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Demand for dairy products in Mexico

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Abstract

Mexico is the world's largest importer of non-fat dry milk (NFDM) and imports of cheese, fluid milk, and whey have increased rapidly in the past four years. In the wake of GATT and the NAFTA, as well as recent economic developments in Mexico, world dairy markets will be affected as a result of changes in the Mexican dairy sector.

The study analyzes both domestic and import demand for dairy products in Mexico to determine price and income elasticities as well as import elasticities. The results indicate that the demand for fluid milk is the most responsive to price changes and NFDM demand is inelastic with respect to its own price. There is little subtitution between fluid milk and non-fat dry milk, although fluid milk is relatively elastic, which suggests the existence of other substitutes for fluid milk.

Estimation of import demand equations reveal similar trends in response to price changes, but income elasticity of imports was highest for fluid milk which suggests that Mexico will import possibly more fluid than dry milk as incomes rise. The exchange rate was the most significant variable influencing all dairy product imports.

1. Introduction

Mexico is one of the world's largest importers of dairy products and the world's largest importer of non-fat dry milk (NFDM). Changes in the demand for dairy products will therefore influence world markets, especially the United States, the European Union and New Zealand as the largest exporters of dairy products. The North American Free Trade Agreement (NAFTA) and the proximity of Mexico to the US has already intensified interest in US dairy product exports to Mexico. In the wake of the Uruguay Round Agreements (URA) of General Agreement on Tariffs and Trade (GATT), and changing economic conditions in Mexico, and the NAFTA impacts, trends in the demand for dairy products take an increased importance.

The Mexican government is the sole importer of NFDM, 70% of which is used for direct milk subsidies, while the rest is sold to private companies. The milk subsidy program is undergoing some privatization and that and other changes in government policy are likely to affect imports of non-fat dry milk considerably.

As incomes grow, Mexico is anticipated to become a larger export market for fluid milk, butter, cheese, and yogurt. Imports of fluid milk, cheese, and whey exhibit the fastest growth rates among dairy products, increasing by 201, 101, and 887% respectively, since 1990 (Table 1). Imports of other products such as non-fat dry milk, butter, yogurt and ice cream have also increased.

This paper examines the market for dairy products in Mexico and documents consumption behavior of Mexican consumers. Domestic and import demand functions are estimated for fluid milk, NFDM, cheese, and butter in Mexico. Given the prevalence of domestic price policies in the dairy sector, past policy

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Table 1
Imports of milk and dairy products in Mexico

Product	1990		1991		1992		1993	
	MT [a]	Value (00$US)	MT	Value (00$US)	MT	Value (00$US)	MT	Value (00$US)
Yogurt	12292	4006	5480	6112	7828	8601	6225	8061
Fluid milk	40071	25538	50061	24892	72311	33607	80702	29358
NFDM	287835	554367	57629	108032	138396	372003	232740	408803
Evap. milk	406	609	185	268	847	581	440	591
Cond. milk	979	11133	376	330	321	400	671	807
Whey	34176	27171	21948	33133	32554	26964	32912	20536
Milk whey	2159	40351	7181	6525	20073	17655	21104	12916
Butter	26775	47764	37370	61694	38035	68214	39647	67596
Cheese	9782	28802	14191	53013	20970	56775	29478	75993

[a] metric tons.
Source: Muñoz et al. (1994).

changes have also been incorporated into the analysis.

An overview of the dairy sector is followed by a summary of dairy policies and the role of CONASUPO (Compañia Nacional de Subsistencias Populares: National Company for Public Food Supplies). The following two sections outline the methodologies used in estimating domestic and import demands and summarize the results, respectively. The final section is devoted to a discussion of the results and implications of the recent devaluation of the peso.

2. Overview of the Mexican dairy sector

The Mexican dairy sector is characterized by a long-standing tradition of government intervention in the form of price policies and subsidies. Agricultural performance was quite favorable in the early eighties, strongly supported by subsidies as part of the Sistema Alimentaria Mexicana (SAM). In 1982, following a drought, agricultural GDP fell 2.9%, and fixed investment, wages, and cultivated land diminished significantly. Also agricultural imports fell by 54.6% in the same year (Villa-Issa, 1990). 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. This led to a slow expansion in milk production, chronic production shortfalls, and increasing imports (Hallberg et al., 1992).

In 1990, the milk system had a nutritional dependency coefficient of 38% (calculated as: imports/disposable milk (imports + production)) which has been steadily increasing over the past four years. Milk and dairy products as a group were the principal food imports in 1993 with a volume of 445 000 t and a value of $626.3 million. This shows a tendency to increase dependency on imports in both volume and value terms (Muñoz et al., 1994).

Mexican dairy policy has tended to favor the consumer at the expense of the dairy producer. Consequently, Mexican milk has the lowest producer subsidy equivalent (PSE) of −56% (Muñoz et al., 1994). This negative PSE reflects a tax on producers rather than a subsidy. The principal factor that explains the negative PSE is low producer prices. Actually, until 1988, producers were forced to sell their milk at below market prices. Decapitalization forced many farmers out of production, especially those who produced low quality milk. Price controls on milk led to the diversification in the use of fluid milk: by using milk for products whose prices were not controlled (cheese, yogurt, butter); adulteration of products by substituting up to 80% vegetable fat instead of butterfat; distribution of milk through less controlled channels; and increased vertical integration of dairy farmers. All this decreased the production of milk which led to an increase in social programs of CONASUPO (Muñoz and Odermatt, 1993).

Table 2
Per-capita dairy product consumption, Mexico and US, 1980-1991

Year	Fluid Milk			NFDM			Cheese			Butter		
	Mexico	US	Mexico as percentage of US	Mexico	US	Mexico as percentage of US	Mexico	US	Mexico as percentage of US	Mexico	US	Mexico as percentage of US
	(gallons)			(pounds)			(pounds)			(pounds)		
1980	29.83	26.47	112.67	0.68	0.68	100.00	1.05	3.64	28.75	0.05	0.91	5.00
1981	26.23	25.81	101.64	0.68	0.59	115.38	1.14	3.77	30.12	0.09	0.86	10.53
1982	23.27	25.10	92.74	0.82	0.64	128.57	1.45	4.14	35.16	0.09	0.95	9.52
1983	21.82	25.04	87.13	0.82	0.64	128.57	1.45	4.27	34.04	0.18	1.05	17.39
1984	16.25	28.19	57.64	0.91	0.59	153.85	1.14	4.45	25.51	0.14	1.05	13.04
1985	14.13	27.66	51.10	0.91	0.55	166.67	1.14	4.68	24.27	0.18	1.00	18.18
1986	15.15	27.63	54.78	0.86	0.59	146.15	1.50	4.77	31.43	0.14	0.95	14.29
1987	15.69	27.71	56.63	0.91	0.59	153.85	1.68	5.00	33.64	0.18	0.95	19.05
1988	11.73	27.42	42.77	1.14	0.59	192.31	2.00	4.91	40.74	0.18	0.91	20.00
1989	11.76	26.73	43.97	1.32	0.45	290.00	2.00	4.91	40.74	0,18	0.86	21.05
1990	12.18	26.60	45.78	1.36	0.55	250.00	2.05	5.09	40.18	0.18	0.91	20.00
1991	12.47	26.60	46.87	1.18	0.41	288.89	2.14	5.41	39.50	0.18	0.91	20.00

Source: Gudmunds and Webb, 1991, PS&D View, USDA.

Dairy-product consumption shows distinct patterns in Mexico, where per-capita consumption of fluid milk is much less when compared to that of the EU or the US However, per-capita consumption of NFDM, is two to three times more than in the US or EU. In 1991, per-capita fluid milk consumption was 46% of US per-capita consumption and NFDM consumption was about 288% of US consumption (Table 2).

Milk is not a traditional consumption item and protein source in Mexico. The high consumption of NFDM occurs because it is easy to store and transport without refrigeration and also because of its price. Therefore, 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 the Mexican consumers prefer fresh cheeses to aged ones. Tastes and preferences are also influenced by income levels, where fresh cheeses are consumed at lower-income levels and aged cheeses consumed more at middle- and high-income levels (Muñoz, 1993). In 1992, 10% of total cheese consumption was made up of imports which were mostly hard or semi-hard cheeses.

3. Food and trade policy

3.1. Milk subsidies and the role of CONASUPO [1]

CONASUPO has existed in Mexico since 1938 under various names, adopting its current name in 1965. CONASUPO is involved in the distribution of basic foods to the poor through subsidized programs. In the 1970s, CONASUPO handled 23 products, in establishing tariffs, licenses for imports, and guaranteed prices. Today, most of CONASUPO's operations are concentrated on distribution of corn, dry beans, and NFDM under guaranteed prices. CONASUPO buys corn and sells it at a subsidized price through public tender. It contracts tortilla factories to produce tortillas and distribute to the poor. CONASUPO also buys dry beans via warehouses during

[1] This section is largely drawn from a personal interview with Lic. Gerardo Luna, (Chief Officer of International Trade), CONASUPO.

harvest and sells the beans at lower than market prices.

In 1994, CONASUPO was responsible for the distribution of 40–50% of pasteurized milk and 30% of NFDM. About 70% of its milk was distributed to the poor. Leche Industrializada CONASUPO (LICONSA) reconstitutes milk powder and distributes the milk through outlets around the country. CONASUPO was the only importer of NFDM in 1995. However, CONASUPO's role as a monopoly or monopsony will likely change in the future. It is already privatizing its plants (which LICONSA maintains), and will primarily focus operations on the distribution of food to the poor. The restructuring of CONASUPO has been an issue since the early 1990s.

3.2. Trade policy

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 (Knutson et al., 1993). 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 US, the first 881 840 cwt of skimmed and whole milk powder will enter the Mexican market duty free. Imports over the quota level will be assessed at a tariff of 133.4% or \$1136.6/mt and will gradually be phased out by the year 2008.

Concerning cheese imports from the US, Mexico immediately converted its import licensing regime to a tariff of 20% to be reduced to zero over a ten year period, except for fresh cheese which will be assessed at a 40% tariff to be phased out over ten years. All other dairy products have the current tariff levels frozen which will be phased out gradually over a ten-year period.

4. Demand analysis

4.1. Data

The period of analysis was 1975–1992. Annual data for consumption of milk and milk products were obtained from the Gudmunds and Webb (1991) PS & D View database. Price data for fluid milk were taken from Diario Oficial de la Federación until 1986 and Secretara de Comercio y Fomento Industrial (SECOFI) after 1986. Since a satisfactory price series was not available for NFDM, cheese, and butter, price indices were used as a proxy. Annual price indices for Mexico City were taken from the Indices de Precios of the Bank of Mexico (Banco de Mexico, 1975–1992) and INEGI (1992). Up to 1984 actual price indices for Mexico City were used (INEGI, 1992). After 1984, variations in indices (which show the yearly percentage variation in each price index) were used to calculate price indices for later years. Income figures were obtained from International Financial Statistics of the International Monetary Fund (1975–1992) and Salinas de Gortari (1994). Real per capita GDP was used for domestic demand estimation and aggregate real GDP was used for import demand. Dummy variables were added to account for changes in policies. In 1988, decapitalization forced many farmers out of milk production as a result of policies between 1982-88. The price controls of 1982 had adverse effects on the dairy sector. The immediate effects of these policies were felt more on the butter and cheese markets, but by 1988, as milk production was channelled more and more to cheese and butter production, the impact of policy was less in the consumption of butter and cheese. In 1988 all price controls were removed except for retail milk which continued to have an adverse effect on the fluid milk market. These effects were captured by a dummy variable for 1983 for butter and cheese, and one for 1988 for fluid milk.

4.2. Estimation

The demand function for each product was specified as:

$$\ln Q_{it} = \alpha_{0i} + \alpha_{1i} \ln P_{it} + \alpha_{2i} \ln Y_t + \alpha_{3i} d_t + u_t \quad (1)$$

where Q_{it} is per capita consumption of product i at time period t; Y_t is per capita GDP at time t; P_{it} is the price of product i at time period t; d_{jt} is the dummy variable to account for past policy change j at time period t; and u_t is the error term.

Demand functions were specified as double-log-linear. Simple plotting of per-capita consumption against per-capita incomes in logarithmic terms showed an almost linear relationship for all dairy products analyzed. In addition, ease of estimation and interpretation of coefficient estimates influenced the choice of a double-log-linear functional form.

Given Eq. (1), The price elasticity of demand is:

$$\frac{\partial Q_i}{\partial P_i} \cdot \frac{P_i}{Q_i} = \alpha_{1i} \tag{2}$$

and the real per capita income elasticity is:

$$\frac{\partial Q_i}{\partial Y} \cdot \frac{Y}{Q_i} = \alpha_{2i} \tag{3}$$

The income and price elasticities are therefore the coefficients of the double-log-linear equation.

Two types of demand functions were specified in this study: domestic and import demand. Demand functions for all products were assumed to be double-log-linear and were estimated using OLS. Choice of variables in each equation was dictated by economic theory, and was generally the same for all products. Dummy variables that reflect policy were different for some products. While most dummy variables were used to account for policy changes, one dummy variable was used to correct for a data problem in the NFDM equation. A summary of estimated elasticities for all dairy products are provided in Table 3. Estimation results for each product are discussed below.

5. Domestic demand and results

5.1. Fluid milk

The following estimates were obtained from OLS estimation, corrected for auto correlation through the Cochrane–Orcutt procedure.

Table 3
Estimated coefficients for domestic demand equations [a]

Product	Equation
	Domestic Demand Equations
Fluid Milk:	$\ln Q_{fl} = -14.336 - 0.678 \ln P_{fl} + 0.438 \ln Y - 0.268\, d_{88}$ (0.18) (3.95) (1.36) (3.89)
NFDM:	$\ln Q_{NFDM} = -1.615 - 0.136 \ln (P_{NFDM}/EXCH) + 0.996 \ln Y + 0.486\, d_{91}$ (3.51) (11.89) (3.92) (4.27)
Butter:	$\ln Q_B = -7.750 - 0.467 \ln P_B + 0.945 \ln Y_B + 0.466\, d_{83} - 0.740 \ln C_{B,t-1}$ (9.81) (1.704) (2.02) (2.53) (4.22)
Cheese:	$\ln Q_{CH} = -7.355 - 0.440 \ln P_{CH} + 1.07 \ln Y_{CH} + 0.169 \ln EXCH - 0.164\, d_{83}$ (16.51) (2.58) (3.92) (14.68) (1.68)
	Import demand equations
Fluid Milk:	$\ln M_{fl\,t} = -13.337 - 1.350 \ln P_{fl(t-1)} + 2.307 \ln Y_t + 0.599 \ln EXCH_{t-1}$ (2.90) (2.96) (1.55) (7.20)
NFDM:	$\ln M_{NFDM\,t} = 6.687 - 0.473 \ln P_{NFDM(t-1)} + 1.235 \ln Y_t + 0.239 \ln EXCH_{t-1} + 0.232 \ln P_{fl,t-1} - 1.395\, d_{91}$ (2.19) (2.30) (2.25) (6.20) (1.11) (5.23)
Butter:	$\ln M_{B\,t} = 2.813 - 0.376 \ln P_{B\,t-1} + 1.288 \ln Y_t + 0.060 \ln EXCH_{t-1}$ (1.15) (2.53) (3.35) (2.48)
Cheese:	$\ln M_{CH\,t} = -0.537 \ln P_{CH\,t-1} + 1.042 \ln Y_{CH} + 0.307 \ln EXCH_{t-1} - 1.001\, d_{88}$ (2.27) (5.36) (8.08) (2.4)

The estimated demand function for fluid milk was:

$$\ln Q_{fl} = -14.336 - \underset{(0.18)}{0.678 \ln P_{fl}} + \underset{(3.95)}{0.438 \ln Y} - \underset{(1.36)}{0.268\, d_{88}} \quad \underset{(3.89)}{} \tag{4}$$

(t-values are in parentheses and $R^2 = 0.97$, DW = 1.70)

The results of the estimation suggest that the price elasticity is −0.68, indicating that fluid milk in Mexico may not be a basic necessity. Consumers readily reduce consumption owing to price increases and other goods are easily substituted for fluid milk when its price rises. This indicates that fluid milk is not a basic necessity. In terms of the consumption response to income, a 1% increase in income induces a 0.44% increase in consumption. The effect of income changes is thus less than the effect of price increases. The positive sign suggests that milk is still a normal good with an income elasticity of 0.44.

The dummy variable for 1988 was added to simulate the effect of policy changes. In 1988, price controls were removed at every level of milk marketing except for retail. Results indicate that fluid milk consumption declined 0.3% as a result of price controls. This led to lower returns for dairy farmers, forcing movement into value-added products for which no price controls exist, such as cheese, yogurt and butter. This is captured in the model which shows a negative response in consumption of milk with respect to the change in policy.

5.2. Non-fat dry milk

Two separate price variables were tested for NFDM, the NFDM price index deflated by the consumer price index (CPI) and the NFDM price index deflated by the exchange rate. The latter was chosen because it was statistically more significant and improved the fit considerably. The exchange rate was incorporated into the price variable because the exchange rate as a separate variable was found to be significant, but resulted in a low R^2 and affected t-values for the price and income parameters. In 1991, there was an inventory problem that was reflected in the data, so that was included to account for the sudden drop in consumption that was caused by this error in the data.

The following estimates were obtained:

$$\ln Q_{NFDM} = -1.615 - \underset{(3.51)}{0.136 \ln \frac{P_{NFDM}}{EXCH}} + \underset{(11.89)}{0.996 \ln Y} \quad \underset{(3.92)}{} \quad \underset{(4.27)}{} + 0.486\, d_{91} \tag{5}$$

(t-values are in parentheses, $R^2 = 0.91$, DW = 1.82)

The incorporation of the exchange rate into the price variable, resulted in a significantly larger price effect on consumption since Mexico is the world's largest importer of dry milk and a large share of total supply is, therefore, made up of imports. To capture the effect of exchange rates on consumption, the price variable was deflated using the exchange rate. This price can be considered as the real price after exchange-rate fluctuations are taken into account.

The results suggest that NFDM is more of a basic necessity than fluid milk. The price elasticity is −0.14, which indicates that NFDM is not given up as easily as fluid milk when prices increase. Mexicans consume far more NFDM than consumers in the US and they do not differentiate as much between reconstituted and fresh milk. It is important to note here that the price variable embodies the combined effect of price of NFDM and the exchange rate on comsumption so the inelastic response is partially due to the effect of exchange rates on imports of NFDM.

The income elasticity of NFDM is slightly higher than that of fluid milk, which shows that demand for NFDM will increase as incomes increase.

5.3. Butter

Butter consumption lagged one period was added to the butter equation along with a policy variable for 1983 which captures the effects of consumer subsidies for fluid milk that were first insituted in 1982.

The estimated equation was:

$$\ln Q_B = -7.750 - \underset{(9.81)}{0.467 \ln P_B} + \underset{(1.704)}{0.945 \ln Y_B} \quad \underset{(2.02)}{} + \underset{(2.53)}{0.466\, d_{83}} \quad \underset{(4.22)}{0.740 \ln C_{B,t-1}} \tag{6}$$

(t-values in parentheses, $R^2 = 0.93$, DW = 2.30)

The results indicate that income is a more signifi-

cant variable than price in the consumption of butter. This is expected as butter is consumed more at higher income levels. Effects of consumer subsidies on milk are quite significant as well as past consumption of butter. Price elasticity of demand is −0.47 and the elasticity of income is 0.95 which indicates that butter is a good consumed at higher income levels, without many substitutes. The fact that lagged consumption of butter is significant indicates that consumption in the past period is an important indicator of the current year's consumption.

5.4. Cheese

The exchange rate was an important variable here since most hard cheeses are imported and therefore influenced by exchange-rate changes. A policy variable for 1983 was also added to account for consumer subsidy effects which moved milk into higher value-added products such as butter and cheese. The estimated equation was:

$$\begin{array}{lll} \ln Q_{CH} = -7.355 - & 0.440 \ln P_{CH} + & 1.07 \ln Y_{CH} \\ \quad (16.51) & \quad (2.58) & \quad (3.92) \\ +0.169 \ln EXCH & 0.164\, d_{83} & \\ \quad (14.68) & \quad (1.68) & \end{array} \qquad (7)$$

($R^2 = 0.95$, DW = 1.66)

Income is highly significant: more so than price. Also, the exchange rate plays an important role, because of the imports. Although the effects of changes in exchange rates are less than changes in prices, an increase in the value of the peso positively effects the consumption of cheese, and is very significant in explaining the variation in consumption. This can be explained by the fact that most imported cheese is different from domestic cheeses so as imports go up, domestic consumption does not fall because imported and domestic cheeses are not substitutable. The exchange-rate elasticity of +0.169 indicates that a 1% increase in the value of the peso will result in a 0.17% increase in overall consumption of cheese.

Price elasticity is −0.440 and the income elasticity is 1.07, higher than any of the other products. This indicates that cheese may be a luxury good, consumed more as incomes rise.

6. Import demand

Import demand equations were also estimated for each of the products to look at effects of prices, exchange rates and incomes on the quantity of imports. All import demand equations were specified in log-linear form. Import prices were calculated from import quantity and value data from FAO Trade yearbooks (Food and Agriculture Organization, 1976–1993), and then converted to pesos and deflated by CPI to get real peso import prices for each year. Prices were lagged one period to account for import decision making and lags in shipment. Generally, lagging income by one year did not matter, so only equations estimated without lagged income were chosen to be reported. Estimation of import demand for each product is discussed below in more detail and results are presented in Table 3.

All import demands were assumed to be of the general form:

$$\ln M_{it} = a + b \ln P_{i(t-1)} + c \ln Y_t + d \ln EXCH_{t-1} + e\, d_{jt} + u_t \qquad (8)$$

where M_{it} is imports of product i at time t; $P_{i(t-1)}$ is real import price of product i in past period in pesos; Y_t id real GDP at time t; $EXCH_{t-1}$ is exchange rate in previous time period (pesos/dollars); and d_{jt} is dummy variable for policy j at time t.

6.1. Fluid milk

The estimated equation for fluid milk was:

$$\begin{array}{lll} \ln M_{fl\,t} = -13.337 - & 1.350 \ln P_{fl(t-1)} + & 2.307 \ln Y_t \\ \quad (2.90) & \quad (2.96) & \quad (1.55) \\ +0.599 \ln EXCH_{t-1} & & \\ \quad (7.20) & & \end{array} \qquad (9)$$

(t-values in parentheses, $R^2 = 0.89$, DW = 2.01)

As expected, price elasticity of imports is quite high, about 1.35 which shows a very strong relationship between prices and imports. This indicates that, for a 1% increase in prices in the previous period, the quantity imported of fluid milk will decline by 1.35% in the next time period. The most significant explanatory variable was the exchange rate. The effect of exchange rates is quite important and for a 1% increase in the value of the peso, the model predicts a 0.6% increase in fluid milk imports. Simi-

larly, a devaluation which will reduce the exchange rate will reduce imports. A strong income response was found, indicating that for each percentage change in GDP, imports will increase by 2.4%.

The import demand function for fluid milk was also estimated with the price of NFDM added as another explanatory variable. The effects of NFDM prices were found to be slightly significant only when these prices were lagged two periods. The cross-price elasticity $(\partial M_{\mathrm{fl},t}/\partial P_{\mathrm{NFDM},t-1}) \cdot (P_{\mathrm{NFDM},(t-1)}/M_{\mathrm{fl},t})$ was +0.71 which shows some degree of substitution between imported fluid milk and non-fat dry milk. A 1% increase in the price of NFDM will cause a 0.7% increase in fluid milk imports.

6.2. Non-fat dry milk

The import demand equation for NFDM was specified in the same way as the fluid milk equation except for a dummy variable for 1991, which was added because of some inventory reporting problems in the data. The model with the fluid-milk import price included (lagged one period) was chosen because it gave the best fit and overall statistical properties. The following results were obtained:

$$\begin{array}{lll} \ln M_{\mathrm{NFDM}\,t} = 6.687 - & 0.473 \ln P_{\mathrm{NFDM}(t-1)} + & 1.235 \ln Y_t \\ \quad (2.19) & \quad (2.30) & \quad (2.25) \\ +0.239 \ln EXCH_{t-1} & +0.232 \ln P_{\mathrm{fl},t-1} - & 1.395\, d_{91} \\ \quad (6.20) & \quad (1.11) & \quad (5.23) \end{array} \qquad (10)$$

($R^2 = 0.87$, DW = 2.17)

The results indicate that NFDM imports are less sensitive to changes in prices and incomes than fluid milk. This possibly reflects the fact that policy variables might be more important, overshadowing the effects of economic variables. NFDM is used mainly to subsidize the poor, so import decisions may not solely be based on economic variables. The coefficient of the dummy reflects data discrepancies. As in the fluid milk equation, the most significant variable is the exchange rate, although its impact is not as strong. The cross price elasticity is not large or highly significant, but improves the overall fit and the significance of the other variables. When fluid milk prices were lagged two time periods, their effect became very small (0.002) and the t-value was not significant.

6.3. Butter

The estimated equation was:

$$\begin{array}{llll} \ln M_{\mathrm{B}\,t} & = 2.813 - & 0.376 \ln P_{\mathrm{B}\,t-1} + & \\ \quad (1.15) & \quad (2.53) & \quad (3.35) & \\ 1.288 \ln Y_t & +0.060 \ln EXCH_{t-1} & & \\ \quad (2.48) & & & \end{array} \qquad (11)$$

($R^2 = 0.81$, DW = 1.85)

Price elasticity of imports was about the same as the domestic demand elasticity, which indicates a 0.38% reduction in imports for each percentage increase in import price of butter of the past period. The coefficient of income is significant and affects imports substantially. These results are similar to those for other products except for the effect of exchange rates. Exchange rates had less of an effect on imports in the case of butter (0.06) and also were less significant although still significant at the 5% interval.

6.4. Cheese

Estimation of the cheese import demand equation indicated a large covariance between the constant term and the income coefficient. The equation was reestimated without the constant term to test for the hypothesis that the constant was equal to one. As this hypothesis could not be rejected, the following model was chosen with a dummy variable added for 1988 to account for the removal of price controls at all levels:

$$\begin{array}{llll} \ln M_{\mathrm{CH}\,t} = -0.537 \ln P_{\mathrm{CH}\,t-1} + & 1.042 \ln Y_{\mathrm{CH}} & +0.307 & \\ \quad (2.27) & \quad (5.36) & \quad (8.08) & \\ \ln EXCH_{t-1} - 1.001\, d_{88} & & & \\ \quad (2.4) & & & \end{array} \qquad (12)$$

($R^2 = 0.89$, DW = 2.22)

The results are similar to those for the other dairy products. The effect of the dummy to account for the policy change in 1988 is negative. This was expected since the domestic demand equation showed a positive relationship. The policy increased production of cheese since more milk was diverted into cheese, and also increased consumption which was shown in the domestic demand equation. Therefore, the negative effect on imports can be explained. Exchange rates were again an important explanatory variable.

7. Conclusions

The results of this study indicate how aggregate dairy consumption in Mexico varies with changes in incomes, prices, and policies. Trade policy reforms and the NAFTA will create changes in economic forces that will ultimately change prices and consumption in Mexico. The magnitude and direction of these changes can be determined through the results obtained in this study and prices and quantities can be projected for the future.

The demand for NFDM is inelastic which suggests that consumption of NFDM is not readily responsive to changes in its own price. However, this implies a larger flexibility which will result in large price changes as the quantity available for consumption is less. NFDM in Mexico appears to be more of a staple than fluid milk. Price elasticities show a large variation between fluid milk and NFDM.

Income elasticities do not show as much variation. The income elasticity for fluid milk was lowest. This was expected since butter and some cheeses are consumed more at higher income levels. In all cases, consumption of dairy producs increases as per-capita incomes grow.

Import demand equations provide a different perspective of the Mexican dairy import market. Import demand elasticities show the relationship between imports, import prices, and exchange rates. Although the estimation of import demand elasticities showed that general demand trends were similar, there were some differences as well. The effects of exchange rate changes were isolated and found to be important determinants of Mexican imports of fluid milk, NFDM, and cheese. Fluid milk price elasticity was the highest import demand elasticity. However, it also showed the highest income elasticity, which, although not highly significant, suggests that increasing incomes will be a determining factor in increased imports of fluid milk. This is an important result, which indicates that as Mexico becomes wealthier it will import possibly more fluid milk than NFDM. This also depends on the rate of increase in domestic milk production.

In estimating import demand, cross price elasticities of fluid and non-fat dry milk were also estimated. These elasticities were insignificant, which did not support the hypothesis that fluid and NFDM were strong substitutes. The fact that both domestic and import demand elasticities for fluid milk were elastic suggests the existence of substitutes and might lead one to hypothesize whether or not soft drinks are stronger substitutes for fluid milk than NFDM.

Income was an important variable for all dairy product imports, and quite significant for butter and cheese, suggesting a trend toward increased butter and cheese imports as incomes rise. The exchange rate was the most significant variable influencing all dairy product imports, although not as large in magnitude as the other variables. Recent peso devaluations have reduced fluid milk imports the most, which is supported by study results and reflected in the high exchange rate elasticity for fluid milk imports compared to that for other dairy products. Despite the peso crisis, and the subsequent decline in dairy imports, the Mexican market appears to be poised to recover economically.

This study provides a preliminary perspective on the market for dairy products in Mexico. Parameter estimates can be used to project future demand trends and imports of dairy products in Mexico. In the wake of the URA and other recent economic changes in Mexico, these results will enable detailed research of the Mexican dairy sector.

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