An Analysis of Latin American Peanut Trade

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Introduction

As one of the leading exporters of peanuts, U.S. export share in the world peanut market has decreased for the past decade due to heavy competition of leading and emerging exporters. The U.S. share of the market was about 32.9 % with trade volume of 354 thousand metric tons (MT) between 1981 and 1985, on average. However, it has decreased to 19.8% with trade volume of 294 thousand MT between 1996 and 2000 (Revoredo and Fletcher, 2002).

U.S. peanut imports were strictly controlled by law with respect to origin and quantity before the GATT and NAFTA. For the past five years, U.S. peanut (shelled) imports have been over 55 thousand metric tons, annually. Argentina, Mexico, and Nicaragua have supplied over 90 percent of U.S. peanut imports (USDA/FAS, 2000). Among the export countries, Argentina has supplied over 75 percent of the U.S. import market.

Despite this, there has not yet been any detailed research on the Latin American peanut industry. The USDA has been the only agency that has monitored Latin American peanut industries. Due to the lack of concern and preparation concerning the Latin American peanut industry, it is very difficult for policy makers and those engaged in international trade to judge competitiveness and prepare for the WTO and FTAA negotiations.

Therefore, this paper attempts to provide information and analyses of the Latin American peanut industry to support public and private decision making related to peanut marketing and trade. This paper analyzes the Latin American peanut industry, including Argentina, Brazil, Mexico, and Nicaragua. Baseline projections are a major focus of the model, a framework that provides short- and long-run projections of the Latin American peanut economy and analysis of market and trade polices. The goal of the analysis is to determine the implications for the Latin American.

The remainder of the paper is organized as follows. The next sections describe the current situation in the Latin American peanut industry, conceptualize the theoretic framework, and apply the framework to the peanut sectors of the four countries, using econometric technique. The last section summarizes the paper and concludes with several suggestions and concluding remarks for the Latin American and the U.S. peanut industries.

Latin American Peanut Industry

In general, there is no government intervention in the Latin American peanut industry except a 3.5% export tax on Argentine unprocessed peanuts. In addition, these countries have adopted more market-oriented trade reforms, particularly through the formation of regional and bilateral preferential trade agreement for the past two decades. These countries previously protected their domestic agricultural sectors through the use of relatively high tariffs, inspection fees, and various registration systems. However, the liberalization of the economy during the past few years has reduced these duties to relatively low levels. Also, these countries' governments are working vigorously through international organizations to attain further reductions in trade restrictions affecting their peanut products, especially Argentina. In recent years, a considerable number of regional trade agreements that do not include the United States have been established in Central and South America such as MERCOSUR, the Andean Pact, the Central America Common Market (CACM), and the Caribbean Common Market (CARICOM). As a result, there are no trade barriers in the Latin American peanut industry.

In Argentina, peanuts are an important minor oilseed crop. In 1992, Argentina announced several measures designed to stimulate oilseed production and exports. Oilseed export taxes were lowered from 6% to 3.5%, while meal and oil exports received a 2.5% rebate on the f.o.b. value of exports. However, there was no change to the existing export tax on unprocessed oilseeds such as soybeans, sunflowerseed and peanuts, which remain at 3.5%. As the largest peanut exporter in Latin America, Argentina generally follows an open market policy for production and trade of peanuts. Moreover, there are no other barriers to trade (USDA/FAS, 2000). Traditionally, Argentina ships most of its peanut production to external markets, with only a small percentage used for human or animal consumption. In addition, over 50 % of production is exported as confectionary product, with the remainder processed into oil and meal, again mostly for export markets.

The Brazilian oilseed market is controlled by the private sector with little government intervention. Market participants include producer cooperatives and national and multinational companies. However, soybeans have dominated the Brazilian oilseeds sector. Brazil accounts for over 20% of total world soybean output. Production of peanuts, cottonseed, castor beans, and sunflower seed is small.

The peanut industry in Brazil was active in terms of trade before 1980. However, the industry became very static, which means Brazil has not been relatively competitive, compared to Brazilian soybeans, in the world market since 1980. This implies that peanuts in Brazil have been a minor oilseed crop that the government does not support the industry financially. The main reason is that most of the early growth in soybean area came at the expense of other crops such as peanut and rice. As a result, the government has heavily concentrated its agricultural policies on soybeans and related products since the 1980s.

Nicaraguan peanut production is almost exclusively for exports and domestic food use. The primary market for Nicaraguan peanuts has been Mexico since 1996. Nicaraguan peanuts are not considered a major oilseed commodity in terms of production and trade volume. However, its production and trade volume has doubled in recent years. For example, its production increased to 67 thousand MT in 2000 from 31 thousand MT in 1998. Therefore, the Nicaraguan peanut industry could be considered as a rising peanut exporter because the industry has been growing dramatically concentrating on exports since 1995 (USDA/FAS).

The Nicaraguan peanut policy has begun to focus on peanut exports from 1996. According to the Nicaraguan government, the main goal of the peanut policy is to export at least 30 thousand MT to the U.S. However, the Nicaraguan peanut policy goal has not been successful. For example, Nicaragua exported 2.7 thousand MT to the U.S in 2001. Nevertheless, Nicaraguan exports have increased to a three-year-average of 30 thousand MT in recent years. Of the exports, on average, 53% of Nicaraguan peanut exports shipped to Mexico, 19% to EU, and 12% to Central American countries in 2001.

Mexico is largely reliant on imports of major oilseeds. Despite the economic volatility that has characterized the Mexican market recently, imports, exports, and domestic consumption of peanuts have steadily increased over the last three years.

The U.S., Nicaragua, and Argentina will continue to be Mexico's main peanut suppliers. As a result of lower prices, peanut imports from Argentina have become very attractive to Mexican peanut importers. Argentina's good crop quality and attractive prices in 2001 impelled Mexican importers to increase Argentine peanut imports by approximately 33 % in 2001.

Conceptual Framework

One approach to modeling the effects of trade liberalization would be to build a structural econometric model consisting of behavioral equations to explain the supply and demand decisions in the market, including producers, consumers, traders, and state agencies involved in the market. However, this would require a large model that embodies many overidentifying restrictions drawn from economic theory. These restrictions usually take the form of excluding variables from particular equations to motivate a particular economic interpretation for the model (Harmon, Preckel, and Eales, 1998). Of course, it is not necessary to work with large systems because there are methods for estimating individual structural equations embedded within a larger system (Seamon and Kahl, 2000). However, estimating liberalization effects in individual equations only provides information on the effects of liberalization on the behavior of the particular agent being modeled. A structural approach to estimating the effects of market reform on equilibrium prices would require behavioral equations for all market participants at each stage in the system, from production to marketing to consumption.

An alternative is to specify a reduced form model for equilibrium price levels. Such a model would include variables that might be included in behavioral equations drawn from economic theory, but otherwise the model is left relatively unrestricted. Data availability will also affect what can be feasibly estimated (Judge et. al. 1985, Chapter 16). In this study, historical price correlations are assumed by including lagged variables, and statistical criteria are used to determine how many lags to include. When the price correlation exists, it may be more efficient to estimate all equations jointly, rather than to estimate each one separately using least squares. The appropriate joint estimation technique is known as seemingly unrelated regressions estimation (SUR). The advantage of this approach is that the minimal restrictions applied to the reduced form provide flexibility that allows the model to be consistent with a wide range of alternative economic structures (Judge et. al. 1988, Chapter 11).

In addition to the estimated structural coefficients of the model, the estimation approaches used in this study generate several statistics such as adjusted R^2 (adj R^2), Durbin-

Watson (D-W), Durbin's *h* (D-*h*), and t-statistics. Based on various statistical tests for autocorrelation, heteroscadasticity, and normality, the model specification and the validation tests are conducted to determine if the estimation method employed in this study is appropriate.

The model is composed of supply, demand, trade, and price equations. Individual country sub-models include behavioral equations for acreage response, yield, production, consumption, import, export, and price. The yield and acreage response are estimated for the supply and an identity for production. For the demand, per capita consumption, feed use, and crush consumption are estimated. In the trade equations, export and import are estimated.

Based upon the derived model, the supply and demand as well as export and import elasticities are derived. In addition, the price equation is assumed to be affected by the ratio between total supply and demand, world price, lagged price, and dummy variables.

The specifications for the study are as follows:

Supply Specification

1) Yield:

$$YD_{it} = f\,(Trend, AHA_{it}, D_{it}, e_{1t})$$

2) Acreage Response:

$$AHA_{it} = f\,(AHA_{it-1}, DPEAP_{it}, YD_{it}, e_{2t})$$

3) Import:

$$IM_{it} = f\,(PROD_{it}/CON_{it}, WPRICE_{t}/DPEAP_{it}, D_{it}, e_{3t})$$

4) Production:

$$PROD_{it} = YD_{it} * AHA_{it}$$

5) Total Supply:

$$TSUP_{it} = PROD_{it} + IM_{it}$$

Demand Specification

6) Per Capita Consumption:

$$PCON_{it} = f(GDP_{it}, DPEAP_{it}, PCON_{it-1}, e_{4t})$$

7) Human Consumption:

$$CON_{it} = PCON_{it} \times POP_{it}$$

8) Crush Consumption:

$$CCON_{it} = f(DPEAP_{it}, PROD_{it}, EXP_{it}, e_{5t})$$

9) Export:

$$EXP_{it} = f(WPRICE_{t}, PROD_{it}, CON_{it}, e_{6t})$$

10) Total Consumption:

$$TCON_{it} = CON_{it} + CCON_{it} + EXP_{it} + \text{Other Consumption}$$

11) Equilibrium Condition:

$$\sum (TSUP_{it} - TCON_{it}) = 0$$

Price equation

12) Domestic Price:

$$DPEAP_{it} = f(PROD_{it}/ TCON_{it}, WPRICE_{t}, DPEAP_{it-1}, D_{it}, e_{7t})$$

where GDP_{it} is real income at time t in country i, $WPRICE_{it}/DPEAP_{it}$ is the price ratio between world price and domestic price at time t in country i, $DPEAP_{it}$ is peanut price at time t in country i, and D_{it} and e_{it} are dummy variables for unusual weather condition and the error terms, respectively. All of the prices and income variables are deflated by consumer price index (CPI), and the CPI is omitted for simplicity.

Historical production and demand data for the Latin American peanut industry is collected from the Foreign Agricultural Service (FAS), U.S. Department of Agriculture (USDA). However, USDA/FAS does not provide 30-year annual data for Nicaragua. Therefore, the data for Nicaragua is obtained from Attaché reports and Nicaraguan export agencies. In addition, demographic data for those countries is collected from the World Bank, IMF, Latin American government agencies, and Banks of Latin American countries. The data used for the research is an annual time series data for 1972 – 2000.

Empirical Results

For the Latin American peanut industries, the seemingly unrelated regression (SUR) estimation method is used. In a general form, the multi-country peanut industry model can be depicted as follows:

13) $y_{1t} = \beta_{10} + \beta_{11} x_{1t} + \ldots + \beta_{1i} x_n + e_{1t}$

$y_{2t} = \beta_{20} + \beta_{21} x_{2t} + \ldots + \beta_{2i} x_n + e_{2t}$

.

$y_{vt} = \beta_{v0} + \beta_{v1} x_{vt} + \ldots + \beta_{vi} x_n + e_{vt}$

where y_{vt} denotes the number of endogenous variables, n represents the number of exogenous variables, β stands for the corresponding parameter estimates, and e_{vt} are the uncontrolled factors in the system of equations. These equations can be written in the usual matrix algebra notation. In a general specification of M seemingly unrelated regression equations the *i*th equation is given by

14) $\boldsymbol{Y}_i = \boldsymbol{X}_i\boldsymbol{\beta}_i + \boldsymbol{e}_i \qquad i = 1,2, \ldots, \mathrm{M}$

However, since there exists autocorrelation in the model, we adopted Prais-Winsten transformation method as following steps: 1) each equation is estimated separately by OLS, $\boldsymbol{Y}_i = \boldsymbol{X}_i\boldsymbol{\beta}_i + \boldsymbol{e}_i$, 2) ρ_i is estimated from $e_{it} = \rho_i\, e_{i,\, t-1} + u_{it}$, 3) each equation is transformed using Prais-Winsten, $\boldsymbol{Y}_i^* = \rho_i\boldsymbol{Y}_i$ and $\boldsymbol{X}_i^* = \rho_i\boldsymbol{X}_i$, and 4) the transformed model is estimated by SUR.

The results of the estimation show the expected signs for all explanatory variables that are implied in the theory of production and consumption except yield variable in Mexican acreage response equation. However, the signs for income and price in Argentine per capita consumption equation are negative and positive, respectively. They might be either the wrong signs or this is because peanuts are not grown for domestic markets like it is in the U.S. The prices received by peanut farmers in acreage response equations have a positive impact and they are all statistically significant at the 5% level. In addition, the soybean price in Brazilian area equation has a negative impact with an estimate of 0.1988 and it is statistically significant at the 5% level. In the meantime, the coefficient estimates of the lagged dependent variables show a stable geometric lag process, and support the existence of a lagged distribution of the dependent variables. The results for supply, demand, and prices are summarized in Table 1, 2, and 3, respectively.

In the yield equations for all countries, the time trend variable as a proxy for the technology is the most significant factor that affects yield except for Argentina. However, one-year lagged area has significant influence on yield for Argentina and Nicaragua. However, the variable does not affect yield significantly for Mexico. It is statistically significant at the 5% level for all countries except for Mexico. A dummy variable is used for Nicaraguan yield to explain unusual weather and other conditions for the years of 1984 and 1985 (Table 1).

For the importing countries such as Mexico and Brazil, the significant factors influencing their imports are production and consumption variables as we expected. If production shortage (surplus) occurs, the countries' imports have increased (decreased). The variables are statistically significant at the 5% level. In addition, world peanut price has a negative effect on peanut import for Brazil and Mexico. Furthermore, the trade equations show all the expected signs for all the explanatory variables, including world peanut price and it is statistically significant, except for Brazil. There are some reasons for the Brazilian insignificancy. First, Brazil has experienced financial turmoil several times for the past two decades. Thus, the deflator, used for the study, obtained from the IMF, may not be appropriate. Moreover, it may not matter to peanut growers if world or domestic price fluctuates because they cannot have any financial support from their government. This means that they would not be able to transfer their peanut area to other crops. Third, Brazilian peanut farmers heavily switched their peanut planting areas to soybeans between mid 1970s and late 1990s due to the government supports to soybean farmers.

For per capita consumption equation, it is hypothesized to be influenced by real prices, income levels, habit formation, and other exogenous variables. The habit formation variable seems to be a dominant factor affecting human consumption in these countries. The variable is statistically significant at the 5% level with proper signs for all countries (Table 2).
In export equations for Argentina and Nicaragua, the world price has a positive impact on both countries. However, it is not statistically significant for Nicaragua. For other consumption such as crush consumption for Argentina and feed consumption for Brazil and Nicaragua, production variable has a positive impact and exports and human consumption have a negative impact on feed and crush consumption as we expected.

For the price equations, it is assumed that the price is affected by changes in production shortage (surplus), lagged price, and world price. The world peanut price has a positive effect on the domestic prices, but it is not statistically significant for Argentine and Nicaraguan domestic price equations. That might be because the peanut industry in both countries has been managed by few oligopolistic firms. Thus, those companies might be able to effect on the domestic prices rather than effected by the world price. However, the world peanut price is statistically significant for the importing countries such as Brazil and Mexico (Table 3).

The supply elasticities for all countries are derived based on the estimation results. The supply elasticities for Argentina, Brazil, Mexico, and Nicaragua are 0.18, 0.21, 0.41, and 0.89, respectively (Table 4). The supply elasticity for Nicaragua is the most elastic compared to the other countries because the peanut industry has been growing dramatically since 1995.

Moreover, the Nicaraguan peanut industry has been restructuring its infrastructure and marketing channel. Therefore, this recent structural changes might influence its supply elasticity.

The price elasticities of demand for Argentina, Brazil, Mexico, and Nicaragua are 0.012, -0.313, -0.008, and –0.103, respectively. Regarding import and export elasticities, for importing countries such as Brazil and Mexico, the eslaticities are inelastic since these countries' import patterns are consistently stable. However, the export elasticity for Nicaragua is more elastic than other countries since the Nicaraguan peanut producers have been focusing on export, particularly to the U.S. and Mexico. Therefore, the Nicaraguan export industry appears to be more sensitive to the prices than the other countries.

Scenario Analysis

This analysis focuses on the domestic impact on supply, demand, and net trade by potential changes in the domestic prices rather than the world price. That is because these countries' impact on the world market has been minimal. Therefore, we consider that these countries have a small-country effect due to their small production volume in international markets. For example, the Latin American peanut production was less than one million metric tons in 2000 comparing with approximately 31 million metric tons in the world production.

Considering the fact, we assume that the industry does not affect the world peanut price significantly. Thus, we consider the world price variable as an exogenous factor.

Furthermore, there are no trade barriers in the Latin American peanut industry. Therefore, the industry needs to be analyzed as a free trade market. Even though Argentina has a 3.5% export tax on unprocessed groundnuts, it has not influenced farmers' production decision dramatically. In addition, according to recent WTO negotiations, it will be eventually eliminated.

However, in recent years, the Latin American peanut industry has a tendency to increase its trade volume. For example, from 1991 to 1994, the average trade volume was approximately 88 thousand metric tons, but it has increased to 198.5 thousand metric tons from 1995 to 2000. This tendency indicates that the Latin American peanut industry might be able to play an important role in the world peanut market in the future. Therefore, four additional scenarios are examined based upon the world price changes in the scenario analysis. For this reason, the domestic prices are endogenized assuming that the world price is a significant factor affecting the Latin American domestic peanut prices.

Thus, eight reasonable scenarios are examined according to the price shocks on individual country's domestic prices and the world price. The eight scenarios are separated into two scenario analyses as follows:

The domestic peanut price change is the first analysis as follows:

1) 20 percent decrease in domestic price
2) 10 percent decrease in domestic price
3) 10 percent increase in domestic price
4) 20 percent increase in domestic price.

The world price change is the second scenario analysis as follows:

1) 20 percent decrease in the world price

2) 10 percent decrease in the world price

3) 10 percent increase in the world price

4) 20 percent increase in the world price.

The scenario analysis is conducted in an aggregated context assuming that farmers adjust their production decision in accordance with the exogenous shock. The base year is 1991 because the year was a turning point for the Latin American peanut industry. The simulation results are reported in sum from Table 5.1 to Table 7.2.

As seen in Table 5.1, the Latin American peanut supply seems to increase as their domestic prices increase. The supply volume ranges from 619 thousand metric tons to 1052 thousand metric tons in the entire simulation time period. Their production volume changes approximately 5% by the exogenous price shock on average. In addition, the production volume has a tendency to increase continuously.

In the meantime, the supply volume in the second scenario analysis seems to be lower than that of the first scenario analysis on average. The supply volume based upon the world price shock ranges from 514 thousand metric tons to 1113 thousand metric tons (Table 5.2). The main reason for the lower average production volume is that the base for the first scenario is estimated higher than the second scenario as seen in the Tables 5.1 and 5.2. Moreover, the domestic price shock has larger production volume with the entire price changes, which ranges from 20% increase to 20% decrease in domestic prices except for the year of 1997. Overall, according to the scenario analysis regarding the changes in the world and domestic prices, the Latin American peanut industry has been more sensitive to the domestic price changes than the world price variations.

In Tables 6.1 and 6.2, there is no noticeable change in the scenario analysis for the Latin American peanut demand, which means the Latin American demand would be stable and the price variables are negligible. As seen in the Tables, the Latin American peanut demand would increase slightly for the simulation time period. Therefore, it is expected to continue to increase slightly in the near future due to the increasing demand for processing industry.

However, the Latin American peanut demand is not significantly affected by both the world and domestic price changes for the entire scenarios. It could be explained by the fact that the human consumption in the Latin America has been small compared to crushing and feed consumption. Thus, the volume of demand would be dependent on the processing industry, which has a steady increasing peanut demand.

For the net trade scenario (Tables 7.1 and 7.2), the base seems underestimated for the domestic price changes, compared to the actual net trade for the domestic price shock. However, this analysis traces the trend for the net trade fairly good. The Latin American net trade volume decreases significantly as their domestic prices increase, which means that the peanut farmers would intend to export their peanuts to the world markets as their domestic prices decrease. However, the net trade volume from 10% decrease to 20% increase in price is not significant, compared to that of 20% decrease in price. This may indicate that the Latin American peanut farmers do not have a high tendency to continue to export their products unless the domestic prices change dramatically. Furthermore, the scenario analysis shows that the domestic price changes affect the net trade drastically. Regarding the world price shock, there is no significant changes for the entire price changes for supply, demand, and net trade.

As seen in the Table 7.2, the world price shock does not affect the Latin American net trade dramatically. The net trade changes slightly as the world price changes. This might imply that the Latin American peanut farmers are more sensitive to the changes in domestic prices than the world price changes.

In the scenario analysis, we have found that the domestic price changes from 20% decrease to 20% increase do not affect their demand dramatically, but their effects on the supply and net trade schedule are noticeable, roughly, from 5% to 15% even though their supply elasticities are inelastic. However, the world price does not affect the Latin American peanut industry significantly, including supply, demand, and net trade. Therefore, it can be summarized that the domestic price changes would affect the Latin American peanut industry more than the world price changes. In supply side, the domestic price can affect by 10% in volume, and the net trade could be affected by the domestic price changes significantly. Roughly, the domestic price changes from 20% increase to 20% decrease could affect the Latin American net trade by more than 50%. This implies that the Latin American peanut farmers are more sensitive to the domestic price policy than to the world price changes.

Concluding Remarks

The objective of the study was to analyze the Latin American peanut industry, including Argentina, Brazil, Mexico, and Nicaragua. Since there has not been any detailed research on the Latin American peanut industry, it has been very difficult for policy makers and people engaged in international trade to judge their competitiveness and movement toward the ongoing WTO and FTAA negotiations in the fast-changing and dynamic export market. Therefore, this paper is an attempt to provide information and analyses to support public and private decision making related to peanut marketing and trade.

The U.S. food market is very attractive to foreign peanut producers, especially Latin America due to the geographic proximity. If the tariff rate quota (TRQ) protection were eliminated, a share of the U.S. domestic peanut market may be captured by foreign peanuts and products. Therefore, this paper attempts to examine the possible implications of the fast growing Latin American peanut industry.

Based upon the estimation findings, the Argentine peanut farmers have a greater willingness to respond to favorable world market prices than the other three countries with respect to their exports. In addition, Argentine peanut farmers also have a high willingness to develop export markets. For the other countries, the world price does not affect planting and trade decisions. In addition, it is noticeable that supply and export elasticities for Nicaragua are more elastic than those of the other countries. This implies that Nicaraguan peanut producers might be more sensitive to a change in prices depending upon how much peanut they produce. However, since these countries have recently experienced financial turmoil, future research should address this aspect of the peanut industry more specifically. In fact, most Latin American countries have consolidated their exchange rates regimes, ending preferential and multiple exchange rate systems due to the economic crisis. Countries have also moved from fixed exchange rates to managed crawling peg or floating exchange rate regimes. However, there has not been official data for the economic indicators regarding those changes in exchange rate and consumer price index revealing price changes and inflation rates. Therefore, we could not be able to incorporate the reforms for the study.

In the scenario analysis, we could conclude that the both price shocks do not affect the Latin American demand significantly, but the supply side was influenced by the domestic price shock by approximately 15% in production volume. In addition, the Latin American net trade of peanut was affected by roughly 50% in the domestic price change scenario, compared to less than 10% in the world price change scenario analysis.

In the meantime, peanuts could be affected by an FTAA. U.S. producers of "additional" peanuts dominated the world export market, under the 1996 Farm Act, indicating that this segment of the industry could compete effectively at world prices and could benefit under an FTAA. However, since the 2002 Farm Act has eliminated the U.S. peanut marketing quota system, which has been the major U.S. peanut policy since 1933, liberalization of the U.S. peanut market under an FTAA would likely imply a continued movement of the industry away from the traditional production areas. Complete liberalization of the U.S. peanut market within an FTAA would drive the domestic peanut price down toward world price levels, or perhaps even raise the world price to meet the domestic peanut price. Thus, the Latin American peanut industry would become more competitive within an FTAA, even within the world peanut industry since their prices are strongly competitive compared to those of the U.S. Therefore, the U.S. peanut industry must consider strategies to enhance its competitive position in order to compete with peanut export countries such as Argentina and Nicaragua.

ABSTRACT

The Latin American peanut industry is estimated using SUR. In scenarios, their demand is not affected dramatically by both price changes. The price changes affect the Latin American supply by roughly 15% and net trade by approximately 50%, compared to less than 10% in world price shock.

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Table 1. Empirical Results for Supply

Argentina:

$$\text{Yield } (YD_t) = \underset{(20.67)^*}{1.0644} + \underset{(1.19)}{0.0025}\ \text{Trend} - \underset{(-12.71)^*}{0.0013}\ AHA_{t-1}$$

Adj R^2: 0.29, DW: 1.95

$$\text{Area Harvested } (AHA_t) = \underset{(0.14)}{3.2684} + \underset{(14.2)^*}{0.8223}\ AHA_{t-1} - \underset{(-1.31)}{0.249}\ YD_t + \underset{(2.43)^*}{7.2638}\ APRICE_t$$

Adj R^2: 0.63 D-*h*: 1.1

Brazil:

$$\text{Yield } (YD_t) = \underset{(27.37)^*}{1.1467} + \underset{(7.12)^*}{0.01702}\ \text{Trend}$$

Adj R^2: 0.53, DW: 1.96

$$\text{Area Harvested } (AHA_t) = -\underset{(-0.79)}{18.3974} + \underset{(19.12)^*}{0.8855}\ AHA_{t-1} - \underset{(-2.04)^*}{0.1988}\ \text{Soybean } PRICE_t + \underset{(4.11)^*}{0.2128}\ PRICE_t$$

Adj R^2: 0.87, D-*h*: 0.97

$$\text{Import } (IM_t) = \underset{(11.91)^*}{37.9868} - \underset{(-9.75)^*}{29.7614}\ (PROD_t/CON_t) - \underset{(-0.89)}{0.1823}\ (WPRICE_t/BPRICE_t)$$

Adj R^2: 0.30, DW: 1.91

Mexico:

$$\text{Yield } (YD_t) = \underset{(15.6)^*}{0.397} + \underset{(1.18)^*}{0.0032}\ \text{Trend} - \underset{(-0.44)}{0.0003}\ AHA_{t-1}$$

Adj R^2: 0.51, DW: 1.71

$$\text{Area Harvested } (AHA_t) = \underset{(1.08)}{4.1833} + \underset{(12.08)^*}{0.6366}\ AHA_{t-1} + \underset{(6.45)^*}{33.4702}\ YD_t + \underset{(2.42)^*}{0.0002}\ PRICE_t$$

Adj R^2: 0.48, D-*h*: 1.0

$$\text{Import } (IM_t) = \underset{(0.42)}{8.3291} - \underset{(-2.52)^*}{0.6989}\ PROD_t - \underset{(-1.87)^{**}}{0.0426}\ WPRICE_t + \underset{(2.20)^*}{0.3723}\ CON_t$$

Adj R^2: 0.44, DW: 1.76

Nicaragua:

$$\text{Yield } (YD_t) = \underset{(11.18)^*}{1.5269} + \underset{(3.69)^*}{0.0331}\ \text{Trend} - \underset{(-2.0)^*}{0.00001}\ AHA_{t-1} - \underset{(-11.23)^*}{1.0444}\ D8485$$

Adj R^2: 0.52, DW: 2.23

$$\text{Area Harvested } (AHA_t) = \underset{(1.71)^{**}}{1356} + \underset{(16.44)^*}{0.9115}\ AHA_{t-1} + \underset{(2.29)^*}{0.01285}\ NPRICE_t$$

Adj R^2: 0.62, D-*h*: 1.03

a: the numbers in the parentheses represent t-value.
b: * indicates the coefficient is statistically significant at the 5% level.
c: ** indicates the coefficient is statistically significant at the 10% level.

Table 2. Empirical Results for Demand

Argentina:

Per Capita $(LnPCON_t) = 4.1407 - 0.88204\,Ln(INCOM_t) + 0.01205\,Ln(PRICE_t) + 0.442\,Ln(PCON_{t-1})$

(16.66)* (-14.17) (-2.91)* (35.19)*

Adj R^2: 0.67 D-h: 1.0

Export $(EXP_t) = 3.883 + 0.8573\,PROD_t/CON_t - 0.00132\,EXP_{t-1} + 0.00056\,WPRICE_t$

(31.37)* (13.77)* (-21.09)* (4.87)*

Adj R^2: 0.29 D-h: 1.08

Crush $(CRUH_t) = -322.384 - 157.192\,EXP_t - 4.0233\,CON_t + 0.5087\,CRUH_t + 0.0414\,WPRICE_t$

(-2.40)* (-2.63)* (-1.71)** (8.39)* (0.88)

Adj R^2: 0.12 D-h: 0.87

Brazil:

Per Capita $(LnPCON_t) = 0.2461 + 0.3139\,Ln(INCOM_t) - 0.313\,Ln(PRICE_t) + 0.9024\,Ln(PCON_{t-1})$

(0.33) (1.82)** (-2.74)* (14.53)*

Adj R^2: 0.77 D-h: 0.94

Feed $(FEED_t) = 1.413 + 0.129\,PROD_t - 0.4076\,EXP_t - 0.0224\,FEED_{t-1}$

(0.43) (9.12)* (-4.66)* (-0.52)

Adj R^2: 0.56 DW: 2.09

Export $(EXP_t) = 2.0338 + 0.6569\,PROD_t - 0.6314\,CON_t + 0.0012\,WPRICE_t$

(0.72) (21.4)* (-18.52)* (0.34)

Adj R^2: 0.90 DW: 2.28

Mexico:

Per Capita $(LnPCON_t) = -6.33 + 1.4154\,Ln(INCOM_t) - 0.0081\,Ln(PRICE_t) + 0.008\,Ln(PCON_{t-1})$

(-4.23)* (-6.28)* (-0.96) (25.12)*

Adj R^2: 0.55 D-h: 1.01

Feed $(FEED_t) = 0.8586 + 0.0012\,PROD_t - 0.0501\,EXP_t + 0.6889\,FEED_{t-1}$

(6.15)* (1.50) (-18.59)* (18.73)*

Adj R^2: 0.62 D-h: 0.79

Nicaragua:

Per Capita $(LnPCON_t) = 0.74 + 0.476\,Ln(INCOM_t) - 0.1028\,Ln(PRICE_t) + 0.5836\,Ln(PCON_{t-1})$

(0.93) (0.16) (-10.53)* (14.42)*

Adj R^2: 0.46 D-h: 0.41

Export $(EXP_t) = 0.0195 + 0.0018\,PROD_t/CON_t + 0.0005\,WPRICE_t$

(1.37) (1.74)** (1.53)**

Adj R^2: 0.14 DW: 1.99

Feed $(FEED_t) = 0.1548 + 0.0106\,PROD_t - 0.00008\,PRICE_t + 0.4183\,FEED_{t-1}$

(2.12)* (1.57)** (-2.08)* (1.39)

Adj R^2: 0.69 D-h: 1.39

a: the numbers in the parentheses represent t-value.

b: * indicates the coefficient is statistically significant at the 5% level.

c: ** indicates the coefficient is statistically significant at the 10% level.

Table 3. Empirical Results for Domestic Price Equations

Prices:

Argentina Price:

$$APRICE = \underset{(4.08)^*}{141.62} - \underset{(-4.49)^*}{149.661}\ PROD_t/CON_t + \underset{(3.41)^*}{0.2203}\ APRICE_{t-1} + \underset{(0.17)}{0.0202}\ WPRICE_t$$

Adj R^2: 0.21, D-h: 0.94

Brazilian Price:

$$BPRICE = \underset{(4.14)^*}{339.217} - \underset{(-3.70)^*}{247.706}\ PROD_t/CON_t + \underset{(11.01)^*}{0.4949}\ BPRICE_{t-1} + \underset{(1.64)^{**}}{0.0622}\ WPRICE_t$$

Adj R^2: 0.37, D-h: 0.91

Mexican Price:

$$MPRICE = \underset{(3.68)^*}{6834.25} - \underset{(2.85)^*}{5458.657}\ PROD_t/CON_t + \underset{(18.42)^*}{0.7158}\ MPRICE_{t-1} + \underset{(3.47)^*}{6.1729}\ WPRICE_t$$

Adj R^2: 0.69, D-h: 0.98

Nicaraguan Price:

$$NPRICE = \underset{(0.45)}{234.157} - \underset{(-3.95)^*}{527.543}\ PROD_t/CON_t + \underset{(4.83)^*}{0.2366}\ NPRICE_{t-1} + \underset{(0.83)}{11.917}\ WPRICE_t$$

Adj R^2: 029, D-h: 1.02

a: the numbers in the parentheses represent t-value.
b: * indicates the coefficient is statistically significant at the 5% level.
c: ** indicates the coefficient is statistically significant at the 10% level.

Table 4. The Elasticities of Supply, Demand, Import, and Export.

Elasticity	Argentina	Brazil	Mexico	Nicaragua
Supply	0.18	0.21	0.41	0.891
Demand	0.012	-0.313	-0.008	-0.103
Import	N/A	-0.42	-0.29	N/A
Export	0.369	N/A	N/A	0.86

Note: the elasticities are derived at the mean.

Table 5.1 Domestic Price Change on Supply (1000MT)

Year	Actual	Base	+20%	+10%	-10%	-20%
1991	529	884	961	941	861	819
1992	540	833	915	893	845	765
1993	496	684	758	740	653	623
1994	577	692	715	708	666	619
1995	791	848	925	905	887	785
1996	657	901	969	953	880	845
1997	1047	896	957	942	864	837
1998	736	882	984	934	870	820
1999	908	990	1052	1039	944	937
2000	860	931	1017	980	905	855

Table 5.2 World Price Change on Supply (1000MT)

Year	Actual	Base	+20%	+10%	-10%	-20%
1991	529	570	573	574	563	556
1992	540	563	569	570	561	553
1993	496	519	520	523	516	514
1994	577	642	648	644	639	639
1995	791	841	846	843	798	767
1996	657	731	758	748	721	707
1997	1047	1010	1113	1065	1012	995
1998	736	882	919	915	908	901
1999	908	910	931	925	901	858
2000	860	851	868	832	819	764

Table 6.1 Domestic Price Change on Demand (1000MT)

Year	Actual	Base	+20%	+10%	-10%	-20%
1991	584	524	562	564	569	570
1992	530	527	569	570	575	577
1993	531	499	558	559	564	565
1994	561	542	566	567	570	571
1995	768	699	678	691	694	695
1996	684	667	668	669	672	673
1997	1050	798	795	796	799	801
1998	805	766	764	766	769	771
1999	929	765	773	774	776	778
2000	890	873	872	873	876	877

Table 6.2 World Price Change on Demand (1000MT)

Year	Actual	Base	+20%	+10%	-10%	-20%
1991	584	545	522	546	537	552
1992	530	530	543	556	572	577
1993	531	493	552	564	558	562
1994	561	530	561	576	584	593
1995	768	633	715	733	728	748
1996	684	662	636	649	662	670
1997	1050	987	896	889	932	940
1998	805	736	776	848	829	865
1999	929	925	883	909	899	917
2000	890	862	884	885	893	899

Table 7.1 Domestic Price Change on Net Trade (1000MT)

Year	Actual	Base	+20%	+10	-10%	-20%
1991	100	62	19	30	63	75
1992	87	74	24	56	79	80
1993	96	69	19	40	83	84
1994	70	42	8	49	61	61
1995	258	179	109	163	224	242
1996	131	96	53	74	96	105
1997	309	271	102	136	221	224
1998	190	175	113	124	176	193
1999	140	168	74	115	136	141
2000	163	144	81	109	150	177

Table 7.2 World Price Change on Net Trade (1000MT)

Year	Actual	Base	+20%	+10%	-10%	-20%
1991	100	101	83	104	99	95
1992	87	88	81	87	88	89
1993	96	85	77	84	86	88
1994	70	83	72	82	85	82
1995	258	222	200	221	222	223
1996	131	160	145	161	167	176
1997	309	254	241	244	261	272
1998	190	187	165	185	190	199
1999	140	143	99	133	140	146
2000	163	124	90	122	131	133