**Cobweb model of economics**

(Mathematically)

The cobweb model is a theoretical explanation of the cyclical nature of prices and quantities through time. We describe the price by a sequence of numbers **p1, p2, p3**, with **p1** representing the price for the first year, **p2** representing the price for the second year, and so forth.

The model involves **three** related quantities.

The price **pt** of the product in year **t**.

The supply **St** for the product in year **t** – that is, how many units of the product are being made in this year. The supply is very low when the price is low and the supply rises as the price rises.

The demand **Dt** for the product in year **t** – that is, how many units of the product are being bought in this year. When the price is low the demand is high and as the price rises the demand falls.

We will make the following three assumptions.

A time lag exists between the decision to produce a particular product and actual production. **Most agricultural commodities are good examples of lagged production.** Farmers typically plant their crops in the spring and harvest them in the fall. Farmers determine how much they will plant in the spring based on the price they received the preceding year and they try to charge the same price in the fall.

Producers are assumed to base production plans on current price. For agricultural commodities the production plans are made after the harvest. The output corresponding to these production plans appears on the market a year later. Due to the time lag, the current supply is a function of the price last year.

**St = S(pt−1)**

It is assumed that the current price is such that current demand is equal to the current supply. This implies that no producer is left with unsold stocks and no consumer with an unsatisfied demand.

**St = Dt**

Consider the linear demand and supply functions

**Dt = a − bpt,**

**St = −α + βpt−1.**

In the equilibrium the demand meets the supply **Dt = St** . . . equilibrium on the market

**a − bpt = −α + βpt−1** . . . linear demand and supply

**pt = a + α/b – β/b pt−1** . . . isolate **pt**

**pt = A – Bpt−1** . . . define new parameters

**pk+1 = A − Bpk** . . . substitute **t by k + 1**

**pk = (−B)k C + A /1 + B** . . . solve linear **∆E**

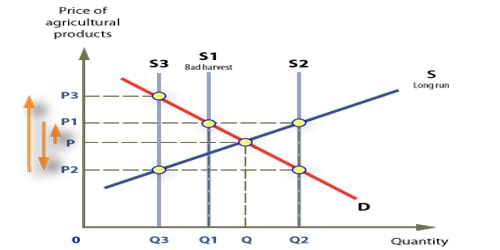
If **0 < B < 1**, then the price is oscillatory and converges to the equilibrium price **p ∗ = A /1 + B.**

**Cobweb Model (Theoretically & Graphically)**

Cobweb model or Cobweb theory is the idea that price fluctuations can lead to fluctuations in supply which cause a cycle of rising and falling prices. It describes cyclical supply and demand in a market where the amount produced must be chosen before prices are observed. Producers’ expectations about prices are assumed to be based on observations of previous prices. Nicholas Kaldor analyzed the model in **1934**, coining the term “cobweb theorem” (see Kaldor, 1938 and Pashigian, 2008), citing previous analyses in German by Henry Schultz and Umberto Ricci (it).

The Cobweb Model is the classic demonstration that dynamic behavior by economic agents might not converge to a stable equilibrium with supply equal to demand. Agricultural markets are a context where the cobweb model might apply since there is a lag between planting/sowing and harvesting (Kaldor, 1934, p. 133-134 gives two agricultural examples: **rubber and corn**).

The cobweb theorem is an economic model used to explain how small economic shocks can become amplified by the behavior of producers.



The equilibrium price is at the intersection of the supply and demand curves. A poor **harvest** in period **1** means supply falls to **Q1** so that prices rise to **P1**. If producers plan their period **2** productions under the expectation that this high price will continue, then the period **2** supply will be higher, at **Q2**. Prices, therefore, fall to **P2** when they try to sell all their output. As this process repeats itself, oscillating between periods of low supply with high prices and then high supply with low prices, the price and quantity trace out a spiral. They may spiral inwards, as in the top figure, in which case the economy converges to the equilibrium where supply and demand cross; or they may spiral outwards, with the fluctuations increasing in magnitude.

The **Inventory-Based Pricing Model** relaxes the assumption that supply must equal demand to consider how maintaining an inventory might moderate the possible instability. Retail stores, for example, very often buy an inventory, set a price, and then wait to see what demand might be.

The Inventory-Based Pricing Model illustrates that the Cobweb Model might or might not be a realistic challenge to supply and demand equilibrium.  Introducing an inventory buffering the difference between supply and demand and letting prices respond to the level of the inventory can be sufficient to eliminate the instability observed for the basic Cobweb Model.

**Limitations of Cobweb Theory –**

**Rational expectations.** The model assumes farmers base next year’s supply purely on the previous price and assume that next year’s price will be the same as last year (adaptive expectations). However, that rarely applies in the real world. Farmers are more likely to see it as a ‘good’ year or ‘bad year and learn from price volatility.

**Price divergence is unrealistic and not empirically seen.** The idea that farmers only base supply on last year’s price means, in theory, prices could increasingly diverge, but farmers would learn from this and pre-empt changes in price.

**It may not be easy or desirable to switch supply.** A potato grower may concentrate on potatoes because that is his specialty. It is not easy to give up potatoes and take to aubergines.

**Other factors affecting the price.** There are many other factors affecting price than a farmers decision to supply. In global markets, supply fluctuations will be minimized by the role of importing from abroad. Also, demand may vary. Also, supply can vary due to weather factors.

**Buffer stock schemes.** Governments or producers could band together to limit price volatility by buying surplus.