FACTORS DETERMINING THE LOCATION OF FOREST PRODUCTS FIRMS

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Abstract: In the past decade there has been an increase in the number of intrastate, state and regional programs aimed at encouraging forest resource based economic development in northeastern USA. These programs were aimed at deriving economic benefits from the large volume of mature forest resources in the region. The improvement of rural communities by creating job opportunities was seen as one of the primary benefits of the development programs, and they therefore focused attention on attracting firms and new manufacturing facilities. Most of these programs set the location of forest products firms as their target and seem to operate on the hypothesis that all forest products firms have the same general requirement when choosing a new location. The purpose of this study was twofold: first to test the hypothesis that different types of forest products firms have the same location requirements and second to test the hypothesis that location determinants within communities are the same irrespective of their size. Statistical analysis of 30 independent variables representing the economic, infrastructural, geographic and social conditions of 1098 northeastern communities indicate that each of the three types of forest industry subsectors studied had a unique combination of location determinants. In addition, each subsector had location determinants in metropolitan communities which were significantly different from the location determinants of non-metropolitan communities. These results suggest that programs aimed at attracting forest products firms may derive greater benefit from matching firms and communities rather than following the common practice of going after whole industries.

INTRODUCTION

In the past decade there has been a significant increase in the number of intrastate, state and regional programs aimed at encouraging forest resources based economic development in northeastern USA (Jones and Koester 1989). These programs are usually geared to deriving economic benefits from the large volume of mature forest resources in the region (State Foresters 1984). Improving the economies of rural communities by creating job opportunities is seen as one of the primary benefits of developmental programs which focus on attracting new manufacturing facilities. Most programs attempt to promote their state\region by advertising the positive aspects of their area. The promotional activities are typically general with respect to content and audience. A possible explanation for this situation, in a marketing analogy, is that the programs (sales departments) have not identified target

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industries (the consumers) to whom they make their 'sales pitch', neither have they identified target communities (the products) they plan to 'sell' to the industries. A possible reason for this may be that implicit in these programs are two very important assumptions: first, firms in all forest products industries have the same requirements and second, these firms have the same requirements irrespective of the size of the community in which they choose to set up new businesses. These assumptions contradict industrial location theory. Since various wood product industries have different input requirements and markets, location theory would suggest that a community which is a good site for plants in one industry might be a poor site for plants in another wood products industry. Further, location theory suggest that plants in a given industry may have different orientations. For example, a furniture factory may locate in a metropolitan area solely because of the market in that area. Another furniture plant may locate in a rural area to take advantage of cheap inputs and plan to serve regional or national markets. Thus, location theory provides the conceptual base for two hypotheses: that is, (i) the location requirement of forest products firms are invariant with respect to industry type; and (ii) the location requirements of forest products firms are invariant with respect to community size.

METHODS

Conceptual Issues And Hypotheses

Types of Forest Products Firms: Conventional wisdom suggests that, in the aggregate, forest product firms would have a set of location requirements that are very different to firms in the broadcasting industry. Firms planning to locate forest products manufacturing plants would be concerned with the availability and cost of raw material, labor and utilities; the location of markets; and the transport linkages. On the other hand, firms planning to set up a new broadcasting facility would be primarily concerned with the size of their broadcast service niche/market and be little concerned about transport facilities or energy costs.

Empirical industrial location studies support this hypothesis. In fact, recent studies have looked at the factors influencing the choice of a geographic area as the site for a new facility. Coughlin's *et al.* (1989) study of foreign direct investment in the USA is an example of such a study. These researchers were able to determine those factors which are important in the site choices of aggregate (2 digit SIC) industries. The fundamental hypothesis of this study was that two digit SIC industries have different location determinants. The empirical analysis supported this analysis. Implicit in this analysis, however, was the hypothesis that the location requirements of sawmills (SIC 2421) and wood kitchen cabinet manufacturers (SIC 2434) are exactly the same. The same, as all other firms in the aggregate Lumber and Wood Products Manufacturing industry (SIC 24).

An alternative hypothesis suggests that, in spite of wood being a common component in the production process, there may be enough differences in the location requirements that a sawmiller would choose an entirely different location from the location chosen by a kitchen

cabinet manufacturer. A sawmiller, for example, would be concerned about the supply of sawlogs in a chosen locality, whereas, the kitchen cabinet manufacturer would be concerned about access to markets in a chosen locality.

Types of Communities: Most economic development programs are based on the conventional wisdom that firms in a given industry would choose similar types of communities to set up businesses. Most industrial location analyses are based on this assumption. Smith, et al, (1978) for example conducted a study of southern communities and found that seven factors (site quality, site ownership, access to interstate highways, availability of bond finance, fire protection, presence of a college, and educational expenditure) were important in explaining why firms chose to locate in these communities.

An alternative hypothesis suggests that the size of the community would affect what factors become important in making location choices. Two possible scenarios are presented to suggest why this hypothesis may have validity. First, large communities, that is metropolitan areas, may have most of the prerequisites to attract most types of firms. In contrast, smaller communities may be limited to meeting only some of the location requirements of some types of firms. In the small cities and towns therefore, there may be many different features of the location, economic base, or labor force which may have significant statistical importance. In larger cities so many important features may be common that only a few differences are statistically significant. Second, and more important, some firms may deliberately choose a larger city because they plan to satisfy a particular market niche within that city. Another firm may be less concerned about such a narrow market and choose, instead, a non-metropolitan community with a low tax rate. Population size and/or population density have been included in industrial location models as a control variable, but, there has never been an explicit test of the differences in the location determinants in metropolitan and non-metropolitan communities. That is, the interaction between community size and other location determinants has not been explored.

The following section contains a discussion of the models that were developed to test two hypotheses:

(i) different types of forest products firms have the same location requirements, and

(ii) location determinants for metropolitan communities are the same as the location determinants for non-metropolitan communities.

Models To Test The Hypotheses

To test these hypotheses it was neccessary to develop a model that contained a set of explanatory variables which would reflect the unique socioeconomic and place-specific attributes of communities. The Northeast Industrial Targeting and Economic Development Database (NIT & EDD) System developed by Goode and Hastings (1989) was the source of the 31 independent variables used in the analysis. These variables were (acronyms in capital letters):

i) Potential Market Access. This variable (MARKET), conceptualized and made operational by Goode (1986), reflects if there is an excess quantity demanded for the industry's product in the market area surrounding the community.

ii) Potential Net Input Availability (PNIA) of Intermediate Manufactured Inputs. There are three (INPUT1, INPUT2, INPUT3) of these intermediate manufactured input variables (operationalized by Goode and Hastings 1988) for each of the three wood processing industries. The input variables are different for each of the wood processing industries. These input variables were selected on the basis of the magnitude of their input coefficient in the national Input/Output model. Positive values of these variables reflect whether the community is located in an area where there is an excess quantity of the inputs.

iii) Potential Net Input Availability of Forest Resources. This variable (FOREST, estimated in the same way as the input variables) reflect whether the community is located in an area where there is an excess quantity of forest resources supplied.

iv) Taxes

Per-Capita State Taxes (STATE)
Per-Capita County + Local Taxes (LOCAL+CNTY)
Source: 1970 Revenue Sharing File - US Department of Treasury

v) Transportation

Number of Railroads (RAILROADS)
Number of Airlines (AIRLINES)
Distance to Interstate Highway (HIWAY)
Distance to Primary Highway (ROAD)
Source: 1970 Rand-McNally Atlas

vi) Labor Force Characteristics

% with College Education (EDUCATED)
Male Labor Force Participation (MALELABOR)
Female Labor Force Participation (LADYLABOR)
% Males Working More Than 27 Weeks (MALEFULL)
% Female Working More Than 27 Weeks (LADYFULL)
Source: 1970 Census of Population

vii) Community Services

% Houses with Sewer (SEWERS)
Number of Hospital Beds (HBEDS)
Source: American Directory of Health Care Providers

viii) Colleges in the Community

viii) Colleges in the Community
% Population in College (COEDS)
Source: Directory of America Colleges and Universities

ix) Level of Development
Per-Capita Income (INCOME)
% Employed in Manufacturing (MFTLABOR)
% Houses Vacant (VACANT)
Source: 1970 Census of Population

x) Community Attributes
Distance to Metropolitan Statistical Area
Source: 1970 Rand McNally Atlas (PROXIMITY)
Population size (POPULATION)
Complexity of Service Sector
SERVICES - developed service sector
BSERVICES - basic service sector
Source: 1970 Duns Market Indicators File

xi) Demographic Characteristics
% Living in Same County for 5 years (RESIDENTS)
% Population that is nonwhite (NONWHITES)
% Population older than 65 years (RETIREES)
Source: 1970 Census of Population
Region - NEWENGLAND
- MIDATLANTIC

The dependent variable in the models was a dichotomous variable with a one (1) indicating that the community had a new plant start in the industry during the period 1970-1980, a zero (0) indicated that the community did not have a start.

Data Analysis

Units of Analysis and Study Area: The units of analysis were communities in 13 northeastern states (Virginia, West Virginia, Pennsylvania, New York, New Jersey, Delaware, Maryland, Massachusetts, Rhode Island, Connecticut, New Hampshire, Vermont, and Maine). Communities were defined as a Census Place and surrounding minor civil divisions whose population centroid was within five miles of the population centroid of the Census Place. One hundred and five large metropolitan areas (population greater 100,000 people) were excluded from the 1203 communities in the NIT&EDD. The remaining 1098 communities were divided into two samples containing 368 small metropolitan and 730 non-metropolitan communities. Metropolitan communities were those located in Metropolitan Statistical Areas.

Forest Industries Studied: Three subsectors of the forest products industries were analyzed in this study. An aggregation of 4 digit SIC industries into subsectors was necessary in order to have large enough samples to provide statistically reliable results. Some problems of using aggregate data were reduced by combining only those industries with similar input requirements as determined from the national input-output table. The subsectors analyzed were:

(i) The Furniture Subsector

Comprised of the SIC industries

2431-Millwork,
2434-Wood Kitchen Cabinets,
2511-Wood Household Furniture, and
2517-Wood TV, Radio, and Sewing Cabinets

The three PNIA variables for this subsector were:
(1) Sawmill, (2)Wood Veneer and Containers, and (3) Plastics.

(ii) The Wood Veneer Subsector

Comprised of the SIC industries

2435-Hardwood Veneer and Plywood,
2436-Softwood Veneer and Plywood,
2439-Structural Wood Members,NEC,
2441-Wood Boxes,
2449-Wood Containers,NEC, and
2452-Prefabricated Wood Building and Components

The three PNIA variables for this subsector were:
(1) Logging, (2) Sawmills, and(3) Plastics.

(iii) The Pallet Subsector

Comprised of the SIC industries

2448-Wood Pallets and Skids,
2492-Particleboard, and
2499-Wood Products,NEC

The three PNIA variables for this subsector were:
(1) Sawmills, (2) Plastics, and (3) Logging.

The Models: Nine models were analysed in this study. Six models were estimated by SAS Stepwise Logistic Regression Procedure (SAS, 1985). The first 3 models were used to determine what subset of the 31 independent variables were significant (alpha=.10) in explaining the location of each of the 3 subsectors in the 368 metropolitan communities. The second 3 models were used to determine what subset of the 31 independent variables were significant (alpha=.10) in explaining the location of each of the 3 subsectors in the 730 non-metropolitan communities.

A third set of 3 models contained 62 independent variables, the 31 variables discussed above and another 31 computed by multiplying each (of those 31 variables) by a dichotomous variable, which had a value of one (1) for metropolitan communities and a value of zero (0) for non-metropolitan communities. The latter 31 variables were used to determine which of

the first 31 variables were significantly different (alpha=.10) in metropolitan and non-metropolitan communities.

RESULTS

The Aggregate Industry Effect

We examined the regression results by organizing the significant variables to highlight a comparison of the location determinants of the three subsectors (Table 1) within metropolitan and non-metropolitan communities. In general, the results indicate that the set of industrial location determinants for each of the three subsectors were different in both types of communities.

Metropolitan Community Models: Of the 11 significant variables in the three subsector models for metropolitan communities none were significant in all three models. Two variables BSERVICE, NEWENGLAND) had coefficients with the same sign in the furniture and the pallet subsectors: indicating that these firms chose New England communities with well developed service sectors. The veneer and pallets subsector were both attracted to larger communities. However, firms in the veneer subsector located in communities with higher per-capita incomes, while firms in the pallet industry located in communities with low per-capita incomes. Opposite signs on the coefficients of a significant variable (NONWHITE) was also evident in the furniture and veneer subsectors models. Here, the result suggest that firms in the furniture subsectors located in communities that had higher proportions of nonwhite residents, while, firms in the veneer subsector located in predominantly white communities.

There were 3 unique significant variables (INPUT1, ROAD, EDUCATED) for the furniture subsector, 1 unique variable (LADYLABOR) for the veneer subsector, and 2 unique variables (AIRLINES, MALELABOR) for the pallet subsector. These results suggest that firms in the furniture subsector tended to concentrate in more remote metropolitan communities with a high proportion of college graduates. On the other hand, firms in the veneer subsector tended to locate where there was a high level of female participation in the workforce. Firms in the pallet subsector located in metropolitan communities with good airline connections and a high level of male participation in the labor force. Thus, while there are some common location determinants there are also significant differences across industries.

Non-Metropolitan Community Models: Of the 16 variables significant in the three subsector models only one (POPULATION) was significant in all three models. A result which clearly indicates that larger non-metropolitan communities are most likely to be chosen by the types of firm represented in these subsectors. However, while firms in the furniture and pallet subsectors tended to locate in non-metropolitan communities where similiar firms are already established, there is no such tendency indicated for firms in the veneer subsector. Further, while firms in the furniture subsector and the veneer subsector displayed regional tendencies,

Table 1.-- Location determinants for metropolitan and non-metropolitan communities for the Furniture, Veneer, Pallet and their allied inputs industries subsectors.

	METROPOLITAN			NON-METROPOLITAN			
VARIABLE	FURN	VENR	PALL	FURN	VENR	PALL	
MARKET	.	.	.	(-)	.	(-)	*
INPUT1	(-)	.	.	(-)	.	(-)	*
INPUT2	.	.	.	.	.	(+)	
INPUT3	.	.	.	.	.	.	
FOREST	.	.	.	(-)	.	.	
STATE	.	.	.	.	.	.	
LOCAL+CNTY	.	.	.	.	.	(-)	
AIRLINES	.	.	(+)	.	(+)	(+)	*
RAILROADS	.	.	.	.	.	.	
ROAD	(+)	.	.	(-)	.	.	
HIWAY	.	.	.	.	.	.	
EDUCATED	(+)	.	.	.	.	.	
MALELABOR	.	.	(+)	(+)	.	.	
LADYLABOR	.	(+)	.	.	.	(+)	
MALEFULL	.	.	.	.	.	.	
LADYFULL	.	.	.	.	(+)	.	
SEWERS	.	.	.	.	.	.	
HBEDS	.	.	.	.	.	.	
COEDS	.	.	.	.	.	.	
MFTLABOR	.	.	.	.	.	.	
INCOME	.	(+)	(-)	.	.	.	
VACANT	.	.	.	(+)	.	.	
PROXIMITY	.	.	.	.	.	.	
POPULATION	.	(+)	(+)	(+)	(+)	(+)	*
SERVICES	.	.	.	.	.	.	
BSERVICE	(-)	.	(-)	(-)	(-)	.	*
NONWHITE	(+)	(-)	.	.	.	.	
RETIREES	.	.	.	.	.	.	
NEWENGLAND	(+)	.	(+)	(+)	.	.	*
MIDATLANTIC	.	.	.	(+)	(-)	.	
RESIDENTS	.	.	.	.	.	(-)	
COMMUNITY	368	368	368	730	730	730	
STARTS	120	44	93	145	80	131	
STARTS (%)	33	12	25	20	11	18	
SIGNIFICANT	6	4	6	10	5	8	
COMMON	<- 0 ->	<- 1 ->		<- 2 ->	<- 2 ->		
COMMON	<----- 2 ---->			<----- 4 ---->			
OVERALL		11			16		19
COMMON		3			5		6

* Significant variables (with the same sign) common to at least two subsectors in the same community.

no such tendency was displayed by firms in the pallet subsector. Firms in the veneer and pallet subsectors located in non-metropolitan communities with good airline connections while firms in the furniture industry located in non-metropolitan communities close to primary roads. A well developed service sector was important to firms in the furniture and veneer subsectors while low local and county taxes appears to be important to firms in the pallet subsector. Finally, firms in the furniture subsector tended to locate in non-metropolitan communities with high housing vacancy rates and high levels of male participation in the labor force, while, firms in the veneer and pallet subsectors located where there was a large female workforce.

The Community Size Effect

The results of the analysis for the three subsectors are presented in Table 2. Variables with coefficients which were significantly different in metropolitan and non-metropolitan communities are also indicated. In general these results indicate that the location determinants for the metropolitan communities were different from the location determinants for non-metropolitan communities.

The Furniture Subsector: Close examination of Table 2 shows that there are 10 variables which are significant in explaining the location of the furniture subsector in non-metropolitan communities, while there are 6 location determinants for metropolitan communities. There were 4 variables (MARKET, FOREST, ROAD, LADYFULL) with coefficients which were significantly different in metropolitan and non-metropolitan communities. The coefficients for one of these variables (ROAD) had opposite signs in the two models. A result which suggests that non-metropolitan communities close to primary roads are more likely to attract a new firm, while remote metropolitan communities are more attractive. This apparently contradictory result may be explained by the market orientation of the firms. Firms locating in non-metropolitan communities may plan to cater to regional markets, while firms locating in remote metropolitan communities may plan to cater to the local market. Thus, highways are important to non-metropolitan furniture plants and not important to metropolitan furniture plants.

Three of the location determinants (INPUT1, NEWENGLAND, BSERVICE) were common to the two models and had the same sign. A result indicating a preference by firms in this subsector to locate in New England communities with a well developed service sector and a sawmill output deficit (i.e. consumption of sawmill output exceeds local supplies. A phenomena Goode (Goode 1989) associated with agglomeration). The two other variables (NONWHITE, EDUCATED) in the metropolitan model suggest that firms may prefer communities with a high proportion of nonwhite and a high proportion of college educated people. The other 6 variables (MARKET, FOREST, MALELABOR, VACANT, POPULATION, MIDATLANTIC) in the non-metropolitan model suggest that these firms tended to locate in larger communities with excess output (i.e. the output from the subsector exceeds local consumption. A phenomena Goode (Goode 1989) also associated with agglomeration). Non-metropolitan communities in Mid-Atlantic states with vacant housing

Table 2.--Variables significant (alpha=.10) in the industrial location models for the Furniture, Veneer, Pallet and their allied inputs industries subsector analysed by metropolitan and non-metropolitan communities.

	-FURNITURE-		--VENEER---		---PALLET-----		
VARIABLE	METRO	NONMETRO	METRO	NONMETRO	METRO	NONMETRO	
MARKET	.	(-)**	.	.	.	(-)	
INPUT1	(-)	(-)	.	.	.	(-)	*
INPUT2	.	.	.	.	.	(+)	
INPUT3	.	.	.	.	.	.	
FOREST	.	(-)**	.	.	.	.	
STATE	.	.	.	.	.	.	
LOCAL+CNTY	.	.	.	.	.	(-)**	
AIRLINES	.	.	.	(+)**	(+)	(+)	*
RAILROADS	.	.	.	.	.	.	
ROAD	(+)	(-)**	.	.	.	.	
HIWAY	.	.	.	.	.	.	
EDUCATED	(+)	.	.	.	.	.	
MALELABOR	.	(+)	.	.	(+)	. **	
LADYLABOR	.	.	(+)	.	.	(+)	
MALEFULL	.	.	.	.	.	.	
LADYFULL	.	. **	.	(+)**	.	.	
SEWERS	.	.	.	.	.	.	
HBEDS	.	.	.	.	.	.	
COEDS	.	.	.	.	.	.	
MFTLABOR	.	.	.	.	.	.	
INCOME	.	.	(+)	.	(-)	.	
VACANT	.	(+)	.	.	.	.	
PROXIMITY	.	.	.	.	.	.	
POPULATION	.	(+)	(+)	(+)**	(+)	(+)	*
SERVICES	.	.	.	.	.	.	
BSERVICE	(-)	(-)	.	(-)	(-)	.	*
NONWHITE	(+)	.	(-)	. **	.	.	
RETIREES	.	.	.	.	.	.	
NEWENGLAND	(+)	(+)	.	.	(+)	.	*
MIDATLANTIC	.	(+)	.	(-)	.	.	
RESIDENTS	.	.	.	.	.	(-)	
SIGNIFICANT	6	10	4	5	6	8	
OVERALL	12		8		12		19
COMMON	<- 3 ->		<- 1 ->		<- 2 ->		5

* Significant variables (with the same sign) common to subsector models in the two types of communities.

** Variables with coefficients in metropolitan models which were significantly different (alpha=.10) from coefficients in non-metropolitan models.

and a high level of male labor force participation were also likely to attract firms in this subsector.

The Wood Veneer Subsector: Examination of Table 2 shows that there were four variables (LADYLABOR, INCOME, NONWHITE, POPULATION) which help to explain the location of the wood veneer subsector in metropolitan communities. There were also four location determinants (AIRLINES, LADYFULL, POPULATION, BSERVICE, MIDATLANTIC) for non-metropolitan communities. Of these variables four (AIRLINES, LADYFULL, POPULATION, NONWHITE) had coefficients which were significantly different in metropolitan and non-metropolitan communities. One of these location determinants (POPULATION) was common to the two models. In both models the effect was positive i.e. larger communities were more likely to get a new firm than a small community, but, in the non-metropolitan communities the size effect was more important since the coefficient for this variable was significantly larger in the non-metropolitan model than the coefficient for the variable in the metropolitan model. These results indicate there is a very clear preference by firms in these industries to locate in larger communities whether they were metropolitan or non-metropolitan. However, firms locating in non-metropolitan communities tended to locate in New England and South Atlantic towns with well developed service sectors, good airline connections and high proportions of working women. In metropolitan communities, firms tended to locate in places with predominantly white populations, high female workforce participation rates, and high per capita incomes.

The Pallet Subsector: Examination of Table 2 shows that there are 8 variables (MARKET, INPUT1, INPUT2, LOCAL+CNTY, AIRLINES, LADYLABOR, POPULATION, RESIDENTS) which help to explain the location of wood veneer subsector in non-metropolitan communities, while there are 6 location determinants (AIRLINES, MALELABOR, INCOME, POPULATION, BSERVICE, NEWENGLAND) for metropolitan communities. There were 2 variables (LOCAL&CNTY, MALELABOR) with coefficients which were significantly different in metropolitan and non-metropolitan communities. A result which shows that the effect of local and county taxes were significantly more important to firms locating in non-metropolitan communities, while the male labor force participation rate was significantly more important to firms locating in metropolitan communities. Only 2 of the location determinants (POPULATION, AIRLINES) were common to the two models. A result indicating a preference by firms in this subsector to locate in larger communities served by a number of airlines. However, firms locating in non-metropolitan communities also tended to locate where there was an excess supply of plastics and a high proportion of working women. While, firms locating in metropolitan communities also tended to locate in New England towns where there were high male labor force participation rates, highly developed service sectors, and low per capita income.

In summary, while the models for the three subsectors of the forest products industry had some variables in common, each subsector model had several unique significant explanatory variables. In the metropolitan community models there were 11 significant variables, of these only three had the same sign in at least two of the subsectors. In non-metropolitan community models there were 16 significant variables, of these only five had the same sign in at least two of the subsectors. Overall, there were 19 significant variables, of these only six

had commonality across subsectors within community type. Therefore, less than a third of the determinants were common to two or more of the subsectors. Evidence which suggest that each subsector has a relatively unique set of location determinants.

SUMMARY AND CONCLUSION

This study was designed to test the hypotheses that location determinants within communities are invariant with respect to community size and industry subsector. To test these hypotheses 31 variables reflecting the socioeconomic and space specific characteristics of 1098 northeastern communities were estimated by stepwise logistic regression. The results indicate that each subsector had location determinants which were different in non-metropolitan communities and metropolitan communities. Comparison of the significant variables for the three subsectors indicate that less than a third of the determinants were common to two or more subsectors. This suggests that each subsector has a relatively unique set of location factors whether they were metropolitan or non-metropolitan community models.

The conclusions of this study are twofold. First, non-metropolitan communities have a different set of location determinants for forest products industries than small metropolitan communities in northeastern USA. Second, subsectors of the forest products industry each have a set of location requirement which are different. These results suggest that programs aimed at attracting forest products firms in northeastern USA need to be make a special effort to target the specific type of firm they are interested in while being aware of the socio-economic and space specific characteristic of the communities they are planning to develop.

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