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9. ABSTRACT

The principal determinants of aggregate milk consumption are population, consumer income, and milk prices. For the families surveyed, there was a negative relationship between income and family size and a positive relationship between family income and each of the other associated variables: price paid, proportion of milk drinkers, and average consumption levels. The positive effect of higher incomes on consumption and expenditure diminishes as incomes rise and finally becomes negligible, first for consumption and then for expenditure. Thus an accurate projection of total demand for milk requires that the number, size, and age distribution of families in each of several broad income groups be specified along with their expected rates of growth. The latter includes net immigration and shifts among income groups in addition to the normal biological increase. The principal implications of a significant increase in demand for the fresh milk industry would seem to depend largely on the origin of the increase in demand for family income groups and the public policy toward the regulation of price and produce quality and the production of reconstituted milk. As for the origin of demand, the pasteurized fresh milk industry clearly will experience a greater impact if the increased demand originates primarily in the upper income groups. If chiefly lower income families are responsible for the demand shift, the increased consumption would be limited mainly to unpasteurized and reconstituted milk, given the present structure of production, marketing, and public regulations.

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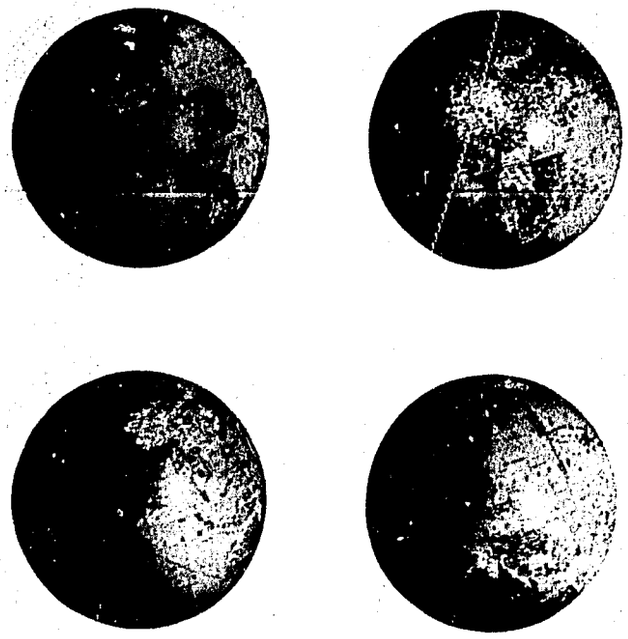

ORGANIZATION AND STRUCTURE OF THE MEXICO CITY FLUID MILK INDUSTRY

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Organization and Structure of the Mexico City Fluid Milk Industry

Paul H. Kipps* and Donald K. Freebairn†

Major urban centers in most low-income countries currently are experiencing rapid growth in population and consumer incomes. A generally buoyant demand for food normally accompanies such conditions. Population growth produces an approximately equal rate of increase in the demand for food, while higher incomes both increase total demand and alter the composition of purchases in favor of certain types of food such as milk and other livestock products.

The relationship between growth in population and income and the demand for food can be viewed from either a national or local perspective. Within a country there are usually localized growth centers, such as the national capital, which experience population and income growth rates significantly higher than those for the nation as a whole. It follows, therefore, that the resulting increase in demand for food will necessitate relatively large and rapid adjustments within those production and marketing segments of the directly affected local economy.

Mexico City is one such center—it is experiencing rapid increases in population and corsumer incomes.[1] Fluid milk is a widely accepted consumer product with a relatively high income elasticity of demand.[2] Therefore, Mexico City provides an appropriate setting to investigate the effects of population and income growth on the demand for food, and milk is an ideal consumption product on which to focus the analysis.

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[1] Estimated at over 5% per year (2:12-13).

[2] Estimated at 0.59 in 1963 for the urban area (2:63).

It cannot be assumed that the necessary increase in production will occur automatically in response to any reasonable projections of demand growth. Moreover, even if the additional production is obtained, consumer preferences with respect to the form and quality and the time and place of purchase may change. The marketing system may not be able to adjust to these shifts in preferences at an increasing rate and at a cost consumers are willing to pay, unless firms can achieve a cost savings by taking advantage of economies of scale in certain marketing services. Thus, the prospect of significantly increasing consumption inevitably raises the question of the adequacy of product supply at both the farm and retail level. And, just as inevitably, these questions lead to an investigation of both the production and marketing segments of the industry that supplies the product.

Basic Approach

Studies of the relationship between economic development and the demand for food have generally been national rather than local in scope (3, 9, 10, 11). From the national perspective, the general problems of production response tend to become dominant because of the characteristically short supply conditions for basic foods in developing counties. Problems of production response may be approached directly with no investigation of demand. In doing this, the implicit assumption is that there is, or will be, a significant excess effective demand for the product in question (3, 10). Alternatively, a demand for a particular agricultural commodity or for factor inputs can be derived from estimates of the rate of increase in demand obtained from population and income growth rates (9).

At the regional level, and with respect to a particular market, the problem of production response becomes relatively less important because of the greater freedom for interarea adjustments. But adjustments, such as expansion of the basic supply area, may create new problems and pressures for the processing and marketing segments of the affected industry. This is most likely to occur when urbanization creates an increase in the demand for services associated with the product, such as pasteurization and home delivery of milk. Also, the expansion of the supply area increases transportation costs and requires different handling methods for a perishable product.

A few recent studies of economic development and the demand for food have explicitly considered the marketing segment (5, 6, 8, 12). These studies have been both national and local in scope, with commercial export crops dominating the former and basic food commodities the latter. Local studies have tended to concentrate on marketing problems with little or no specific attention to questions of consumer demand or production response. From a national perspective, the marketing segment

of the industry supplying a basic food commodity may be relatively less important than the production segment, simply because a large portion of the total output is both produced and consumed by the same economic unit—the rural household.

However, at the regional or local level this condition no longer holds. Rather, the marketing segment tends to become an integral part of the general process of transforming basic resources into the various products that satisfy consumer demand. At the subnational level, the marketing segment essentially takes the farm-produced commodity and, with respect to form, time, and location, changes it to conform with the preferences consumers indicate by their food purchases. This process is even more pronounced when rapid urbanization leads to increased specialization and the distinct separation of production and consumption. For example, in the case of fresh milk in Mexico City, pasteurized milk, most of which is delivered in sealed containers on regular delivery routes, now accounts for nearly two-thirds of total fresh milk consumption; also an increasing proportion of the total milk supply, now over 28 percent, is transported more than 100 miles.

General Survey of the Market and Industry

Market Setting: General Economic Conditions

Mexico City is located in a high valley 7400 feet above sea level. With a population of about 7 million, it is the fifth largest city in the western hemisphere and the tenth largest in the world. The city is well within the tropical zone, but, because of its altitude, it enjoys a mild year-round climate. There is virtually no rainfall from October through April. Agricultural production is limited to one crop per year except where irrigation supplements natural rainfall.

The city has grown rapidly over the politically stable period since 1930, and particularly during the last decade and a half. The rapid growth has been accompanied by generally rising prosperity, although in the mid-1960s monthly incomes of 50 percent of all families were still 1500 pesos (US $120) or less, and those of 75 percent did not exceed 3000 pesos (US $240) (1: table 18-1).

Much of the population growth is from the in-migration of low-income rural families. Their effect on the local economy is difficult to assess. Most of them have limited skills and little else to contribute to the urban community; consequently, though their incomes may rise above those achieved in the former rural setting, their earnings remain quite low.

Much of the presently observed pattern of milk consumption in the market can be traced to the influence of two broad groups of consumers. The very low income group accounts for virtually all of the unpasteurized and reconstituted milk consumed in the market. On the other hand, the

rising incomes of significant numbers of families contribute to the upward pressure on milk prices, particularly for the higher grades of pasteurized milk. Likewise, consumption patterns and market development in the future will probably be influenced significantly by the relative rates of growth of these two broad income groups, both with respect to each other and to the total population of the city.

Growth and Expansion

Both public and private interests have been instrumental in the development of the dairy industry for Mexico City. The public sector has intervened indirectly through price maintenance and product quality control programs administered by the bureau of price control in the Ministry of Commerce and Industry and by the bureau of food quality control in the Ministry of Health and Welfare. Also an agency of the federal government manufactures a reconstituted milk product using nonfat dry milk and vegetable oils for distribution to low income families (Compañía Nacional de Subsistencias Populares, CONASUPO). Production of reconstituted milk began in 1945. The total volume produced remained relatively small until about 1960, but since then output has increased rapidly and now accounts for over 25 percent of the total consumption. The government, however, has made no move to take over and operate the fresh milk industry and shows no inclination to do so.

The rapid growth of the Mexico City metropolitan area is reducing the land resource base of the immediately surrounding milk-producing area. The reduced land base has restricted the ability of nearby producers to respond to increased demand and has forced higher production costs. The net effect of this contracting land base is to improve the competitive position of more distant producing areas. These areas, however, are economically feasible sources of supply only if transportation costs are not prohibitive and if satisfactory product quality can be maintained. The entry into the market of the Durango-Coahuila supply region in 1966 indicates that localities as much as 750 miles from the city can become feasible sources of supply.

Consumer Demand

Population and consumption trends, Mexico City

It is appropriate to begin the analysis of demand by examining the trends in population and consumption in recent years. It was stated in the previous section that the rapid population growth of Mexico City has tended to create pressures on available milk supplies. The effects of these pressures is clearly evident in figures 1 and 2, which show the levels of total population, consumption, and per capita availability of fresh milk for the period 1940-1967.

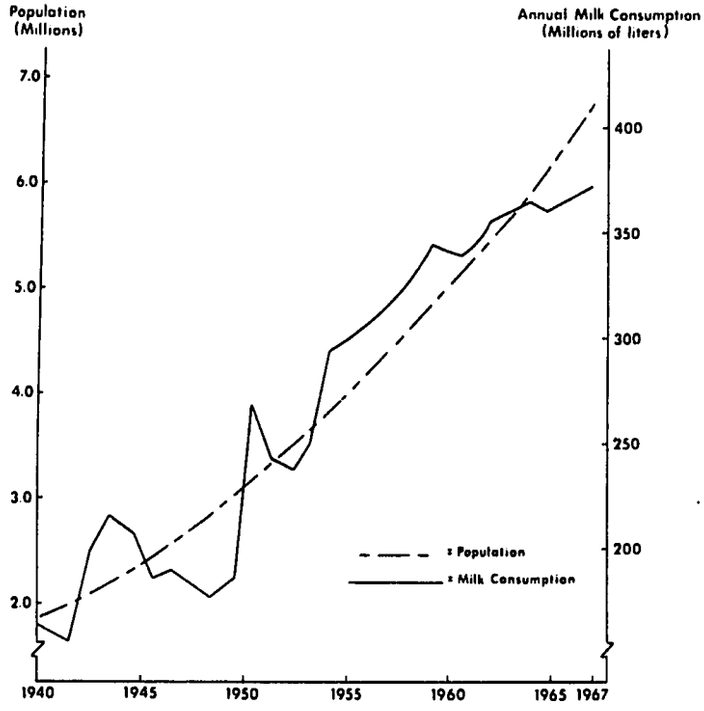

Figure 1. **Total population and consumption of fresh milk, Greater Mexico City 1940-1967.**

The persistent downward trend in per capita availability of fresh milk since 1954 has been accompanied by a gradual increase in the production of reconstituted milk. Also, canned and dried milk have become more readily available and less expensive in recent years. However, even when the estimate for consumption of these products, as given in table 1, is added to the series for fresh milk, the per capita availability in 1967 would still be only 84 liters compared with 80 liters in 1954.

A priori, one expects that the age distribution of the immigrant rural low-income families is younger than that of the rest of the population; this assumption suggests that the demand for milk would be higher than what is predicted on the basis of population growth alone because of the large nutritional requirements. However, the per capita consumption level of rural families appears to be only about half that of their urban counterparts.[3] Therefore, the net effect of this population shift on the actual de-

[3] Monthly per capita consumption of fresh milk, kilograms (1)
4.7—localities with 2,500 inhabitants or less; 9.3—localities with more than 500,000 inhabitants; 10.0--federal district.

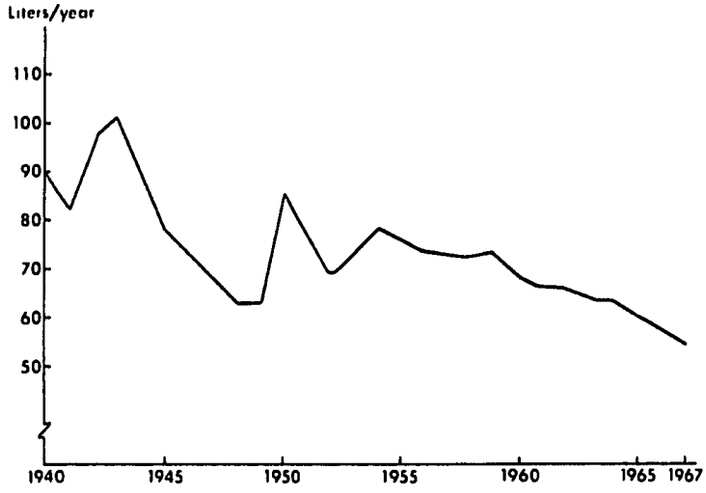

Figure 2. **Per capita availability of fresh milk, Greater Mexico City, 1940-1967.**

Table 1. **Daily consumption of milk, all forms**
Mexico City, 1967

Type of milk	Total consumption	Per capita availability*
	1000 liters	**liters**
Fresh milk	1,022.5†	.155
Reconstituted milk	400.0‡	.060
Total fluid milk	1,422.5	.215
Estimate for evaporated, condensed, and dried milk	100.0§	.015
Total, all milk	1,522.5	.230

* Based on a population of 6.6 million.
† Includes pasteurized and unpasteurized milk. Obtained by summing the production of 1429 herds regularly supplying the Mexico City market plus additional milk shipped from Torreon in October, 1967.
‡ Data supplied by Dr. Sanchez Lara, Head, Dept. Milk Products, Bur. Food and Alcoholic Beverage Control, Ministry of Public Health & Welfare.
§ Estimate based on information provided by the largest firm producing evaporated milk.

mand for fresh milk, while positive, is probably less than equally proportional to the increase in population. The production of reconstituted milk, which low-income families can purchase for about one-third of the price of pasteurized fresh milk, probably has been stimulated by this same population movement.

Meanwhile, a generally rising income level for the city as a whole has been accompanied by an increased demand for high-quality pasteurized milk. This development, along with a generally sluggish output response from the traditional supply zones, appears to have been a significant factor in the opening of the Durango-Coahuila supply area in 1966.

Finally, milk prices, which are fixed by an agency of the Ministry of Commerce and Industry, have increased over the years, but probably less than they would have without control, so the price system as a means of adjustment has not been permitted to operate freely. Producers in the traditional supply area have continually sought higher prices for their milk, asserting that output will not be increased, perhaps not even maintained, given the present cost-price structure.[1]

Current levels of milk consumption

Population growth and generally rising incomes normally are expected to contribute to an increase in milk consumption. It is at first anticipated that consumption would increase in direct proportion to population growth, with a secondary increase coming from increased per capita income. This overstates the case for Mexico City for two reasons. First, the consumption rates of rural migrant families are low, and secondly, the effect of rising incomes will depend on the proportion of the increase spent on milk; this, in turn, depends on the initial level of income.

It is estimated that there is an annual per capita availability of 84 liters of milk from all sources (total annual consumption of 556 million liters or 970 million pesos expenditure). Daily consumption by higher income families, or those whose monthly income exceeds 1500 pesos, is approximately 2.7 liters, while consumption drops to about half this amount for families with incomes of about 550 pesos per month. In spite of larger family size, lower income families consume less because a higher proportion of family members do not drink milk and, most importantly, those who do drink less. Rising incomes for other segments of the population, however, tend to increase consumption more than in proportion to population growth, thus partly offsetting the above tendency. As incomes rise, consumers shift to a better milk category at a higher price. Consequently, expenditure for milk tends to increase more than the level of consumption on an individual basis over the entire range observed.

The estimates for daily milk consumption given in table 1 will be used

[1] Conversations during March 1967 with Guillermo Quesada Bravo, who was then General Secretary, National Association of Pure Milk Producers.

for the remainder of the study. Per capita availability from all sources is .23 liter per day; for fluid milk alone the figure is .22 liter (per capita expenditure of 0.40 peso per day). This study is concerned primarily with the production and marketing of fresh milk on the supply side of the market; consequently, the analysis on the demand side will be focused on consumer purchases of fresh milk. The proportions of pasteurized and unpasteurized milk consumed are, respectively, 43 and 24 percent; but it must be recognized that consumption of reconstituted milk and canned and dried milk are believed to account for 26 and 7 percent, respectively, of the total consumption. Therefore, with respect to consumption, and more generally to the entire demand side of the market, all types of milk must be considered with their accompanying range of price.

The total daily volume of milk can be divided into several subclasses including the several grades of pasteurized milk (I, II, III) to obtain estimates of the daily consumption of each category as shown in table 2. Multiplying the estimate for each class by the appropriate price yields an estimate of total consumer expenditure for milk. The estimate for fresh milk, 2.25 million pesos, can also be taken as an estimate of the total revenue of the fresh milk industry. It is estimated that an additional 320,000 pesos is spent for reconstituted milk. None of the money expended for reconstituted milk goes to the fresh milk industry. This goes directly to CONASUPO, the government agency responsible for reconstituted milk production. The estimate of total daily expenditure for all milk is about 2.7 million pesos (U.S. $216,000).[5]

It should be noted that the level of consumption has been based on reported farm production.[6] Since there is no general surplus in the market, if the supply coming on to the market has been identified, approximate levels of consumption can be derived. Administered prices at the retail level are known and remain relatively constant. Thus, a price-quantity relation can be defined, but only for a single point in time, 1967.

It is not the purpose of this study to make a detailed investigation of the demand for milk. However, it is desirable to proceed a little further with the analysis in order to have more than "single points" to work against in examining the supply side of the market. Population, price, and income are important variables in determining demand, and the relative importance of changes in these variables must be considered for their effect upon total consumption and expenditure.

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[5] This compares with 2.61 million pesos reported in a study conducted by the Bank of Mexico (1).

[6] The data for production reported here have not been adjusted for farm consumption, nor has any allowance been made for production from farms which, though not identified, may in fact be supplying the Mexico City market. The error resulting from these omissions is believed to be small relative to total market volume and would tend to be offsetting.

Table 2. **Daily consumption and consumer expenditure for milk—total and by classes of milk**
Mexico City, 1967

Class of milk	Volume of milk	Price per liter	Consumer expenditure for milk
	1000 liters	**pesos**	**1000 pesos**
Pasteurized			
I	498.4	2.472*	1,232.1
II	88.9	2.156*	191.6
III	12.6	2.128*	26.7
Unspecified‡	36.3	2.156†	125.7
Total pasteurized	658.2		1,576.3
Unpasteurized			
Unpasteurized§	315.7	1.850*	584.1
Unspecified¶	48.5	1.850†	89.8
Total unpasteurized	364.3		673.9
Total fresh milk	1,022.5		2,250.1
Reconstituted	400.0	0.800*	320.0
Total all fluid milk	1,422.5		2,570.1
Canned and dried milk	100.0	0.955*	95.5
Total all milk	1,522.5		2,665.1

* Based on prices reported in consumer survey of 170 families. Peso = US $0.08.
† Estimated.
‡ Includes milk from Queretaro, Guanajuato, and Hidalgo for which category was not specified.
§ Includes milk from producer members of the Association of Small Producers.
¶ Includes milk from the Federal District and Mexico for which category was not specified.
Source: Adapted from appendix tables 5 and 6 (7).

First, prices for milk are set by the Bureau of Price Control in the Ministry of Commerce and Industry. Price changes tend to be infrequent and not necessarily the direct result of normal market forces; in practice, they follow changing market conditions only after a considerable time lag. The usual inverse relationship between price and quantity purchased prevails, and the level of prices can be expected to be an important

determinant of consumption. But under conditions of rising incomes and delayed price adjustments, the net effect of price increases on consumption, is small.

The effects of relative price changes in milk categories, however, are much greater. One would expect the different categories of milk, particularly the three pasteurized categories, to be close substitutes in consumption. If this is indeed the case, then price changes that are not uniform over all categories would result in significant shifts in demand for the different categories, but a relatively minor change in the total level of consumption of all the categories.

It follows, then, that the effect on industry of uniform price changes for all categories might be quite different from that of differential price changes. In the former case, a price increase, in the absence of other changes, would likely reduce consumption slightly and increase total industry revenue, assuming the price elasticity of demand to be less than one. The ultimate recipients of this increase could be any or all firms in the production and marketing segments.

An increase in the relative price of a single category, however, would be expected to reduce consumption and possibly expenditure for that category if another milk category is a close substitute. When this happens, total revenue will decline for the industry subsegments which produce and market the now higher priced product while total revenue and product demand for the substitute product will increase. If firms can easily shift from one product to the other, that is, if the two products are good substitutes in production and marketing as well as in consumption, then the real industry adjustments would be relatively small, and firms would simply be reclassified.[7] But if the products are not good substitutes, if firms cannot easily shift from one product to the other, for example, from unpasteurized to pasteurized milk, then significant real adjustments in production and(or) marketing would be required.

Finally, changes in the respective market shares of the several milk categories will probably accompany any general increase in total market volume. Rising incomes on the demand side and the probability of different production elasticities on the supply side made uniform growth with respect to different milk categories unlikely. Nonuniform growth over time will in turn result in a different industry structure. For example, an increase in the proportion of pasteurized milk will require additional processing facilities or greater utilization of existing ones. And, if milk category is related to location or herd size, changes in these variables will also be accompanied by shifts in market shares for the different milk categories.

[7] It follows that price differences should be small between substitutable products as in the case of Class II and III milk; the reported price per liter is 2.16 and 2.13 pesos, respectively (table 2).

Production Segment

The total production is equal to the product of 3 factors: production per cow, cows per farm, and the number of farms. Changes in output are possible only if one or more of these factors change. Farm numbers and herd size together clearly determine the total number of cows. Changes in the number of farms would result from changes in the density of farms for a given supply area and (or) changes in the geographic supply area itself.

Herd size is simply a measure of the concentration of cows per farm; changes in herd size, in the absence of other changes, would be translated directly into changes in market volume. But under certain conditions, the relationship is not nearly so direct. For example, a significant reduction in the number of small farms would increase the concentration of cows per farm, or average herd size, but may have little effect on total market volume. If these farms together supply only a small proportion of the total volume, the effect of their leaving the market would be small, although negative. Actually, the effect on volume would be near zero if the cows are purchased by large farms in the market. In neither case would larger herd size lead to increased market volume. There could, of course, be other intra-industry effects such as shifting of the proportions of milk in the various categories and the location of milk supply.

Production per cow is determined in the final analysis by a host of biological, technical, and economic conditions, the analysis of which would go well beyond the scope of this study. But production rates and other measures of production or management efficiency are relevant insofar as they are related to location, herd size, and milk categories. Favorable geographic areas or types of farm that are subject to superior management are likely sources of increased market supply.

Data for the number of cows and other animals, volume of milk produced, and location were obtained from the Ministry of Public Health for 1047 farms which regularly supply the Mexico City market. These farms account for approximately 75 percent of the total volume of fresh milk. In addition, a milk category was designated for the milk production of 834 of these farms. The data obtained for the 1047 farms also provide limited but useful indications of general management and productivity for different groups of farms. Having the data in this form makes it possible to study the characteristics of these farms from the four perspectives of location, herd size, production efficiency, and milk category.

Location of milk supply

The principal interest in the location variable derives from the relationship between expansion of the geographic supply area and market volume of milk. But, in addition, particular locations may impose certain restrictions on the types of farm organization and the category of milk

produced. Urban dairies, for example, of necessity tend to be smaller and more specialized than their open country counterparts, while farms located sufficiently far from the point of consumption do not have the option of selling unpasteurized milk directly to the public in the Mexico City market.

Individual supply zones and volume marketed. The Mexico City milkshed consists of the Federal District and all or parts of the states of Mexico, Puebla, Hidalgo, Querétaro, Guanajuato, Durango, and Coahuila (fig. 3). The principal supply zones and the estimated daily volumes shipped from each to the Mexico City market are shown in table 3. The largest single source of supply is the Federal District, followed closely by the state of Mexico; 92 percent of the farms identified are in these two areas. Together they account for 69 percent of the total volume. The remaining 31 percent is divided among the other 6 states as shown in table 3.

Characteristics of the 4 principal supply regions. To facilitate the exposition for the remainder of the study, the total supply area will be divided into the following 4 principal subareas or regions: (1) the Federal District, (2) the states of Mexico, Hidalgo, and Puebla, (3) Guanajuato and Querétaro, and (4) Durango and Coahuila. Regional data for population and total milk production are based on the census of 1960. Dairy herd size of the 1047 farms used in the study which supply the Mexico Cty market ranges from 1 to 1200 cows, and their combined annual production is estimated to be 320 million liters. An additional 53 million liters is estimated as being supplied from farms in the Durango-Coahuila supply zone.

The Federal District consists of a portion of the Mexico City metropolitan area and some of the immediate environs, an area of approximately 580 square miles. Virtually all of the milk produced in the Federal District can be assumed to enter the Mexico City market. Approximately 38 percent of the total market volume is produced in the Federal District. Only 4.7 percent of the area population is classified as rural.

Many of the suppliers in the area are located within the city proper; these are not really farms in the usual sense, but rather partly covered, paved corrals or stables, which house cows, young animals, and bulls. Many of these corrals open directly on to the street and are interspersed among houses and small shops. All feed is purchased, and since there is little available storage space, forage (green or half-cured, baled alfalfa) is delivered daily. Milking is usually done by hand. Part of the milk is sold to pasteurizing plants (category III); the remainder, unpasteurized and uncooled, is sold directly to the public either at the corral or through small independent distributors who make home deliveries. Those that sell unpasteurized milk to the public are technically illegal operators; however, they are usually permitted to function without interference from the authorities.

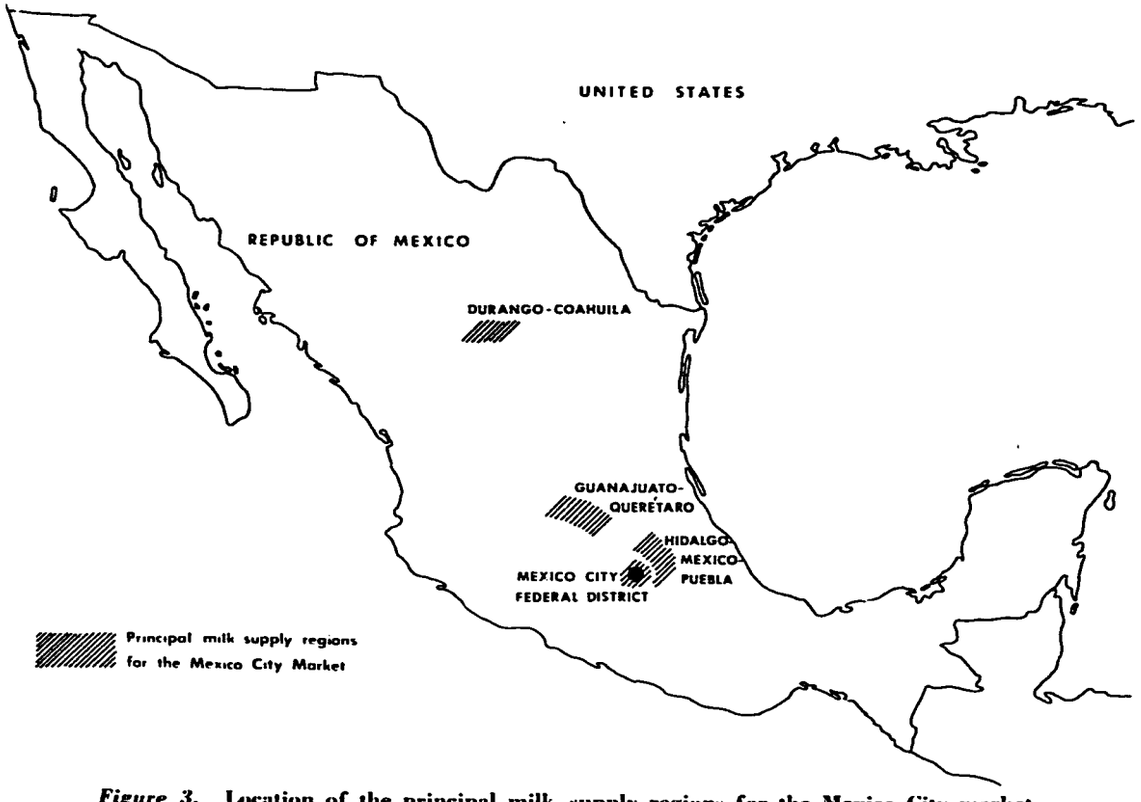

Figure 3. **Location of the principal milk supply regions for the Mexico City market.**

Table 3. **Volume of daily milk shipments—by states and production zones**
Mexico City market, 1967

State and production zone	Liters	
Federal District (total)		391,378
Postal zone 8	4,380	
9	22,870	
13	29,898	
14	62,888	
16	52,827	
17	13,440	
18	3,600	
20	10,372	
21	45,409	
22	15,260	
23	3,698	
Various other locations	126,730	
Mexico (total)		316,259
Acólman	480	
Amecemeca	2,077	
Cuautitlán	71,090	
Chalco	18,199	
Ixtapalapa	31,665	
Tepotzotlán	15,035	
Teotihuacán	17,877	
Texcoco	100,210	
Tlalnepantla	23,110	
Zumpango	36,516	
Querétaro (total)		75,727
Querétaro	52,847	
San Juan Del Río	22,880	
Guanajuato: Celaya		15,280
Hidalgo: Tulancingo		20,915
Puebla: Puebla		2,900
Durango and Coahuila: Gómez Palacio and Torreón		200,000*
Total		1,022,459

* Approximate estimate.
Source: Appendix tables 5 and 6 (7).

Because of the small area available in the city, most of the animals must be kept tied. Cows remain in the herd for 2 to 4 years, or about half as long as those kept under the less confining conditions of the outlying regions. The herds range in size from 1 to about 1200 cows. The average size is 49; the median is 24.

Most of the production zones of Mexico, Hidalgo, and Puebla are located to the north and east of the city and generally within 40 miles. This combined area supplies about one-third of total market volume, slightly less than the Federal District. The region is predominantly rural; 64 percent of the people live in rural areas or in towns of less than 2500 persons.

The area contains a variety of types and sizes of farms. Herd sizes range from 1 to about 900 cows, with an average of 116 and a median of 43. Many of the dairy farms are large, specialized operations with small acreages intensively cultivated. They may produce most, but usually not all, of their forage requirements by growing alfalfa and corn, and some of the farms produce and use silage. All feed concentrates are purchased. Alfalfa is irrigated, as is part of the corn acreage; however, one crop of corn can be produced without irrigation. Alfalfa is cut and fed green to the cows daily, with some limited grazing also being practiced. Many of the large farms maintain their own battery of bulls from which they collect semen to breed their herds artificially; they also sell semen to other producers at about 25 pesos per first service and 16 pesos per repeat. These large herds are machine milked, usually under quite sanitary conditions. The newer installations are complete with automatic equipment for washing the cows before milking, herringbone parlors, and milk-o-meters with automatic metering of concentrates for individual cows as they are milked. Milk from these operations flows directly through the pasteurizer, is packaged, hauled into the city, and distributed by retail routes twice daily. Some is packaged in paper cartons, but glass bottles are predominantly used.

The third subarea, Querétaro and Guanajuato, is located about 140 miles northwest of Mexico City. It consists of the production zones of San Juan Del Río, Querétaro, and Celaya. The area is now fourth in importance in terms of market volume and accounts for approximately 8 percent of the total supply. The relative importance of the area as a source of supply declined significantly after the opening of the Durango-Coahuila region in 1966. Slightly more than half (57%) of the population is classified as rural. The farms of this area have larger herds, on the average, than those in the state of Mexico, and farming operations are generally less specialized. Herds range in size from 1 to 640 cows; the average is 134 and the median is 84. Milk is pasteurized and packaged in the area, then hauled by truck to Mexico City.

The fourth and newest supply subarea consists of parts of the states of Durango and Coahuila near the city of Torreón. Located 750 miles northwest of Mexico City, the area is an extensive irrigation district. Herd size on dairy farms in this region is the largest of the 4 subareas with an average of 150 cows; the median size is 120 and the range is 15 to 670. In this region, 48 percent of the people live in places with populations of less than 2500 persons.

Shipments from the area to Mexico City date from April 1966, and by the fall of 1967 were estimated to represent 20 percent of the total market volume.[8] Initially, one of several plants in the area shipped pasteurized, packaged milk by truck to Mexico City, but this practice was superseded by the construction of a subsidiary plant in Mexico City completed in June 1966. Currently, milk is shipped daily by tank truck from Torreón to this new plant where it is pasteurized and packaged in paper containers.

The characteristics for farms in each of the 4 subareas are summarized in table 4. For each more distant region farm numbers are smaller, while herd size and production per farm increase. The median of each group is smaller than the average, often substantially so, implying a significantly biased size distribution.

Dairy herd size

The size and character of dairy herds is different for each of the major supply regions—as might be expected, considering the quite different factor proportions and factor markets for the separate zones. As shown by the data presented in table 4, average herd size increased as production moved outward from the metropolitan market. While dairies close in to the city were the most specialized, the fact that they often produced milk for direct sale provided fewer scale economies which would tend to force concentrated production as occurred, for example, on those farms which had heavy overhead expenditures for specialized dairy and crop farming equipment.

At the present time most of the Mexico City milk supply originates in the Federal District and in the nearby states of Mexico, Puebla, and Hidalgo. Expansion of milk supplies in response to demand has been modest except for the growth of the more distant markets. Within any region, expansion of production can occur as the result of more farms, more cows per farm, or of higher production per cow. In the short run, the reduction in number of farms would not necessarily mean a reduction in total production because, for the most part, the animals would be absorbed into the herds of already established dairies. To the degree that there might be better feeding and other management practices on the larger farms, there might be an increase in total marketings. Expanding farm numbers and bringing in additional cows and other dairy farm resources would almost always be expected to increase market supplies.

Perhaps the most promising basis for increasing production is through the introduction of an output-increasing technology. A farmer's decisions about adopting the technology are conditioned by his awareness of feasible alternatives and his willingness and capacity to absorb the risks

[8] More recent inquiry suggests that shipments from the zone may be overestimated; for lack of a more precise number, we allow this estimate to stand.

Table 4. **Farm characteristics by state or region**
1,047 dairy farms, Mexico City market, 1967

Characteristics	All farms	State or region			
		Federal District	Mexico, Puebla, & Hidalgo	Querétaro & Guanajuato	Durango
Number of farms . . .	1,047	643	309	69	26
Size range (total cows)	0-1,200	0-1,200	0-900	0-640	15-670
Cows per farm					
average	77	49	116	134	150
median	--	24	43	84	120
mode	--	24	12	30,120	30,120,135
modal frequency .	--	10	15	3	2
Daily milk production average liters					
per farm	717	412	1,101	1,319	2,096
percent of total supply originating in the zone	100	35	45	12	7

Source: Data from Ministry of Public Health and Welfare, Mexico City.

associated with the changes. The decision-making environment of the relatively large and well-financed farms may be more conducive to such adoption than is that of the smaller farms. The decisions of the latter may be just as rational, given their knowledge of alternatives and constraints, but it is just these factors that constitute the decision-making environment. Officials associated with developmental programs have long pointed out the relative simplicity of providing information and working on the adoption of improved farming systems with a limited number of large producers, in contrast to the complications of working with a large number of small producers. (Of course, to the degree that the environment of large-scale producers is unfavorable to change, the reverse would obtain.)

The relatively low absolute number of large farms shown in table 5 is particularly significant. The 74 farms with 300 or more cows control 45 percent of the reported output of the 1047 farms and approximately a third of the total market volume of fresh milk from all sources. Such a market concentration of private firms at the farm level is probably quite

Table 5. **Farm characteristics by herd size class**
1,047 dairy farms, Mexico City market, 1967

Characteristics	Size class				
	All farms	Small	Medium	Large	Very large
Number of farms . . .	1,047	516	319	138	74
Cows per farm					
size range	0-1,200	0-29	30-99	100-299	300-1,200
average	77	12	54	166	459
median	--	11	49	148	384
mode	--	8,10	30	100	320
modal frequency .		32	27	10	5
Daily milk production average liters per farm	717	92	469	1,561	4,558
percent of total supply originating in size category . .	100	6	20	29	45

Source: Data from Ministry of Public Health and Welfare, Mexico City.

exceptional in developing urban milk markets. The principal economic significance of the fact derives from this group's apparent potential to exploit its relatively strong market position in setting milk prices and influencing market policy in general. Moreover, as will be shown later, this same group controls a large portion of the processing and distribution facilities, and until 1966, nearly all the production of the Class I category.

Measures of production efficiency

Average production per cow is probably the most satisfactory overall measure of technical efficiency in production. It reflects the general level of herd management, feeding practices, and inherent productivity of the animals. The data obtained from the surveyed farms included the number of cows and total production for each herd, hence the average production per cow could be determined. This and other measures calculated from the data are believed to be valid for intergroup comparisons where large numbers of farms are included and the interest is in relative, not absolute, magnitudes. Other measures of production efficiency include the proportion of cows in milk, the ratio of calves to cows, and the ratio of total dairy animals to cows in milk.

The average production per cow can be calculated both on the basis of total cows and cows in milk. The latter measure is more indicative of the inherent productivity of the cows, plus feeding and management practices excluding breeding. The total cow basis, on the other hand, reflects the additional influence of the presence of dry cows in the herd, the proportion of which will vary with the herd's conception rate and other factors. This is probably a better indicator of the relative overall efficiency of different groups of farms.

The percent of cows in milk is the best available measure of breeding efficiency. A relatively high proportion of cows in milk will be associated with a short dry period, which in turn normally implies high conception rates. Other considerations enter the picture and their inclusion would modify the above statements; for example, a high proportion of cows in milk could be the result of greater than normal sales and purchases of cows or movement of cows between herds rather than from a higher level of breeding efficiency. One could expect such a shifting of cows, which, in a sense, represents a greater degree of specialization, to be more prevalent in the Federal District than in the more outlying regions. But, unexpectedly, the actual percent of cows in milk for herds in the Federal District turns out to be lower than for any other region (7: 80).

The ratio of calves to cows provides an indication of the relative self-sufficiency, in terms of herd replacements, of the individual farm or groups of similar farms. A magnitude of from .45 to .75 for this ratio would be required for herd size to be just maintained by its own replacements. The smaller ratio value reflects superior management—a 6-year productive cow life and 90 percent of calves becoming mature cows. The higher figure is based on 4 years of productive cow life and 80 percent of calves reaching maturity. Both are based on all heifer calves that have survived the early high mortality rate and a first calving age of about 30 months. Observed ratios lower than the above imply purchases of herd replacements, but do not in themselves suggest any explanation for the practice other than that it is perceived as being more profitable by the dairy farmer.

A final measure suggested is the ratio of the total number of dairy animals to cows in milk. This is primarily an indication of the degree of specialization. A relatively low magnitude for this ratio implies a small number of dairy animals other than cows in milk, hence greater specialization. More definitive statements with respect to the actual degree of specialization for different groups of farms and the underlying causes would require additional information concerning the structure of production costs. Higher land prices in and near the city, for example, tend to prohibit or substantially limit feed production. Specialization in dairying, as opposed to general farming, increases as a result.

Differences in relative input prices and productivity for different farm groups influence both the degree of specialization and the scale of opera-

tion. Relatively higher factor prices and/or lower productivity, other things being equal, tend to reduce the input of a given factor in the production process and reduce total farm output or the scale of operation. In the case of dairy farms, if a reduction in inputs reduces the output of (1) cash crops, (2) feed crops, (3) young animals and (4) cows not in milk, in that order, then specialization, as viewed here, would be increased in each instance. Scale of operation for the farm as a whole would be reduced, however, although not necessarily as measured by herd size or milk production alone. In analagous fashion, if identical conditions of production and factor prices obtain, different relative product prices between farm groups resulting from different market locations, for example, may lead to differential results with respect to scale of operation and specialization.

Categories of milk produced

The foregoing discussion has implicitly assumed that all farms produce an identical product, but in reality this is not so; different categories of milk are produced on different farms. Each category has its own distinct set of specifications, associated market services, and prices. Thus, in practice, each milk category becomes a slightly different product, and the distinction is maintained as the product passes through the marketing system and on to customers. The introduction of milk categories into the discussion clearly increases the complexity of the analysis because much of the preceding discussion must be applied separately to the subgroup of farms within each milk category rather than to all farms together. The complication is accompanied by some beneficial aspects also. The characteristics differentiating the individual milk categories also help to explain certain other structural conditions, such as herd size and location. Considering the individual milk categories on the supply side of the market, and relating them to the demand forces already studied provides a unique opportunity to investigate some of the intra-industry adjustments that might be expected to accompany market development and expansion.

Dairy farms supplying the Mexico City market are classified according to 3 pasteurized-milk categories (Classes I, II, and III) and the unpasteurized category, which is another submarket. Also, for the purposes of this study, the term "unspecified" is used to designate farms and milk for which no category was listed on the records of the Ministry of Public Health and Welfare.

The milk categories are listed above in order of highest to lowest minimum quality standards and price. Table 6 gives the relative importance of each category, including the unspecified, in terms of the total market volume of fresh milk and estimated industry revenue. Industry revenue has been defined as the income accruing to firms that produce, process, and distribute fresh milk and is considered as being equivalent to final consumer expenditure for fresh milk. Total income for the pro-

duction segment equals industry revenue minus that received by the processing and distributing segments. The relative distribution of income between the three industry segments will differ for different categories, mostly in accordance with the different services combined in the particular category.

Slightly less than half of the total market volume of fresh milk is produced by Class I category farms. Consumption of Class I milk is concentrated in high-income families where the observed income elasticity of demand was low. If, as is probable, the price elasticity is also low, then a modest increase in the price of milk would result in a significant increase in consumer expenditure for milk and in total revenue for the Class I subindustry. But, as will be seen later, this subindustry is characterized by a high degree of vertical integration. This condition generally tends to increase the market power of Class I producers as a group. The degree of integration will also be shown to influence the distribution of consumer expenditure among the production, processing, and distribution segments of the industry.

Producers of unpasteurized milk account for 30 percent of the market volume. Uniform production adjustments by farms in this group is unlikely to affect total market volume significantly, the probability of such actions being low where, as in this case, there is a large number of farms. The remaining 20 percent of market volume is about evenly divided between the two lower pasteurized categories together and unspecified milk.

Table 6. **Annual volume of milk and industry revenue, fresh milk**
Mexico City market, 1967

Milk category	Volume of milk* (liters/year)		Industry revenue† (pesos/year)	
	millions	**percent**	**millions**	**percent**
I	181.9	48.7	449.7	54.8
II	32.4	8.7	69.9	8.5
III	4.6	1.2	9.8	1.2
Unpasteurized	115.2	30.9	213.2	25.9
Unspecified	39.1	10.5	78.7‡	9.6
Total	373.2	100.0	821.3	100.0

* Adapted from appendix tables 5 and 6 (7).
† Based on prices reported in a survey of 170 families (table 2).
‡ Based on allocation of unspecified milk (table 2).

It should be noted that changes in production of Class I milk will result in a more than proportional change in industry revenue, while the opposite is true for unpasteurized milk. This follows from the price differences between categories and reflects, at least in part, the cost of providing the additional services of pasteurizing, cooling, and packaging.

Additional characteristics of farms in each of the 4 milk categories are specified in table 7. The 834 farms for which milk category was identifiable are included. Farm size, in terms of cow numbers, is smallest for Class III farms and is only slightly larger for unpasteurized producers; the smallness of Class III farms seems to follow from the regulations which allow Class III plants to purchase milk from many producers. Then there is a 5-fold increase in herd size for Class II farms and an additional 60 percent increase for Class I farms. The median farm in each group is smaller than the average; no single herd size is dominant in any of the groups.

The small number of farms in proportion to the output of Class I pasteurized milk increases the significance of the management decision of each Class I farm in the market, although the primary effect of actions taken by these farms would be concentrated in one submarket, namely,

Table 7. **Farm characteristics by milk category, 834 dairy farms**
Mexico City market, 1967

Characteristics	All farms	Milk category			
		I	II	III	Unpasteurized
Number of farms	834	102	48	47	637
Cows per farm					
size range	1-1,200	15-1,200	10-430	1-120	1-880
average	82	320	200	31	39
median	--	310	180	22	23
mode	--	120	67,100	4,6,10	8
modal frequency .	--	4	2	3	27
Daily milk production average liters per farm	771	3,460	1,852	267	297
percent of total supply originating in milk category . . .	100	55	14	2	29

Source: Data from Ministry of Public Health and Welfare, Mexico City.

that for the highest quality milk. The effect on the rest of the market would depend on the various interproduct relationships. In general, the greater the degree of substitution between milk categories, the more widespread will be the overall market effect of a disturbance originating with one particular category.

Processing Segment

The processing segment of the fluid milk industry for the Mexico City market includes the pasteurizing plants for the several categories and the government operated plant that produces reconstituted milk. The scope of this study with respect to the processing segment is confined to the former group of plants. Most of the plant data was obtained from the Ministry of Public Health and Welfare. A total of 110 plants were identified, with estimated daily capacity ranging from 600 to 200,000 liters each. The combined daily plant capacity was reported to be 870,000 liters, compared with the daily consumption estimate of 658,000 liters given in table 2. The quantities differ for 2 principal reasons. First, some of the plants, particularly those that pasteurized Class III milk, do not operate at full capacity. One of the plant managers interviewed reported an average daily plant volume of just over 50 percent of stated capacity. The 870,000 liters, therefore, probably indicate plant capacity rather than actual volume processed, particularly for Class III plants. Secondly, some of the discrepancy results simply from the fact that the lists of plants and producers were not given for identical dates. Both, however, were based on maximum volumes reported for the period 1966-67.

Location of processing facilities

The number of plants and daily capacity of milk pasteurized in each of the 4 previously defined regions is shown in table 8. As mentioned, milk from Durango and Coahuila is shipped to a single large plant in Mexico City for processing. Of the total of 110 plants, 60 percent are located in the Mexico-Puebla-Hidalgo region; all but 4 of these are in the state of Mexico. The Federal District has 29 plants and 15 more are located in the Querétaro-Guanajuato region.

Two principal factors account for the observed pattern of plant location, namely, location of supply and milk category. The Federal District is the largest single source of supply (table 3), but a relatively large proportion is sold unpasteurized directly to consumers. Hence, there are fewer pasteurizing plants in proportion to total milk supply in the Federal District than in the other regions. The Mexico–Puebla–Hidalgo region, on the other hand, has a relatively high proportion of Class I farms, and it supplies nearly as much milk in this category as the Federal District. Since Class I producers generally are required by law to have their own pasteurizing plants, a relatively large number of plants are

Table 8. **Number of pasteurizing plants and volume of milk processed**
4 supply regions, Mexico City market, 1967*

Region	Number of plants	Total daily capacity	Percent of total	
			Plants	Volume
		liters		
Federal District	29	524,100	26	60
Mexico, Puebla, and Hidalgo . .	66	297,000	60	34
Querétaro and Guanajuato . . .	15	48,886	14	6
Durango and Coahuila	0	0	0	0
Total–all regions	110	869,986	100	100

* Refers only to those plants supplying the Mexico City market.
Source: Appendix tables 11 and 12 (7), and information from Mexican Ministry of Public Health and Welfare.

found in the Mexico–Puebla–Hidalgo region. Fewer plants are located in the Querétaro-Guanajuato region because the region has a relatively small share of market volume.

Two points must be considered in understanding the concentration of central processing at the consumption center and the likelihood that it will increase in the years ahead. First, the recent opening of the Mexico City plant to receive milk from the Durango-Coahuila region increased by a substantial amount the relative proportion of milk processed in the Federal District. Since the Durango-Coahuila region is the most distant supplier in the market, there are no reasons of a technical nature for the other regions not to do likewise if opportunity affords. Secondly, there is currently a relatively large volume of milk being produced in the Federal District that is not being pasteurized. If health regulations were enforced, much of this milk probably could be pasteurized by Class III plants. Some farms likely would go out of business or be relocated outside the city, but a significant reduction in the volume of unpasteurized milk now in the market would almost certainly increase the relative proportion of volume pasteurized, and (or) plant capacity, in the Federal District.

Size of pasteurizing plants

The 110 pasteurizing plants are divided among 5 size groups in table 9. The predominance of small plants is clearly evident, with 98 having a daily volume of less than 10,000 liters per day. Of these, 66 handle less than 4500 liters each. At the other extreme, 12 plants process 10,000 liters or more each day; of the 4 having a capacity of more than 40,000 liters a

Table 9. **Size distribution of pasteurizing plants**
Mexico City market, 1967

Item	Total, all plants	Plant-size group (in liters/day)				
		Very small (under 2,000)	Small (2,000-4,499)	Medium (4,500-9,999)	Large (10,000-40,000)	Very large (over 40,000)
Number of plants	110	24	42	32	8	4
Size range (liters/day)	450-200,000	450-1,800	2,000-4,300	4,500-9,800	10,000-20,000	50,000-200,000
Average plant capacity	7,909	1,200	3,115	6,245	13,813	100,000
Median plant capacity	3,800	1,200	3,000	6,000	14,250	75,000
Total capacity	869,986	28,800	130,850	199,836	110,500	400,000
Percent of all plants	100	22	38	29	7	4
Percent of total capacity	100	3	15	23	13	46

Source: Data from Ministry of Public Health and Welfare, Mexico City.

day, one has a capacity of 200,000 liters per day. This one plant accounts for 23 percent of the total reported plant capacity. The data presented here indicate that 4 plants of this size could handle virtually all of the present market volume. If processing costs are significantly lower for the largest plant size reported than for the considerably smaller plants now in operation, substantial savings in total processing costs are possible if the small plants consolidate.

Categories of milk processed

The categorization of pasteurizing plants and the volume processed among different milk categories is presented in table 10. It shows 77 identified as Class I plants, 20 as Class II, and 13 as Class III. The underlying relationship between milk category and plant size can be discerned also in table 10. It would be even more pronounced were it not for the one large Class I plant from the Durango-Coahuila region.

The positive correlation between lower milk category and larger plant size is largely due to the health regulations concerning plant operations, and wherever the relationship is modified, it is the result of selective enforcement of regulations. Class I plants are required to be located adjacent to the milking facility for a single herd. Purchase of additional milk from other farms is not permitted, thus severely restricting feasible plant size. Even a large herd of 500 cows would support a plant of only about 5000 liters per day capacity. But the single major departure from this rule has resulted in the establishment of the largest plant in the market, the Durango-Coahuila plant in Mexico City. This plant has twice the capacity of the next largest plant in the market, one that processes Class III milk, and 17 times the capacity of any other Class I plant. If

Table 10. **Number of pasteurizing plants and milk processing capacity—total and by milk categories**
Mexico City market, 1967

Milk category	Number of plants	Total daily capacity	Percent of total	
			Plant	Volume
		liters		
I	77	498,436	70	57
II	20	57,050	18	7
III	13	314,500	12	36
Total—all categories	110	869,986	100	100

Source: Data from Ministry of Public Health and Welfare, Mexico City.

the regulation for individual farm processing were to apply in this case 100 plants would be required to handle the same volume based on the average herd size reported for the Durango-Coahuila supply region. An enforcement of the regulation would more likely result in eliminating the region as a feasible source of supply. This in turn would reduce reported market volume by as much as 20 percent unless other sources were found and would result in even greater upward pressure on retail milk prices.

On the other hand, average volume and capacity for Class III plants would probably increase if the regulation requiring all milk to be pasteurized were enforced. A total volume in excess of 315,000 liters per day of unpasteurized milk is currently being marketed, according to the data obtained for this study. Most of this milk is produced in the Federal District, and 80 percent of the reported Class III plant capacity is also in this district. The total is slightly greater than reported Class III plant capacity and is probably considerably greater than actual volume processed. Even if the production of a significant fraction of this volume were to shift outside the city or outside the Federal District, given the present quality specifications, a large proportion would almost certainly be processed in Class III plants, thus increasing average plant volume.

There are 20 Class II plants with a combined daily volume of 57,050 liters. Together they account for 7 percent of market volume. Their average size is slightly smaller than Class I plants. As in the case of the latter, Class II plants are required to be located adjacent to the milking facility of a single herd and to be under the same ownership. However, Class II plants are permitted to purchase additional milk from a limited number of other farms. Quality standards are lower than for Class I milk. There were no apparent instances of these regulations not being enforced, at least none comparable to the tacit approval of unpasteurized milk and central processing in Mexico City of Class I milk from the Durango-Coahuila region. If unpasteurized milk were no longer permitted, there would probably be some increase in total volume and individual capacity of Class II plants. This could be achieved through the establishment of new farms and plants or by enlarging the existing ones.

The current schedule of administered retail milk prices appears to be an additional constraint on the expansion of Class II volume. The observed retail prices for Class I, II, and III milk were 2.47, 2.16, and 2.13 pesos per liter, respectively (table 2), making Class II and III categories of milk almost interchangeable from the standpoint of price. Significant economies of scale almost certainly exist between the average of 2851 liters for Class II plants and 50,000 liters for Class III plants. This being the case and given the above milk prices, Class III plants could pay higher prices to producers than could the Class II plants.

Therefore, rigorous enforcement of all regulations as now specified would tend to reduce the average size for Class I category plants, increase the average size of Class II and III category plants, increase total plant

numbers for each category and reduce market volume. Selective enforcement and (or) modification of the present health and price regulations, of course, could lead to many different types of market and industry adjustments, depending on the particular actions taken by the authorities.

Distribution Segment

For the purpose of this study, the distribution segment includes those firms that derive all, or most, of their income from selling milk to consumers at the retail level. There are, of course, other types of retail outlets, such as general grocery stores, supermarkets, and restaurants. In these cases, however, milk is a relatively minor item in terms of the total goods and services provided.

The interest here will center on the various retail outlets and home delivery systems that handle fresh pasteurized milk. This means in effect that no explicit recognition is given to the distribution of either unpasteurized or reconstituted milk. A large portion of the unpasteurized milk is sold directly to consumers at the urban stables; thus, both the processing and distribution segments are bypassed. However, some independent operators regularly purchase milk from the farm or urban stable and make home deliveries to regular customers. But both the number of such distributors and the volume of milk handled are unknown.

The manufacturing agency for reconstituted milk, CONASUPO, has established a number of retail outlets at various locations within the city. The presence of this product in the market is an important consideration because it is a close substitute for fresh milk. The distribution of reconstituted milk could be considered as a part of the dairy industry generally, but it does not come within the scope of the subindustry dealt with in this study, namely, those firms engaged in the production and marketing of fresh milk.

Numbers and types of distribution firms

A total of 1974 firms were licensed to sell milk to the public in July 1967.[9] Of these, 35 were classified as providing home delivery service only, and 438 were listed as specialized retail dairy stores. Many of the latter also maintained retail home-delivery routes. The remaining 1501 firms were classified as general grocery stores and supermarkets.

The specialized dairy stores vary considerably in size and general operation. The largest and most modern are those of the large, integrated, Class I firms; most of these are located in the higher income neighborhoods and are operated in conjunction with the same Class I firm's home delivery system. The larger firms frequently have several of these joint

[9] Based on records maintained by the Ministry of Public Health and Welfare, Bureau of Food and Alcoholic Beverage Control, Mexico City.

retail dairystore–home–delivery systems located in different parts of the city. Each of these stores is supplied by the parent firm only. Sales are usually limited to whole milk and cream produced by the parent firm although, in some instances, fresh eggs or other food items are also stocked. Home-delivery routes serviced by these firms generally are covered twice each day.

A second broad group of retail dairy stores consists of the numerous, small, independent operators. These firms are scattered throughout the city but tend to be somewhat more heavily concentrated in the lower income neighborhoods. These store operations are less specialized; frequently they sell more than one category of milk as well as other food and nonfood items. Also, they often service one or more small home-delivery routes. Milk is delivered to these independent operators in small lots by truck from the supplying farms or plants at least once daily. One plant may supply many of these small dairy stores. These operators usually cover their home-delivery routes twice a day as the larger distributors do.

Interviewed for this study were 12 distribution firms. Of these, 5 reported daily sales of less than 200 liters, 4 had volumes of between 200 and 1000 liters, and 3 sold over 1000 liters per day. Slightly more than half of the total volume were sold during the morning, although the smaller distributors reversed this pattern. This might be due to the fact that all of the 5 largest firms contacted made morning home deliveries, which the various distributors and route managers believe result in the sale of a larger volume of milk than afternoon routes do. Only one of the smaller distributors made home deliveries.

Home-delivery systems

Retail home-delivery systems assume many forms in Mexico City. Methods of delivery range from pushcarts and bicycles to larger 3-wheeled motorized vehicles, automobiles, pickups, and larger trucks. Some of the larger trucks have closed vans and the pickups are usually covered, but bicycles and carts are not. No refrigerated vans were observed although ice is used frequently.

Except in the bicycle delivery system, 2 or more men normally are required each time the route is covered. It is reported that over 90 percent of the pasteurized milk was packaged in glass bottles in 1964 (6), but packaging in paper cartons is increasing. For milk packaged in glass bottles, consumers frequently meet the deliveryman on the street with their containers and the transfer is made at the point of sale. Sales are strictly on a cash basis.

The truck routes are relatively long, both in terms of time and distance. Two distributors reported routes of 170 and 180 kilometers, respectively. One morning route observed as this study was carried out required 6.5 hours to complete. In this case, 2 men were employed for the route; they

handled 648 liters in 151 stops, delivering an average of 4.3 liters per stop. Afternoon routes generally are somewhat shorter. In this case, the same neighborhoods were serviced by both a morning and afternoon route, but the volume sold in the afternoon was only about half as much as for the morning route.

Milk not sold on the route is returned to the dairy store, if one is available, and sold there. Milk not sold either on the delivery routes or through the specialized dairy stores is picked up the following day by the processor. In general, the individual pasteurizing plants supply their own retail dairy store outlets first, then other dairy stores, supermarkets, grocery stores, and restaurants, in that order.

Of the 12 distribution firms interviewed in this study, 6 operated home-delivery routes. These included the 5 largest distributors and 1 of the small firms which had a daily volume of only 180 liters. This small distributor serviced 1 route twice a day using a bicycle. The other 5 had from 2 to 9 routes each with a combined total of 21 routes; all but 2 routes were serviced twice each day. Bicycles were used on 3 routes and trucks on the remainder. A total of 88 persons were employed by the 12 firms interviewed. The average daily volumes handled per person employed were 124, 173, and 263 liters for the 5 small, 4 medium, and 3 large firms, respectively.

Conclusions and Implications

The principal determinants of aggregate milk consumption are population, consumer income, and milk prices. For the families surveyed, there was a negative relationship between income and family size and a positive relationship between family income and each of the other associated variables: price paid, proportion of milk drinkers, and average consumption levels. The positive effect of higher incomes on consumption and expenditure diminishes as incomes rise and finally becomes negligible, first for consumption and then for expenditure. Taking into account these effects, monthly family incomes in the neighborhood of 3500 to 5000 pesos yield near zero income elasticities for milk consumption and expenditure. At higher income levels, family consumption of milk may decline because of smaller family size and changing age distribution of family members. Individual and aggregate consumption levels, however, would be expected to remain relatively constant with respect to income changes above some minimum level.

Given the above conclusions, an accurate projection of total demand for milk requires that the number, size, and age distribution of families in each of several broad income groups be specified along with their expected rates of growth. The latter includes net immigration and shifts between income groups in addition to the normal biological increase. Intergroup shifts will be particularly important under conditions of rapid-

ly increasing incomes. A more detailed investigation of the structure of demand for milk would require additional data regarding the behavioral characteristics of families in different income groups.

The principal implications of a significant increase in demand for the fresh milk industry would seem to depend largely on the origin of the increase in demand with respect to family income groups and the public policy toward the regulation of price and product quality and the production of reconstituted milk. With respect to the origin of demand, the pasteurized fresh milk industry clearly will experience a greater impact if the increased demand originates primarily in the upper income groups. If lower income families are primarily responsible for the demand shift, the increased consumption would be limited mainly to unpasteurized and reconstituted milk, given the present structure of production, marketing, and public regulations.

Since the public sector has been instrumental in creating the present structure; it is reasonable to assume that it would be equally instrumental in initiating changes in that structure. The recent granting of permission for centralized processing in Mexico City of Class I milk from the Durango-Coahuila region is a rather conspicuous example of the type of structural change that is possible. Further modifications of this nature would have a significant effect on the processing segment of the industry as would the elimination of unpasteurized milk. Other structural changes could be induced through milk price manipulations and adjusting the volume of reconstituted milk supplied by the public sector.

The numerous large integrated farms near Mexico City, the recent opening of the distant Durango-Coahuila supply zone, and the small urban stables located within the city proper all are prominent features of the production segment. Several broad conclusions appear to follow almost directly as a result of such extremes in location and type of operation within the same general market.

First, whatever economies of scale there are in promotion almost certainly have been realized by the many 300-500-cow farm operations. In fact, increasing economies of scale in processing may have provided an incentive for integrated firms to expand their farm operations beyond the optimum scale based on production costs alone.

Secondly, in spite of higher transportation costs, a supply region as distant as Durango-Coahuila is able to compete favorably with the nearby traditional supply zones because of lower processing costs and probably lower production costs. Apparently, milk is not nearly so perishable when properly handled as is implied by the various systems in the nearby area, which feature a less than 24-hour time lag from cow to consumer.

Finally, the small urban dairies are competitive, in spite of almost certainly higher production costs, primarily because their product by-passes a relatively high-cost marketing system. These producers are able to undersell their pasteurized milk competitors and, by avoiding the pas-

teurizing, bottling, and transportation costs associated with more conventional marketing, apparently realize a sufficient return to remain in business.

Of the three groups just considered, urban producers appear to have the poorest long-run prospects. The relative operating cost disadvantage of these firms likely will worsen in the future as the urban area continues to develop, expand, and modernize. Also, possible future enforcement of the regulations against unpasteurized milk would effectively cut off their present market outlet. Some, but probably not all, could shift to having their production pasteurized in Class III plants, but the fact that they have not already done so suggests that such a forced shift may at least reduce profits, or perhaps even increase losses, for these firms.

The group of large farms near the city have the advantage of cost savings resulting from large-scale production and low farm-to-market transportation costs. If they should adopt centralized processing and thereby eliminate their present low-volume and high-cost plant operations and distribution system, they probably could improve their competitive position relative to the Durango-Coahuila or similarly distant supply regions.

Durango-Coahuila producers, on the other hand, probably enjoy both a production and processing cost advantage. Their long-run position in the market, however, depends primarily on their production and processing cost advantages relative to the disadvantage of high transportation costs.

The large number of extremely small plants is a striking feature of the processing segment. This condition probably means that processing costs are relatively high for the market in general and for these small plants in particular. If centralized processing were initiated, the potential cost savings implicit in such a situation would accrue first to the processing segment of the industry, although in the final analysis both producers and consumers probably would share in some measure. But the prospect of financial losses to the individual small plant owners, plus the loss of their own identity in the market, may be sufficient for the integrated Class I firms to maintain the present system intact in the absence of other forces for change.

At this time, the regulations of public agencies encourage a system of many integrated firms even though the specified milk prices may not permit a sufficient return on plant investment to attract new firms into the market. The distinction between milk categories also contributes to the duplication of relatively small plant facilities. Centralized processing generally is limited to Class III plants, but in the outlying regions, the density of Class III farms is not sufficient to support more than a relatively small plant volume, even though there may be additional Class I and II farms and plants in the same area.

The structure of the processing segment is highly dependent on the kinds of policies promulgated by the public agencies. If no change in

these policies is assumed, then several conclusions clearly follow. Stimulated by an increased demand, the present system of small integrated Class I and II plants could increase to some extent, but a significant increase in average plant volume would not be likely. Plant volumes are restricted effectively by the size of the supporting herd which is already quite large on the average.

On the other hand, Class III plants could experience a greater increase in volumes processed because of their more flexible operating policies. And, if the apparent excess capacity is in fact real, a substantial increase in volume processed would be possible with little real plant alteration or new construction. As an exception to the standard Class I producers, the Durango-Coahuila suppliers seem to have significant cost advantages which would permit them to further increase their present share in the market and to be an expansive segment of the industry.

The distribution segment is closely related to processing because of the relatively high degree of vertical integration that exists between these two segments. The apparent saturation of a residential neighborhood with home delivery routes seems to result from the large number of processing plants, each competing for the relatively affluent customers. Just as small individual plant volumes suggest high processing costs, excessive duplication of home delivery routes suggests high distribution costs, although the degree of inefficiency may be less. The small-scale processing plants and the overlapping home-delivery routes stem from the same cause which is the system of many small, integrated firms, and both patterns will tend to remain or fall with that system. Future changes in the distribution segment will depend in the first instance on the nature of adjustments in the processing segment. Additional variables in determining the structure of the distribution segment include consumer preferences for location and frequency of purchase. For example, a relatively small shift in favor of store purchase over home delivery might stimulate a significant reduction in home-delivery services if these services are relatively unprofitable as some distributors suggested. Also, less frequent purchases would require increased storage capacity somewhere in the processing–distribution system and more careful attention to quality control.

The probable future volume of unpasteurized and reconstituted milk has not been considered explicitly here because these products do not pass through the marketing system being discussed. It was concluded earlier, however, that total market volume of unpasteurized milk likely would not increase. This leaves only reconstituted milk which, if present regulations are maintained, can be expected to increase significantly, simply because there are no other principal potential sources of milk supply for the lowest income families.

The present structure of public regulations affects milk prices and quality and farm–plant operational structures in a particular way; a public agency, CONASUPO, is provided with an incentive to increase the supply

of a close substitute for fresh milk, largely because the requirements of a regulatory agency in the Ministry of Public Health and Welfare tend to perpetuate a system of high-cost, integrated firms. The fresh milk industry, particularly Class I firms, generally have opposed the expansionist policy for CONASUPO and supported those of the regulating agency. Superimposed on the industry's sanitary regulations is a schedule of prices specified by the Bureau of Price Control in the Ministry of Commerce and Industry. Given the sanitation and price control regulations, prices probably are at least as favorable to firms supplying lower category and unpasteurized milk as to Class I firms, in spite of the greater political influence of the latter.

In view of the conclusions about consumer demand and given the basic structure of milk production, a feasible approach to market expansion might be built around an increase in retail prices for Class I milk coupled with permission for centralized processing and price incentives for store purchasers. Part of the additional industry net revenue implicit in this approach, if recovered through taxation, could constitute the basis for subsidy for low-income families through the expansion of reconstituted milk supplies by CONASUPO. As a result of industry development and modernization, there is a potential for long-run community gains in the form of higher product quality and lower milk prices.

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