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U.S.-Mexico Corn Trade During the NAFTA Era: New Twists to an Old Story

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Abstract

Although the growing U.S.-Mexico corn trade has changed significantly since the implementation of the North American Free Trade Agreement in 1994, it retains many of its pre-trade-liberalization characteristics. The majority of U.S. corn exports to Mexico still consists of yellow corn, which is primarily used as an ingredient in animal feed. From 1998 to 2002, the United States also exported to Mexico substantial quantities of white corn, which is used to make tortillas, but these exports have since diminished, possibly due to Mexican Government support for domestically produced white corn. The number of agricultural producers in Mexico declined substantially during the 1990s, but the Mexican corn sector still features a large number of small-scale producers, whose efforts are also supplemented by government payments. Broader access to U.S. yellow corn is fostering the expansion of hog and poultry production in Mexico, while Mexico's large flour companies are increasing their role in tortilla production, not only in Mexico but also in the United States.

Keywords: International trade, corn, Mexico, North American Free Trade Agreement, NAFTA.

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Introduction

During the creation of the North American Free Trade Agreement (NAFTA), corn was of special concern to U.S. and Mexican negotiators. It was widely believed that a sudden opening of the Mexican corn market to U.S. exports would be extremely disruptive, displacing many small-scale corn producers in Mexico and forcing them to migrate to other job opportunities in either Mexico or the United States. For this reason, negotiators stretched NAFTA's transition to free trade for U.S. exports of corn (both yellow and white) to Mexico across a 14-year period (January 1, 1994, to January 1, 2008), the longest transition period contained in the agreement.¹ Although Mexico has pursued a transitional policy toward U.S. corn that is more liberal than that required by NAFTA, its restrictive treatment of corn still contrasts sharply with the agreement's provisions for other major U.S. grains and oilseeds. Rice, soybeans, and wheat each became free of Mexican tariff restrictions in 2003, following a 9-year transition to trade liberalization, while the seasonal duties on U.S. sorghum were immediately eliminated upon NAFTA's implementation in 1994.

With the loosening of Mexican trade restrictions, U.S. corn exports to Mexico have increased dramatically, with exports of yellow corn, white corn, and cracked corn totaling 7.7 million metric tons in 2003, according to U.S. trade statistics. Mexican trade statistics suggest that this trade is even larger, with U.S. exports reaching 8.4 million metric tons in 2003 (app. table 1). Still, U.S.-Mexico corn trade during the NAFTA era retains many of the characteristics that defined this trade during the pre-NAFTA period. Yellow corn, which is primarily used as an ingredient in animal feed, continues to make up the majority of U.S. corn exports to Mexico, and white corn, which is used to produce tortillas and other traditional Mexican foods, has steadily decreased in export volume since 2000, possibly due to Mexican Government support for the marketing of domestically produced white corn. Interestingly, the Mexican corn sector still includes a large number of small-scale producers, whose efforts to market traditional varieties of corn and other commodities are supplemented by government farm payments. Broader access to U.S. corn is fostering the growth of Mexico's hog and poultry industries, and Mexico's large flour companies are positioning themselves to assume a greater role in the production of tortillas and other corn-based products, not only in Mexico but also in other countries, such as the United States. Over the next decade, Mexican corn demand is expected to follow recent trends. The demand for feed corn (yellow) is expected to increase rapidly with per capita income, as Mexicans incorporate more meat into their diets, while the demand for food corn (white) is expected to expand with population growth.

Yellow Corn Versus White Corn

The liberalization of U.S.-Mexico corn trade is not simply a case in which producers in the two countries are serving a newly unified market for a single commodity. Each country's agricultural sector focuses on producing a different type of corn. Yellow corn accounts for the bulk of U.S. corn production, while white corn dominates production in Mexico. Yellow corn is primarily used as animal feed and to manufacture ethanol, high-fructose corn syrup, corn starch, and other products. In contrast, white corn is culti-

¹Several other agricultural commodities are also subject to the 14-year transition, including U.S. exports to Mexico of nonfat dried milk and dried beans and Mexican exports to the United States of sugar, peanuts, and asparagus.

vated mainly for direct human consumption. There is some substitutability between yellow and white corn, however. Food-grade yellow corn is used to make corn flakes, chips, beer, and other foods, and white corn can be used as animal feed.

Given this dichotomy between the feed and food uses of corn, the growing corn trade between Mexico and the United States is better viewed as the result of the further opening of not one but two Mexican markets to U.S. corn. In the feed market, yellow corn from the United States is supplementing Mexican production, which is clearly insufficient to meet growing domestic demand. In fact, broader access to U.S. feed corn is fostering the development and growth of Mexico's hog and poultry sectors, enabling them to compete more effectively against U.S. and Canadian meat products. In the food market, trade liberalization is exposing Mexican corn farmers for the first time to significant competition from U.S. producers, at the same time that Mexican consumers are diversifying their diets. In both markets, the increasing concentration of millers and processors may present additional challenges to commercially oriented corn producers in Mexico.

NAFTA and U.S. Corn Exports to Mexico

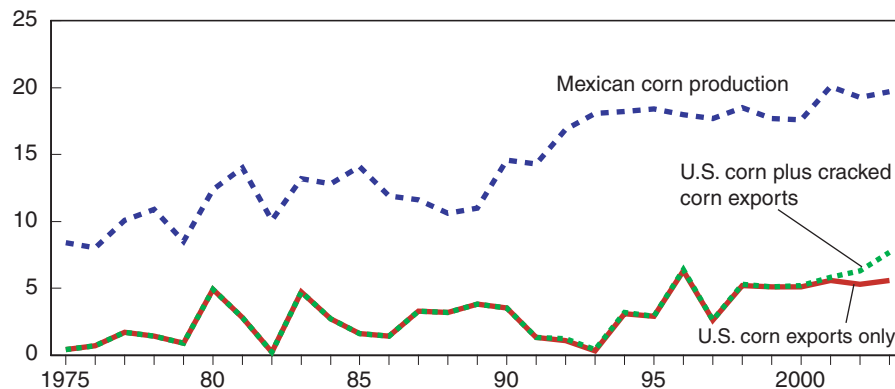
NAFTA is having a pronounced effect on U.S.-Mexico corn trade. Since the agreement took effect in 1994, U.S. corn exports to Mexico have increased by 240 percent, compared with their average annual level during 1984-93 (the 10 years prior to NAFTA's implementation) (fig. 1).² The export volume for 2003—7.7 million metric tons—includes 2.1 million metric tons of cracked corn, which consists of broken or ground kernels of corn and is used as animal feed. NAFTA treats cracked corn as a distinct commodity from corn. Specifically, cracked corn is not subject to the trade restrictions that apply to U.S. and Canadian corn in general, and the commodity has enjoyed duty-free status in Mexico since 2003. Wider knowledge of this provision among U.S. exporters triggered a large increase in U.S. cracked corn

²Because of fluctuating corn export levels in the 10 years leading up to NAFTA, the agreement's impact on U.S.-Mexico corn trade is more accurately reflected by a comparison between current trade levels and the average annual level during 1984-93.

Figure 1

Contrary to some expectations, Mexican corn production has increased in the face of rising U.S. corn exports to Mexico

Mil. metric tons



Note: Trade data before 1989 do not include cracked corn.

Sources: U.S. Department of Agriculture, Economic Research Service, Foreign Agricultural Trade of the United States database (exports); Food and Agriculture Organization of the United Nations (production).

exports to Mexico between 2000 and 2003, but major feed importers in Mexico are reported to be disappointed with the quality and price of this commodity (Juarez and Trejo, p. 19).

Prior to NAFTA, U.S. corn exports to Mexico were controlled by import licenses, with no guarantee as to the amount of U.S. access to the Mexican market. Nevertheless, exports frequently exceeded 3 million metric tons during the 1980s, as Mexican authorities allowed U.S. product to supplement domestic production. As a transition to free trade, NAFTA specified the conversion of these import licenses into a duty-free, tariff-rate quota (TRQ) during the period 1994-2007. The quota was initially set at 2.5 million metric tons for 1994, and the amount increases by 3 percent each year until the TRQ is eliminated on January 1, 2008. Under NAFTA, over-quota trade is potentially subject to a prohibitive tariff that gradually decreases during the transition to free trade. For 2004, this tariff equals the greater of 72.6 percent by value or 6.9 cents per kilogram.

To ensure that domestic demand for corn is fully met, however, the Mexican Government has customarily issued additional import permits beyond the amount required by NAFTA. For 2003, Mexico authorized import permits for nearly 3.8 million metric tons of U.S. corn, in addition to the roughly 3.3 million metric tons associated with NAFTA's transitional duty-free quota (Mexican Secretariat of Economy, as cited by Juarez and Trejo, p. 20). Usually, these additional imports have been subject to minor tariffs—roughly 1-2 percent on yellow corn and 2-3 percent on white—rather than the prohibitive, over-quota tariff specified by NAFTA. For 2004, however, the Mexican Congress has decided that over-quota imports of white corn will be subject to the 72.6-percent tariff specified by NAFTA (Juarez and Trejo, p. 21).

This generally less restrictive policy has boosted U.S. corn exports to Mexico to about 25 percent of Mexican production, compared with 15 percent during 1984-93. With the full liberalization of U.S.-Mexico corn trade on January 1, 2008, U.S. exports should increase even further, as corn demand in Mexico is expected to grow faster than domestic production. The 2004 USDA Agricultural Baseline Projections (USDA, OCE) suggest that Mexican corn imports will reach 14 million metric tons per year by 2013. Already, Mexico is the second largest export customer for U.S. corn (after Japan), accounting for about one-ninth of U.S. corn exports in 2003.

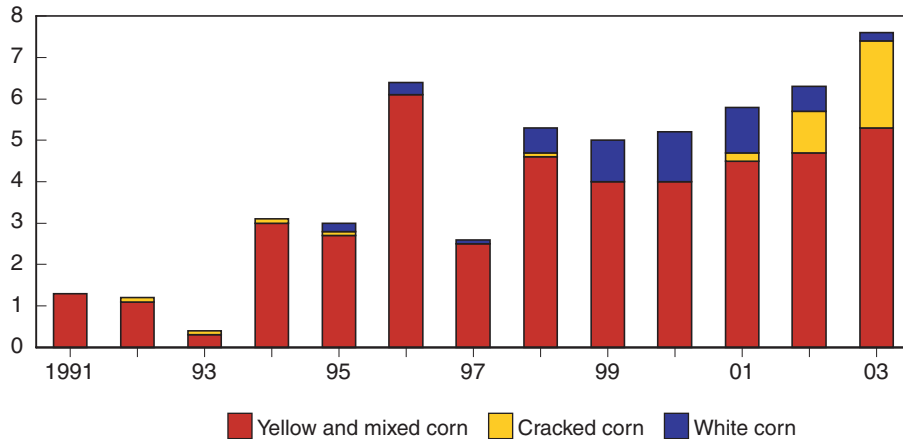
In the late 1990s, white corn emerged as a significant component of U.S. corn exports to Mexico. From 1998 to 2002, white corn made up about 15 percent of U.S. corn exports to Mexico, compared with roughly 2 percent during 1991-93 (fig. 2). The growth in white corn exports was accompanied by both an expansion in U.S. production of white corn and an improvement in the quality of resources devoted to white corn production. Seed companies have reported white corn yields that are roughly equivalent to yields for standard yellow dent corn. About 5 years ago, white corn yields were about 75-80 percent of yellow corn yields (U.S. Grains Council).

Since 2000, however, U.S. white corn exports to Mexico have steadily declined, as the Mexican Government has directed some farm payments to support the marketing of domestically produced white corn. Given the

Figure 2

Since 2000, U.S. white corn exports to Mexico have declined

Mil. metric tons



Note: Yellow and mixed corn exports were calculated by subtracting white corn exports from total corn exports.
 Sources: Inspection data from U.S. Department of Agriculture, Agricultural Marketing Service (white corn exports); and U.S. Department of Agriculture, Economic Research Service, Foreign Agricultural Trade of the United States database (total corn and cracked corn exports).

announced intent of the Mexican Congress to apply the over-quota tariff specified by NAFTA to this trade, the short-term prospects for U.S. white corn exports to Mexico do not look very promising.

Fields Apart: A Quick Look at U.S. and Mexican Corn Production

Underlying U.S.-Mexico corn trade are sharp differences in corn production across the two countries. According to the 2001 Agricultural Resource Management Survey, the size of a typical U.S. corn farm is about 270 hectares, roughly one-third of which is devoted to corn. Tillage, planting, harvesting, and the application of farm chemicals are all highly mechanized, to the extent that about one-half hour of labor is required to produce 1 metric ton of corn. Successive improvements in technology and production practices over the past 40 years have doubled U.S. corn yields, which now average about 8.5 metric tons per hectare.

While some corn farms in Mexico resemble U.S. corn farms in size, technology, and production practices, a more representative Mexican producer has access to roughly 10 hectares of farmland. Indeed, according to Mexico’s 1991 National Agricultural and Livestock Census, 61 percent of the farms where corn was the principal crop were smaller than 5 hectares (INEGI). Census data also reveal that only 31 percent of all corn farms used improved varieties of corn, 35 percent had tractors, and 9 percent had access to irrigation, a critical input to the Mexican corn sector (Nadal). Persistent efforts to improve corn production in Mexico have raised yields to about 5.8 metric tons per hectare on irrigated land and 2.0 metric tons per hectare on rainfed land during 2000-02 (app. table 2), compared with a national average of just 1.0 metric ton per hectare in the early 1960s (FAO).

The small size of farms in Mexico is largely the result of efforts during various parts of the 20th century to redistribute farmland among the rural populace, and these small parcels of land provide a basis for the subsistence of lower-income rural households. Many of the smaller plots make up communal farms called *ejidos*, in which the government grants user rights to farmland to specific individuals. Prior to a constitutional reform in 1992, *ejidatarios* were not allowed to transfer their user rights, although informal sales and rentals occasionally took place. With the retirement of older producers, significant emigration from rural areas, and the conversion of arable land to nonagricultural uses, many smaller farms appear to have folded or been consolidated. Between 1991 and 2000, the number of private-sector agricultural producers declined from 1.2 to 1.0 million, while the number of *ejidal* and other communal producers fell from 2.1 to 1.6 million (table 1).

Impact of Mexican Farm Programs

Though the number of producers in Mexico's corn sector has decreased in recent years, the total amount of land devoted to corn in Mexico has remained fairly stable by historical standards (fig. 3). In fact, the average annual area harvested of corn during the NAFTA period is larger than the average for the 10 years immediately preceding the agreement (7.7 million hectares versus 7.0 million hectares).

Mexican farm supports may provide a partial explanation for this stability. Governments in both the United States and Mexico give a substantial amount of support to corn producers. As measured by the producer subsidy equivalent, which is used by the Organization for Economic Cooperation and Development (OECD) to indicate the value of gross transfers to agricultural producers from government policies, Mexico's corn programs averaged 37 percent of the value of production during 2000-02, compared with 26 percent for the United States.

The U.S. and Mexican support programs have many similarities. The Mexican Government recently developed a countercyclical program that closely resembles the U.S. program created as part of the 2002 Farm Act, and both countries provide direct payments to their corn producers. In Mexico, the vast majority of agricultural producers receive direct payments

Table 1—The number of agricultural producers in Mexico declined 21 percent during the 1990s

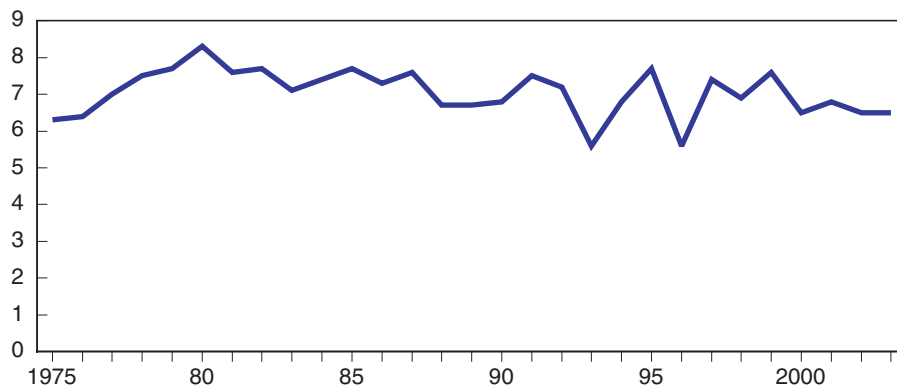
	1991	2000	Change
	<i>Thousands</i>		<i>Percent</i>
All producers	4,318	3,405	-21
Private property owners	1,243	1,046	-16
<i>Ejidatarios</i> and communal farmers	2,078	1,644	-21
Other occupants	492	271	-45
Renters and sharecroppers	411	264	-36
Livestock producers without land	94	180	93

Source: *Secretaría del Trabajo y Provisión Social, Encuesta Nacional de Empleo, 2002.*

Figure 3

The amount of land devoted to corn production in Mexico during the NAFTA period has remained fairly stable by historical standards

Area harvested, in millions of hectares



Source: Food and Agriculture Organization of the United Nations.

through the Program of Direct Support for Agriculture (PROCAMPO). This program, launched in 1994, was designed to provide transitional assistance to Mexican producers during the course of NAFTA's implementation and the elimination of guaranteed prices for corn and other basic staples.

Currently, any producer who cultivates a legal crop on eligible land or uses that land for livestock or forestry production or some ecological project can receive PROCAMPO payments, which are made on a per hectare basis. Eligible land is defined as having been cultivated with corn, sorghum, beans, wheat, barley, cotton, safflower, soybeans, or rice in any of the agricultural cycles from fall-winter 1990-91 to spring-summer 1993. Given the comprehensive coverage of the program, it should be no surprise that PROCAMPO constitutes the largest component of the Mexican agricultural secretariat's (SAGARPA) budget, accounting for 35 percent of expenditures in 2003 (fig. 4). For spring-summer 2004 and fall-winter 2004-05, PROCAMPO payment rates equal 1,120 pesos per hectare for producers with less than 5 hectares and 935 pesos per hectare for all others (SAGARPA, 2004). These amounts correspond to about \$102 and \$85, using the exchange rate of March 17, 2004 (11.02 pesos per dollar).

Key input markets related to agriculture are severely constrained in Mexico, with agricultural credit being the most critical example. Several studies suggest that PROCAMPO payments fill in these gaps in the economic fabric of rural Mexico. Sadoulet et al. find that PROCAMPO has generated a multiplier effect on the incomes of *ejido* households in the neighborhood of 1.5 to 2.6. This means that each peso received by the household from PROCAMPO results in a total increase of household income of about 1.5 to 2.6 pesos, as some portion of program payments are invested in agricultural production, thereby boosting farm income. In addition, economic modeling conducted by Taylor et al., based on household survey data from a rural area in the State of Michoacán, suggests that a 10-percent decrease in grain prices coupled with an offsetting income transfer would result in a modest, 0.4-percent increase in staple production. This simulation corresponds with the situation in Mexico shortly after the implementation of NAFTA, when

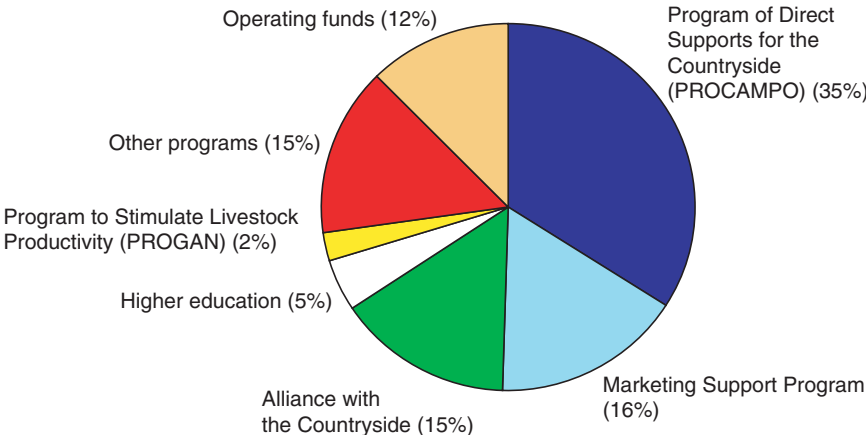
the elimination of official prices for staples was accompanied by the initiation of PROCAMPO.

Some Mexican corn producers also receive direct payments through a second program called the Program of Direct Supports for Marketing and the Development of Regional Markets (Marketing Support Program). This program includes a major subprogram, Direct Supports for Basic Grains and Oilseeds (Direct Supports Subprogram), in which producers in regions with a surplus of marketable output are eligible to receive a fixed subsidy per ton directly from the Mexican Government. In order to participate, producers must have a marketable surplus, but the share of such producers (about 10 percent) is fairly small (Rosenzweig). Nevertheless, the Marketing Support Program is the second largest component of SAGARPA’s budget, accounting for 16 percent of expenditures in 2003 (fig. 4).

Given its size and focus, the Direct Supports Subprogram may be linked to the decrease in U.S. white corn exports to Mexico since 2000, when U.S. shipments peaked at 1.2 million metric tons. In 2002, the subprogram accounted for about three-fourths of the Marketing Support Program’s expenditures. Thirty-seven percent of the subprogram’s expenditures were devoted to white corn, and these supports went to producers in Sinaloa, Sonora, and Baja California Sur (SAGARPA/ASERCA, statistical annex). Another 6 percent of expenditures in 2002 supported the marketing of corn from Chiapas and Chihuahua.

The northwestern State of Sinaloa is the largest beneficiary of the Direct Supports Subprogram. In 2002, producers in that State accounted for 38 percent of the subprogram’s expenditures (SAGARPA/ASERCA, statistical annex). Sinaloa produces 42 percent of the corn cultivated on irrigated land in Mexico (app. table 2), and production techniques there are generally

Figure 4
Mexico's agricultural secretariat had a budget of 40.1 billion pesos (about \$4 billion) in 2003



Note: Figure is based on the secretariat's modified annual budget.
 Source: Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca y Alimentación (SAGARPA), *Estado de Ejercicio Presupuestal 2003 por Unidad Responsable*.

comparable with those in the United States. A study of grain production in Sinaloa finds that the marketing supports, along with the constitutional reforms that allow the rental of ejidal lands, have facilitated the emergence of large-scale farms for corn and dried beans (de Ita Rubio). The study indicates that the majority of the agricultural land rented in the State is devoted to corn and presents a hypothetical scenario in which a producer who rents 3,000 hectares of land and produces about 25,000 metric tons of corn could hope to receive about 10 million pesos (roughly \$910,000) from the Marketing Support Program. Though such large-scale operations are in the minority in Sinaloa, the study provides three examples of producers who cultivate more than 1,000 hectares of farmland.

Steady Demand Anticipated for Food Corn

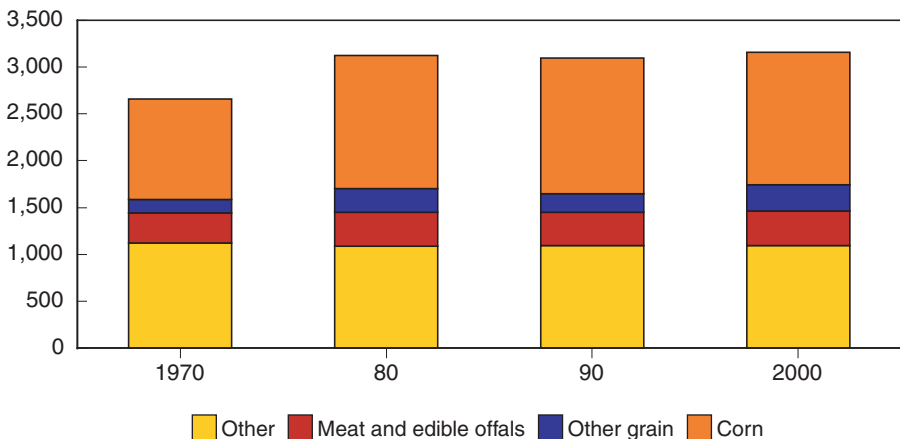
Corn continues to be central to Mexican cuisine, with direct food use of corn accounting for about one-third of the country’s per capita supply of calories (fig. 5). Direct human consumption of grain tends to decline with income growth and urbanization, as evidenced by consumption patterns of rice in Japan and wheat in the United States. But in Mexico, a middle-income country, per capita food use of grain has remained stable for the past 30 years and now stands at about 1,300 calories per day—approximately twice the level of Canada and the United States.

The principal food use of corn in Mexico is the tortilla, a food with a history going back thousands of years. For many years, tortilla prices were subsidized by the Mexican Government as a welfare measure to keep down the cost of this food staple. At the same time, prices paid to corn farmers were kept high, supporting a large number of small-scale producers. During the second half of the 1990s, the Mexican Government liberalized tortilla prices. Some consumers paid for this policy shift at the marketplace, as tortilla prices rose 127 percent from 1997 to 1999 and another 22 percent from 2000 to 2002 (fig. 6). Many poor households, however, continue to receive government assistance

Figure 5

Per capita food use of corn and other grains in Mexico has remained fairly steady for over 30 years

Daily per capita supply of calories



Source: Food and Agriculture Organization of the United Nations, food balance sheets for Mexico.

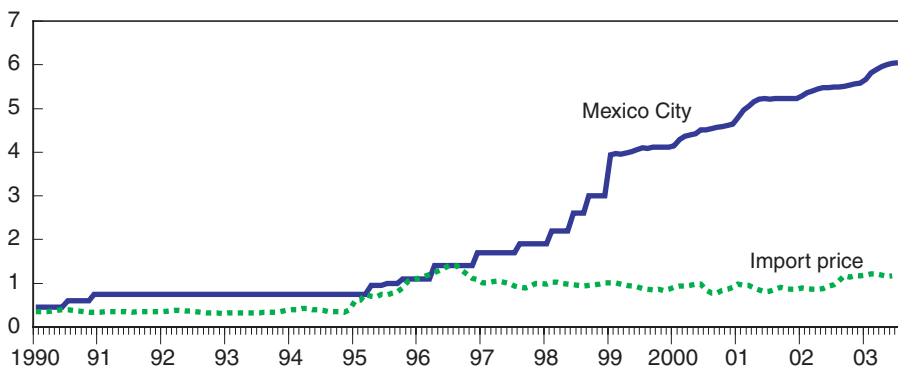
through such programs as the DICONSA stores, which sell tortillas and other basic staples at subsidized prices. Overall, changes in Mexico's corn-related policies in the late 1990s and early 2000s have maintained a high level of support for producers (shifting in form from price to nonprice support) but lowered supports for consumers (fig. 7). Since raw material prices remained low, corn processors enjoyed a growing profit margin.

It is not yet clear whether the increase in tortilla prices will have a long-term impact on the consumption of food corn. For the past four decades, Mexico's per capita food supply of corn has remained steady at about 120-130 kilograms per year (FAO). Limited income growth in Mexico over the past 20 years helps to explain this stability. Although real per capita income experienced sustained growth during much of the 1990s, this expansion barely offset the economic stagnation of the 1980s. In 2001, real per capita

Figure 6

The price of tortillas in Mexico is rising faster than the price of imported corn

Pesos/kg

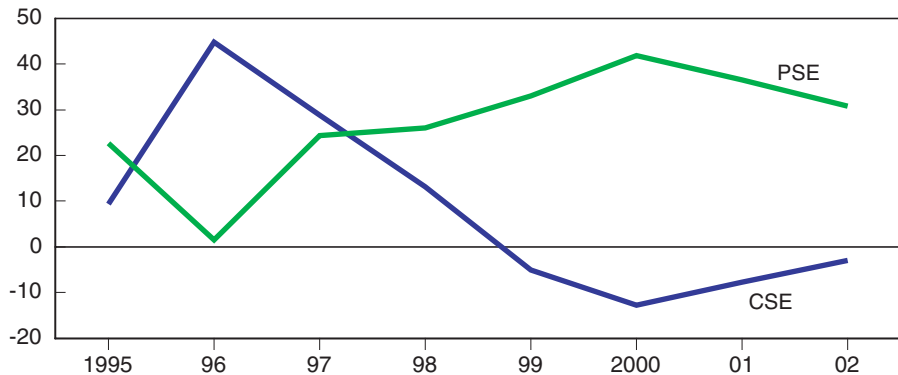


Note: Monthly unit value of U.S. corn exports to Mexico was converted to pesos using exchange rates from the Pacific Exchange Rate Service, <http://pacific.commerce.ubc.ca/xr/>
 Sources: U.S. Department of Agriculture, Economic Research Service, Foreign Agricultural Trade of the United States database (unit value of imports); Rosenzweig and Espindola (price of tortillas); Banco de Mexico (price index for tortillas); and Pacific Exchange Rate Service.

Figure 7

Mexico's corn policies after 1998 taxed consumers

Percentage PSE and CSE for corn



Source: Organization for Economic Cooperation and Development.

income in Mexico was a mere 7 percent above the 1981 level, compared with a 48-percent increase in the United States over the same period (World Bank).

Not all food prices in Mexico rose as sharply during the late 1990s as tortilla prices (fig. 8), which encouraged Mexicans to alter the composition of their diets. Between 1996 and 2001, per capita meat consumption in Mexico climbed from 50 to 62 kilograms per year, carcass weight, according to USDA Production, Supply, and Distribution data (USDA, FAS). This change probably foreshadows a broader, long-term modification of Mexican diets, away from corn and other food grains and toward meat.

Demand forecasts must consider the duality of the Mexican corn market, as some varieties of corn are really distinct in their end use. White corn (along with some yellow corn varieties) is used in tortilla production because its soft starch is easily ground into meal. Yellow dent corn has a harder starch content and is more appropriate for feed. Food corn is sometimes substituted for feed when the premium for white corn is low, but feed corn is less often substituted for food use.

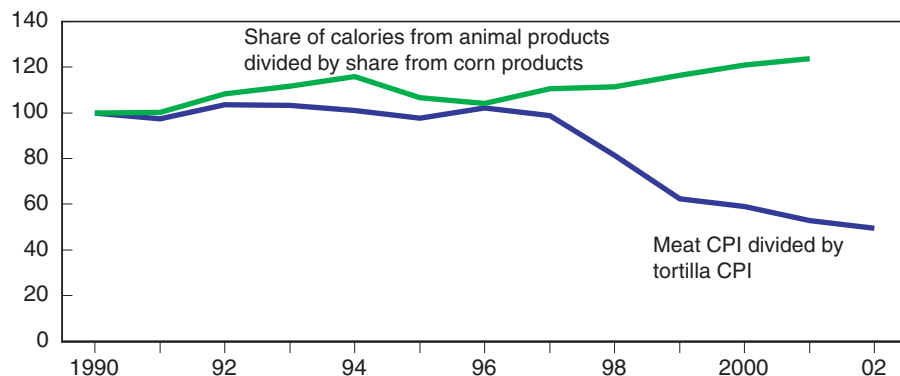
The processing of tortillas is fragmented and dispersed around Mexico, with 45,000 tortilla producers and 10,000 corn millers. Flour production, however, is very concentrated. Two of Mexico's largest food companies, Gruma and Grupo Minsa, control more than 90 percent of domestic corn flour production (table 2). Gruma, headquartered in Monterrey, Nuevo León, is the world's largest producer of corn flour and tortillas. Its largest Mexican subsidiary, Grupo Industrial Maseca, specializes in the production of corn flour, while two other subsidiaries focus on the manufacture of packaged tortillas and tortilla-making machinery. Gruma also has subsidiaries in Central America, Europe, the United States, and Venezuela.

Interestingly, Gruma's U.S. and European operations (through Gruma Corporation) accounted for 48 percent of corporate sales in 2002, reflecting the extensive reach of the company. Competition between Gruma and U.S.

Figure 8

Changes in relative prices have favored increased meat consumption in Mexico in the late 1990s and early 2000s

1990 = 100



Source: Food and Agriculture Organization of the United Nations, food balance sheets for Mexico; Banco de Mexico.

Table 2—Two Mexican firms control over 90 percent of domestic corn flour production

Company	Activity	Rank in Expansión 500, 2002	Sales, 2002 <i>Billion pesos</i>	Personnel <i>Number</i>
Gruma (parent company):		49	19.2	13,714
Gruma Corporation	Corn flour and tortillas	n.a.	n.a.	n.a.
Grupo Industrial Maseca	Corn flour	144	4.8	2,949
Molinera de Mexico	Wheat milling	n.a.	n.a.	n.a.
Productora y Distribudora Azteca	Packaged tortillas	n.a.	n.a.	n.a.
Tecnomaz	Tortilla machinery	n.a.	n.a.	n.a.
Grupo Minsa	Corn flour	233	2.0	844

Note: The Expansión 500, produced by the Mexican business magazine *Expansión*, is a list of the 500 largest businesses in Mexico.
n.a. = not available.

Source: Delaunay et al., supplemented by information in Gruma and Grupo Minsa.

tortilla producers is intense. In December 2003, the U.S. District Court for the Southern District of Texas dismissed a lawsuit brought by 17 U.S. tortilla manufacturers alleging, among other things, that Gruma was monopolizing shelf space at grocery stores through slotting fees, which manufacturers pay to retailers to secure shelf space for their products.

Minsa, which is about one-tenth the size of Gruma, is headquartered in Tlal-nepantla, State of Mexico. Its origins lie in a government-owned corn flour company called MICONSA, some of whose assets were sold to form Minsa in 1993. Today, Minsa has six plants located in Mexico, two plants in the United States, and one plant in Guatemala. In 2002, Minsa closed subsidiaries devoted to the manufacture of tortillas and tortilla-making machinery to concentrate on the production of corn flour (Grupo Minsa).

The future growth of Gruma and Grupo Minsa will depend on the continuing substitution of corn flour for the more traditional wet corn dough in the manufacture of tortillas in Mexico and on expanding sales in markets outside of Mexico, particularly in the United States, where demand for Mexican food is growing. In the traditional method of tortilla production, corn is first soaked and cooked in water with lime. The resulting softened corn (*nixtamal*—an Aztec word meaning “corn softened in wood ashes”) is then ground into wet dough (*masa*), shaped in the form of tortillas, and baked. The contemporary method of tortilla production also uses wet corn dough but dries it into flour. Flour is easier to transport and has a longer shelf life (about 3 months) than wet corn dough (4 to 24 hours). These advantages will give large flour producers an edge in capturing market share from small millers and tortilla producers as a larger share of the consumer market becomes urban. The stakes are high given the continuing stability in Mexico’s per capita demand for tortillas and other corn-based foods.

Rising Demand for Feed Corn

While Mexico's per capita demand for food corn is relatively stable, demand for feed corn is expanding, as Mexico's consumers are eating more meat and other animal products. With Mexico's economy projected to grow faster than the economies of its NAFTA partners—Canada and the United States—and with a larger income elasticity of demand for meat in Mexico, due to its status as a middle-income country, meat consumption in Mexico is expected to continue to expand rapidly (USDA, OCE). Mexico's livestock producers are responding to rising demand, but production growth is not keeping up with consumption growth. Thus, Mexico is increasingly relying on animal product imports, particularly from the United States, to help meet domestic demand.

While Mexican cattle are primarily grass fed, the ability of Mexico's hog and poultry producers to compete with imports depends heavily on access to large quantities of imported corn and other grains, oilseeds, and feed products. In hindsight, Mexico's transitional restrictions on corn imports may be hurting Mexico's hog and poultry sectors, even though these restrictions are more liberal than what is required by NAFTA. These restrictions limit the amount of corn that can be imported and exert upward pressure on the price of substitute feed products (Ochoa and Zahniser).

Both the hog and poultry sectors in Mexico are undergoing a period of profound structural change. The outlook for meat production in Mexico varies by firm size. Large operations should be able to grow and thrive without much assistance. These firms often integrate feed and meat production and generally enjoy steady access to financial capital, including direct investment and commercial lending from abroad. Mexico's largest poultry company is listed on the New York Stock Exchange and counts itself among the world's largest producers of poultry meat. Mexico's largest hog producer, Grupo Porcícola Mexicano, is the 12th largest hog operation in North America, with about 70,000 sows.

Medium-sized operations face the greatest challenge from import competition and structural change due to their relatively high cost structures, which are marked by higher feed costs, a scarcity of capital, and an insufficiently developed marketing infrastructure. Subsistence operations are largely independent of the commercial market. Most of their output is sold locally or consumed directly by the producer's household; a small proportion is sold to butchers in regional and relatively isolated markets.

What Does the Future Hold?

The outlook for U.S.-Mexico corn trade reflects the differences in Mexico's feed and food corn markets. These markets are largely distinct. The United States specializes in feed corn and will continue to supply Mexico with large quantities of this type of corn to support its expanding livestock sector. U.S. prospects for white corn exports, on the other hand, are less certain because per capita consumption of food corn in Mexico has leveled off and government assistance appears to be sustaining domestic production of white corn. Greater opportunities may exist in the U.S. market where

demand for Mexican foods, including tortillas and other corn-based products, is expanding due to increased general popularity and continuing growth of the U.S. population that is of Mexican origin or descent. Mexico's two largest corn flour companies have sizable operations in the United States, which both confirms high U.S. demand and indicates the growing integration of the U.S. and Mexican markets.

With the upcoming elimination of Mexico's transitional restrictions for U.S. corn in 2008, Mexican corn imports are expected to rise dramatically, perhaps reaching 14 million metric tons by 2013. Since the over-quota tariff specified by NAFTA is gradually declining to zero, trade may increase markedly once this tariff falls to a level sufficient to make over-quota tariff economical. In 2005, the over-quota tariff will equal the greater of 54.5 percent by value or 52 cents per kilogram.

Several Major Factors May Affect the Outlook for U.S.-Mexico Corn Trade

Income growth will drive changes in the structure of demand. Economic growth in Mexico is expected to be relatively brisk over the next decade, with some observers forecasting a real growth rate of 4 percent in 2004. Already, income growth is fostering the addition of more meat to the Mexican diet, a pattern observed in other countries at Mexico's stage of development. This change will favor feed corn over food corn, as livestock production requires feed. Sustained growth will also help small-scale producers in Mexico to further diversify the economic base of their households, a process that should eventually lessen the prominence of small-scale operations in the corn sector.

Economic pressure will keep corn prices low. Continuing urbanization in Mexico and the population's growing dependence on a complex delivery system for safe, reasonably priced, fresh and processed foods are driving structural change in Mexico's food system. This change is reflected in the emergence of a small number of larger and more efficient firms that are more able to compete with low-priced imports and to meet consumer demand for low prices. This tendency toward concentration is underway in many of Mexico's agricultural and food sectors, including corn flour and livestock production. Mexico's large multinational corn flour producers want the lowest possible input prices in order to maximize profit. From a purely economic standpoint, they may be indifferent about the source of their primary raw material, white corn. Likewise, Mexico's livestock producers seek abundant quantities of low-priced feed in order to compete with meat imports in their own market and to compete in overseas markets. As livestock production and corn milling become more concentrated, smaller commercial producers may find it difficult to supply the high volumes of corn needed by these firms.

Policy will mitigate pressure for change. The greatest economic pressure in the future will fall on Mexico's numerous small-scale corn producers. Overall government support to corn producers has remained high over the last 10 years, while the form of support has shifted from price support to direct transfers. This assistance has fostered stability in Mexican corn production despite falling prices during the NAFTA period. The budgetary pressure of Mexico's farm supports may rise as the country attempts to implement a broader set of

farm programs featuring not only direct payments but also a countercyclical program patterned after the 2002 U.S. Farm Act. A key issue in the future will be Mexico's capacity and willingness to sustain these supports.

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Appendix table 1—Mexican statistics suggest that U.S. corn exports to Mexico are larger than U.S. statistics indicate

Description	1995	1996	1997	1998	1999	2000	2001	2002	2003
Mexican corn imports from the United States, as reported by Mexico									
	<i>Million U.S. dollars</i>								
Corn plus cracked corn, excluding seed	373	1,033	347	629	612	576	734	867	1,036
Corn, excluding seed ¹	361	1,012	334	610	588	539	628	623	702
Cracked corn	12	21	13	18	24	37	106	244	334
Seed corn	15	12	24	13	8	10	15	20	23
Total	388	1,046	371	642	620	586	749	887	1,059
	<i>1,000 metric tons</i>								
Corn plus cracked corn, excluding seed	2,754	5,780	2,581	5,421	5,676	5,613	7,043	7,551	8,448
Corn, excluding seed ¹	2,682	5,692	2,512	5,328	5,520	5,344	6,168	5,505	5,756
Cracked corn	68	86	64	90	153	266	870	2,039	2,685
Seed corn	5	2	6	4	4	4	5	6	7
Total	2,759	5,782	2,587	5,425	5,680	5,617	7,048	7,557	8,455
U.S. corn exports to Mexico, as reported by the United States									
	<i>Million U.S. dollars</i>								
Corn plus cracked corn, excluding seed	372	1,020	328	613	546	524	631	760	923
Corn, excluding seed ¹	359	1,003	317	590	530	506	562	585	653
Cracked corn	13	18	11	23	16	18	70	174	269
Seed corn	19	11	15	11	15	19	58	49	29
Total	391	1,031	343	623	561	543	690	809	951
	<i>1,000 metric tons</i>								
Corn plus cracked corn, excluding seed	2,913	6,356	2,611	5,304	5,094	5,173	5,842	6,314	7,685
Corn, excluding seed ¹	2,859	6,314	2,566	5,246	5,069	5,147	5,592	5,327	5,577
Cracked corn	54	41	45	59	25	26	249	987	2,108
Seed corn	15	15	10	9	11	16	51	46	69
Total	2,928	6,371	2,621	5,313	5,105	5,189	5,892	6,360	7,755

¹This category corresponds to the definition of corn in the Foreign Agricultural Trade of the United States database. It excludes seed corn and cracked corn. All categories in the table exclude sweet corn.

Sources: Mexican Secretariat of Economy, as cited by Global Trade Information Services (Mexican statistics); and U.S. Department of Agriculture, Economic Research Service, Foreign Agricultural Trade of the United States database (U.S. statistics).

Appendix table 2—Access to irrigation greatly improves corn yields in Mexico

	Total			Rainfed			Irrigated		
	Production <i>Metric tons</i>	Area harvested <i>Hectares</i>	Yield <i>Metric tons per hectare</i>	Production <i>Metric tons</i>	Area harvested <i>Hectares</i>	Yield <i>Metric tons per hectare</i>	Production <i>Metric tons per hectare</i>	Area harvested <i>Hectares</i>	Yield <i>Metric tons per hectare</i>
Total, Mexico	18,996,770	7,353,783	2.58	12,643,669	6,265,367	2.02	6,353,101	1,088,416	5.84
Aguascalientes	44,291	38,164	1.16	19,013	33,203	0.57	25,278	4,961	5.10
Baja California	7,074	2,109	3.35	219	285	0.77	6,855	1,824	3.76
Baja California Sur	33,058	6,007	5.50	--	--	--	33,058	6,007	5.50
Campeche	160,939	109,856	1.47	158,649	109,209	1.45	2,290	647	3.54
Coahuila	24,364	21,936	1.11	9,927	16,001	0.62	14,436	5,935	2.43
Colima	39,524	15,987	2.47	30,221	13,164	2.30	9,303	2,822	3.30
Chiapas	1,833,276	936,987	1.96	1,780,554	920,476	1.93	52,722	16,510	3.19
Chihuahua	556,299	154,621	3.60	91,776	90,855	1.01	464,523	63,766	7.28
Distrito Federal	11,764	7,481	1.57	11,764	7,481	1.57	--	--	--
Durango	207,430	161,950	1.28	106,306	139,457	0.76	101,124	22,493	4.50
Guanajuato	1,028,356	317,347	3.24	414,363	227,012	1.83	613,993	90,335	6.80
Guerrero	1,046,494	457,966	2.29	957,805	430,287	2.23	88,689	27,679	3.20
Hidalgo	594,020	244,186	2.43	235,979	188,043	1.25	358,041	56,143	6.38
Jalisco	2,702,981	642,954	4.20	2,514,903	605,017	4.16	188,078	37,938	4.96
State of Mexico	2,006,393	585,298	3.43	1,570,728	485,027	3.24	435,665	100,271	4.34
Michoacan	1,246,999	465,596	2.68	913,502	389,041	2.35	333,497	76,555	4.36
Morelos	87,413	39,276	2.23	61,277	29,597	2.07	26,135	9,679	2.70
Nayarit	208,457	58,272	3.58	175,763	51,938	3.38	32,695	6,334	5.16
Nuevo Leon	39,578	40,551	0.98	22,761	34,363	0.66	16,817	6,188	2.72
Oaxaca	741,159	524,216	1.41	617,680	476,651	1.30	123,480	47,565	2.60
Puebla	923,961	507,779	1.82	731,348	457,383	1.60	192,614	50,396	3.82
Queretaro	253,535	93,535	2.71	95,249	70,220	1.36	158,286	23,315	6.79
Quintana Roo	29,997	56,416	0.53	29,709	56,301	0.53	289	115	2.51
San Luis Potosi	140,350	160,843	0.87	88,083	142,919	0.62	52,267	17,924	2.92
Sinaloa	2,706,728	364,883	7.42	58,765	55,333	1.06	2,647,963	309,550	8.55
Sonora	98,768	20,488	4.82	2,076	2,902	0.72	96,693	17,586	5.50
Tabasco	166,326	104,438	1.59	166,213	104,409	1.59	113	29	3.91
Tamaulipas	209,643	105,250	1.99	131,743	74,665	1.76	77,900	30,585	2.55
Tlaxcala	254,529	108,693	2.34	202,748	92,717	2.19	51,780	15,975	3.24
Veracruz	1,179,727	623,576	1.89	1,162,825	618,877	1.88	16,902	4,700	3.60
Yucatan	101,000	110,817	0.91	93,936	108,598	0.86	7,063	2,218	3.18
Zacatecas	312,335	266,304	1.17	187,784	233,933	0.80	124,550	32,371	3.85

Note: Data are annual averages for the agricultural years 2000-02. For corn, the agricultural year encompasses the fall-winter (October 1 to March 31) and spring-summer (March 1 to September 30) agricultural cycles. -- = None reported.

Source: Secretaría de Agricultura, Ganadería, Desarrollo Rural, Pesca, y Alimentación, Servicio de Información Estadística Agroalimentaria y Pesquera, Sistema de Información Agrícola de Consulta (SIACON).