Market Segmentation: Identifying the High-Growth Export Markets for U.S. Agriculture

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A cluster analysis based on a five-year growth rate of agricultural imports from the United States was conducted on 86 countries and revealed two significant market segments for U.S. agriculture: the high-growth markets and the low-growth markets. Multiple discriminant analysis was then used to test the significance of the countries' trade-related and macroeconomic variables to their market growth classification. The discriminant function was used to predict the high-growth markets for U.S. agriculture in 1994.

High-growth markets for U.S. agriculture exhibit faster GDP and agricultural import growth rates, are relatively agriculturally self-sufficient, and are near the United States. On the other hand, low-growth markets exhibit slower GDP and agricultural import growth rates, and are geographically distant from the United States.

Key words: market segmentation, target marketing, market assessment, agricultural exports, international marketing

Introduction

Segmenting a total market into groups of consumers with similar needs and characteristics is a critical first step in the strategic marketing process. Unfortunately, market segmentation as a strategic marketing tool has failed to gain popular acceptance in the field of agricultural marketing, primarily due to the generally accepted notion that agricultural products are homogeneous by nature and that further differentiation of agricultural markets is not necessary.

The increasing trend towards globalization of the marketplace, both in the manufactured food and agricultural sectors, has convinced agricultural marketers about the importance of market assessment in marketing management, particularly in international agricultural trade. Ideally, an exporter's decision to either enter a foreign market or expand coverage of an existing market should not be made unless a systematic evaluation of all alternative target markets has been conducted to identify countries which present the greatest opportunities in terms of market size and growth. This, basically, is an application of the market segmentation concept.

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The market segmentation process consists of three steps: (1) the identification of relevant market segments, (2) target-market selection, and (3) marketing strategy formulation tailored to meet the specific requirements of the selected target markets. The successful fulfillment of each step is necessary for the marketer to efficiently serve the needs and wants of the market at the least possible cost (Enis, 1980).

Although a number of market assessment models have been proposed in the past, most of these models have generally been qualitative in nature and lack the high degree of predictive accuracy that most agricultural economists and marketing managers desire in a model (Salvacruz, Reed, and Mather, 1992). In order to fill this gap, the USDA has made several attempts to design predictive models that would identify the best market prospects for U.S. agricultural exports. In accordance with the provisions of the Food Security Act of 1985, for instance, Evans (1990) identified the best market prospects for U.S. agricultural exports through the mid-1990s by predicting market growth rates of U.S. agricultural exports to prospective foreign markets based on the countries' trade and macroeconomic variables. On a related note, Salvacruz and Reed (1993) presented an econometric model (herein referred to as the SR model) which identified the foreign countries' GDP growth rate, agricultural self-sufficiency, exchange rate depreciation rate, growth rate of total agricultural imports from all sources, and distance from the United States as the variables significantly associated with the respective growth rate of their agricultural imports from the United States. Consequently, the SR model predicted the top ten market prospects for U.S. agricultural exports for 1994.

This paper presents a segmentation of the foreign markets for U.S. agriculture into growth categories. It groups countries into clusters according to their market growth potential for U.S. agricultural exports. Hypothesized variables were tested for their significance in determining growth cluster to which a country would be assigned. The resulting discriminant function was used to predict the high growth markets for U.S. agricultural exports in 1994.

Theoretical Considerations

A significant relationship between exchange rates and agricultural trade flows has been espoused by most agricultural economists. They claim that a depreciation of a country's currency generally results in an increase in its exports and/or a reduction in its imports (Schuh, 1974; Chambers and Just, 1982), inferring that an increasing depreciation rate of a country's currency against the U.S. dollar tends to decrease the country's growth rate of agricultural imports from the United States.

Another macroeconomic variable which is believed to affect a country's trade flow is national income. Salvacruz and Reed (1993) have shown that faster gross domestic product (GDP) growth is associated with faster growth in agricultural imports from the United States.

The concept of agricultural self-sufficiency as a determinant of a country's import growth rate has presented some conflicting views. Some economists argue that a self-sufficient country would logically preclude trade, thereby reducing both its export and import activities (Grennes, 1984). On the other hand, others argue that as agricultural self-sufficiency sets in, a country would tend to pursue some degree of import liberalization. Thus, a high degree of self-sufficiency can be associated with a high import growth rate--a relationship which was verified by the results of Salvacruz and Reed (1993).

The distance between two trading partners is another major determinant of trade since this factor is significantly related with transportation cost. Considering that the net benefit of additional imports can be viewed as the value of these imports less the costs of producing them in the exporting country and transporting them to the importing country, then a higher transportation cost (i.e., longer distance between two trading partners) is expected to reduce the importer's rate of growth of imports.

Methodology

Model Specification

The primary objective of this study is to construct a discriminant model which can be used to classify countries based on their market growth rate for U.S. agriculture. Thus, a two-stage procedure involving cluster and discriminant analyses was adopted. That is, the 1990 market growth rate classification of each country was determined through a cluster analysis, using the SAS FASTCLUS procedure. The resulting clusters were then considered to be the dependent variable in conducting a stepwise discriminant analysis, using the five significant variables identified in the SR model as the hypothesized discriminators of market growth rate classification.

Although the question of how many clusters a researcher should estimate remains a controversial issue at this time, this problem has been considered by many scientists as not being of paramount importance simply because the goal of any cluster analysis is to explore the general patterns of the relationships between entities (Aldenderfer and Blashfield, 1984). Lehman (1979) suggested that a cluster should be formed for every 50 observations. Adopting this convention, two market growth clusters were determined in this particular study. The growth rate of U.S. agricultural exports to country i from the 1976-80 period, to the 1986-90 period was used as the basis for classification in the cluster analysis. Data are averaged over a five-year period to minimize the effects of unusual circumstances possibly associated with one year.

The specification for the stepwise discriminant model is:

$$GRCLASS_i = \alpha_0 GDPGR_i + \alpha_1 XRDEPN_i + \alpha_2 AGIMGR_i + \alpha_3 SSRAG_i + \alpha_4 DIST_i$$

where:

$GRCLASS_i$ is the market growth rate classification of country i in 1990, resulting from the cluster analysis;

$GDPGR_i$ is country i's real GDP growth rate from 1980 to 1985;

$XRDEPN_i$ is the depreciation rate of country i's currency against the U.S. dollar from 1980 to 1985, computed as follows:

$$\frac{XR_{i,1985} - XR_{i,1980}}{XR_{i,1980}}$$

where:

XR_i is country i's exchange rate against the U.S. dollar, expressed as country i's currency per U.S. dollar;

$AGIMGR_i$ is the growth rate of country i's total agricultural imports from the 1981-85 period to 1986-90 period, i.e.,

$$\frac{\sum_{t=86}^{90} \frac{AGIM_{it}}{5} - \sum_{t=81}^{85} \frac{AGIM_{it}}{5}}{\sum_{t=81}^{85} \frac{AGIM_{it}}{5}}$$

where:

$AGIM_{it}$ is the total value of country i's agricultural imports from all sources in period t (in billion U.S. dollars);

$SSRAG_i$ is country i's self sufficiency ratio for agriculture in 1985; and,

$DIST_i$ is the distance between country i and the United States in kilometers.

One can think of the discriminant model as having a base of 1985. At that point a decision-maker is assessing the macroeconomic variables available at that time to predict the market growth rate classification of each country of the world.

The stepwise discriminant procedure selects those variables which add most to the explanation of the variance between the two group means using a backward elimination process (The differences in means between the two groups for each variable was tested by the one-way ANOVA F-test). The backward elimination process begins with all the variables in the model and removes the variable that contributes least to the discriminatory power of the model at each step until all remaining variables meet the F-test criterion to stay in the model. The accuracy of this F-test is generally considered inferior to the test of significance used in regression analysis. Results of the above ANOVA F-test, however, serve as a guide in determining the relative significance of each variable in the discriminant function (Rao, 1952).

Results of the stepwise discriminant analysis were used to eliminate the less significant discriminators of market growth rate in the process of specifying the final discriminant model--the model which would be used to predict the market growth rate classification of each foreign country in 1994.

Data Sources

Cross-sectional data on agricultural import volumes of each country from the United States and the relevant macroeconomic variables discussed in the model specification were gathered from various trade and financial publications of the International Monetary Fund, United Nations, U.S. Department of Agriculture, and the World Bank. The distance measurements between the United States and its prospective trading partners were taken from *Direct Line Distance (International Edition)* by Fitzpatrick and Modlin. Some countries were excluded from the analysis because data were not available.

Analytical Procedures

The basic econometric tool used in testing the preceding specifications was discriminant analysis, with F-tests conducted at the 15 percent level, the default used by the SAS STEPDISC procedure in evaluating the models. Considering that the models were specified primarily for predictive purposes, heavy emphasis was placed on results of the F-test, R^2, and "Percent Correctly Classified" (PCC) measurement in evaluating the models. The PCC represents a summary of the performance of the specification's classification criterion and is analogous to R^2 in regression analysis. In order to arrive at this measure, the number of correct predictions is divided by the number of observations and then multiplied by a factor of 100. The statistical significance and signs of resulting coefficient estimates were also evaluated to verify their consistency with economic theory.

Results and Discussion

Market Growth Rate Clusters

The SAS FASTCLUS procedure yielded two significant clusters of U.S. foreign agricultural markets: one with a mean five-year growth value of 14.44 percent and another with a mean five-year growth of -36.09 percent (Table 1). An R-squared value of 0.76 and an F-value of 129 led us to conclude the significance of these two classifications. These clusters were appropriately named "High-growth Market" and "Low-growth Market," respectively.

Table 1. Results of Cluster Analysis of U.S. Foreign Agricultural Markets

Cluster	Mean Value	Standard Deviation	Cluster Name
1	0.1444	0.1799	High-growth Market
2	-0.3609	0.1993	Low-growth Market

F-statistic = 129.01
R-Squared = 0.76
Number of observations = 86

Table 2. F-values and Prob > F from the Stepwise Discriminant Analysis

Variable	F-value	Prob > F
GDPGR85	2.88	0.09
XRVR8085	0.99	0.32
AGIMGR85	2.09	0.15
SSRAG85	2.26	0.14
DIST	1.51	0.22

Table 3. Number of Observations and Percent Classified into Market Growth Clusters

TRUE CLASSIFICATION	Number of countries classified as		TOTALS
	High Growth Market	Low Growth Market	
High Growth Market	19	8	27
Low Growth Market	19	36	55
TOTALS	38	44	82

Percent correctly classified = 67.07%

Evaluating Market Growth Classification of Foreign Markets

As reflected in Table 2, the stepwise discriminant analysis revealed three variables which were significant discriminators of market growth prospects of the United States at the 15 percent level: the five-year GDP growth rate (GDPGR85), the five-year growth rate of total agricultural imports from all sources (AGIMGR85), and agricultural self-sufficiency (SSRAG85). These results would have led one to come up with a final discriminant function specification using these three independent variables. However, due to the caveat that the resulting F-values should only serve as a guide in determining the relative significance of each variable in the discriminant function rather than their respective absolute significance, a discriminant specification to include not only these three variables but also proximity to the United States (DIST) was conducted. This four-independent variable specification resulted in a better fit of the data than the three-independent variable model suggested by the stepwise results, as reflected by the former's higher PCC--67.07 percent (Table 3), compared with the latter's 57.31 percent.

The final specification yielded the following discriminant function:

$$D = 2.1913\ GDPGR + 0.8149\ AGIMGR + 0.0079\ SSRAG - 0.0001\ DIST$$

The discriminant coefficients indicate that GDPGR is the best discriminator among the four significant variables identified and DIST is the worst. This is because the magnitude of the discriminant coefficients indicate the relative contribution of a unit of the independent variables to the discriminant function (Lehmann). Thus, GDPGR has the greatest influence in determining the likelihood that a country will be classified as either a high-growth market or a low-growth market for U.S agricultural exports. In the same manner, DIST has the least influence in determining such likelihood of classification. The signs of coefficients are all consistent with a-priori expectations. The positive sign of the GDP growth rate coefficient suggests that countries exhibiting high GDP growth rates during the past five years are more likely to exhibit high growth rate of agricultural imports from the United States. This may suggest the prospect of foreign market creation or expansion through foreign economic development programs in which the United States can be an active participant. At the very least, it suggests the need for the United States to constantly monitor economic growth performances of its current and prospective trade partners.

The positive sign of the agricultural import growth rate coefficient indicates that countries exhibiting higher growth rate for agricultural imports from all sources during the past five years are classified as good prospects for U.S. agricultural exports. This result has some significant repercussions in terms of the efforts that the United States should devote in protecting its share of the world market for agriculture.

The positive sign of the agricultural self-sufficiency variable suggests a positive relationship between a country's level of agricultural self-sufficiency and its import growth rate from the United States. This may imply the possibility that products in the U.S foreign markets are becoming more differentiated which may be resulting in a greater volume of intra-industry trade.

The negative coefficient of the distance variable indicates that countries located nearer the United States are more likely to exhibit high growth rate of agricultural imports from the United States. This result may suggest the need for the establishment of trade liberalization agreement among the neighboring North American countries in order for the United States to at least maintain its market share in the international agricultural market. This has become particularly important considering the emergence of trading blocs and economic cooperation agreements in various regions of the world which tend to promote intra-regional trade and discourage inter-regional commerce, particularly in the agriculture sector.

High Growth Markets for U.S. Agricultural Exports in 1994

Using the discriminant function for classification and prediction purposes calls for the calculation of the mean values for the two groups on the discriminant function. As Table 4 suggests, a country which could typically be considered a high-growth market for U.S. agriculture would have experienced a 12.64 percent five-year GDP growth, a 10.23 percent five-year growth in its agricultural imports from all sources, an agricultural self-sufficiency ratio of 110.48, and is on the average, located 7670 kilometers from the United States. On the other hand, a typical low-growth market would have experienced a five-year GDP growth of 3.15 percent, a five-year 5.01 percent decline in its agricultural imports from all sources, an agricultural self-sufficiency ratio of 92.75 and is 8771 kilometers or farther away from the United States.

Denoting the discriminant function for the high growth market category as D_{HI} and that of the low growth market as D_{LO}, the mean value for the two classifications on the discriminant function are as follows:

Table 4. Means of Variables in the Discriminant Function

Variable	High Growth Market	Low Growth Market
GDPGR85	0.1264	0.0315
AGIMGR85	0.1023	-0.0501
SSRAG85	110.4815	92.7455
DIST	7670	8771

Table 5. List of Countries Predicted to be High-Growth Markets for U.S.Agricultural Exports in 1994

Country	Score	Country	Score	Country	Score
Uruguay	2.69	Sweden	1.10	Haiti	0.84
Dominican Rp	2.22	U Kingdom	1.07	Iceland	0.78
Spain	2.03	Ethiopia	1.07	Mexico	0.75
France	1.98	Denmark	1.01	Philippines	0.65
Canada	1.97	Turkey	0.96	Switzerland	0.64
Thailand	1.73	S Korea	0.92	Hungary	0.63
Botswana	1.66	Mauritius	0.90	Greece	0.55
Guyana	1.28	Germany FR	0.88	Pakistan	0.45
Finland	1.27	Ireland	0.87	Norway	0.30
China	1.26	Honduras	0.85	Taiwan	0.29
Australia	1.25	Guatemala	0.84	Netherlands	0.28
Austria	1.12	Italy	0.84	Costa Rica	0.27

$$D_{HI} = 2.1913(0.1264) + 0.8149(0.1023) + 0.0079(110.4815) - 0.0001(7670) = 0.4663$$

$$D_{LO} = 2.1913(0.0315) + 0.8149(0.0501) + 0.0079(92.7455) - 0.0001(8771) = 0.1162$$

The cut-off point can be derived as

$$(D_{HI} + D_{LO})/2 = (0.4663+(-0.1162))/2 = 0.1751$$

This cut-off point is used as a dividing line between the scores of countries which are more likely to be classified as high-growth markets and those which are more likely to be classified as low-growth markets.

By plugging in the 1989 values of each country's attributes in the discriminant function, each country's score is determined and serves as a basis in their market prospect classification for 1994. Thus, countries scoring 0.1751 and above are more likely to be classified as high growth markets and those with scores below 0.1751 are more likely to be classified as low growth markets.

Table 6. Selected Countries Classified as Low-Growth Markets and Values of Their Attributes

Country	GDPGR 85	GDPGR 89	AGIMGR 85	AGIMGR 89	SSRAG 85	SSRAG 89	SCORE 1990	SCORE 1994
N Zealand	0.11	0.12	0.17	0.59	125	77	-0.05	-0.06
Japan	0.15	0.12	-0.05	0.56	31	29	-0.57	-0.13
Indonesia	0.34	0.08	-0.42	0.45	107	96	-0.38	-0.33
Malaysia	0.16	0.23	0.07	0.27	173	32	0.24	-0.57
Singapore	0.32	0.38	0.20	0.14	26	57	-0.48	-0.42

High-Growth Market Predictions for 1994

The scoring procedure discussed above resulted in the list of high growth markets as reflected in Table 5. The scores listed opposite each country give an approximation of how likely a particular country can be classified as a high-growth market for U.S. agriculture. Thus, the greater one's score is relative to the cut-off point of 0.1751, the more likely that country is to be classified as a good market prospect. It is also evident from the list that countries which are more likely to be classified as high-growth markets (i.e., those with higher scores) tend to be located nearer the United States (e.g. Canada) and those countries which have lower chances tend to be geographically located farther away from the United States (e.g., Australia, South Korea, and Taiwan).

Among the countries classified as low-growth markets, New Zealand and Japan appear to have a high likelihood of being classified as high-growth markets for U.S. agricultural exports in 1994. Although they scored lower than 0.1751, their scores were closest to the cut-off point among the low-growth markets. In addition, they have demonstrated significant improvement in the values of their AGIMGR and GDPGR from 1985 to 1989 (Table 6). Similarly, Malaysia and Singapore exhibit great promise in turning into a high-growth market from 1990 to 1994 resulting from significant improvements in their AGIMGR and GDPGR.

An analysis of the actual magnitudes of the trade-related and macroeconomic variables used in the 1990 growth rate predictions reveals that **GDPGR, AGIMGR, AGSSR** and **DIST** are the variables which discriminate between the high growth and the low growth markets for U.S. agricultural exports. The discriminant function was used to predict the high-growth markets for U.S. agriculture in 1994. Among the countries more likely to be classified as high growth markets are those which exhibit faster GDP and agricultural import growth rates, are relatively agriculturally self-sufficient, and are located near the United States such as Canada. On the other hand, countries which exhibit a lower likelihood of being classified as high-growth markets are those countries exhibiting slower GDP growth and lower agricultural import growth rates, and are geographically distant from the United States such as Japan, New Zealand, Indonesia, Singapore, and Malaysia. One must be careful to note that results of this study should be considered only as a first step in the final target market selection. The next step is the determination of projected market size, and demand and sales potentials for U.S. agricultural exports in each of the good market prospects. In finalizing the "best market" list for U.S. agricultural exports, one must also recognize the possible impact of other significant factors such as the political climate prevailing in the prospective country, its diplomatic relationship with the United States, and the existence of tariff and non-tariff barriers to trade.

Summary and Conclusion

This paper is an attempt to classify countries according to their growth rate potentials for U.S. agricultural exports by looking at their respective trade-related and macroeconomic variables. A cluster analysis conducted on 86 countries revealed the existence of two significant market segments for U.S. agricultural exports: the high-growth markets and the low-growth markets.

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