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Time Series Forecasts of Mexican Import Demand for Fluid Milk and Cheese

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ABSTRACT

Time Series Forecasts of Mexican Import Demand for Fluid Milk and Cheese

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Import demand for fluid milk and cheese in Mexico is forecast from 1996 to 2000. Estimated demand functions were used to forecast prices, real incomes, and import quantities. Results indicate that fluid milk imports are forecast to rise by 5,000 to 8,500 metric tons per year, reaching 43,000 metric tons by the year 2000. Cheese imports on the other hand, are not expected to continue the strong growth of the early 1990's, but should stabilize near 10,000 metric tons. Implications for U.S. dairy exports are discussed.

Key words: Mexican dairy imports, forecasting import demand, dairy trade, import demand estimation, dairy exports.
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Introduction

Mexican dairy product imports have experienced strong growth in past years, especially preceding the implementation of the North American Free Trade Agreement (NAFTA). Fluid milk, cheese, and whey exhibited the fastest growth rates among all Mexican dairy products imports, increasing by 201 percent, 101 percent, and 887 percent respectively, from 1990 to 1993. Imports of other products such as non-fat dry milk, butter, yogurt and ice-cream have also increased. With future income growth, Mexico is anticipated to become a larger export market for fluid milk, butter, cheese, and yogurt. Although recently, due to the devaluation of the Mexican peso and the subsequent economic crisis, there has been a fall in dairy imports to Mexico, dairy product imports will remain important and are expected to grow as their consumption increases.

In a previous study, the authors estimated domestic and import demand functions for four dairy products in Mexico (Tanyeri-Abur and Rosson). The results indicate how aggregate dairy consumption in Mexico varies with changes in incomes, prices, and domestic and trade policies. Results indicate that the demand for fluid milk is the most responsive to price changes and non-fat dry milk (NFDM) demand is inelastic with respect to its own price. There is no evidence of a strong substitute relationship between fluid milk and non-fat dry milk, although fluid milk demand is relatively elastic, which suggests the existence of other substitutes for fluid milk.
The fact that price elasticity for fluid milk is elastic suggests the existence of substitutes and might lead one to hypothesize whether or not other drinks, such as Coca-Cola® or other soft drinks, are stronger substitutes for fluid milk than NFDM. Income elasticities show that fluid milk, butter, and cheese are consumed more at higher income levels whereas non-fat dry milk has a low income elasticity.

Recent economic events affecting U.S./Mexico trade, along with the NAFTA and the Uruguay Round Agreements (URA) of the General Agreement on Tariffs and Trade (GATT), will impact Mexican dairy product imports in the near and long term. Changes in both the U.S. and Mexico in grain and livestock sectors will also affect dairy trade.

This paper estimates the import demand for fluid milk and cheese and forecasts Mexican fluid milk and cheese imports from 1996 to the year 2000. Import demand functions for fluid milk and cheese were estimated using data from 1975 to 1995. Estimated demand functions were used to forecast prices for fluid milk and cheese, along with real income for Mexico. These forecasts were then used to forecast import quantities for the two products for 1996-2000.

Import demand forecasting for Mexico is a difficult task. Time series data are often unreliable and limited, coming from many different sources. There are numerous government policies affecting economic variables, which are difficult to model accurately. Despite these problems, the results of this study are theoretically sound and provide a departure point for more detailed analysis.

The next section gives an overview of the Mexican dairy sector and domestic and trade policies affecting dairy products. The following sections describe the import demand model and its estimation,
the forecasting model and summarizes forecasted values for fluid milk and cheese imports, and conclusions and implications for further research, respectively.

**Overview of the Mexican Dairy Sector**

The Mexican dairy sector is characterized by government intervention in the form of producer and consumer price policies and subsidies. Agricultural performance was quite favorable in the early 1980’s, strongly supported by subsidies as part of the Sistema Alimentario Mexicano (SAM). In 1982, following a drought and economic crisis brought on by falling oil prices, agricultural Gross Domestic Product (GDP) fell 29 percent, while fixed investment, wages, and cultivated land diminished significantly. Agricultural imports declined 54.6 percent in the same year. In 1982, several government policies were instituted which influenced the dairy sector. Price controls were put in at every level of milk production and marketing (production, processing, and consumption). Retail prices were fixed, despite rising production costs which led to a slow expansion in milk production, chronic production shortfalls, and higher imports.

Milk and dairy products as a group were Mexico’s principal food imports in 1993 with a volume of 445,000 metric tons (mt) and a value of $626.3 million. During the early 1990s, Mexico became the world’s largest importer of NFDM. In 1992, Mexican milk and dairy products had a Nutritional Dependency Coefficient of .38, which has been steadily increasing over the past four years. This coefficient reveals an increased dependency by Mexico on imported dairy products.

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3The nutritional dependency coefficient is calculated as: imports/total disposable milk supplies, where total disposable supplies equal imports plus production.
Mexican dairy policy has favored the consumer at the expense of the dairy producer. Consequently, Mexican milk production has a relatively low producer subsidy equivalent (PSE) of -56, reflecting an equivalent 56 percent tax on dairy producer incomes. The principal factor that explains the negative PSE is a producer price for milk maintained below market clearing levels through the early 1990s. Decapitalization forced many dairy farmers out of production, especially those who produced higher cost, low quality milk.

Milk price controls also resulted in lower milk production and the increased use of social programs to meet the dietary needs of consumers. There was an increased demand for products whose prices were not controlled, such as cheese, yogurt, and butter. In addition, 80 percent vegetable fat was substituted for butterfat in some dairy products, leading to claims of adulteration.

Dairy product consumption shows distinct patterns in Mexico. Per capita consumption of fluid milk is much less when compared to levels in the United States of the European Union. However, per capita consumption of NFDM is two to three times higher. Fresh fluid milk is not a traditional consumption item and protein source in Mexico because of its perishability, high cost of transport, and refrigeration requirements. The high consumption of NFDM occurs because it is easy to store and transport without refrigeration and also because of government subsidies which have altered the taste preferences of the Mexican consumers, especially the poor. So, one would expect a low price elasticity of NFDM compared to fluid milk, since fluid milk is not a staple. Fluid milk is consumed by higher income groups mainly in urban areas.

Cheese is a very important item in the daily diet of the average Mexican household. It is consumed either as an appetizer or topping, or as a main dish, replacing meat or eggs. Different types
of cheese are used for different purposes. However, the majority of Mexican consumers prefer fresh cheeses to aged ones. Demand for cheese is also influenced by income levels where fresh, less expensive, cheeses are consumed at lower income levels and aged, more expensive, cheeses are consumed more at middle and high income levels. In 1992, 10 percent of total cheese consumption was made up of imports which were mostly hard or semi-hard cheeses.

Prior to 1986, the Mexican dairy sector was, like most of the rest of the Mexican economy, characterized by high tariffs, prevalent non-tariff barriers, such as licensing, and extensive government involvement in import purchases. Since Mexico's entrance into GATT in 1986 and the beginnings of a more open economy, trade barriers have been lowered, and in the case of import licensing, eliminated. In early 1992, CONASUPO began negotiating direct purchases with individual bids instead of using public tenders as it had previously. In 1996, consumer milk prices were deregulated, leading to higher prices in most regions of the country. These NFDM purchases were held as stocks and in turn sold to Mexican dairy product producers.

Under the NAFTA, Mexico converted its import license for NFDM to a tariff-rate-quota (TRQ) to be phased out over fifteen years. For the U.S., the first 881,840 cwt of skim and whole milk powder will enter the Mexican market duty free. Imports over the quota level are assessed a tariff of 133.4 percent or $1136.6/mt and will gradually be phased out by the year 2008.

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4 Compania Nacional de Subsistencias Populares or National Company for Public Food Supplies.
Mexico immediately converted its aged cheese import licensing regime to a tariff of 20 percent to be reduced to zero over a ten year period. Fresh cheese is assessed a 40 percent tariff to be phased out over ten years. For 1997, the import duty for fluid milk was six percent.

**U.S. Dairy Exports to Mexico**

Trade liberalization and economic growth in Mexico led to increased demand for U.S. dairy products in the early 1990s, but exports have since declined due primarily to lower sales of nonfat dry milk (Figure 1). NFDM and evaporated milk combined to account for 87 percent of all U.S. dairy exports to Mexico in 1996, with the major of shipments subsidized under the Dairy Export Incentive Program (DEIP). Economic recession, a weaker peso and higher import prices, lower consumer spending-especially on higher value foods, and reduced DEIP sales all combined to reduce the demand for U.S. exports.

**Import Demand Estimation**

Import demand functions have traditionally included own price, relative prices of substitute products, real incomes, and dummy variables to account for unusual periods such as abrupt exchange rate changes or policy changes. The relative price measure is often the ratio of the import price to the domestic price index for the commodity adjusted for the exchange rate, which gives a measure of the real exchange rate. A lagged dependent variable may also be added to improve the statistical fit of the model.
The import demand function in this study is expressed as:

\[ M_{i,t} = f(M_{i,t-1}, (P_m e/P_d)_{i,t}, Y_t, d_t) \]  

(1)

Where:

\( M_{i,t} \) = Imports of product \( I \) in period \( t \)

\( M_{i,t-1} \) = Imports of product \( I \) in period \( t-1 \)

\( (P_m e/P_d)_{i,t} \) = Import Price * Exchange rate/real domestic price for product \( I \), reflecting the real exchange rate.

\( Y_t \) = real GDP at time \( t \).

\( d_t \) = dummy variable for time period \( t \).

Import demand is expected to increase as real incomes rise. The relationship between the real exchange rate and quantity of imports is expected to be negative. In other words, as the relative price of imports increase, imports should decline.

The period of estimation was 1975-1995. Import prices were calculated from import quantity and value data from FAO Trade yearbooks, which gave the unit-value for imports. These were then converted to pesos and deflated by CPI to get real peso import prices for each year. Income is real GDP obtained from Bank of Mexico. Import quantities lagged one period were chosen as an explanatory variable to account for time of adjustment to changes in demand.

The functional form chosen was double-log-linear. Plotting imports relative to income showed an almost linear relationship in logarithmic terms. In addition, the double log form is generally the preferred functional form in import demand estimation because of its ease of interpretation, as coefficients of the log-linear equation are the actual estimated elasticities (Leamer).
The estimated equations were specified as:

\[ \ln M_t = a_0 + a_1 \ln(P_m/P_d) + a_2 \ln Y_t + a_3 \ln M_{t-1} + a_4 d_1 \]  \hspace{1cm} (2)

Results of the estimation for fluid milk and cheese imports are given in Table 1. Values for the t-statistic are given in parentheses.

The Durbin-h statistic was calculated because of the inclusion of the lagged dependent variable. Durbin-h is the appropriate measure to test for the existence of serial correlation. The Durbin-h for the fluid milk equation was 0.85. Therefore, the null hypothesis of no serial correlation could not be rejected. For the cheese equation, the Durbin-h was 0.32, which also ruled out the existence of serial correlation.
Table 1. Estimated Import Demand Equations*

<table>
<thead>
<tr>
<th>Commodity</th>
<th>Constant</th>
<th>( \frac{P_m}{P_d} )</th>
<th>( Y_t )</th>
<th>( M_{t-1} )</th>
<th>d80</th>
<th>d83</th>
<th>d84</th>
<th>d88</th>
<th>R²</th>
<th>DW</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fluid Milk</td>
<td>-11.61</td>
<td>-1.20</td>
<td>1.66</td>
<td>0.32</td>
<td>-2.55</td>
<td>-2.15</td>
<td></td>
<td></td>
<td>.96</td>
<td>1.97</td>
</tr>
<tr>
<td>Cheese</td>
<td>-9.08</td>
<td>-0.85</td>
<td>1.53</td>
<td>0.48</td>
<td>-1.32</td>
<td>-1.96</td>
<td></td>
<td></td>
<td>.89</td>
<td>2.05</td>
</tr>
</tbody>
</table>

* t-values in parentheses

Results indicate a very strong positive relationship between income and both fluid milk and cheese imports. Income elasticities for fluid milk and cheese were 1.66 and 1.53, respectively, for the study period. This indicates imports of both of these products will increase as incomes rise. It should be noted here that this response will differ among income levels (Nicholson). For example, expenditure elasticities calculated by Nicholson indicate that for lower income deciles, income elasticity is higher. For fluid milk, the calculated expenditure elasticity is 3.56 at the lowest income decile compared to 0.48 at the highest income decile. For lower income groups, fluid milk appears to be a luxury good, while for higher income groups fluid milk is a regular dietary component.

The real exchange rate was also significant, although the elasticity is much lower than the income elasticity. Imports in the previous time period were significant for both fluid milk and cheese. Elasticities for the real exchange rates were -1.20 and -0.85 for fluid milk and cheese, respectively.
Forecasting Mexican Import Demand for Fluid Milk and Cheese

Import demand for the period 1996–2000 was forecasted for fluid milk and cheese using forecasted prices and income. Forecasts for prices, GDP, and the Mexican peso/U.S. dollar exchange rate were used to forecast import demand quantities. The following is a discussion of the forecasting results for prices and income.

**Forecasting the Real Import Price (real exchange rate) for Fluid Milk**

The price variable in the import equation is a real exchange rate for milk. The unit value of imports is multiplied by the exchange rate and divided by the Mexican consumer price index for fluid milk.

The model is as follows:

\[
P_t = a_0 + a_1 P_{t-1} + a_2 P_{t-2} + a_3 P_{t-3} + d_{82} + d_{86} + d_{94} + d_{95}
\]

Where:

- \( P_t \) = Price of fluid milk at time period \( t \)
- \( P_{t-1} \) = Price of fluid milk at time period \( t-1 \)
- \( P_{t-2} \) = Price of fluid milk at time period \( t-2 \)
- \( P_{t-3} \) = Price of fluid milk at time period \( t-3 \)
- \( d_{82,86,94,95} \) = dummy variables for designated years.

The equation was estimated using OLS, and the dummies were added to account for major currency devaluations. As seen in Figure 2, the Mexican peso experienced sharp declines relative to the U.S. dollar in 1982, 1986, and then most recently in 1994 and 1995. Real exchange rate changes have been an important factor affecting imports since the early 1980s. Periods following increased real exchange rates are marked by lower imports.
Real exchange rates for cheese were forecast using the following model:

\[ P_t = B_0 + B_1(P_{t-1} - P_{t-2}) + B_3d_{87} + B_4d_{93} \]  \hspace{1cm} (4)

Where \((P_{t-1} - P_{t-2})\) is the price difference between year t-1 and t-2.

**Forecasting Real Income for Mexico**

GDP for Mexico was used as a proxy for income and was forecast according to the following model:

\[ Y_t = B_0 + B_1Y_{t} + B_2Y_{t-1} + B_3d_{94} + B_4d_{95} + B_5d_{80} + B_6d_{86} \]  \hspace{1cm} (5)

Where \(Y_t\) is real GDP in period t and \(Y_{t-2}\) is real GDP in period t-1, and \(d\) represents dummy variables for the appropriate years. Values obtained from this model were used to forecast cheese and fluid milk imports.

**Forecasts of Fluid Milk Imports 1996-2000**

Using income and price forecasts, fluid milk imports were forecasted according to the import demand model explained above. Results are shown in Table 2.

<table>
<thead>
<tr>
<th></th>
<th>Fluid Milk</th>
<th>Cheese</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>15000</td>
<td>18000</td>
</tr>
<tr>
<td>1996</td>
<td>16565</td>
<td>12647</td>
</tr>
<tr>
<td>1997</td>
<td>21469</td>
<td>11046</td>
</tr>
<tr>
<td>1998</td>
<td>27495</td>
<td>10552</td>
</tr>
<tr>
<td>1999</td>
<td>36048</td>
<td>10410</td>
</tr>
<tr>
<td>2000</td>
<td>43338</td>
<td>10413</td>
</tr>
</tbody>
</table>
Fluid milk imports are forecast to begin rising steadily from 1996 through 2000, averaging about 24 percent growth per year. This forecast import growth depends on average annual income growth of one percent per year, which appears reasonable given the rapid growth of Mexico’s economy. More optimistic assumptions about rates of economic growth would lead to higher imports of fluid milk.

Deregulated consumer milk prices, which have ranged from $1.93-$2.36/gallon, led to rising raw mild prices and increased production in 1997. Large confined system dairies, mostly located in the North, have been improving productivity due to higher domestic prices for raw milk, which range from $10-$14/cwt. Higher prices have also spurred production by many small and medium sized dairies located in central Mexico. As a result, total milk production increased 10 percent in 1997, up from 8.0 million metric tons in 1996.

*Forecasts of Cheese Imports 1996-2000*

Cheese imports are forecast to decline an average of 5.6 percent through the year 2000. This occurs primarily due to the lower income elasticity for imports of cheese. The rate of decline does slow down after 1998 and imports stabilize near 10,000 metric tons.

*Comparison of Forecasts, Actual and Estimated Results*

Two years have passed since the model estimation and forecast. During that time, the Mexican economy has experienced an extremely rapid recovery from the 1994/95 peso and related macroeconomic crises, creating a situation where annual income growth was well above the 1% per year used in the forecast. Mexican domestic production of fluid milk also has lagged below expected levels. As a result, 1996 Mexican imports of fluid milk and cheese exceeded forecast values 202% and 58%,
respectively, Table 3. While fluid milk imports were forecast to grow at 28% per year, USDA estimates the volume to remain at 50,000 metric tons per year through 1998, the last year for which these estimates are currently available. Further, cheese imports, forecast to decline through 1999, are estimated by USDA to grow by 5,000 metric tons per year through 1998. Again, this is due to actual macroeconomic conditions differing from expected conditions.

Table 3. Forecast, Actual and Estimated Values for Cheese and Fluid Milk Imports for Mexico, Metric Tons

<table>
<thead>
<tr>
<th>Year</th>
<th>Fluid Milk Forecast</th>
<th>Actual/Estimated*</th>
<th>Cheese Forecast</th>
<th>Actual/Estimated*</th>
</tr>
</thead>
<tbody>
<tr>
<td>1995</td>
<td>15000</td>
<td>23000</td>
<td>18000</td>
<td>18000</td>
</tr>
<tr>
<td>1996</td>
<td>16565</td>
<td>50000</td>
<td>12647</td>
<td>20000</td>
</tr>
<tr>
<td>1997</td>
<td>21469</td>
<td>50000</td>
<td>11046</td>
<td>25000</td>
</tr>
<tr>
<td>1998</td>
<td>27495</td>
<td>50000</td>
<td>10552</td>
<td>30000</td>
</tr>
</tbody>
</table>

* 1995 and 96 data are actual, 1997 are revised estimates, and 1998 are preliminary estimates.
Conclusions and Implications for U.S. Dairy Exports to Mexico

Mexican imports of fluid milk and cheese were expected to grow moderately at first, then at a more rapid rate as per capita income increases. After recovering from the 1994-95 economic crisis, fluid milk imports were forecast to rise by 5,000-8,500 mt each year through 2000, but exceeded that to reach 50,000 mt in 1996. Cheese imports on the other hand, were not forecast to exhibit the rapid growth of the early 1990s but did reach 25,000 mt in 1997 (Table 3).

The primary purpose of this study was to forecast Mexican import demand for fluid milk and cheese. It was necessary to estimate the elasticities of income and the real exchange rates for fluid milk and cheese for a sound analysis of these markets. The response to changes in the real exchange rate can be different depending on the degree of elasticity of demand. Fluid milk imports are more responsive to changes in price than cheese, but income elasticities for both goods are similar. Taking into account Mexico’s economic recession of 1994-1995, fluid milk import demand was forecast to approach its 1992 level of 46,000 mt by the year 2000.

U.S. cheese exports to Mexico have gained market share due to promotional activities by the dairy industry. Competition, especially from Italian and Mexican firms, will limit U.S. sales unless Mexican market growth rebounds, leading to higher demand. Although there appears to be demand potential for high quality cheeses, market growth has been limited due to economic recession and reduced consumer spending on more expensive products.

While Mexico has been an important market for U.S. dairy products, these results suggest that there will continue to be growth potential for fluid milk and cheese. U.S. exporters, with their close proximity to the Mexican market, should capture the majority of this forecasted market growth. U.S.
exports of fluid milk are likely to be erratic, however, as U.S. suppliers attempt to meet both domestic and international demand. The United States remains the sole supplier of fluid milk to Mexico and has a strong competitive advantage in the regions along the common U.S.-Mexico border. U.S. suppliers should also be able to capitalize on market opportunities created by seasonal fluctuations in Mexican milk output, poor sanitation in some regions, and transport problems which limit Mexican efficiency. The major limitations on greater Mexican import demand are slow rates of broad based per capita income growth among consumers and rising domestic production.

Future work in this area will greatly be enhanced by more accurate data on prices, especially in differentiated products at both consumer and producer levels. Another important consideration is the incorporation of actual policy instruments and analysis of policy variables. Most important may be the requirement to effectively model the impacts of trade transition measures, such as Mexico’s tariff-rate quota on nonfat dry milk and its estimated impacts on nonfat dry milk and fluid milk imports.
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