (notes and coin) in circulation outside the banks and bank deposits.

## 8.2 Measures of the Canadian money supply

The **money supply** is traditionally defined as cash in circulation outside the banks, plus bank deposits. But as the banking and financial system evolved so did the types of deposits issued to the non-bank public. Now there are questions about the measurement of money supply.

**Money supply**: notes and coin in circulation outside banks plus bank deposits.

In the early days of banking there were demand deposits on which cheques could be written and savings deposits which often required a period of notice before funds could be withdrawn. Today banks offer a much wider spectrum of deposits to customers from demand to savings deposits that may or may not be chequable, pay interest under different terms, and some which can only be accessed online. Not all deposits serve as means of payment. For these the balance must be transferred to another account before it is available to make a payment. Which deposits should be counted in the money supply?

The structural evolution of the financial system raises further questions. What is a 'bank'? Today banks compete vigorously for deposits with other businesses, including trust companies and credit unions whose deposits are widely accepted as means of payment. There is no longer a reason to exclude those deposits from measures of the money supply. Different measures of the money supply illustrate the importance of different financial institutions in the industry.

The Bank of Canada now publishes data on the **monetary base** in response to continuing changes in the types of bank deposits available to households and businesses. Advances in technology, financial deregulation, and competition in the financial services sector, which have led to more types of financial assets, make it easy for customers to substitute between those assets we include in narrow definitions of money supply and other assets. But once we leave the monetary base as a measure of money supply, there is no single measure of money that is clearly the means of payment. There is, however, only one type of money that is legal tender; namely, notes and coin.

**Monetary base**: legal tender comprising notes and coins in circulation plus the cash held by the banks.

Table 8.1 shows the size of the money supply in Canada based on different definitions and money aggregates. These data illustrate the range of choice involved in the selection of a specific measure of the money supply. But one thing is clear: Bank deposits are the major component of money supply by any measure other than the currency component of the monetary base.

**Table 8.1: The money supply in Canada in February 2014 (billions $)**

| | |
|---|---|
| Monetary base (MB) | 70.6 |
| Currency in circulation (CR) | 65.7 |
| M1B=currency+chequable chartered bank deposits | 640.6 |
| M2 = M1B + notice and savings deposits in the banks | 1,249.0 |
| M2+ = M2 + deposits at other financial institutions | 1,611.5 |

*Source:* Statistics Canada, CANSIM Table 176-0025. Revised 26/10/2014.

Currency in circulation is only about 5 percent of M2. Deposits account for the remaining 95 percent. The importance of bank deposits as money means that understanding the operations of banks as sources of loans and deposits is the key to understanding the money supply function in the economy.

## 8.3 Banking in Canada today

In Canada today, and in other industrial countries, the banking system is made up of a *central bank* and a number of *commercial banks* and other deposit-taking institutions called *near banks*. Table 8.2 illustrates the structure of the banking industry in Canada. The industry is defined broadly to include deposit-taking institutions, not just those that operate under the federal Bank Act.

**Table 8.2: The Canadian banking system in 2012**

| Banking Institution | Number |
|---|---|
| Central bank: | |
| The Bank of Canada | 1 |
| Number of Chartered Banks: | |
| Schedule I domestic banks | 23 |
| Schedule II foreign banks subsidiaries | 26 |
| Schedule III foreign bank branches | 23 |
| **Total** | **72** |

*Source:* Canadian Bankers' Association. http://goo.gl/sQYV4z

Banks are **financial intermediaries**. They borrow money from the public, crediting them with a deposit. The deposit is a liability of the bank. It is money owed to depositors. The money raised from depositors provides the funds to support the bank loans made to businesses, households, and governments.

> **Financial intermediary**: a business that specializes in bringing borrowers and lenders together.

Banks are not the only financial intermediaries. Trust companies, credit unions, caisses populaires, insurance companies, securities dealers, mutual fund companies, and independent financial advisors all play a role in this industry. But banks hold more than 70 percent of the assets in the financial services sector, and the six largest Canadian banks account for over 90 percent of the assets of the banking industry. Trust companies, credit unions, and caisses populaires also accept deposits that are used as money, but those deposits are a small fraction of the total of deposit money. As a result, bank deposits are the focus of our discussion of money in Canada.

The **Bank of Canada** is Canada's central bank. It is the source of the bank notes used to make payments and held as cash reserves by commercial banks. Established by the government in 1935, it has the responsibility to regulate the national money supply and support the operation of financial markets. The Bank's power to meet these responsibilities comes from its monopoly on the issuance of bank notes.

> **Bank of Canada**: Canada's central bank.

The Bank of Canada also is the provider of:

- Banking services for the commercial banks in the system
- Banking services for the federal government

- Lender-of-last-resort facilities in times of liquidity crises and reserve shortfalls

Commercial banks hold some of their reserves as deposits in the Bank of Canada, and make payments among themselves using their Bank of Canada deposits. These interbank payments arise from wire transfers, direct deposits, pre-authorized debits, bill payments, point-of-sale debits, and online payments made by bank customers. For example, cheques written by customers at one bank, say *Scotiabank*, but paid to and deposited by customers of the *Royal Bank* result in transfers of deposits between these banks. To settle these transfers, *Scotiabank* must pay the Royal Bank. Funds held by *Scotiabank* on deposit in the Bank of Canada are used for this purpose. They are called "settlement balances." In 2014, the *Canadian Payments Association*, which coordinates this clearing of interbank transactions, handled more than 6.7 billion transactions including 715 million cheques and 3.8 billion point-of-sale debits.

The government holds some deposits in the Bank of Canada. Government receipts, like income taxes paid to the Receiver General, are deposited in government accounts in the Bank of Canada. Government payments like Old Age Security, Employment Insurance benefits, bond interest, and income tax refunds are paid with government cheques or transfers drawn on its Bank of Canada account. Government funds over and above those needed to make regular payments are held on deposit in the commercial banks, and earn interest income for the government.

The key difference between a central bank and the commercial banks in the banking system is the profit motive. Central banks *do not* pursue profits. Their operations focus on the management of the cash reserves available to the public and the banks. The supply of cash reserves affects the behaviour of other banks and financial markets more generally. This is the monetary policy role of the central bank. We will examine it in detail in Chapter 10.

Commercial banks, on the other hand, are profit-oriented businesses. They operate, as we will see shortly, to maximize the profit they earn for their owners. To this end, they offer banking services to the public. Using the notes and deposits issued by the Bank of Canada as reserves, they issue bank deposits to their customers—which are widely used as the medium of exchange—and they make loans to finance purchases made by businesses and households.

To illustrate the business of these banks, Table 8.3 shows the consolidated balance sheet of Canadian chartered banks in November 2013. In the table we see that the banks held small cash balances as reserves against their deposit liabilities. Their other Canadian assets were mainly loans to households and businesses, including mortgage loans, and their holdings of financial securities. Because cash and many of their financial securities have high **liquidity**, banks can make long-term loans and still have cash and funds available if depositors withdraw their money.

> **Liquidity**: the cost, speed, and certainty with which asset values can be converted into cash.

**Table 8.3: Balance sheet of Canadian chartered banks, November 2013**

| **Assets** | **billions $** | **Liabilities** | **billions $** |
|---|---|---|---|
| Canadian dollars: | | Canadian dollars: | |
| Cash | 26.7 | Personal deposits | 791.9 |
| Government of Canada securities | 227.7 | Non-personal deposits | 662.4 |
| Corporate securities | 232.0 | Government deposits | 10.3 |
| Personal and business loans | 815.5 | Advances from Bank of Canada | 1.0 |
| Mortgages | 954.0 | Other liabilities | 542.0 |
| Foreign currency assets | 1717.9 | Foreign currency liabilities | 1773.0 |
| **Total assets** | 4006.3 | **Total liabilities and shareholders' equity** | 4006.3 |

*Source:* Bank of Canada, Banking and Financial Statistics, February 2014, Tables C3 and C4 and author's calculations. Figures have been rounded to one decimal place.

However, many loans to businesses and households are quite *illiquid*. The bank cannot easily get its money back in a hurry. This is not really a cause for concern when people and businesses have confidence in the banks and make widespread use of bank deposits as money. Payments and receipts are both in bank deposit form, which are cleared quickly and efficiently through the cheque-clearing and transfer facilities. Banks need only small cash balances to cover the net clearings and net public demand for cash. In Table 8.3, the banks are holding only $26.7 billion against deposit liabilities of $1,454.3 billion.

Canadian banks also carry on important international banking operations, as do banks in many other countries. We see this business recorded on the balance sheet as foreign currency assets and liabilities. The foreign currency assets are mainly loans to customers and holdings of foreign financial securities. Foreign currency deposits of customers are the main foreign currency liabilities. These foreign currency operations are similar to the banks' domestic currency operations. The banks provide loan financing to customers needing foreign currency to make payments in other countries, and they provide deposit facilities for customers using foreign currency for international transactions.

Competition and co-operation are important to the efficient operation of the banking system. Banks compete among themselves for customer deposits and customer loans. Some of the competition for deposits is based on the location, convenience, and quality of bank branches, some on the offers of service packages including personal financial advice and wealth management, and some on the interest rates offered on deposit balances. If you watch TV, you are probably aware that some small banks like *President's Choice Financial* and *Tangerine Bank* offer you a relatively high interest rate and will make no service charges if you would put some of your funds on deposit with them. Success in attracting deposits is very important to size and growth of a bank's business.

Credit-worthy customers willing to borrow funds are equally important to a bank's operations. Interest income earned on customer loans is the major source of bank revenue. As a result, banks compete in the personal and business loan markets, using both the terms of loans and the interest rates charged on loans to attract borrowers. The market for mortgage funds is one of the most competitive areas of bank operations. Mortgage rates and terms are advertised widely in the media and in displays in bank offices and even in supermarkets.

Despite this competition for deposits and loans, the banking system depends on the co-operation among banks that makes deposits the medium of exchange. Co-operation in the cheque-clearing system and the debit card *Interac* system are two important examples of banks working jointly to provide the payments system. A cheque book or a debit card is not very useful if it can make payments only to other people or businesses that do business with the same bank you use. Joint interests in *VISA* and *MASTERCARD* are a second important part of inter-bank co-operation that makes these cards widely acceptable as a source of credit.

There are also important areas of bank co-operation on the lending side of their operations. It often happens that businesses and industries have projects that need more financing than any one bank can or wants to provide. However, several banks might agree to provide funding jointly, increasing their lending capacity and spreading the risks associated with the project among them.

These dimensions of competition and co-operation among banks, and their contribution to the efficient functioning of the money and financial sector of the economy, appear regularly in the debate over bank mergers in Canada.

## Banking operations and profits

A commercial bank is a profit-oriented business. Its profits come from the difference between what it costs it to raise funds and the revenues it earns from lending. To bring deposits in, the bank offers customers a range of banking services, including safekeeping, record keeping, access to banking offices or bank machines, chequing, internet banking and debit card facilities, and interest income on some types of deposits. Service charges or fees cover the costs of some of these services. The interest payments to depositors are the main net cost of funds to the bank.

To be profitable, banks have to find ways to lend, at acceptable levels of risk, the funds they have attracted from depositors. Table 8.3 shows how banks lend their money. In Canadian dollars, most is lent to households and businesses at interest rates established for different types of personal, business, and mortgage lending. Some is used to buy government securities and other financial assets, usually with a short time to maturity. These assets pay a lower rate of interest than loans, but they are more liquid and provide the banks with funds if people decide to withdraw a lot of money from their deposit accounts. Notice that the banks also hold some cash, on which no interest is earned, to cover the day-to-day clearing balances that come from the withdrawals, deposits, and transfers made by their customers.

Bank profits come from the difference or spread between the interest cost of raising funds from depositors and the interest income earned on bank assets. If, for example, the banks pay, on average, 4 percent on their deposit liabilities of all types and earn, on average, 6 percent on their assets of all types, their **net interest income** would be 2 percent. To take an actual example, the *Scotiabank Annual Report* for 2013 reports net interest income of 2.32 percent of average assets in 2013. *Scotiabank* net interest income was higher than the same quarter of the previous year as a result of asset growth in residential mortgages, consumer auto and commercial lending, which increased deposit to lending interest rate spreads. The other large banks report net interest income of the same order of magnitude but there are variations among them. The key to profitability is choosing the right mix of high-quality (low-risk) loans and investments while at the same time controlling the costs of raising funds.

**Net interest income**: the excess of loan interest earned over deposit interest paid.

As we saw in Table 8.3 Canadian banks held only $26.7 billion in cash against $1,454.3 billion in personal and non-personal deposit liabilities. Their cash reserve assets were about 1.8 percent of their total deposits. The skill in running a bank entails being able to judge just how much must be held in liquid assets, including cash, and how much can be lent out in less liquid forms that earn higher interest income. The profit motive pushes the bank toward riskier, higher interest paying assets and higher net interest income. **Banker's risk**, the risk that customers will withdraw their deposits and demand cash, pushes the bank toward holding higher cash balances. But cash balances earn no interest income and reduce the bank's net interest income.

**Bankers risk**: the risk that customers may demand cash for their deposits.

## 8.4 Money created by banks

Banks *create money* when they increase their *deposit liabilities* to pay for the loans they make to customers, or for the financial securities they buy. The public uses the deposit liabilities of the banks as money to make payments or to hold as a store of wealth. There are *four key conditions* that give banks the ability to create money:

1. The non-bank public has confidence in banks and is willing to hold and use bank deposits as money.
2. The non-bank public is willing to borrow from the banks to finance expenditure or asset purchases.
3. The banks are willing to operate with cash reserves equal to some small fraction of their deposit liabilities.
4. The banks are willing to accept the risks involved in lending to the non-bank public.

If any of these is absent, the banks cannot create money, although they may provide safekeeping services.

The first two conditions underlie the demand for banking services. Banks acquire cash by providing customers deposit services and bank customers use bank loans as a source for funds to pay for purchases of goods, services and financial assets like equities and bonds. If the non-bank public is unwilling to use bank services there is no banking industry.

The third condition required for the banks to create money is a bank reserve ratio that is less than one. The **reserve ratio** ($rr$) is the ratio of cash on hand to deposit liabilities that banks choose to hold.

$$rr = \frac{\text{reserve assets}}{\text{deposit liabilities}} \tag{8.1}$$

**Reserve ratio** ($rr$): the ratio of cash reserves to deposit liabilities held by banks.

Cash holdings are reserve assets. If banks choose to hold reserves equal to their deposit liabilities, $rr = 1$ and the banks cannot create deposits. They are simple safety deposit boxes.

A simplified case shows how banks can and do create deposits. Assume banks use a reserve ratio of 10 percent ($rr = 0.10$). Suppose initially the non-bank public has wealth of $1,000 held in cash, before they decide to switch to bank deposit money. This cash is a private sector asset. It is a liability of the central bank or government, which issued it, but not a liability of the private banks. The 'Initial position' in Table 8.4 uses a simple balance sheet to show this cash as an asset of the non-bank private sector.

**Table 8.4: How the banking system creates money**

| Banks | | | | Non-bank public | | | |
|---|---|---|---|---|---|---|---|
| **Assets** | | **Liabilities** | | **Assets** | | **Liabilities** | |
| **1. Initial position** | | | | | | | |
| Cash | 0 | Deposits | 0 | Cash | 1,000 | Bank loans | 0 |
| **2. People deposit their cash in the banks** | | | | | | | |
| Cash | 1,000 | Deposits | 1,000 | Cash | 0 | Bank loans | 0 |
| | | | | Deposits | 1,000 | | |
| **3. Banks make loans of $9,000 and create $9,000 in new deposits for customers** | | | | | | | |
| Cash | 1,000 | Deposits | 10,000 | Cash | 0 | Bank loans | 9,000 |
| Loans | 9,000 | | | Deposits | 10,000 | | |

Then in the second part of the table people deposit this $1,000 of cash into the banks by opening bank accounts. Banks get assets of $1,000 in cash, distributed among individual banks by their customers and issue total deposit liabilities of $1,000. These deposits are money the banks owe to their depositors. If banks were simply safety deposit boxes or storerooms, they would hold cash assets equal to their deposit liabilities. Their reserve ratio would be 100 percent of deposits, making $rr = 1.0$. Table 8.4 would end with part 2.

However, if the public uses bank deposits as money, the banks don't need all deposits to be fully covered by cash reserves. It is unlikely that all depositors will show up at the same time and demand cash for their deposits. Recognizing this, the banks decide that reserves equal to 10 percent ($rr = 0.10$) of deposits will cover all *net* customer demands for cash. In this case, the banks have excess reserves which in total equal 90 percent of their deposit liabilities or, initially, $900.

The banks use their excess reserves to expand their lending. Each bank makes new loans equal to its excess reserves. It pays for those loans by *creating an equal amount of deposits*. If you were to borrow from bank your personal deposit would be increased by the amount of the loan. The same thing happens to other people who borrow from their banks.

In our example, all banks combined can create $9,000 of loans based on $1,000 in new cash reserves. In part 3 of Table 8.4, we see loans of $9,000, as assets on the banks' balance sheets, and $9,000 of new deposits to customers, against which they can write cheques or make payments online or by transfers. The newly created deposits of $9,000 are a part of the $10,000 liability on the banks' balance sheets. The public now has bank deposit assets of $10,000 and liabilities, loans owed to the banks, of $9,000. Non-bank public net worth, assets minus liabilities is $1,000, the cash they originally deposited in the banks. Because the public uses bank deposits as money, the banks can buy new loans by creating new deposits.

The reserve ratio is 10 percent in part 3 of Table 8.4 ($rr = \$1,000$ cash/$10,000 deposits $= 0.10$ or 10%). It does not even matter whether the 10 percent reserve ratio is imposed by law or is merely smart profit-maximizing behaviour by the banks that balances risk and reward. The risk is the possibility of being caught short of cash; the reward is the net interest income earned.

Why were the banks able to create money? Originally, there was $1,000 of cash in circulation. That was the money supply. When paid into bank vaults, it went out of circulation as a medium of exchange. But the public got $1,000 of bank deposits against which cheques could be written. The money supply, cash in circulation plus bank deposits, was still $1,000. Then the banks created deposits *not* fully backed by cash reserves. Now the public had $10,000 of deposits against which to write cheques. The money supply rose from $1,000 to $10,000. *The public was willing to use bank deposits as money, willing to borrow from the banks and the banks were willing to lend*. This allowed the banks to create money by making loans based on their fractional reserve ratio.

Alternatively, suppose the public loses confidence in banks and withdraws and holds more currency. The banks are still able to create deposits but the extent of the deposit creation is limited by the public's withdrawal of currency. Bank reserves are reduced. A fall in public confidence in the banks in times of financial problems and bank failures like those in that arose in the autumn of 2008 and even today in some European countries would result in a rise in the currency holdings outside banks. Bank deposits and lending capacity would be reduced as a result, and in extreme cases bank solvency might be at risk without central bank support.

## Financial panics

Most people know that banks operate with fractional reserve ratios and are not concerned. But if people begin to suspect that a bank has lent too much, made high risk loans or faces problems in raising funds which would make it difficult to meet depositors' claims for cash, there would be a *run on the bank* and a **financial panic**. Recognizing the bank cannot repay all depositors immediately, you try to get your money out first while the bank can still pay. Since everyone does the same thing, they ensure that the bank is unable to pay. It holds cash equal to a small percentage of its deposit liabilities and will be unable to liquidate its loans in time to meet the demands for cash.

> **Financial panic**: a loss of confidence in banks and rush to withdraw cash.

Banking problems in Greece in the spring and early summer of 2015 provide an example. Concerns that the Greek government might default on loan payment agreements with IMF and European Union raised the possibility that Greece might leave the euro and return to its earlier national currency: the drachma. Should that happen, all euro deposits in Greek banks would convert to drachmas at an exchange rate that would reduce their real value substantially. Fearing this possibility, depositors in Greek banks tried to withdraw their balances in cash while they were still convertible into euros.

Greek banks, like other banks, operate on a fractional reserve basis. They could not meet this 'run on the bank' without outside support and assistance. The European Central Bank provided emergency cash to the banks but the run continued. In response, limits were placed on the amount of cash a depositor could withdraw at any one time. These measures sustained the banks until a solution to Greek debt crisis was negotiated and immediate concerns about Greek membership in the euro and the value of Greek bank deposits subsided.

However, earlier experience shows how financial crises can arise in other ways. In 2008-2009 the crisis originating in the US mortgage market and real estate sector caused wide spread problems for banks. Many banks had become reliant on large denomination, short-term deposits as sources of funds to support their mortgage lending. Other non-bank financial institutions like insurance companies and pension funds, as well as a relatively small number of individual customers bought these deposits. As the recession and falling property values emerged, the financial community began to worry that home-owners would not be able to pay back their mortgages.

If that happened banks would not be able to pay back depositors money, especially the large denomination short-term deposits. Once non-bank portfolio managers realized that it was difficult if not impossible to evaluate the risks of large denomination deposits, financial institutions that relied on renewing and issuing new deposits to raise funds were in difficulties. The supply of funds to replace expiring deposits dried up and banks could not repay depositors. Several large financial institutions in the United States and in other countries required government rescues or failed. The plight of famous names like *Bear Sterns*, *Countrywide Financial*, *Fannie May*, and *Freddie Mac* became headline news.

Banks in Canada were not immune to the financial difficulties created by the collapse of the large denomination deposit markets. All the major chartered banks were holding some. They were forced to accept that without a market these deposits would no longer be a source of funds. Fortunately, Canadian banks relied more heavily on strong smaller retail depositor bases as sources of funds. The banks remained financially strong and public confidence in the banks did not collapse. No Canadian bank failed or required a government bailout.

Fortunately, financial panics involving depositor runs on the bank are rare, particularly in Canada. A key reason for this, which we discuss in the next chapter, is that the central bank, the Bank of Canada, and other national central banks, will lend cash to banks in temporary difficulties. Furthermore, deposit insurance plans like the Canadian Deposit Insurance Corporation, CDIC, cover individual bank deposits up to $100,000 against default. Knowledge of these institutional arrangements helps prevent a self-fulfilling stampede to withdraw deposits before the bank runs out of cash.

By contrast, the financial crisis and the extended real estate and credit collapse in 2008 created large problems for US banks. Loan and financial asset defaults destroyed bank assets and bank liquidity. Even in the absence of panics and bank runs, many banks became insolvent without sufficient liquid assets to cover their liabilities. Failed bank data illustrates the scale of the problem. The US Federal Deposit Insurance Corporation lists 457 US bank failures over the period January 2008 to September 2012. In the four preceding years, January 2004 to December 2007 there were just 7 US bank failures.

(`http://www.fdic.gov/bank/individual/failed/banklist.html`)

## 8.5 The monetary base and the money supply

Table 8.1 showed that bank deposits are the major component of the money supply in Canada, as in most industrial countries. Bank deposits depend in turn on the cash reserves held by banks and the public's willingness to hold bank deposits and borrow from the banks.

To complete our analysis of how the money supply is determined, we need to examine three things:

1. The source of the cash in the economy.
2. The amount of that cash that is deposited in the banking system, rather than held as cash balances by the public.
3. The relationship between the cash supply to the economy and the money supply that results from public and bank behaviour.

Today, in developed countries, central banks are the source of bank reserves. The central bank, the Bank of Canada in Canada, controls the issue of token money in the form of Bank of Canada notes. These are the $5, $10, $20, $50, and $100 bank notes you can withdraw from the bank when you wish to covert some of your bank balance to cash. Bank reserves are mainly the banks' holdings of these central bank notes in their vaults and bank machines. Our bank deposits are now convertible into Bank of Canada notes. The central bank has the responsibility to manage the supply of cash in the economy. We will examine the details of central bank operations in Chapter 10.

The cash the central bank provides to the economy is called the **monetary base** (*MB*) and is sometimes referred to as the stock of high-powered money. It is the legal tender into which bank deposits can be converted. It is the ultimate means of payment in transactions and the settlement of debts. Notes and coins in circulation and held by the banking system are the main part of the high-powered money issued by the central bank. As we discussed earlier, the commercial banks hold small settlement balances in the central bank to make inter-bank payments arising from cheque clearings.

> **Monetary base (*MB*)**: legal tender comprising notes and coins in circulation plus the cash held by the banks.

The public's decisions about the use of cash or banks deposits determine how much of the monetary base is held by the banks. The simple example of deposit creation in Table 8.4 assumed the public deposited all its cash with the banks. This was a useful simplification that ignores the cash people hold. We will drop this assumption in what follows.

Our main interest is the relationship between the money supply in the economy, *the total of cash in circulation plus bank deposits*, and the *monetary base* created by the central bank. Assuming the public holds just a small fixed amount of cash and using our earlier discussion of the fractional reserve ratio in the banking system, we can define a **deposit multiplier**. The deposit multiplier provides the link between the monetary base created by the central bank and the money supply in the economy. It also predicts the change in money supply that would result from a change in the monetary base supplied by the central bank.

> **Deposit multiplier**: the change in the bank deposits *caused* by a change in the monetary base.

$$\text{Bank deposits} = \text{deposit multiplier} \times \text{bank reserves}$$

$$\text{Deposit multiplier} = \frac{\Delta \text{ deposits}}{\Delta \text{ bank reserves}}$$

The value of the deposit multiplier depends on *rr*, the banks' ratio of cash reserves to total deposits. Banks' choice of a ratio of cash reserves to total deposits (*rr*) determines how much they can expand lending and create bank deposits based on their reserve holdings. The lower the reserve ratio (*rr*), the more deposits banks can create against given cash reserves, and the larger is the multiplier. This is the relationship illustrated in Table 8.4.

Similarly, the lower the non-bank public's holding of cash, the larger is the share of the monetary base held by the banks. When the banks hold more monetary base, they can create more bank deposits. The lower the non-bank public's currency ratio, the larger are bank holdings of monetary base and the larger the money supply for any given monetary base.

## The money multiplier

Suppose banks wish to hold cash reserves $R$ equal to a fraction $rr$ of their deposits $D$. Then:

$$\text{Bank cash reserves} = \text{reserve ratio} \times \text{deposits, i.e.}$$

$$R = rrD \tag{8.2}$$

To keep the example simple assume that we can ignore the small amount of cash held by the non-bank sector. As a result, the monetary base is mainly held as cash in bank vaults and automatic banking machines. This means from Equation 8.2 that:

$$\text{Monetary base} = \text{reserve ratio} \times \text{deposits, i.e.}$$

$$MB = rrD \tag{8.3}$$

and the *deposit multiplier*, which defines the change in total deposits as a result of a change in the monetary base, is:

$$\text{Change in deposits} = \text{change in monetary base divided by the reserve ratio, i.e.}$$

$$\frac{\Delta D}{\Delta MB} = \frac{1}{rr} \tag{8.4}$$

which will be greater than 1 as long as $rr$ is less than 1.

If, for example, banks want to hold cash reserves equal to 5 percent, and the non-bank public does not change their holdings of cash, the deposit multiplier will be:

$$\frac{\Delta D}{\Delta MB} = \frac{1}{0.05} = 20$$

When public cash holdings are constant, the deposit multiplier tells us how much deposits (and therefore the money supply in the economy), notes, and coins in circulation (outside the banks and bank deposits) would change as a result of a change in the monetary base. In this example, a \$1 change in the monetary base results in a change in deposits and the money supply equal to \$20.

$$\text{Money supply } (M) = \text{cash in circulation} + \text{bank deposits } (D)$$

$$M = \text{cash} + R/rr \tag{8.5}$$

We can see from the way we have found the deposit multiplier that it depends on the decisions made by the banks in terms of their reserve holdings. For simplicity the public holds a fixed amount of cash in addition to bank deposits as money. If you experiment with different values for $rr$, you will see how the deposit and money multiplier would change if the reserve ratio were to change. Furthermore, if the public were to change their cash holdings the cash reserves available to the banks would change and the deposit multiplier would cause a larger change in the money supply.

The importance of bank reserve decisions and public cash holdings decisions is illustrated by recent financial conditions in Europe. As a result of banking crisis and bailouts during and after the financial crisis of 2008, the public had concerns about the safety of bank deposits and decided to hold more cash. At the same time banks found it difficult to evaluate the credit worthiness of potential borrowers and the risks involved in short-term corporate lending or junior government bonds. The public's cash holdings increased and the banks increased their reserve ratios. These shifts in behaviour would reduce the money supply, making credit conditions tighter, unless the central bank provided offsetting increases in the monetary base.

## How big is the money multiplier?

Now that we have a formula for the money multiplier, we can ask: What is the size of the multiplier in Canada? Based on data in Table 8.1 above, in February 2014, the monetary base was \$70.6 billion, and the money supply defined as M1B was \$640.6 billion. These data suggest a bank reserve ratio with respect of M1B $= \$70.6/640.6$ which is approximately 11 percent giving a money supply multiplier of $1/0.11 = 9.1$.

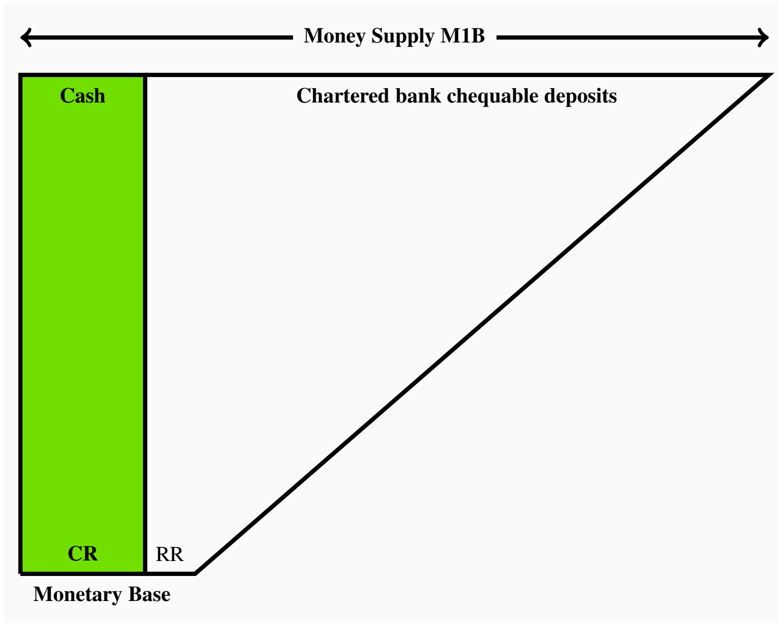
$$\frac{\Delta M}{\Delta MB} = \frac{\$640.6}{\$70.6} = 9.1$$

Each \$100 change in monetary base would change the money supply by about \$910.

However, using a broader definition of money supply such as 'currency outside banks and all chartered bank deposits' gives a Canadian money supply of \$1,240.9 and a money multiplier of \$1,240.9/\$70.6 = 17.58.

Figure 8.1 summarizes the relationship between the monetary base and the money supply. It shows the monetary base used either as cash in circulation or held as cash reserves by the banks. Since banks operate with fractional reserve ratios, the leverage banks have to expand the money supply through their lending and deposits creation based on their reserves *RR*. We also see that the money supply is heavily dependent on the size of the monetary base, reserve ratios used by the banks and the willingness of the public to hold bank deposits and the willingness of the banks to lend.

**Figure 8.1: The monetary base and the money supply**




The explanation of banking and the money supply in this chapter provides the money supply function we will use in the next chapter. It is combined there with a demand for money function in the money market to determine the equilibrium rate of interest. That rate of interest integrates money and financial markets with the markets for goods and services in aggregate demand.

A simple money supply function illustrates the determinants of the money supply. The three key variables are:

1. $MB$, the monetary base;
2. the public's holdings of cash; and
3. $rr$, the banks' reserve ratio.

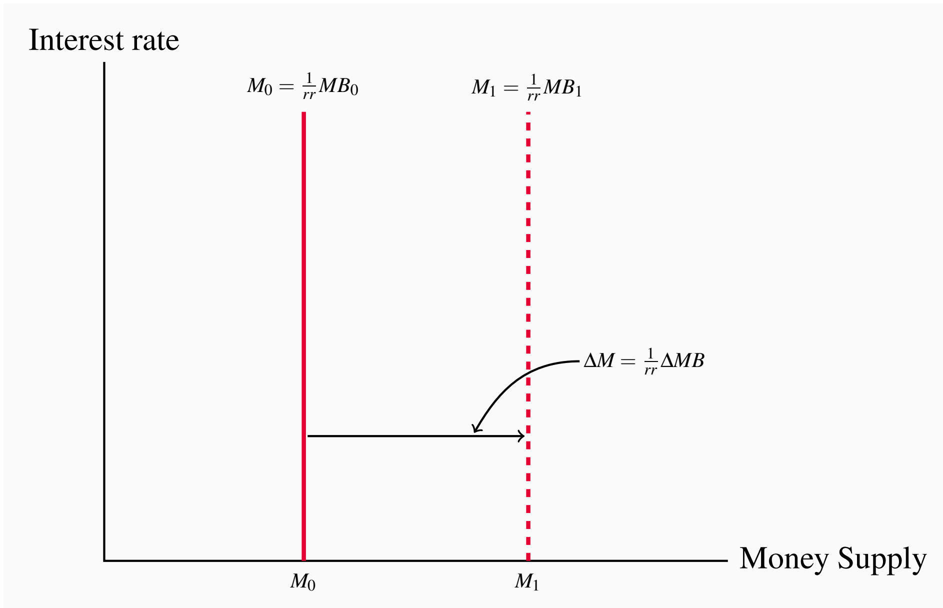
Using Equation 8.5 above, where $M$ is the money supply, we can write:

$$M = \frac{1}{rr} \times MB \tag{8.6}$$

*The central bank's control of the monetary base, MB, gives it control of the money supply, M, as long as cash holdings and rr are constant.*

Figure 8.2 uses a diagram to illustrate the money supply function and changes in the money supply. The line $M_0$ shows the size of the money supply for a given monetary base $MB_0$ and the money multiplier. The money supply in this diagram is vertical, because we assume cash holdings and the reserve ratio are not affected by the interest rate. $M$ is therefore independent of the nominal interest rate $i$, which is measured on the vertical axis. This is the supply side of the money market with quantity measured on the horizontal axis and interest rate, which is analogous to price, on the vertical axis.

**Figure 8.2: The money supply function**




The vertical $M_1$ illustrates the increase in the money supply as a result of an increase in monetary base from $MB_0$ to $MB_1$, working through the money multiplier. A reduction in the monetary base would shift the $M$ line to the left based on the same relationship.

## Monetary policy

The central bank conducts monetary policy through its control of the monetary base. The money supply function shows us how, *if rr is constant, the central bank's control of the monetary base gives it the power to change money supply and other financial conditions in the economy*. If the central bank increases the monetary base, banks have larger cash reserves and increase their lending, offering favourable borrowing rates to attract new loans and create more deposits. In Figure 8.2 the increase in the monetary base to $MB_1$ causes an increase in money supply ($\Delta M$) by the change in $MB$ ($\Delta MB$), multiplied by the money multiplier. The money supply function shifts to the right to $M_1$. A decrease in the monetary base would shift the $M$ function to the left, indicating a fall in the money supply.

## Next

Now that we have examined money, the banking system, and the size of the money supply, we have one important side of the *financial market* that will link money to expenditure and economic activity. This is the supply side of the market. In the next chapter, we will study the reasons why people wish to hold money balances. We also study how the portfolio choices people make between money and other assets create the demand for money balances. The interaction between the supply of money balances and the demand for money balances determines the prices of financial assets and interest rates. Interest rates in turn provide an important link between money, financial markets, and expenditures in markets for goods and services, both directly and through the foreign exchange rate.

## Key Concepts

**Money** has four functions: a **medium of exchange** or means of payment, a **store of value**, a **unit of account**, and a **standard of deferred payment**. The medium of exchange function distinguishes money from other assets.

In a **barter economy**, trading is costly because there must be a double coincidence of wants. Money, a medium of exchange, reduces the costs of exchange and allows resources to be used for other things.

A **token money** is a convertible claim on commodity money. Because its monetary value greatly exceeds its production costs, token money economizes on the resource costs of transactions.

**Fiat money** is money the government has declared **legal tender**. The **central bank** controls the supply of legal tender.

The Canadian **money supply** is the sum of currency in circulation outside the banks and bank deposits.

The **monetary base** is comprised of notes and coins in circulation plus cash held by banks.

The Canadian banking system is made up of a **central bank** and a number of **commercial banks** and other institutions called **near banks**.

Banks are **financial intermediaries**. Bank deposits, which can be transferred by cheque or debit card, provide a convenient means of payment. Bank services plus interest payments on deposits attract funds into the bank. Banks use these funds to make loans, purchase securities, and finance expenditures. The general acceptance of bank deposits as money, and well-developed financial markets, allow modern banks to operate with very low cash reserve ratios.

**Banks create money** by making loans and creating deposits based on a **fractional cash reserve ratio,** $rr$. The banks' reserve ratio involves a trade-off between earnings and **bankers' risk**.

The **monetary base** $MB$ is currency in circulation plus banks' cash reserves. The **money multiplier** is a ratio of a change in the money supply to the change in the monetary base that caused it, $\Delta M/\Delta MB$. The money multiplier is larger the smaller is the cash reserve ratio of the banks, $rr$.

The **money supply**, $M$, is currency in circulation plus bank deposits. The size of the money supply is determined by the monetary base, $MB$, the banks' cash reserve ratio, $rr$, and the private sector's cash holdings, when cash holdings are contant. From Equation 8.5:

$$M = \text{cash} + \frac{1}{rr} \times MB$$

## Exercises for Chapter 8

**Exercise 8.1** What are the functions of money? What is money in Canada today? What is the money supply in Canada today? Are debit cards and credit cards money?

**Exercise 8.2** Since both central banks and commercial banks can create money what is the key difference between a central bank, like the Bank of Canada, and the many commercial banks in the financial industry?

**Exercise 8.3** Suppose the banks receive $100 cash from a new deposit of funds previously held outside the banking system. If banks operate with a 5% reserve ratio, use simple balance sheets to show by how much this new cash would affect lending and deposits of all banks in the system.

**Exercise 8.4** If banks have a 10% reserve ratio how much lending and deposit creation can they undertake after they receive a new $1,000 cash deposit? Would it be in the banks' interest to find ways to reduce any cash balances the public holds? Why?

**Exercise 8.5** What protection does the Canadian Deposit Insurance Corporation provide for your money if your bank is unable to pay cash to its depositors?

**Exercise 8.6** Define the money multiplier and explain how it might be used.

**Exercise 8.7** Suppose a crisis in financial markets, like the collapse of public willingness to hold large denomination term deposits in 2007 and 2008, increases the risk banks attach to lending and the non-bank public attaches to all bank deposits. What are the implications for the desired reserve ratio, the money supply multiplier, and the money supply?

**Exercise 8.8** Using a diagram illustrate and explain the determinants of the position and slope of the money supply function assuming an initial monetary base of $1,000 when $rr = 5\%$. If the monetary base were to increase by 10% how would the money supply and the money supply function in your diagram change?

# Chapter 9

## Financial markets, interest rates, foreign exchange rates & AD

**In this chapter we will explore:**



Interest rates are everywhere. They provide income to lenders and impose costs on borrowers. Many types of bank and near-bank deposits pay interest income to their holders, as do guaranteed investment certificates (GICs) and bonds issued by businesses and governments and other income paying assets. These are assets to holders and liabilities to issuers in terms of interest payments and redemptions.

Households, businesses and governments borrow using consumer loans, credit cards, lines of credit, mortgages, leases, bonds and other forms of debt. The interest rate attached to these borrowings is a cost of financing expenditures not covered by current income.

The interest rate links financial markets to markets for goods and services. But what is 'the interest rate'? There are different interest rates attached to different forms of borrowing. There are different spectrums of interest rates based on the terms of the loan and the perceived risk of default. However, it is usually the case that interest rates across a spectrum rise or fall together. Changes in 'the interest rate' describe these shifts up or down across the spectrum for all assets.

This chapter addresses two key questions:

1. How is the interest rate determined?
2. How does the interest rate affect aggregate demand?

Explaining why the public decides to hold some wealth in money balances rather than other types of financial assets is the first step.

## 9.1 Portfolio choices between money and other assets

A financial portfolio is a collection of financial assets. It might include money balances, bonds, equities, mortgages, and mutual funds. The structure of a portfolio, the proportion held in each type of asset, reflects two main characteristics of the assets involved:

1. The *returns* paid by different financial assets
2. The *risks* arising from changes in the market prices of assets

Wealth holders and institutional portfolio managers for pension funds and insurance companies like their portfolios to pay high returns with low risk. To achieve this, they hold mixed portfolios of money and other financial assets.

Suppose you win $10 million in a lottery. Now that you have wealth, what are you going to do with it? You will no doubt spend some and give some away. That is a wealth effect, but what about the balance of your winnings? You have to make a portfolio choice. Will you hold your wealth as money in the bank? Will you put your money in the stock market? Will you put your money in the bond market?

If you consult a financial planner, he or she will probably recommend a mixed portfolio made up of money, bonds, and equities. That recommendation will be based on your intention to increase your wealth and draw income from it while protecting it from losses in financial markets.

Money holdings are an important part of the portfolio. Money is the medium of exchange. It can be used directly to make payments for goods and services or to settle debts. Other assets, for example bonds, cannot be used as a means of payment. Furthermore, money has a fixed nominal price. It is a "safe asset." Wealth held as money does not rise or fall with the rise or fall in financial asset prices on stock and bond markets. However, money is exposed to the risk that inflation will lower its real purchasing power.

Other financial assets differ from money in three respects. First, they cannot be used as a means of payment. To use them to make a payment you would first have to sell them for money, at their current market price, and then use the money to make the payment. Second, they offer a return in the form of an interest payment, a dividend payment, or a rise in price that provides income to the portfolio holder. Third, because the prices of financial assets like bonds or stocks fluctuate daily on financial markets, these assets carry the risk that their values may decline significantly from time to time.

Portfolio management recognizes these differences between assets by trading some return for lower risk and greater convenience in the mix of assets held. Money in the portfolio offers the convenience of the means of payment, providing low risk but zero return. Other assets offer a flow of interest and dividend income, and possible capital gains if asset prices rise, but the risk of capital loss if prices fall.

This portfolio choice between money balances and other assets is the basis for our discussion of the demand for money balances in the remainder of this chapter.

## Bond prices, yields and interest rates

The demand for money comes from an understanding of the relationship between interest rates, bond coupons, the prices of financial assets, and yields on financial assets. To keep the examples simple assume only one type of financial asset, a bond. However, the prices and yields of other financial assets are related to interest rates in the same way as bond prices.

Several basic concepts and definitions are important. A **bond** is an asset that makes one or more *fixed money payments* to its holder each year until its maturity date. On its maturity date, it also repays its principal value. Governments and businesses issue and sell bonds on financial markets to raise funds to finance expenditures.

> **Bond**: a financial contract that makes one or more fixed money payments at specific dates in the future.

The **interest rate** is the *current* market rate, expressed as a percentage, paid to lenders or charged to borrowers.

> **Interest rate**: the current market rate paid to lenders or charged to borrowers.

A **bond coupon** is the *fixed money payment* made *annually* to the holders of the bond from the date of issue until the date of maturity. The coupon rate is a fixed percentage of the principal value of the bond at the time of issue. For example a 3% bond pays $3.00 annually per $100 of principal until its maturity date.

> **Bond coupon**: the *annual* fixed money payment paid to a bond holder.

The **price of a marketable bond** is the current price at which it can be bought or sold on the open bond market at any time between its date of issue and its maturity date.

> **Price of a marketable bond**: the current price at which the bond trades in the bond market.

The **yield on a bond** is the return to a bond holder expressed as an annual percentage rate, which is a combination of the coupon payments and any change in the market price of the bond during the period in which it is held.

> **Yield on a bond**: the return to a bond holder expressed as an annual percentage.

Bond prices depend on current market interest rates. The **current price of a bond** is the present value of the future payments it will provide. The **present value** is the *discounted* value of those future payments. It recognizes that money payments in the future are worth less than money payments today.

> **Bond price**: the *present value* of future payments of interest and principal.
>
> **Present value** is the *discounted* value of future payments.

To help understand present value, ask the following question: If someone promises to give you \$1,000, would you rather have it today or a year from today? Notice that \$1,000 lent at an interest rate of 3% (i.e. $3/100 = 0.03$) would give you a sum of:

$$\$1,000 \times (1 + \text{the interest rate}) = \$1,000 \times (1.03) = \$1,030$$

one year from today. In the same way, the amount of money you need to lend today to have \$1,000 one year from today is:

$$\begin{aligned} \$M \times (1.03) &= \$1,000 \\ \$M &= \$1,000/1.03 \\ \$M &= \$970.87 \end{aligned}$$

When the market rate of interest is 3 percent, the present value of \$1,000 to be received one year in the future is \$970.87.

Experimenting with different interest rate assumptions in this present value calculation illustrates that the present value of \$1,000 to be paid one year from today changes with the rate of interest. Higher interest rates reduce present values while lower rates increase them. For example, if the current market rate is 5% the present value of \$1,000 to be received one year from today is:

$$\begin{aligned} \$M \times (1.05) &= \$1,000 \\ \$M &= \$1,000/1.05 \\ \$M &= \$952.38 \end{aligned}$$

This relationship is the key to understanding bond prices and how they fluctuate over time. A rise in market interest rates lowers the present value of fixed future payments. A fall in market rates increases present values of fixed future payments.

In general, because the future payments offered by bonds are fixed in dollar terms, the prices of marketable bonds vary inversely to market rates of interest. Rising interest rates mean falling bond prices, and falling interest rates mean rising bond prices. There are many types of bonds that differ by coupon, maturity date, frequency of future payments, and in other ways. However, the relationship between prices, yields, and interest rates remains the same. Because bond prices are the present value of future payments, prices and interest rates move in opposite directions.

Furthermore, the size of the change in the price of a bond as a result of a change in the interest rate depends on the bond's term to maturity. The prices of longer-term bonds are more volatile than those of shorter-term bonds. This an important consideration for bond portfolio managers concerned with trade-offs between risk and return.

Asset markets like the bond market are very active. Large volumes of bonds are bought and sold every business day. Example Box 9.1 at the end of the chapter gives a more detailed example of the relationship between market interest rates and bond prices. You can find a long list of outstanding bonds and see their coupons, term to maturity and current prices and yields at:

http://www.globeinvestor.com/servlet/Page/document/v5/data/bonds/

## 9.2 The demand for money balances

Canadians held M2 money balances of $1,326 billion in July 2015. Three variables that may explain the size of these holdings are: the interest rate, the price level, and real income. Together they provide the basis for a theory of the demand for money.

### Why hold money?

It is important to distinguish between money and income when discussing the demand for money. You might have a high income but no money, or no income and lots of money. That is because income is a flow of funds over a period of time. If you spend your income as it is received you will not accumulate a *stock of money*. Alternatively, you might have a stock of money or a money balance but no income. Then you can choose to either hold or spend your money. If you have no income you can finance a flow of expenditures by spending your money balance.

In Chapter 8, money was a means of payment and a store of value. Those two functions motivate the demand to hold at least some wealth in money balances. There are alternative stores of value. Bonds, equities, precious metals, real estate, and art are a few examples. The quantity of money people choose to hold is part of the *portfolio decision* they make about their wealth. They choose money instead of some other asset.

To develop the demand for money balances it is useful to simplify the portfolio decisions by assuming there are only two assets:

1. *Money*, which has a constant money price, pays no interest income but does serve as the means of payment.
2. *Bonds*, representing all interest-earnings assets, have money prices that change if market interest rates change, but are not means of payment.

The financial wealth people build up by saving some of their income calls for a decision. People could hold this wealth as money, which pays no interest, but is a *safe asset* because its price is constant. Or they could hold this wealth in bonds, which pay interest income but are *risky* because bond prices move up and down as market interest rates move down and up. If the *expected return* to holding bonds is positive (due to the interest rate together with any change in price) why would people hold any money balances?

The demand for money comes in three parts, namely:

1. The transactions demand;
2. The precautionary demand; and
3. The asset or speculative demand.

## The transactions demand

As the name suggests, the transactions demand for money is based on money being the means of payment. People and businesses hold some money to pay for their purchases of goods, services and assets. This demand reflects the lack of coordination of receipts and payments. Income is paid bi-weekly or monthly but purchases are made more frequently and in smaller amounts. Pocket money and bank balances that can be transferred by debit card are readily available to make these purchases between paydays. If all income receipts were used on paydays to buy bonds to earn interest income it would be costly and inconvenient to sell bond holdings bit by bit as payments were made. The costs of frequent switching between money, bonds and money would more than offset any interest income earned from very-short-term bond holdings.

## The precautionary demand

Uncertainty about the timing of receipts and payments creates a precautionary demand for money balances. There are two sides to this uncertainty. On one side there may be some unexpected changes in the timing or size of income receipts. Regular payments can still be made if enough money is available, over and above that need for usual expenses and payments. Alternatively, unexpected or emergency expenses in terms of appliance, computer or car breakdowns or unexpected opportunities for bargains or travel can by covered by precautionary money holdings. Money balances cover the unexpected gaps between income receipts and payment requirements without the costs and inconvenience of selling bonds on short notice.

## The asset or speculative demand

The asset or speculative demand comes from financial portfolio decisions rather than the lack of coordination and uncertainty behind the two preceding demands. Businesses and professional portfolio managers use money balances to take advantage of expected changes in interest rates. Essentially they speculate by switching between bonds and money based on their own forecasts of future interest rates.

Recall that bond prices and interest rates vary inversely. If while holding money balances you predict a fall in interest rates, you buy bonds. If your prediction is right and interest rates do fall, the prices of your bonds rise. Now you can sell and harvest the capital gain you earned by speculating in the bond market. Alternatively, if you correctly predict a rise in interest rates and act before it happens you can avoid a capital loss on your bond holds by selling and holding money before the interest rate rises.

Even if portfolio managers are not interested in speculating on interest rate changes there is an asset demand for money. A mixed portfolio of money and bonds is less risky than one that holds only bonds. The money component has a stable market price while the bond component provides interest income along with the risk of a variable price. Changing the shares of money and bonds in the portfolio allows the manager a trade-off between return and risk. However, as interest rates rise the opportunity cost of holding a share of the portfolio in money rises. Furthermore, the estimated risk from the bond share of the portfolio may fall if interest rates are expected to fall in the near future. As a result, rising interest rates reduce the asset demand for money balances.

## The demand for money function

The demand for money balances is summarized by a simple equation. Let the size of the real money balances people wish to hold for transactions and precautionary reasons ($L_t$) be a fraction $k$ of GDP. With nominal GDP defined as real GDP ($Y$) times the GDP deflator ($P$), nominal GDP $= PY$. Using this notation, the demand for nominal money balances for transactions and precautionary reasons is $kPY$, and the demand for real balances is $kY$, where $k$ is a positive fraction. When real income changes, bringing with it changes in spending, the change in the demand for real money balances changes is determined by $k$. This makes a link between part of the demand for money balances ($L_t$) and income, namely $L_t = kY$.

What is the value of $k$ in Canada? In the second quarter of 2015, Canadians held money balances as measured by M2 of \$1,325 billion. Nominal GDP in that quarter was \$1,364 billion measured at an annual rate. If we divide M2 holdings by GDP, we get $k = 1,325/1,364 = 0.97$, or about 97 percent of annual income. This value of $k$ suggests that a rise in GDP of \$100 will increase the demand for money balances by \$97, measured in either nominal or real terms.

Changes in nominal interest rates also change the size of the money balances people wish to hold, based on the asset motive. A rise in interest rates increases the opportunity cost of holding money balances rather than bonds. It may also create the expectation that interest rates in the future will fall back to previous levels. As a result, people will want to use some of their money balances to buy bonds, changing the mix of money and bonds in their wealth holdings. A fall in interest rates has the opposite effect.

The way people adjust their portfolios in response to changes in interest rates results in a negative relationship between the asset demand for money balances and the nominal interest rate. Then using $-h$ to measure the change in money balances in response to a change in interest rates can be written as $-h = \Delta L/\Delta i$. If individual and institutional portfolio mangers' decisions are very sensitive to the current interest rates, $h$ will be a large negative number. A small rise in interest rates will cause a large shift from money to bonds. Alternatively, if portfolio decisions are not at all sensitive to interest rate changes, $h$ would be zero.

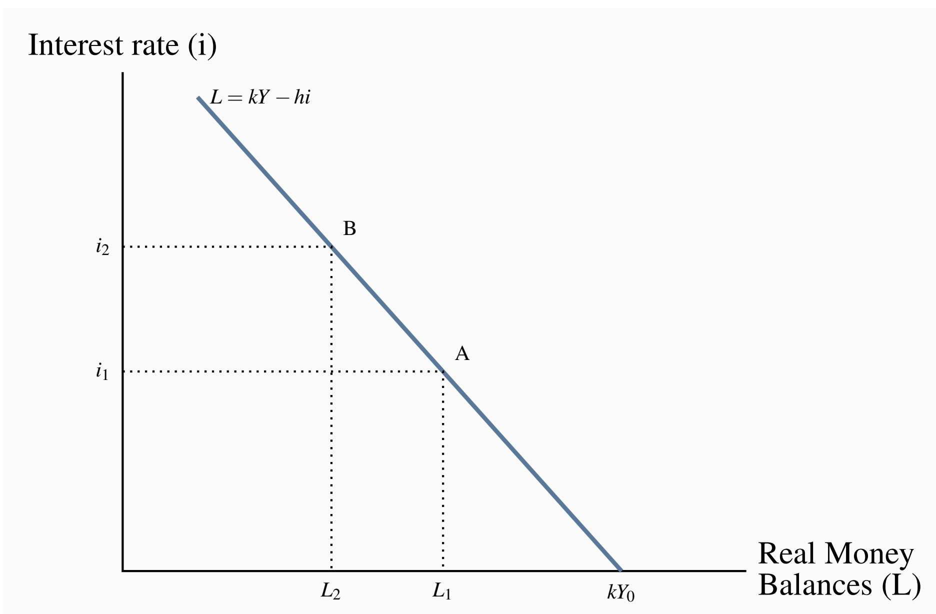
Putting these components of the demand for real money balances together gives the demand for money function, which is a demand to hold real money balances $L$:

$$\text{Money balances demand} = \text{transactions and precautionary balance based on income } (kY) + \text{the asset demand based on interest rates } (-hi)\text{, i.e.:}$$

$$L = kY - hi \tag{9.1}$$

Figure 9.1 shows the relationship between the demand for real money balances and the interest rate, drawn for a given level of real GDP, $Y_0$. The demand for money function would have an intercept of $kY_0$ on the horizontal axis. At higher interest rates the opportunity cost of holding money balances is higher because the expected return from holding bonds is positive. The negative slope of the demand function shows how people change their demand for money when interest rates change. The slope of the demand curve for money is $-1/h$. The effect of a change in the interest rate is shown by a movement along the $L$ function. A change in real income would require us to draw a new demand for money function, to the right of $L_0$ if $Y$ increased, or to the left if $Y$ decreased.

**Figure 9.1: The demand for real money balances**




This straight line demand for money function is a useful simplification. However, it would be more realistic to draw the function with a decreasing slope as interest rates decline. That would capture two important ideas.

First, as interest rates fall, and fall relative to the costs of buying and selling bonds, opportunity costs decline faster than interest rates.

Second, consider the speculative demand for money. As interest rates fall, the riskiness of bonds increases. A subsequent rise in interest rates has a larger negative effect on bond prices. Expectations of future increases in interest rates may strengthen as interest rates decline. As a result, portfolio managers may shift funds increasingly from bonds to money as interests fall. If their expectations are confirmed by events they avoid the capital losses caused by falling bond prices.

## 9.3 Financial market equilibrium & interest rates

The money supply and the demand for money in the financial market determine nominal interest rates. From Chapter 8 a nominal money supply depends primarily on the monetary base and the money multiplier, namely:

$$M = \frac{1}{rr} \times MB \tag{8.6}$$

The demand for money is a demand for *real* money balances as determined by real income and interest rates.

$$L = kY - hi$$

The **real money supply** is simply the nominal money supply $M$ divided by the price level $P$, $M/P$, which measures its purchasing power in terms of goods and services.

> **Real money supply** $(M/P)$: the nominal money supply $M$ divided by the price level $P$.

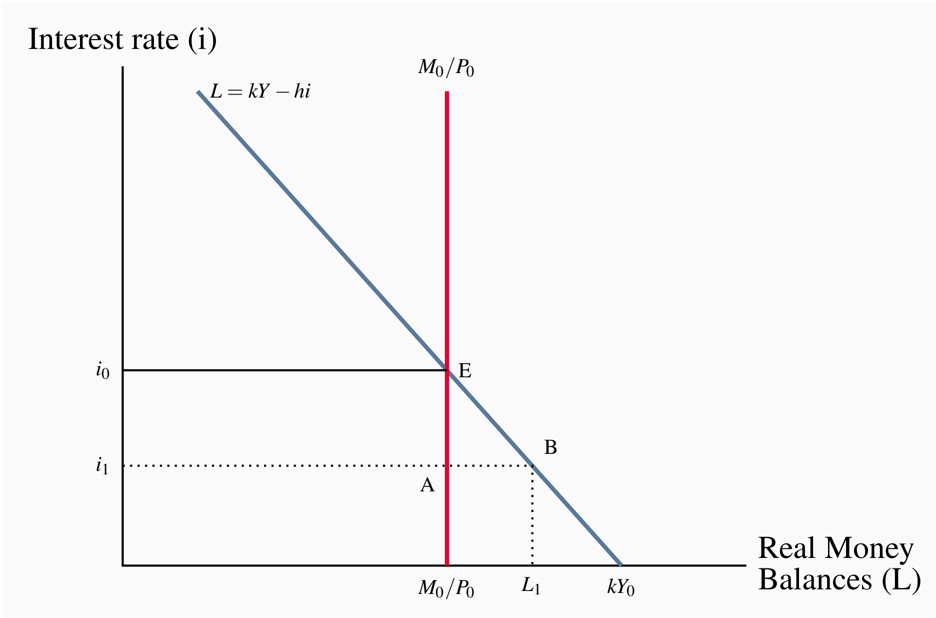
The central bank, as the source of the monetary base $MB$, controls the nominal money supply, *as long as the reserve ratio rr and the public's holdings of cash are constant*. The next chapter explains how the central bank manages the monetary base. If the price level is fixed, the central bank also controls the real money supply. Changes in nominal money tend to lead eventually to changes in prices. However, the central bank can still control the real money supply in the short run—it can change $M$ faster than prices $P$ respond—but in the long run other forces determine real money $M/P$. For the moment, assume the price level as fixed.

The demand for money as a demand for real money balances is summarized above. The quantity of real money demanded rises when real income rises, but falls when nominal interest rates rise.

### Money market equilibrium

Figure 9.2 combines the demand curve for real money balances from Figure 9.1 with the money supply function in Figure 8.2 to give a money market diagram. The demand curve is drawn for a given level of real income, $Y_0$, and the supply curve for a given monetary base $MB_0$. With a given price level, the central bank controls the supply of nominal and real money. The supply curve is vertical at $M_0/P_0$. Equilibrium in the money market is at E. At the interest rate $i_0$, the real money balances people wish to hold just equal the money supplied by the central bank and the banking system.

**Figure 9.2: Equilibrium in the money market**




To see how this market operates, suppose the interest rate is $i_1$, lower than the equilibrium level $i_0$. There is excess demand for money in the amount AB in the diagram. People want to hold money balances equal to B at the interest rate $i_0$, but only A is available. How does the market adjust to remove this excess demand? The answer lies in the portfolio decisions that distribute wealth between money holdings and bonds.

Consider the interaction between the bond and money markets. When portfolio managers want to restructure their holdings of bonds and money they do so by buying or selling bonds on the bond market. Their actions cannot change the supply of money balances. That is fixed by the monetary base and the money supply multiplier. As a result, bond prices and interest rates change to maintain money market equilibrium.

In Figure 9.2 the excess demand for money at the interest rate $i_1$ will result in a rise in interest rates. With an excess demand for money, people sell bonds to adjust their money balances. There is an excess supply of bonds. Bond prices fall. Lower bond prices mean higher bond yields and interest rates, as you will recall from our earlier discussion of asset prices and yields. The higher interest rates reduce both the excess supply of bonds and the excess demand for money. The money market adjusts by *moving along* the $L$ curve from B to E, as people want smaller money balances relative to their bond holdings at higher interest rates.

This inverse interest rate – bond price relationship is the key to adjustments in the money market caused by changes in either the demand for or supply of money balances. Those adjustments involve trades in bonds that change bond prices and interest rates to maintain money market equilibrium.

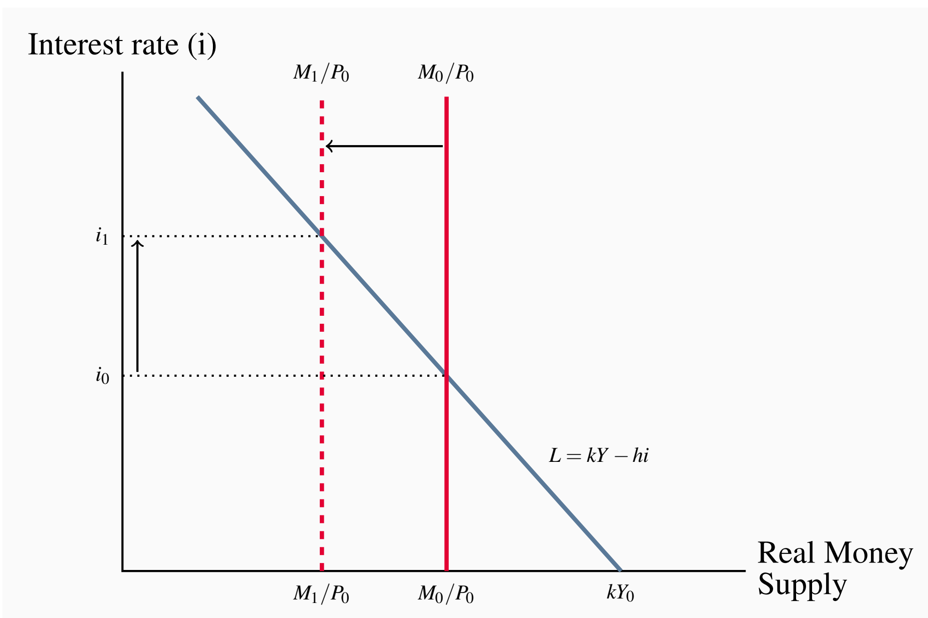
## Changes in financial market equilibrium

A shift in either the money supply or money demand changes equilibrium in the money market (and the bond market). Interest rates move to restore equilibrium. Figures 9.3 and 9.4 give examples.

## The effect of a change in the money supply

Suppose the central bank lowers the monetary base and the money supply contracts. For a fixed price level, lower nominal money reduces the real money supply. Figure 9.3 shows this leftward shift in the money supply curve from $M_0/P_0$ to $M_1/P_0$. The equilibrium interest rate rises from $i_0$ to $i_1$ as people sell bonds. A higher interest rate reduces the quantity of real money balances demanded, moving along the demand curve $L(Y_0)$, bringing quantity of balances demanded into line with the reduced supply. Hence, a lower money supply raises equilibrium interest rates. Conversely, a rise in the money supply lowers the equilibrium interest rate.

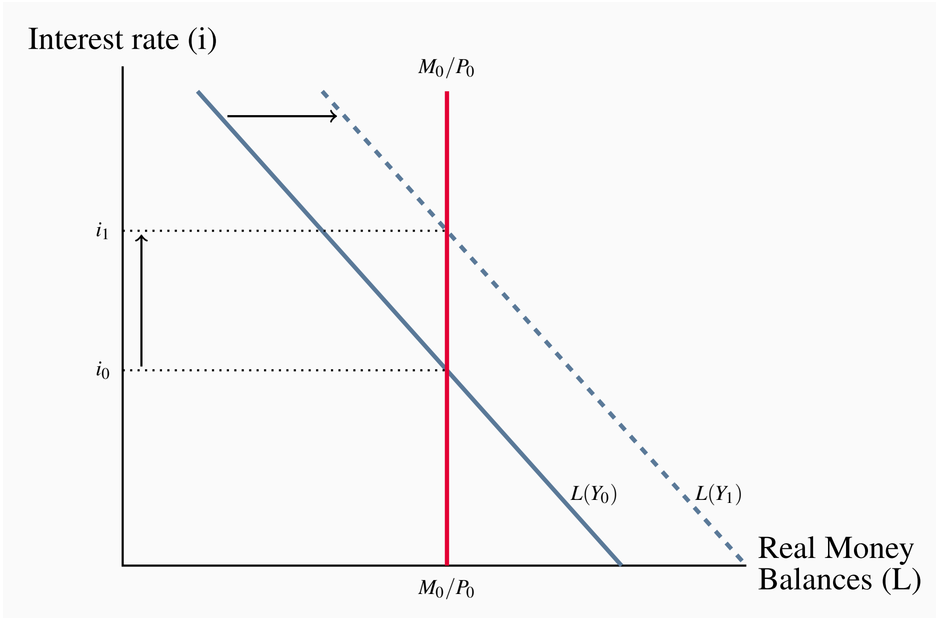
**Figure 9.3: Effect of a fall in the money supply**




## The effect of a change in real income

Figure 9.4 shows real money demand $L(Y_0)$ for the real income $Y_0$. A rise in real income increases the quantity of real money balances demanded at each interest rate, shifting the demand for money function from $L(Y_0)$ to $L(Y_1)$. The equilibrium interest rate rises as portfolio managers sell bonds in an attempt to increase their money holdings. The rise in the interest rate lowers the quantity of real balances demanded, moving along the money demand function $L(Y_1)$, and keeps demand for money equal to the unchanged supply. Conversely, a fall in real income would shift the demand for money to the left and reduce the equilibrium interest rate.

**Figure 9.4: Effect of a rise in real income**




## 9.4 Interest rates and foreign exchange rates

The interest rates determined in the money market have important effects on the **foreign exchange rate**. With free international trade in financial assets, portfolio managers, having chosen to hold some part of their portfolios in bonds, have an additional choice. They can hold some bonds issued by domestic borrowers and some issued by foreign borrowers. They might, for example, hold some bonds issued by the Government of Canada, some issued by the United States Treasury and some issued by other governments. Similarly, residents of other countries can choose to include bonds issued by the Government of Canada in their holdings. These choices are made on the basis of the yields on bonds established by conditions in different national money and bond markets.

**Foreign exchange rate**: the domestic currency price of a unit of foreign currency.

To achieve the highest return on the bond portion of their portfolios, managers buy bonds that offer the highest rate of return for a given level of risk. If interest rates are constant in other financial markets, a rise in Canadian interest rates and bond yields makes Canadian bonds more attractive to both domestic and foreign bondholders. The demand for Canadian bonds increases. A fall in Canadian interest rates has the opposite effect.

Bonds are issued and priced in national currency. Most Government of Canada bonds are denominated in Canadian dollars. US Treasury bonds are denominated in US dollars, and bonds issued by European governments are denominated in euros. If Canadians want to purchase bonds on foreign bond markets they need foreign currency to make payment. Similarly, if residents of other countries want to purchase Canadian bonds they need Canadian dollars to make payment. These *foreign exchange* requirements for trading in financial assets are the same as those for trading in goods and services. The foreign exchange market is the market in which currencies of different countries are bought and sold and foreign exchange rates are determined.

Foreign exchange markets and rates are examined in detail in Chapter 13. For now it will be enough to consider the effects of changes in domestic interest rates on the foreign exchange rate.

Consider an *increase* in the domestic money supply in Canada. Money and bond market adjustments to this increased money supply lower the Canadian interest rate. At these lower interest rates domestic bond yields are lower relative to foreign bond yields than they were before. This provides the incentive for domestic portfolio managers to switch their purchases from domestic bonds to foreign (US) bonds. To pay for foreign bonds they need foreign currency. The demand for US dollars increases.

Simultaneously, bond holders in the US shift their purchases from the now relatively low-yield Canadian bonds to US bonds. Lower sales of Canadian securities in the US market reduce the supply of US dollars. This drop in the supply of US dollars combined with the increase in demand raises the Canadian dollar price of U.S dollars. This is a **depreciation of the Canadian currency**. If the initial exchange rate was \$1.10Cdn = 1.00US, the exchange rate would be somewhat higher, say \$1.15Cdn = \$1.00US

> **Depreciation of the national currency**: a decline in the value of the currency relative to other national currencies, which results in a rise in the domestic price of foreign currencies.

In this example a fall in domestic interest rates, other things constant, causes depreciation in the domestic currency relative to foreign currencies. This interest rate-exchange rate linkage is symmetrical. Rises in domestic interest rates cause **appreciation of the national currency.**

> **Appreciation of the national currency**: an increase in the value of the currency relative to other national currencies, which results in a fall in the domestic currency price of foreign currencies.

A *decrease* in the money supply or a change in the demand for money with a fixed money supply would affect the foreign exchange rate through the same linkages. Changes in domestic financial markets and foreign exchange markets happen simultaneously. With current communications and information technology these markets adjust very rapidly and continuously. The changes in interest rates and foreign exchange rates that result from changes in domestic money market conditions have important effects on aggregate expenditure and aggregate demand.

## 9.5 Interest rates, exchange rates, and aggregate demand

Interest rates and exchange rates link the changes in money and financial markets to the expenditure decisions that determine aggregate demand.

The impact of financial markets, interest rates, and exchange rates on aggregate expenditure, aggregate demand, and real output is described by the **transmission mechanism**. It has three important channels, namely:

1. the effect of interest rate changes on consumption expenditure;
2. the effect of interest rate changes on investment expenditure; and
3. the effect of interest rate changes on foreign exchange rates and net exports.

> **Transmission mechanism**: links money, interest rates, and exchange rates through financial markets to output and employment and prices.

## Interest rates and consumption expenditure

The basic consumption function in Chapter 6 was illustrated by a straight line relating aggregate consumption to disposable income. The positive slope of that line, the marginal propensity to consume, showed the change in consumption expenditure that would result from a change in disposable income. The vertical intercept of the consumption function showed *autonomous consumption* expenditure, the consumption expenditure *not* determined by disposable income. Changes in income moved households *along* the consumption function. Changes in autonomous consumption expenditure changed the vertical intercept, shifting the consumption function up or down.

Changes in interest rates affect autonomous consumption expenditure in two ways.

1. Through a **wealth effect** from changes in the prices of financial assets; and
2. Through a **cost of credit** effect.

> **Wealth effect**: the change in expenditure caused by a change in real wealth.
>
> **Cost of credit**: the cost of financing expenditures by borrowing at market interest rates.

The market prices of bonds are the present values of expected future interest and principal payments. Current market interest rates are the key factor in this relationship. Similarly, interest rates and the expected stream of profits and dividend payments determine the present values and prices of company shares. Lower discount rates give higher present values and higher interest rates reduce present values. As a result, falling interest rates raise financial asset prices and rising interest rates reduce financial asset prices.

This means that changes in interest rates, by changing prices of financial assets, change the wealth held in household portfolios. A fall in market interest rates raises household financial wealth which increases household consumption expenditure. Autonomous consumption expenditure increases as a result of this **wealth effect**. A rise in interest rates would reduce autonomous consumption expenditure.

Changes in interest rates also have important effects on house prices by lowering the **cost of credit**, increasing the present values of rental incomes, and increasing the market prices of residential real estate. Households often used the increased market values and equity in their housing to set up home equity lines of credit with relatively low borrowing rates. This borrowing is used to finance other expenditures. Autonomous consumption expenditures change as interest rate changes change the cost and extent of this financing.

Thus, two forces—wealth effects, and availability and cost of credit—explain the effects of money on planned consumption expenditure. This is one part of the *transmission mechanism* through which money and interest rates affect expenditure. Operating through wealth effects and the supply and cost of credit, changes in money supply and interest rates *shift* the consumption function. We can recognize the effects of both income and interest rates on consumption by using an equation, namely:

Consumption expenditure depends on both national income and interest rates, or:

$$C = C(Y, i) \tag{9.2}$$

The marginal propensity to consume out of national income is a positive fraction, $0 < (\Delta C/\Delta Y) < 1$, and the relationship between consumption and interest rates is negative, $\Delta C/\Delta i < 0$.

When consumption expenditure is plotted relative to national income as in the 45° line diagrams of Chapters 6 and 7, a change in the interest rate *shifts the consumption function* but does not change its slope.

## Interest rates and investment expenditure

In Chapters 4 and 6 we defined investment expenditure as the purchase of currently produced fixed capital, which includes plants, machinery and equipment; and inventories of raw materials, components, and finished goods. Spending on new residential and non-residential construction is also included in investment. Assume investment is independent of current income and therefore an autonomous component of aggregate expenditure. However, the interest rates determined in money and financial markets affect investment expenditure.

The data in Chapters 4 and 6 showed investment at about 20 percent of GDP in 2013 but with the *level* of investment spending changing from year to year within a range of $+/-$ 20 percent. Although the total change in inventories is quite small, this component of total investment is volatile and contributes to the fluctuations in the total level of investment. Interest rate changes are responsible for some part of the volatility in investment spending.

Government capital expenditures on buildings, roads, bridges, and machinery and equipment are a part of government expenditure $G$. We treat government capital expenditure as part of fiscal policy and include it in $G$, not in $I$.

Businesses spend on fixed capital, plant and equipment to expand their output capacity if they expect growth in demand for their output, or if they see opportunities to reduce costs by adopting new technology and production techniques. Wireless companies like *Bell Canada*, *Rogers* and *Telus* spend continuously on new equipment to accommodate subscriber growth and new products that require more and faster data and voice transmission. Auto makers add to or reduce assembly capacity and develop new product and production technologies to remain competitive and to meet needs for increased fuel efficiency. Solar, wind energy and biofuel companies build new solar farms, wind farms and ethanol plants to provide new sources of electricity and fuels.

The firm's decision to invest is based on its *expectation* of future markets and profits that will justify the estimated cost of new plant and equipment. Financial markets provide some important guidance.

The current market values of existing firms are the *present values of their expected profits*. A firm thinking about entering an industry or expanding its current capacity can compare the cost of building a new plant and buying equipment with the market value of capital already in the industry. The investment looks profitable if the cost to enter the industry or build and install new capacity is less than the value the market places on existing businesses. Alternatively, if the value the market places on existing business is less than the capital cost of new business there is no incentive to invest in more plant and equipment. However, there might be an opportunity to enter the industry, or expand by taking over an existing business.

The present value of expected profits depends on the interest rate. Changes in interest rates change both the values the market puts on existing businesses and productive capacity and the costs of financing new investment. A rise in interest rates lowers the market value of existing firms and increases the costs of financing new investment. A fall in interest rates increases current market values and lowers financing costs. As a result, investment expenditures are inversely related to interest rates, if all other conditions are constant.

Inventory management is another important part of investment expenditure. Some firms hold inventories of basic inputs to production like raw materials and may also hold components and finished product. Other firms organize their production and coordinate with suppliers to minimize inventories to achieve 'just in time' delivery of inputs. Financial services firms often hold inventories of bonds and other assets to help customers adjust their portfolios.

Inventories can accommodate differences in the timing of production and sales for the benefit of both producers and consumers. If demand for output rises sharply, plant capacity cannot be changed overnight. If demand exceeds current output, sellers would rather not disappoint potential customers. Car dealers hold inventories in part to help smooth the flow of production, and in part to be able to offer immediate delivery. Retail stores carry inventories so customers can buy what they want when they want it. As demand fluctuates, it can be more efficient to allow inventories of finished goods to fluctuate than to try to adjust production to volatile market conditions.

But inventories involve costs. To the producer, unsold goods represent costs of labour, materials, and energy paid but not yet recovered from the sale of the product. These costs have to be financed, either by borrowing or tying up internal funds. Retailers have similar carrying costs for their inventories. Thus, interest rates determine the important finance costs of holding inventories. If we assume prices are constant and interest rates rise, producers and retailers will want smaller inventories. Alternatively, if prices are rising, the difference between the nominal interest rate and the rate of inflation is the real cost of carrying inventories.

The **investment function** is based on these explanations of expenditure on fixed capital and inventories. The negative effect of interest rates in the investment function, $(\Delta I/\Delta i) < 0$, shows that higher interest rates cause lower levels of planned investment expenditure. But how sensitive are investment plans to financing costs? If these financing costs were not a large factor in the investment decision, $\Delta I/\Delta i$ would be small. A rise in the interest rate from $i_0$ to $i_1$ would still lower planned investment, but by only a small amount. Alternatively, a larger value for $\Delta I/\Delta i$ would mean that investment plans are sensitive to interest rates.

Investment expenditure depends on the interest rates:

$$I = I(i) \tag{9.3}$$

A rise in the interest rate lowers investment expenditure: $\Delta I/\Delta i < 0$.

> **Investment function, $I = I(i)$:** explains the level of planned investment expenditure at each interest rate.

When plotted in a diagram with interest rate ($i$) on the vertical axis and investment ($I$) on the horizontal axis, the slope of the investment function, $I = I(i)$, is $-(\Delta i/\Delta I)$. The *position* of the investment function reflects the effect of all factors, other than interest rates, that affect investment decisions. The price of new capital equipment, optimism or pessimism about future markets and market growth, the introduction of new technologies embodied in newly available equipment, and many other factors underlie investment decisions. Changes in any of these conditions would *shift the I function* and change planned investment at every interest rate. The sharp drop in oil company expenditures on new equipment and production capacity in response to the collapse in oil prices is a clear example of a shift in the investment function. Increased business confidence and expectations of stronger and larger markets shift the $I$ curve to the right. Pessimism shifts it to the left.

The volatility of investment that causes business cycle fluctuations in output and national income comes from volatility in business profit expectations, rather than from interest rates. Changes in investment, a result of changes in interest rates or as a result of other factors, shift aggregate expenditure and work through the multiplier to change AD, output, and employment. The reaction of investment expenditure to changes in interest rates provides the important link in the monetary transmission mechanism but does not explain the volatility of investment expenditure we saw in Chapter 6.

## Exchange rates and net exports

The changes in foreign exchange rates caused by changes in interest rates affect the competitiveness and profitability of imports and exports relative to domestically produced goods and services. A rise in interest rates leads to an appreciation of the domestic currency. Import prices fall relative to the prices of domestic goods and services. Exports become less competitive and less profitable. Imports rise and exports fall, lowering the net export component of aggregate expenditure and demand. Alternatively, a fall in interest rates leads to a depreciation of the domestic currency. Prices of imported goods and services rise relative to the prices of domestic goods and services. Exports are more competitive and more profitable. Net exports increase.

In Chapter 6 we assumed exports were autonomous, independent of national income but dependent on foreign incomes, foreign prices relative to domestic prices, and the exchange rate, which we held constant. Imports were a function of national income, based on a marginal propensity to import, with an autonomous component to capture relative price and exchange rate conditions. Exchange rates were assumed to be constant.

Dropping the assumption that the exchange rate is constant makes the important third link between interest rates and aggregate expenditure through net exports. Exchange rate effects reinforce the negative relationship between interest rates and expenditures in the consumption and investment functions. If interest rates rise, other things constant, the domestic currency appreciates and the exchange rate, *er*, falls. Exports fall, and imports rise, reducing net exports and aggregate expenditure. A net export function that describes this relationship would be:

$$NX = NX[er(i), Y, \ldots] \tag{9.4}$$

In Equation 9.4, the variable $er(i)$ captures the effect of interest rates on exchange rates, and exchange rates on net exports. The variable $Y$ captures the effect of changes in $Y$ through the marginal propensity to import. From the foreign exchange market we know that a rise in interest rates leads to an appreciation of the domestic currency that lowers the exchange rate, $(\Delta er/\Delta i) < 0$. Also, a fall in the exchange rate lowers net exports, $(\Delta NX/\Delta er) > 0$.

The appreciation of the Canadian dollar that reduced the Canadian/US dollar exchange rate from \$1.57Cdn for \$1.00US in 2002 to \$1.014Cdn to \$1.00US in March 2008 and \$0.9814Cdn to \$1.00US in November 2012 illustrates the point. Although due more to the rise in commodity and energy prices than to interest rate differentials, the lower exchange rate increased imports and reduced the viability of manufacturing based on exports to the US market, or competition with imports. To the extent that interest rate changes affect exchange rates, they also change net exports and aggregate expenditure.

The depreciation of the Canadian dollar following the collapse of energy and commodity prices in late 2014, and the subsequent lowering of interest rates by the Bank of Canada raised the Cdn/US dollar exchange rate to \$1.31Cdn to \$1.00US in early August 2015. Although only partly a result of lower Canadian interest rates, this lower dollar makes exports more competitive and profitable and imports more expensive. Over time, net exports should increase and increase aggregate demand.

**Figure 9.5: Interest rates & autonomous expenditure**

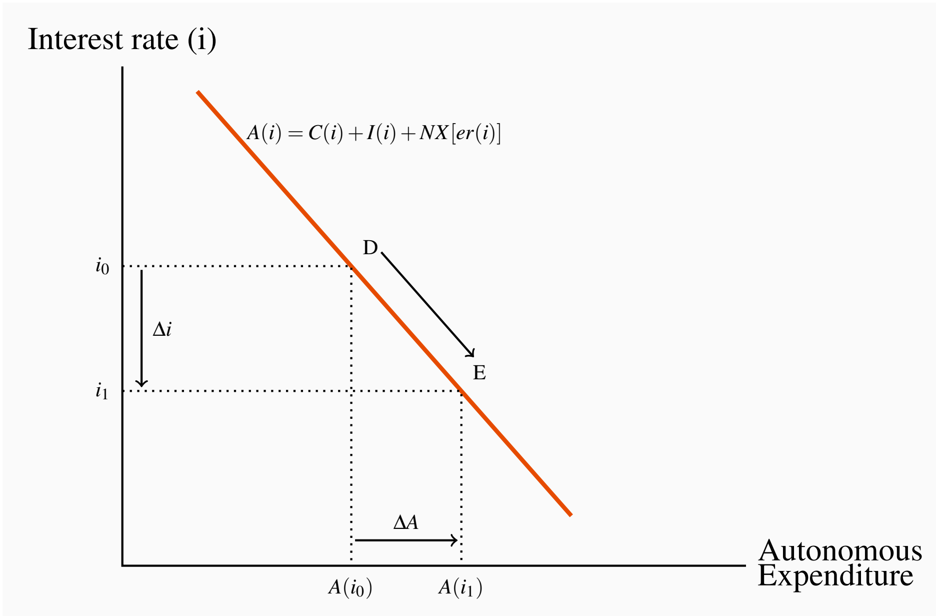



Figure 9.5 summarizes the relationship between interest rates and expenditures, assuming all things other than interest rates and exchange rates are constant. The downward sloping line $A(i)$ illustrates the inverse relationship between the consumption, investment, and net export components of autonomous expenditure and the interest rate. Starting with interest rate $i_0$, the level expenditure related to interest rates is $A(i_0)$, given by point D on the expenditure function. A fall in interest rates from $i_0$ to $i_1$ increases expenditure to $A(i_1)$, moving along the expenditure function to point E. Lower interest rates increase consumption and investment expenditure directly through wealth and cost and availability of finance effects. Lower interest rates also increase net exports through the effects of lower interest rates on the foreign exchange rate. A rise in interest rates would have the opposite effect.

The changes in interest rates and exchange rates are the key linkages between the monetary and financial sector and aggregate demand.

## 9.6 The transmission mechanism

We can now summarize and illustrate the relationships that transmit changes in money, financial markets, and interest rates to aggregate demand, output, and employment. There are four linkages in the transmission mechanism:

1. With prices constant, changes in money supply change interest rates.
2. Changes in interest rates change consumption expenditure through the wealth effect and the cost and availability of credit.

3. Changes in interest rates also cause changes in planned investment expenditure through the cost and availability of credit to finance the purchase of capital equipment and to carry inventories.
4. Changes in interest rates also cause changes in exchange rates, which change the price competitiveness and profitability of trade goods and services.

Working through these linkages, the effects of changes in money and interest rates on aggregate expenditure, aggregate demand and equilibrium real GDP is illustrated as follows:

$$\Delta M \rightarrow \Delta i \rightarrow \begin{pmatrix} \Delta C + \Delta I \\ \Delta er \rightarrow \Delta NX \end{pmatrix} \rightarrow \Delta \text{AE} \times \textbf{multiplier} \rightarrow \Delta \text{AD} \rightarrow \Delta Y$$

**Figure 9.6: The monetary transmission mechanism**

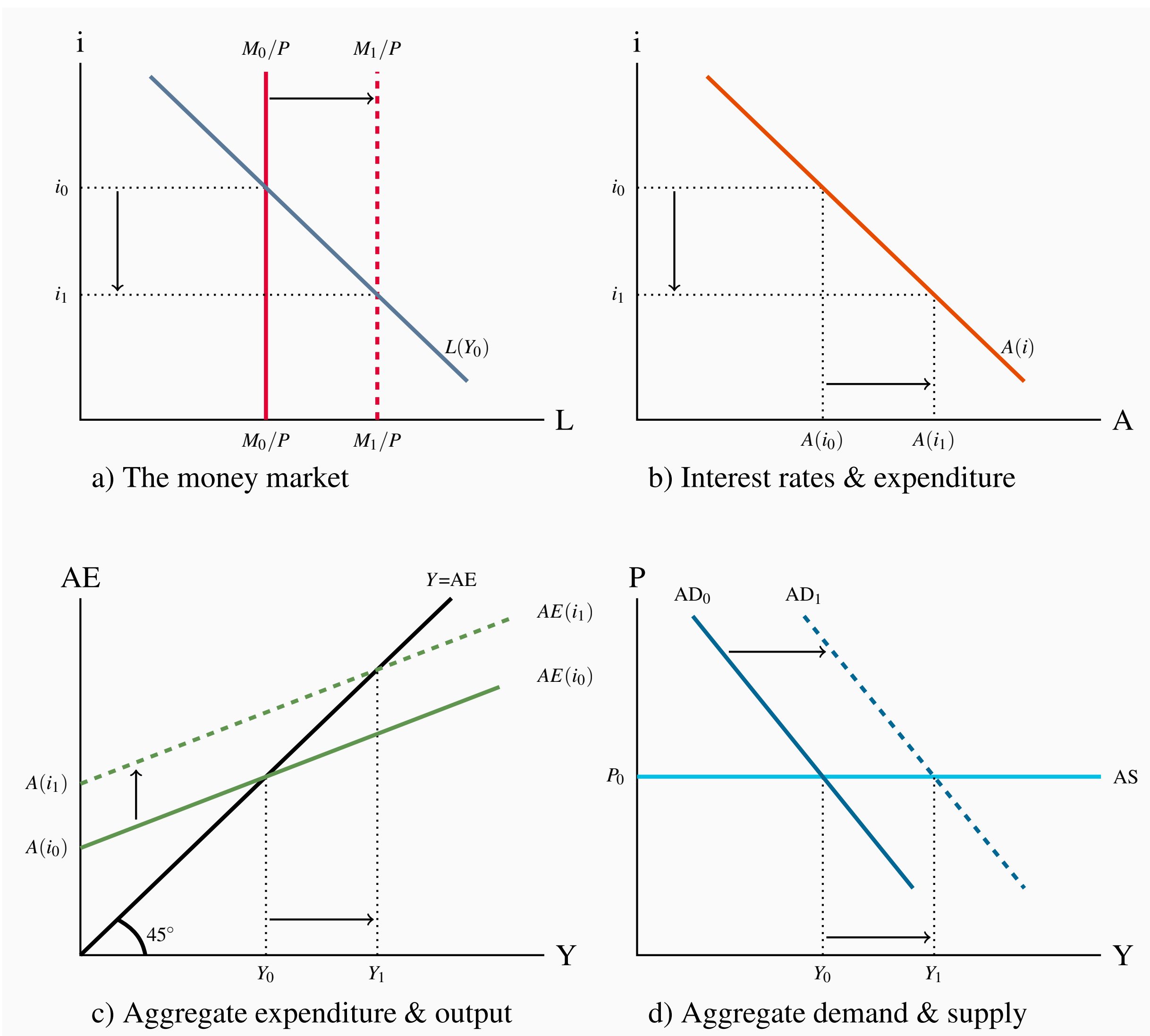


Figure 9.6 shows the transmission mechanism using four interrelated diagrams: a) the money market, b) interest rates and planned expenditure, c) aggregate expenditure and equilibrium output, and d) aggregate demand and supply, output, and prices. We continue to assume a constant price level, as the diagrams show. Changes in the money and financial sector affect aggregate demand and output, to add another dimension to our understanding of the sources of AD and fluctuations in AD.

To see the linkages in the transmission mechanism start in Panel a) with an equilibrium interest rate $i_0$ determined by the initial money supply $M_0/P$ and demand for money $L(Y_0)$. This interest rate $i_0$ induces autonomous expenditure $A(i_0)$ in Panel b). That autonomous expenditure is the vertical intercept $A(i_0)$ of the aggregate expenditure function $\text{AE}(i_0)$ in Panel c), and through the multiplier the equilibrium GDP, $Y_0$. In Panel d) the corresponding aggregate demand curve $\text{AD}_0$ crosses the horizontal AS curve at the equilibrium real GDP $Y_0$.

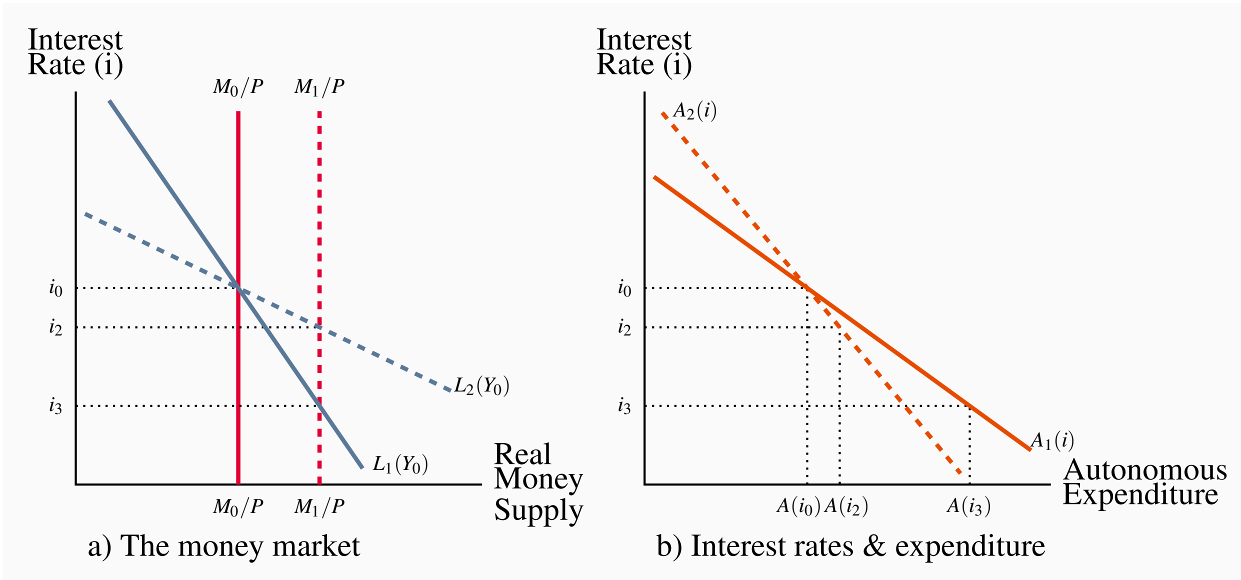
An increase in the money supply in Panel a) lowers equilibrium $i$ to $i_1$. This causes an increase in autonomous expenditure to $A(i_1)$ in Panel b) and an upward shift in the AE function on Panel c). Increased autonomous expenditure and the multiplier increase equilibrium real GDP and shift the AD curve to the right by the increase in A times the multiplier. The new equilibrium is $Y_1$ at the price level $P_0$.

There are several key aspects to these linkages between money, interest rates, and expenditure. The effect of changes in the money supply on interest rates in the money market depends on the slope of the demand curve for real money balances. A steep curve would show that portfolio managers do not react strongly to changes in market interest rates. It would take relatively large changes in rates to get them to change their money balances. Alternatively, if their decisions were very sensitive to the interest rates, the $L$ function would be quite flat. The difference is important to the volatility of financial markets and interest rates, which in turn affect the volatility of expenditure.

Panel a) in Figure 9.7 shows the effects of an increase in money supply under different money demand conditions.

The sensitivity of expenditure to interest rates and financial conditions is a second important aspect of the transmission mechanism. If the interest rate/expenditure function in Panel b) is steep, changes in interest rates will have only small effects on expenditure, aggregate demand, and output. A flatter expenditure function has the opposite implication.

**Figure 9.7: The transmission mechanism under different conditions**




a) The change in interest rates caused by a change in money supply depends on the interest rate elasticity of the demand for money. $L_2$ is more elastic than $L_1$. A small change in interest rates under $L_2$ induces portfolio managers to increase their money holdings. b) The change in autonomous expenditure caused by a change in interest rates depends on the rate elasticity of autonomous expenditure. Under $A_2(i)$ changes in interest rates have very small effects on expenditures.

## Business cycles, output gaps, and policy issues

The effect of money and financial markets on expenditure, output, and employment raises two issues for macroeconomic policy. First, fluctuations in money supply and financial conditions are an important source of business cycle fluctuations in output and employment. These effects are particularly strong and important when the small changes in money supply have big impacts on interest rates and expenditure. A steep $L(i)$ function and a flat expenditure/interest rate function would create these conditions. Stabilization policy would then need to control and stabilize the money supply, a policy approach advocated by monetarists, who see money supply disturbances as the major source of business cycles. If you can fix money supply at $M_0$ in Figure 9.6, and the demand for money $L(Y,i)$ and the interest rate/expenditure function are stable, you remove monetary disturbances as a source of business cycles.

This Monetarist approach to money and the financial sector concentrates on the "automatic" stabilization effects of money supply control. With the money supply fixed, any tendency for the economy to experience a recessionary or inflationary gap changes the demand for money, and interest rates change in an offsetting direction. A fall in real output that creates a recessionary gap reduces the demand for money $L(Y,i)$ and, with a fixed money supply, interest rates fall to induce additional expenditure. An inflationary gap would produce an automatic rise in interest rates. The monetary sector automatically resists fluctuations in expenditure and output.

The second policy issue is the alternative to this approach. Discretionary monetary policy would attempt to manage money supply or interest rates or financial conditions more broadly. The objective would be to counter persistent autonomous expenditure and financial disturbances that create output gaps. The intent is to manage aggregate demand in an active way. In other words, if business cycles were caused by shifts and fluctuations in the interest rate/expenditure function in Panel b) of Figure 9.6, monetary policy would react by changing interest rates and money supply and move the economy along the new expenditure function to stabilize autonomous expenditure and aggregate demand. Keynesian and New-Keynesian economists advocate this active approach to policy in the money and financial sector, based on a different and broader view of the sources of business cycles in the economy.

Recent experience extends beyond these two policy concerns. A collapse in the financial sector on the supply side was a major cause of the recession of 2009. Banks and other financial institutions suffered losses on mortgages and other assets followed as energy and commodity prices dropped and expectations of business profits followed. Uncertainty on the part of many lenders about the quality of assets and the risks of lending reduced the availability of credit. Uncertainty on the part of households and businesses reduced their confidence in financial institutions. Although central banks worked to keep interest rates low and bank reserves strong, shifts in the availability of credit and the willingness to borrow shifted the $A(i)$ curve in Figure 9.6 sharply to the left, expenditure fell, and AD shifted left, opening a strong recessionary gap that has been persistent in many industrial countries.

This recent experience has led to serious debates about the role and effectiveness of monetary policy and the objectives of fiscal policy. These are issues we examine in more detail in the chapters that follow.

## Next

This chapter makes the link between money, interest rates, aggregate demand, and output in the model of the economy. It also shows that monetary policy, working through the monetary transmission mechanism, provides a second policy channel, in addition to fiscal policy, which government might use to stabilize business cycle fluctuations. Chapter 10 studies in detail the monetary policy operations of central banks, including the Bank of Canada.

**Example Box 9.1: Bond prices and interest rates**

Consider the price of the 4.25 percent bond with a maturity date of June 1, 2018. *Let's assume that the 3 year market rate of interest on the date you buy the bond, say June 1, 2015 is 4.25 percent*. The price of the bond is the present value of the future payments: $4.25 on June 1, 2016, $4.25 on June 1, 2017, and $104.25 on June 1, 2018. Payments to be received two years in the future are discounted twice, and three years in the future three times, to give:

$$PV = (\$4.25)/(1.0425) + (\$4.25)/(1.0425)^2 + (\$104.25)/(1.0425)^3$$
$$PV = \$4.076 + \$3.911 + \$92.013$$
$$PV = \$100.00$$

A bond bought for $100 and held to maturity would *yield* 4.25 percent, the current market rate of interest *assumed in this example*. The bond is trading *at par* because the market price equals the face value.

As an alternative *assume that the 3 year market rate of interest on June 1, 2015 is 1.75 percent*. The price of the bond is then the present value of the future payments: $4.25 on June 1, 2016, $4.25 on June 1, 2017, and $104.25 on June 1, 2018. Payments to be received two years in the future are discounted twice, and three years in the future three times, to give:

$$PV = (\$4.25)/(1.0175) + (\$4.25)/(1.0175)^2 + (\$104.25)/(1.0175)^3$$
$$PV = \$4.177 + \$4.125 + \$98.962$$
$$PV = \$107.26$$

The price of this 4.25 percent bond on June 1, 2018 would be $107.26 per $100 of face value. The assumption that the market rate of interest is 1.75 percent, which is clearly lower than the 4.25 percent coupon on the bond, means the bond trades at a *premium*. The premium price means that buying the bond and holding it to its maturity date will give an annualized return of 1.75 percent on your money. That is the then current assumed 3 year rate.

Taking account of the changes in bond prices as market interest rates change, the **yield on the bond**—the present value of its coupon payment plus the **capital loss** as its price falls to par at maturity—gives a rate of return equal to the market interest rate of 1.75 percent.

**Application Box 9.1: A basic guide to financial assets**

Three broad classes of financial assets are bought and sold in financial markets. These are *bills*, *bonds*, and *equities*.

**Bills** are short-term financial assets that make no interest payment to the holder but do make specified cash payment on their maturity date. They trade at a discount. A government treasury bill or T-Bill is an example. Every second week the government sells T-Bills that promise to pay the buyer \$100 for each \$100 of face value on the date that is about three months in the future. The interest earned is the difference between the price paid and the face amount received at the maturity date.

**Bonds** are longer-term financial assets that pay a fixed money income payment each year and repay their face value on a fixed maturity date. Bonds are marketable, and trade on the bond market between their issue dates and maturity dates at prices determined by supply and demand. As with T-Bills, the return to the holder of a bond depends on the price paid for the bond. In this case, the calculation is more complex however, because it involves a fixed annual money payment and a fixed value at maturity.

**Equities** are shares in the ownership of the business. They give the holder the right to a share in the profits of the business, either in the form of dividend payments or in terms of the increase in the size of the business if profits are used for business expansion. The shares or stocks in publicly traded businesses can be bought and sold on stock markets like the Toronto Stock Exchange. The financial pages of major newspapers give you daily reports on stocks prices and stock markets. Shareholders' returns from their stock holdings depend on the combination of dividend income they receive and the changes in the market price of the shares they hold. Equity prices are the expected value of the future profits of business. Because expectations of future business performance are volatile, equity prices are volatile and therefore risky. Equities do however offer the prospect of higher long-term returns.

**Application Box 9.2: Nominal and real interest rates**

Both nominal and real interest rates play important roles in the economy. The **nominal** (or money) **interest rate** is the annual percentage of the principal of a loan that the borrower pays to the lender. It is determined by supply and demand conditions in money markets. The **real interest rate** is the nominal interest rate adjusted for annual changes in the price level (real interest rate = nominal interest rate minus the inflation rate). When the inflation rate is zero, nominal and real interest rates are equal.

*Nominal interest rates* and financial asset prices are linked. The present value calculation of asset prices uses the nominal rate for discounting. Nominal interest rates and asset prices vary inversely.

*Nominal interest rates* also affect nominal cash flows of both households and businesses. A rise in nominal rates on lines of credit or mortgages increases the current cash cost of that borrowing. A fall in nominal rates on lines of credit or mortgages releases current cash commitments.

*Real interest rates* determine the *real* cost of borrowing and the real return to lending.

A family borrows $200,000 for one year at a nominal interest rate of 5 percent to buy a house. At the end of the year they would owe the lender $200,000 plus $10,000 ($\$200,000 \times 0.05$) interest. Their nominal interest cost is $10,000. If the price level has been constant over the year, their nominal interest cost and their real interest cost are equal at 5 percent.

Suppose however that the all prices are rising by 3 percent a year. The house bought today for $200,000 will sell for $206,000 one year from now. Borrowing at 5 percent to buy the house cost $10,000 but the rise in the price of the house by $6,000 offsets part of that cost. The real interest cost is $\$10,000 - \$6,000 = \$4,000$. The real interest rate is 2 percent based on the nominal interest rate of 5 percent minus the change in the price level of 3 percent.

With inflation rates greater than zero, lenders' real interest earnings are less than nominal interest earnings. In the preceding example, the mortgage lender's real return was just 2 percent (5 percent – 3 percent inflation) because the $210,000 received at the end of the year had its purchasing power reduced to approximately $204,000 by the 3 percent rise in the price level.

Nominal and real interest rates affect expenditure decisions by their effects on asset prices, cash flows, and the real costs and returns involved in borrowing and lending.

# Key Concepts

A **financial portfolio** is a mixed holding of money and other financial assets, such as bonds and equities, structured, to balance expected return and risk.

The price of a financial asset like a bond that promises to make future payments is the **present value** of those payments. Because current interest rates are used to discount future payments and determine this present value, **bond prices and interest rates are inversely related**.

The **demand for money** ($L$) is a demand for real money balances measured in terms of purchasing power over goods and services. It arises from the portfolio decisions people make about the form in which to hold their wealth. Holding money reduces the costs of making both routine and unexpected **transactions**. It also provides a **safe asset**, with a fixed nominal price, as a store of wealth. The cost of holding money is the **interest income** and potential capital gain sacrificed by not holding bonds.

The quantity of real money demanded rises with real incomes, to finance higher transactions, and falls with higher nominal interest rates, the opportunity cost of holding money instead of bonds. The demand for money function is $L = kY - hi$.

The **interest rate** ($i$), is determined by supply and demand in the money market, together with supply and demand in the bond market. As people adjust the holdings of bonds and money in their wealth portfolios, bond prices and yields adjust to clear both bond and money markets simultaneously.

Changes in interest rates lead to changes in **exchange rates** that change net exports. The international sector makes an additional link between money, interest rates, and expenditure.

Interest rates play a key role in the **transmission mechanism** that links money and financial markets to aggregate expenditure.

Household consumption expenditure and business investment expenditure are dependent, in part, on interest rates. A higher interest rate reduces household **wealth** and increases the **finance costs** of borrowing. Lower wealth and higher finance costs reduce planned autonomous consumption, shifting the consumption function down. Lower interest rates have the opposite effect.

The **monetary transmission mechanism** links changes in money supply to changes in aggregate expenditure, aggregate demand, and output through interest rates and exchange rates.

## EXERCISES FOR CHAPTER 9

**Exercise 9.1** If the current market interest rate is 3 percent and a bond promises a coupon of \$3 each year in perpetuity (forever), what is the current market price of the bond? Suppose you were holding such a bond and current market interest rates fell from 3 percent to 2.5 percent. Would you be pleased or disappointed by the return on your bond holding? Why?

**Exercise 9.2** Suppose you are holding a bond that will pay \$5 each year for the next two years from today and mature two years from today.

(a) If current two-year market interest rates are 5 percent, what is the market price of your bond?

(b) If market interest rates rise tomorrow to 6 percent, what happens to the market price of your bond?

(c) What is the "market risk" in holding bonds?

**Exercise 9.3** Draw a diagram to illustrate the relationship between the demand for real money balances ($L$), GDP ($Y$) and the interest rate ($i$), $L = kY - hi$, when real GDP has a given value $Y_0$.

(a) Explain your choice of the intersection of your demand for money function with the horizontal axis, and your choice of the slope of the function.

(b) Using your diagram, illustrate and explain the quantity of real money balances demanded for a specific interest rate, say $i_0$. Pay particular attention to the underlying motives for holding these money balances.

(c) Suppose interest rates declined from your initial assumption of $i_0$ to a new lower rate $i_1$. Illustrate and explain the effect of the change in interest rates on the demand for money balances.

(d) Holding interest rates constant at either $i_0$ or $i_1$, suppose real GDP were to increase. Illustrate and explain the effect of the increase in real GDP on the demand function and the quantity of real money balances people hold.

**Exercise 9.4** Today it costs \$1.25Cdn to buy \$1US. Suppose tomorrow US interest rates rise. What would happen to the foreign exchange rate between Canadian and US dollars? Explain why.

**Exercise 9.5**

(a) Draw a diagram to illustrate equilibrium in the money market.

(b) Starting from your initial equilibrium, suppose real national income ($Y$) increased. Illustrate and explain how the money market would adjust to this change in economic conditions.

(c) How does the interest rate in the new equilibrium compare with the interest rate in the initial equilibrium?

**Exercise 9.6** Construct a set of diagrams that shows the monetary transmission mechanism linking interest rates to aggregate demand and output. Using these diagrams, show and explain:

(a) How a reduction in the money supply would affect aggregate demand and output.

(b) Alternatively, how an increase in the precautionary demand for money balances caused by terrorist activity, or severe weather events, or an increase in uncertainty in general would affect aggregate demand and output. Assume the money supply is held constant.

(c) Alternatively, how would an increase in autonomous investment expenditure and exports affect aggregate demand, output, and interest rates?

# Chapter 10

## Central banking and monetary policy

**In this chapter we will explore:**



On January 21, 2015 Stephen Poloz, the Governor of the Bank of Canada, announced a cut in the Bank's key monetary policy rate, the overnight rate, from 1.00% to 0.75%. The Bank wanted provide monetary stimulus to offset the negative growth rate and inflation rate effects of the sharp drop in oil prices. A further cut in the overnight rate to 0.50% followed on July 15, 2015. The Bank's forecast for growth and inflation in Canada had been revised downward based on weakness in the international economy, particularly the slowdown in growth in China and declining commodity prices. This called for continued monetary stimulus. These are two very recent examples of monetary policy changes by the Bank of Canada, Canada's central bank, to defend its inflation rate target and support the economy's growth rate.

This chapter examines the role of the central bank. The central bank is responsible for monetary policy. Its monopoly control of the supply of cash, or monetary base, gives it a powerful influence in financial markets. Sometimes the central bank controls the monetary base to control the supply of money. Other times it controls short-term interest rates. In either case, central bank actions are designed to affect inflation, output, and employment. They work through the transmission mechanism that links monetary policy to aggregate demand, as we discussed in the last chapter.

## 10.1 Central banking and the Bank of Canada

Most countries have a **central bank**. Some of these central banks, like the Bank of England, were private firms originally in business for profit, but began to operate in part to promote stability in financial market conditions. The focus of their business shifted to take on an informal role in what is now called monetary policy. As governments also became interested in monetary policy, central banking institutions were established in countries where none previously existed. The Federal Reserve System, the United States central bank, was created under federal law in 1913. It is a system of 12 regional banks, each owned by the commercial banks that are its members. Canadas central bank, the Bank of Canada, was set up and started operations in 1935 as a privately owned institution, but was nationalized in 1938. In the United Kingdom, the Bank of England was nationalized in 1947.

> **Central bank**: an institution that conducts monetary policy using its control of monetary base and interest rates.

In every case, the important distinction between a private bank and a central bank is the purpose that drives the institution's operations. Private banks are profit-oriented businesses providing financial services to businesses and households. Central banks conduct their operations to influence the behaviour of other banks and intermediaries in the financial system. Profits are *not* the motive behind central banks' operations, although they do make profits. They also serve as banker to the government and to the banks. But their primary role and responsibility is to conduct **monetary policy**: To control inflation and support economic growth through their control of the monetary base and interest rates, and perhaps the foreign exchange rate.

> **Monetary policy**: central bank action to control inflation and support economic growth through control of the money supply, interest rates, and exchange rates in order to change aggregate demand and economic performance.

The Bank of Canada is Canada's central bank. A visit to its website www.bankofcanada.ca provides detailed information on its structure, operations and monetary policy objectives. The information the bank provides on monetary policy is of particular relevance for this chapter.

See http://www.bankofcanada.ca/core-functions/monetary-policy/.

The current governor, Stephen Poloz, like governors before him, manages the Bank's balance sheet to implement monetary policy. He can expand the Bank's asset holdings and pay for that expansion by creating new Bank of Canada liabilities, which are additions to the monetary base. Alternatively, he can sell some of the Bank's assets, destroying an equal amount of liabilities and monetary base. No *reserve requirements* (explained in Section 10.2) limit these operations. The management of the Bank's balance sheet and the monetary base depends on the wisdom and judgment of the Governor and management of the Bank. They work to get the monetary base and interest rates that are appropriate for the economy.

There is a further interesting difference between the commercial and central bank balance sheets. Private banks concentrate on their deposit base and loan operations. These are the main entries in their balance sheets and the source of their banking profits as discussed in Chapter 8. The Bank of Canada, by contrast, does very little direct lending, and any it does is of very short duration. Indeed lending to banks and other financial institutions, advances to members of the Canadian Payments Association, which would be central bank loans, were zero at the end of July 2015.

Nor does the Bank of Canada hold many deposits. It does not need deposits as a source of funds. Deposit facilities are provided to the commercial banks and other members of the Canadian Payments Association for their use in settling cheque-clearing balances and transfers among the banks, and to the Government of Canada. Cheques issued by the Government of Canada, like income tax refunds, Old Age Security payments, and Employment Insurance benefits, are drawn on the government's account in the Bank of Canada. This difference in the structure of operations again shows the difference between profit-oriented commercial banks and a central bank with responsibility for monetary policy.

Having the power to conduct monetary policy is one thing; how you use it is another. The Bank of Canada's responsibilities are set out in the Bank of Canada Act, the act of Parliament that established the Bank in 1934. According to the Act, the Bank is to conduct its policy in ways that support the economy by reducing fluctuations in output, prices, and employment while protecting the external value of the currency. In terms of our study of the economy, we can describe these goals of monetary policy as the pursuit of potential output and low, stable inflation rates.

Exactly how the Bank is to achieve those objectives has been, and continues to be, a topic for discussion and debate. Over the years, our understanding of what monetary policy can and cannot do has evolved, as have the Bank's interpretation of its mandate and the techniques it uses to conduct monetary policy. The Canadian economist Robert Mundell has been a major contributor to this work. His explanations of the transmission mechanism and the strength of monetary policy under different foreign exchange rate systems were recognized by his Nobel Prize in economics.

Currently, the Bank works to maintain inflation within a target range of 1 percent to 3 percent, but that has not always been its explicit policy objective. Gordon Thiessen, a recent Governor of the Bank of Canada, provides an interesting overview of the evolution of monetary policy in Canada from the 1930s to the end of the 1990s[1].

## 10.2 Central bank operating techniques

The money supply—currency in circulation plus the deposits of the commercial or chartered banks—is partly a liability of the central bank (currency) and partly a liability of the commercial banks (deposits). In Chapter 8 we discussed the *monetary base* supplied by the central bank. You will recall that the *money multiplier* ties the size of the money supply to the size of the monetary base. The money multiplier is larger when

1. the reserve ratio $(rr)$ banks hold is smaller; and
2. the amount of currency the non-bank public wishes to hold is small and constant.

*If these two ratios are constant*, the central bank can change the size of the money supply by changing the size of the monetary base.

In general, central banks have three main techniques for the control of the monetary base and the money supply. These are:

[1] Thiessen, G., "Can a Bank Change?" *Bank of Canada Review*, Winter 2000/2001, pp. 35-46, and also available at http://www.bankofcanada.ca/2000/10/can-a-bank-change/.

1. Establishing reserve requirements
2. Using open-market operations
3. Adjusting central bank lending rates

Not all central banks use all three techniques, but we will examine each of them. Later we will see that the Bank of Canada has some additional operating techniques it uses to influence interest rates in the short run.

In the financial crisis and deep recession of 2008-2009, central banks developed additional techniques to support the banking system, the availability of credit, and the money supply. The 'Quantitative Easing' techniques used in the US and more recently in Europe are examples of these techniques discussed later in this chapter.

## Reserve requirements

In some cases, commercial banks operate under a legal **required reserve ratio**. They are required by law to hold cash reserves and central bank deposits not less than some specified percentage of their deposit liabilities.

> **Required reserve ratio**: a legal minimum ratio of cash reserves to deposits.

Banks can hold more than the required reserves but not less. If their reserves fall below the required amount, they must borrow cash, from the central bank, to restore their required reserve ratio. Since a loan from the central bank carries an interest rate, usually higher than the market interest rate, borrowing imposes a cost on the bank and lowers profitability. Banks usually hold slightly larger reserves than required to avoid the costs of falling short.

A required reserve ratio is essentially a regulation used to give the central bank control of the money supply. The reserve ratio is a key determinant of the money multiplier. If a central bank has the power to change the commercial banks' required reserve ratio, it can use it to change the money supply. For a given monetary base, a rise in the required reserve ratio reduces the size of the money multiplier and the money supply. A reduction in the reserve ratio has the opposite effect.

However, changing required reserve ratios are blunt techniques for monetary control. They simultaneously affect the reserve positions of all banks in a system and require large adjustments in financial markets. As a result, changes in reserve ratios are not widely used as techniques for money supply control.

Required reserve ratios are different in different national banking systems. In the United States, for example, the Federal Reserve is authorized to impose reserve requirements of 8 percent to 14 percent on chequable deposits, and up to 9 percent on non-personal time deposits. As of February 2002, the ratios were set at 10 percent for chequable deposits and 0 percent for time deposits. The European Central Bank also imposes reserve requirements. In 2012, both India and China reduced deposit reserve ratios on several occasions to encourage monetary expansion in the face of declining GDP growth rates.

Until 1994, banks in Canada were subject to legal minimum reserve requirements. These have now been phased out, as have reserve requirements in many other countries. In Canada, the banks hold reserves made up of very small settlement balances in the Bank of Canada, in addition to their cash holdings. The banks decide the size of their reserve ratios based on their own assessments of their reserve needs, rather than a legal requirement. We will see later that reserve holdings, and the Bank of Canada's management of the available cash reserves, are important to the implementation of monetary policy in Canada.

The absence of legal reserve requirements in Canada means that reserve ratios in the banking system change from time to time. They may change as the banks change their outlook on financial conditions and their evaluation of banker's risk. These changes are linked to the profit motive of the banks rather than the control interests of the central bank. Whether they come from central bank action or commercial bank asset management, changes in the banks' reserve ratio change the money multiplier and the money supply.

## Open market operations

**Open market operations** are central bank purchases or sales of government securities in the open financial market. They are the main technique used by central banks to manage the *size of the monetary base*. Whereas reserve requirements affect the money supply through control of the money multiplier, open market operations work directly on the monetary base. Since the money supply is the monetary base multiplied by the money multiplier, open market operations alter the money supply.

> **Open market operation**: central bank purchases or sales of government securities in the open financial market.

Central banks use open market operations to provide the monetary base needed to support the demand for money and the increase in the demand for money as the economy grows. If monetary policy is conducted by setting interest rates, as discussed later in the chapter, open market operations are passive. They provide the monetary base needed to meet the demand for money at the interest rate set by the central bank. An open market purchase makes a permanent addition to the central bank's assets and monetary base.

There are times when monetary policy is conducted through control of the money supply. If the money multiplier is constant, a central bank can control the size of the money supply by controlling the monetary base using open market operations. Open market purchases increase the monetary base and increased bank lending increases the money supply. Open market sales have the opposite effect.

In times of financial and economic crisis, as in 2008 and 2009, open market operations are used along with interest rate setting. High uncertainty in financial markets and falling demand in goods-and-services markets increased the demand for liquid cash balances. If interest rates are reduced close to zero without increasing lending and spending and asset demand, the central bank may undertake "quantitative easing," using open market purchase to increase the monetary base and offset a shortage of liquidity in the economy. This topic comes up again after we look at monetary policy in more normal times.

Table 10.1 illustrates an open market purchase and its effect on bank reserves and the money supply. To keep the example simple, we will assume the banks hold reserves equal to 5 percent of their deposits, $rr = 0.05$, but the public's currency holdings are constant. This means a simple money multiplier is equal to $1/rr = 1/0.05 = 20$.

**Table 10.1: An open market purchase and the money supply**

| Central Bank: Assets | | Central Bank: Liabilities | | Commercial Banks: Assets | | Commercial Banks: Liabilities | |
|---|---|---|---|---|---|---|---|
| **1. Open market purchase of \$100 million in government bonds.** | | | | | | | |
| Gov't bond | +100 | Cheque issued | +100 | No change | | No change | |
| **2. Pension fund deposits proceeds of bond sale in commercial bank.** | | | | | | | |
| No change | | No change | | Central bank cheque | +100 | Pension fund deposit account | +100 |
| **3. Central bank cheque clears giving commercial banks \$100 million in cash.** | | | | | | | |
| No change | | Cheque o/s | −100 | Central bank cheque | −100 | No change | |
| | | Cash issued | +100 | Cash reserves | +100 | | |
| | | | | (excess reserves +95) | | | |
| **4. Commercial banks increase lending and create new deposits backed by their increased cash reserves.** | | | | | | | |
| No change | | No change | | Loans | +1,900 | Deposits | +1,900 |
| **5. Final effect of central bank open market purchase.** | | | | | | | |
| Gov't bond | +100 | Cash issued | +100 | Cash reserves | +100 | Deposits | +2,000 |
| | | ($\Delta MB$) | | Loans | +1,900 | | |
| | | | | | +2,000 | | |

In the example, the central bank buys $100 million of government bonds on the open market. Assume a large pension fund sold these bonds, and received in payment a cheque for $100 million issued by the central bank. This transaction is recorded (as $100) under item 1 in the table.

Item 2 in the table records the pension fund's deposit of the central bank cheque in the commercial banking system. The commercial bank issues a deposit to the pension fund in return for the cheque drawn on the central bank.

The commercial bank does not want to hold the central bank cheque. It presents it for payment and receives, in this example, cash in the form of central bank notes. Cash is a reserve asset for the commercial bank. In item 3 in the table, the central bank has created new monetary base, which has increased the cash reserves of the commercial bank by $100. The commercial bank now has new reserves of $100 against its increased deposit liabilities of $100. Based on its reserve ratio $rr = 0.05$, it has excess reserves of $95.

Excess reserves in the commercial banking system support an increase in lending and the creation of new bank deposits. Item 4 in the table shows the final results of this loan and deposit expansion, for the entire banking system. Based on a simple money multiplier of 20, we know that the increase in the monetary base in the form of new cash reserves by $100 will result in an increase in the money supply of $2,000. Bank lending and deposit creation continue until total deposits have increased by $2,000, based on an initial deposit of $100 and increased lending of $1,900. Item 5 in the table shows these final results.

In this example, an open-market purchase increased the monetary base and the money supply. The purchase was paid for by the creation of new monetary base. An *open market sale* would have the opposite effect. The monetary base and the money supply would be reduced. An open market operation is a technique a central bank can use to shift the money supply function and affect equilibrium conditions in the money market.

Open market operations are today the principal channel by which central banks, including the Bank of Canada, manage the *longer-term* growth of the monetary base.

## The bank rate

The **bank rate** is the interest rate the central bank charges the commercial banks if the commercial banks borrow reserves. The bank rate or lending rate is set by central banks as a part of their monetary policy operations.

> **Bank rate**: the interest rate the central bank charges on its loans to commercial banks.

Suppose the banks think the minimum safe ratio of reserves to deposits is 5 percent. It does not matter whether this figure is a commercial judgment, as in Canada, or a legal requirement, as in the United States. Banks may also hold a little extra cash to cover day-to-day ups and downs in deposits and withdrawals, but maximum profit requires minimum cash holdings.

One way in which an individual bank can cover a shortage in its reserves is to borrow from other banks that have unexpected excess reserves. This creates a market for monetary base. In Canada, this borrowing and lending takes place on an overnight basis—you borrow today and repay tomorrow, at the overnight interest rate. In the United States, the rate for similar lending and borrowing among banks is the federal funds rate.

If it happens that no other bank in the system has excess reserves to lend, a bank that is short of reserves borrows from the central bank. The interest rate charged is the bank rate, which is set higher than the overnight rate by the central bank, to encourage banks to borrow and lend reserves in the overnight market.

The bank rate is used in different ways by different central banks. There is a long tradition of using changes in the rate as a signal of changes in monetary policy. A cut in the bank rate signals the central bank's intention to increase the monetary base. A rise in the bank rate signals tighter monetary conditions. The role the bank rate currently plays in Canada is discussed later in this chapter.

## Money supply versus interest rates

Control of the monetary base through open-market operations and stable desired reserve and cash ratios for the banks and the public give the central bank control of the money supply. This is easy in theory but not in practice.

There are several problems. Can the central bank control the monetary base precisely? The commercial banks can borrow from the central bank at the bank rate when they are short of reserves. Borrowings increase the monetary base. In more difficult financial market circumstances, like those of 2007 to 2009, orderly financial markets may call for large changes in the monetary base to offset extraordinary demands for cash. Meeting these demands takes time and adds to turmoil in markets.

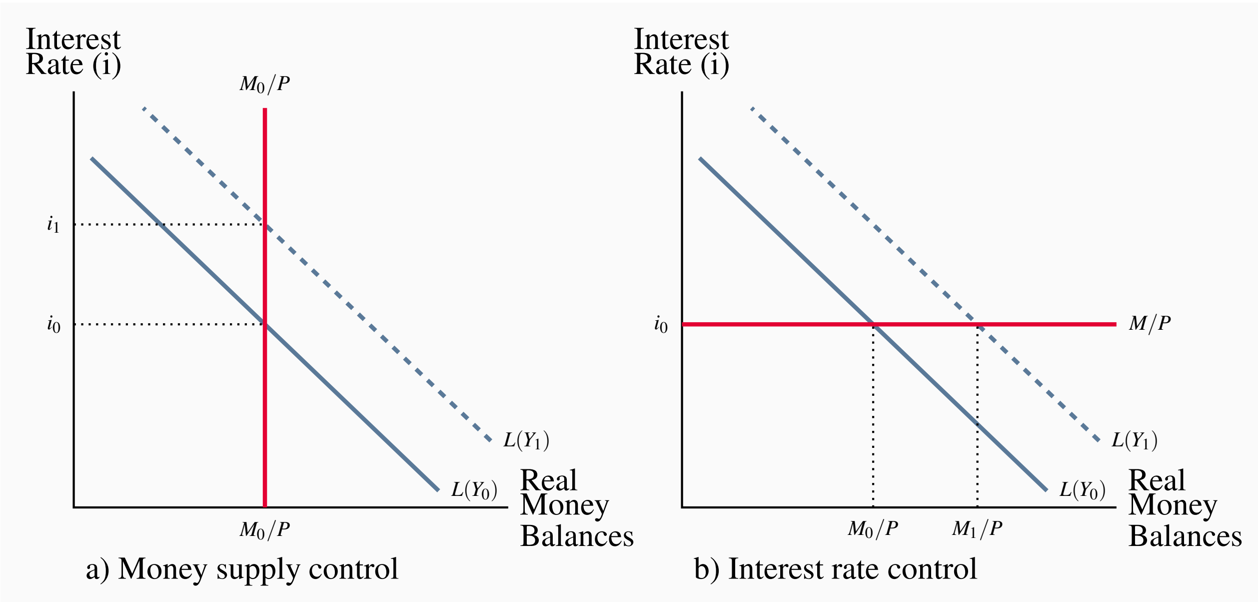
What is the size of the money multiplier? Are desired reserve ratios and cash ratios *stable and predictable* or do they fluctuate? If they fluctuate, the size of the money multiplier is difficult to predict. The money supply function may be unstable.

What money supply measure should the central bank control: MB, M1B+, M2, M2+, or some other aggregate? Households and businesses can shift among the different deposits with different terms and interest rates. Furthermore, the banks are imaginative and competitive in developing new types of deposits.

In short, precise control of the money supply is difficult. Most central banks no longer try. Instead, they set interest rates. The television news and financial press report decisions by the central bank about interest rates, not decisions about money supply. The Bank of Canada and the United States Federal Reserve make regular announcements about their settings of the overnight rate and the federal funds rate, respectively. Two examples of changes in the overnight interest rate by the Bank of Canada were noted in the introduction to this chapter.

Figure 10.1 shows the money market under two different conditions. In both cases we draw the demand for money function $L(Y_0)$ for a given level of real GDP. If the central bank can control money supply, then, for a given level of prices, it fixes the money supply at $M_0/P$. The equilibrium interest rate is $i_0$. This is the case in Panel a) of the figure.

**Figure 10.1: Money supply control vs. interest rate control**




a) We assume the central bank can fix the money supply at $M_0/P$ and the equilibrium rate is $i_0$. An increase in $Y$ increases demand for money from $L(Y_0)$ to $L(Y_1)$. With a fixed money supply, the interest rate rises to $i_1$. Alternatively, if the central bank knows the demand for money it can control money supply using interest rates. When $Y$ increases it increases $i$ to $i_1$ to reduce the demand for money to its money supply target. A fall in $Y$ would call for a fall in interest rates to control money supply. b) We assume the Bank sets the interest rate at $i_0$. To do this it must supply whatever quantity of money is demanded at $i_0$. An increase in $Y$ increases $L$ and results in an increase in $M/P$. Now the money supply is demand determined.

Alternatively, the central bank can fix the interest rate at $i_0$ and supply whatever money is needed to clear the market at this rate. This is the case in Panel b). In equilibrium, the central bank supplies exactly the quantity of money demanded at interest rate $i_0$. The quantity of money supplied is still $M_0/P$, but the money supply function is horizontal at the interest rate $i_0$.

*The central bank can fix either the money supply or the interest rate* ***but not both****. If it fixes the money supply, it must accept the equilibrium interest rate implied by the demand for money. If it fixes the interest rate, it must accept the equilibrium money supply implied by the demand for money equation. Central banks now do the latter.*

## 10.3 Monetary policy objectives & instruments targets

A central bank can use the power it has over the monetary base and interest rates to pursue any one of three possible *instrument targets*. It might:

1. Control the foreign exchange rate, or
2. Control the money supply, or
3. Control the inflation rate.

However, *it must choose*. Controlling one of these instrument targets uses all the central bank's power, and it cannot pursue a second target at the same time.

The central bank chooses among these instrument targets based on its judgment as to which target will achieve the best results in terms of its broad *monetary policy objective*: To promote economic stability at potential output with low inflation. The Bank of Canada has conducted its monetary policy in terms of each of these instruments at different times in the recent past.

The brief discussion of the foreign exchange rate in Chapter 9 explained that changes in interest rates will result in changes in the foreign exchange rate. Wealth holders shift their financial portfolios between assets of different countries based on differences in interest rates and bond yields between countries. Rather than allow private supply and demand in the foreign exchange market to set the exchange rate, the central bank can intervene to control the rate. It buys or sells foreign exchange in the market, which affects the supply or demand for Canadian dollars in the foreign exchange market and changes the exchange rate.

Central bank purchases or sales in the foreign exchange market change the domestic monetary base just like open market operations in domestic money market. The domestic money supply and interest rates change until the difference between domestic and foreign interest rates is eliminated. To maintain a fixed **exchange rate target**, the central bank matches domestic interest rates to those set in the country to which it wishes to fix its exchange rate. In Canada, for example, to fix the exchange rate between the Canadian dollar and the US dollar, the Bank of Canada would set its interest rate equal to that set by the Federal Reserve.[2]

> **Exchange rate target**: monetary policy maintains a fixed price for foreign currency in terms of domestic currency.

A central bank may choose to fix the exchange rate because it believes that is the best way to achieve the broader objectives of monetary policy. Canada operated with fixed exchange rates from 1962 to 1970. The Canadian-dollar price of the US dollar was fixed at $1.075, and the Bank of Canada focused its monetary policy on that target. During the late 1950s and early 1960s, there was an intense debate over the monetary policy pursued by the Bank of Canada. Economic growth was slow, unemployment rates were high, and there was turmoil in financial markets. A

[2] Different exchange rate policies are explained in detail in Chapter 12.

fixed exchange rate was seen as the best solution to these economic problems. It essentially gave Canada the monetary policy of the United States, where economic performance had been stronger and more stable than in Canada. The fixed exchange rate target determined Canadian interest rates and money supply until 1970.

Rather than fixing the exchange rate, a central bank can choose to fix the size or growth rate of the domestic money supply. Chapter 9 discussed the money market in terms of a fixed money supply. However, central banks have found that the money multiplier, based on the desired reserve ratios of the banks and cash holdings of the public, is not stable enough to give them control of the money supply directly through their control of the monetary base. Instead, they set interest rates to get their target money supply from the demand for money. If money supply is above their target, they raise interest rates, reducing the demand for money until money holdings fall within their target range. They reduce interest rates if money holdings are less than their target.

In the 1970s, a sharp rise in inflation shifted the focus of monetary policy toward inflation control. At that time, developments in economic theory emphasized a strong link between money, money supply growth, and inflation. Central banks in many industrial countries shifted their focus to money supply control. Canada had dropped the fixed exchange rate target in 1970. In 1975, the Bank of Canada adopted **money supply targets** as its policy instrument and used them until 1982 in an attempt to control inflation and promote a strong economy. By adjusting interest rates based on its understanding of the demand for money balances, the Bank was able to meet the targets for the growth in the money supply M1 that it set and revised from time to time.

> **Money supply target**: a central bank adjusts interest rates and the monetary base to control the nominal money supply, or the rate of growth of the nominal money supply.

However, controlling the money supply required wide fluctuations in interest rates and in the exchange rate. Financial markets did not like this volatility. More importantly, success in controlling M1 did not bring success in controlling inflation. The relationship between money supply, prices, and inflation turned out to be less stable than expected. The Bank abandoned its M1 control targets in 1982 and began a search for a better target for monetary policy.

In the early 1990s, the Bank of Canada and central banks in many other countries, including Australia, New Zealand, Sweden, the United Kingdom, and the European Union, decided to set explicit **inflation rate targets** for monetary policy. The Bank of Canada began to use *interest rate setting* as its **monetary policy instrument**, making changes in the interest rate, as necessary, to keep the Canadian inflation rate within a target range of 1 percent to 3 percent.

The shifts to formal inflation targets for monetary policy in 1991, and the adjustment to that policy shift, were sources of a substantial policy debate in Canada. Inflation was reduced as planned, but with a deep and prolonged recession in real GDP and persistently high rates of unemployment. Sustained economic growth did not resume until the mid-1990s, and by most estimates, including those by the Bank of Canada, the recessionary GDP gap persisted until the end of the decade.[3] The Bank continues today to focus on an inflation rate in the 1 percent to 3 percent range as its monetary policy target. A summary of the costs and benefits of inflation that lie behind its inflation targeting are offered by the Bank of Canada at:

`www.bankofcanada.ca/wp-content/uploads/2010/11/benefits_low_inflation.pdf`

> **Inflation rate target**: monetary policy objective defined as an announced target inflation rate.
>
> **Monetary policy instrument**: the monetary variable the central bank manipulates in pursuit of its policy target.

## Bank of Canada operating techniques

In Canada, the **overnight rate** is now the Bank of Canada's key policy instrument. This is the interest rate that large financial institutions receive or pay on loans from one day until the next. The Bank implements monetary policy by setting a target for the overnight rate at the midpoint of an *operating band* that is plus or minus one-quarter of one percentage point, or 25 basis points, from the target rate.

> **Overnight rate**: the interest rate large financial institutions receive or pay on loans from one day until the next.

The *bank rate* now marks the upper end of this operating band for the overnight rate. It is still the rate at which the Bank of Canada is willing to lend to the banks. The lower end of the operating band, *the deposit rate*, is the interest rate the Bank of Canada pays on deposits. Because the highest cost of borrowing cash is the bank rate, and the lowest return from lending cash is the deposit rate paid by the Bank of Canada, the rate on overnight borrowing and lending among the banks falls within the target range set by the Bank of Canada.

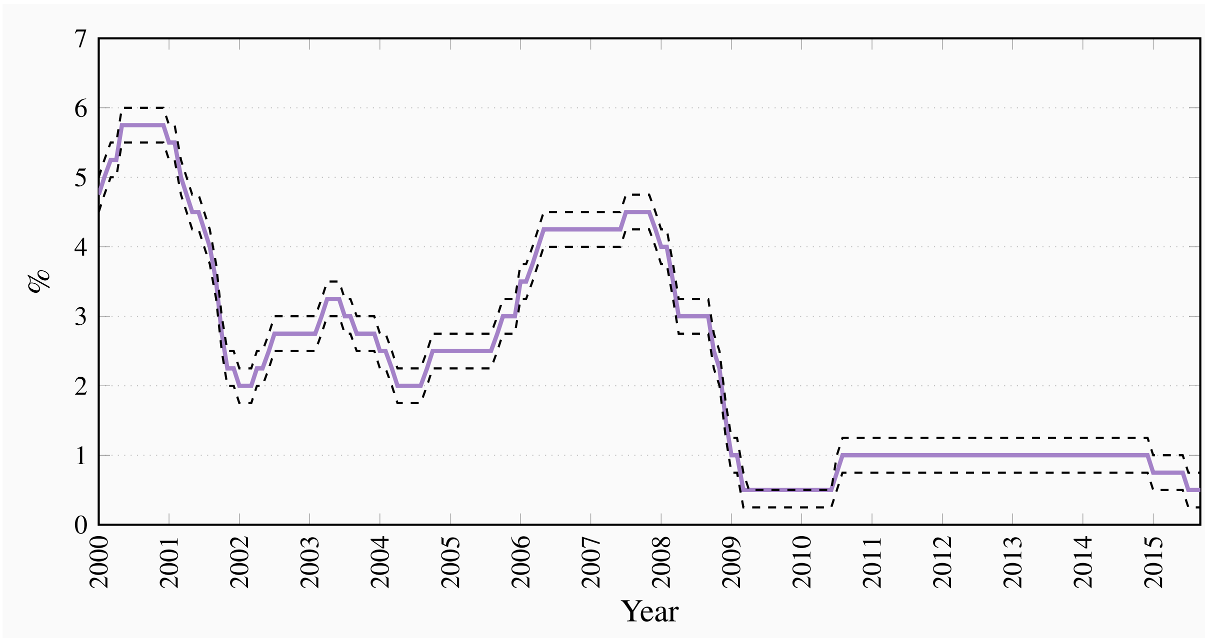
The Bank of Canada tells financial markets the direction in which it wants interest rates to move, by making changes to its target overnight rate and operating band as it did in January and July 2015. Changes in the target overnight rate lead to changes in interest rates banks offer to lenders and depositors. A lower target lowers bank lending rates, encouraging more borrowing by households and businesses and a corresponding expansion in the money supply.

Figure 10.2 shows the Bank's settings and changes of the overnight interest rate operating band over the past 13 years. From mid-2004 to late 2007, for example, the plot shows the Bank raised its overnight rate setting by steps of 0.25 percent (25 basis points) from 2.5 percent to 4.5 percent.

[3] You can read about this debate in: D. Laidler, and Wm. Robson, The Great Canadian Disinflation: The Economics and Politics of Monetary Policy in Canada 1988-1993 (Toronto: C.D. Howe Institute, 1993). P. Fortin, "The Great Canadian Slump," Canadian Journal of Economics 29, No. 4 (August 1996), pp. 1082-1092. C. Freedman and T. Macklem, "A Comment on the 'Great Canadian Slump' ", Canadian Journal of Economics 31, No. 3 (August 1998), pp. 646-665.

Its intention was to reduce monetary stimulus to keep the economy working at potential output, with projected growth of real GDP at 3.0 percent and projected inflation at its target 2.0 percent.

**Figure 10.2: The Bank of Canada operating band for the overnight rate**




*Source*: Statistics Canada, CANSIM Series V39076, V39077, V39079.

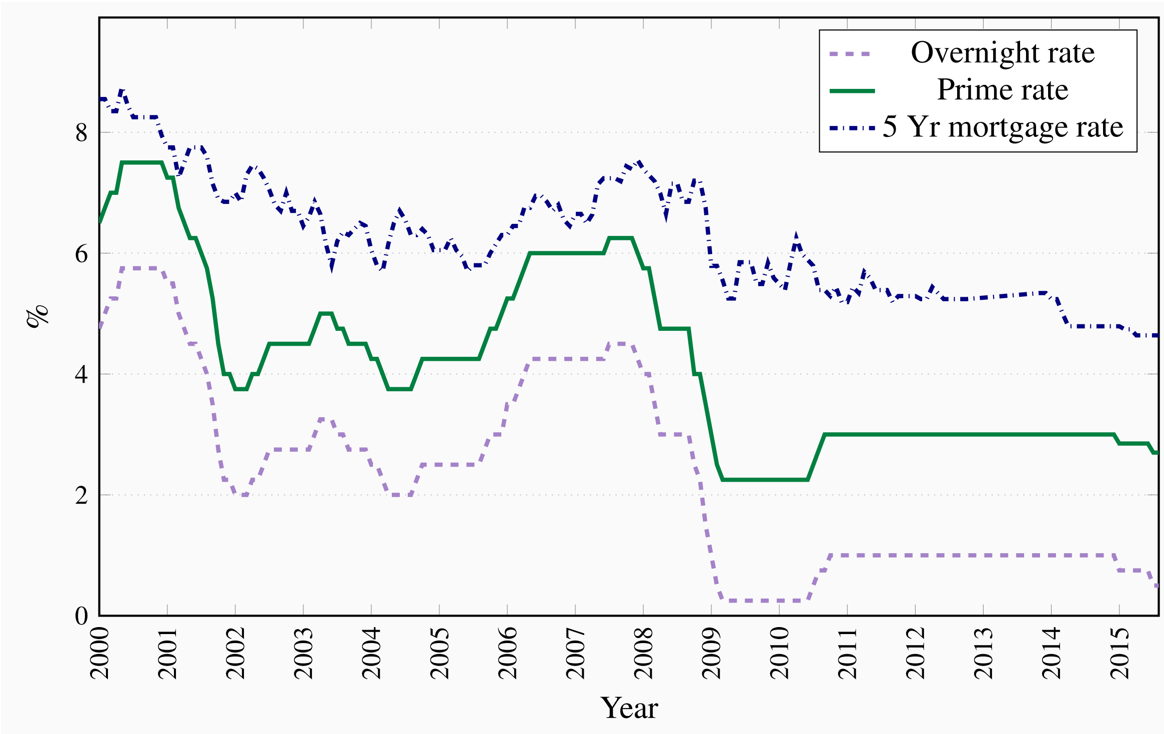
By contrast from July 2007 to March 2009 the Bank cut its setting for the overnight rate, in steps of 25 to 75 basis points, by a total of 400 basis points from 4.5 percent to 0.5 percent. Its intention then was to provide stimulus to and support for domestic financial markets and economic activity as the global financial crisis developed and spread. You can read a brief analysis underlying each of the Bank's decisions to change or hold constant its overnight rate target in the press releases on the Bank's website:

http://www.bankofcanada.ca/publications-research/press-releases/.

By setting the overnight interest rate, the Bank has a direct impact on interest rates that are important to the monetary transmission mechanism. Banks respond to a rise in the overnight rate by raising their **prime lending rate**, which is the base for most of the interest rates on their lending. Rates on business and consumer lines of credit, for example, are linked to the prime rate, and move up and down with it. The connection to mortgage rates is also strong and they move with the overnight rate, although the link is not quite as tight. These interest rates cover about two thirds of bank financing in Canada. They make a strong link between the Bank of Canada's monetary policy action, expenditure, and aggregate demand. Figure 10.3 shows the relationship between changes in the setting of the overnight rate and other interest rates.

**Prime lending rate**: the base for setting the interest rates charged by banks on loans and lines of credit.

**Figure 10.3: The overnight rate, prime rate and 5 year mortgage rate**




*Source*: Statistics Canada, CANSIM Series V39079, V122495, V122521.

Other countries implement monetary policy by setting similar interest rates. The overnight rate set by the Bank of Canada is comparable to the United States Federal Reserve's target for the 'federal funds rate', and the Bank of England's two-week 'repo rate', and the minimum bid rate for refinancing operations, the 'repo rate', set by the European Central Bank.

Institutional arrangements are the key to the Bank of Canada's use of the overnight rate as its policy instrument. The payments made by individuals and businesses, and their receipts, flow through the banking system. Some are small paper-based transactions that involve the writing of cheques on deposit accounts. Others, and indeed the majority, are transfers of large deposits between bank customers. On any day, an individual bank may take in more deposits through these transfers than it pays out, or pay out more than it takes in. Any difference in either case is settled using balances held on deposit at the Bank of Canada. Technology now allows for *same day settlement* of large-value transactions, and an individual bank's settlement balances can change quickly.

Chartered banks in Canada operate under a *zero settlement balance requirement*. This means that the balances they hold in their deposit accounts at the Bank of Canada cannot be less than zero at the end of the day. If a bank's account is overdrawn from making payments to other banks, it must borrow to cover the overdraft either from another bank or from the Bank of Canada. Borrowing from other banks costs the *overnight rate*. Borrowing from the Bank of Canada costs the *bank rate*, which is set by the Bank of Canada as one-quarter of a percentage point above the overnight rate. As a result, falling short of the zero-balance requirement imposes a cost on a bank, reducing its profitability, which it would like to avoid.

A positive settlement balance also imposes a cost. The Bank of Canada does pay interest on a positive balance in a bank's account, but it pays at its *deposit rate*. That rate is set one-quarter of one percentage point below the overnight rate. Not lending a positive balance to another bank at the overnight rate and accepting the Bank of Canada's *deposit rate* carries an opportunity cost a bank would prefer to avoid. This is a further incentive to maintain a zero settlement balance at the Bank of Canada.

This regulatory and institutional environment gives the Bank of Canada a framework for setting the interest rate to implement its monetary policy. The Bank makes eight scheduled announcements per year about its target for the overnight rate, and the operating band it is setting for the overnight rate. These announcements are made in press releases and include a brief explanation of the economic conditions on which the Bank's rate-setting decision is based.

## Special purchases and sales (SPRAs and SRAs)

To maintain the overnight interest rate within the target band, the Bank of Canada must intervene in the market to cover any shortages or remove any surpluses of funds that would push rates beyond its target. The Bank has two tools it uses for this purpose.

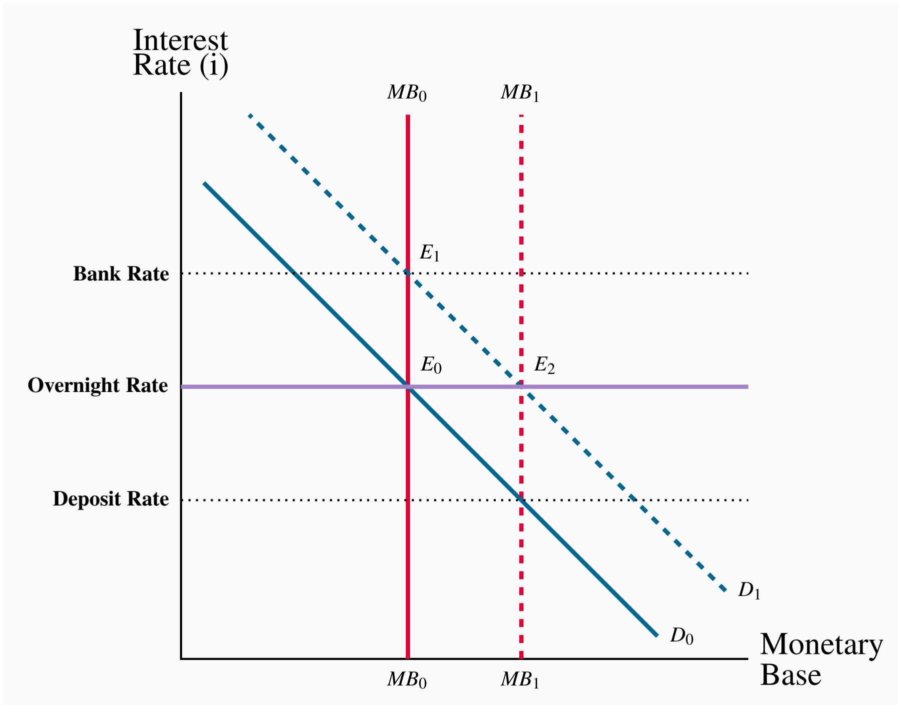
One tool is the **special purchase and resale agreement (SPRA)**. This is a transaction initiated by the Bank of Canada that puts cash into the system on a very short-term basis. It is used to maintain the target overnight rate, more specifically to offset upward pressure on the rate.

In an SPRA, the Bank offers to buy Government of Canada securities from major financial institutions with an agreement to sell them back the next business day, at a predetermined price. The financial market gets an overnight injection of monetary base. The difference between the purchase and resale price determines the overnight interest rate on the transactions. Banks are willing to enter into these agreements with the Bank of Canada because they provide cash for the banks at rates of interest below what they would otherwise have to pay in the overnight market.

> **SPRA**: A Bank of Canada purchase of securities one day combined with an agreed resale of the securities the next day.

Figure 10.4 shows how this works. We start in equilibrium at $E_0$ with the demand for cash reserves just equal to the supply of monetary base at the overnight rate set by the Bank. Suppose a change in economic and financial circumstances causes a *temporary* increase in the demand for cash and settlement balances. The demand for monetary base shifts to the right to $D_1$. If the Bank took no action the overnight rate would rise to $E_1$ at or even above the target band the Bank has set for the overnight rate. To prevent this, the Bank provides an overnight increase in the monetary base by buying securities on the agreement that it will sell them back the next business day. This is an SPRA. It gives a temporary increase in monetary base to $MB_1$ and reinforces the Bank's overnight rate.

**Figure 10.4: Setting the overnight interest rate**




In the opposite case of a fall in the demand for monetary base, the Bank makes use of a second tool to reduce the monetary base; namely, a **sale and repurchase agreement (SRA)**. This is a sale of securities to major financial institutions for one day combined with a repurchase the following day. It makes a one day reduction on the monetary base to offset a drop in the demand for cash that has put downward pressure on the overnight rate.

> **SRA**: A Bank of Canada sale of securities one day combined with an agreed repurchase of the securities the next day.

What if the increased demand for monetary base is permanent, not just a one-day event? Chapter 8 showed how the demand for monetary base comes from public demand and from bank demand for cash and reserve balances. Increases in nominal income increase the demand for money, including cash. Suppose the increased demand for monetary base shown in Figure 10.4 is permanent, the result of growth in the economy. Now, if the Bank of Canada wants to keep the overnight rate constant, it must make a permanent increase in the monetary base, not just an overnight increase. It will do this using the open-market operations discussed earlier. An open-market purchase of government securities makes a lasting increase in the Bank of Canada's asset holdings, permanently increasing the monetary base.

While these operations by the Bank of Canada may seem quite complex, they have a simple effect. Like open-market operations, SPRAs and SRAs increase or decrease the monetary base. In this case, however, the buyers and sellers in the market are limited to a few major financial institutions rather than the full market. Furthermore, changes in the monetary base are very short term, just one day. The objective is to set and control short-term interest rates, the *monetary policy instrument* used by the Bank of Canada.

## 10.4 Monetary policy rules

Most central banks now use interest rates as the main instrument of monetary policy. But how does a central bank decide what rate of interest to set and when to change its settings of the interest rate? What lies behind the announcement of the overnight rate by the Bank of Canada or the setting of the federal funds rate in the United States? How are these interest rate decisions related to economic variables? Professor John Taylor of Stanford University found that most central banks, in fact, adjust interest rates in response to changes in two variables, output and inflation.

This finding was contentious. It implied monetary supply targets no longer played a role in decisions about setting interest rates. Instead, the interest rate target was and is set based on expected inflation and expected output relative to the central bank's inflation target and the economy's potential output.

A central bank that follows a Taylor rule cares about output stability as well as price stability. However, the basic aggregate demand and supply model in Chapter 5 showed that deviations of output from potential output had predictable effects on prices and inflation rates. Booms leading to inflationary gaps push prices up and lead to inflation. Recessionary gaps tend to reduce inflation. Thus, a Taylor rule is also compatible with the interpretation that the central bank cares about prices and inflation, both now and in the future. It is hard to distinguish empirically between these two interpretations of why a Taylor rule is being followed. Indeed, recently inflation rates in most industrial economies have been very low and central banks have come to focus more on output gaps and corresponding unemployment rates in making their interest rate setting decisions.

Nevertheless, until the financial crisis of 2008, Taylor's claim that such a rule effectively described central bank policy had strong empirical support. Most of the leading central banks, including the US Federal Reserve, the Bank of England, and the new European Central Bank used an interest rate target as a policy instrument in pursuit of an inflation control objective. Taylor's insight is so widely used that it is called the "**Taylor rule**". It still provides a useful way to explain monetary policy decisions.

**Taylor rule**: central bank interest rate settings based on inflation and output targets.

### A simple Taylor rule

It is useful to assume *prices are constant*, so the inflation rate is zero for the first part of the study of policy rules. When prices are constant, monetary policy follows the output part of a Taylor rule.

In simple terms, the rule is:

The overnight rate set ($i$) equals:

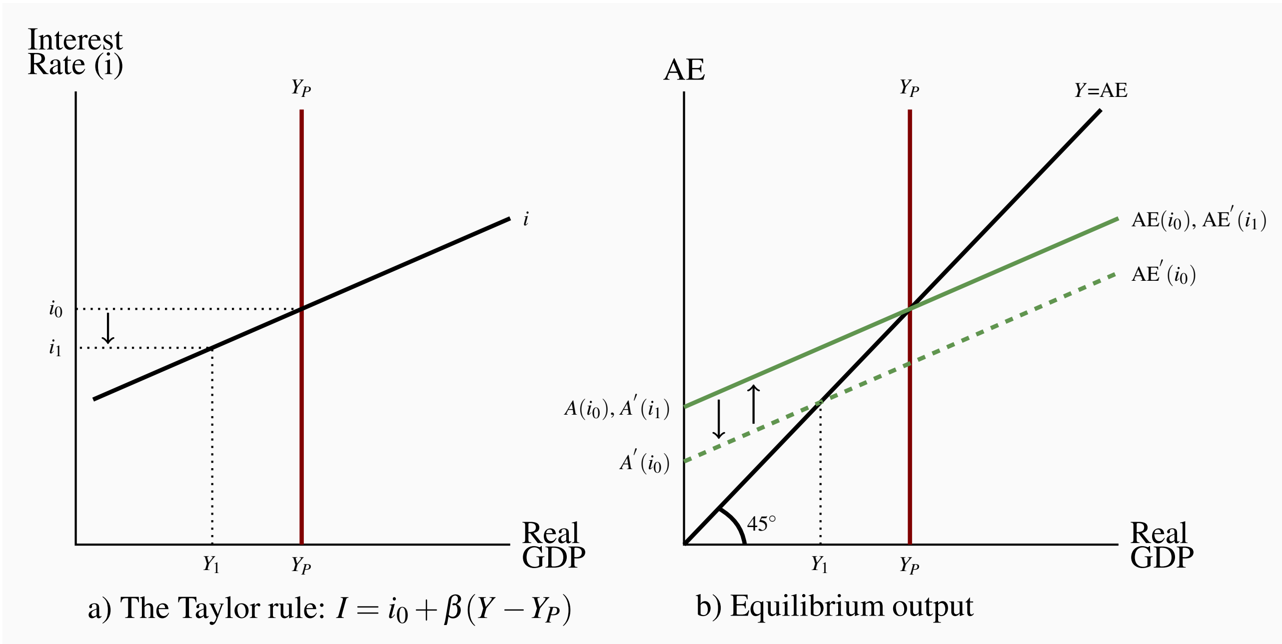
1. ($i_0$) the interest consistent with equilibrium at potential output ($Y_P$) plus an adjustment to that rate if:
2. there is currently an output gap $(Y - Y_P) \neq 0$, which can be written as:

$$i = i_0 + \beta(Y - Y_P) \tag{10.1}$$

When real output ($Y$) is at potential output ($Y_P$), the output gap is zero and the interest rate is set at $i_0$. That is the central bank's judgment on the interest rate required to support aggregate demand and equilibrium at potential output. If, according to this rule, output temporarily exceeds $Y_P$, $(Y - Y_P) > 0$, the central bank raises interest rates to reduce aggregate expenditure. At levels of output below $Y_P$, it lowers interest rates. The size of the difference between $i$ and $i_0$ is determined by the size of the parameter $\beta$, which reflects the central bank's estimate of the size of the effect of an interest rate change on aggregate expenditure.

Figure 10.5 shows how this policy rule works. In Panel a), output is measured on the horizontal axis and interest rates on the vertical axis. A vertical line is drawn at the potential output level $Y_P$. The positively sloped line showing the central bank's reaction to fluctuations in output crosses the $Y_P$ line at the interest rate $i_0$ with a slope of $\beta$. If output were lower than $Y_P$, at $Y_1$ for example, the bank would lower interest rates to $i_1$ to provide some stimulus to aggregate expenditure.

**Figure 10.5: Interest rates and output with a simple Taylor rule**




a) Central bank sets interest rate $i_0$ consistent with $Y_P$. $Y \neq Y_P$ changes $i$ with a set range. Slope of line defines central bank reaction to *temporary* $Y \neq Y_P$. b) A fall in $A(i)$ causes recessionary fluctuation in $Y$ to $Y_1$. Bank reacts, allowing $i < i_1$. Lower $i$ increases $A(i)$ to restore AE and equilibrium $Y = Y_P$. If decline in $A$ is persistent and not offset by small fall in $i$ the Bank will reset its target rate.

Alternatively, for an output greater than $Y_P$, the central bank would raise interest rates to reduce aggregate expenditure. This simple Taylor rule describes how the central bank resets its interest rate to achieve the target of equilibrium output at $Y_P$, and reacts to offset or moderate *temporary fluctuations* about $Y_P$.

Panel b) shows the effect of the changes in interest rates on equilibrium output. We studied the transmission mechanism from interest rate changes to expenditure changes in Chapter 9. The central bank chooses the interest rate $i_0$ that gives aggregate expenditure AE$(i_0)$ and equilibrium output at $Y_P$.

If *short-run* economic conditions changed and autonomous expenditure declined, the AE line would shift down to AE$'(i_0)$. $Y$ would fall to $Y_1$, which is less than $Y_P$. From the Taylor rule in Panel a), we see the reaction of the central bank. It lowers the interest rate to $i_1$. Lower interest rates work through the cost of and availability of finance, wealth effects, and exchange rate effects to increase expenditure. The AE line shifts back up to AE$'(i_1)$ to restore equilibrium at $Y_P$. By reacting to temporary changes in the state of the economy, the central bank attempts to stabilize output at $Y_P$.

A specific Taylor rule in Figure 10.5 sets an interest rate target $i_0$ based on an assessment of the *fundamental conditions* in the economy that underlie potential output. It calls for changes in the interest rate in response to temporary fluctuations in those conditions. A more lasting change in economic conditions would need a different policy rule. Changes in the Bank of Canada's overnight interest rate in 2015 in response to falling oil and commodity prices provide an example. The central bank would choose an interest rate target different from $i_0$, and appropriate to equilibrium at $Y_P$ in the new conditions. A more expansionary monetary policy at each output level would mean a target rate lower than $i_0$. The policy rule line in Panel a) would shift down to cross the vertical line at $Y_P$ at the new lower target rate. A more restrictive policy would shift the line vertically up. Changes in the overnight rate in Canada or the federal funds rate in the United States are announced to tell financial markets of these changes in monetary policy.

## Policy rules and inflation

The assumption that prices are constant ignores the importance of inflation, making a policy rule based on the output gap alone too simple. Central banks today, like the Bank of Canada, conduct their monetary policy by setting *inflation targets*. The Bank of Canada's inflation target of 2 percent with an operating band of 1 percentage point on either side. This does not mean that they ignore the level of output in the economy. Instead, inflationary and recessionary gaps, and changes in unemployment rates, are seen as important predictors of future inflation. The simple monetary policy rule of Equation 10.1 is easily extended to recognize this current approach to monetary policy.

The central bank's setting of its interest rate instrument could then be:

1. ($i_0$) the interest consistent with equilibrium at potential output ($Y_P$) plus an adjustment to that rate if:
2. ($\pi$) the current inflation rate differs from $\pi^*$, the Bank's inflation rate target plus a second adjustment if:
3. ($Y - Y_P$) the output gap does not equal zero.

This gives a basic equation that describes the central bank's policy reaction to economic conditions.

$$i = i_0 + a(\pi - \pi^*) + \beta(Y - Y_P) \tag{10.2}$$

As before, the central bank sets an interest rate $i_0$. This is the nominal interest rate the bank thinks is consistent with output at potential output and inflation at the target rate $\pi^*$ under current conditions.

The Bank of Canada's current inflation target, for example, is $\pi^* = 2.0$ percent, the midpoint of a 1 percent to 3 percent range. If inflation rises above the target $\pi^*$, the central bank raises the nominal interest rate. The parameter $a$ in the equation tells us by how much the nominal interest rate is changed in response to an inflation rate different from the bank's target.

Expenditure decisions depend on the interest rate. To stick to its inflation target, the bank must change the interest rate by changing the nominal interest rate by more than any change in inflation. This requires the parameter $a > 1$. A rise in inflation is then met by a rise in interest rates that is large enough to reduce expenditure and inflationary pressure.

By this rule, the central bank also reacts to any departure of output from potential output, as it did in our earlier study of the simple rule, Equation 10.1. The parameter $\beta$ measures how much the central bank would raise the interest rate in response to an inflationary gap, or lower it in response to a recessionary gap. Output stabilization requires that interest rates be raised in the case of an inflationary gap or lowered in the case of a recessionary gap thus $\beta$ is greater than zero ($\beta > 0$).

Changing interest rates to offset an output gap is intended to stabilize output, but it will also work to offset any changes in the *future* inflation rate that would be caused by a persistent output gap. The size of the central bank's reactions, as measured by the parameters $a$ and $\beta$ are indications of the relative importance it attaches to inflation control and output stabilization.

Any change in economic conditions that the central bank thinks is *going to last for some time* will result in a change in its setting of $i_0$. The policy line in a diagram would shift up or down. Interest rates would then be higher or lower for all inflation rates and output gaps, depending on the change in $i_0$. The central bank would announce this change in the setting of its policy instrument, the overnight rate in Canada or the federal funds rate in the United States. Bank of Canada press releases explain overnight rate settings. See for example:

http://www.bankofcanada.ca/2015/10/fad-press-release-2015-10-21/

This approach to monetary policy has similarities to our earlier discussion of fiscal policy. In that case, we distinguished between automatic and discretionary policy. In the case of monetary policy, the discretionary component is the setting of the operating range for the overnight rate. These decisions are based on an evaluation of longer-term economic conditions relative to the target inflation rate. It *positions* the monetary policy line in a diagram in much the same way as the structural budget balance *positions* the government's *BB* line in Chapter 7. Short-term fluctuations in economic conditions result in short-term variations in the overnight rate—movements along the monetary policy line. This is similar to the automatic stabilization that comes from movements along the government's *BB* line as a result of fluctuations in output and income.

*There is, however, an important difference between monetary and fiscal policy. Monetary policy that uses the interest rate as the policy instrument provides strong automatic stabilization in response to money and financial market disturbances. Automatic stabilization in fiscal policy reduces the effects of fluctuations in autonomous expenditures.*

## The effective lower bound (ELB)

The financial crisis and recession of 2008-09 led to new and more intense monetary policy actions by central banks. Most continued with cuts to basic policy rates as their first response. The Federal Reserve in the United States lowered its federal funds rate, in steps, to a range of zero to 0.25

percent. The Bank of Canada followed, lowering its overnight rate setting to 0.5 percent by early March 2009. But these lower rates were not sufficient to stimulate borrowing and expenditure. Banks and other lenders were concerned by the increased risks of losses on their current lending and the risks involved in new lending. They had suffered losses on previous large denomination fixed term and mortgage lending. Bankruptcies were rising across many business and consumer loan markets.

With their policy interest rates cut to near zero, central banks hit the **effective lower bound (ELB)**. Nominal interest rates could not be reduced any further. Central banks needed additional policy tools to meet deep concerns about risk and liquidity in financial markets. Increased demands for liquidity raised desired reserve and currency holdings and lowered money supply multipliers in many countries, and restricted access to bank credit.

> **Effective lower bound (ELB)**: A Bank's policy interest rate cannot be set below a small positive number.

Two previously used techniques were introduced. The first was increased "**moral suasion**," an increase in communications with financial market participants to emphasize the central bank's longer-term support for markets and its actions to promote stability. More directly the banks were urged to maintain their lending operations.

> **Moral suasion**: a central bank persuades and encourages banks to follow its policy initiatives and guidance.

The second was "**quantitative easing**," and in the case of the US, an even more extensive "**credit easing**." "Quantitative easing" is the large scale purchase of government securities on the open market. It expands the central bank's balance sheet and the size of the monetary base. A version of this policy action was used in Japan earlier in the decade after the Bank of Japan had lowered its borrowing rate to zero and wanted to provide further economic stimulus.

> **Quantitative easing**: a large scale purchase of government securities to increase the monetary base.

Credit easing is measured by the expanded variety of loans and securities the central bank willingly holds on its balance sheet. These come from purchases of private sector assets in certain troubled credit markets. The mortgage market for example was in trouble as a result of falling real estate prices and mortgage defaults. Cash is put directly into specific markets rather than letting it feed it through commercial banks' lending and loan portfolio decisions.

> **Credit easing**: the management of the central bank's assets designed to support lending in specific financial markets.

Monetary policy practice continues to evolve. In the last few years, with policy interest rates at or near the effective lower bound and persistent weakness in economic growth and employment, major central banks have relied increasingly on "**forward guidance**" to support their economies. Forward guidance is contained in the explanation a Bank gives in its formal announcement of setting of the policy interest rate. If for example the Bank's opinion that economic growth and inflation will be slow and weak, the Bank suggests that interest rates will be unchanged for some time into the future. Alternatively a prediction of a revival in growth and inflationary pressure may lead the Bank to predict increases in policy interest rates in the near future.

> **Forward guidance**: information on the timing of future changes in the central bank's interest rate setting.

This forward guidance is intended to help firms and households make expenditure decisions that require debt financing. In some cases it is based on an explicit economic criterion.

For example, the US and the UK recently introduced unemployment rate thresholds for changes in the monetary policy rate settings. This is in essence a variety of forward guidance. In the UK, for example, in August 2013 the Bank of England, under the heading "Forward Guidance" announced:

> *In particular, the MPC [Monetary Policy Committee] intends not to raise Bank Rate from its current level of 0.5% at least until the Labour Force Survey headline measure of the unemployment rate has fallen to a threshold of 7%, subject to the conditions below.*
>
> *Source*:
>
> `www.bankofengland.co.uk/monetarypolicy/pages/forwardguidance.aspx`

In effect, putting an unemployment rate target into the interest rate setting rule is a variation on the Taylor Rule specified by Equation 10.2. It adds to or replaces the output gap target with an unemployment rate target.

## 10.5 Monetary policy indicators

Policy rules describe how a central bank, like the Bank of Canada, would use interest rates to stabilize output, prices, and inflation in the economy. To see how the Bank's actions affect economic activity and inflation, we need some indicators of the expansionary or restrictive stance of monetary policy. These **monetary policy indicators** will allow us to go beyond the central bank's descriptions of its policy and observe the effects of its policy actions on monetary conditions in the economy.

> **Monetary policy indicators**: variables that provide information about the stimulus or restraint coming from the central bank's policy.

Our earlier discussion of the monetary transmission mechanism suggests two monetary policy indicators, namely, *interest rates* and *exchange rates*. The central bank sets nominal interest rates, which have important effects on asset prices, cash flows, and expenditures. Interest rates are also important to expenditure decisions. Changes in nominal interest rates over time will show how monetary policy has been implemented.

The foreign exchange rate as it affects net exports also provides an indicator of policy stance. Because exchange rates change in part as a result of interest rate differences between countries, changes in the exchange rate provide an indicator of the thrust of domestic monetary policy relative to foreign monetary policy. Although in Canada it is important to recognize that commodity prices also have strong exchange rate effects as illustrated by the recent depreciation of the Canadian dollar.

The monetary transmission mechanism works through both interest rates and exchange rates. In setting its interest rates, a central bank in a small open economy needs to consider recent changes in the exchange rate. If economic conditions, or policies in other countries, have caused changes in the foreign exchange rate, those changes will affect expenditures and output in Canada.

The depreciation of the Canadian dollar in 2015 is an important example. The corresponding appreciation of the US dollar raised import prices and increased the profitability of exports. Even without monetary policy, action expenditure and output in Canada would rise. The Bank of Canada had to make a decision. Was the setting of its operating range for the overnight rate still consistent with its inflation target once the exchange rate had risen? Should the Bank count on the stimulus from the exchange rate to offset the effects of lower energy and commodity prices or cut its interest rate to provide some further stimulus? If it were to respond, by how much should it lower interest rates? The Bank of Canada lowered interest rates. In this case the combined effect of interest rates and exchange rates was increased stimulus. However, the Bank could have decided that the exchange rate alone would suffice or even that the exchange rate depreciation gave too much stimulus. Clearly both are very important for designing and judging and monetary policy.

While interest rates and exchange rates provide important indicators of monetary policy, many economists and the Bank also regard the money supply or the rate of growth of the money supply as a policy indicator. Some suggest a monetary policy rule for money supply, which uses money supply as the central bank's policy instrument. The demand for nominal money balances depends on nominal income. Taking this into account, the difference between the rate of growth of the money supply measure, M1B, and the rate of growth of nominal GDP provides an indicator of the stance of monetary policy. M1B growth that exceeds growth in nominal GDP provides easier financial market conditions and suggests an expansionary policy stance.

The growth rates in the money aggregates M1B+ and real M2+, adjusted for inflation, provide alternative indicators of the effect of monetary policy. In the current policy context, the Bank of Canada sets the interest rates and the growth rates of money supply reflect the demand for money balances at those interest rates. Empirical research at the Bank and by other monetary economists has found that the growth in real M1B+ is a useful indicator of future growth in real GDP. Growth in real M2+ also provides a leading indicator of inflation. From these findings, an observed increase in the growth rates of these money aggregates indicates that the Bank's current policy is adding to aggregate demand.

Thus we have a basic set of monetary policy indicators: interest rates, exchange rates, and the growth rate in nominal and real measure of money supply. They come from our understanding of the way changes in monetary variables may affect expenditures, incomes, and prices and from our discussion of how monetary policy is designed and implemented. The Bank of Canada provides a more extensive list of key monetary policy variables at:

http://www.bankofcanada.ca/rates/indicators/key-variables/

## Next

This chapter completes the development and explanation of the basic expenditure and monetary structure of the economy under the assumption that the general price level is constant. Chapter 11 introduces a basic modern AD/AS model that explains short-run fluctuations, output, and inflation. That model is built on modern monetary policy that sets interest rates to achieve inflation control. It is used to illustrate and evaluate recent Canadian fiscal and monetary policies.

# Key Concepts

**Central banks** operate to influence the behaviour of other banks and intermediaries in the financial system.

A central bank conducts **monetary policy** through its control of the monetary base and interest rates. It is also banker to the government and to the commercial banks.

The **Bank of Canada** is Canada's central bank. It is the source of the monetary base. It sets short-term interest rates, acts as banker to the commercial banks and the federal government, and is the lender of last resort to the banks.

**Monetary policy** in Canada is the responsibility of the Bank of Canada. The Bank uses its control of the monetary base and interest rates to promote economic stability at potential output and a low stable inflation rate.

Central banks have three main operating techniques: **reserve requirements imposed on commercial banks**, **open-market operations**, and **bank rate** setting. These techniques are used to manage the monetary base, the money multiplier, and interest rates.

Central banks can implement **monetary policy through the monetary base and money supply control** or through interest rate control, but cannot do both simultaneously.

In practice, the Bank cannot control money supply exactly. Thus, for most central banks, a short-term **interest rate is the instrument of monetary policy**.

The Bank of Canada uses the **overnight interest rate as its policy instrument**, and an inflation rate of **1 percent to 3 percent as its policy target**.

The Bank of Canada uses **SPRAs** and **SRAs** to intervene in the market for overnight funds and to reinforce its setting of the overnight interest rate.

A **monetary policy rule** such as a Taylor rule for setting the interest rate provides a useful description of the way the central bank sets and adjusts its interest rate policy instrument.

Changes in the central bank's policy instrument change nominal and real interest rates and change aggregate demand through the **transmission mechanism**, which includes wealth effects, cost of financing effects, and exchange rate effects on the components of aggregate expenditure.

**Quantitative easing** is the use of central bank purchases of securities with the aim of increasing the monetary base to meet unusually high demands for liquid cash balances in times of financial and economic crisis.

**Credit easing** is the increase in specific kinds of central bank asset holdings (for example, commercial paper) designed to provide liquidity and support lending in specific markets facing shortages of funds.

**Forward guidance**: information on the timing of future changes in the central bank's interest rate setting.

Real and nominal interest rates, exchange rates and rates of growth of money aggregates relative to national income can be used as **monetary policy indicators**.

## Exercises for Chapter 10

**Exercise 10.1** Explain carefully why a central bank does not operate to make a profit but a commercial bank does. What is the central bank's operating objective? What unique power does a central bank have that allows it to pursue its operating objective?

**Exercise 10.2** Explain carefully why a central bank's power to conduct monetary policy is based on its unique position as supplier of the monetary base.

**Exercise 10.3** Why would a change in the monetary base $\Delta MB$ cause a change in the money supply?

(a) Suppose a central bank buys $10 million on the open market. What effect does this have on the monetary base and the reserve position of the commercial banks?

(b) If the banks hold reserves equal to 2.5 percent of their deposit liabilities, and the public holds a constant amount of cash, calculate the effect of this open-market transaction on:
   i. The money supply.
   ii. The banks' reserve balances.

**Exercise 10.4** Suppose the central bank decides to use its power to set interest rates. Use a money market diagram to show and explain what happens to the real money supply if real output increases $(\Delta Y > 0)$ and the central bank maintains a constant interest rate.

**Exercise 10.5** In terms of a monetary policy rule

(a) What is the Bank of Canada's monetary policy target?

(b) What monetary policy instrument does the Bank use to pursue this target?

(c) What do the Bank's procedures for implementing policy mean for its control over money supply?

**Exercise 10.6** Use a diagram to show circumstances in the market for overnight funds that might lead the Bank of Canada to make an SRA. Why would the Bank use an SRA in this case rather than an open market operation?

**Exercise 10.7** Suppose a central bank decides to conduct monetary policy according to a Taylor rule for interest rates.

(a) How does it choose the basic setting for the interest rate within the rule?

(b) How would it respond to a rise in the output gap $(Y - Y_P)$?

(c) How would the bank react to an inflation rate higher than its target inflation rate?

(d) Why would the bank decide to change the basic setting of its interest rate?

# Part Four

## Real GDP, Business Cycles, Policy and Growth



This Part integrates the material of the preceding chapters. Chapter 11 builds a 'modern' aggregate demand-aggregate supply model to explain the *inflation rate*, and real GDP and stabilization policy. The current approaches in inflation control, in which monetary policy sets the interest rate, are discussed. Chapter 12 introduces international aspects of macroeconomics and the importance of foreign exchange rates to the design and effectiveness of monetary and fiscal policy, using the model from Chapter 11. Chapter 13 introduces theories of economic growth and the importance of technology and productivity growth for standards of living.

# Chapter 11

## Inflation, real GDP, monetary policy & fiscal policy

**In this chapter we will explore:**



Chapter 4 identified the inflation rate, the unemployment rate and the GDP growth rate as key indicators of economic performance. This chapter combines the concepts of earlier chapters into a full basic macroeconomic model of the economy for the study of causes of change in the first two of these indicators. It is representative of the models currently used by central banks and policy analysts to evaluate current economic performance and policy, forecast future performance and prescribe policy action. Economic growth and growth rates are covered in Chapter 13.

Underlying short-run conditions on the supply side of the economy are the same in this chapter as in earlier chapters. Labour force and technology are fixed by assumption, fixing potential output at $Y_P$. Instead of a fixed short-term equilibrium price level, the modern model assumes equilibrium rates of change in money wage rates, and inflation rates are stable in the short run and adjust slowly to output gaps.

On the demand side, monetary policy is aimed at inflation control using the short-term interest rate as the instrument as explained in Chapter 10. It reflects current Bank of Canada monetary policy as explained by the Bank at: `www.bankofcanada.ca/core-functions/monetary-policy/`. In normal conditions this allows fiscal policy to target the budget deficit and public debt ratio.

The model provides explanations of business cycle fluctuations in output, employment and inflation rates. It also provides a basis for evaluating recent changes in economic conditions and monetary and fiscal policy actions.

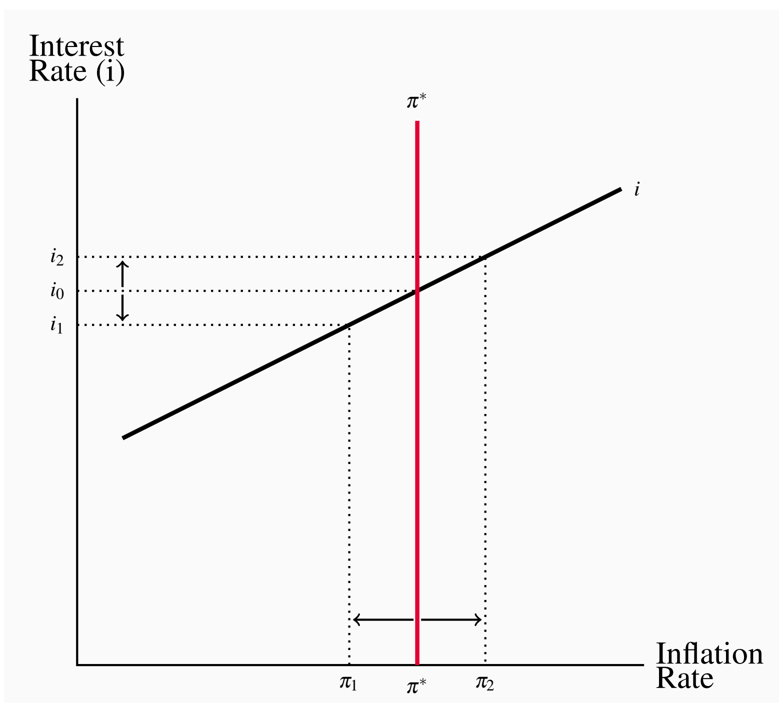
## 11.1 Inflation and aggregate demand

Monetary policy establishes the link between the inflation rate and aggregate expenditure that determines the *slope of the AD curve*. Central banks set *interest rates* to control the *inflation rate* based on an inflation rate target. A monetary policy that reacts to changes in the inflation rate by changing the interest rate causes changes in expenditures. The link between the inflation rate and aggregate expenditure still comes through interest rates and the monetary transmission mechanism, but it is the central bank's decision to change its policy interest rate that provides the impulse.

Changes in autonomous expenditure that are independent of interest rates are still an important part of aggregate demand. They cause *shifts in the AD* curve based on the multiplier as explained in earlier chapters. Changes in government fiscal policy and in the central bank setting of its interest rate target also shift AD. It is the monetary policy response to transitory variations in the inflation rate that give the AD curve its slope.

Figure 11.1 illustrates this monetary policy. Assume the central bank has an inflation control target such as $\pi^*$. Based on its evaluation of current and near future aggregate expenditure and supply conditions the Bank sets the interest rate $i_0$ to get its target inflation rate. If the actual inflation rate differs from $\pi^*$ as a result of changes in economic conditions that the Bank views as temporary, rather than fundamental, it reacts with temporary changes in its interest rate, allowing some variation around $i_0$ such as $i_1$ to $i_2$. The Bank of Canada, for example, sets its overnight rate as the midpoint between the bank rate and the deposit rate. The upward sloping line in the diagram shows this 'reaction function'.

**Figure 11.1: Monetary policy sets interest rate**




A Taylor Rule: $i = i_0 + \beta(\pi - \pi^*)$.

This is a simple Taylor Rule you will recall from Chapter 10. An equation that describes this policy rule would be:

$$i = i_0 + \beta(\pi - \pi^*) \tag{11.1}$$

In this rule $i_0$ is the interest rate the Bank sets and announces. It is set based on the underlying demand conditions in the economy relative to potential output. The Bank's target inflation rate is $\pi^*$. An economy working at potential output would have a constant inflation rate $\pi^*$ at $i_0$.

The parameter $\beta$ defines the size of the change the Bank would make to its interest rate in response to temporary differences between the observed inflation rate and the target rate. $\beta$ is the slope of the interest rate line ($i$) in the diagram. If the inflation rate were to rise to $\pi_2$ in Figure 11.1 the Bank would raise its interest rate above $i_0$ to $i_2$ to defend its inflation rate target. The larger is $\beta$, the stronger the Bank's reaction to short-term variation in the inflation rate and the steeper the interest rate line.

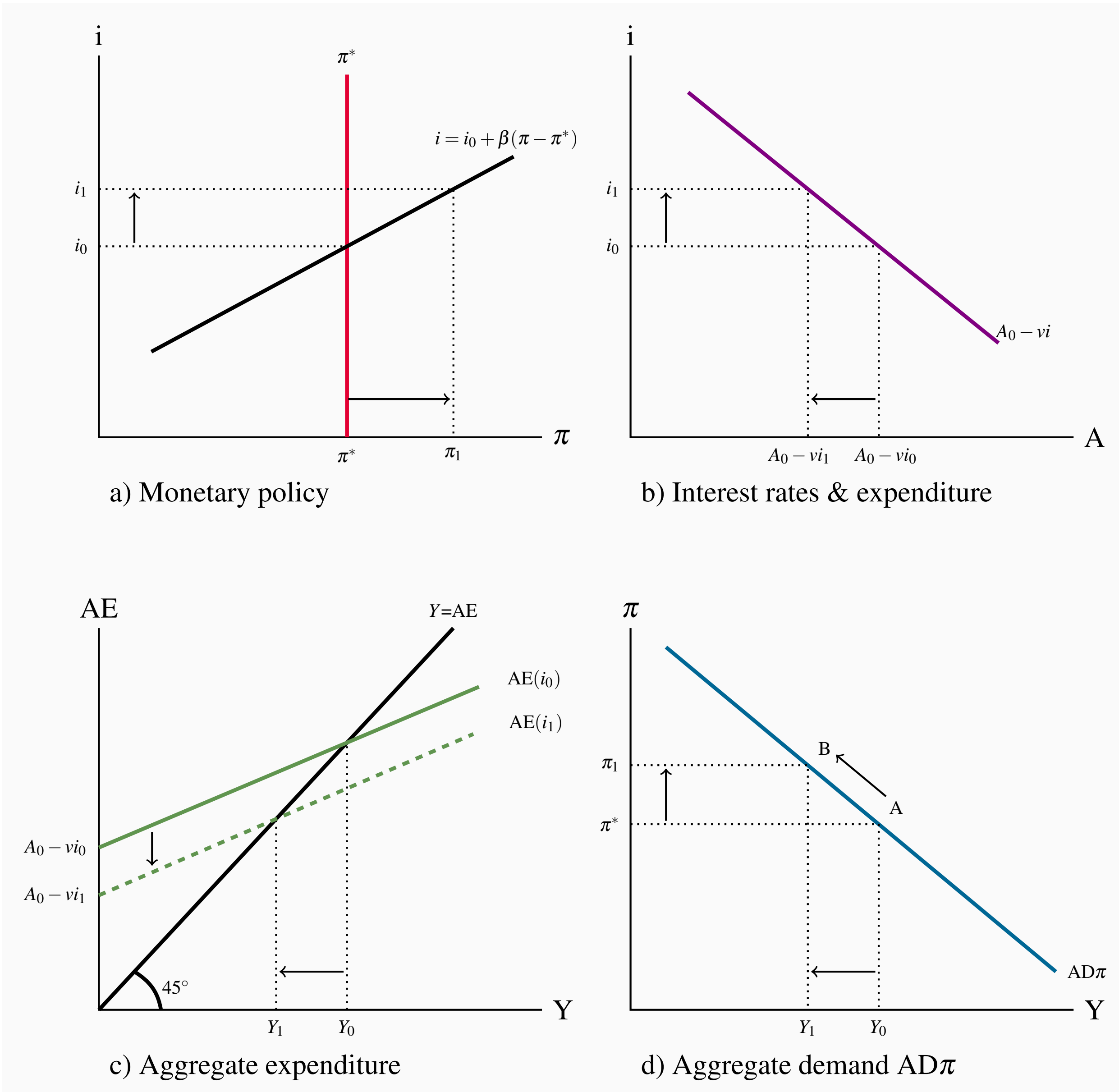
Alternatively if the Bank does not react to temporary departures from $\pi^*$, that is if $\beta = 0$, the interest rate line is horizontal. Changes in the Bank's official setting of the overnight rate would then shift the interest rate line up or down as the case may be.

This approach to monetary policy and the inflation rate aggregate demand is based on two familiar relationships:

1. The monetary transmission mechanism as in Chapter 9, and
2. The expenditure multiplier from Chapters 6 & 7.

Figure 11.2 shows the derivation of the aggregate demand curve labelled AD$\pi$. This is to differentiate it from the AD curve in Figure 9.5. In that example and examples in earlier chapters in which the equilibrium price level was constant, the inflation rate was zero, and a change in the money supply *shifted the AD curve*.

**Figure 11.2: The AD$\pi$ function**




Start in equilibrium with $\pi = \pi^*$ and interest rate $i = i_0$ in a), and $\pi^*$ and $Y_0$ at A in d). Suppose the inflation rate rises to $\pi_1$. The central bank then raises its interest rate to $i_1$. The higher interest rate reduces expenditure in b), lowering AE in c) and equilibrium real GDP to $Y_1$. The new equilibrium combination $pi_1 Y_1$ is point B on the AD$\pi$ curve.

Figure 11.2 illustrates the relationship between the inflation rate, monetary policy and the slope of the AD curve. In this example the central bank does react to temporary variations in $\pi$, ($\beta > 1$). Monetary policy as described by a Taylor type rule or reaction function like Equation 11.1 is in Panel a) of the diagram. Interest rates set by policy in Panel a) determine autonomous expenditures in Panel b) giving the monetary transmission mechanism. Autonomous expenditures determine the position of the AE line in Panel c) and work through the multiplier to determine equilibrium real GDP. The combination of the inflation rate $\pi^*$ and equilibrium real GDP, $Y_0$, give one point $(\pi^*, Y_0)$ on an AD$\pi$ curve plotted in Panel d) and labeled A.

The central bank's reactions to changes in the inflation rate, other things constant, move the economy *along* the AD$\pi$ function. In Panel a) the Bank reacts to a temporary or *transitory* rise in the inflation rate to $\pi_1$ by allowing its policy interest rate to rise to $i_1$. This reduces autonomous expenditure in Panel b) to $A_0 - vi_1$ and lowers the AE curve in Panel c) to AE$(i_1)$. The multiplier then lowers equilibrium real GDP to $Y_1$ and plotting $(\pi_1, Y_1)$ in Panel d) gives a second point on an AD$\pi$ curve labeled B.

Changes in autonomous expenditures ($\Delta A$) not caused by changes in interest rates, like changes in autonomous consumption, investment, exports, or government expenditure would shift the AD function by amounts driven by the multiplier. Similarly, a *change in monetary policy made by changing* $i_0$, in response to a change in *economic fundamentals* would *shift the AD$\pi$ function*.

The recession of 2009, for example, brought a sharp drop in Canadian exports and a shift in AD$\pi$ to the left. The Bank of Canada lowered its setting for the overnight interest rate in steps from 4.75 percent to 0.25 percent to offset some of this drop in AD$\pi$. However the monetary stimulus to AD through lower interest rates was not enough by itself to avoid a recession. Fiscal stimulus was also needed.

## 11.2 Aggregate supply

The supply side of the economy explains output, *inflation*, and the economy's adjustment to equilibrium at $Y_P$, potential output. If the economy is operating with an output gap, changes in the *rate of increase in wage rates* and other factor prices may push the economy toward a long-run equilibrium at potential output and a constant rate of inflation. But this internal adjustment process is slow at best.

No matter what time frame we use, the economy's output depends on:

1. The state of technology;
2. The quantities of factor inputs to production (labour, capital, land, energy, and entrepreneurship); and
3. The efficiency with which resources and technology are used.

A simple **production function** defines the relationship between outputs and labour and capital inputs to production as follows:

$$Y = A \times F(N, K) \tag{11.2}$$

In this equation, $Y$ is real GDP, $A$ is the state of technology, and $N$ and $K$ are inputs of labour and capital, respectively, used in the production process.

> **Production function**: outputs determined by technology and inputs of labour and capital.

The notation $F(...)$ tells us that the size of output as measured by real GDP depends on the amount of labour and capital used in the production process. More labour and more capital used means more output. An improvement in technology would make A larger, and increase the output produced by any given amount of labour and capital employed. This would be an increase in **productivity**, an increase in output per unit of input.

> **Productivity**: output per unit of input.

## Long-run aggregate supply ($Y_P$)

**Potential output** $(Y_P)$ is determined by the current state of technology, $A_0$, the current stock of capital, $K_0$, and the *equilibrium* level of employment, $N_F$. In terms of the simple production function, this means:

$$Y_P = A_0 \times F(N_F, K_0)$$

> **Potential output** $(Y_P)$: the real GDP the economy can produce on a sustained basis with current labour capital and technology without generating inflationary pressure on prices.

The short-run fluctuations in output studied in earlier chapters are linked to differences between actual labour input $N$ and the "full employment" labour input $N_F$. Unemployment rates fluctuate as a result of these changes in actual output and employment relative to potential output.

## Short-run aggregate supply

Short-run aggregate supply in the 'modern' model defines the relationship between output and the inflation rate, when capital stock, technology and the *rate of growth in money wages* are fixed. The basic argument is that monopolistically competitive firms set prices at a mark-up over marginal costs of production. The rates of increase in marginal costs of production depend in turn on the rates of increase in money wage rates, prices of material inputs, and productivity.

Prices are sticky in the very short run. Changing prices is costly and competition among producers means relative prices are important to market position. Furthermore, stable prices may help to build customer loyalty. As a result, price changes only follow changes in costs that last beyond the current short term. A horizontal short-run aggregate supply curve as in Figure 11.3 captures this output-inflation relationship.

Persistently strong aggregate demand would increase employment, output and capacity utilization, and lower productivity. Employment would rise and the unemployment rate would fall below the

**NAIRU**, increasing the growth in money wage rates. This upward pressure on current and future marginal costs would compress producers' markups and profitability. Alternatively, persistently weak aggregate demand would lower rates of increase in money wage rates, lower material costs, lower marginal costs, and increase mark-ups. Producers wouldn't adjust price setting practices immediately in either case. But they would react if their mark-ups are persistently pushed away from what they see as the profit maximizing level.

> **NAIRU**: the 'non-accelerating inflation rate of unemployment' that corresponds to $N_F$ at $Y_P$.

These short-run aggregate conditions are described in a simple AS$\pi$ function that explains the current inflation rate as:

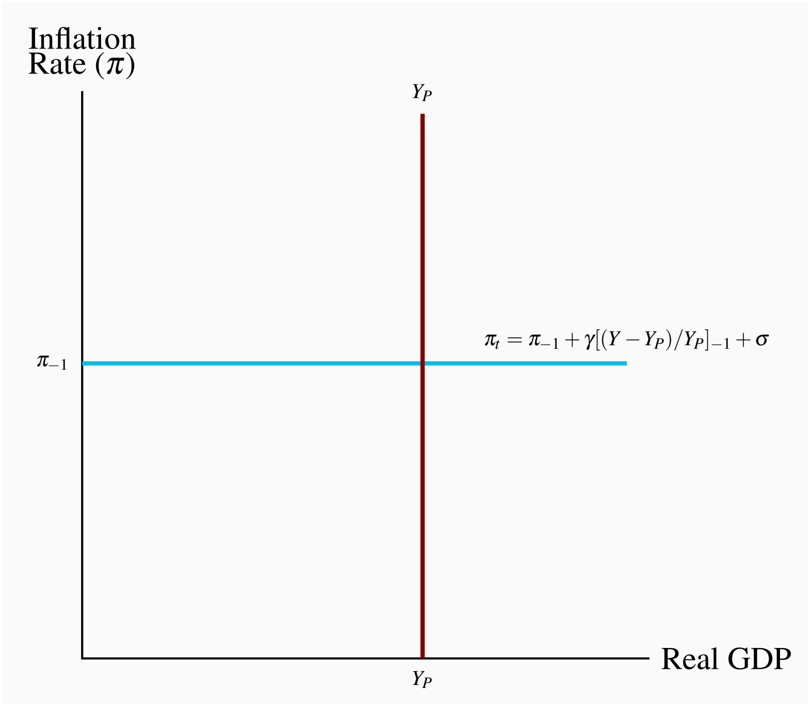
1. ($\pi_{t-1}$) The rate of inflation last period or last year.
2. ($[(Y-Y_P)/Y_P]_{t-1}$) The output gap last period or last year.
3. ($\sigma$) A term that captures the effects of disturbances such as commodity price shocks or extreme climate conditions or political events that would shift supply conditions.

These factors are combined in an equation along with the parameter $\gamma$ which measures the size of the effect an output gap has on the inflation rate:

$$\pi_t = \pi_{-1} + \gamma[(Y-Y_P)/Y_P]_{-1} + \sigma \tag{11.3}$$

Equation 11.3 gives a horizontal short-run AS$\pi$ curve that is sometimes called an 'inflation adjustment' function. The current inflation rate ($\pi_t$) is 'last year's' inflation rate $\pi_{-1}$ adjusted up or down in reaction to 'last year's' output gap. In other words the inflation rate changes with a lag in response to the effect of an output gap on costs and prices. If there is no output gap, the inflation rate would be the same from year to year. As an alternative, AS$\pi$ could be specified as an upward sloping function by dropping the lag on the output gap, but that would remove some of the short-run stickiness observed in wage rates and prices. Figure 11.3 illustrates potential output ($Y_P$) and short-run aggregate supply AS$\pi$.

**Figure 11.3: Potential output and short-run AS**

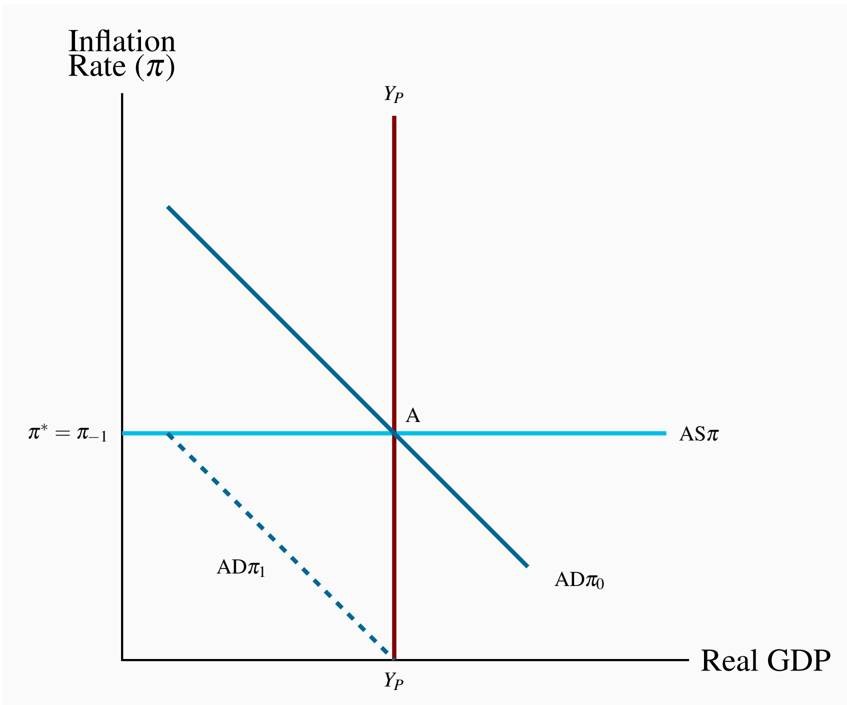



In the short run the inflation rate is constant as long as the economy is at $Y_P$. If the economy is not at $Y_P$ the output gap will change the $\pi$ rate, shifting the line up or down in the next time period.

## 11.3 The equilibrium inflation rate

Figure 11.4 shows the aggregate demand curve $AD\pi_0$ and the vertical long-run aggregate supply curve $Y_P$. Output is at potential output, and the *inflation rate*, $\pi^*$, is determined by aggregate demand. At point A there is equilibrium in all markets: for output, money, and labour.

**Figure 11.4: The equilibrium inflation rate**




The equilibrium inflation rate is determined by $AD_{\pi_0}$ and $Y_P$, as at point A in the diagram. This is also the short-run equilibrium inflation rate. If $\pi^*$ is the central bank's monetary policy target, the bank sets its interest rate to get $AD_{\pi_0}$.

The position of aggregate demand curve $AD\pi_0$, is determined by autonomous expenditure, fiscal policy, and the monetary policy of the central bank.

If monetary policy were directed to a constant equilibrium price level, as in earlier chapters, the equilibrium inflation rate is zero. This is shown in Figure 11.4 by the aggregate demand curve $AD\pi_1$. Then equilibrium is at output $Y_P$ and the inflation rate $\pi = 0$. This $AD\pi_1$ curve is not extended below a zero inflation rate. The discussion of deflation, negative inflation rates, on output and policy are important issues covered in Section 11.6.

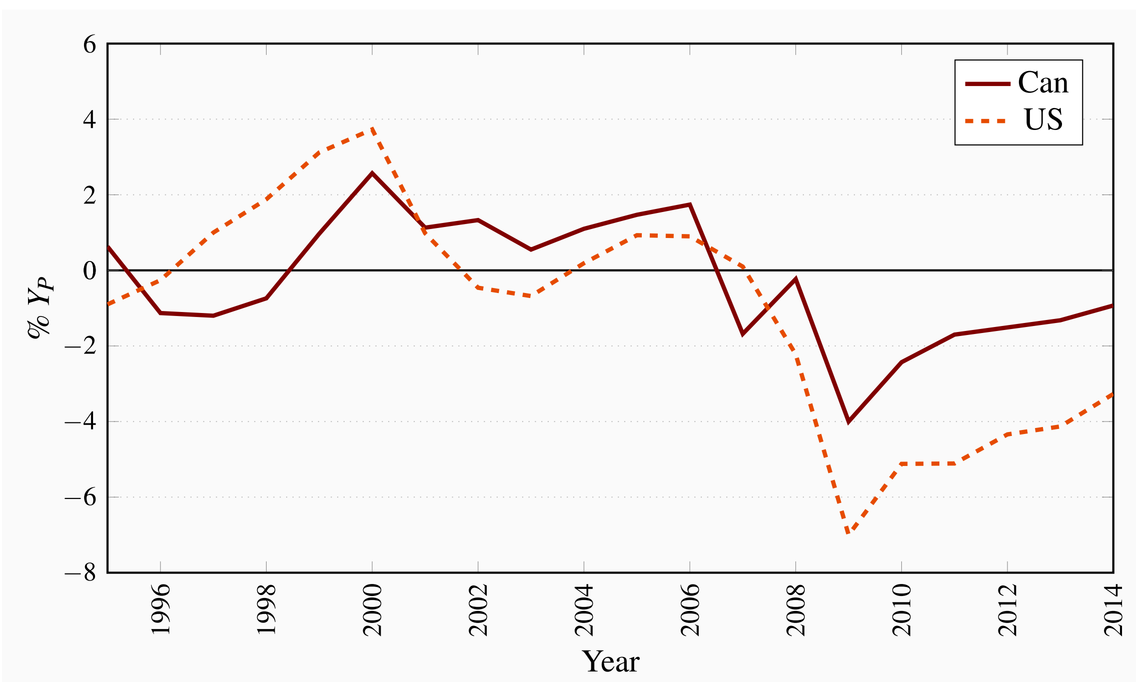
In practice, central banks do not set zero inflation targets for monetary policy. Some, including the Bank of Canada, set explicit low inflation rate targets. Others, including the United States Federal Reserve, work to implicit inflation rate targets that are also positive and low. There has been and still is a lot of discussion among economists about the appropriate level of the inflation rate target. The Bank of Canada's 2 percent target represents a current consensus on the issue.

The AD$\pi_0$ curve in Figure 11.4 is based on a monetary policy inflation target of $\pi^*$. In setting its inflation target, the central bank recognizes that *money is neutral* when wages and prices are flexible and there is no money illusion. This means that the central bank cannot influence potential output, but it can determine the equilibrium inflation rate. It sets the interest rate and accepts growth in the money supply consistent with its inflation target. A rate of inflation, $[(P_t - P_{t-1})/P_{t-1}]$, greater than zero means the rate of growth of the money supply, $[(M_t - M_{t-1})/M_{t-1}]$, is greater than zero. This puts the AD$\pi$ curve at AD$\pi_0$, and keeps it there as inflation raises the price level at the target rate.

## 11.4 Adjustments to output gaps

Now consider how demand or supply shocks that move the economy away from potential output trigger an *adjustment process*. In combining the AD$\pi$ and AS$\pi$ curves, it is assumed the market for goods and services clears even in the short run, but the labour market takes longer to adjust. The inflation rate changes over time as wage rate growth adjusts to the unemployment rate. If this process goes smoothly and other conditions are tranquil, it may eventually restore full employment at potential output. But in the meantime output gaps can be quite persistent.

**Figure 11.5: Output gaps: Canada and the US**



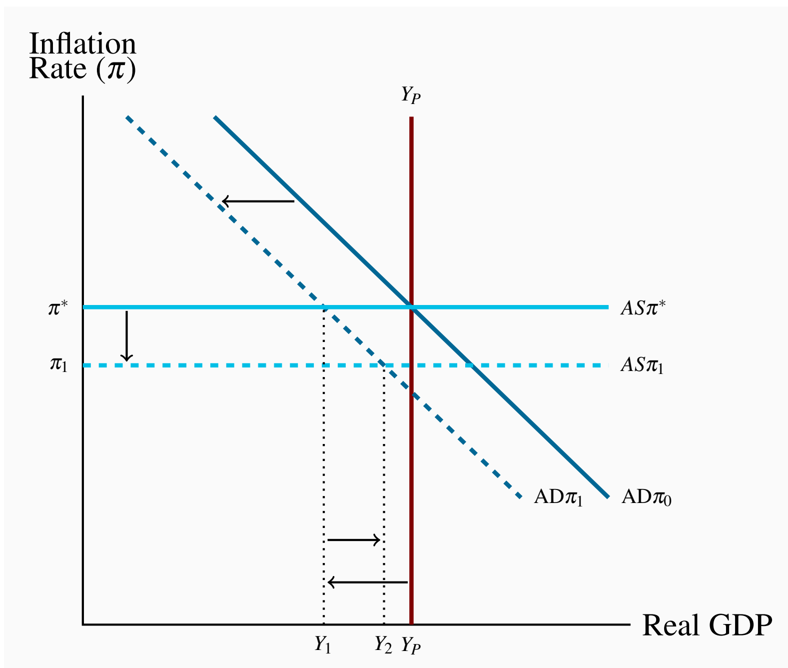

*Source*: IMF World Economic Outlook Database, April 2014

Figure 11.5 provides some empirical evidence. For Canada, the recessionary gap of the last half of the 1990s lasted for about five years. The small inflationary gaps that followed persisted for seven years, and were followed by large recessionary gaps in the financial crisis of 2008-09, which continues into 2014-15. The data show that automatic adjustments are slow at best.

## An aggregate demand shock

Figure 11.6 shows the adjustment to an output gap that is built into the AD$\pi$/AS$\pi$ model. In the diagram, an unexpected fall in aggregate demand shifts the AD$\pi$ function to the left. A decline in exports or investment or government expenditure, or a change in the inflation target set for monetary policy, would have this effect on AD$\pi$. Before this change, the economy was in equilibrium at full employment and potential output with inflation rate $\pi^*$, the central bank's inflation target.

**Figure 11.6: Adjustment to a recessionary gap**




A fall in AD$\pi$ to AD$\pi_1$ creates a recessionary gap $(Y_1 - Y_P)$. The increase in unemployment and reduction in output cuts the rate of increase in wage rates and prices to $\pi_1$. Lower inflation leads the central bank to reduce its interest rate, supporting a move along AD$\pi_1$ to $Y_2$.

In the short run, the fall in AD$\pi$ creates a recessionary gap $(Y_1 - Y_P)$. Since producers cannot cut costs per unit of output, they reduce employment and output to $Y_1$ to cut total costs. Unemployment rates rise. At $Y_1$ the goods market clears. It is a point on both the AS$\pi^*$ and AD$\pi_1$ curves. Inflation has not fallen because of the short-run stickiness in wage rate increases and price increases.

As time passes there are opportunities to negotiate smaller wage rate increases and to reduce some planned price increases. The scale of these changes depends on the size of the output gap and the sensitivity of costs and prices to that gap. In the AS$\pi$ function the term $\gamma[(Y_1 - Y_P)/Y_P]_{t-1}$ defines this adjustment. AS$\pi$ shifts down to AS$\pi_1$. As long as the central bank allows some flexibility in its policy interest rate, expenditure can increase along AD$\pi_1$ to $Y_2$ and offset some of the output gap.

In the real world, adjustments to changes in aggregate supply come from the effects of GDP gaps and unemployment on the wage agreements negotiated, formally and informally, in labour markets. A recessionary gap like that in Figure 11.6 lowers *wage rate increases*, lowers inflation, and allows monetary policy to support an increase in demand *along the AD$\pi_1$ curve*. The output gap shrinks gradually but the inflation rate is below the central bank's target.

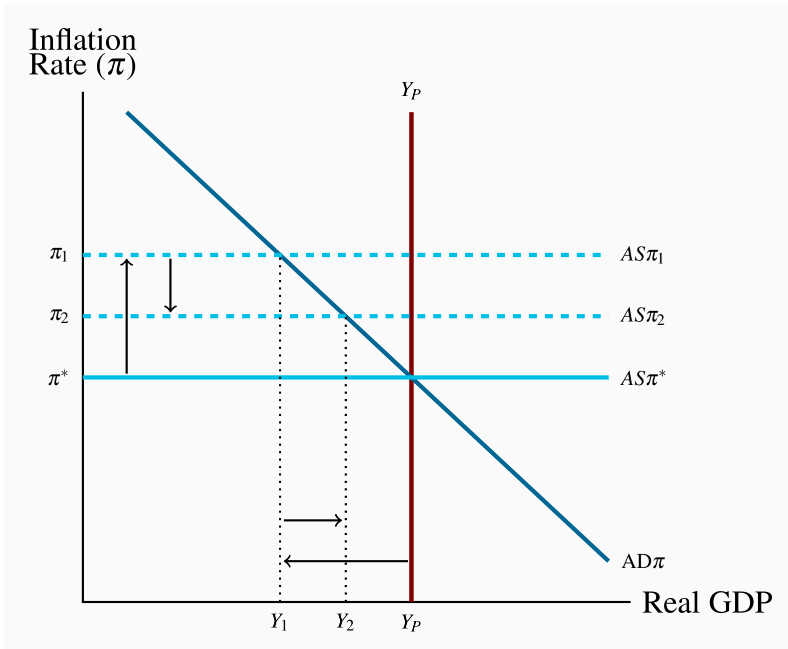
An inflationary gap results in the opposite process. Employment and output rise. Unemployment rates fall. Wage rate increases rise, inflation rises, and monetary policy reactions result in higher interest rates to reduce expenditure. In both cases, the eventual changes in wage rate agreements and rates of inflation together with the reaction of monetary policy to changes in inflation rates move the economy, over time, from short-run to long-run equilibrium. But the new equilibrium inflation rate would be higher than the Bank's target.

This adjustment process has important implications for the inflation targets set by monetary policy. It means prolonged changes in aggregate demand conditions require changes in the central bank's interest rate setting to defend the inflation target. It also means that, if the inflation target is cut, shifting the AD$\pi$ curve to the left, the economy will go through a recession, and perhaps a prolonged recession, while money wage rate agreements are renegotiated and price setting practices adjust to reflect the new inflation target. The time required for this adjustment is linked in a very important way to the independence and the credibility of the central bank. Canadian experience in the 1990s provides an interesting example. Recessionary gaps were persistent after the Bank of Canada adopted an inflation target of 2 percent at a time when current inflation rates were about 5 percent.

## An aggregate supply shock

Figure 11.7 shows the model's internal adjustment to unexpected shift in AS$\pi$. A sharp increase in crude oil and commodity prices, for example, enters the AS$\pi$ function as an increase in $\sigma$ ($\Delta\sigma > 0$) in Equation 11.3. That pushes costs up and prices follow, increasing the inflation rate at least temporarily. Increases in indirect taxes like the HST or the taxes on alcohol and gasoline would have a similar effect. They increase the sellers' tax remittances to government, which sellers attempt to offset by increasing prices.

**Figure 11.7: An aggregate supply shift**




An increase in commodity prices ($\Delta\sigma > 0$) increase $\pi$ as AS$\pi$ shifts up to AS$\pi_1$. Inflation is higher than the Bank's $\pi$ target and output falls, creating a recessionary gap. This is '*stagflation*'. The central bank faces a dilemma. It cannot defend its inflation target without increasing the gap. Alternatively it can wait until $\pi$ falls back to $\pi^*$.

In Figure 11.7 the AS$\pi$ curve shifts up to AS$\pi_1$. The inflation rate is higher and output falls creating a recessionary gap. These are the economic conditions often described as 'stagflation'. They pose a dilemma for the central bank.

Inflation is higher than its official target rate but trying to bring inflation down by raising the policy interest setting would only make things worse by raising the unemployment rate. Alternatively, cutting the policy interest rate to reduce the recessionary gap would shift AD$\pi$ to the right and validate the higher inflation rate. Doing nothing, on the assumption that the increase in commodity prices is a one-time jump, would mean living with inflation above the target and high unemployment until the rates of increase in wage rates and prices fall. Then AS$\pi$ would shift down to AS$\pi^*$. The cost of waiting is the cumulative loss of employment and output during the adjustment process and the redistribution of income in favour of commodity producers if that is the source of the supply shift.

## 11.5 Monetary and fiscal policies

The inflation-output model sets clear roles for monetary and fiscal policies, at least in normal times. Monetary policy, which is embedded in the AD$\pi$ curve, is aimed at an inflation control target using a short-term interest rate instrument. Within the structure of the model this monetary policy simultaneously moderates business cycle fluctuations in output and supports equilibrium output at potential output. Fiscal policy can be aimed at a government debt ratio target through budget balance control. The net tax rate in the government's budget provides automatic fiscal stabilization to moderate business cycle fluctuations.

Canadian monetary and fiscal policy followed this pattern from the early 1990s until the financial crisis of 2008. The Bank of Canada, in consultation with the Ministry of Finance has set inflation control targets for monetary policy since 1991. With the policy independence provided by a flexible exchange rate, the Bank uses the overnight interest rate as its policy instrument and intervenes in the market for overnight clearing balances. This keeps the overnight rate within the operating band it sets. An interest rate policy rule provides a useful description of the Bank's reactions to inflation rates that deviate from its control target.

In 1994 the Government of Canada announced *A New Framework for Economic Policy* that focused fiscal policy on deficit control and debt ratio reduction: `http://goo.gl/GZKyxP`.

It set an initial budget deficit target of 3 percent of GDP as the first step in a fiscal policy program aimed at achieving first a balanced budget and then a surplus to reduce the federal government debt as a percentage of GDP. This was followed in 2004 by a target: Reducing the debt-to-GDP ratio to 25 percent within 10 years. The government then managed the budget balance through a combination of taxation and expenditure programs to pursue this debt ratio target.

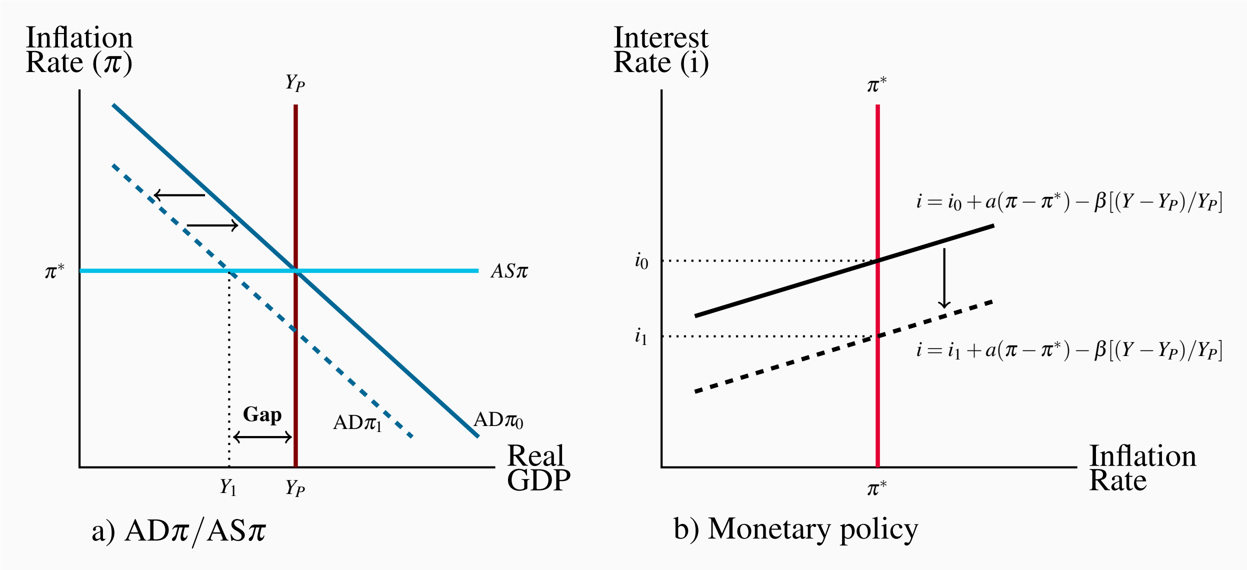
## Monetary policy

In practical terms central banks set their short-term interest rate instruments based on their inflation rate control target and their assessment of current and future economic conditions. This approach is described by a policy rule for setting the interest rate like that introduced in Chapter 10, namely:

$$i = i_0 + a(\pi - \pi^*) + \beta\left[(Y - Y_P)/Y_P\right] \tag{11.4}$$

Adding a term for the output gap means the central bank looks at both the inflation rate and the state of the economy in making its interest rate setting decisions. In terms of the AD$\pi$/AS$\pi$ model, the output gap is a predictor of the way the inflation rate will move if current conditions persist. In times of recession, for example, the output gap term in the policy rule calls for a cut in interest rates even if the inflation rate is still $\pi^*$. This way the central bank pre-empts the fall in inflation that a recession would cause.

**Figure 11.8: Central bank lowers overnight rate target**



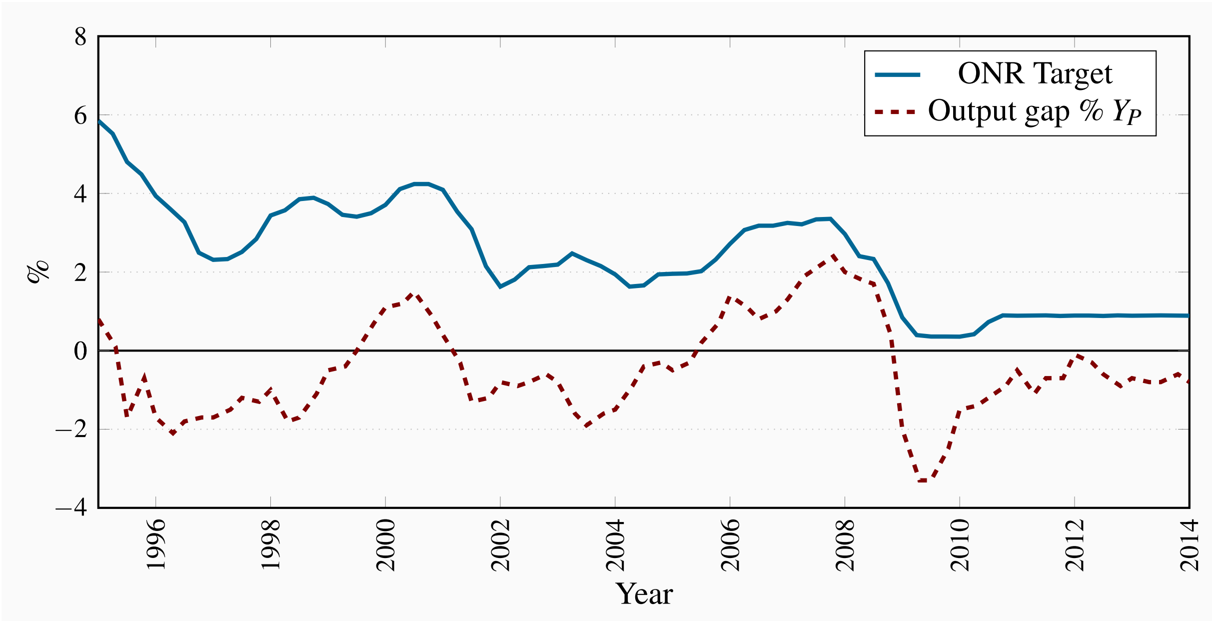

Initially, equilibrium is $Y_P\pi^*$ in a) with the Bank's overnight rate set at $i_0$. Then $AD\pi$ falls to $AD\pi_1$ as a global recession reduces exports. GDP falls to $Y_1$ causing an output gap $Y_1 - Y_P$. The central bank reacts to the output gap with a cut in its overnight rate target to $i_1$ in b), to provide stimulus and increase $AD\pi$.

Figure 11.8 illustrates the central bank's policy response to a persistent fall in $AD\pi$. Lower $AD\pi$ creates a recessionary gap but does not immediately lower the inflation rate. The central bank sees the fall in $AD\pi$ as a lasting change in economic conditions that will reduce inflation below its inflation control target. It cuts its policy interest rate setting from $i_0$ to $i_1$ to increase $AD\pi$, shifting $AD\pi$ to the right, and reduce the output gap and downward pressure the gap puts on the inflation rate.

The Bank of Canada's cut in its overnight rate target by 75 basis points (3/4 of 1 percentage point) in December 2008 is a real world example of this monetary policy. In the press release announcing this rate cut the Bank explained that the outlook for the global recession was worse than earlier predicted. The prospects for Canadian GDP growth and inflation were weaker than previously thought. In these circumstances the cut in the overnight rate was intended to provide some offsetting monetary stimulus. In terms of Figure 11.8, the cut in the interest rate target is the downward shift in the monetary policy rule. It was intended to pre-empt the shift from $AD\pi_0$ to $AD\pi_1$ at least in part. You can read the full text of the press release at: `http://goo.gl/W6UMg0`.

Figure 11.9 shows that the Bank of Canada's setting for its overnight interest rate has been related to the output gap over the 1995-2014 period. The interest rate setting rule described by Equation 11.4 calls for the Bank to raise its overnight rate as the output gap increases and lower its rate when the output gap falls. Figure 11.8 gives one example of how this works in theory. It is indeed the pattern of overnight rate settings we see in the data plotted in Figure 11.9.

**Figure 11.9: The ONR and the output gap**



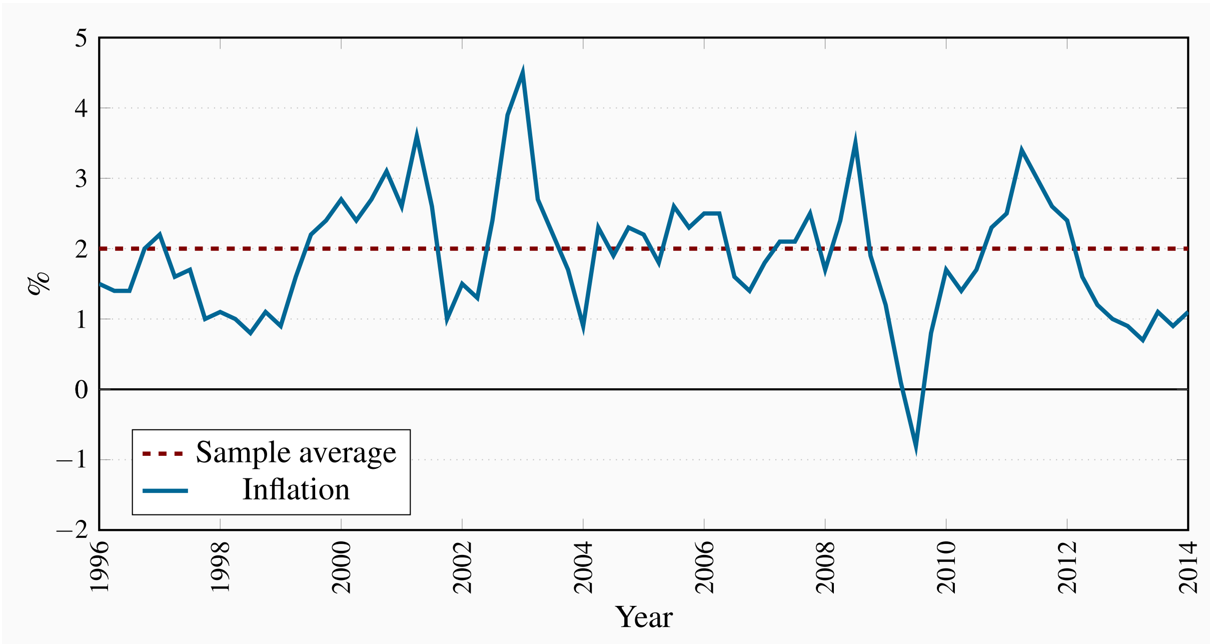

*Source*: CANSIM Series V39078, Bank of Canada, Indicators and author's calculations.

More recent examples of the Bank's reaction to an anticipated recession were the cuts in the overnight rate in 2015 following the drop in oil and commodity prices. This rate cut was intended to offset the negative effects of lower oil prices on the revenue, employment and investment expenditures of major oil and commodity producers. The economy was already working with a recessionary gap and that gap was growing in the first half of 2015.

Changing overnight interest rates in response to changes in the output gap is only one aspect of the interest rate rule. The underlying argument is that output gaps are indicators of future changes in inflation rates. This is consistent with the AD$\pi$/AS$\pi$ model, which explains changes in the inflation rate that follow from persistent output gaps. The AS$\pi$ function also provides for changes in the inflation rate as a result of other economic changes such as changes in the prices of raw materials or changes in indirect taxes. The Bank might change its overnight rate setting in response to these changes in inflation that are not driven by the output gaps.

Figure 11.10 shows the success of the Bank of Canada's monetary policy over the 1996-2014 period. The inflation rate as measured by the annualized rate of change in the Consumer Price Index has averaged 2.0 percent. This is the midpoint of the Bank's inflation control target range. Monetary policy cannot eliminate all variations in the inflation rate. Many changes come and go before the underlying causes are recognized. Furthermore, it takes considerable time for changes in the interest rate to work their way into the economy and affect inflation. Recognizing the transitory nature of short-term fluctuations in the inflation rate and the time lags in the effects of interest rate changes the Bank aims to hit its inflation rate target within a time frame of six to eight quarters of a year.

**Figure 11.10: Canadian inflation rates, 1996-2014**




*Source*: CANSIM V41690914 and author's calculations.

The data plotted in Figure 11.10 show the volatility of the annualized quarterly inflation rates but the average rate over the period is indeed 2 percent. Over the same period the economy went through both recessionary and inflationary gaps, with a small recessionary gap, -0.5 percent of $Y_P$, on average. If the period following the financial crisis of 2008 is excluded the average output gap from 1995 to 2008 is -0.2 percent with a range of -2.1 percent to +2.4 percent.

While success with inflation control did not eliminate the business cycle in real GDP and employment, economic performance was consistent with the argument of the $AD\pi/AS\pi$ model. From 1995 to 2007 the inflation rate fluctuated around the 2 percent target and output was, on average, close to estimates of potential output.

The financial crisis of 2008 changed the economic fundamentals, the focus of monetary and fiscal policies, and the economic performance of the economy. This more recent experience is covered after a discussion of recent fiscal policy in terms of the $AD\pi/AS\pi$ model.

## Fiscal policy

Under normal conditions in the $AD\pi/AS\pi$ model with a flexible foreign exchange rate, monetary policy dominates discretionary fiscal policy. Monetary policy sets the interest rate that will give the $AD\pi$ needed to get the inflation rate target at potential output. A change in discretionary fiscal policy would change the conditions on which the Bank's interest rate is set. To defend its inflation rate target the Bank would react, changing its interest rate setting to offset any new fiscal stimulus or restraint. Monetary policy aimed at inflation control deliberately crowds out the effect of fiscal policy on AD$\pi$ through the interest rate-exchange rate links in the monetary transmission mechanism.

For example, in 2006 and 2007 the Government of Canada cut the GST by a total of 2.0 percentage points. The Bank of Canada raised its overnight interest rate from 3.25 percent to 4.50 over the same time period. At the time the economy was also working at an inflationary gap. The increase in interest rates offset the fiscal stimulus from the GST cut by raising costs of current and future credit.

However, fiscal policy does have two important roles to play when the central bank successfully targets inflation and potential output:

1. Provide automatic fiscal stabilization; and
2. Control, and perhaps reduce, the ratio of the public debt to GDP.

The fiscal policy instruments are:

1. The net tax rate, $t$, set in the budget plan, which will also be a component of,
2. The structural primary budget balance, $SPBB = tY_P - G$.

Fiscal policy is implemented through the government's budget. The budget balance function provides the framework. Elaborating on the basic government budget of Chapter 7 to recognize the importance of the public debt gives:

$$BB = tY - G - iPD \tag{11.5}$$

The term $iPD$ is the interest paid on the government bonds, $PD$, issued in the past to finance budget deficits. $G$ represents *program spending*. $G + iPD$ is total government spending.

The Department of Finance, *Fiscal Reference Tables, 2014* (`http://goo.gl/NvuFAc`) report the Government of Canada paid interest ($iPD$) of $28.2 billion in the fiscal year 2013-14. That was an amount equal to 3.2 percent of its outstanding interest bearing debt and 10.2 percent of total government expense ($G + iPD$).

Government tax and expenditure programs linked to GDP provide *automatic* fiscal stabilization, as explained in Chapter 7. In addition, with a monetary policy consistent with equilibrium at potential output, *discretionary* fiscal policy can aim to control the **public debt ratio ($PD/Y$)** by managing the government's **structural primary budget balance**. This is the fiscal policy objective that has caused serious debates in both the US and Europe, and in the 2015 federal election campaign in Canada.

**Public debt ratio** ($PD/Y$): the ratio of government debt to GDP.

**Structural primary government balance** ($SPBB = tY_P - G$): the difference between net tax revenue at $Y_P$ and government program expenditure. It excludes interest payments on the public debt and the effect of output gaps.

Current interest payments on the public debt are the result of past issues of government bonds and the average of coupon rates on those bonds. This expenditure cannot be changed in the current budget but can be controlled going forward as current budget balances reduce or increase the public debt.

## Automatic stabilization

Automatic fiscal stabilization comes from the net tax rate $t$ in the budget function. This rate changes government revenues and transfers automatically when GDP changes. Cyclical changes in the government budget balance reduce the size of the expenditure multiplier and the size of the change in GDP caused by shifts in AD$\pi$/AS$\pi$ conditions. The budget function:

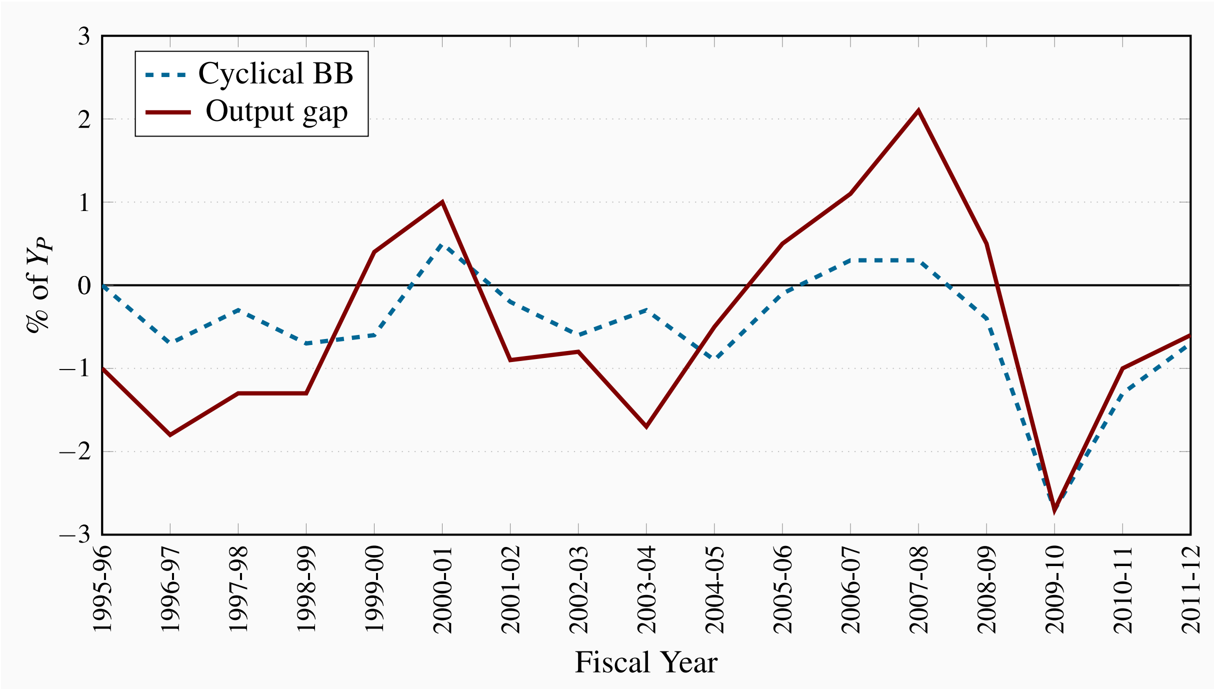
$$BB = SPBB + t(Y - Y_P) - iPD \tag{11.6}$$

separates the *cyclical component* $t(Y - Y_P)$ of the budget balance $BB$ from the structural primary budget balance $SPBB$. The structural primary budget balance evaluates the government's fiscal program *net of interest payments on the public debt* at $Y_P$. The cyclical component is the effect of an output gap on the actual budget balance. The actual budget balance $BB$ in Equation 11.6 has three components, the structural primary budget balance ($SPBB$), the cyclical component $[t(Y - Y_P)]$ and the interest payments on the public debt ($iPD$).

Setting the net tax rate that will provide automatic stabilization is a simple mechanical question but a difficult economic and political question. A higher net tax rate provides more stabilization. It involves the design of the tax system and transfer payment programs like employment insurance, social assistance programs and subsidy programs where revenues collected and expenditures made vary inversely to economic conditions. The types of taxes to be used and the bases to which those taxes are to be applied generate heated debates. The design and eligibility requirements for transfer benefits are also controversial. There are also strong differences of opinion over the economic impacts of different types and rates of taxes and transfers. These issues have been important to recent election campaigns in Canada and the US and will dominate ongoing US debates about budget deficits and public debt control.

We will leave the details of those debates to specialists in public finance and ask a question that is somewhat easier to answer. Have changes in the cyclical balance of the Canadian federal government budget provided automatic stabilization? To answer this question, Figure 11.11 plots the output gap and the cyclical budget balance over the 1995-2014 time period. These data show a pattern of cyclical budget deficits and surpluses that coincide with recessionary and inflationary gaps to provide automatic fiscal stabilization.

**Figure 11.11: Output gaps and the cyclical budget balance, 1995-96 to 2011-12**




*Source*: Department of Finance, Fiscal Reference Tables, 2012, Bank of Canada and author's calculations.

For most years in the period covered by Figure 11.11 the absolute magnitude of the cyclical budget balance is noticeably less than that of the output gap. That pattern changes after 2008 when expansionary fiscal policy, the *'Economic Action Plan'* of 2009 was introduced to fight the recession that followed the 2008 financial crisis. Although this was clearly a discretionary policy change the Department of Finance reported it in its *Fiscal Reference Tables, 2011* as a component of the cyclical balance, excluding it from its structural budget balance estimates, and continues this practice with additional revisions in the *Fiscal Reference Tables, 2014*. This is an interesting treatment of this discretionary stimulus program that was extended into 2011 and 2014 and continues to feature prominently in government advertisements. As a result, the 'automatic stabilization' illustrated in Figure 11.11 is overstated in the 2009-2014 period and the reported structural budget balance is increased.

## Controlling the debt ratio

The *public debt ratio* is usually defined as the outstanding public debt as a percentage of annual nominal GDP. Explaining the budget balances required to control and reduce the *public debt ratio* is a bit more complicated. The change in the debt ratio, $PD/Y$ from one year to the next is determined by the percentage change in the debt $\Delta PD/PD$ together with the effect of percentage change in GDP, $\Delta Y/Y$.

The annual change in the outstanding debt is equal to the annual budget deficit or surplus as in

Chapter 7; namely, $\Delta PD = -BB$. However, even if the primary budget is balanced, $PBB = tY - G = 0$, interest payments on the public debt will increase the outstanding debt by $iPD$. This increase in the public debt, the numerator of the debt ratio, will increase the debt ratio unless there is an offsetting increase in GDP, the denominator of the ratio, of $[(\Delta Y/Y) \times PD]$. This relationship is illustrated as:

$$\Delta PD/Y = -(PBB/Y) + (iPD/Y) - (\Delta Y/Y)(PD/Y) \tag{11.7}$$

Table 11.1 uses Equation 11.7 to provide a numerical example of a change in the Government of Canada's debt ratio based on a small sample of recent data from the Department of Finances Fiscal Reference Tables 2014. The public debt ratio declined from 32.2 percent in the fiscal year ended March 31, 2013 to 31.0 percent in 2014. This decline was the result of a small surplus in the primary budget balance and growth in nominal GDP which, when combined, offset the interest cost of carrying the public debt. A small error in the predicted change in the public debt ratio from one year to the next is not unexpected given the small magnitude of the variables and the effects of rounding. Estimates based on longer sample periods do not produce significant annual or cumulative errors.

**Table 11.1: A numerical example of a change in the debt ratio**

| (1) Time Period | (2) Predicted $\Delta(PD/Y)$ | (3) Observed $PBB/Y$ | (4) Observed $iPD/Y$ | (5) Observed $(\Delta Y/Y)(PD/Y)$ | (6) Observed $\Delta(PD/Y)$ |
|---|---|---|---|---|---|
| 2013-2014 | -0.012 | 0.007 | 0.032 | 0.037×0.322 | -0.013 |

*Note*: The estimate in Column (2) uses Equation 11.7 namely: $[(2) = -(3) + (4) - (5)]$.
*Source*: Department of Finance, *Fiscal Reference Tables, 2014*, Tables 13, 15, and 17, Statistics Canada, *CANSIM*, Table 3800083 and author's calculations.

To control the debt ratio at its present level so that $(\Delta PD/Y) = 0$, fiscal policy has to set net tax rates and program expenditures such that the primary budget balance relative to GDP $(PBB/Y)$ offsets any difference between:

1. The effects of interest rate on the public debt ratio, $(iPD/Y)$; and
2. The growth rate in GDP times the debt ratio , $(\Delta Y/Y)(PD/Y)$.

This condition can be expressed as:

$$0 = -(PBB/Y) + (iPD/Y) - (\Delta Y/Y)(PD/Y),$$

which when rearranged gives:

$$(PBB/Y)^* = [i - (\Delta Y/Y)] \times (PD/Y) \tag{11.8}$$

Any primary budget balance other than $(PBB/Y)^*$ will result in a change in the public debt ratio. A larger primary budget balance reduces the debt ratio. A smaller balance increases it.

However, the primary budget balance does not need to be a surplus to reduce the debt ratio. If the growth rate of nominal GDP, $\Delta Y/Y$ is greater than the rate interest on the public debt, $i$, the debt ratio may decline even if the primary budget has a deficit relative to GDP that is less than the difference between the growth rate and the interest rate.

If instead the policy objective is to reduce the debt ratio substantially so that $(\Delta PD/Y < 0)$, the structural primary budget balance would have to be significantly larger over a considerable time period.

When the Government of Canada in 1995 set reducing the public debt ratio as its fiscal policy target, that ratio stood at 68 percent of GDP. The primary budget balance was in deficit and interest payments on the public debt absorbed about 35 percent of government revenue. In the years that followed, the public debt ratio declined steadily to a low 29 percent in 2008-09. Interest payments on the debt fell to less than 13 percent of revenue. Fiscal policy was on track to meet the debt ratio target of 25 percent set in the 2004 Budget. Significant structural primary surpluses were the major fiscal contributor to this decline in the ratio. The fiscal stimulus introduced in 2009 reversed this pattern, creating budget deficits and raising the net public debt by 30 percent between 2009 and 2014.

Figure 11.11 illustrates the sources of this significant reduction in the Canadian federal public debt ratio. The large increase in the primary budget surplus ($PBB$) was the main part of the fiscal adjustment, particularly in the first five years when it was increased from 2.5 percent to 6.1 percent of GDP. Its effect on the debt ratio is shown by the lower line in the diagram which plots ($-PBB$). The weighted interest rate-growth rate spread $(i - \Delta Y/Y)$ was a much smaller factor and on balance put upward pressure on the debt ratio. Clearly the budget surplus offset this effect and as the debt ratio declined the budget surplus was reduced and fiscal restraint eased.

Canadian success with debt ratio control and reduction from 1995 until 2009 has been cited as an example for countries currently facing very high debt ratios. But it may not be fit with current economic conditions in those countries. Canada's fiscal adjustment was made easier by a substantial easing of monetary conditions in terms of both interest rates and exchange rates and strong growth in the US economy, which all supported a large increase in exports. This economic environment is not available to the countries that now face a debt crisis.

Even with favourable conditions, the Canadian adjustment was costly. There was a cumulative loss of output from an output gap that lasted from 1995 to 1999 that was at times as large as 2 percent of $Y_P$. Unemployment rates reached 9 percent and low rates of capacity utilization in industry reduced profitability and investment in new capacity and technology.

These and the negative fiscal effects of the earlier monetary restraint following the shift to inflation targeting are now sunk costs. In the years that followed monetary and fiscal policies worked to deliver stable inflation and declining public debt ratios until the crisis and recession of 2008-09.

## 11.6 Recession, disinflation and deflation

The financial crisis of 2008 and the recession that followed uncovered the limitations of monetary policy and renewed the case for fiscal stimulation. The assignment of monetary policy to an inflation target at $Y_P$ and fiscal policy to debt ratio control did not work in the new economic conditions. Moreover, the depth of the recession and the collapse of the banking and financial sectors led to **disinflation** and raised fears of **deflation** as a result of rising real interest rates and output gaps. The Great Depression of the 1930s was an historical example. The Japanese experience starting in the 1990s with zero interest rates and a continuing slump was another. Stephan Poloz, the Governor of the Bank of Canada has at times worried out loud about the risks of deflation in Canada and discussed concerns briefly in an earlier speech on monetary policy. The full text of that speech is available at:

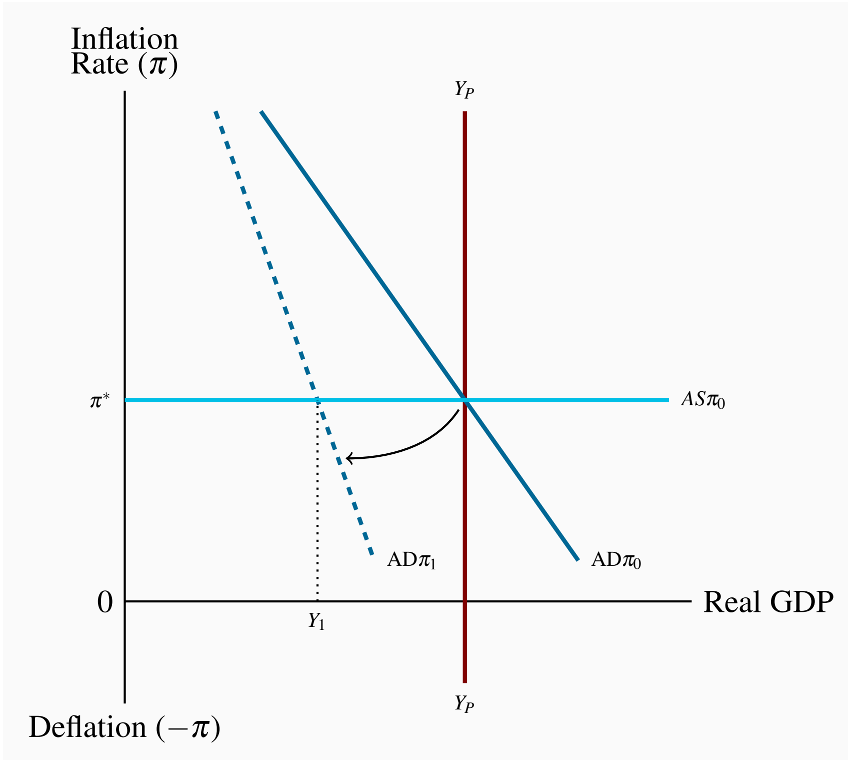
`http://www.bankofcanada.ca/2013/12/monetary-policy-as-risk-management/`

Although the risk of deflation may have receded somewhat the issues raised by *disinflation* remain at least as long as central banks have reached the zero lower bound and cannot provide monetary stimulus through interest rate cuts. A rethinking of macroeconomic policy was necessary.

> **Disinflation**: a persistent fall in the inflation rate.
>
> **Deflation**: a persistent fall in the general price level.

Some of the issues involved can be explained with the basic $\mathrm{AD}\pi/\mathrm{AS}\pi$ model. In Figure 11.12 a financial crisis shifts $\mathrm{AD}\pi$ by undermining the interest rate-expenditure link in the monetary transmission mechanism. Financial risk and uncertainty increase and demands for liquidity increase. Banks are reluctant to lend and businesses are reluctant to borrow. The $\mathrm{AD}\pi$ curve shifts left and pivots to show the reduction in financing and the fall in the interest sensitivity of expenditure. Equilibrium shifts to $\pi^*Y_1$ with a recessionary gap.

**Figure 11.12: Recession, disinflation & monetary policy**




Financial crisis undermines monetary transmission mechanism. AD$\pi$ falls but central bank interest rate cuts cannot offset the fall in $\pi$. At zero lower bound deflation raises real interest rate and the output gap continues to grow.

The recessionary gap triggers two reactions. The inflation rate falls and the central bank cuts its interest rate to offset the fall in inflation and output. But the steeper AD$\pi_1$ function reflects the disruption to financial markets. Nominal interest rate cuts have limited the effects on expenditure. To prevent a rise in the real interest rate $(i-\pi)$ the Bank must cut its nominal policy rate by more than the fall in inflation.

But the central bank cannot lower its rate below zero – it hits the lower bound. *If the output gap persists and pushes disinflation into deflation, rising real interest rates cut expenditure and increase the gap. The* ***AD$\pi$ function would be kinked backward at*** $i = 0$ *to capture these negative effects of disinflation and deflation.* Falling inflation rates reduce aggregate expenditure and aggregate demand along the AD$\pi$ curve.

Fortunately economic conditions did not deteriorate badly enough to trigger deflation:

> *"It appears today that the world will likely avoid a major deflation and thus avoid the deadly interaction of larger and larger deflation, higher and higher real interest rates and larger and larger output gaps."*

Blanchard, O. et al. (2010). Rethinking Macroeconomic Policy. ***IMF Staff Position Note***, SPN/10/03

Nevertheless, faced with the financial crisis and recession, major industrial countries shifted their policy programs. Cutting interest rates to defend inflation targets was the first policy initiative. The Bank of Canada cut its target overnight interest rate from 4.25 percent in late 2007 to a record low 0.25 percent in early 2009 and held the rate at that level until mid-2010. In the US the Federal Reserve cut its federal funds rate, the policy rate that corresponds to the Bank of Canada's overnight rate, from 5.25 percent in late 2007 to 0.0 percent in late 2008. It is still at that rate today in late 2014. These interest rate cuts reduced policy rates to the zero lower bound and exhausted the potential for monetary stimulus with that policy instrument.

Monetary policy in the US turned then to instruments used before it adopted interest rate setting to get an inflation target. The first was increased "moral suasion," an increase in communications with financial market participants, including *conditional statements about the future path of policy rates*, to emphasize the central bank's longer-term support for markets and its actions to promote stability. More directly the banks were urged to maintain their lending operations. The second was "**quantitative easing**," and in the case of the US, an even more extensive "**credit easing**." "Quantitative easing" extends the use of open market operations described above. The central bank purchases a broader range of financial assets to expand its balance sheet to increase substantially the monetary base and cash positions of the banks. In other words, the objective is to increase the quantity of cash reserves in the banking system directly.

> **Quantitative easing**: a central bank purchase of financial assets to increase its asset holdings and the monetary base.
>
> **Credit easing**: the management of the central bank's assets designed to support lending in specific financial markets.

Open market operations usually involve central bank purchases of short-term government bonds. The US Federal Reserve went beyond this, introducing three sets of policy tools:

1. lending to financial institutions,
2. providing liquidity directly to other key credit markets by buying highly rated commercial paper, and
3. buying longer-term securities, including mortgage backed securities.

Using these tools increases the size of the central bank's balance sheet and changes the structure of central bank asset holdings. Quantitative easing is measured by the impact on the quantity of bank reserves. Credit easing is measured by the wider variety of loans and securities the central bank willingly holds on its balance sheet. A purchase of these assets puts cash directly into specific markets rather than feeding it through banks and bank lending. Both are intended to increase lending to businesses and households in times when very low, near zero, interest rates alone are not working.

The effect of three rounds of quantitative easing by the US Federal Reserve has been to raise the monetary base in the US from about $800 billion in to $2.62 trillion in October 2012. While this monetary stimulus has not offset the full effects of the 2008-09 recession, it is credited with avoiding a US deflation. A version of this policy action was used in Japan earlier in the decade after the Bank of Japan had lowered its borrowing rate to zero and wanted to provide further economic stimulus. In terms of the AD$\pi$/AS$\pi$ model the intent was to support demand and shift the AD$\pi$ curve to the right or least avoid deflation if recessionary gaps persisted.

The Bank of Canada also developed plans for quantitative easing that were not used as economic conditions improved more quickly here than in some other countries. You can see the Bank's explanation of these policies in its Monetary Policy Report, April 2009 pp. 24-28, at `http://www.bankofcanada.ca/wp-content/uploads/2010/03/mpr230409.pdf`.

These monetary policies were supported by discretionary fiscal policies. With interest rates a zero, crowding out was not a concern and increased AD$\pi$ was the objective. The earlier focus on deficit and debt ratio control was set aside to provide aggregate demand stimulus. In Canada the federal government's '***Action Plan***' included direct support for infrastructure projects and tax incentives for certain household expenditures. In terms of budget data the federal government structural budget shifted from a surplus of $3.8 billion in fiscal 2007-08 to a deficit of $10.6 billion in 2009-10. But as noted earlier, the 'Action Plan' stimulus was treated as a 'cyclical' budget component. Thus the change in the actual federal budget balance from a surplus of $9.6 billion in fiscal 2007-08 to a deficit of $55.6 billion in fiscal 2009-10 is probably a better measure of the fiscal stimulus that addressed the recession. However, this stimulus was relatively short lived as the government returned to its earlier deficit and debt control focus and left monetary policy to provide sustained support for economic recovery. The monetary/fiscal policy mix remained that way in mid-2015.

**Example Box 11.1: The Algebra of the AD$\pi$ curve**

The AD$\pi$ curve is based on:

1. An AE function that includes the effect of interest rates on expenditures, and
2. Central bank monetary policy that sets interest rates to defend an inflation rate target.

The AE function is:

$$\text{AE} = A_0 - vi + [c(1-t) - m]Y \tag{1}$$

In this equation $A_0$ is autonomous expenditure, $v$ measures the impact of a change in the interest rate, $i$, on expenditure, and $[c(1-t)-m]$, the marginal propensity to spend. Using the equilibrium expenditure condition $Y = \text{AE}$ gives:

$$Y = A_0 - vi + [c(1-t) - m]Y$$

$$Y = (A_0 - vi)/(1 - c(1-t) + m) \tag{2}$$

The central bank sets interest rates to achieve a *target inflation rate* and reacts to changes in the inflation rate by changing short-term interest rates according to:

$$i = i_0 + \beta(\pi - \pi^*) \tag{3}$$

In this equation $i$ is the Bank's interest rate instrument, $\pi^*$ is the Bank's inflation rate target and $\pi$ is the actual inflation rate. With $\beta > 1$ the central bank's response to a change in the inflation rate changes the nominal interest rate enough to change the real interest rate. The monetary policy objective is to keep inflation at the target value $\pi^*$.

Substituting the interest rate determined by monetary policy in (3) into the equilibrium expenditure condition (2) gives an aggregate demand curve that includes the inflation rate:

$$\mathrm{AD}\pi = (A_0 - v[i_0 + \beta(\pi - pi^*)])/(1 - c(1-t) + m) \tag{4}$$

This aggregate demand curve is labeled AD$\pi$ to distinguish it from the traditional $P$, $Y$ aggregate demand curve. AD$\pi$ is the relationship between *real output and inflation*.

A numerical example illustrates this AD$\pi$ curve. Suppose

$$\mathrm{AE} = 200 + 0.5Y - 10i,$$

and the central bank has an inflation target $\pi^* = 1.0$ percent. The bank estimates that a real interest rate of 2.0 percent is needed for equilibrium at potential output. It sets the nominal interest rate $i_0 = (r + \pi^*) = 3.0$ and reacts to *transitory* departures from its inflation target according to the policy rule:

$$i = 3.0 + 1.5(\pi - 1)$$

Then by substitution,

$$\mathrm{AE} = 200 + 0.5Y - 10[3.0 + 1.5(\pi - 1.0)]$$
$$\mathrm{AE} = 185 - 15\pi + 0.5Y$$

In equilibrium $Y = \mathrm{AE}$ giving:

$$Y = (185 - 15\pi)/((1 - 0.5)) = 370 - 30\pi \tag{5}$$

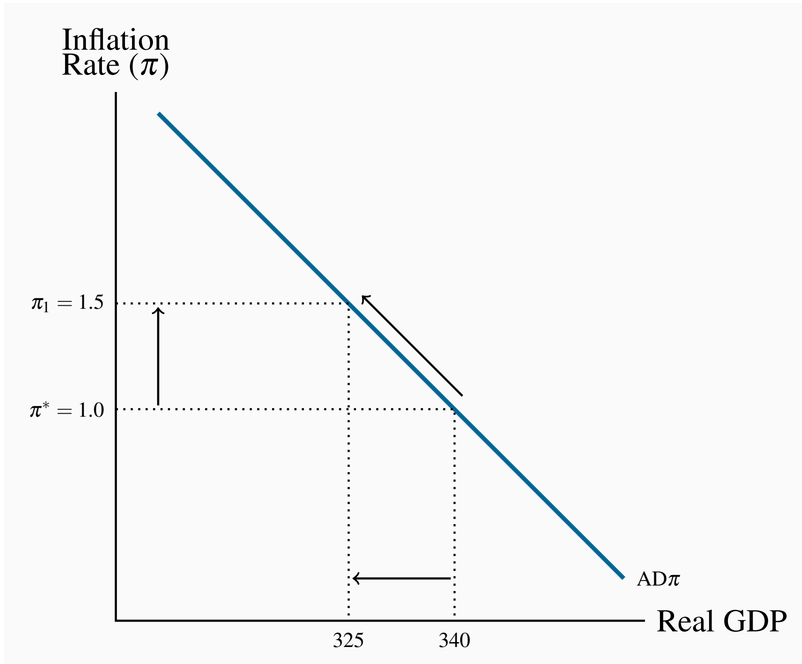
The aggregate demand curve:

$$\mathrm{AD}\pi : Y = 370 - 30\pi$$

defines a negative relationship between the inflation rate and equilibrium real GDP.

When the inflation rate is equal to the monetary policy target of 1 percent ($\pi = \pi^*$), the equilibrium level of real GDP and demand is 340. If the inflation rate were to rise to 1.5 percent, which exceeds the target by 0.5 percent, the Bank's reaction would be to raise the interest rate by $[1.5(1.5 - 1)] = 0.75$ percent. This would lower aggregate expenditure by $(10 \times 0.75 = 7.5)$ and equilibrium real GDP by $(7.5 \times \text{multiplier} = 15)$ to 325, moving up along the AD$\pi$ curve. A fall in inflation from the target would bring the opposite reaction. This scenario is depicted in Figure 11.13.

**Figure 11.13: The AD$\pi$ curve**




## Next

This chapter provides the basic model for the analysis of macroeconomic performance and policy that integrates the design, instruments and objectives of modern monetary and fiscal policies. Inflation, deflation, public debt ratios and business cycles are explained. But two issues remain. One is international macroeconomics and the importance of exchange rate policy for the effectiveness of monetary and fiscal policies. The second is economic growth, growth theory and growth accounting. These are covered in the next two chapters.

# Key Concepts

The AD$\pi$ curve describes the relationship between equilibrium real GDP and the inflation rate.

**Monetary policy** that sets an **inflation rate target** and uses the **short-run interest rate** as a policy instrument is integral to the AD$\pi$ curve.

The **production function** $Y = A \times F(N,K)$ determines the output of goods and services.

In the long run, labour market equilibrium determines the equilibrium level of employment and **potential output** $Y_P$.

In the short run, employment and output fluctuate in response to changing economic conditions. However, there is **no trade-off between inflation rates and output**.

The short run AS$\pi$ function describes the lagged adjustment to the inflation rate in reaction to output gaps.

The AS$\pi$ function is based on the **price setting decisions** of producers in imperfectly competitive markets.

The **equilibrium inflation rate** is the inflation control target set by the central bank.

**Business cycles** in output and employment caused by persistent AD$\pi$ and/or AS$\pi$ shifts create output gaps.

Persistent output gaps lead to an **internal adjustment** based on **changes in the rate of increase in money wage rates and changes in the rate of inflation**.

A **monetary policy rule** describes the central bank's setting of its interest rate policy instrument as reactions to inflation rates that differ from its inflation control target and to output gaps.

**Fiscal policy** controls government budget balances to control or reduce the size of the **public debt ratio**.

The **primary budget balance** is the **fiscal policy instrument**.

The arithmetic of changes in the public debt ratio links the **change in the debt ratio** to the primary budget balance and the difference between the interest rate on the debt and the growth rate of GDP.

Over the 1995-2008 period Canadian monetary and fiscal policies effectively **controlled the Canadian inflation rate and reduced the federal government debt ratio**.

The financial crisis of 2008 and the recession that followed in 2008-09 demonstrated the limits of monetary policies based on interest rates and fiscal policies focused on debt ratio control. In Canada, a combination of monetary and fiscal stimulus reduced the fall in output and employment. In other countries, a broader set of monetary policy instruments and fiscal austerity have yet to solve employment and public debt issues.

## Exercises for Chapter 11

**Exercise 11.1** Use a diagram to illustrate an economy at the equilibrium inflation rate. In this diagram, show how a permanent increase in exports would affect the equilibrium inflation rate and the equilibrium level of GDP if the central bank did not react and change its monetary policy.

**Exercise 11.2** Suppose the central bank reacted to defend its inflation target from the effect of the increase in exports in Exercise 11.1. Use an AD$\pi$/AS$\pi$ diagram to show the change in the equilibrium interest rate setting and real GDP you would observe.

**Exercise 11.3** Suppose opportunities for investing in high tech applications boost aggregate demand in the short run, and aggregate supply in the long run. Using AS$\pi$ and AD$\pi$ curves with equilibrium at potential output, show why output might rise in the long run without much of an increase in inflation.

**Exercise 11.4** Suppose a new round of labour negotiations results in a higher average rate of increase in money wage rates for the next three years. Illustrate and explain how this would affect short-run aggregate supply conditions and the AS$\pi$ curve.

**Exercise 11.5** Draw an aggregate supply and demand curve diagram to show an economy in short-run equilibrium at potential output. Suppose a wide-spread recession reduces incomes in foreign countries, leading to reduced demand for exports. Illustrate and explain how this would affect the short-run equilibrium $Y$ and $\pi$ in your diagram.

**Exercise 11.6** Suppose central banks have reduced their policy interest rates to the lower bound to fight a deep and prolonged recession. Use a diagram to show how either a reduction in the inflation rate, or deflation, would change the slope of the AD$\pi$ curve. Would cuts in nominal money wage rates and further reductions in the inflation rate reduce the recessionary gap when the central bank is constrained by the lower bound on its interest rate?

**Exercise 11.7** In the two years before 2008 the Canadian federal government reduced the GST from 7 percent to 5 percent. Use an AD$\pi$/AS$\pi$/$Y_P$ diagram to illustrate and explain the effects of this tax change on equilibrium output and inflation. If the economy was in equilibrium at $Y_P$ and the target inflation rate $\pi^*$ before the tax cut, what monetary policy action, if any, would the central bank make to maintain those equilibrium conditions after the tax cut? What short-run net benefit, if any, would households and businesses realize as a result of the cut in the GST?

**Exercise 11.8** Define the ‘public debt’ and explain why and how it might increase from one year to the next.

**Exercise 11.9** Would it be possible for the ratio of the public debt to GDP $(PD/Y)$ to fall even if the government's primary budget is in deficit? Explain your answer.

**Exercise 11.10** Would it be possible for the ratio of public debt to GDP $(PD/Y)$ to rise even if the government's primary budget balance is in surplus? Explain your answer.

**Exercise 11.11** *Optional*: Suppose the central bank's monetary policy sets the interest rate according to the function:

$$i = 3.0 + 2.0(\pi - \pi^*) \text{ with } \pi^* = 4.0,$$

and aggregate expenditure is the sum of:

$$\begin{aligned} C &= 200 + 0.75Y \\ I &= 85 - 2i \\ G &= 100 \\ X - IM &= 50 - 0.15Y - 3i \end{aligned}$$

(a) What is the equation for the AD$\pi$ curve?

(b) Plot the AD$\pi$ curve in a diagram, not necessarily to scale, that shows the horizontal intercept and slope of the curve.

**Exercise 11.12** *Optional*: If careful research estimates potential output $Y_P$ at 1,000, and the AD$\pi$ function is as derived in Exercise 11.2, what is the equilibrium inflation rate? What interest rate must the central bank set to defend its inflation target?

# Chapter 12

## Exchange rates, monetary policy, and fiscal policy

**In this chapter we will explore:**



In 1999 the Canadian economist Robert Mundell won the Nobel Prize in Economics for his work on the importance of exchange rate policy for the effectiveness of monetary and fiscal policies as tools to manage aggregate demand. Mundell showed for a small open economy like Canada, with a high degree of international capital mobility, that:

- With *flexible* exchange rates monetary policy is a powerful demand management tool, but fiscal policy is weak, and
- With *fixed* exchange rates monetary policy is ineffective as a demand management tool, but fiscal policy is strong.

The Bank of Canada's monetary policy framework, using interest rates, flexible exchange rates and an inflation rate target reflects these strong theoretical arguments. Furthermore, the difficulties European countries using the euro have experienced trying to cut budget deficits and stimulate income growth show the constraint a fixed exchange rate imposes on fiscal adjustments.

This chapter explains the foreign exchange market, flexible and fixed exchange rates and the reasons why different exchange rate policies affect the design and effectiveness of monetary and fiscal policy.

## 12.1 The balance of payments

The **balance of payments accounts** provide the background to supply and demand in the foreign exchange market. They record transactions between residents of one country and the rest of the world that involve payments in different national currencies. Taking the Canadian economy as the domestic economy and the United States as the "rest of the world," all transactions that give rise to an inflow of US dollars to Canada are entered as credits in the Canadian balance of payments. Transactions requiring payments in US dollars are debits, entered with a minus sign.

Table 12.1 shows the actual Canadian balance of payments accounts in 2012. Entries in the 'Exports' column represent supplies of foreign currency coming to the Canadian foreign exchange market, converted to Canadian dollars. Entries in the 'Imports' column represent the demand for foreign currency in the Canadian foreign exchange market, converted to Canadian dollars. Row 5 in the table shows that after adjustment for statistical error and changes in official reserves, the foreign exchange market is in equilibrium – supply equals demand.

> **Balance of payments accounts**: a record of trade and financial transactions between residents of one country and the rest of the world.

**Table 12.1: The Canadian balance of payments, 2012 ($Cdn billions)**

| | **Exports** (receipts) | **Imports** (payments) | **Balance** |
|---|---|---|---|
| **1. Current account** | | | |
| Merchandise trade (goods) | 458.2 | 455.9 | 2.3 |
| Non-merchandise trade (services) | 75.3 | 100.0 | −24.7 |
| Investment income, (interest & dividends) | 66.4 | 89.0 | −22.7 |
| Transfers, etc. | 8.7 | 12.0 | −3.3 |
| **Balance** | | | −48.4 |
| **2. Capital account** | | | |
| Capital account: net transfers & intangibles | | | 4.8 |
| Financial account: | | | |
| Investment: | | | |
| Foreign in Canada | 161.5 | | 161.5 |
| Canada in foreign countries | – | 110.5 | −110.5 |
| **Balance** | | | 55.8 |
| **3. Statistical discrepancy** | | | −7.5 |
| **4. Change in official international reserves** | | | −0.1 |
| **5. Balance of payments** $[(1)+(2)+(3)-(4)]$ | | | 0 |

*Source:* Bank of Canada Banking and Financial Statistics, October 2014, Tables J1 and J2, Bank of Canada, 2014.

The **current account** of the balance of payments records international flows of goods, services, and transfer payments. The merchandise trade is exports and imports of goods; things like cars and car parts, steel, wheat, and electronic equipment. Non-merchandise trade measures exports and imports of services like travel, banking and financial services, transportation, and tourism. The total of merchandise and non-merchandise trade is the trade balance defined as *net exports* in our earlier study of planned expenditure and aggregate demand.

> **Current account**: a record of trade in goods, services, and transfer payments.

However, the trade balance is not the same thing as the current account of the balance of payments. There are also flows of investment income in the form of interest payments, dividends and reinvested earnings, and transfer payments between countries as a result of government programs like foreign aid, and private receipts and payments.

But exports and imports of goods and services are the largest components of the current account. Trade in goods and services is based, in part on differences across countries in tastes, in the types of goods and services available, in economic structure, in national income levels and differences in the prices of domestic goods and services relative to foreign goods and services.

Three factors determine the prices of foreign goods and services relative to prices of domestic goods, namely:

1. The domestic price level ($P_{\text{Cdn}}$) for Canada;
2. The foreign currency price of imports ($P_{\text{US}}$) in the case of imports from the US; and
3. The **nominal exchange rate** (*er*): the domestic currency price of foreign currency.

*International price competitiveness* is measured by the **real exchange rate**, which combines these three factors. For example, the real exchange rate between Canada and the United States would be:

$$\text{Real exchange rate} = \frac{er \times P_{\text{US}}}{P_{\text{Cdn}}} \tag{12.1}$$

where the nominal exchange rate *er* is the Canadian dollar price of the US dollar and $P_{\text{US}}$ and $P_{\text{Cdn}}$ are general price levels as measured, for example, by GDP deflators or consumer price indexes. The real exchange rate measures the price of United States goods and services in Canadian dollars *relative to* Canadian goods and services in Canadian dollars.

The real exchange rate makes an important link in the transmission mechanism between the foreign exchange rate and the impact of domestic price levels and inflation rates on net exports, aggregate expenditure and aggregate demand.

> **Nominal exchange rate** (*er*): the domestic currency price of a unit of foreign currency.

**Real exchange rate**: the relative price of goods and services from different countries measured in a common currency.

Consider the following example:

- The nominal exchange rate $er$ =\$1.25Cdn/\$1US
- The GDP deflator for Canada is 121.3, on the base year 2002.
- The GDP deflator for the US is 110.4, on the base year 2002.

Then the real exchange rate, which gives the price of US goods in Canadian dollars relative to the price of Canadian goods in Canadian dollars, is:

$$\text{Real exchange rate} = \frac{er \times P_{\text{US}}}{P_{\text{Cdn}}} = \frac{1.25 \times 110.4}{121.3} = 1.138 \tag{12.2}$$

By this example, US goods and services are about 14 percent more expensive than Canadian goods and services, on average, when both are priced in Canadian dollars. At the same time, Canadian goods and services are less expensive than domestic goods in the US when both are priced in US dollars. These price differentials as are important to the flows of exports and imports of goods and services between countries.

The **capital account** of the balance of payments makes a link between interest rates and the supply and demand for foreign exchange and the exchange rate.

It records two types of transactions. Under the sub-title 'capital account' it records international net transfers such as migrants' assets, inheritances and government pension payments. The much larger 'financial account' records the flows of funds for international purchases and sales of real and financial assets. Table 12.1 shows a net capital inflow of \$55.8 billion in 2012. The payments by foreigners buying Canadian assets exceeded the payments made by Canadians buying foreign physical and financial assets. A capital account surplus was the result.

**Capital account**: the record of capital transfers and the purchases and sales of real and financial assets.

Receipts and payments in the capital account reflect sales and purchases of foreign assets. These flows have become increasingly important. Computers and electronic communications make it as easy for a Canadian resident to buy and sell stocks and bonds in the financial markets of New York or London as in Toronto. Moreover, controls on international capital flows have gradually been dismantled with globalization and financial integration.

The world's financial markets now have two crucial features. First, capital account restrictions have been abolished for capital flows between advanced countries. Funds can move freely from one country to another in search of the highest expected *rate of return*. Second, trillions of dollars are internationally footloose, capable of being switched between countries and currencies when assets with similar degrees of risk are expected to offer different rates of return in different countries and currencies.

This is the age of **perfect capital mobility** when small differences in expected returns trigger very large flows of funds from country to country. Indeed, the stock of international funds is now so huge that capital flows could swamp the typical current account flows from exports and imports.

> **Perfect capital mobility**: when very small differences in expected returns cause very large international flows of funds.

In international asset markets, capital gains or losses arise not merely from changes in the domestic price of an asset, but also from interest rate differentials and changes in exchange rates while temporarily holding foreign assets. Table 12.2 provides an example.

**Table 12.2: Returns from lending $1,000 for a year**

| $1,000 Lent in | Interest Rate (%) | Exchange rate ($Cdn/$US) Initial | Final | Final asset value $Cdn | $US |
|---|---|---|---|---|---|
| 1. Canada | 4.0 | | | 1,040.00 | |
| 2. United States | 5.0 | 1.03 | 1.009 | 1,028.50 | 1,019.41 |

Suppose you can invest $1,000 Canadian for a year. Canadian one-year interest rates are 4 percent. In the United States one-year rates are 5 percent. The higher United States rates look attractive. If you keep your funds in Canadian dollars, Row 1 shows that you will have $1,040 at the end of the year. Can you do better by buying a United States asset?

Row 2 shows what happens if you convert $1,000Cdn into US dollars at an initial exchange rate of $1.03Cdn/$1US You have $970.87US to invest at the United States interest rate of 5 percent. You get $1,019.41US You would be ahead if the exchange rate remained constant. $1,019.41US is $1,050Cdn, a return of 5 percent, as you would expect.

Suppose, however, the exchange rate changes while your funds are out of the country. Let's say the Canadian dollar appreciates by 2 percent during the year, lowering the exchange rate to $1.009Cdn/$1US When converted back to Canadian dollars your $1,019.41US now buys $1,028.50 Cdn. You get 1 percent more interest income from holding the United States asset instead of the Canadian asset, but you suffer a capital loss of 2 percent by temporarily holding US dollars, whose value relative to Canadian dollars fell by 2 percent in that year.

In this example, you end up with about $1,028.50Cdn if you lend in US dollars. The Canadian dollar appreciated by more than 1 percent, the difference between Canadian and United States interest rates. As a result, the capital loss from the exchange rate while holding US dollars outweighed the gain on interest. This was the experience of many portfolios in 2008 as the Canadian dollar appreciated strongly and the exchange rate fell. The total return on lending in US dollars was lower than the return in Canadian dollars.

Conversely, if the Canadian dollar depreciated against the US dollar while you were holding your United States asset, your total return would be higher than the 1 percent interest rate differential. You would get a gain on the exchange rate when you converted back to Canadian dollars. This was the experience of portfolios holding assets denominated in US dollars as the Canadian dollar depreciated over the period from May 2008 to March 2009, raising the nominal exchange rate from $er = 0.9994$ to $er = 1.2645$. The exchange rate movement provided a 26.5% annual return, in terms of Canadian dollars, to portfolios holding US dollar assets. The depreciation of the Canadian dollar in 2014-15 had the same effect.

Equation 12.3 summarizes this important result. The total return on temporarily lending in a foreign currency is the interest paid on assets in that currency plus any capital gain (or minus any capital loss) arising from the depreciation (appreciation) of the domestic currency during the period.

$$\begin{array}{ccccc} \text{Return on holding} & = & \text{Interest rate on} & \pm & \text{\% increase/ \% decrease in} \\ \text{foreign asset} & & \text{foreign asset} & & \text{nominal exchange rate } (er) \end{array}$$

$$\text{Total return on foreign asset} = i_f + \%\Delta er \tag{12.3}$$

As a result, the net capital flow in the balance of payments depends positively on the differential between domestic and foreign nominal interest rates $(i - i_f)$. A rise in domestic rates relative to foreign rates would attract a flow of funds into the domestic financial market. A fall in domestic rates would push the flow toward foreign financial markets, assuming in both cases that the exchange rate is not expected to change in an offsetting direction.

Alternatively, assuming the interest rate differential is constant, the net capital flow depends negatively on the expected rate of depreciation of the domestic currency suggested by $[(er^e/er) - 1]$. An expectation that the domestic currency will depreciate (a rise in $er^e$) will increase the returns from holding foreign assets and lead to a net capital outflow. An expected appreciation would reduce expected returns on foreign assets with the opposite effect. These capital flows are important parts of the supply and demand for foreign exchange on the foreign exchange market.

The **change in official international reserves** in Table 12.1 records the increase or decrease in the Government of Canada's holdings of foreign currency balances. A government's holdings of foreign currencies are in its official international reserves account. These balances are like investments in foreign countries because they are the government's holdings of foreign assets. An increase in the official reserves is like a payment item in the capital account of the balance of payments. Because Canada maintains a flexible exchange rate, annual changes in international reserves are small. When it comes to discussing different exchange rate policies, countries that adopt fixed exchange rates often experience large changes in their foreign currency reserves in defense of the exchange rate they have set.

> **Change in official international reserves**: the change in the Government of Canada's foreign currency balances.

The **balance of payments** is the sum of the balances in current and capital accounts minus the change in the official international reserves account. In Table 12.1, this balance is shown as the sum of accounts $(1+2+3-4)$ namely $(-48.4+55.8-7.5-(-0.1)=0)$. If all items in the accounts were measured correctly, the balance would be zero. To recognize this, a statistical discrepancy adjustment is made, as shown in the table, to account for any errors in the measurement of other items.

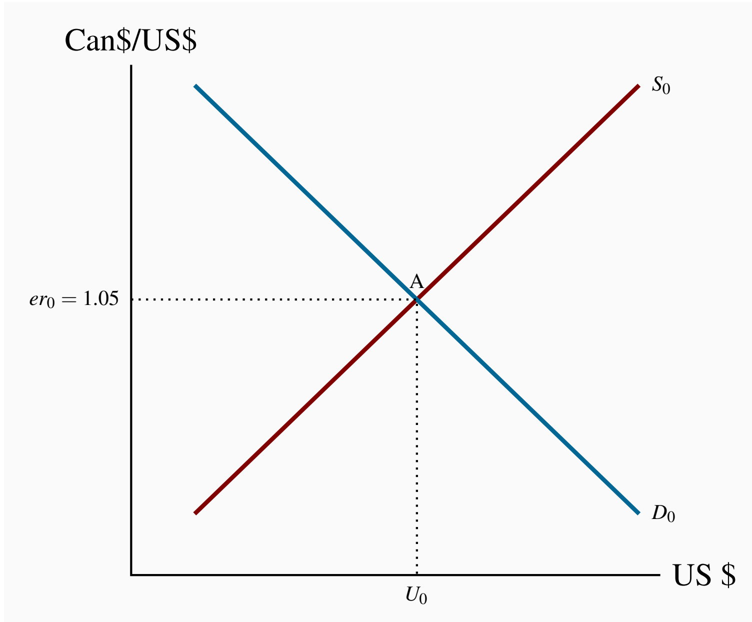
> **Balance of payments**: the sum of the balances in current accounts and capital accounts, minus the change in the holdings of official reserves.

The record of the change in official reserves is always of equal magnitude to the sum of the balances on the current and capital account, if there is no statistical discrepancy in the measurements. As a result, the *balance of payments always balances*, but the state of the individual accounts underlying that overall balance need not be in balance. Indeed, changes in the foreign exchange rate in the foreign exchange market reconciles the different account balances to produce overall balance.

## 12.2 The foreign exchange market

The foreign exchange market is the market in which the currencies of different countries are bought and sold and the prices of currencies, the foreign exchange rates, are established. Consider the market for US dollars as foreign currency. The sources of supply and demand for foreign exchange are shown by the balance of payments in Table 12.1. Exports of goods, services, and financial assets generate a supply of foreign currencies that are sold in the foreign exchange market for Canadian dollars. Imports of goods, services, and securities must be paid for in foreign currencies. The demand for foreign exchange is derived from this demand for imports. Without intervention by governments, demand and supply determine the exchange rate, as, for example, $er_0 = 1.05$ in Figure 12.1.

**Figure 12.1: The foreign exchange market**




The supply of US dollars on the foreign exchange market comes from US purchases of Canadian goods, services and assets. The demand for US dollars comes from Canadian demand for imports of goods, services and assets. Supply and demand determine the equilibrium exchange rate $er_0$.

The exchange rate $er_0 = \$1.05$ is what it costs in Canadian dollars to buy each US dollar you want for your winter reading week break in Florida. Alternatively, if you as an exporter of lumber to the US market receive $1,000US for every 1000 board feet of 2x4 boards you sell to US builders, your Canadian dollar revenue to cover your Canadian costs is $1,050.

If the price of goods in US markets is constant, a lower exchange rate $er_1$; say, $er_1 = 1.01$, *other things constant*, by lowering the price and raising the quantity of Canadian imports, must raise the demand for US dollars. In Figure 12.1, the demand curve for US dollars $D_0$ *slopes downwards*. More US dollars are demanded to buy more imports at a lower Cdn$/US$ exchange rate.

The US dollars supplied on the foreign exchange market are the receipts from the export of goods, services, and securities to US residents. From the discussion of the current and capital accounts of the balance of payments, exports of goods and services depend on foreign income, the relative prices of domestic and foreign goods and services, and the exchange rate. Net exports of securities depend on the difference between domestic and foreign interest rates, for given expectations of the future exchange rate.

In Figure 12.1, the supply curve shows the quantities of US dollars that would come to the market at different exchange rates, *er*, all other things constant. It slopes upward because a higher Cdn$/US$ exchange rate ($er > \$1.05$) lowers the prices of Canadian goods and services to US buyers. As a result, United States residents buy more Canadian exports and total export receipts rise. The quantity of US dollars coming onto the foreign exchange market increases as we move up the supply curve. The supply curve has a positive slope.

Figure 12.1 assumes that the demand for Canadian exports and the Canadian demand for imports are price elastic. Price increases caused by changes in the exchange rate reduce total revenue. Price reductions caused by changes in the exchange rate increase total revenue. These conditions give the slopes shown for the supply and demand curves.

At the equilibrium exchange rate $er_0$, the quantities of US dollars supplied and demanded are equal. In terms of the balance of payments, the balance is zero. Receipts equal payments.

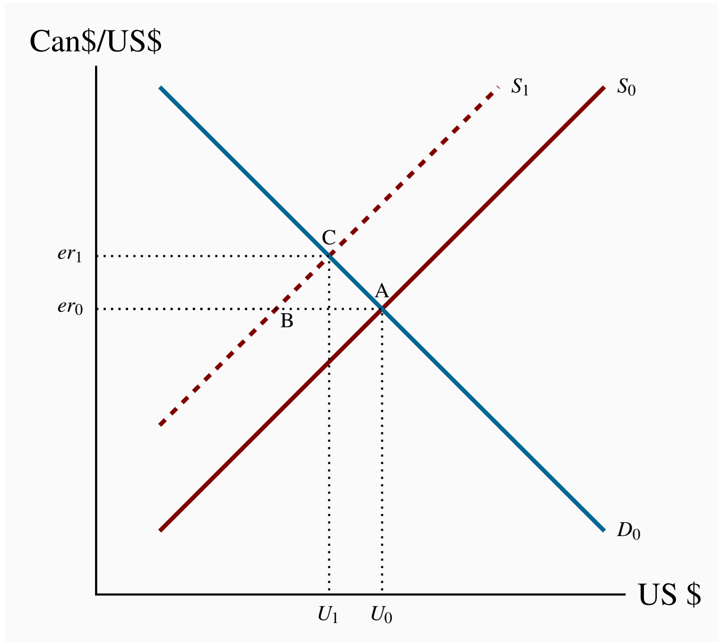
In practice, as seen in Table 12.2, the balance of payments is recorded in domestic currency. However, the equality of receipts and payments still holds. Both are easily converted to Canadian dollars by multiplying the US dollar amounts by the exchange rate. In terms of Figure 12.1, multiplying $U_0$ on the horizontal axis by the exchange rate $er_0$ on the vertical axis gives the area of the rectangle $er_0AU_0O$, the Canadian dollar value of total receipts or total payments recorded in the balance of payments.

What would change the equilibrium in Figure 12.1? A change in any of the factors held constant in order to draw the supply and demand curves will shift one or the other or both curves. We see this in both the net export and capital flow functions. A rise in United States income would increase US imports from Canada and shift the supply of foreign exchange to the right. As discussed above and in Chapter 9, a change in interest rates in Canada or the United States would change the trade in financial assets and affect both the supply curve and the demand curve. In short, a change in any market condition *other than the exchange rate er* will change supply and demand conditions in the market. The exchange rate will then change to a new equilibrium. Figure 12.2 and 12.3 provide examples.

## The effect of a recession in the US economy on the exchange rate

The demand and supply curves in the foreign exchange market of Figure 12.2 are drawn on the assumption that tastes, incomes, prices of goods and services, interest rates, and expectations of future exchange rates are constant. The flows of payments and receipts under these conditions result in the equilibrium exchange rate $er_0$. This would be a Canadian dollar price for the US dollar of, for example, \$1.05. From the United States perspective, a Canadian dollar costs a United States resident about \$0.952US

**Figure 12.2: The effect of a recession in the US on the exchange rate**




A recession in the US reduces Canadian exports to the US and reduces the supply of US$ on the foreign market. $S$ shifts from $S_0$ to $S_1$. The exchange rate rises as the Can$ depreciates.

Now suppose, as occurred in early 2008 and 2009, a recession in the United States lowers United States real income. United States imports fall, based on the US marginal propensity to import. United States imports are Canadian exports, and the US dollar receipts of Canadian exporters are reduced. The recession and difficult household financial conditions reduce US residential construction and Canadian lumber exports decline. Recession also reduces travel by US residents, and the Canadian tourism industry suffers a decline in bookings and receipts. If expenditures on new cars in the United States are reduced, Canadian auto industry sales to the United States market are reduced. In the balance of payments, the balance on trade in goods and services falls, and in the foreign exchange market *the supply of US dollars on the market is reduced*.

The supply curve in Figure 12.2 shifts leftward to $S_1$. At the initial exchange rate $er_0$, the demand for US dollars exceeds the supply, putting upward pressure on the exchange rate. In terms of the balance of payments, the excess demand for US dollars represents a balance of payments deficit. In the example shown here, the Canadian dollar depreciates and the exchange rate rises to restore equilibrium in the foreign exchange market and the balance of payments. A higher price for the US dollar reduces Canadian imports and increases the Canadian dollar receipts of Canadian exporters. The effects of the US recession on the Canadian balance of payments are offset by the exchange rate change.

The rise in the exchange rate in this case is a **depreciation** of the Canadian dollar and a corresponding **appreciation** of the US dollar.

> **Currency depreciation**: a fall in external value of the domestic currency that raises domestic currency price of foreign currency.
>
> **Currency appreciation**: a rise in external value of the domestic currency that lowers the domestic currency price of foreign currency.

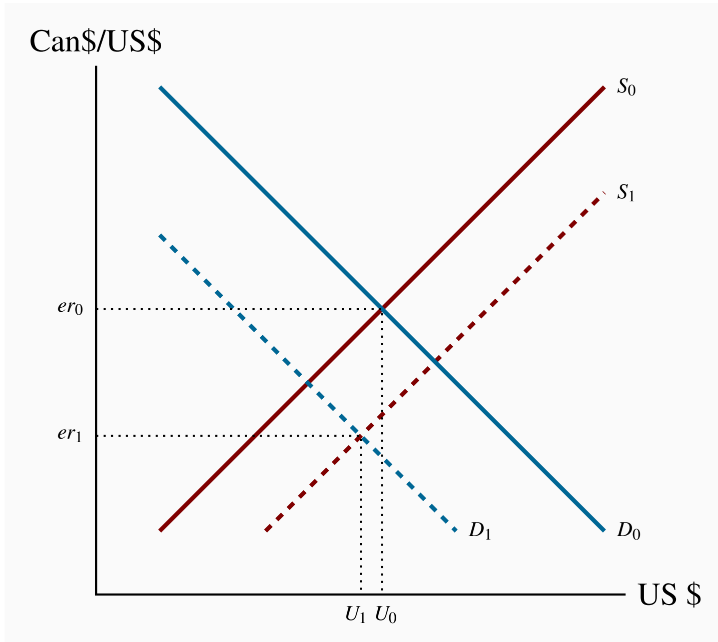
Before the recession of 2009, Canadian experience was the opposite of this example. High GDP growth rates in the US and Asia created very strong international demand for Canadian commodities and crude oil at high international prices. Strong oil and commodity exports increased the supply of foreign currencies on the Canadian foreign exchange market. The Canadian dollar *appreciated* strongly, with the exchange rate falling from $1.57Cdn/$1US in 2002 to an average of $0.9994 Cdn/$1US in May of 2008, a fall of about 60 percent over the six year period. Exchange rate changes led to a restructuring of both exports and imports to maintain equilibrium in the balance of payments as Canada's international trade changed dramatically.

## The effect of a fall in foreign interest rates on the foreign exchange rate

In the previous example a change in foreign income and the supply of foreign exchange disrupted the equilibrium in the foreign exchange market and changed the exchange rate. As an alternative to that example, consider the effects of a cut in foreign interest rates.

In Figure 12.3 the foreign exchange market is in equilibrium, initially at an exchange rate $er_0$. A fall in foreign interest rates, other things constant, disrupts this equilibrium. Now lower foreign rates make domestic (Canadian) bonds more attractive to foreign portfolios than they were previously. The demand for domestic bonds rises. The supply of US dollars on the market to pay for these bond exports increases, shifting $S_0$ to $S_1$ in the diagram. At the same time, the attractiveness of foreign bonds for domestic portfolios is reduced, reducing the demand for US dollars to pay for them. The demand curve shifts from $D_0$ to $D_1$. The equilibrium exchange rate falls to $er_1$.

**Figure 12.3: The effect of a cut in foreign interest rates**




A cut in foreign interest rates shifts portfolios toward the Canadian bond market and away from foreign markets. The supply of foreign currency increases from the increased export of bonds at the same time as the demand for foreign currency to buy foreign bonds falls. The domestic currency appreciates and the exchange rate falls.

In balance of payments terms the net capital inflow, the balance on capital account, is increased. The change in the exchange rate causes an offsetting change in the current account that restores equilibrium in the foreign exchange market and the balance of payments. A lower nominal exchange rate lowers the real exchange rate. Imports are now cheaper and exports, priced internationally in US dollars, are less profitable. Export receipts are reduced. As we saw in Chapter 9, changes in the exchange rate are one channel by which changes in financial conditions impact AD and equilibrium GDP.

Figures 12.2 and 12.3 provide two examples of adjustments in the foreign exchange rate. The underlying assumption is that *exchange rates are flexible* and allow the market to adjust freely and quickly to changing circumstances.

However, there are alternative exchange rate arrangements. To understand how the foreign exchange rate operates in different countries, we need to consider the different *exchange rate policies* governments can adopt. These result in different foreign exchange rate regimes, different ways that the balance of payments adjusts to change, and different roles for monetary and fiscal policies.

## 12.3 Flexible exchange rates and fixed exchange rates

To grasp the basics of **exchange rate regimes**, we focus on two extreme forms that have been adopted to handle international transactions in the world economy: *flexible exchange rates and fixed exchange rates*.

> **Exchange rate regime**: the policy choice that determines how foreign exchange markets operate.

### Floating or flexible rates

In a **floating or flexible exchange rate** regime, the exchange rate is allowed to find its equilibrium level on the foreign exchange market *without central bank intervention*.

> **Flexible exchange rates**: Supply and demand in the foreign exchange market determine the equilibrium exchange rate without central bank intervention.

Figures 12.2 and 12.3 showed the exchange rates that would result if rates adjusted flexibly and freely in response to changes in demand and supply. The central bank *did not intervene* to fix or adjust the rate. The rise in the demand for US dollars would result in a rise in the exchange rate to clear the foreign exchange market and maintain the balance of payments. Alternatively, the fall in demand would result in a fall in the exchange rate. The Bank of Canada would not intervene in either case. The holdings of official foreign exchange reserves and the domestic money supply would not be affected by foreign exchange market adjustments.

The alternative is a *fixed exchange rate* as explained below. In this regime, the central bank sets an official exchange rate and intervenes in the foreign exchange market to offset the effects of fluctuations in supply and demand and maintain a constant exchange rate. In Canada in the 1960s the exchange rate was fixed by policy at \$1US=\$1.075 Cdn (\$1Cdn$\approx$\$0.925US) and the Bank of Canada intervened in the foreign exchange market to maintain that rate.

How do countries choose between fixed and floating exchange rates? Obviously, there is not one answer for all countries or we would not see different exchange rate regimes today. With flexible rates, the foreign exchange market sets the exchange rate, and monetary policy is available to pursue other targets. On the other hand, fixed exchange rates require central bank intervention. *Monetary policy is aimed at the exchange rate*.

The importance a country attaches to an *independent monetary policy* is one very important factor in the choice of an exchange rate regime. Another is the size and volatility of the international trade sector of the economy. A flexible exchange rate provides some *automatic adjustment and stabilization* in times of change in net exports or net capital flows.

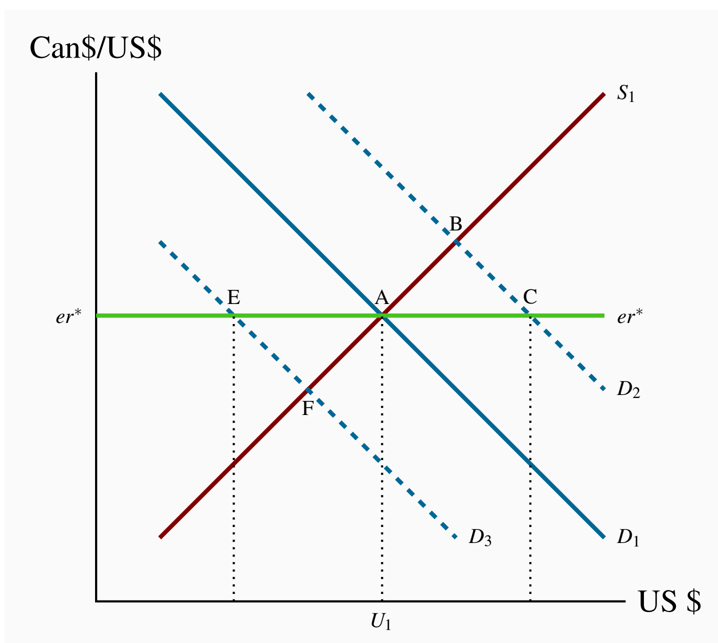
## Fixed exchange rates

In a **fixed exchange rate** regime, the government intervenes actively through the central bank to maintain convertibility of their currency into other currencies at a fixed exchange rate. A currency is **convertible** if the central bank will buy or sell as much of the foreign currency as people wish to trade at a fixed exchange rate.

> **Fixed exchange rate**: an exchange rate set by government policy that does not change as a result of changes in market conditions.
>
> **Convertible currency**: a national currency that can be freely exchanged for a different national currency at the prevailing exchange rate.

In Figure 12.4, suppose the exchange rate is *fixed at* $er^*$. There would be a free market equilibrium at A if the supply curve for US dollars is $S_1$ and the demand curve for US dollars is $D_1$. The central bank does not need to buy or sell US dollars. The market is in equilibrium and clears by itself at the fixed rate.

**Figure 12.4: Central bank intervention to fix the exchange rate**




With exchange rate fixed at $er^*$ a shift in demand for US$ to $D_2$ creates excess demand AC. The central bank intervenes, supplying AC US$ from official reserve holdings in exchange for Can$. To maintain $er^*$ if demand shifted to $D_3$ would create the opposite condition and central bank would have to buy US$.

Suppose demand for US dollars shifts from $D_1$ to $D_2$. Canadians want to spend more time in

Florida to escape the long, cold Canadian winter. They need more US dollars to finance their expenditures in the United States. The free market equilibrium would be at B, and the exchange rate would rise if the Bank of Canada took no action.

However, with the exchange rate fixed by policy at $er^*$ there is an excess demand for US dollars equal to AC. To peg[1] the exchange rate, the Bank of Canada *sells* US dollars from the **official exchange reserves** in the amount AC. The supply of US dollars on the market is then the "market" supply represented by $S_1$ plus the amount AC supplied by the Bank of Canada. The payment the Bank receives in Canadian dollars is the amount ($er^* \times$AC), which *reduces the monetary base* by that amount, just like an open market sale of government bonds. The lower monetary base pushes domestic interest rates up and attracts a larger net capital inflow. Higher interest rates also reduce domestic expenditure and the demand for imports and for foreign exchange. *The exchange rate target drives the Bank's monetary policy*, which in turn changes both international capital flows and domestic income and expenditure.

> **Official exchange reserves**: government foreign currency holdings managed by the central bank.

What if the demand for US dollars falls to $D_3$? The market equilibrium would be at F. At the exchange rate at $er^*$ there is an excess supply of US dollars EA. To defend the peg, the Bank of Canada would have to buy EA US dollars, reducing the supply of US dollars on the market to meet the "unofficial" demand. The Bank of Canada would have to *buy* EA US dollars, reducing the supply of US dollars on the market to meet the "unofficial" demand. The Bank of Canada's purchase would be added to foreign exchange reserves. The Bank would pay for these US dollars by *creating more monetary base*, as in the case of an open market purchase of government securities. In either case, maintaining a fixed exchange rate requires **central bank intervention** in the foreign currency market. The central bank's monetary policy is expansionary because it is committed to the exchange rate target.

> **Central bank intervention**: purchases or sales of foreign currency intended to manage the exchange rate.

When the demand schedule is $D_2$, foreign exchange reserves are running down. When the demand schedule is $D_3$, foreign exchange reserves are increasing. If the demand for US dollars fluctuates between $D_2$ and $D_3$, the Bank of Canada can sustain and stabilize the exchange rate in the long run.

However, if the demand for US dollars is, on average, $D_2$, the foreign exchange reserves are steadily declining to support the exchange rate $er^*$, and the monetary base is falling as well. In this case, the Canadian dollar is overvalued at $er^*$; or, in other words, $er^*$ is too low a price for the US dollar. A higher $er$ is required for long-run equilibrium in the foreign exchange market and the balance of payments. As reserves start to run out, the government may try to borrow foreign exchange reserves from other countries and the International Monetary Fund (IMF), an international

[1] Typically, a country will "peg" its currency to an major currency such as the US dollar, or to a basket of currencies.

body that exists primarily to lend to countries in short-term difficulties.

At best, this is only a temporary solution. Unless the demand for US dollars decreases, or the supply increases in the longer term, it is necessary to **devalue** the Canadian dollar. If a fixed exchange rate is to be maintained, the official rate must be reset at a higher domestic currency price for foreign currency.

> **Devaluation (revaluation)**: a reduction (increase) in the international value of the domestic currency.

For many years frequent media and political discussions of the persistent rise in China's foreign exchange holdings provide a good example of the defense of an undervalued currency. With the yuan at its current fixed rate relative to US dollars and other currencies, China has a large current account surplus that is not offset by a capital account deficit. Balance of payments equilibrium requires ongoing intervention by the Chinese central bank to buy foreign exchange and add to official reserve holdings. Buying foreign exchange adds to the monetary base and money supply, raising concerns about inflation. The Bank has responded in part with a small revaluation of the yuan and in part with an increase in the reserve requirements for Chinese banks. Neither of these adjustments has been sufficient to change the situation fundamentally and growth in official foreign exchange reserves continues.

In Europe the euro currency system effectively fixes exchange rates among member countries. Individual member countries do not have national monetary policies. Monetary policy is set by the European Central Bank. In the years following the 'great recession' this has been a source of controversy because economic and fiscal conditions have differed significantly among countries. Countries trying to adjust fiscal deficits and country public debt crises have been forced into fiscal austerity without offsetting monetary policy support. In many cases the results have been deep and prolonged recessions without solving their debt problems. Greece is the poster child.

Of course, it is not necessary to adopt the extreme regimes of pure or clean floating on the one hand and perfectly fixed exchange rates on the other hand. *Dirty or managed floating* is used to offset large and rapid shifts in supply or demand schedules in the short run. The intent is to smooth the adjustment as the exchange rate is gradually allowed to find its equilibrium level in response to longer-term changes.

## 12.4 Monetary and fiscal policy with flexible exchange rates

In a closed economy with slow wage and price adjustments, monetary and fiscal policies are both important tools for aggregate demand management in the short run. Things are different in open economies with high international capital mobility. *With flexible exchange rates monetary policy is powerful* for changing AD. It works through both interest rate and exchange rate linkages in the transmission mechanism, not just the interest rate linkages of the closed economy. By contrast, *the effects of fiscal policy on aggregate demand are reduced.* In the absence of supporting monetary policy, fiscal expansions crowd out private sector expenditures through both interest rate and exchange rate linkages, leaving AD unchanged.

*Fixed exchange rates* have the opposite implications for policy effectiveness as an AD management tool. *The effects of fiscal policy are enhanced by induced changes in monetary conditions, but monetary policy alone is almost powerless to change AD*. As a result, the first important step in the design of macroeconomic policy in the open economy is the choice of an exchange rate regime.

## Monetary policy

With flexible exchange rates, monetary policy causes changes in both interest rates and exchange rates. Net international capital flows link exchange rates and changes in domestic interest rates when exchange rates are flexible. Given the exchange rate expected in the long run, higher interest rates in the short to medium run cause a capital inflow, an increased supply of foreign exchange on the foreign exchange market, which lowers the exchange rate, *er*.

Conversely, lower domestic interest rates relative to international rates cause a rise in the exchange rate, *er*.

As a result, current monetary policy and expected future monetary policies have strong effects on the nominal exchange rate and the international competitiveness of the domestic economy and AD. Changing current interest rates for a short time will have only small exchange rate effects. However, a credible change in monetary policy for a sustained period will cause a large and persistent change in current exchange rates, an important factor in the monetary transmission mechanism. This can have large short-run effects on the real economy.

As a result, in an open economy with flexible exchange rates, monetary policy affects aggregate demand not just through the effects of interest rates on consumption and investment. Changing interest rates, by changing the exchange rate, also change the international competitiveness of exports and imports. Net exports change in the same direction as domestic expenditure, increasing the impact of interest changes on aggregate demand. Lower interest rates boost domestic expenditure, raise the exchange rate, and increase net exports. Higher interest rates reduce domestic expenditure, lower the exchange rate, and reduce net exports. With linkages through both domestic and international components of expenditure, monetary policy is more powerful under flexible exchange rates than in a closed economy.

Canada and a number of other countries conduct monetary policy in terms of a target for the domestic inflation rate. A flexible exchange rate policy is essential for the monetary policy independence and power required to pursue that target. That is why the Bank of Canada defines Canada's flexible exchange rate as a key component of Canada's monetary policy framework. The other key component is the Bank's inflation control target.

## Fiscal policy

With flexible exchange rates, but without monetary policy accommodation or support, the effect of interest rate changes on exchange rates and competitiveness undermines the power of fiscal policy to manage aggregate demand.

Suppose the government undertakes a *fiscal expansion*, raising government expenditures or lowering taxes or some combination of the two: Aggregate demand increases. When monetary policy targets an inflation rate based on either an interest rate rule or a money supply rule, the expansion in AD caused by fiscal policy changes the economic fundamentals on which the central bank's policy had been set and induces the bank to *raise interest rates*. The higher interest rates cause a net capital inflow and an increased supply of foreign exchange on the foreign exchange market, and the nominal exchange rate falls. A fall in the nominal foreign exchange rate *lowers the real exchange rate*. International price competitiveness (as measured by the real exchange rate) is reduced and net exports fall, offsetting the expansionary effects of the change in fiscal policy. *With flexible exchange rates monetary policy targeted to the inflation rate dominates fiscal policy* as a tool for AD management.

As discussed previously, Canadian experience provides an example. In the 2005-2007 period, the federal government provided fiscal stimulus through tax cuts and expenditure increases. The primary structural budget balance fell from an average 3.4 percent of potential GDP for 2002 to 2004 to 2.6 percent for 2005 to 2007. At the same time the Bank of Canada's estimates showed the economy operating with a small but persistent inflationary gap. The inflation rate was in the upper level of the Bank's target range. The Bank responded to strong current and expected demand (coming from both the government and private sector) by raising its overnight rate in steps, from 2.5 percent in late-2005 to 4.5 percent by mid-2007, to defend its inflation target. The inflationary gap and inflation were contained as higher interest rates and lower exchange rates limited the growth of aggregate demand, including that coming from fiscal stimulus.

In a closed economy, fiscal expansions that push up interest rates cause partial **crowding out** of private expenditure by reducing consumption and investment. In an open economy with flexible exchange rates the crowding out mechanism is stronger. Fiscal expansion causes both a rise in interest rates and a fall in the exchange rate. Both domestic expenditure and net exports are reduced. The extended crowding out through the change in exchange rates and net exports when exchange rates are flexible reduces the power of fiscal policy to manage aggregate demand in the short run.

However, if control or reduction of the debt ratio is the prime target of fiscal policy, the flexible exchange rate is helpful. If the government raises tax rates or cuts expenditures to raise its structural budget balance and reduce the debt ratio, lower settings for the central bank's interest rate and a rising exchange rate provide some offsetting "crowding in" through both domestic expenditure and net exports. The limited aggregate demand effects of fiscal policy under flexible exchange rates facilitate control of the government's budget balance and debt ratio.

## Policy co-ordination

This analysis of the policy implications of flexible rate regimes leads to a clear recommendation for policy co-ordination. Flexible exchange rates provide the framework for effective monetary policy focused on a medium term inflation target. The exchange rate regime enhances the power of monetary policy to moderate business cycle fluctuations and the output gaps they create. Stabilizing the economy at or close to potential output avoids the cumulative inflationary or recessionary pressures that would push inflation rates away from the monetary policy target. Monetary policy is then the aggregate demand management tool.

Fiscal policy is not an effective AD management tool when exchange rates are flexible. Its impacts on aggregate demand are limited by crowding out and dominated by monetary policy. However, this does enhance the power of fiscal policy to pursue deficit control and debt ratio control. The effects of fiscal restraint aimed at improved public finances are moderated by a monetary policy focused on an inflation target in a flexible exchange rate regime.

The Canadian experience with economic policy and performance provides an excellent example of this sort of coordinated policy. Starting in 1995 the federal government introduced a policy of strong fiscal adjustment through restraint aimed at reducing the public debt-to-GDP ratio. The structural primary budget balance was increased through expenditure cuts and tax increases. At the same time, monetary policy was aimed at maintaining inflation within the 1-3 percent target band, which required monetary stimulus. The nominal and real overnight interest rates were reduced. Economic growth was constrained by the fiscal austerity but still sufficient to eliminate the recessionary gap by the end of the decade. The support of domestic monetary policy, a significant depreciation of the Canadian dollar, strong growth in the US economy and strong export growth were keys to this successful fiscal adjustment. The coordination of fiscal restraint and monetary stimulus moved the economy to potential output with stable inflation and a falling ratio of public debt to GDP.

Policy responses to the recession of 2009 also involved strong policy co-ordination, both domestic and international. Monetary policy was the first line response, with central banks in most industrial countries lowering their interest rate to or close to the **zero lower bound**. Some countries, like the US, then went further to provide quantitative and credit easing through general and selective open market operations. Fiscal stimulus added to these highly accommodative monetary conditions. Central bank commitments, like those in both the US and Canada, to maintain policy rates at their minimum for periods as long as a year or more eliminated concerns about fiscal crowding out.

> **Zero lower bound**: a problem that occurs when the short-term nominal interest rate is at or near zero.

Coordinating the focus of both monetary policy and fiscal policy was designed to stimulate aggregate demand and restore growth in real GDP. In a time of deep recession, high indebtedness, and high uncertainty even very low interest rates won't induce households and business to take on more debt to build more houses or factories. There is already an excess supply of productive capacity and housing. Monetary conditions can support an expansion in expenditure but cannot trigger it.

Fiscal policy, by contrast, can add directly to expenditure and aggregate demand, especially expenditure on infrastructure, education, research, and similar public investments. Tax cuts are likely to have smaller expenditure effects if only because the recipients have marginal propensities to spend that are less than one. Nonetheless, there is an important debate about whether expenditure increases or tax cuts should be used for fiscal stimulus, and which will have the larger and more desirable effect.

With this policy coordination there is no cause for concern about crowding out. Central banks were not concerned about the effects of increased aggregate demand on inflation rates and their inflation targets. Quite the opposite, like the Bank of Canada they hoped to raise inflation to their target. Fiscal expansion will not induce higher interest rates or lower exchange rates.

## 12.5 Monetary and fiscal policy with fixed exchange rates

### Monetary policy

If a country adopts a fixed exchange rate policy, *the exchange rate is the target of monetary policy*. Monetary policy cannot pursue an inflation target or an output target at the same time as it pursues an exchange rate target. Nor can it set either interest rates or money supply growth rates independently.

With a fixed exchange rate, interest rates must be set as needed to maintain the exchange rate when capital mobility is high. Indeed, the higher international capital mobility is, the less is the scope for independent monetary policy. This is what we mean when we say fixed exchange rates eliminate monetary policy sovereignty. The central bank cannot follow an independent monetary policy.

### Fiscal policy with fixed exchange rates

A fixed exchange rate and perfect capital mobility undermine the scope for monetary policy, but maintain the effectiveness of fiscal policy.

In a closed economy, in the short run, fiscal expansion raises output. Under a Taylor rule, *as long as output is less than potential output*, the central bank supports the increase in output by maintaining interest rates and increasing the money supply as output expands. However, at outputs equal to or greater than potential output, central banks raise interest rates to crowd out the effect of fiscal expansion.

In an open economy with fixed exchange rates, monetary policy adjusts passively to keep the interest rate fixed in order to defend the exchange rate. Interest rates do not change to support fiscal policy or moderate the effect of fiscal policy. Hence, any fall in domestic demand can be offset by a fiscal expansion to help restore potential output. If the change in domestic demand is the only reason that the current account balance departed from equilibrium, this fiscal expansion will also restore the current account balance.

Fiscal policy is potentially an important stabilization policy under fixed exchange rates. It helps to compensate for the fact that monetary policy can no longer be used. Automatic fiscal stabilizers play this role. Discretionary changes in government spending or taxes are useful only if fiscal policy can react quickly to temporary shocks. In some political systems, such as in Canada, this is feasible. In others, such as in the United States, where Congress and the President may be from different parties and budget decisions are more protracted, rapid changes in fiscal policy are more difficult.

In times of prolonged recession, discretionary fiscal policy can contribute importantly to a return to potential output, *provided it is not constrained by high public debt ratios*. With interest rates tied to the exchange rate, financing a fiscal expansion does not push rates up to crowd out private sector expenditure; nor does the recovery of the economy result in rising rates. Indeed, fiscal policy is the only effective domestic demand management tool available.

Unfortunately, high public debt ratios and concerns about the default risk of sovereign debt cause problems for fiscal policy. This is the current situation in Europe. Fiscal expansion is impossible if financial markets are unwilling to buy more sovereign debt from economies in recession that already have high debt ratios. On the other hand, fiscal austerity to control deficits and debt ratios makes recessions worse and may even raise already high debt ratios as GDP and government net revenue fall. The euro fixes exchange rates within Europe and precludes stimulus from currency depreciation. Neither domestic fiscal nor monetary policy offers a solution.

Things are further complicated because many European countries have similar economic and financial difficulties. Canadian success with fiscal austerity and adjustment in the 1990s came from a very different economic environment. Monetary policy and exchange rate depreciation provided stimulus. Strong economic growth in major trade partners provided further stimulus through export growth. These conditions are clearly not met in Europe and coordinated fiscal austerity to address sovereign debt issues has been described as an 'economic suicide pact'.

## Next

This chapter extended the discussion of short-run macroeconomic performance and policy by covering in more detail the importance of international trade, capital flows, and exchange rates for the design, coordination and effectiveness of monetary and fiscal policies. The next chapter introduces the theory of economic growth that explains the long-run growth in potential output based on growth in the labour force, growth in the capital stock and changes in productivity based on advances in technology.

# Key Concepts

The **balance of payments** records transactions between residents of one country and the rest of the world. The **current account** shows the trade balance plus net international transfer payments, and income earned on holdings of foreign assets. The **capital account** shows net purchases and sales of foreign assets. The balance of payments is the sum of the current and capital account balances.

The trade in goods and services recorded in the current account is **net exports**, based on tastes, incomes, and the real exchange rate, which measures the price of foreign goods and services relative to the price of domestic goods and services.

The **trade in financial** assets recorded in the capital account is based on the total return expected from holding foreign rather than domestic assets.

The total return on holdings of foreign assets depends on the interest rate differential between countries and the change in the exchange rate during the period in which assets are held. **Perfect international capital mobility** means that an enormous quantity of funds shifts between currencies when the perceived rate of return differs across currencies.

The **foreign exchange market** is the market in which currencies of different countries are bought and sold and foreign exchange rates are established. The **exchange rate** is the price at which one currency trades for another.

The **demand for foreign currency** on the foreign exchange market arises from imports of goods and services and purchases of foreign assets. The **supply of foreign currency** on the foreign exchange market arises from exports of goods and services and sales of domestic assets to foreigners.

Under a **fixed exchange rate regime**, a balance of payments surplus or deficit must be matched by an offsetting quantity of **official financing**. The **central bank** intervenes in the foreign exchange market.

Under **floating or flexible exchange rates**, supply and demand in the foreign exchange market change the exchange rate as necessary for a current account balance that offsets a capital account balance. As a result, the balance of payments is zero and *no official intervention* is involved.

The **choice between fixed and floating exchange rate regimes** reflects a country's assessment of *the importance of an independent monetary policy*, the volatility of exports and imports, and the financial discipline that may come with fixed rates.

**Flexible exchange rates** increase the *effectiveness of monetary policy* as a tool to manage aggregate demand. *The effectiveness of fiscal policy* for demand management is reduced, but pursuit of deficit and debt ratio control may be enhanced.

Monetary policy sovereignty is lost when **fixed exchange rates** are adopted. Monetary policy cannot effectively pursue domestic inflation or output targets. However, the *effectiveness of fiscal policy as a demand management tool is enhanced*.

## Exercises for Chapter 12

**Exercise 12.1** Consider a country with a fixed exchange rate that has a current account surplus of \$20 billion, but a capital account deficit of \$18 billion.

(a) Is its balance of payments in deficit or surplus? Why?

(b) What change in official exchange reserves would you see? Why?

(c) Is the central bank buying or selling foreign currency?

(d) What effect does the central bank's foreign currency purchase or sale have on the monetary base? Explain why.

**Exercise 12.2** Assume the initial exchange rate is \$1.20Cdn for \$1.00US After 10 years, the United States price level has risen from 100 to 200, and the Canadian price level has risen from 100 to 175. What was the inflation rate in each country? What nominal exchange rate would preserve the initial real exchange rate? Which country's currency depreciated?

**Exercise 12.3** Suppose portfolio managers shift \$100 million in assets under their control out of Canadian government securities and into United States government securities. What change would this portfolio shift make in the Canadian balance of payments?

**Exercise 12.4** What is the expected rate of appreciation of the US dollar if interest rate parity prevails and Canadian nominal interest rates are 1 percent higher than United States interest rates?

**Exercise 12.5** Suppose natural gas and crude oil prices were to drop sharply and expectations were they would remain low. Use a foreign exchange market diagram to show the effect on the Canadian/US dollar exchange rate?

**Exercise 12.6** Using a diagram to illustrate:

(a) The demand for foreign exchange and the demand curve for foreign exchange.

(b) The supply of foreign exchange and the supply curve for foreign exchange.

(c) The equilibrium exchange rate.

**Exercise 12.7** Use a foreign exchange market diagram with a flexible or floating exchange rate to show:

(a) How a decline in exports would affect the foreign exchange rate.

(b) How exports and imports would change to give balance of payments equilibrium at the new equilibrium exchange rate.

(c) The effects, if any, on the holdings of official reserves.

**Exercise 12.8** Use a foreign exchange market diagram to show:

(a) Equilibrium with a fixed exchange rate.

(b) The effect of a decline in exports on conditions in the foreign exchange market when the exchange rate is fixed.

(c) The amount of the purchase or sale of foreign exchange reserves required if the central bank defends the fixed exchange rate.

(d) The effects of a change in the holdings of official reserves and the monetary base as a result of the defence of the fixed exchange rate.

**Exercise 12.9** Use AD/AS and foreign exchange market diagrams to show why monetary policy is powerful and fiscal policy is weak when a country has a flexible exchange rate regime.

**Exercise 12.10** Use AD/AS and foreign exchange market diagrams to show why the choice of a fixed exchange rate makes fiscal policy a more powerful tool for demand management. What happens to the domestic money supply when a government austerity program cuts its expenditures on goods and services and raises taxes?

# Chapter 13

## Economic growth

**In this chapter we will explore:**



Economic growth is one of the most historic, challenging and important topics in macroeconomics. Standards of living within a country are measured by real GDP *per capita*. Growth in real GDP is growth in potential output, $Y_P$, and growth in real GDP *per capita* is a measure of change in the standard of living. Over time, growth in $Y_P$ that exceeds population growth raises per capita real GDP and standards of living. But grow that falls persistently short validates Thomas Malthus' prediction in his *First Essay on Population* (1798) that population growth would exceed output growth causing starvation and the end of population growth. But what determines growth in real GDP and real GDP per capita? A theory of economic growth is needed to answer that question.

Observations on the recent history of economic growth raise four questions.

1. What is long-term growth?
2. What are the causes or sources of growth?
3. What are the effects of economic growth, both positive and negative?
4. Can economic policies affect growth?

Although the focus here is mainly on industrial countries, the growth or lack of it in poor countries is also an extremely important issue for the economics of development. To see many other interesting dimensions of growth compared across a much larger sample of countries over longer time periods, visit *Gapminder World* on the web site www.gapminder.org.

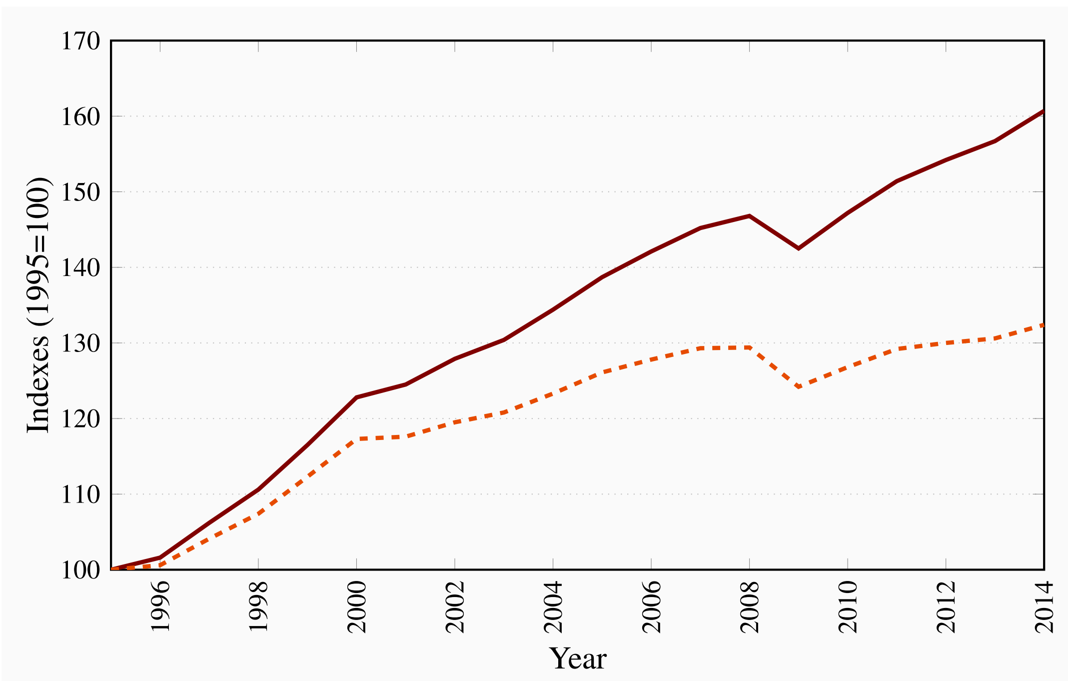
## 13.1 Patterns of economic growth

Recall, from Chapter 4, that the growth rate of a variable is its percentage change over time. To define economic growth we must specify both the variable to measure and the period over which to measure it. Percentage changes in real GDP and real GDP per person over periods of one year are used to measure annual rates of **economic growth**.

**Economic growth**: the annual percentage change in real GDP or per capita real GDP.

Annual real GDP measures the total output of final goods and services in the economy for one-year periods. As a result, the annual rate of growth in real GDP is the change in the size of the total economy. But, as discussed in Chapter 4, increases in the size of the total economy may not reflect changes in standards of living or economic welfare. To get an indication of how these grow, stagnate or decline we need to look at growth in real GDP per person. Growth in real GDP can raise standards of living only if it exceeds the growth in population, providing, on average, more goods and services to the average individual.

**Figure 13.1: Indexes of real GDP & real GDP per capita, 1995-2014**




*Source*: Statistics Canada CANSIM tables 3800084 and 0510005 and author's calculations

Figure 13.1 illustrates the growth of real GDP and real GDP per capita in Canada from 1995 to 2014. In that time frame the index of real GDP, with 1995 as the base year, increased by about 45 percent from 1995 until the financial crisis of 2008, then declined during the 'Great Recession' before resuming growth in 2010. Over the full 1995-2014 period real GDP grew by 60 percent.

Population in Canada was also growing in the 1995-2014 period. As a result the growth in per capita real GDP was less than in real GDP. Figure 13.1 shows that growth in real GDP per capita grew by about 32 percent over the 1995-2014 period. This is a rough measure of the improvement in standard of living for the average Canadian over that time.

**Table 13.1: Importance of small differences in annual growth rates**

| Growth Rate | 0.5% | 1.0% | 2.0% | 3.0% | 3.5% | 4.0% |
|---|---|---|---|---|---|---|
| **Initial value** | 100 | 100 | 100 | 100 | 100 | 100 |
| **Year 1** | 100.5 | 101.0 | 102.0 | 103.0 | 103.5 | 104 |
| **Year 5** | 102.5 | 105.1 | 110.4 | 115.9 | 118.8 | 121.7 |
| **Year 10** | 105.1 | 110.5 | 121.9 | 134.4 | 141.5 | 148.0 |
| **Year 20** | 110.5 | 122.0 | 148.6 | 180.6 | 199.0 | 219.1 |
| **Year 40** | 122.1 | 148.9 | 220.8 | 326.2 | 395.9 | 480.1 |

One interesting aspect of growth in real GDP or any other variable is the importance of small differences in compound annual growth rates on growth paths over time. Table 13.1 provides and illustration for selected time periods from one year to the 40 years. Annual growth rates in the range of about 0.5% to 4.0% in real GDP and per capita real GDP are common among industrialized countries.

Over a twenty year period an annual growth rate of 2.0 percent would increase per capita real GDP by almost 50 percent, a growth rate of 3.0 percent would increase it by 80 percent and a growth rate of 3.5 percent would double it. Even over a shorter period like the Great Recession and recovery of 2007-2012, a drop in the average annual growth rate from 3.0 percent to 1.0 percent would mean a GDP 10 percent lower than it would have been under steady 3.0 percent growth.

Table 13.2 illustrates the actual variations in growth rates of per capita real GDP across selected industrial economies from 1995 to 2014. Differences in growth rates in 1995-2001 were relatively small and in the range of 2.3 percent and 3.5 percent for most countries in this sample, except for Japan and Korea with rates of 0.5 percent and 4.6 percent respectively. The standard of living was catching up with those in other countries while that in Japan was roughly constant. Except for Japan, all these growth rates by country declined in the next two time periods reported, with particularly large declines as a result of the international financial crisis and recession after 2008. The underlying causes of this slowdown in growth will be examined in terms of a basic theory of economic growth.

**Table 13.2: Growth rates in per capita real GDP: Selected countries**

| | (Average annual % change) | | |
|---|---|---|---|
| | **1995-2001** | **2002-2008** | **2009-2014** |
| Australia | 2.7 | 1.9 | 0.9 |
| Canada | 2.7 | 1.6 | 0.5 |
| France | 2.3 | 1.1 | -0.1 |
| Greece | 3.3 | 3.8 | -4.5 |
| Japan | 0.5 | 1.5 | 0.5 |
| Korea | 4.6 | 4.5 | 2.7 |
| Spain | 3.5 | 1.7 | -1.2 |
| Sweden | 3.1 | 2.8 | 0.3 |
| United Kingdom | 2.7 | 2.4 | -0.1 |
| United States | 2.6 | 1.7 | 0.5 |

*Source*: International Monetary Fund, *World Economic Outlook Database*, October 2015, and authors' calculations.

## 13.2 Growth in potential output

Basic economic growth theory steps back from short-run variations in growth rates. It applies to the **very long run**, a time frame in which wages *and* prices are fully flexible, and the labour force, the stock of capital equipment, and the technology used in production can change. In this time frame, output fluctuations around potential output are swamped by the growth of potential output itself.

> **Very long run**: the time required for changes to occur in the stock of capital, the size of the labour force, and the technology of production.

The aggregate production function used in Section 11.2 described the links between inputs to production and real GDP produced. Recall that, for the whole economy, $Y$ is real GDP produced by using inputs of labour ($N$) and capital ($K$). The function $F$ tells us how much we get out of particular amounts of labour and capital used in the production process.

$$Y = A \times F(N, K) \tag{13.1}$$

The function $F(...)$ does not change, but changes in $N$ and $K$ cause changes in output $Y$. Technical progress or improvements in technology are captured separately through $A$, which measures the state of technology at any date. As technology improves, $A$ increases and more real GDP is produced from the same inputs of labour and capital. A 10 percent increase in $A$ gives 10 percent more real GDP from the same inputs of labour and capital. We describe this as an increase in productivity because outputs per worker and per unit of capital increase. $A$ is often called a measure of total factor productivity (TFP).

> **Total factor productivity (TFP)**: output relative to the combined inputs of labour and capital, the total factor inputs to production.

Actual real GDP is the output produced at any time based on the actual inputs of capital and labour. In terms of the production function:

- $Y_t$ is real GDP in year $t$;
- $A_t$ is determined by the current state of technology; and
- $K_t$ and $N_t$ measure the actual use of capital and labour.

These inputs are combined to give output in year $t$:

$$Y_t = A_t \times F(N_t, K_t) \tag{13.2}$$

*Potential output* is the real GDP produced when labour and capital are employed at equilibrium rates using the best available technology. A specific production function to recognize this is:

$$Y_P = A_t \times F(N_F, K_0) \tag{13.3}$$

$Y_P$ is potential output produced by operating plants and machinery at their designed capacity ($K_0$) and using the full employment equilibrium supply of labour services ($N_F$). $A_t$ is the state of knowledge and technology used in the production process and reflected in the productivity of labour and capital.

Any *growth* in the potential output of goods and services then comes from *growth* in labour inputs to production, *growth* in capital inputs to production, and *changes* in factor productivity as a result of new and improved technology.

**Growth accounting** measures the sources of growth in real GDP. From the production function, it follows that:

| | | | | | | |
|---|---|---|---|---|---|---|
| | | Effect of | | Effect of | | Effect of |
| Growth in | = | Growth in | + | Growth | + | Growth in |
| Real GDP | | Total Factor | | in Labour | | Capital |
| | | Productivity | | Inputs | | Inputs |

> **Growth accounting**: measurement of the contributions of labour, capital, and technology to growth in output.

The way that growth in capital and labour affects the growth in total output can be measured by the incomes they receive. The income approach to the measurement of net domestic product and GDP in Section 4.5 identifies these factor income shares in Canada in 2013 as the sum of:

| | |
|---|---|
| Employee compensation | \$957 billion |
| Net Corporate surplus | \$240 billion |
| Net mixed income | \$168 billion |
| Total factor income | \$1,365 billion |

From that data, employment income was about 70 percent of factor income. This is higher than the longer-term average share of employment income in total factor, but it shows where the measure comes from. Labour's average contribution to and share of national income, measured over time periods of many years, is approximately two-thirds of total factor income. Capital's contribution and share is the remaining one-third of factor income.

The growth in potential GDP over time can then be expressed as the growth in total factor productivity plus the *weighted sum* of the growth in the capital and labour inputs to production as follows:

$$\text{Growth in } Y_P = \text{growth in } A + (2/3) \times (\text{growth in } N) + (1/3) \times (\text{growth in capital stock})$$

This is the basic *growth accounting* equation.

The weights (2/3) and (1/3) applied to growth in labour and capital inputs are based on their shares in national income. They determine the rate of growth in real GDP as a result of growth in the inputs of capital and labour. By these weights, a 10 percent increase in labour input, capital and technology held constant, would result in an increase in real GDP of $2/3 \times 10$ percent, which is 6.6 percent. Similarly, a 10 percent increase in capital input would result in a $1/3 \times 10 = 3.3$ percent increase in real GDP. However, if both $N$ and $K$ grow by 10 percent real GDP grows by 10 percent.

The increase in productivity from improvements in technology cannot be seen and measured directly. As a result, growth accounting classifies these effects as a *residual*. The difference between the growth in real GDP and the weighted sum of the growth in labour and capital inputs is called the **Solow residual**, named after Professor Robert Solow, whose work on growth theory was recognized with a Nobel Prize. The Solow Residual is a measure of the contribution to growth made by improvements in the technology of production that raise the productivity of both labour and capital.

> **Solow residual**: the growth in real GDP or per capita real GDP not caused by growth in factor inputs, but attributed to improved technology.

The Solow residual measured by growth in $A$ is found by rearranging the growth accounting equation as follows:

$$\text{Growth in } A = \text{growth in } Y - (2/3) \times \text{growth in } N - (1/3) \times \text{growth in } K$$

The numerical example in Table 13.3 illustrates the procedure. It assumes data are available for a specific sample period; say 10 years, for the growth rates of real GDP, capital stock, and employment, measured as average annual percentage changes.

**Table 13.3: An estimate of the Solow residual using growth accounting**

| **Observed average annual growth rates, %Δ, in:** | | | | | |
|---|---|---|---|---|---|
| Real GDP($Y$) | 5.0 | Employment($N$) | 2.4 | Capital stock($K$) | 3.9 |
| **By growth accounting:** | | | | | |
| Growth in $A = 5.0 - (2/3)(2.4) - (1/3)(3.9)$ | | | | | |
| Growth in $A = 5.0 - 1.6 - 1.3$ | | | | | |
| Contribution of growth in $A$ to growth in real GDP= 2.1 percent | | | | | |

The calculation made using growth accounting shows that the increased productivity of both labour and capital resulting from improvements in technology was the source of 2.1 percent of the 5.0 percent growth in real GDP in this example.

Recent research at the Bank of Canada[1] estimated the sources of growth in real GDP and poten-

[1] J. Kuszczak and R. Dion, "Potential Output Growth: Some Long-Term Projections." *Bank of Canada Review*,

tial GDP in Canada over the period 1950 to 1996 and projections for future growth in potential GDP. The contributions of capital and labour inputs are weighted as in the simple example above. Growth in actual and potential real GDP are the result of growth in factor inputs and the growth in productivity coming from improvements in the technology of production.

That work shows growth in real GDP and potential GDP declined over the 1950 to 1996 period. This slowdown was partly a result of a slowdown in the growth of population, and labour and capital inputs to production. But starting in the 1970s there was also a slowdown in productivity growth, which reduced the rate of growth of output per worker. This slowdown in productivity is examined in more detail later in this chapter. It had important implications for the standard of living in many countries, including Canada. Some further research on productivity growth in Canada by the Centre for the Study of Standards of Living, `www.csls.ca`, and at the Bank of Canada has uncovered another productivity slowdown in Canada relative to the United States after the year 2000, which has continued and is a current source of concern.

# 13.3 Growth in per capita GDP

Growth in potential GDP measures the increase in the size of the economy, but it does not tell us what is happening to per capita GDP and *standards of living*. To discover the sources of growth in per capita GDP and improvements in standards of living, we need to study the production function in more detail. Then we can use growth accounting to uncover the sources of past growth in per capita GDP.

Consider the same production function we have used for total GDP:

$$Y = A \times F(N,K) \tag{13.1}$$

Again, assume that if technology ($A$) is constant, real GDP ($Y$) will grow by 2/3 of the growth in labour input and 1/3 the growth in capital input. If, for example, labour force growth increases employment by 10 percent, with fixed capital stock ($K$), and technology ($A$), GDP will increase by 6.67 percent. A similar calculation shows the effects of growth in the capital stock. The weights 1/3 and 2/3 are the *elasticities* of output with respect to the inputs of labour and capital based on factor income shares in national accounts.

## Factor contributions and scale economies

The increase in total output when an additional unit of a factor (labour or capital) is used in the production process, and other inputs are held constant, is the **marginal product** of that added factor. The production functions widely used in economics have *diminishing marginal productivity*. As more and more workers are employed using a fixed number of machines, each additional worker adds less and less to total output. The marginal product of labour, the change in total output as a result of a one using one more worker ($\times Y/\Delta N$), falls. Furthermore, because each additional input of labour adds less to total output than the unit before it, output per worker, $Y/N$, also falls.

Winter 1997-1998.

> **Marginal product**: the change in total output caused by a change of one unit in the input of that factor to production.

It is often assumed that production involves *constant returns to scale*. Instead of increasing just one input to production, suppose all inputs are increased together, in the same proportions. Labour and capital inputs might both be doubled, for example. Then, if output increases in exactly the same proportions as inputs have increased, there are constant returns to scale.

The production functions used in growth accounting have these properties. Consider the following example. Holding technology constant at $A = 1$ to simplify matters, we can write:

$$Y = N^{2/3} \times K^{1/3} \tag{13.4}$$

using the weights we have used in growth accounting to measure the contributions of labour and capital to output, based on their shares in national income, as the exponents on labour and capital inputs. Table 13.4 gives numerical examples of the way this production function works.

**Table 13.4: Changes in outputs as factor inputs change**

| Production function: | | | $Y = N^{2/3} \times K^{1/3}$ | | |
|---|---|---|---|---|---|
| **Labour input ($N$)** | **Capital input ($K$)** | **Output ($Y$)** | $\%\Delta N$ | $\%\Delta K$ | $\%\Delta Y$ |
| 50 | 20 | 36.8 | – | – | – |
| 55 | 20 | 39.3 | 10.0 | 0 | 6.6 |
| 55 | 22 | 40.5 | 0 | 10.0 | 3.3 |
| 60.5 | 24.2 | 44.6 | 10.0 | 10.0 | 10.0 |

The first row of the table shows that a labour input of 50 units combined with a capital input of 20 units gives output:

$$Y = 50^{2/3} \times 20^{1/3} = 36.8 \text{ units}$$

The next three rows illustrate the underlying diminishing returns and constant returns to scale in this production process. An increase of either labour input of 10 percent or capital input of 10 percent with the other input constant increases output, but by less than 10 percent in each case. Because output grows by less than the growth of the input in each case, output per worker or per unit of capital falls.

However, when only one input grows, output per unit of the factor held constant rises. In the second row of the table, capital input is constant when labour input grows. More labour inputs increase total output and output per unit of capital. Similarly, in the third row an increase in capital input increases labour productivity.

The fourth row of the table shows **constant returns to scale**. When labour and capital inputs both increase by the same proportion, output also increases by that proportion – 10 percent in this example. As a result, output per worker and output per unit of capital are constant. In terms of economic growth, equal growth rates of labour input and capital stock make total GDP grow at that same rate, *but leave per capita GDP unchanged*.

> **Constant returns to scale**: equal percentage increases in inputs of labour and capital increase output by the same percentage.

To see the sources of growth in *per capita GDP*, we can manipulate the production function and apply growth accounting. To get per capita GDP, simply divide both sides of the production function in Equation 13.4 by $N$ to give output per worker as follows:

$$Y = A \times N^{2/3} \times K^{1/3} \tag{13.4}$$

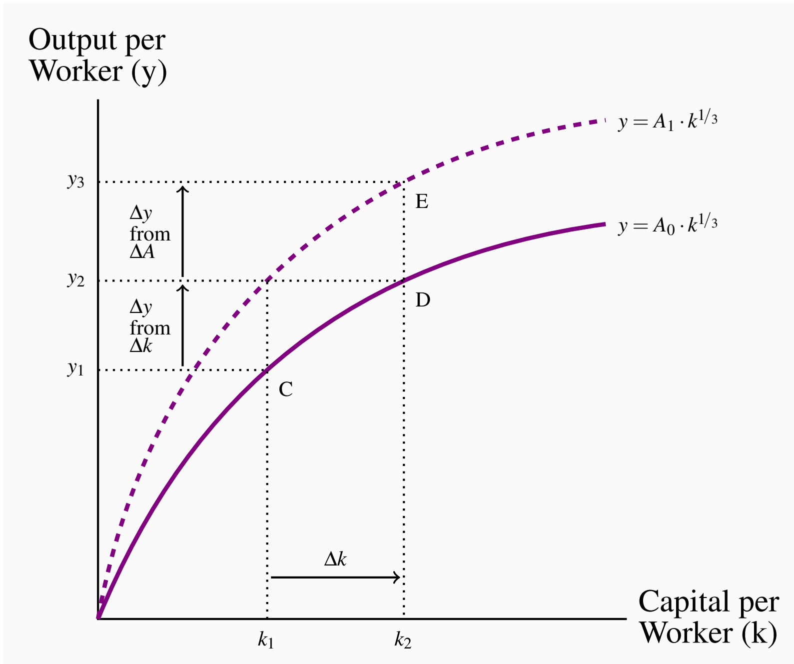
Output per worker $(Y/N) = [A \times (N^{2/3} \times K^{1/3})$ divided by $(N)]$, the number of workers employed.

To make the notation a bit neater, we can use lower case letters to indicate *output per worker* $(y = Y/N)$ and *capital per worker* $(k = K/N)$. This gives:

$$y = A \times k^{1/3} \tag{13.5}$$

Figure 13.2 illustrates this production in a diagram. The ratio of capital stock to labour, $k$, is measured on the horizontal axis. Output per worker, $y$, is measured on the vertical axis. Two per-worker production functions are used to distinguish between the effects of increases in capital stock and the effects of improvements in technology.

**Figure 13.2: The effects of increases in the capital labour ratio and improvements in technology on output per worker**




An increase in the capital to labour ratio from $k_1$ to $k_2$ raises output per worker from $y_1$ to $y_2$. The shape of the production function shows that further increases in $k$ will give further but smaller increases in $y$. A change in technology shifts the production function up as $y$ increases at every $k$. The combined effects of an increase in $k$ and an increase in A are increased output per worker from $y_1$ to $y_3$.

The declining slopes of both production functions illustrate the diminishing returns that lead to the smaller and smaller changes in output per worker as the capital/labour ratio increases. For example, starting at point C, an increase in the ratio of capital to labour moves the economy along the production function to point D. Output per worker increases at a decreasing rate. This shows that increased capital to labour ratios can increase output per worker until diminishing returns set in and limit sustained increases in output per worker. **Sustained growth in per capita real GDP**, in this basic model of growth, depends on improvements in technology to overcome the diminishing returns to increases in the capital to labour ratio.

> **Sustained growth in per capita real GDP**: improvements in technology overcome the diminishing returns to increases in the capital to labour ratio.

An improvement in technology that increases productivity ($A_2 > A_1$) shifts the production function up. At capital to labour ratio $k_2$, for example, the increased productivity moves the economy from D to E as output per worker rises from $y_2$ to $y_3$. This shows that growth in per capita output, moving from $y_1$ to $y_3$, points C to E in Figure 13.2, is a result of both the growth in the capital to labour ratio and improvements in productivity.

Once again, growth accounting allows us to sort out the effects of these two factors on growth in output per worker and per capita GDP. Table 13.5 uses Canadian experience before the 'Great Recession' of 2008-09 as an example.

**Table 13.5: Sources of growth in per-worker GDP in Canada, 1990 to 2005**

| | **Real GDP** $Y$ **($b)** | **Employ** $N$ **($m)** | **Capital Stock** $K$ **($b)** | **Real GDP per worker** $Y/N = y$ **($k)** | **Capital per worker** $K/N$ **($k)** | **Growth in** $Y/N$ $\$\Delta y$ | **Growth in** $K/N$ $\%\Delta k$ | **Contribution from** $\Delta k =$ $\%\Delta k/3$ | **Solow Residual** $\%\Delta A$ |
|---|---|---|---|---|---|---|---|---|---|
| | **(1)** | **(2)** | **(3)** | **(4)** | **(5)** | **(6)** | **(7)** | **(8)=(7)/3** | **(9)=(6)-(8)** |
| 1990 | 762 | 13.07 | 1,308 | 58.30 | 100.07 | – | – | – | – |
| 1995 | 832 | 13.27 | 1,450 | 62.69 | 109.27 | 7.5 | 9.2 | 3.1 | 4.4 |
| 2000 | 1,010 | 14.76 | 1,560 | 69.11 | 105.69 | 10.2 | −3.3 | −1.1 | 11.3 |
| 2005 | 1,158 | 16.18 | 1,873 | 71.56 | 115.76 | 3.5 | 9.5 | 3.2 | 0.3 |

*Source:* Adapted from Statistics Canada CANSIM Database Table 380-0002 Series V1992067, Table 031-0002 Series V4419841, and Table 282-0087 Series V2062811, and author's calculations.

The first three columns of the table give data on real GDP, employment, and real capital stock for four years over the 1990 to 2005 period. Columns **(4)** and **(5)** use these data to calculate the output per worker and capital per worker that we see in our per-worker production function. The growth in output per worker and the growth in capital per worker are reported in columns **(6)** and **(7)** as the percentage changes over the five-year periods.

Growth accounting divides the sources of growth in output per worker between increases in capital per worker and increases in productivity based on improvements in technology. From the production function, we know that an increase in the capital/labour ratio increases output per worker by a factor of 1/3. Column **(8)** in the table reports this weighted contribution of the increase in capital per worker to the increase we see in output per worker. Subtracting these contributions from the increases in output per worker gives the Solow residual, column **(9)**, which again is a measure of the effect of improvements in technology on output per worker.

The 1990 to 2005 period is of interest because the Canadian experience provides three different examples of growth in GDP per worker. In the first five years, 1990 to 1995, there was very little growth in employment but substantial growth in capital stock. As a result, the capital to labour ratio, $k$, increased by 9.2 percent and accounted for 3.1 percentage points, or 41 percent of the 7.5 percent growth in real GDP per worker. Improved technology as measured by the Solow residual contributed the other 4.4 percentage points.

By contrast, employment and capital stock both grew strongly from 1995 to 2000, but employment growth (11.2 percent) exceeded capital stock growth (7.6 percent). As a result, the growth in the capital to labour ratio was negative, at −3.3 percent. Nevertheless, output per worker grew more in the second period, up 10.2 percent. Productivity gains from improved technology, again measured by the Solow residual, were the major source of strong growth in GDP per worker.

The decline in the capital to labour ratio in the 1995 to 2000 period appears to have reduced the growth in output per worker in the 2000 to 2005 period. Even though capital stock increased by about 20 percent and employment grew by just 9.6 percent, output per worker increased by only 3.5 percent over the period. The Solow residual in column **(9)** shows a very small contribution to growth in output per worker from improved technology.

Thinking of these experiences in terms of the production functions in Figure 13.2 illustrates the differences between sub-periods. From 1990 to 1995, the economy moved to the right along the production function as $k$ grew by 9.2 per cent, for example, from C to D in the diagram. This provided a 3.1 percent increase in $y$, as from $y_1$ to $y_2$. Improved technology shifted the production function up to further increase output per worker from $y_2$ to $y_3$ at point E in the diagram. In the next period, 1995 to 2000, the movement along the production function was in the opposite direction, to the left from E, as $k$ declined. However, a very strong effect from improved technology as measured by the Solow residual of 11.3 percent shifted the production function upward (not shown in the diagram) and sustained the growth in output per worker at 10.2 percent.

By contrast, the economy experienced a sharp slowdown in productivity growth in the 2000 to 2005 period. Even though capital per worker did grow strongly in this five-year period, output per worker grew by only 3.5 percent. The Solow residual shows a very weak contribution by improvements in technology to the growth in productivity. This slowdown in productivity has raised concerns about future improvements in standards of living and calls for government action to address this decline in productivity growth and the lower rate of productivity growth in Canada than in the United States.

These examples and the discussion of the sources of growth emphasize two key aspects of the growth process. One aspect is the growth in the stock of capital, which comes from the flow of savings and investment in the economy. The other is changing technical knowledge and technology of production. These are the keys to sustained growth in total output and standards of living, but their sources are more obscure than the sources of growth in capital stock. Indeed, pessimism about the fate of society was based on both the inadequacy of investment and stagnant technology.

## 13.4 Technology & growth in per capita output

Advances in knowledge based on research and development and experience are the key to sustained rates of productivity growth and improvements in standards of living.

## Technical knowledge

Every society has some level of technical knowledge about production practices. Part of this knowledge is recorded in technical documents, books, and plans. But it develops and is often captured in current working practices based on experience. This technical knowledge grows through **invention** that uncovers new understanding and knowledge. What usually follows is **innovation** that applies new knowledge to actual production techniques.

> **Invention**: the discovery of new knowledge.
>
> **Innovation**: the application of new knowledge into production techniques.

Industrial and economic history is often written in terms of the sequence of major inventions and innovations. Improvements in transportation from the wheel, to steam engines, internal combustion engines and aircraft transformed the size of the market and the degree of specialization and trade. The generation and transmission of electricity provided a new, more efficient and flexible source of light and power leading to improved communications and data management.

Historically, the agriculture 'revolution' was based on the application of science and technology to products and production processes. That evolution continues: New organization and techniques increased productivity; new machinery further increased labour productivity and yielded economies of scale; and new science provided better seed, fertilizer and fuels to power new mechanical equipment. Increases in agriculture productivity based on these and other advances reduced the labour and land required to supply food to the population. At the same time, increased industrialization increased the demand for labour. Economies became more sector specialized with identifiable primary, manufacturing and service sectors that worked together to improve productivity and standards of living.

Additions to human capital were as important as increases in physical capital in this growth process. Human capital is knowledge and experience with production processes. Experience improves workers' efficiency. Higher levels of education and training lets workers use more complex production equipment and techniques and contribute to cost improvements in the organization of production. In short, productivity is enhanced by the complementarity and synergy between human and physical capital.

## The role of research and development

The invention and innovation that lies behind productivity improvements has many sources. Familiarity with a product, process or production technique often suggests a better way to work, or a better product design. Experience and frustration can lead to curiosity and invention. However, most invention and innovation has its origin in specialized research and development. From this perspective the output of new ideas depends on the resources allocated to R&D. There are costs involved and the focus and usefulness of the results may not be apparent for some time, if ever. Some research is pure research that seeks new knowledge and understanding. Most of it takes place in university departments, usually funded in part by industry, in part by government and in part by private individuals. Applied research, on the other hand is usually based in and financed by industrial firms, with some support from government grants and tax incentives. New knowledge with commercial applications is the goal of this applied R&D.

Investment in R&D, like investment in human and fixed capital, is risky. It cannot be known in advance that new, useful knowledge will result. Funding is provided and committed in the hope and expectation that research projects will be successful. Even if research succeeds it may be difficult to apply the new knowledge or technology in a way that increases your market power enough to allow recovery of the costs. Success gives competitors strong incentives to copy the new product or create a close substitute for it. Patent laws and government subsidies are designed to help private companies and individuals recover their costs of R&D, recognizing that society benefits from improvements in technology.

## 13.5 Recent growth studies and policy issues

Basic growth theory and the basic growth accounting methodology leave a large part of aggregate growth and productivity growth in the Solow Residual and unexplained. Growth in employment and capital stock, and the relationship between them, play important roles in aggregate growth and labour productivity growth, but the effects of changes in the characteristics of labour and the composition of capital stock reside in the total factor productivity estimates of the Solow residual. This residual captures changes in technology along with other undefined factors.

Recent work on productivity growth still uses the growth accounting methodology, but focused on particular sectors of the economy and with extensions designed to unpack some things previously left in the residual. These include, in particular, investment in different components of the capital stock and changes in the composition and quality of labour.

Increases in capital per worker or per hour of work—capital deepening—continues to be important, but increases in capital stock are disaggregated into investment into several categories such as:

- Information and communications technology;
- Machinery and equipment; and
- Physical structures.

Changes in educational qualifications, gender structure, and age structure are used as indicators of changes in the composition and quality of the labour force. To the extent that these measures of change in characteristics and structure affect productivity less remains in the residual. More importantly, these are areas in which policies to support education, training, and labour force participation could affect productivity growth. Table 13.6 gives an example of some recent results based on this approach.

The estimates in the table show the effect of increases in the information, communications, and technology components of the capital stock. Particularly over the 1997 to 2000 period, the increase in ICT capital per unit of labour input was the largest part of capital deepening. This is also the period of strongest growth in labour productivity and the largest increase in total factor productivity. The latter captures the effects of other improvements in technology.

**Table 13.6: Sources of Canadian business sector labour productivity growth, 1974-2005 (%/yr)**

| | 1974-1996 | 1997-2000 | 2000-2005 |
|---|---|---|---|
| Labour productivity | 1.4 | 3.0 | 1.0 |
| Capital deepening | 1.1 | 1.0 | 0.7 |
| Info & communications technology (ICT) | 0.4 | 0.7 | 0.3 |
| Non-ICT | 0.7 | 0.4 | 0.4 |
| Labour quality | 0.4 | 0.4 | 0.4 |
| Total factor productivity | 0.0 | 1.6 | –0.1 |

*Source:* R. Dion, "Interpreting Canada's Productivity Performance in the Past Decade: Lessons from Recent Research." Bank of Canada Review, Summer 2007.

The estimated contributions of changes in labour quality to labour productivity growth provide an interesting refinement of the growth accounting methodology. Ignoring this change, as the simple accounting process did in earlier examples, leaves the contribution of changes in the structure and characteristics of the labour force in the residual measure of total factor productivity. The results in the table extract and quantify this important source of productivity growth.

Changes in the structure of investment and in the quality of labour are both areas in which public policy plays a role. Government tax policy can be designed to encourage producers to direct investment to areas like communications and information technology. Some of this investment has effects confined to specific industries. Other parts create and strengthen national capacity and efficiency that is widely available and used by business and households, for example high-speed internet service and expanded wireless service and capacity. Educational policy and other human resource policies contribute to the quality, adaptability, and mobility of the labour force.

## Endogenous growth theory

Another interesting strand of work makes more fundamental changes in growth theory. The simple neoclassical growth theory made economic growth depend on **exogenous variables**, the rate of population growth, the saving rate, and the rate of capital accumulation, whose values are determined outside the growth model. The subsequent work on catch-up and convergence makes technical progress respond to economic and political factors. But it would be nice to have a stronger link between economic behaviour and the rate of economic growth. We want to make *growth endogenous*, or determined within our model. **Endogenous growth** implies that the steady-state growth rate is affected by economic behaviour and economic policy.

> **Exogenous variable**: a variable with a value determined outside the model.
>
> **Endogenous growth**: growth determined economic behaviour and policy within the model.

Professor Paul Romer of the University of Chicago pioneered endogenous growth theory. Growth theories are built on the saving that drives investment and capital accumulation. While the production function used the basic growth model, increasing the stock of capital and the capital labour ratio leads to a diminishing marginal product of capital. Output and output per worker increase at a decreasing rate but in the steady state output grows at the rate of growth of population and labour force. Output per worker cannot grow indefinitely.

Endogenous growth theory is based on a different view of the roles capital plays in the growth process. It retains the assumption that, for the individual firm, the marginal product of capital decreases as capital stock increases. But it adds the insight that in the *aggregate economy* there may be significant positive externalities to the increase in capital stock. In other words increases in capital stock by one firm may result in improved productivity and output in other firms. Improved internet speed and access, or faster wireless voice and data transmission comes from investment by internet service providers and wireless companies. Using the new capacity provided improves the efficiency and productivity of production in other companies. Aggregate productivity and output grows as a result of increased investment by individual producers.

This line of argument is illustrated by the shapes of the production functions. For the individual firm the production function still looks like that in Figure 13.1, concave to the horizontal axis. Increases in the capital/labour ratio increase output per worker at a decreasing rate. For the *aggregate economy*, according to endogenous growth theory, increases in capital per worker do not face diminishing returns because of the externalities that come with increases in the capital stock. As a result, the aggregate production function has *constant returns* to capital. It is a straight line rising from the origin with a constant slope. Growth in the capital/labour ratio produces a constant rate of growth in output per worker and aggregate output. A 10 percent increase in capital per worker gives a 10 percent increase in output per worker.

Constant returns to raising the *aggregate* capital to labour ratio in the economy allows an escape from the key growth limitation in the neoclassical theory. It makes growth endogenous and dependent upon parameters that could be influenced by private behaviour or public policy. Any policy that succeeded in raising the rate of investment would permanently raise the growth rate. Similarly, any policy achieving a one-time improvement in technology (for example, greater workplace efficiency) would permanently raise the growth rate of capital per worker. This would mean permanently faster output growth.

Not only can government policy affect growth in this framework, government intervention may also increase efficiency. In the simple endogenous model described here, there are externalities to capital accumulation. Individual producers may not realize that by investing to increase their capital stock they may also improve productivity in other firms. Public policy that recognizes this economy wide effect can subsidize investment to increase investment and aggregate economic growth. By the same argument, externalities to investment in human capital support government subsidies to education and training.

However, endogenous growth theory faces criticism based on the assumption that there are exactly constant returns in the aggregate from accumulating one factor of production. The diminishing returns in the basic model make long-run growth exogenous. An economy with *increasing* returns experiences continuously increasing capital stock and output. This sort of explosive growth does not correspond to any empirical observation.

New growth theory emphasizes the roles of research and development, innovation, education and "learning by doing" as sources of improved technology and productivity. Research, development, and innovation come from decisions to invest in new knowledge and to apply it to production processes. Education comes from decisions to invest in human capital. Learning by doing is a natural outcome of employment experience. All these are ongoing processes, although they may be pursued unevenly over time as economic conditions and economic policies change.

As a result, increases in the stock of capital and the level of employment always embody new technology and knowledge. There is no separation between increases in the capital to labour ratio and the state of technology, as in the basic neoclassical model. But if new capital stock and new employees bring new technology to the production process, the per worker production function *shifts up* as capital per worker increases. As capital per worker increases, the economy moves up and along a new per worker production function because the embodied technological improvements offset otherwise diminishing returns.

Recent studies of the sources of productivity growth based on growth accounting are consistent with this approach to reconciling neoclassical and new growth theory. The findings reported in Table 13.6 above show the contributions to productivity growth made by different types of capital equipment and changes in labour force structure. These changes in "technology" are made integral parts of the growth in capital stock and employment rather than left as exogenous residuals.

## The costs of growth

Can the benefits of economic growth be outweighed by its costs? Pollution, congestion, and a hectic lifestyle are a high price to pay for more cars and trucks, washing machines, video games, smart phones and tablets.

Since GDP is an imperfect measure of the true economic value of goods and services produced by the economy, there is no presumption we should want to maximize the growth of measured GDP. Without government intervention, a free market economy produces too much pollution. But the elimination of all pollution is also wasteful. Society should undertake activities accompanied by pollution up to the point at which the marginal net benefit of the goods produced equals the marginal pollution cost imposed on society. Government intervention, through pollution taxes or regulation of environmental standards, can move the economy towards a more efficient allocation of resources and a higher standard of living, broadly defined.

The full implementation of such a policy would (optimally) reduce growth of measured GDP to below the rate when there is no restriction on pollution and congestion. This is the most sensible way in which to approach the problem. It tackles the issues directly.

In contrast, the "zero growth" solution is a blunt instrument. It does not differentiate measured outputs that have social costs, from outputs without new social costs. As a result there are no new incentives to minimize the externalities already caused by pollution, congestion and environmental degradation. These call for taxes or incentives to reduce current social costs. 'No growth' does not go far enough.

A more extensive and inclusive measure of GDP would be a step toward recognizing and dealing with the costs of growth. Such a measure might include both positive aspects of production and consumption that contribute to welfare, such as environmental quality and low levels of congestion. It might also adjust to give a more complete measure of both private and social costs of different patterns of production, consumption and leisure. We have seen one way to approach this in the United Nations Human Development Index in Chapter 4, but a broader based index is needed.

# Conclusion

This completes the introduction to the theory and modelling needed to study the major performance and policy issues in the macro economy. This approach has integrated household and business expenditure decisions, government taxation, expenditure and budget balances, and the monetary, financial sectors and monetary policy, to explain the causes and effects of business cycle fluctuations in national output and employment. It also defines and explains monetary and fiscal policy stabilization roles for the central bank and the government. The brief discussion of the theory of economic growth puts a longer-term perspective on the changes in standards of living over time. Perhaps most importantly, modelling the macro economy emphasizes the complex linkages and interdependencies that determine the modern industrial economy's responses to aggregate demand and supply disturbances.

# Key Concepts

**Economic growth** is the percentage annual increase in real GDP or per capita real GDP. It is an imperfect measure of the rate of increase of economic well-being because of the limitations of the measurement of GDP.

**Very long run**: the time required for changes to occur in the stock of capital, the size of the labour force, and the technology of production.

**Total factor productivity (TFP)**: output relative to the combined inputs of labour and capital, the total factor inputs to production.

**Growth accounting**: a method of measuring the contributions of growth in inputs of labour and capital and the state of technology to overall growth.

**Solow residual**: the growth in real GDP or per capita real GDP not caused by growth in factor inputs, but attributed to improved technology.

Growth in per capita real GDP has **two main sources**, namely, growth in the ratio of capital to labour in the production process, and improvements in technology. Growth accounting provides a way of measuring the sources of growth in per capita real GDP.

**Marginal product**: the change in total output caused by a change of one unit in the input of that factor to production.

**Sustained growth in per capita real GDP**: improvements in technology overcome the diminishing returns to increases in the capital to labour ratio.

Recent research on the **growth of Canada's potential GDP** found that the contribution of productivity growth from technology declined in the 1980s and early 1990s and again from 2000 to 2005.

**Invention**: the discovery of new knowledge.

**Innovation**: the application of new knowledge into production techniques.

**Exogenous variable**: a variable with a value determined outside the model.

**Endogenous growth**: growth determined economic behaviour and policy within the model.

# Exercises for Chapter 13

**Exercise 13.1**

(a) What is the distinction between growth in potential GDP and growth in per capita real GDP?

(b) Why is this distinction important to an evaluation of the relationship between economic growth and growth in standards of living?

(c) Which grows more rapidly, potential GDP or per capita real GDP?

**Exercise 13.2** Consider two countries with the same level of potential GDP, say \$100 billion, today. Suppose potential GDP grows at an annual rate of 3.5 percent (0.035) in one country and 3.25 percent (0.0325) in the second country. Based on this information:

(a) What do you predict for the percentage difference in potential GDP between the two countries 10 years in the future?

(b) 20 years in the future? [Note that the growth rates will compound to determine real GDP according to the following formula: $Y_t = Y_0(1 + \text{growth rate})^t$.]

**Exercise 13.3** Suppose you have the following information about an economy:

Average annual rates of growth from 1998 to 2008:

| | |
|---|---|
| Potential GDP | 3.5% |
| Labour force | 2.1% |
| Capital stock | 3.0% |

Share of labour income in national income: 2/3. Using growth accounting, find the contribution to the annual growth in potential GDP that came from:

(a) Growth in labour force

(b) Growth in capital stock

(c) Improved productivity as measured by the Solow residual.

**Exercise 13.4** If technology were constant while labour force grew at a rate of 2.5% a year, capital stock grew at 1.5% per year and the share of labour income in national income was 70%, how fast would potential GDP grow?

**Exercise 13.5** Suppose you have the following information for two economies:

| | | Country A | Country B |
|---|---|---|---|
| **Average annual** | **i. Labour force** | 2.5% | 4.0% |
| **growth rates:** | **ii. Capital stock** | 3.5% | 3.5% |
| **Labour income/national income:** | | 2/3 | 2/3 |

(a) Assuming a constant state of technology, which of these two countries will have the faster rate of growth in total real GDP?

(b) Which of the two countries will have the faster rate of growth in per capita real GDP?

(c) What differences, if any, do you see in the growth rates of the capital to labour ratios in the two countries?

(d) Explain the reasons for the differences in growth rates you have found.

**Exercise 13.6** In Wonderland, labour force and capital stock both grow at the rate of 2.5% a year but technology is constant. At what rate will potential GDP grow? At what rate will per capita GDP grow? If improvements in technology increased total factor productivity by 1.5% year, how fast would per capita real GDP grow?

**Exercise 13.7**

(a) Why do economists emphasize that improvements in technology are the key to improvements in standards of living?

(b) Using a diagram that shows the relationship between capital per worker and output per worker, illustrate and explain why growth in capital per worker cannot provide sustained growth in output per worker and standards of living.

(c) In the diagram in part (b), show how an improvement in productivity coming from improved technology could provide sustained increases in standards of living.

# Glossary

**AD/AS model**: a framework used to explain the behaviour of real output and prices in the national economy.(5.1)

**Aggregate demand**: *planned aggregate expenditure* on final goods and services at different price levels, all other conditions remaining constant. (5.1)

**Aggregate expenditure (AE)**: *planned expenditure* by business and households. (6.2)

**Aggregate expenditure (AE)**: the sum of *planned induced* and *autonomous* expenditure in the economy. (6.2)

**Aggregate supply**: the output of final goods and services businesses would produce at different price levels, all other conditions held constant. (5.1)

**Automatic stabilizers**: tax and transfer programs that reduce the size of the multiplier and the effects of *transitory* fluctuations in autonomous expenditures on equilibrium GDP. (7.5)

**Autonomous expenditure (*A*)**: planned expenditure that is not determined by current income. (6.2)

**Balance of payments accounts**: a record of trade and financial transactions between residents of one country and the rest of the world. (12.1)

**Balance of payments**: the sum of the balances in current accounts and capital accounts, minus the change in the holdings of official reserves. (12.1)

**Balanced budget**: revenues are equal to expenditures. (7.3)

**Bank of Canada**: Canada's central bank. (8.3)

**Bank rate**: the interest rate the central bank charges on its loans to commercial banks. (10.2)

**Bank reserves**: cash (legal tender) held by banks to meet possible withdrawals by depositors. (8.1)

**Bankers risk**: the risk that customers may demand cash for their deposits. (8.3)

**Barter exchanges**: direct exchanges of goods or services for goods or services without the use of money. (8.1)

**Bond coupon**: the *annual* fixed money payment paid to a bond holder. (9.1)

**Bond price**: the *present value* of future payments of interest and principal. (9.1)

**Bond**: a financial contract that makes one or more fixed money payments at specific dates in the future. (9.1)

**Boom**: a period of high growth that raises output above normal capacity output. ( 1.6)

**Budget deficit**: revenues are less than expenditures. (7.3)

**Budget function**: the relationship between the budget balance and the level of national income for a specific budget program. (7.3)

**Budget surplus**: revenues are greater than expenditures. (7.3)

**Business cycles**: short-term fluctuations of actual real GDP. (5.4)

**Capital account**: the record of capital transfers and the purchases and sales of real and financial assets. (12.1)

**Capital stock**: the buildings, machinery, equipment and software used in producing goods and services. ( 1.6)

**Central bank intervention**: purchases or sales of foreign currency intended to manage the exchange rate. (12.3)

**Central bank**: an institution that conducts monetary policy using its control of monetary base and interest rates. (10.1)

**Change in official international reserves**: the change in the Government of Canada's foreign currency balances. (12.1)

**Circular flow diagrams**: show the flows of money payments, real resources, and goods and services between households and businesses. (4.3)

**Comparative static analysis**: compares an initial equilibrium with a new equilibrium, where the difference is due to a change in one of the conditions behind the initial equilibrium. (3.4)

**Complementary goods**: when a price reduction (rise) for a related product increases (reduces) demand for a primary product it is a complement for the primary product. (3.3)

**Constant returns to scale**: equal percentage increases in inputs of labour and capital increase output by the same percentage. (13.3)

**Consumer price index (CPI)**: a measure of the cost of living in any one year to the cost of living in a base year. (4.1)

**Consumer price index**: the average price level for consumer goods and services. (2.1)

**Consumption possibility frontier (CPF)**: the combination of goods that can be consumed as a result of a give production choice. (1.4)

**Convertible currency**: a national currency that can be freely exchanged for a different national currency at the prevailing exchange rate. (12.3)

**Cost of credit**: the cost of financing expenditures by borrowing at market interest rates. (9.4)

**Credit easing**: the management of the central bank's assets designed to support lending in specific financial markets. (10.4)

**Credit money**: the debt of a private business or individual. (8.1)

**Cross-section data**: values for different variables recorded at a point in time. (2.1)

**Currency appreciation**: a rise in external value of the domestic currency that lowers the domestic currency price of foreign currency. (12.2)

**Currency depreciation**: a fall in external value of the domestic currency that raises domestic currency price of foreign currency. (12.2)

**Current account**: a record of trade in goods, services, and transfer payments. (12.1)

**Cyclical unemployment**: would be eliminated by higher levels of economic activity. (4.1)

**Data**: recorded values of variables. (2.1)

**Deflation**: a persistent fall in the general price level. (11.6)

**Demand curve**: a graphical expression of the relationship between price and quantity demanded with all other influences unchanged. (3.3)

**Demand**: the quantity of a good or service that buyers wish to purchase at each possible price with all other influences on demand remaining unchanged.(3.2)

**Deposit multiplier**: increase in bank deposits as the result of an increase in monetary base. (8.5)

**Depreciation of the national currency**: a decline in the value of the currency relative to other national currencies, which results in a rise in the domestic price of foreign currencies. (9.3)

**Devaluation (revaluation)**: a reduction (increase) in the international value of the domestic currency. (12.3)

**Discretionary fiscal policy**: changes in net tax rates and government expenditure intended to offset *persistent* autonomous expenditure shocks and stabilize aggregate expenditure and output. (7.5)

**Disinflation**: a persistent fall in the inflation rate. (11.6)

**Disposable income ($Y_D$)**: national income minus net taxes. (7.2)

**Economic equity**: the distribution of well-being among members of the economy. (2.2)

**Economic growth**: an increase in real GDP. (4.1)

**Economic growth**: the annual percentage change in real GDP or per capita real GDP. (13.1)

**Economic recession**: national output falls below the economys capacity output. (1.6)

**Economy-wide PPF**: the set of goods and services combinations that can be produced in the economy when all available productive resources are in use. (1.5)

**Effective lower bound (ELB)**: A bank's policy interest rate cannot be set below a small positive number. (10.4)

**Employment rate**: percent of the population 15 years of age and over that is employed. (4.1)

**Employment**: number of adults employed full-time and part-time and self-employed. (4.1)

**Endogenous growth**: growth determined economic behaviour and policy within the model. (13.5)

**Equilibrium GDP**: AD = AS, planned expenditure equals current output and provides business revenues that cover current costs including expected profit. (5.1)

**Equilibrium price**: the price at which quantity demanded equals quantity supplied. (3.2)

**Excess demand**: amount by which quantity demanded exceeds the quantity supplied at the current price. (3.2)

**Excess supply**: amount by which quantity supplied exceeds the quantity demanded at the current price. (3.2)

**Exchange rate regime**: the policy choice that determines how foreign exchange markets operate. (12.3)

**Exchange rate target**: monetary policy maintains a fixed price for foreign currency in terms of domestic currency. (10.3)

**Exogenous variable**: a variable with a value determined outside the model. (13.5)

**Expenditure-based nominal GDP**: sum of the market value of all the final goods and services bought in a given time period, say one year. (4.4)

**Fiat money**: money the government has declared as legal tender. (8.1)

**Final goods and services**: goods and services are purchased by the ultimate users. (4.4)

**Financial intermediary**: a business that specializes in bringing borrowers and lenders together. (8.3)

**Financial panic**: a loss of confidence in banks and rush to withdraw cash. (8.4)

**Fiscal austerity**: cuts in government expenditure and /or increases in taxes aimed at improving the government's budget balance. (7.4)

**Fiscal policy**: government expenditure and tax changes designed to influence AD. (5.7)

**Fixed exchange rate**: an exchange rate set by government policy that does not change as a result of changes in market conditions. (12.3)

**Flexible exchange rates**: Supply and demand in the foreign exchange market determine the equilibrium exchange rate without central bank intervention. (12.3)

**Foreign exchange rate**: the domestic currency price of a unit of foreign currency. (9.3)

**Forward guidance**: information on the timing of future changes in the central bank's interest rate setting. (10.4)

**Frictional unemployment**: a result of the time involved in adjusting to changing labour force and employment opportunities. (4.1)

**Full employment output $Y_c$**: $Y_c = (\text{number of workers at full employment}) \times (\text{output per worker})$. (1.6)

**GDP deflator**: index of current final output prices relative to base year prices. (4.5)

**GDP ($Y$)**: the national accounts measure of the sum of actual expenditure in the economy. (6.2)

**Government budget**: planned government spending and revenue. (7.3)

**Government expenditure ($G$)**: government spending on currently produced goods and services. (7.2)

**Growth accounting**: measurement of the contributions of labour, capital, and technology to growth in output. (13.2)

**High (low) frequency data**: series with short (long) intervals between observations. (2.1)

**Income-based GDP**: sum of the factor costs of production of all goods and services plus the net in direct taxes included in market price. (4.4)

**Index number**: value for a variable, or an average of a set of variables, expressed relative to a given base value. (2.1)

**Induced expenditure** $(c-m)Y$: planned consumption and imports expenditures that change when income changes. (6.2)

**Inferior good**: a good for which demand falls in response to higher incomes. (3.4)

**Inflation (deflation) rate**: the annual percentage increase (decrease) in the level of consumer prices. (2.1)

**Inflation rate target**: monetary policy objective defined as an announced target inflation rate. (10.3)

**Inflation**: a persistent rise in the general price level. (4.1)

**Innovation**: the application of new knowledge into production techniques. (13.4)

**Interest rate**: the current market rate paid to lenders or charged to borrowers. (9.1)

**Intermediate inputs**: services, materials, and components purchased from other businesses and used in the production of final goods. (4.4)

**Invention**: the discovery of new knowledge. (13.4)

**Investment function,** $I = I(i)$: explains the level of planned investment expenditure at each interest rate. (9.4)

**Labour force**: adults employed plus those not employed but actively looking for work. (4.1)

**Legal tender**: money that by law must be accepted as a means of payment. (8.1)

**Liquidity**: the cost, speed, and certainty with which asset values can be converted into cash. (8.3)

**Longitudinal data**: follow the same units of observation through time. (2.1)

**Macroeconomics**: the study of the economy as a complete system that determines national output, employment and prices. (1.1)

**Marginal product**: the change in total output caused by a change of one unit in the input of that factor to production. (13.3)

**Marginal propensity to consume** ($mpc = c = \Delta C/\Delta Y$): the change in consumption expenditure caused by a change in income. (6.2)

**Marginal propensity to import** ($mpm = m = \Delta IM/\Delta Y$): the change in imports caused by a change in income. (6.2)

**Market demand**: the horizontal sum of individual demands. (3.7)

**Market value of output**≡total expenditure≡market value of factor services≡household income. (4.3)

**Means of payment**: a commodity or token generally accepted in payment for goods and services or the repayment of debt. (8.1)

**Microeconomics**: the study of individual behaviour in the context of scarcity. (1.1)

**Mixed economy**: goods and services are supplied both by private suppliers and government. (1.1)

**Model**: a formalization of theory that facilitates scientific inquiry. (1.2)

**Monetary base** ($MB$): legal tender comprising notes and coins in circulation plus the cash held by the banks. (8.5)

**Monetary policy instrument**: the monetary variable the central bank manipulates in pursuit of its policy target. (10.3)

**Monetary policy**: central bank action to control inflation and support economic growth through control of the money supply, interest rates, and exchange rates to change aggregate demand and economic performance. (10.1)

**Monetary policy**: changes in interest rates and money supply designed to influence AD. (5.7)

**Money supply target**: a central bank adjusts interest rates and the monetary base to control the nominal money supply, or the rate of growth of the nominal money supply. (10.3)

**Money supply**: notes and coin in circulation outside banks plus bank deposits. (8.2, 8.5)

**Money supply**: the means of payment in the economy, namely currency (notes and coin) in circulation outside the banks and bank deposits. (8.1)

**Moral suasion**: a central bank persuades and encourages banks to follow its policy initiatives and guidance. (10.4)

**Multiplier ($\Delta Y/\Delta A$)**: the ratio of the change in equilibrium income $Y$ to the change in autonomous expenditure $A$ that caused it. (6.4)

**NAIRU**: the 'non-accelerating inflation rate of unemployment' that corresponds to $N_F$ at $Y_P$. (11.2)

**Natural unemployment rate**: the unemployment rate at "full employment". (4.1)

**Natural unemployment rate**: the unemployment rate that corresponds to potential GDP. (5.2)

**Net interest income**: the excess of loan interest earned over deposit interest paid. (8.3)

**Net taxes**: taxes on incomes minus transfer payments. (7.2)

**Nominal exchange rate ($er$)**: the domestic currency price of a unit of foreign currency. (12.1)

**Nominal GDP**: the output of final goods and services, the money incomes generated by the production of that output, and expenditure on the sale of that output measured at current prices in a specific time period. (4.4)

**Normal good**: a good for which demand increases in response to higher incomes. (3.4)

**Normative economics**: offers recommendations that incorporate value judgments. (2.2)

**Official exchange reserves**: government foreign currency holdings managed by the central bank. (12.3)

**Open market operation**: central bank purchases or sales of government securities in the open financial market. (10.2)

**Opportunity cost**: what must be sacrificed when a choice is made. (1.3)

**Output gap**: the difference between actual output and potential output. (5.4)

**Overnight rate**: the interest rate large financial institutions receive or pay on loans from one day until the next. (10.3)

**Participation rate**: percent of the population that is either working or unemployed. (4.1)

**Per capita real GDP**: real GDP per person. (4.6)

**Percentage change**: $[(\text{change in value})/(\text{original value})] \times 100$. (2.1)

**Perfect capital mobility**: when very small differences in expected returns cause very large international flows of funds. (12.1)

**Positive economics**: studies objective or scientific explanations of how the economy functions. (2.2)

**Potential output**: the real GDP the economy can produce on a sustained basis with current labour force, capital and technology without generating inflationary pressure on prices. (5.2, 11.2)

**Present value** is the *discounted* value of future payments. (9.1)

**Price controls**: government rules or laws that inhibit the formation of market determined prices. (3.7)

**Price index**: a measure of the price level in one year compared with prices in a base year. (4.1)

**Price level**: a measure of the average prices of all goods and services produced in the economy. (4.1)

**Price of a marketable bond**: the current price at which the bond trades in the bond market. (9.1)

**Prime lending rate**: the base for setting the interest rates charged by banks on loans and lines of credit. (10.3)

**Production function**: outputs determined by technology and inputs of labour and capital. (11.2)

**Production possibility frontier (PPF)**: the combination of goods that can be produced using all resources available. (1.4)

**Productivity of labour**: the output of goods and services per worker. (1.6)

**Productivity**: output per unit of input. (11.2)

**Public debt** (*PD*): the outstanding stock of government bonds issued to finance government budget deficits. (7.6)

**Public debt ratio** ($PD/Y$): the ratio of outstanding government debt to GDP. (7.6, 11.5)

**Quantitative easing**: central bank purchases of financial assets to increase its asset holdings and the monetary base. (10.4, 11.6)

**Quantity demanded**: the amount purchased at a particular price. (3.2)

**Quantity supplied**: the amount supplied at a particular price. (3.2)

**Quotas**: are physical restrictions on output. (3.7)

**Rate of economic growth**: the annual percentage change in real GDP. (4.1)

**Real exchange rate**: the relative price of goods and services from different countries measured in a common currency. (12.1)

**Real GDP**: the quantity of final goods and services produced by the economy in a specified time period. (4.1)

**Real money supply ($M/P$)**: the nominal money supply $M$ divided by the price level $P$. (9.2)

**Real price**: the actual price adjusted by the general (consumer) price level in the economy. (2.1)

**Recession**: decline in economic activity, often defined as two consecutive quarters of negative growth in real GDP. (4.2)

**Regression line**: representation of the average relationship between two variables in a scatter diagram. (2.2)

**Repeated cross-section data**: cross-section data recorded at regular or irregular intervals. (2.1)

**Required reserve ratio**: a legal minimum ratio of cash reserves to deposits. (10.2)

**Reserve ratio ($rr$)**: the ratio of cash reserves to deposit liabilities held by banks. (8.4)

**Short run**: a time frame in which factor prices, supplies of factors of production, and technology are fixed by assumption. (5.1)

**Short-run equilibrium output**: Aggregate expenditure and current output are equal ($Y = \text{AE}$). (6.3)

**Solow residual**: the growth in real GDP or per capita real GDP not caused by growth in factor inputs, but attributed to improved technology. (13.2)

**SPRA**: A Bank of Canada purchase of securities one day combined with an agreed resale of the securities the next day. (10.3)

**SRA**: A Bank of Canada sale of securities one day combined with an agreed repurchase of the securities the next day. (10.3)

**Standard of deferred payments**: the units in which future financial obligations are measured. (8.1)

**Store of value**: an asset that carries purchasing power forward in time for future purchases. (8.1)

**Structural budget balance** (*SBB*): the government budget balance at potential output. (7.4)

**Structural primary government balance** ($SPBB = tY_P - G$): the difference between net tax revenue at $Y_P$ and government program expenditure. It excludes interest payments on the public debt and the effect of output gaps. (11.5)

**Structural unemployment**: caused by changes in economic structure relative to labour characteristics. (4.1)

**Substitute goods**: when a price reduction (rise) for a related product reduces (increases) demand for the primary product, then it is a substitute for the primary product. (3.4)

**Supply curve**: a graphical expression of the relationship between price and quantity supplied with all other influences unchanged. (3.3)

**Supply**: the quantities of a good or service that sellers are willing to sell at each possible price with all other influences on supply reaming unchanged. (3.2)

**Sustained growth in per capita real GDP**: improvements in technology overcome the diminishing returns to increases in the capital to labour ratio. (13.4)

**Taylor rule**: central bank interest rate settings based on inflation and output targets. (10.4)

**Theory**: a logical view of how things work. Frequently formulated on the basis of observation. (1.2)

**Time-series**: a set of measurements made sequentially at different points in time. (2.1)

**Token money**: convertible claims on commodity money. (8.1)

**Total factor productivity** ($TFP$): output relative to the combined inputs of labour and capital, the total factor inputs to production. (13.2)

**Transmission mechanism**: links money, interest rates, and exchange rates through financial markets to output and employment and prices. (9.4)

**Unemployment rate** is the number of unemployed persons as a percentage of the labour force. (4.1)

**Unemployment**: number of adults not working but actively looking for work. (4.1)

**Unit of account**: the standard in which prices are quoted and accounts are kept. (8.1)

**Unplanned changes in business inventories**: indicators of disequilibrium between planned and actual expenditures – incentives for businesses to adjust levels of employment and output ($Y$). (6.3)

**Value added**: the difference between the market value of the output of the business and the cost of inputs purchased from other businesses. (4.4)

**Variables**: measures that can take on different values. (2.1)

**Very long run**: the time required for changes to occur in the stock of capital, the size of the labour force, and the technology of production. (13.2)

**Wealth effect**: the change in expenditure caused by a change in real wealth. (9.4)

**Yield on a bond**: the return to a bond holder expressed as an annual percentage. (9.1)

## CHAPTER 1 SOLUTIONS

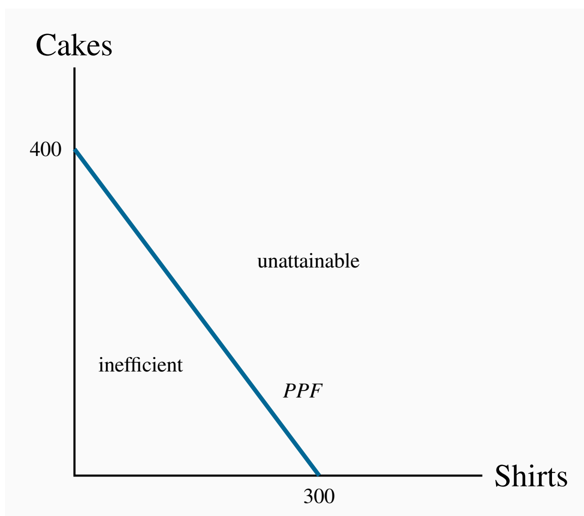
### Exercise 1.1

(a) If all 100 workers make cakes their output is $100 \times 4 = 400$.

(b) If all workers make shirts their output is $100 \times 3 = 300$.

(c) The diagram shows the $PPF$ for this economy.

(d) As illustrated in the diagram.



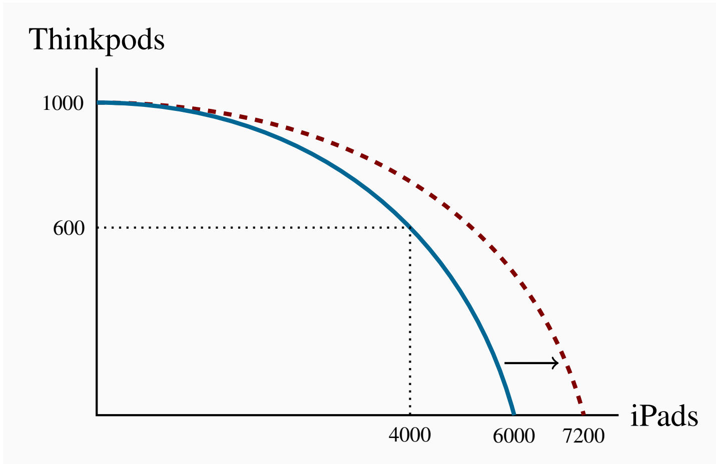

### Exercise 1.2

(a) The $PPF$ is curved outwards with intercepts of 1000 on the Thinkpod axis and 6000 on the iPad axis. Each point on the $PPF$ shows one combination of outputs.

(b) Different.

(c) 400 $X$.

(d) The new $PPF$ in the diagram has the same Thinkpod intercept, 1000, but a new iPad intercept of 7200.

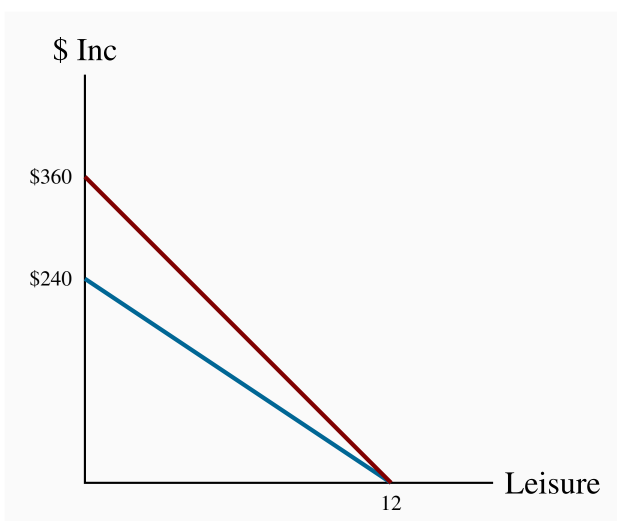



**Exercise 1.3**

By examining the opportunity cost in the region where the combinations are defined, and by assuming a linear trade-off between each set of combinations, it can be seen that the first combination in the table is feasible, but not the second combination.

**Exercise 1.4**

(a) $20.
(b) $30.
(c) See diagram.
(d) See diagram.
(e) The person with the lower wage.



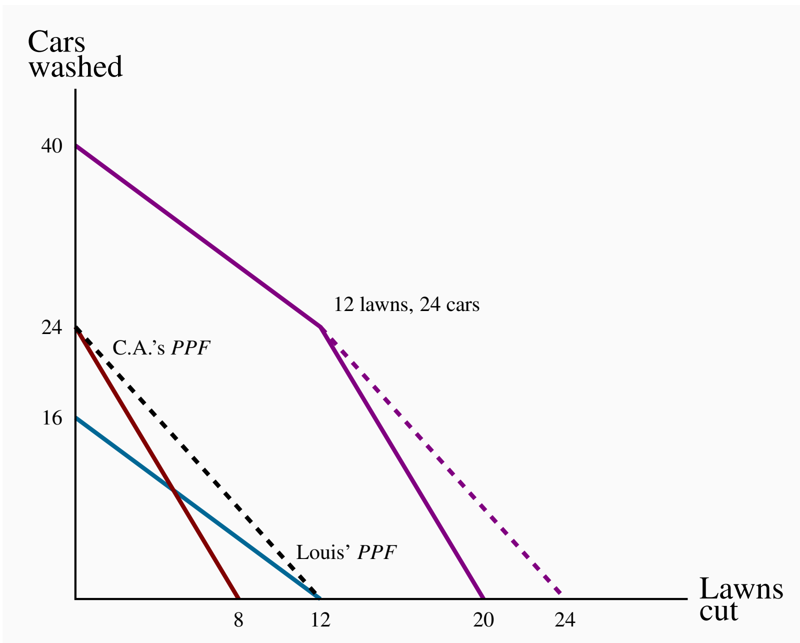
**Exercise 1.5**

(a) Louis has an advantage in cutting the grass while Carrie Anne should wash cars.

(b) If they each work a twelve-hour day, between them they can cut 12 lawns and wash 24 cars.

**Exercise 1.6**

Following the method described in the text:




(a) Carrie Anne's lawn intercept is now 12 rather than 8.

(b) Yes, specialization still matters because C.A. is more efficient at cars.

(c) The new coordinates will be 40 on the vertical axis, 24 on the horizontal axis and the kink point is $(12, 24)$.

**Exercise 1.7**

(a) 220 cakes requires 55 workers, the remaining 45 workers can produce 135 shirts. Hence this combination lies inside the *PPF* described in Exercise 1.1.

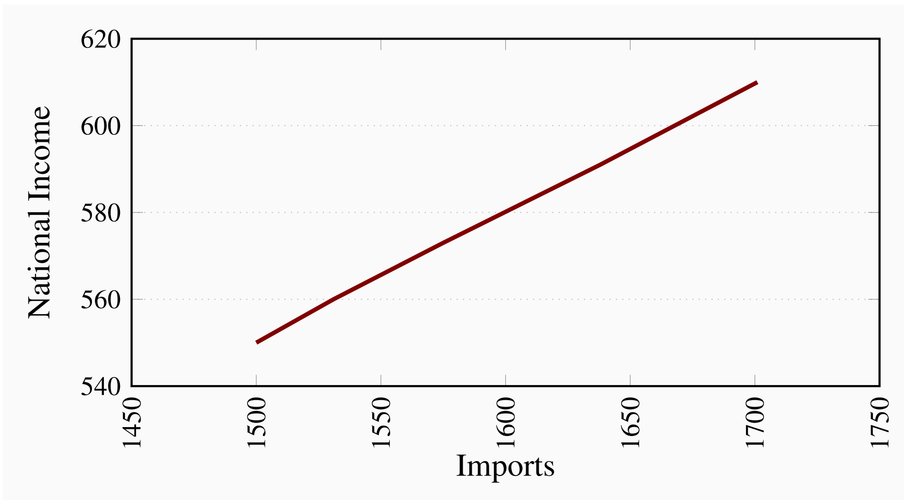
(b) 98 workers.

(c) 2%.

# CHAPTER 2 SOLUTIONS

### Exercise 2.1

These variables are positively related.




### Exercise 2.2

For (b) the answer is 30%, for (c) the answer is 4.0%, and for (d) the answers are 3.5% and -2.0%.

| **Year** | 2005 | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 | 2014 |
|---|---|---|---|---|---|---|---|---|---|---|
| **Index** | 100.0 | 105.0 | 109.0 | 115.0 | 120.0 | 120.0 | 127.0 | 130.0 | 139.0 | 142.0 |

### Exercise 2.3

The scatter diagram plots observed combinations of income and consumption as follows. For parts (c) and (d): the variables are positively related and the causation runs from income to consumption.

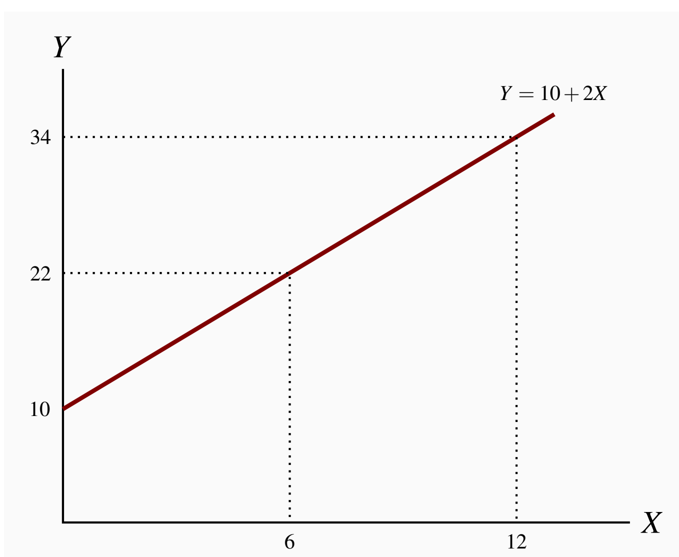

**Exercise 2.4**

The percentage changes in income are:

| **Pct Inc** | 1.3 | 2.7 | 2.0 | 4.0 | 2.7 | 2.0 | 3.1 |
|---|---|---|---|---|---|---|---|
| **Pct Con** | 3.0 | 1.6 | 3.7 | 3.8 | 4.1 | 4.1 | 3.4 |

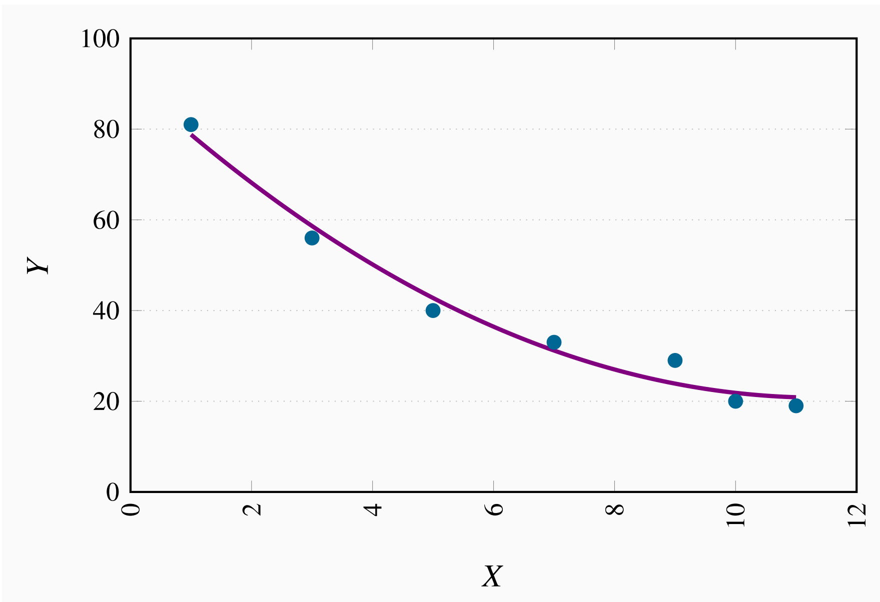
**Exercise 2.5**

The relationship given by the equation $Y = 10 + 2X$ when plotted has an intercept on the vertical ($Y$) axis of 10 and the slope of the line is 2. The maximum value of $Y$ (where $X$ is 12) is 34.



| X | 0 | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | 10 | 11 | 12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Y | 10 | 12 | 14 | 16 | 18 | 20 | 22 | 24 | 26 | 28 | 30 | 32 | 34 |

**Exercise 2.6**




(a) The relationship is negative.

(b) The relationship is non-linear.

# Chapter 3 Solutions

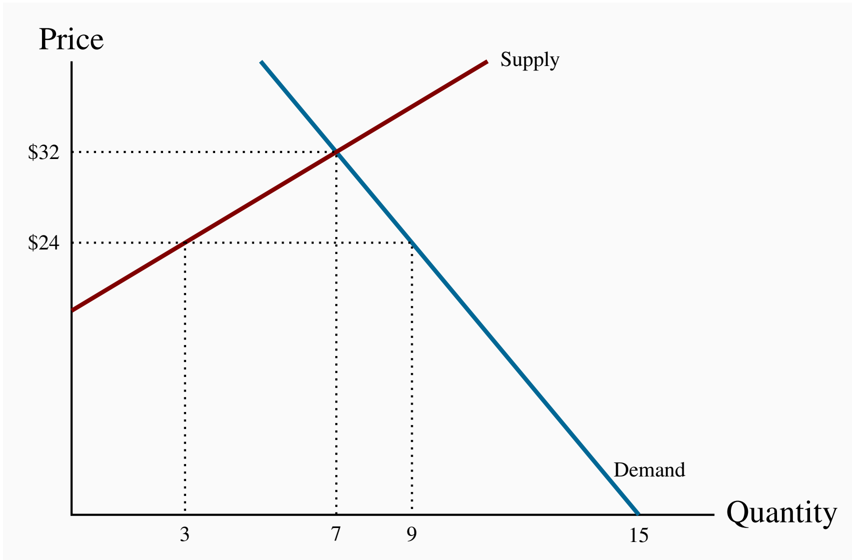
**Exercise 3.1**

(a) The diagram shows the supply and demand curves from the data in the table. These curves intersect at the equilibrium price \$32 and the equilibrium quantity 7.

(b) Excess demand is 6 and excess supply is 3.

(c) With excess demand the price is bid up, with excess supply the price is pushed down.

(d) Equate supply $P$ to demand: $18+2Q = 60-4Q$, implying $6Q = 42$, which is $Q = 7$. Hence $P = 32$.




**Exercise 3.2**

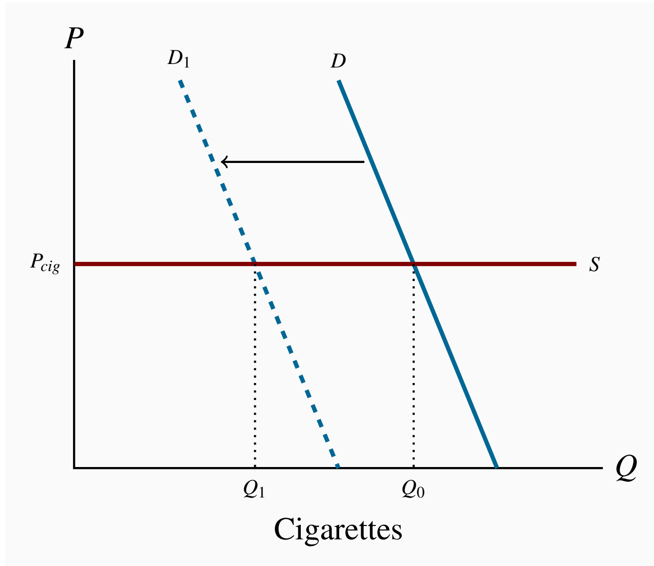
(a) Demand curve facing *Air Canada* shifts left and down. The price of the substitute *Via Rail* has fallen and reduced the quantity of air transport services demanded at any price.

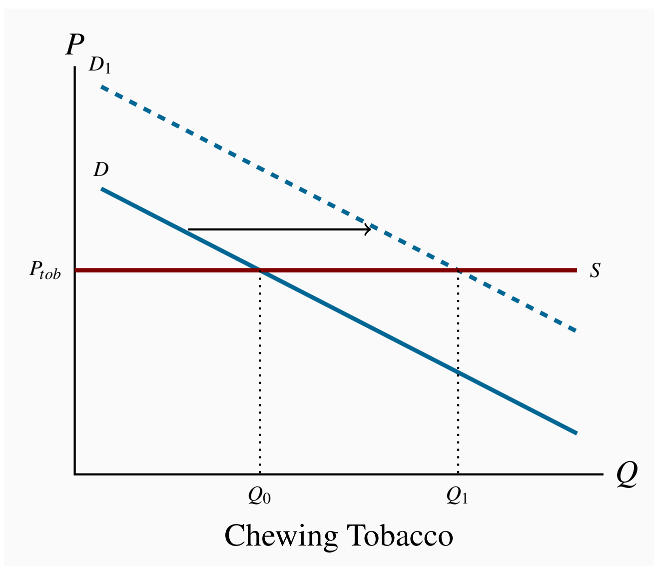
(b) Demand curve facing *Air Canada* shifts left and down. The substitute car travel has improved in quality and perhaps declined in cost.

(c) Demand curve facing *Air Canada* shifts left and down. A new budget air carrier is another substitute for *Air Canada* that will divide the market for air transport.

**Exercise 3.3**

The market diagrams are drawn on the assumption that each product can be purchased for a given price, the supply curve in each market segment is horizontal. A downward sloping demand should characterize each market. If the cigarette market is 'quashed' the demand in the market for chewing tobacco, a substitute, should shift outward, leading to higher consumption at the same price.

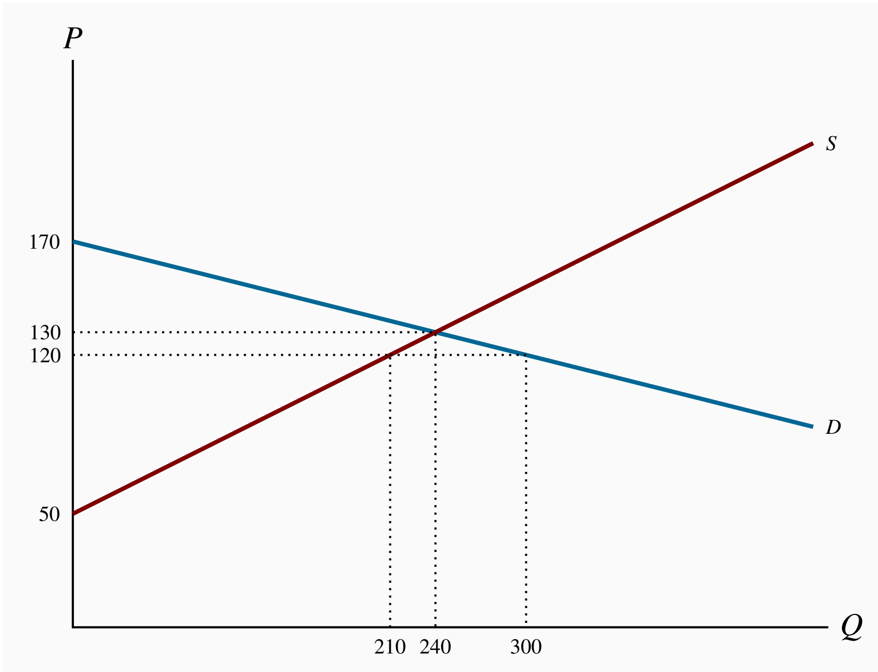



**Exercise 3.4**

(a) The diagram shows that equilibrium quantity is 240, equilibrium price is $130, which are the values obtained from equating supply and demand.

(b) At a price of $120 the quantity demanded is 300 and the quantity supplied 210. Excess demand is therefore 90.




**Exercise 3.5**

(a) At a price of \$140 quantity demanded is 180 and quantity supplied is 270; excess supply is therefore 90.

(b) Total quotas of 180 will maintain a price of \$140. This is obtained by substituting the price of \$140 into the demand curve and solving for $Q$.

**Exercise 3.6**

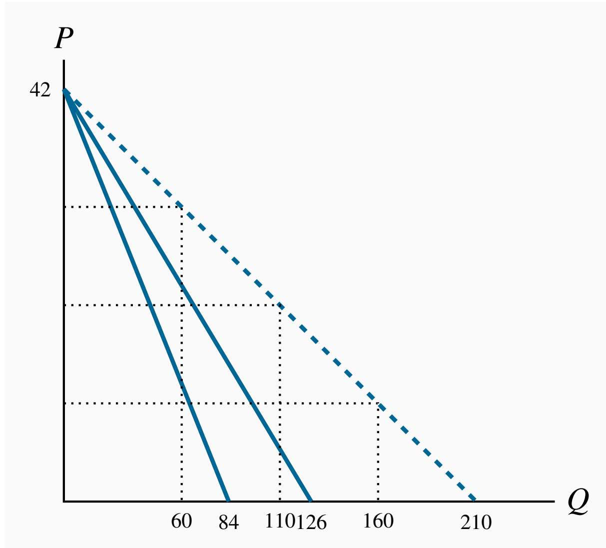
It must buy 90 units at a cost of \$140 each. Hence it incurs a loss on each unit of \$60, making for a total loss of \$5,400.

**Exercise 3.7**

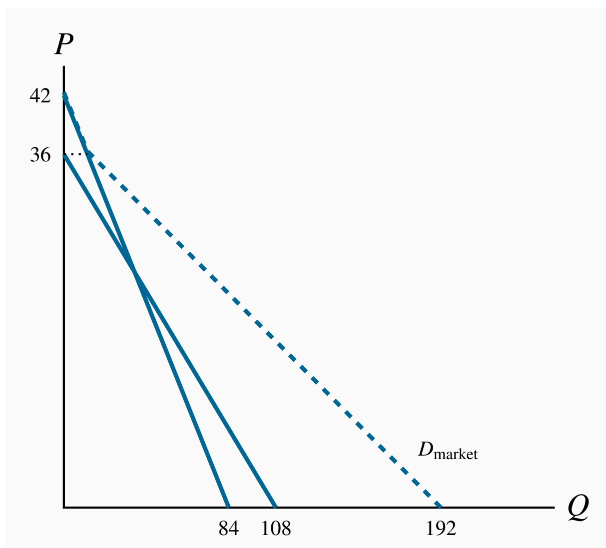
(a) The quantity axis intercepts are 84 and 126.

(b) The quantities demanded are 160, 110 and 60 respectively, on the market demand curve in the diagram. These values are obtained by solving the quantity demanded in each demand equation for a given price and summing the quantities.

(c) The equation for the market demand curve is: $Q = 210 - 5P$.




**Exercise 3.8**

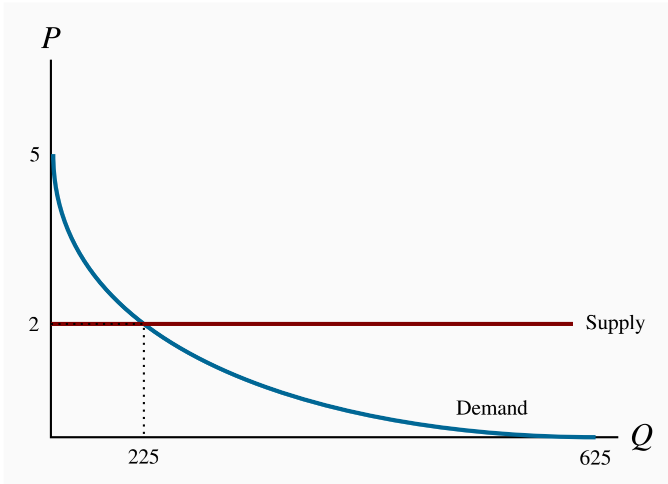



**Exercise 3.9**

(a) The demand curve is plotted below.

(b) The supply function is horizontal as plotted.

(c) Equilibrium quantity traded at $P = 2$ is $Q = 225$.



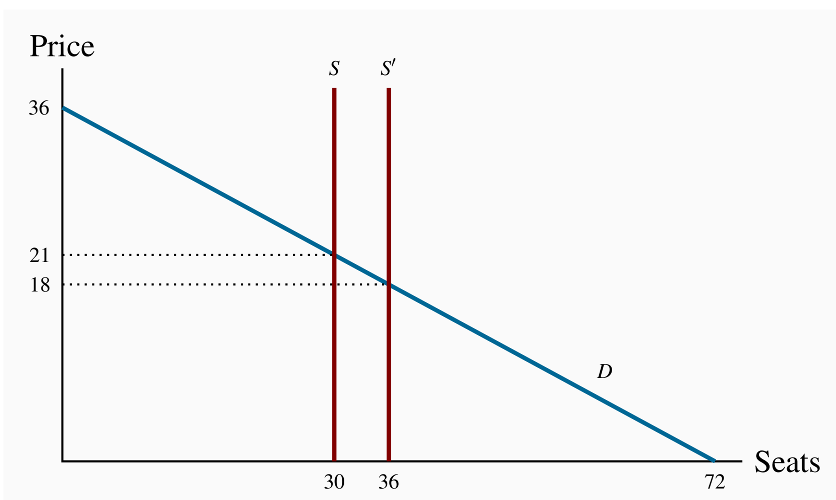

**Exercise 3.10**

(a) See the diagram below.

(b) The equilibrium admission price is $P = \$21$, $TR = \$630$.

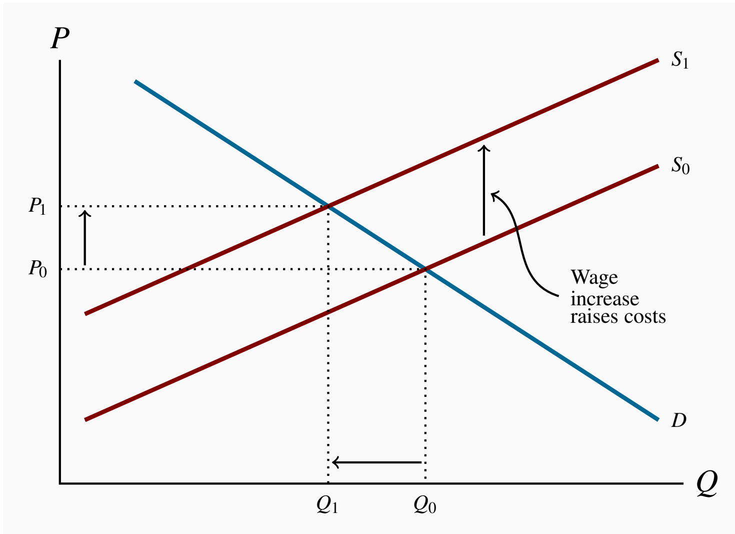
(c) The equilibrium price would now become \$18 and $TR = \$648$. Yes.

(d) The answer is no, because total revenue falls.




**Exercise 3.11**

Wages are a cost of bringing lettuce to market. In the market diagram the supply curve for lettuce shifts upwards to reflect the increased costs. If demand is unchanged the price of lettuce rises from $P_0$ to $P_1$ and the quantity demanded falls from $Q_0$ to $Q_1$.




# Chapter 4 Solutions

**Exercise 4.1**

(a) Rates of growth of real GDP:

$$2012\text{-}13\text{:}\ \left(\frac{1307}{1282}-1\right)\times 100\% = 1.95\%\,,\ 2013\text{-}14\text{:}\ -1.45\%$$

(b) Rates of inflation:

$$2013\text{:}\ \left(\frac{111.9}{109.1}-1\right)\times 100\% = 2.7\%\,,\ 2014\text{:}\ 24.1\%$$

(c) Rates of growth of labour force and employment:

2012-2013:

Labour: $\left(\frac{17.857}{17.593}-1\right)\times 100\% = 1.5\%$, Employ: $\left(\frac{16.696}{16.573}-1\right)\times 100\% = 0.95\%$

2013-2014:

Labour: $1.5\%$, Employ: $0.96\%$

(d) Unemployment rates 2010-2012:

$$2012\text{:}\ \left(\frac{17.593-16.537}{17.593}\right)\times 100\% = 6.0\%$$

$$2013\text{:}\ 6.5\%$$

2014: 7.0%

Unemployment increased in 2011 and 2012 because the growth in employment was less than the growth in the labour force.

**Exercise 4.2**

(a) The participation and employment rates in 2014 were:

$$\left(\frac{18.125}{27.885}\right) \times 100\% = 65\% \text{ and } \left(\frac{16.856}{27.885}\right) \times 100\% = 60.4\%$$

(b) The labour force would decline to $(0.645 \times 27.885) = 17.986$ without any change in employment. As a result the unemployment rate in 2012 would fall to 6.3% but the employment rate would be unchanged. The fall in the participation rate lowers the size of the labour force. The population and employment, and the employment rate are unchanged.

**Exercise 4.3**

Value added is the difference between the market value of final output and the costs of intermediate inputs to production. In this case the market value of final output is \$1,000, the cost of inputs is \$625, i.e. $(\$350 + \$125 + \$150)$, and value added is \$375 $(\$1,000 - \$625)$. If brewers wholesale some of their output it is an intermediate input to the service provided by pubs and is not counted in GDP.

**Exercise 4.4**

Nominal GDP is the market value of final goods and services produced in the economy. The value of final goods produced by the goods industry is \$4,000, $\$5,000 - \$1,000$ sold as intermediate inputs to the service industries. The value of final services produced by the service industries is \$9,000, $\$10,000 - \$1,000$ sold as intermediate inputs to the goods producing industries. Nominal GDP is \$13,000, i.e. $\$4,000 + \$9,000$.

The value of output is the sum of value added in the goods and service industries, namely

**i.** Value added in services= $\$10,000 - \$1,000$ intermediate inputs of computers, paper etc.= $\$9,000$.

**ii.** Value added in goods= $\$5,000 - \$1,000$ intermediate financial and other services= $\$4,000$.

**iii.** Value of aggregate output= $\$13,000$.

**Exercise 4.5**

(a) Nominal GDP by expenditures= $C + I + G + X - IM = 4,000$.

(b) Net domestic income=Employ income+Business income+invest income= $3,650$.

(c) Nominal GDP by income=Net domestic income+capital consumption allowance+net indirect taxes= $4,000$.

**Exercise 4.6**

(a) Investment expenditure is $Y-(C+G+NX) = \$2,000-(\$1,700+\$50+\$40) = \$210$.

(b) If exports are \$350 and net exports are \$40 imports are \$310.

(c) Yes. Net exports would be negative if imports exceed exports.

**Exercise 4.7**

(a) Growth in nominal GDP from 2012 to 2013 is 10%.

(b) Real GDP in 2012 was \$721.15. Real GDP in 2013 was \$736.60. Real GDP grew by 2.14%.

(c) Per capita real GDP was \$28.8 thousand in 2012 and \$24.5 thousand in 2013.

(d) The standard of living declined because population grew faster than real GDP.

# Chapter 5 Solutions

**Exercise 5.1**

(a) The AD and AS curves are as shown below.

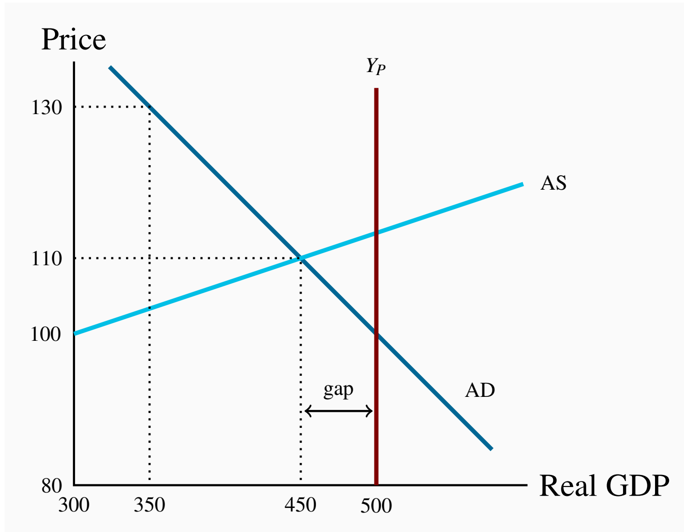
(b) The short-run equilibrium values are $P = 110$, $Y = 450$, where the AD and AS curves intersect.

**Exercise 5.2**

(a) The diagram shows potential output of $Y_P = 500$ added to the diagram.

(b) The diagram shows an output gap. Equilibrium $Y \neq Y_P$.

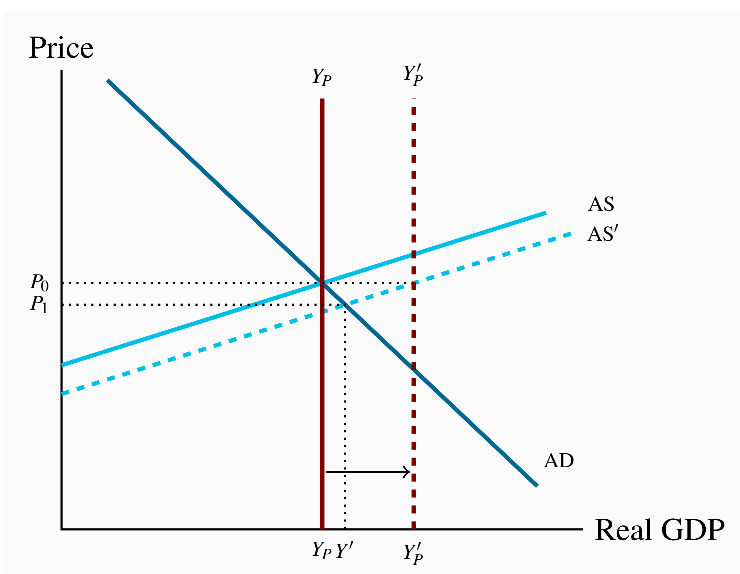
(c) The output gap is $Y - Y_P = (450-500) = -50$.




**Exercise 5.3**

Growth in labour force, or the stock of capital, or improvements in technology that increased the productivity of labour and capital would increase the economy's capacity to produce goods and services and increase potential GDP. As shown in the diagram below, the vertical line measuring potential output would shift to the right. Without an increase in AD a recessionary gap opens. The economy could produce more output at any price level without putting upward pressure on the price level beyond the initial level $P_0$.

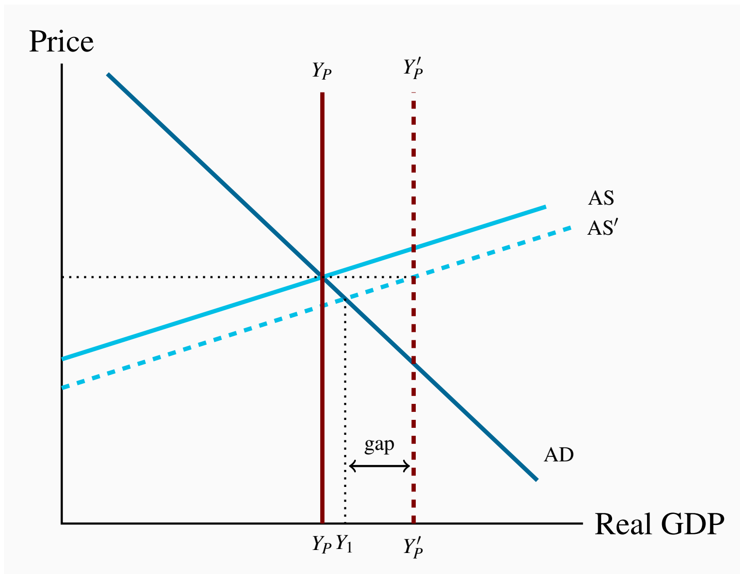
The effect of growth in labour force, or capital stock, or improved technology, is shown:



**Exercise 5.4**

(a) A simple approximation of the annual growth in potential output is the sum of the growth in labour force and labour productivity, namely $1.5\% + 1.0\% = 2.5\%$. However it is more accurate to recognize the compounding effect and multiply $1.015 \times 1.01 = 1.0252$, which gives an annual rate of growth of potential output as $2.52\%$.

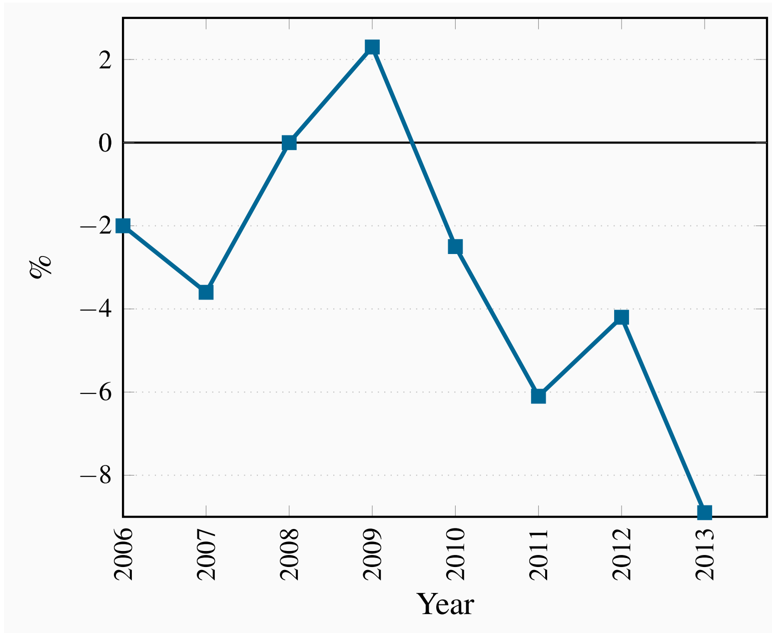
(b) The growth in potential output is illustrated by a rightward shift in the $Y_P$ and AS curves as shown below.




**Exercise 5.5**

Output gaps in a growing economy are calculated as: $\frac{Y - Y_P}{Y_P} \times 100\%$. The data give the following annual gaps:

| **Year** | 2006 | 2007 | 2008 | 2009 | 2010 | 2011 | 2012 | 2013 |
|---|---|---|---|---|---|---|---|---|
| **Gap** | −2.0 | −3.6 | 0 | +2.3 | −2.5 | −6.1 | −4.2 | −8.9 |

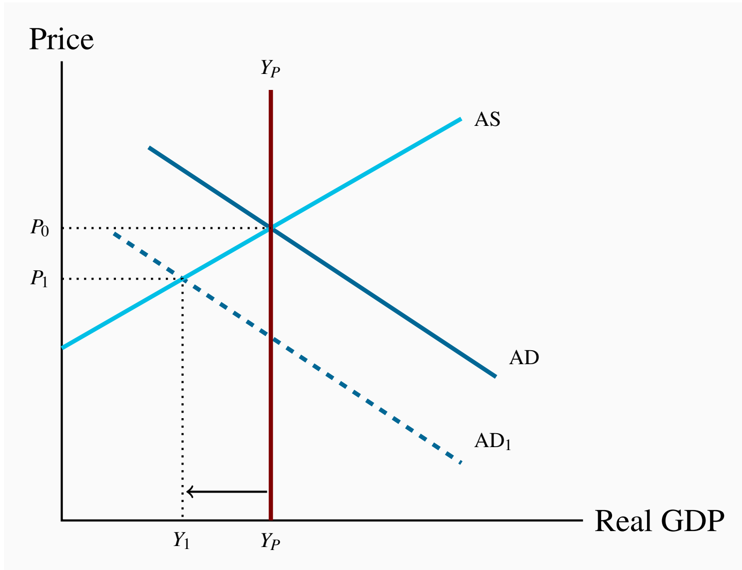



The plot of the output gaps shows the economy in recession in 2006-07, followed by recovery and boom from 2008-09, followed by recession starting in 2010, running into 2011 and then moderating in 2012 before deepening in 2013.

**Exercise 5.6**

(a) A slowdown in growth in Chinese imports from Westland would reduce AD in Westland from AD to $AD_1$ in the diagram. After this fall in demand Westland producers would reduce growth in their output and continue to reduce output reducing $Y$ relative to $Y_P$ as at $Y_1$. The price level would fall as lower of output growth reduced production costs. The economy would move toward a new equilibrium at $P_1Y_1$ in the diagram.

(b) Lower growth in GDP in China would lower growth in employment and raise unemployment rates in Westland if employment growth rates there were lower than labour force growth rates.




**Exercise 5.7**

Short-run equilibrium values for $Y$ and $P$ are found by solving the AD/AS model.

(a) Short-run equilibrium means AD=AS. For the aggregate demand and supply functions given:

$$\begin{aligned} Y &= 2250 - 10 \times (125 + 0.1Y) \\ 2Y &= 2250 - 1250 \\ Y &= 500 \end{aligned}$$

Then substituting $Y = 500$ into the AS function gives:

$$\begin{aligned} P &= 125 + 0.1 \times 500 \\ P &= 175 \end{aligned}$$

Short-run equilibrium values are: $P = 175$, $Y = 500$.

(b) The economy is in short-run equilibrium at potential output. The diagram is shown below.

(c) Higher oil and commodity prices increase production costs and raise the AS curve, changing the equation from:

$$\begin{aligned} \text{AS:} \quad & P = 125 + 0.1Y \;\text{ to} \\ \text{AS}' : \quad & P' = 130 + 0.1Y \end{aligned}$$

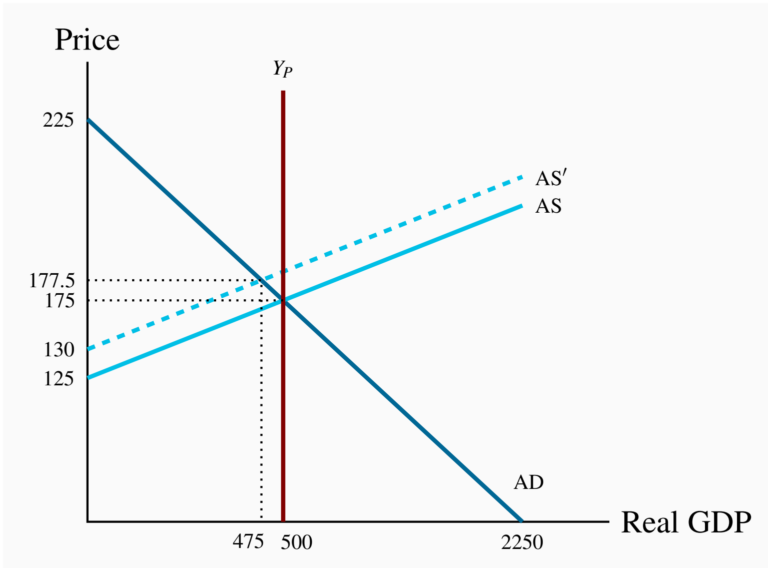
The new equilibrium $Y$ by substituting AS$'$ in AD by:

$$\begin{aligned} Y &= 2250 - 10(130 + 0.1Y) \\ Y &= 2250 - 1300 - Y \\ 2Y &= 950 \\ Y &= 475 \end{aligned}$$

The new equilibrium price level, from AS′:

$$P' = 130 + (0.1 \times 475)$$
$$P' = 177.5$$

(d) The new AS′ curve is shown as a dotted line in the diagram. There is a recessionary gap of 25.




# Chapter 6 Solutions

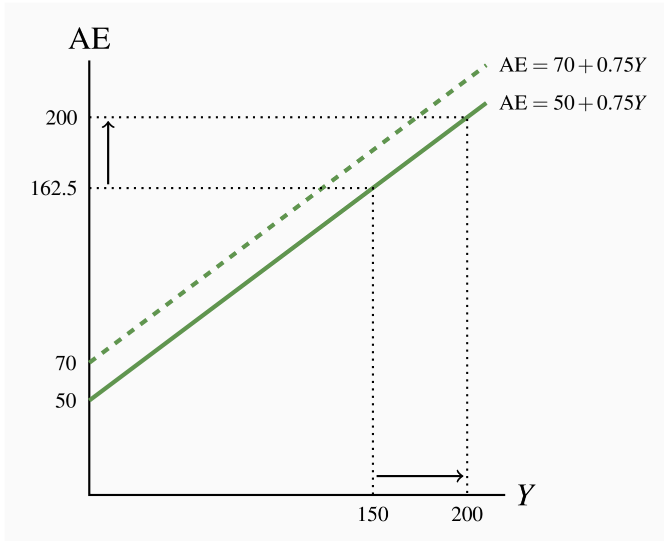
### Exercise 6.1

(a) See the diagram below.

(b) If $Y$ were to increase from 150 to 200 AE would increase by $(0.75 \times 50) = 37.5$ to 200 as shown in the diagram.

(c) Autonomous expenditure is constant at 50 in both (a) and (b) but induced expenditure increase from 112.5 when $Y = 150$ to 150 when $Y = 200$.

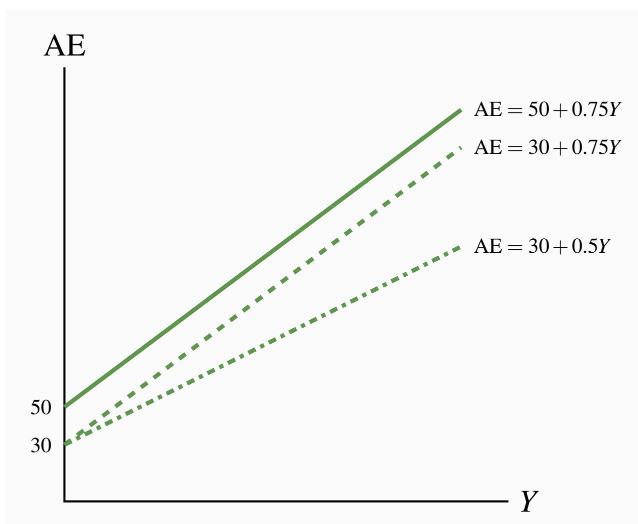
(d) If autonomous expenditure increased by 20 the AE line in the diagram would shift up as shown, with AE higher by 20 at every $Y$. The new AE equation would be $\text{AE} = 70 + 0.75Y$.




**Exercise 6.2**

(a) Initial AE: $\text{AE} = 50 + 0.75Y$. After drop in $A$: $\text{AE}' = 30 + 0.75Y$.

(b) After reduction in induced expenditure $\text{AE}'' = 30 + 0.5Y$ with lower slope $\Delta\text{AE}/\Delta Y = 0.5$.




**Exercise 6.3**

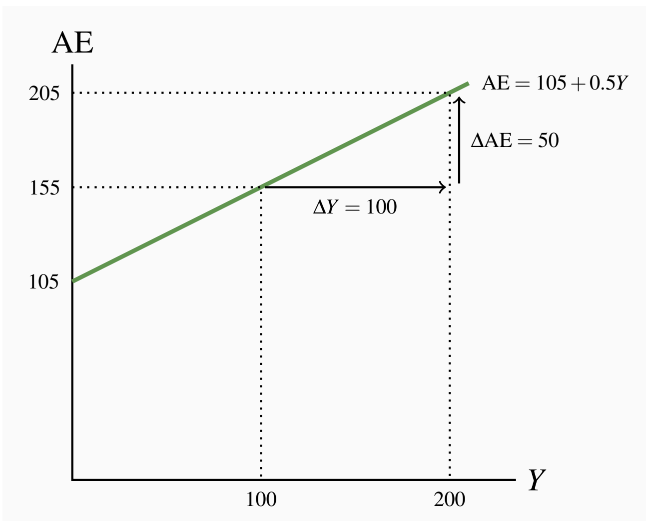
Given $\text{AE} = 105 + 0.5Y$, the table is:

| $Y$ | $A$ | $0.5Y$ | $\text{AE} = 105 + 0.5Y$ |
|---|---|---|---|
| 0 | 105 | 0 | 105 |
| 50 | 105 | 25 | 130 |
| 100 | 105 | 50 | 155 |
| 200 | 105 | 100 | 205 |

(a) In the diagram the intercept on the vertical axis is 105 and the slope of AE is 0.5.

(b) The slope of the AE function is 0.50. It measures the change in AE caused by a change in national income.

(c) The equation for AE is $\text{AE} = 105 + 0.5Y$.



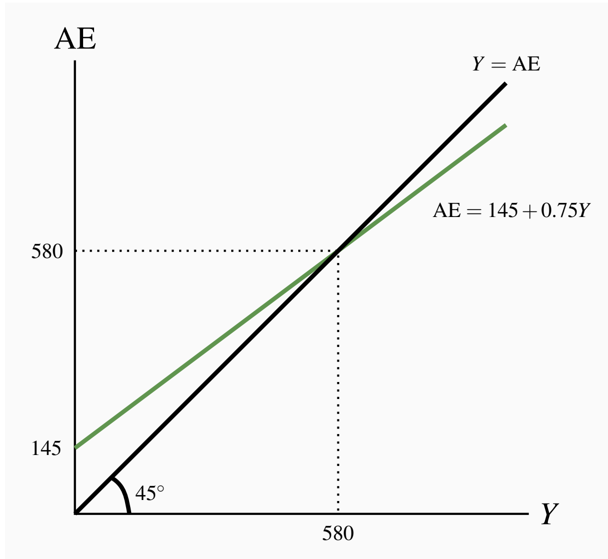

**Exercise 6.4**

(a) The aggregate expenditure function is $\text{AE} = C + I + X - IM$. See the diagram below.

(b) The 45° line is shown in the diagram.

(c) Algebraically, in equilibrium:

$$\begin{aligned} Y &= \text{AE} \\ Y &= 145 + 0.75Y \\ Y - 0.75Y &= 145 \\ 0.25Y &= 145 \\ Y &= 580 \end{aligned}$$




**Exercise 6.5**

(a) If output is OG, planned expenditure would be OB. Planned expenditure would be greater than current output.

(b) At output OG the *unplanned decrease* in inventories is AB.

(c) Business firms will respond by increasing output to meet the strong demand for output.

(d) The equilibrium level of output and expenditure is OH=OD.

(e) If output where at OJ, there would be an *unplanned increase* in inventories in the amount EF.

**Exercise 6.6**

(a) The initial equilibrium would be at $Y =$OG.

(b) If there were a decrease in induced expenditure, the slope of the AE function would decrease by a corresponding amount and the new AE function would be AJ.

(c) The new equilibrium, based on the AE function AJ, would be $Y =$OF.

(d) If induced expenditure increased the new AE function would be AL and the new equilibrium would be $Y =$OH.

**Exercise 6.7**

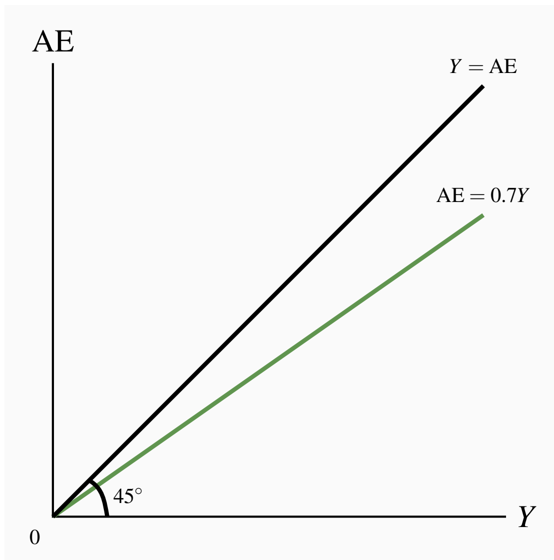
(a) When autonomous expenditure $A = 0$, induced expenditure $(c - m) = 0.7$ the AE function is:

$$\text{AE} = (c - m)Y$$
$$\text{AE} = 0.7Y$$

(b) A diagram to illustrate this AE is shown below.

(c) The equilibrium level of real GDP is $Y = 0$.

(d) The equilibrium $Y = 0$ because expenditure is not sufficient, does not provide sufficient revenues, to cover the costs of production at any positive level of real GDP.




**Exercise 6.8**

(a) The slope of the AE function is 0.6. This means the multiplier, the size of the change in equilibrium income as a result of a change in autonomous expenditure is $[1/(1 - \text{slope of AE})] = [1/(1 - 0.6)] = 2.5$. Then an increase in planned investment by 10 would increase equilibrium $Y$ by $10 \times 2.5 = 25$.

(b) An increase in real GDP by 25 as a result of an increase in autonomous expenditure by 10 means induced expenditure has increased by 15.

(c) If the slope of AE were 0.8 the multiplier would be $[1/(1 - 0.8)] = 5$ and an increase in investment by 10 would increase equilibrium real GDP by $10 \times 5 = 50$. Induced expenditure would increase by 40. The larger is induced expenditure the steeper is the slope to AE and the larger the multiplier.

**Exercise 6.9**

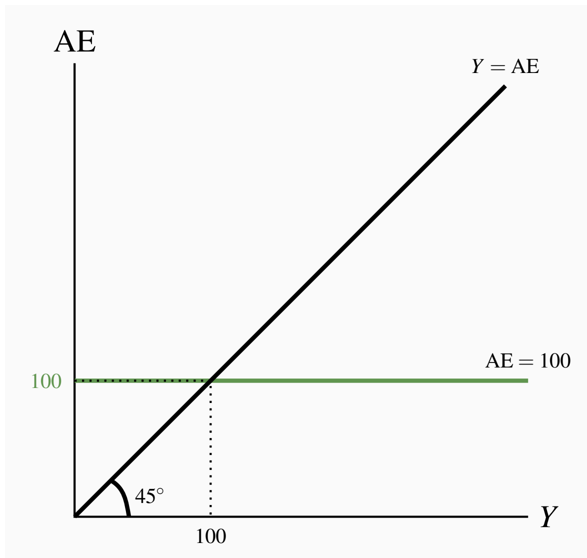
(a) The AE function would be $\text{AE} = 100$.

(b) In the diagram AE would be a horizontal line at 100.

(c) The equilibrium level of $Y = \text{AE} = 100$.

(d) If autonomous expenditure increased by 25 to 125 equilibrium in come would increase by 25.

(e) The multiplier $[1/(1 - \text{slope of AE})] = 1/1 = 1$. The slope of AE $= 0$. There is no induced expenditure to change equilibrium income by more than a change in autonomous expenditure.




# CHAPTER 7 SOLUTIONS

**Exercise 7.1**

Before government is established autonomous expenditure is 200 and induced expenditure is $0.6Y$ and the aggregate expenditure function is:

$$\text{AE} = 200 + 0.6Y$$

Then for equilibrium:

$$\begin{aligned} Y &= \text{AE} \\ Y &= 200 + 0.6Y \\ Y_0 &= \frac{200}{1 - 0.6} = 500 \end{aligned}$$

After government is established and $G = 100$: $\text{AE} = 300 + 0.6Y$. Equilibrium $Y = Y_1 = 750$.

**Exercise 7.2**

(a) The slope of AE in Exercise 7.1 is 0.6. The slope of AE in Exercise 7.2 is:

$$c(1-t)-m = 0.75(1-0.1)-0.15 = 0.675-0.15 = 0.525$$

(b) The multiplier in Exercise 7.1 is 2.5. The multiplier in Exercise 7.2 is 2.11.

(c) With a tax rate $t = 0.1$ disposable income would be $Y_d = 0.9Y$ giving AE $= 300+0.525Y$ and equilibrium $Y = 632$, compared to the equilibrium of 750 in Exercise 7.1.

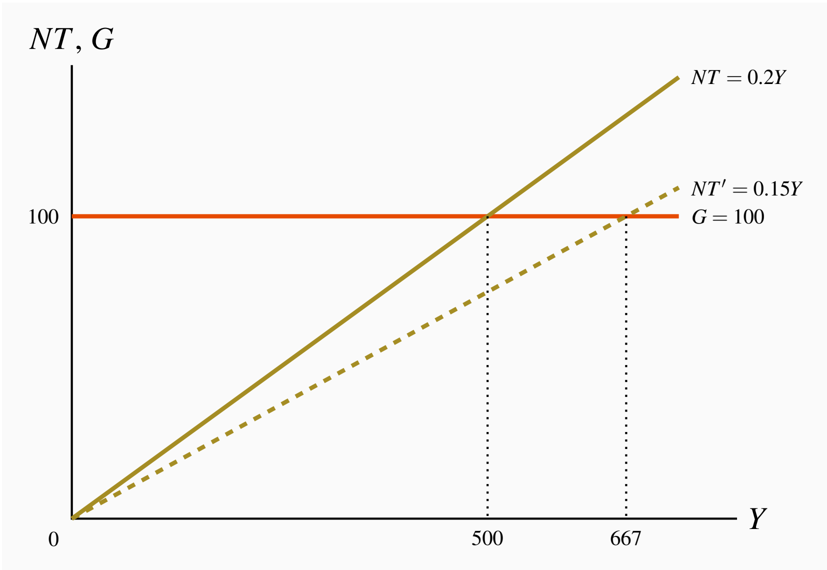
**Exercise 7.3**

(a) The table values are as follows:

| $Y$ | $NT = tY$ | $G$ | $BB = NT - G$ |
|---|---|---|---|
| 100 | 20 | 100 | −80 |
| 200 | 40 | 100 | −60 |
| 300 | 60 | 100 | −40 |
| 400 | 80 | 100 | −20 |
| 500 | 100 | 100 | 0 |
| 600 | 120 | 100 | +20 |
| 700 | 140 | 100 | +40 |

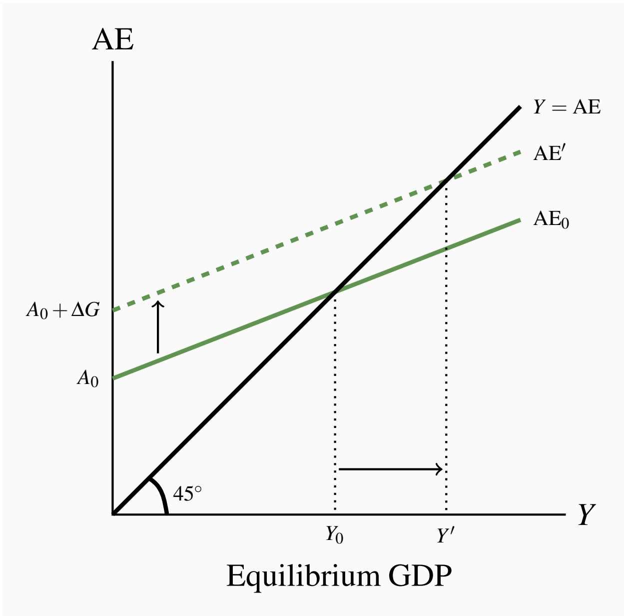
(b) The $NT$ function has an intercept of 0 because there is no autonomous tax revenue, and a slope of 0.2. The $G$ function has a vertical intercept at 100 and zero slope because $G$ is autonomous. See the diagram below.

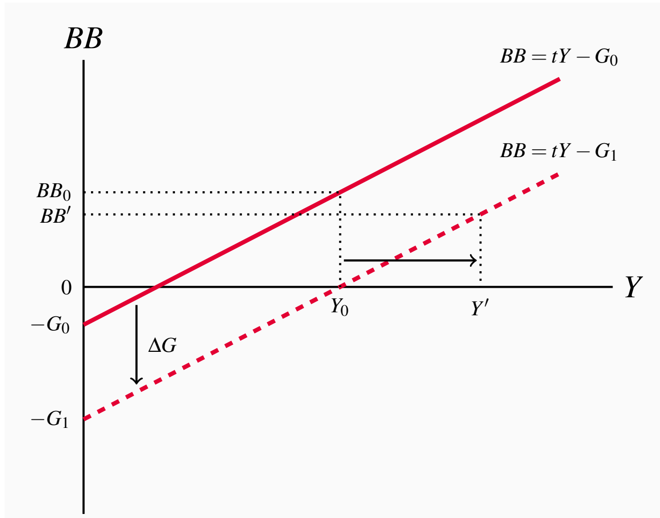
(c) A cut in the net tax rate from $t = 0.20$ to $t = 0.15$ reduces tax revenue proportionately at every level of $Y$ as shown by the lower slope on the tax function $NT'$ in the diagram. The budget balance $NT - G$ is correspondingly lower at every $Y$.




**Exercise 7.4**

Before the increase in $G$, equilibrium is $Y = Y_0$ and the government's budget balance is $BB_0$. The increase in $G$ shifts AE up and the $BB$ function down. The increase in $Y$ combined with the new budget function $BB = tY - G_1$ give a new budget balance $BB'$, smaller than the initial balance, but not reduced by the full amount of the increase in $G$ because the expansionary effect of increased $G$ raised $Y$ and tax revenue.





Government budget function

**Exercise 7.5**

(a) The slope of AE is the change in $C$ minus the change in $IM$ caused by a change in real income $Y$.

$$\text{AE}/\Delta Y = MPC \times (1-t) - m = (0.8 \times 0.75) - 0.15 = 0.45$$

and the multiplier $\Delta Y/\Delta A = [1/(1-0.45)] = 1.82$.

(b) Autonomous expenditure is $300+400 = 700$. Equilibrium real GDP is autonomous expenditure times the multiplier:

$$Y = 700 \times 1.82 = 1,274$$

With equilibrium income 1,274 the government budget balance, $BB$, is:

$$\begin{aligned} BB &= tY - G \\ &= 0.25 \times 1,274 - 400 \\ &= 318.5 - 400 \\ &= -81.5 \end{aligned}$$

(c) An increase in $G$ by 100 will increase equilibrium $Y$ by 182 and raise tax revenue by 45.5 increasing the government budget deficit to $BB = -136$.

**Exercise 7.6**

(a) With $Y = 750$ and $Y_P = 850$ there is a recessionary gap$= Y - Y_P = -100$.

(b) If the $MPC = 0.75$, $MPM = 0.10$ and $t = 0.20$ the slope of $\text{AE} = 0.75(1-0.20) - 0.1 = 0.5$, and the multiplier is:

$$\frac{1}{1-0.5} = 2.0$$

To increase equilibrium income by 100 requires an increase in $G$ by $100/2 = 50$.

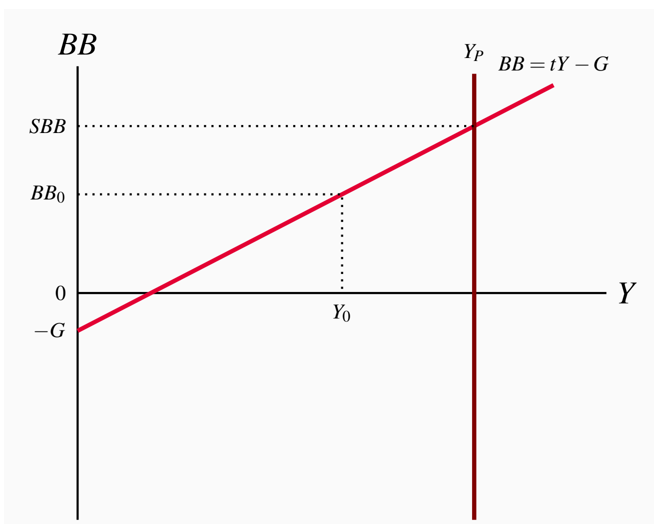
(c) With the initial tax rate $t = 0.20$, the $MPC = 0.75$ and $MPM = 0.10$ and $Y = 750$, total autonomous was $750/2 = 375$. The new tax rate needed for equilibrium $Y = 850$ and $A_0 = 375$ must give a multiplier of $850/375 = 2.267$.
Then $\frac{1}{1-0.75(1-t_1)+0.10} = 2.267$, and solving for $t_1$ gives $t_1 = 0.121$. As an alternative to increasing $G$ by 50 to eliminate the GDP gap, the government could cut the net tax rate by $0.20 - 0.121 = 0.079$ or close to 40%.

### Exercise 7.7

(a) The vertical intercept of $BB$ is $-G$ and the slope of $BB$ is the net tax rate $t$. See the diagram below.

(b) The structural budget balance is shown at $SBB$, the budget balance at $Y_P$. If the economy has a recessionary gap as at $Y_0$ the actual budget balance is $BB_0$.

(c) Automatic stabilization comes from the slope of the budget function. Changes in $Y$ move the economy along the budget function, causing pro-cyclical changes in the actual budget balance but do not change the structural balance. Discretionary fiscal policy changes $t$, or $G$ or both $t$ and $G$. The result is a new budget function and a new structural budget balance.




### Exercise 7.8

(a) With initial equilibrium $Y = 1,274 = (700 \times 1.82)$ and the government's budget balance $(NT - G) = (318.5 - 400) = -81.5$.

(b) If public debt is 500 the debt/GDP ratio is $500/1274 = 0.392$ or 39.2%.

(c) After an increase in government expenditure $\Delta G = 100$, equilibrium $Y = 1,456$ i.e. $(800 \times 1.82)$ and the new budget balance is $(0.25 \times 1,456) - 500 = -136$, an increase in the deficit by 54.5.

(d) In the new equilibrium the government's outstanding public debt is 636 and the debt ratio is $636/1456 = 0.437$ or 43.7%.

The deficit of 81.5 prior to the increase in $G$ would have increased the public debt to 581.5 with no change in equilibrium income and the debt ratio to $581.5/1,274 = 0.456$ or 45.6%. The increase in $G$ by 100 increased equilibrium income by 182, tax revenue by $182 \times 0.25 = 45.5$, the deficit by $(100 - 45.5) = 55.5$, raising the public debt from 581.5 to 637. As a result, expansionary effect of the increased government expenditure resulted in a debt ratio of $637/1456 = 43.7\%$. This is lower than the 45.6% debt ratio that would have occurred with no increase in fiscal expansion.

# Chapter 8 Solutions

### Exercise 8.1

Money is anything generally accepted as a means of payment, a store of wealth and a unit of account.

In Canada today, Bank of Canada notes, coins and bank deposits are money.

The money supply is the sum of notes and coin in circulation outside the banking system, and bank deposits.

A debit card is money because, like a cheque, it transfers bank deposits from the bank account of the payer to the bank account of the payee. There is no payment further financial obligation. Using a credit card to make a payment creates a credit card debt for the payer that must be settled by a money payment – notes or bank deposits.

### Exercise 8.2

A central bank, like the Bank of Canada works to control money and financial conditions in the economy using its position as monopoly supplier of monetary base – bank reserve assets. It is not profit oriented. It does not attempt to make a profit.

A commercial bank works to earn a profit for its owners (shareholders) by providing banking services to the non-bank public on terms that generate net interest income. It is profit oriented.

### Exercise 8.3

Banks create money by issuing their own deposit liabilities (IOUs) in payment for the assets they buy, such as financial securities and customer loan contracts.

Suppose banks operate to a 5% reserve ratio. $rr = 0.05$.

The following balance sheets show the initial new deposit and the deposit creation that follows.

(a) The new deposit provides the banks with a 100 increase in cash (reserve asset) in exchange for 100 in new deposit liabilities.

(b) In part (a) banks hold \$95 excess reserves based on the reserve ratio of 5%. In part (b) they make loans equal to their excess reserves \$95, and pay for those loans by creating new deposit liabilities, \$95.

(c) Assuming the public uses bank deposits as money and does not withdraw cash from the banking system, the banks expand their lending and create new deposits to a total of $+1,900$, based on the initial increase in cash reserves and the reserve ratio of 5%. The deposit multiplier is: $\Delta D = \Delta R/rr = 100/0.05 = 2,000$.

**Table for part (a):**

| All banks | | | |
|---|---|---|---|
| Assets | | Liabilities | |
| Cash | +100 | Deposits | +100 |

(excess reserves +95)

**Table for part (b):**

| Assets | | Liabilities | |
|---|---|---|---|
| Loans | +95 | Deposits | +95 |

**Table for part (c):**

| Assets | | Liabilities | |
|---|---|---|---|
| Cash | +100 | Deposits | +2,000 |
| Loans | +1,900 | | |
| | +2,000 | | |

**Exercise 8.4**

If banks have a reserve ratio of $rr = 10\%$ a new cash deposit of $1,000 to the banking system would allow an expansion of bank deposits by:

$$\Delta D = \Delta MB \times [1/(rr)]$$
$$\Delta D = 1,000 \times [1/(0.10)]$$
$$\Delta D = 10,000$$

Deposit expansion beyond the initial $1,000 would be the result of a $9,000 increase in bank lending.

Yes. If the banks could encourage the public to hold less cash the banks have a larger share of the monetary base. These larger reserves would support more bank lending and deposit creation.

**Exercise 8.5**

Confidence in the banking system is based partly on the established reputations of banks in converting deposits into cash and the general acceptability of bank deposits as means of payment. This confidence is reinforced by the insurance coverage on deposits up to $100,000 provided by CDIC.

**Exercise 8.6**

The money multiplier is defined as the change in money supply that results from a change in monetary base, or $\Delta M_S/\Delta MB$. For example, a monetary base of 1,100, of which the public holds 100 in cash and a reserve ratio of $rr = 0.10$, the money supply function is:

$$M_S = \left(\frac{1}{rr} \times MB - 100\right) + 100 = \left(\frac{1}{0.10} \times 1,000\right) + 100 = 10,100$$

If the monetary base decreased by 100, money supply would decrease by:

$$\Delta M_S = \frac{1}{rr} \times \Delta MB = \frac{1}{0.10} \times (-100) = -1,000$$

In this example the money multiplier is: $\Delta M_S/\Delta MB = (-1,000)/(-100) = 10 = 1/rr$.

**Exercise 8.7**

The financial crisis made both banks and the non-bank public more concerned about the risks attached to making loans and to holding bank deposits. The banks responded by increasing their reserve ratios and by being more selective about the quality of loans and other assets they bought. Even if total bank assets were not reduced overall some forms of bank credit did dry up and some potential borrowers are denied credit.

Concerns about the stability of banks and other financial institutions led the non-bank public to hold more of their money in cash rather than deposits. If the share of the monetary base held by the public as cash is increased and the banking system's lending capacity is reduced.

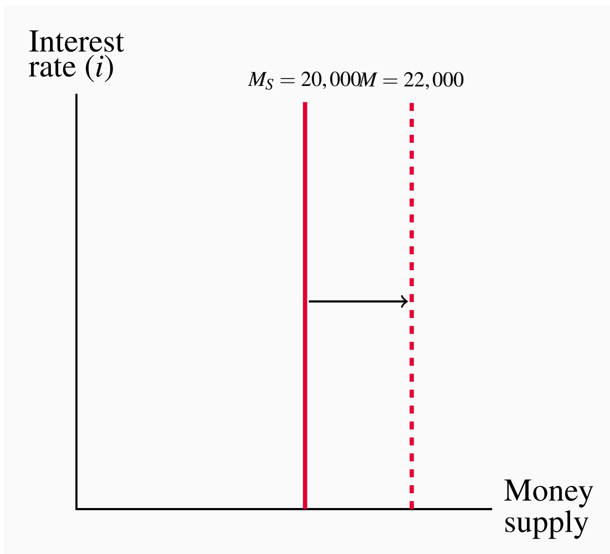
The effects of increased reserve ratios are smaller deposit multipliers. Higher public cash holdings reduce bank reserves, reduce bank lending and reduce money supply in the absence of an offsetting increase in the monetary base.

**Exercise 8.8**

With monetary base $MB = \$1,000$, $rr = 0.05$ and assuming no cash held by the public the money supply would be:

$$M_S = 1,000 \times \left(\frac{1}{0.05}\right) = 1,000 \times 20 = 20,000$$

This money supply is shown by the vertical line $M_S$ in the diagram. Changes in interest rates do not affect the size of the money supply in our simple examples.




If the monetary base were to increase by 10 percent to 1,100 the money supply would be increased by $(100 \times (1/0.05) = 2,000$ to 22,000. The money supply function in the diagram is shifted to the right to show this effect.

## Chapter 9 Solutions

**Exercise 9.1**

A perpetual bond with a 3% coupon would have a market price of \$100 if the current market rate were 3%. (Yield = coupon/ price. Price = coupon/yield = \$3.00/0.03 = \$100)

If current market rates fell to 2.5% you would be pleased. The price of your 3% perpetual bond would be $\$3.00/0.025 = \$120$. You would have a 20% capital gain if you sold your bond.

**Exercise 9.2**

(a) The market price of the bond is the present value of the future stream of payments it provides. A two-year 5% bond, when market rates are 5% has a present value of:

$$P_B = PV = \frac{\$5}{1.05} + \frac{\$105}{1.05^2} = \$4.76 + \$95.24 = \$100$$

(b) If market rates rise to 6%, then the market price of the two-year 5% bond will be:

$$P_B = PV = \frac{\$5}{1.06} + \frac{\$105}{1.06^2} = \$4.72 + \$93.45 = \$98.17$$

A rise in market interest rates reduces the prices of outstanding bonds.

(c) The market risk in holding bonds is that bond prices and interest rates vary inversely. A rise in market interest rates means a fall in bond prices and capital losses for bond holders, at least on paper. A fall in market rate means a rise in bond prices.

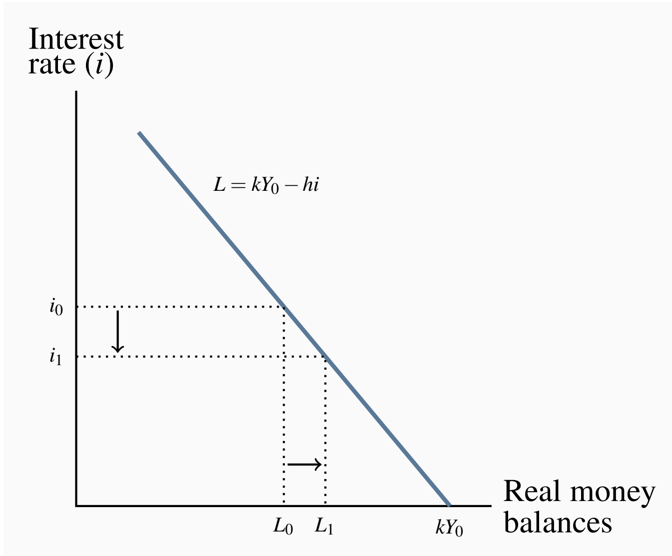
**Exercise 9.3**

(a) The horizontal intercept in the diagram (below) shows the money balances people would want to hold, based on their income ($Y_0$) if the interest rate, and thus the opportunity cost of holding money were zero. The slope of the line shows how portfolio managers would adjust their holdings of money (vs bonds) if interest rates were to change.

(b) At the interest rate $i_0$ the demand for money balances is $L_0$. Some money balances are held to make regular payments, some to provide for uncertainty in the timing of receipts and payments, and some to lower the risks in portfolios of bonds and money.

(c) If interest rates dropped from $i_0$ to $i_1$ in the diagram, the people's demand for money balances would increase from $L_0$ to $L_1$. Lower interest rates mean lower opportunity costs to holding money balances.
A fall in interest rates increases the demand for money balances and reduces the demand for bonds. Portfolios shift from bonds to money.

(d) An increase in real GDP ($\Delta Y > 0$) would shift the demand for money function to the right by the amount $k\Delta Y$. Higher $Y$ means higher income and expenditure levels and a need for larger transaction balances to make payments.




**Exercise 9.4**

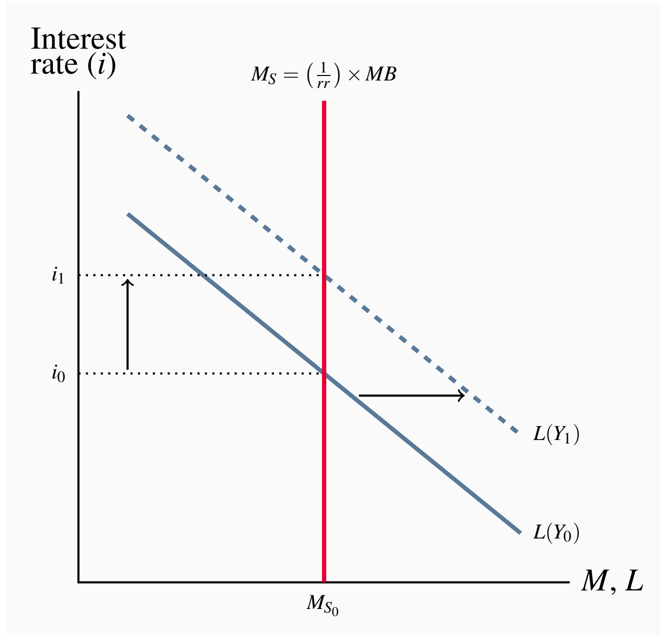
If US interest rates rose the Canadian dollar price of a $US would rise. A rise in US interest rates relative to Canadian rates increases the returns to holding US$ bonds relative to Cdn$ bonds. Portfolio managers would demand more US$ in order to increase holdings to US$ bonds relative to Canadian bonds. Increased demand for US$ raises the Cdn$ price of the US$ to more than $1.25Cdn. The Canadian dollar depreciates.

**Exercise 9.5**

(a) In the diagram the $M_S$ line is vertical. $M_S$ is not affected by interest rates. The monetary base and the money multiplier determine the position of the $M_S$ line. The position of the demand for money function $L$ is determined by the level of real income $Y_0$, and the transactions demand $kY_0$. The slope of the $L$ function illustrates the reaction of portfolio managers, changing the mix of money and bonds in portfolios in response to changes in interest rates. Higher interest rates reduce the demand for money balances and increase the demand for bonds.

(b) An increase in income to $Y_1$ shifts the demand for money function $L$ to the right to $L(Y_1)$. The excess demand for money balances at the initial interest rate $i_0$ results in the sale of bonds, bond prices fall and yields increase until interest rates rise to $i_1$.

(c) With higher $Y$ and higher demand for money the new equilibrium interest rate is higher but money holdings are unchanged because the money supply is fixed.

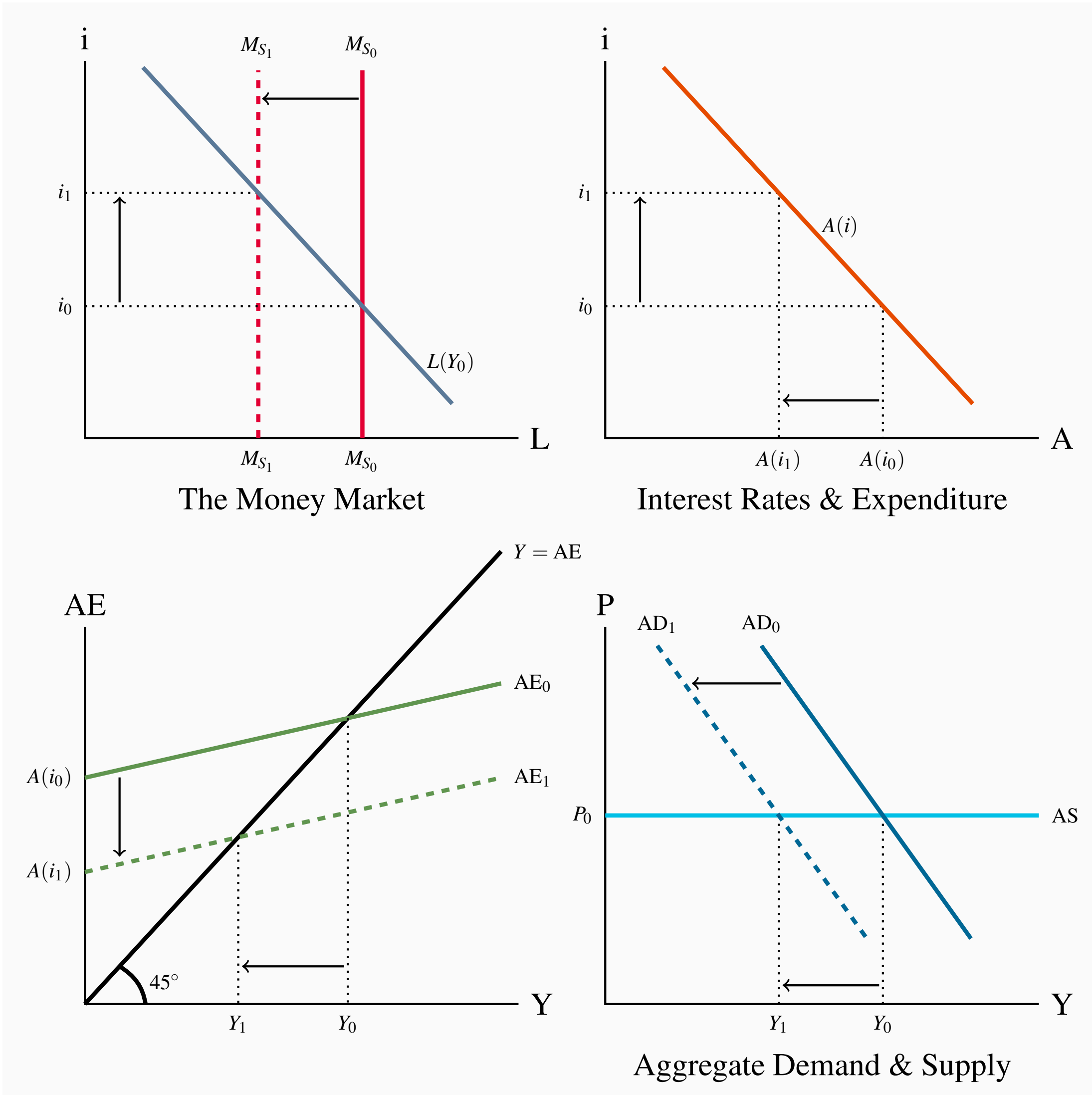



**Exercise 9.6**

(a) A reduction in $M_S$ shifts the $M_S$ line to the left, raising interest rates and lowering expenditure to $A(i_1)$. AD shifts to the left by the change in $A$ times the multiplier to $\text{AD}_1$ and $Y$ is reduced to $Y_1$.

(b) Alternatively, an increase in precautionary demand for money would shift the demand for money $(L)$ to the right, raising interest rates and lowering expenditure and aggregate demand and equilibrium $Y$.

(c) Alternatively, any increase in autonomous expenditure would shift the aggregate expenditure function up, the AD function to the right and higher $Y$ would increase the demand for money balances $L$. As a result interest rates would rise offsetting some of the increase in investment expenditure (moving along the $A(i)$ function) and shifting AD back to the left. The net result would be a increase in investment, interest rates and equilibrium $Y$.




# Chapter 10 Solutions

### Exercise 10.1

A central bank that operated to make maximum profits would cause financial market instability by expanding the monetary base through its purchase of interest bearing government bonds until the yields on those bonds were driven to (approximately) zero.

A commercial bank pursues profits as long as the costs of raising funds through deposit expansion are less than the interest revenue earned by expanding its lending. The bank's shareholders expect a positive return on their equity in the business. Competition among banks and the public's concern about the solvency of a bank means the costs of funds rises as the bank expands, thereby eliminating the profitability of further expansion.

Currently, the central bank's operating objective is to control the rate of inflation based on an agreed target inflation rate of 2%.

The central bank's unique position as monopoly supplier of the monetary base, cash and central bank deposits, gives it the power to pursue its monetary policy objectives.

**Exercise 10.2**

Monetary base, central bank notes (cash) and deposits, are the ultimate means of payment in the economy. Commercial banks issue deposits that are convertible into cash on demand. This convertibility together with the public's demand for cash balances creates a demand for monetary base that limits the size of commercial bank deposit liabilities. The central bank's control of the monetary base gives it control of the money supply and interest rates.

**Exercise 10.3**

A change in monetary base is by itself a direct change in the money supply. But the profit seeking behaviour of the commercial banks causes a larger change in the money supply as a result of $\Delta MB$. If $\Delta MB > 0$, for example, and the public deposits these new funds in the banks, the banks find they are holding excess reserves. These reserves support an increase in bank lending and the deposit creation that goes with it. The money supply increases based on the money supply multiplier provided the currency and reserve ratios are constant.

(a) The purchase of \$10 million in the open market by the central bank creates \$10 million in monetary base, which increase the reserves of the commercial banks, provided it is not held as cash by the non-bank public.

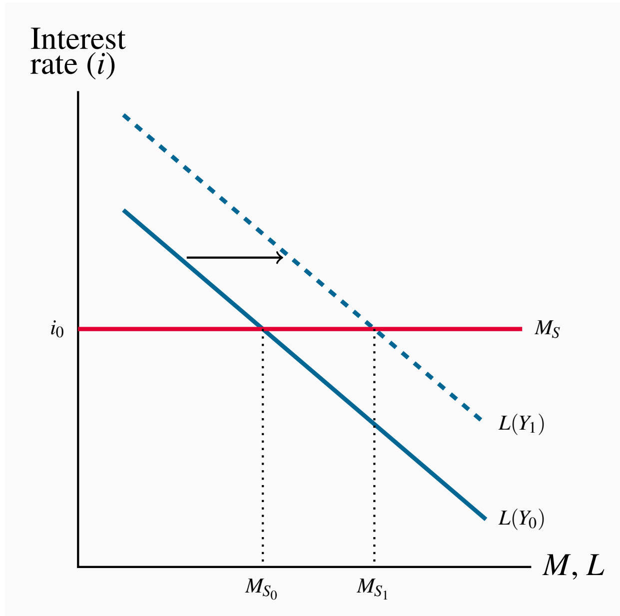
(b) With a reserve ratio $rr = 0.025$ a \$10 million increase in monetary base results in:
   i. An increase in money supply of \$400 million. The money supply multiplier is $[(1/0.025) = 40]$
   ii. An increase in bank reserve balances of \$10 million, the full amount of the increase in the monetary base because the public does not increase cash holdings.

**Exercise 10.4**

To set and maintain interest rate at $i_0$ in the diagram the central bank provides whatever money supply is demanded at that interest rate. This is shown in the diagram by the horizontal $M_S$ line at $i_0$.

An increase in real output from $Y_0$ to $Y_1$ would increase the demand for money, shifting the $L(Y)$

line in the diagram to the right to $L(Y_1)$. The money supply would increase to $M_{S1}$ to meet the increased demand for money at the interest rate $i_0$.




**Exercise 10.5**

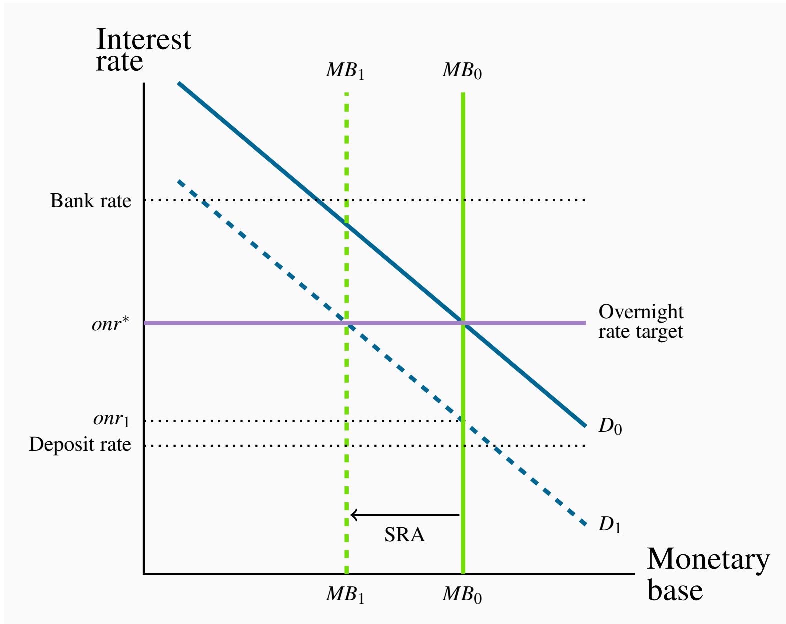
(a) The Bank of Canada's monetary policy target is an inflation control target of 2% in the CPI within a range of 1%-3%. The Bank aims at a 2% inflation rate over six to eight quarters.

(b) The Bank uses the overnight interest rate as its monetary policy instrument to influence short-term interest rates by raising or lowering the target and operating band it sets for the overnight rate.

(c) Implementing monetary policy by setting the interest rate means the Bank gives up its short-term control of the money supply.

**Exercise 10.6**

The market for overnight funds:




The Bank has set its target for the overnight rate at onr* consistent with a demand for monetary base $D_0$. If it happens that the demand for monetary base is less than $D_0$, for example $D_1$, the ONR will fall below the Bank's target. To prevent this the Bank can remove some monetary base from the overnight market by selling short term securities to the banks on the agreement that it will buy those securities back the next day. This is a 'sale and repurchase agreement', and SRA. Its effect is to reduce the monetary base, as illustrated by the shift to $MB_1$, and maintain onr* as shown by the intersection of $D_1$ and $MB_1$.

The Bank uses an SRA rather than an open market operation because an SRA makes an immediate change in the clearing balance position of the banks that last for one day. It is a very short-term adjustment. An open market operation takes time to affect the clearing balance position of the banks as it works its way through bond markets and bank customer accounts to clearing balances. It is better suited to longer term management of the monetary base rather than very short term and likely temporary adjustments to bank clearing balances.

**Exercise 10.7**

(a) The central bank chooses and sets the interest rate it thinks will be consistent with equilibrium at potential output at its target rate of inflation.

(b) A rise in the unemployment rate would indicate a fall in aggregate demand and call for a decrease in the Bank's interest rate from its basic setting.

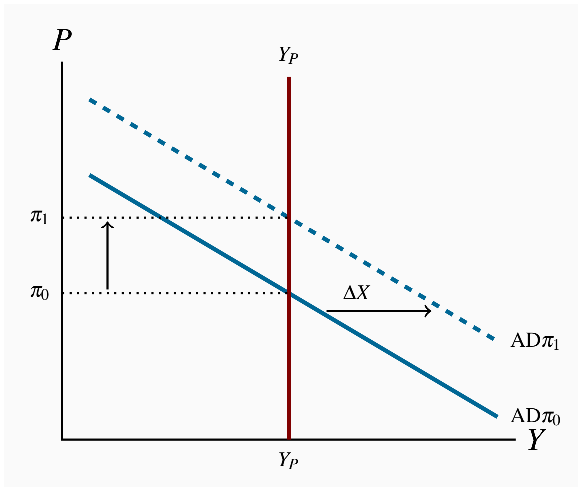
(c) An inflation rate above the Bank's target would indicate stronger than expected aggregate demand and call for a rise in the Bank's interest rate from its basic setting.

(d) A persistent change in either unemployment or inflation would lead the Bank to change its basic interest rate setting.

# Chapter 11 Solutions

### Exercise 11.1

The equilibrium inflation rate is determined by AD and $Y_P$ at the expected inflation $\pi^e$. An increase in export demand would shift AD to the right and raise the equilibrium inflation rate.



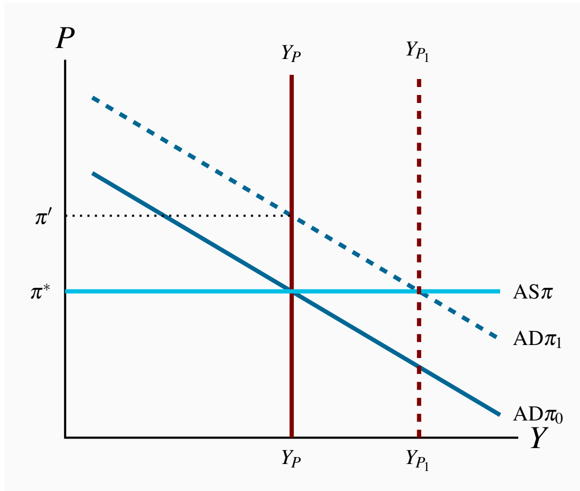

If the central bank reacted to defend its inflation target as $\pi_0$, it would raise its interest rate and money supply growth would decrease to shift AD back from $AD_1$ to $AD_0$.

### Exercise 11.2

If the central bank reacted to defend its inflation target as $\pi_0$, it would raise its interest rate and money supply growth would decrease to shift AD back from $AD_1$ to $AD_0$.

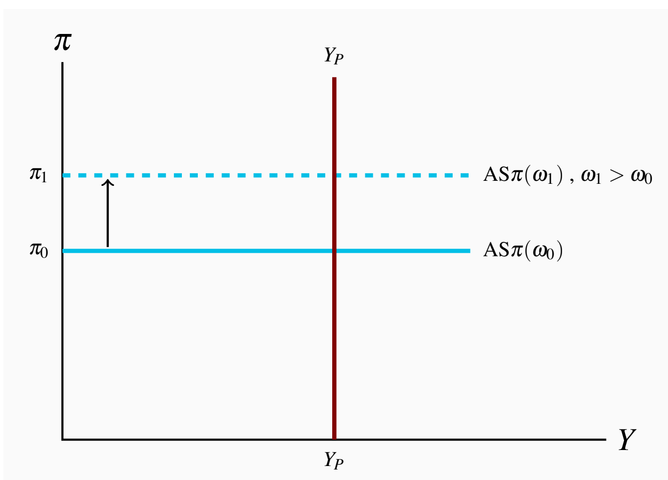
### Exercise 11.3

Increased investment shifts AD$\pi$ to AD$\pi_1$, increase real GDP and will put upward pressure on the inflation rate. However, as the new capital stock and technology comes on stream $Y_P$ grows to $Y_{P1}$, offsetting the initial inflationary gap. The final result is a higher level of real GDP at $Y_{P1}$ with inflation at the initial level $\pi^*$, the central bank's target.



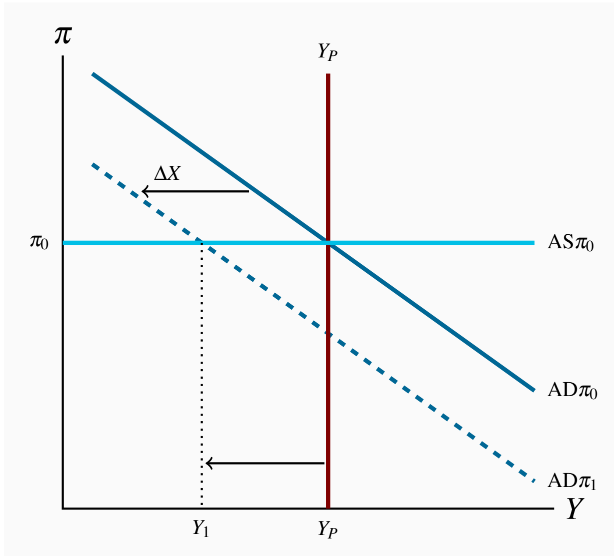

**Exercise 11.4**

A higher rate of increase in wages shifts AS up as the rate of increase in real costs of production rises at each level of output.

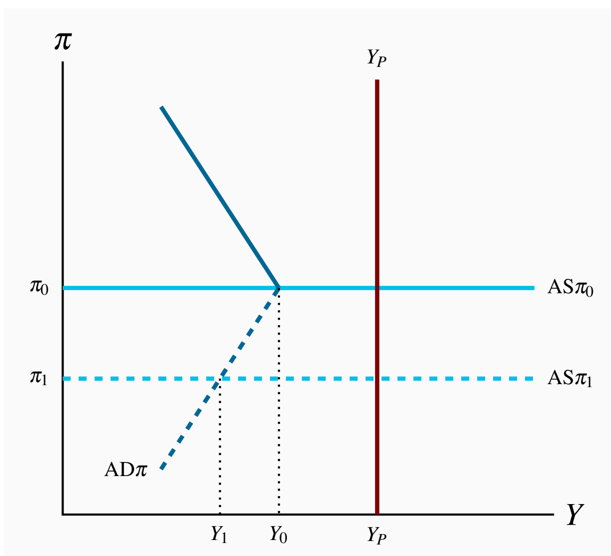



**Exercise 11.5**

The economy is initially in equilibrium at $Y_P$ and $\pi_0$. A fall in exports shift AD$\pi$ left to AD$\pi_1$, opening a recessionary gap $Y_1 - Y_P$ . The inflation rate is not changed in the short run but will decline over time if the recessionary gap persists.



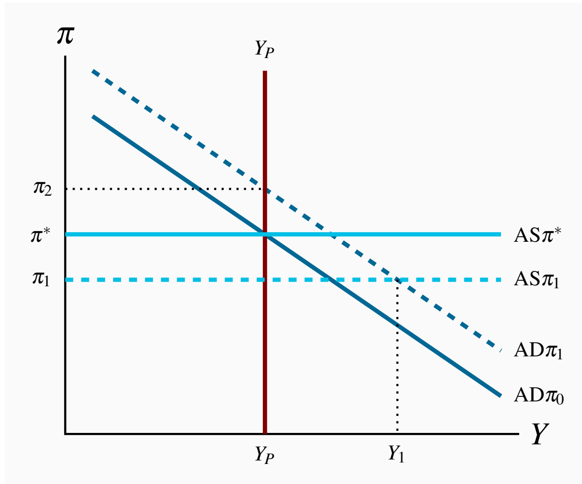

**Exercise 11.6**




With the economy at $Y_0$ and the central bank having reduced its policy rate to the lower bound to fight the persistent recessionary gap, the AD$\pi$ curve has a positive slope at any inflation rate less than $\pi_0$. Any fall in the inflation rate from $\pi_0$ raises the real interest rate $(i - \pi)$ because the bank cannot counter with a lower nominal interest rate. Higher real rates reduce expenditures and output.

Furthermore, cuts in the rate of increase in money wage rates or any other cost reductions that lower the inflation rate that shift AS$\pi$ down, will increase rather than reduce the recessionary gap: e.g. $Y_1 - Y_P$ in the diagram.

**Exercise 11.7**




In the diagram the economy is at $\pi^* Y_P$ before the tax cut. Cutting the GST lowers AS$\pi$ to AS$\pi_1$ and shifts AD to AD$\pi_1$. The result is an initial fall in the inflation rate and an inflationary gap $Y_1 - Y_P$. However, AD$\pi_1$ is too strong for long run equilibrium at the Bank's target inflation rate $\pi^*$. The Bank reacts by raising its policy interest rate to reduce AD$\pi$ to its initial value. When equilibrium is restored at $\pi^*$,$Y_P$ households and businesses enjoy lower rates of GST on expenditures but higher interest rates on debt.

**Exercise 11.8**

The public debt is the total dollar value of government bonds outstanding. That total is the cumulative sum of federal government budget balances in Canada since Confederation in 1867. The public debt would increase in any year the government budget was in deficit or decrease in any year in which there was a budget surplus.

$$\Delta PD = -PBB + iPD$$

**Exercise 11.9**

Given that, $\Delta PD/Y = -(PBB/Y) + (iPD/Y) - (\Delta Y/Y)(PD/Y)$ and neither $i$ or $\Delta Y/Y$ is a policy instrument, the size of the primary budget balance relative to $Y$ required for $\Delta PD/Y = 0$ is:

$$0 = -(PBB/Y) + (i - \Delta Y/Y) \times (PD/Y)$$
$$PBB/Y = (i - \Delta Y/Y) \times (PD/Y)$$

If the interest rate on the public debt ($i$) is greater than the rate of growth in nominal GDP ($\Delta Y/Y$) a primary budget surplus $(PBB/Y) > 0$ is required to stabilize the debt ratio. Alternatively, if the rate growth of nominal GDP ($\Delta Y/Y$) is greater than the interest rate on the public debt ($i$), the primary budget deficit may not increase the debt ratio.

**Exercise 11.10**

A surplus in the $PBB/Y$ reduces AD$\pi$ and reduces rate of growth of nominal GDP, $\Delta Y/Y$. The fiscal austerity coming from the primary budget surplus may lower $\Delta Y/Y$ relative to $i$ to an extent that the debt ratio rises despite the budget surplus. This has been the recent experience of several European countries.

Because the debt ratio is the ratio of debt to income its evolution is driven by differences between the growth in the debt (the numerator) relative to growth in nominal GDP (the denominator). Debt ratio control and/or reduction through changes in the primary budget balance also affect the rate of growth of nominal GDP.

**Exercise 11.11**

(a) The AE function in this case is:

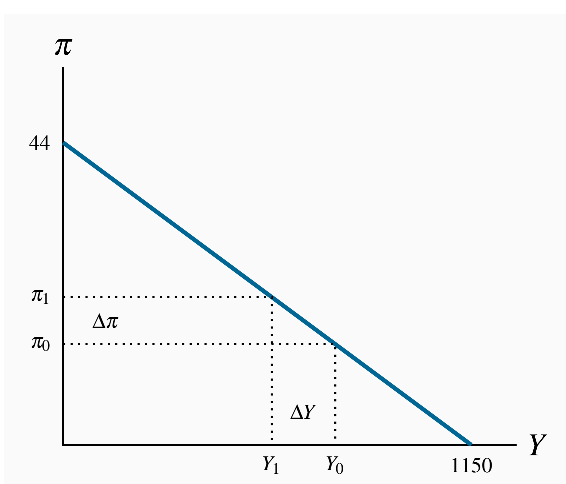
$$\text{AE} = C + I + G + NX$$
$$\text{AE} = 435 + 0.6Y - 5r$$

Monetary policy sets $r = 3.0 + 2.0(\pi - \pi^*)$ with an inflation target $\pi^* = 4.0$. Then AE $= 460 + 0.6Y - 10\pi$. $Y =$ AE gives equilibrium real $Y$ and AD:

$$Y - 0.6Y = 460 - 10\pi$$

The equation for the AD curve is: $Y = 1,150 - 25\pi$.

(b) The AD curve with slope $\Delta\pi/\Delta Y = -0.038$.



**Exercise 11.12**

With AD: $Y = 1,150 - 25\pi$ and $Y_P = 1,000$ the equilibrium inflation rate is:

$$\begin{aligned} 1,000 &= 1,150 - 25\pi \\ 25\pi &= 150 \\ \pi &= 6.0 \end{aligned}$$

This inflation rate is above the central bank's $\pi^* = 4.0$ target. Defending the inflation rate target. It calls for the central bank to raise its interest rate to:

$$r = 3.0 + 2.0(6.0 - 4.0) = 7.0$$

# Chapter 12 Solutions

**Exercise 12.1**

(a) The balance of payments is always zero, neither deficit nor surplus. Any deficit or surplus on current account that is not offset by a surplus or deficit on capital account results in a change in official reserve holdings, and a corresponding entry to balance the balance of payments account. The current account balance, the capital account balance and the change in official reserves sum to zero.

(b) Official reserves would increase by $2 billion, the difference between the surplus on current account and the deficit on capital account.

(c) The central bank would buy foreign currency to add to the official reserve account.

(d) The monetary base increases. The central bank pays for the foreign currency it buys by issuing new central bank deposits, which are monetary base.

**Exercise 12.2**

The US experienced the higher inflation rate as prices doubled over 10 years while Canadian prices increase by 75%. A nominal exchange rate of $1.05 Cdn for $1.00US would preserve the real exchange rate. The Canadian dollar appreciated in terms of US dollars and the US dollar depreciated in terms of Canadian dollars.

**Exercise 12.3**

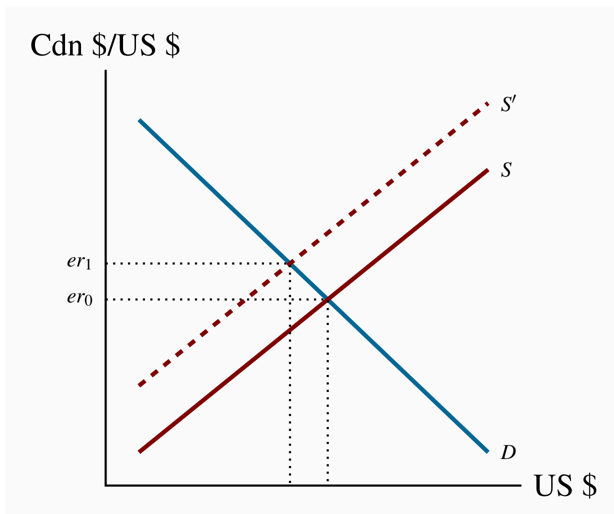
The purchase of US government securities by Canadian portfolio managers is an import of securities. Payment for these securities is made to residents of other countries and capital flows out from Canada to other countries. The capital account balance in the balance of payments is reduced.

**Exercise 12.4**

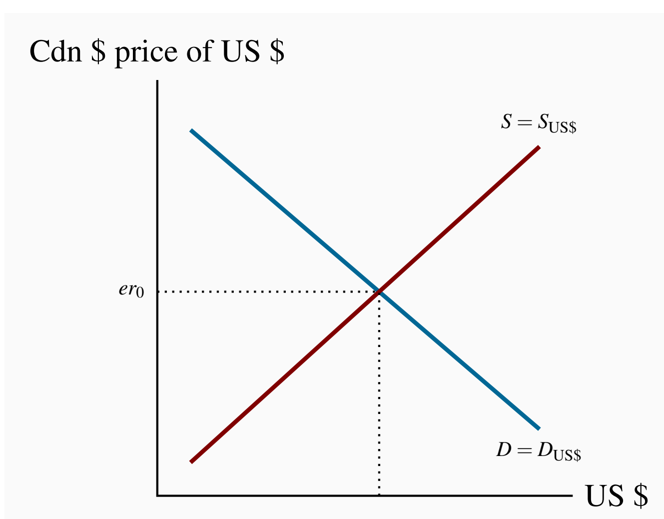
A nominal interest rate in Canada that is higher by 1 percent than the nominal interest rate in the US means the expected rate of appreciation the US dollar, relative to the Canadian dollar is 1 percent if interest rate parity prevails.

**Exercise 12.5**

A sharp and persistent drop in natural gas and crude oil prices would lower Canadian export receipts and the supply of US dollars on the foreign exchange market. The Canadian exchange rate would rise as the Canadian dollar depreciated.




**Exercise 12.6**

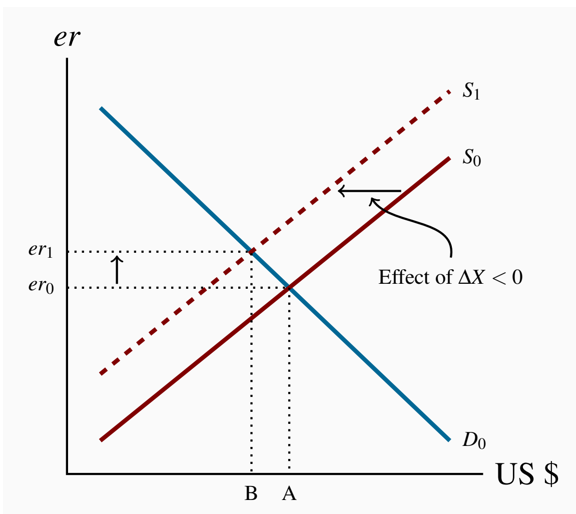


(a) The demand for foreign exchange (US dollars) in the diagram comes from Canadian demand for imports of foreign goods and services on the current account and foreign financial assets on the capital account. The demand for goods and services comes from Canadian incomes and tastes in terms of the propensity to import and the real exchange rate. The demand for foreign assets comes from Canadian portfolio decisions to hold foreign assets based on interest rate differentials and expected returns.

(b) The supply of foreign exchange (US dollars) comes from foreign demand for Canadian goods, services and assets based on foreign incomes and tastes, the real exchange rate, interest rate differentials and expected returns.

(c) The equilibrium exchange rate $er_0$ is the exchange rate at which the balances on current account and capital account sum to zero.

**Exercise 12.7**

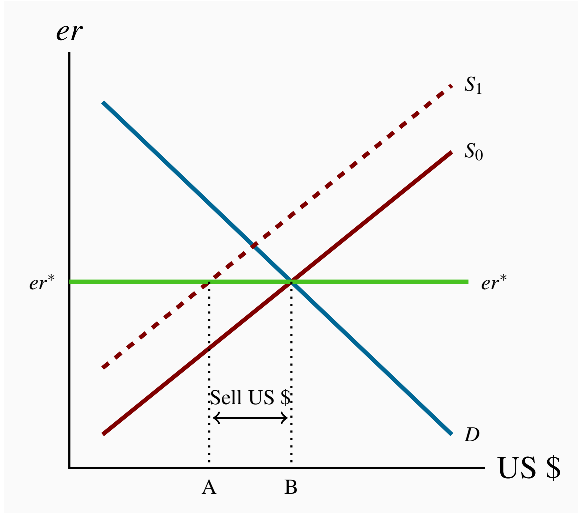



(a) A decline in exports reduces the supply of foreign exchange on the foreign exchange market, shifting the supply curve to the left from $S_0$ to $S_1$ in the diagram. The exchange rate increase from $er_0$ to $er_1$ as the domestic currency depreciates.

(b) The rise in the exchange rate raises the domestic currency price of imports while at the same time making exports more price competitive in foreign markets and more profitable for domestic producers. Expenditures on imports decline while export revenues rise which maintains balance of payments equilibrium.

(c) The adjustment to the initial fall in exports comes from the flexibility and change in the foreign exchange rate. There is no government intervention and no change in official reserve holdings.

**Exercise 12.8**




(a) Fixed exchange rate $(er^*)$:

(b) The decline in exports reduces the balance on the current account in the balance of payments and reduces the supply of foreign exchange in the foreign exchange market. In the diagram the decline in the current account balance, measured in US dollars is $U_0 - U_1$, $(= er^* \times (U_0 - U_1)$ in Cdn $). The supply curve shifts to the left by this amount.

(c) To defend the fixed exchange rate at $er^*$ the central bank sells foreign exchange from the official reserve account equal to the AB in the diagram, the difference between market supply and demand at the fixed rate $er^*$.

(d) The central bank sale of US $ would reduce holdings of official reserves and the monetary base.

**Exercise 12.9**

Flexible exchange rates provide for two linkages in the transmission mechanism for monetary policy. Changes in interest rates in pursuit of short-term stabilization objectives produce complementary changes in the exchange rate. Higher interest rates cause an appreciation of the domestic currency and lower interest rates depreciation. Monetary policy has simultaneous effects on domestic expenditures and net exports. By contrast, with flexible exchange rates and a monetary policy that controls money supply, fiscal policy is weakened by both interest rate and exchange rate crowding out. Fiscal expansion raises income and the demand for money pushing interest rates up and lowering the exchange rate with the result that investment and net exports are reduced.

**Exercise 12.10**

With a fixed exchange rate policy, interest rates must be maintained at the level required by the fixed exchange rate. Expansionary fiscal policies that raise real GDP and the demand for money must be matched by an expansion in the money supply to keep interest rates from rising. As a result crowding out does not impair the power of fiscal policy as it would in a closed economy or in an open economy with flexible exchange rates.

## Chapter 13 Solutions

**Exercise 13.1**

(a) Growth in potential GDP is growth in the capacity of the economy to produce goods and services. Growth in per capita real GDP is growth in the economy's output of goods and services per person.

(b) Growth in per capita real output is a measure of growth in the standard of living. Growth in per capita real output depends on both the growth in total real output and the growth in population.

(c) If population is growing, growth in per capita real GDP will be less than growth in potential GDP.

**Exercise 13.2**

(a) Ten years in the future the country with a growth rate of 3.5% will have potential GDP of $141 billion, while the country with a growth rate of 3.25% will have potential GDP of $138 billion, a difference of 2.2 percent.

(b) Twenty years in the future the potential GDPs will be $200 billion and $190 billion respectively, a difference of 5.3 percent.

**Exercise 13.3**

By growth accounting the contributions to annual growth in potential output are:

(a) Labour force growth 1.4%.

(b) Capita stock growth 1.0%.

(c) Improved productivity 1.1%.

**Exercise 13.4**

By growth accounting the growth in real GDP=0.7(growth in labour force)+0.3(growth in capital stock)=0.7(2.5)+0.3(1.5)=1.75+0.45=2.2%. Capital stock does not grow as fast as labour force with the result that falling labour productivity reduces output per worker.

**Exercise 13.5**

(a) Annual growth in country A is 2.9% and in country B 3.9%.

(b) Country A because output growth is greater than labour force growth.

(c) The capital to labour ratio rises in A but falls in B.

(d) Faster growth in total output in B comes from faster growth in the labour force but the fall in the capital to labour ratio in B lowers labour productivity, which is output per worker.

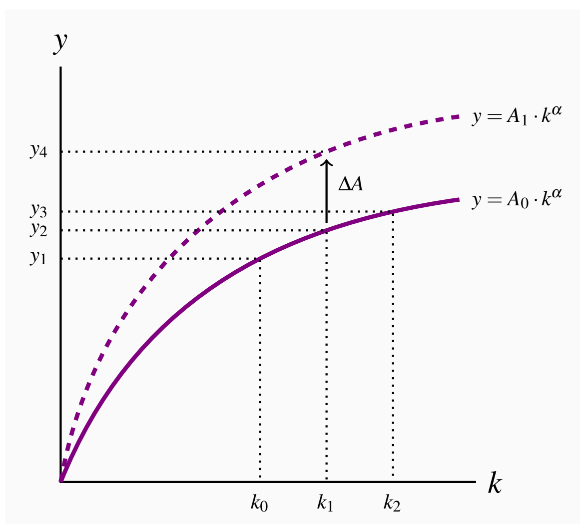
**Exercise 13.6**

With equal growth rates of capital and labour at 2.5% a year, the capital/labour ratio is constant and the economy enjoys constant returns to scale. Potential output will grow at 2.5% a year.

Per capita output will be constant as output and labour grow at the same rate.

Improved technology that increased total factor productivity by 1.5% a year would result in growth in per capita real GDP by 1.5% a year.

**Exercise 13.7**




(a) Technology is the key to improved standards of living because increases in output per worker arising from increases in the capital to labour ratio are limited by diminishing returns and eventually fall to zero.

(b) Increasing capital per worker $(K/N = k)$ move the economy along the per worker output function with a decreasing slope caused by diminishing returns to the capital per worker ratio. Increase in $k$ from $k_0$ to $k_2$ result in smaller and smaller increase in $y$.

(c) An improvement in productivity $(\Delta A)$ shifts the production function up, raising $y$ at every $k$ and is not subject to diminishing returns. In the diagram, improved productivity increases $y$ from $y_2$ to $y_4$ without any change in labour or capital inputs. Productivity growth from new technology has the potential to provide sustained increases in output per worker and standards of living.

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