Transition Policy and the Structure of the Agriculture of Mexico

North American Agrifood Market Integration: Current Situations and Perspectives

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TRANSITION POLICY AND THE STRUCTURE OF THE AGRICULTURE OF MEXICO

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Beginning in the early 1980s, Mexico witnessed a radical change in the economic orientation of its development policies, from a strategy of import substitution to a model of outward orientation with diminishing direct state intervention. A phase-out of government intervention in agriculture started at the end of the 1980s and deepened during the second quarter of the Salinas Administration, culminating with the implementation of the North American Free Trade Agreement or NAFTA in 1994.

The inclusion of agriculture in NAFTA has, since the beginning of negotiations with the USA, provoked a deep controversy in Mexico. At one extreme is the official view arguing that trade liberalization helps to promote the structural transformation of the agricultural and rural economy of Mexico; at the other extreme are some academics and journalists maintaining that agricultural trade liberalization between Mexico and the USA adversely affects Mexican farmers and jeopardizes the country's food self sufficiency. Recently, farmers, peasants and other groups of Mexican civil society have criticized NAFTA in an organized fashion, arguing that agricultural trade liberalization with the US has negatively affected the agriculture of Mexico. The pressures have intensified to such an extent that, in 2003, the Fox administration agreed with farmers and peasant organizations to evaluate the effects of the accord on Mexico's countryside.

The overall purpose of this paper is to contribute towards understanding the impacts of NAFTA and other policy reforms in the agricultural and rural economy of Mexico, with special reference to the field crops sub-sector, to small farmers and to trade between Mexico and the US. Our starting point is the effect of liberalization policies on relative prices, which according to received economic wisdom leads to predictable changes in resource allocations on farms. Profound liberalization is expected to result in major changes in prices, provoking a structural transformation of trade and domestic supply.

Recent literature on the effects of agricultural reforms on Mexico's rural economy seeks insights from trends or descriptive statistics of relevant variables during the periods before and after major policy changes.[1] We propose that that analysis of policy impacts be based on econometric methods, to test whether or not a shock (such as NAFTA) has caused structural change, and on micro economy-wide analysis, to explore the effects of shocks on rural economies. We have carried out econometric analyses of prices, planted area and yields, and trade of major commodities imported and exported by Mexico to the US.[2] We also have developed new methods to uncover rural economy-wide impacts of policy reforms, by embedding "micro" models of agricultural households within larger, regional economy-wide models.

This paper has three main objectives. The first is to review major changes in Mexico's agricultural policies in the context of trade liberalization. The second is to explore

[1] This has been specially the case of studies on NAFTA impacts on the Mexican agricultural sector (see, for example, Schwentesius, *et al.*: 2003, and Puyana and Romero:2004)
[2] Details are in Yunez.-Naude and F. Barceinas: 2002 and 2004. We have not covered other important traded commodities, such as sugar and livestock, due to data and time limitations.

econometrically the impact of these policy changes on key variables of interest, including prices, trade, production and rural out-migration. The third is to illustrate the use of disaggregated policy modeling techniques to explore the sometimes paradoxical impacts of recent policy changes on Mexico's rural economies. After reviewing trends in the evolution of the rural economy of Mexico, including employment, land property rights and poverty, we suggest hypotheses to explain why some of the expected effects of NAFTA and agricultural reforms have not occurred. The paper ends with a reflection on the current political-economic situation in Mexico.

MAJOR REFORMS AND NEW INSTITUTIONS

The National Company of Popular Subsistence (CONASUPO) was a major player in government intervention in agriculture. Before the reforms of the 1980s, the Company's programs involved eleven agricultural field crops (termed basic crops): barley, beans, copra, maize, cotton, rice, sesame, sorghum, soybeans, sunflower and wheat. By supporting prices for the producers of these crops, by processing, storing, and distributing the crops and by regulating trade through direct imports, CONASUPO exacted control over an important component of Mexico's food chain.

Table 1. Agricultural Policy Reforms: 1985-2003

POLICY	DESCRIPTION	YEARS
Mexico joins GATT	By 1990/1, most licenses to import agricultural products were abolished. In 1991-1994 most agricultural commodities were subject to tariffs fluctuating between 0% and 20%.	1986/94
Institutional reforms and the government's new role	Privatization of State companies: seed and production of fertilizer, grain storage and marketing of coffee, sugar and tobacco ASERCA (1991) was created to give marketing support and services to producers	From 1988/99
Reform of the Agrarian Law	Land redistribution ends. Recognizes the individual rights of each ejido.	1992
North American Free Trade Agreement (NAFTA) two separate agricultural agreements: Mexico-Canada and Mexico-US	Defines which are the obligatory conditions for market access and for export subsidies. Each country has the right to choose its own internal subsidies, phytosanitary measures, rules of origin and regulations for packing and tagging products. Consistency with the World Trade Organization and with the Uruguay Round. Import and export licenses are abolished and substituted by tarification. In Jan. 2008 all tariffs will be eliminated by NAFTA members.	1994
PROCAMPO (Program of Direct Support for the Countryside), part of ASERCA (see below)	Direct payments to the producers of basic crops that compensate producers for the loss of input subsidies, price supports and import protection. Grants annual direct payments per hectare to those producers who continue to produce, based on historical acreage for nine crops.	Winter 1993-1994
Elimination of producer price supports, abolition of CONASUPO	In 1991 guaranteed prices for wheat, sorghum, soy beans, rice, barley, safflower, sesame seed and sunflower were eliminated, and in 1999 support prices for beans and maize producers were abolished.	1991-1999
Creation of the Ministry for Social Development	PROGRESA: monetary transfers to poor rural female household heads for nutrition, school and health services (from 2001 the program is extended and called OPORTUNIDADES	1991
Alliance for the Countryside (Alianza para el Campo)	A set of programs designed to support farmers with productive potential in an open economy. Federalized. Each state is responsible for the application of Alliance's programs. Farmers in the programs have to contribute to its financing.	1995
Agri-food Armour	To protect Mexican farmers from impacts of US Farm Bill of 2002	2002
Privatization of rural credit	Reduction of official credit and credit subsidies. Creation of Financiera Rural and abolishion of BARURAL	1990-2003
National Accord for the Countryside	An agreement between the Fox Administration and farmer and peasant organizations to define policies for rural development	2003

Source: Yunez-Naude and Barceinas: 2004 (in press)

By 1995-96, most of CONASUPO's subsidiaries and financial activities were dismantled, privatized or transferred to farmers, and by 1999, the liquidation of CONASUPO was practically complete (Table 1, details are in Yunez-Naude, 2003).

In 1991, an agricultural marketing agency, ASERCA (Support Services for Agricultural Marketing), was created as a substitute for some of CONASUPO's functions. The operations of ASERCA are directed towards marketing of basic crops, but the agency does not buy or store commodities, as CONASUPO did. Another important function of ASERCA is the program of direct income transfers to farmers (PROCAMPO; see below).

A major reform in Mexican state intervention in staple production was implemented parallel to the creation of ASERCA: the elimination of guaranteed prices that CONASUPO had traditionally awarded to the producers of basic crops (the exceptions were beans and maize, whose guaranteed prices were eliminated in the mid-1990s). Starting in 1995, the Administration of President Zedillo (1995-2000) took further steps towards a more liberalized food chain that lead to the final decision to liquidate CONASUPO before the end of his mandate in 2000.

Some months before NAFTA was signed, PROCAMPO began to be implemented. The program is a "de-coupled" income support for all farmers producing basic crops with the purpose of facilitating producers' transition from price supports to freer and more open international markets. PROCAMPO is planned to last until 2008, when full liberalization under NAFTA will be reached.

In addition to ASERCA and PROCAMPO, in 1995 the Zedillo Administration created "Alliance for the Countryside." Alliance's main objective is to increase agricultural productivity and to capitalize farmers by participating with funds in farmers' investment and sanitary projects leading to integration of farmers with the food chain. A major purpose of Alliance is to promote farming efficiency through crop substitution (mainly from basic crops to fruits and vegetables) for farmers who have a potential comparative advantage in producing such crops in the context of an open economy. Alliance includes a phytosanitary program and has a decentralized character, with state-level control of its programs and contributions to the funding by participating farmers (www.sagarpa.gob).

In relation to credit, the Salinas Administration decided to reduce its subsidies, with the expectation that private credit institutions would satisfy the credit requirements of Mexican farmers.

With the *ejidal* reform of 1992, the Mexican State also enacted a major change in land property rights. Up to 1991, farms in Mexico were either private or *ejidal*, and *ejidal* lands could not be sold or leased out by *ejidatarios*.[3] The *ejidal* reform seeks to give security to those who own land, to enhance well defined property rights in land and, through this, to develop the land market. (Saldivar: 2004).

The first step the Mexican government took towards trade liberalization was to join the GATT in 1986: by 1990/1, most licenses to import agricultural products were abolished, and in 1991-1994 most agricultural commodities were under a tariff regime. The second step was NAFTA.

Under NAFTA, some agricultural commodities were liberalized in January 1994; others —ones considered sensitive by the signing governments—were subject to a process of year-to-year liberalization, so that full free trade was reached in January 2003 or will be attained in January 2008. For the latter group of commodities, tariff rate quotas (TRQs) and/or seasonal tariffs were used: Mexico imposed TRQs on the imports of barley, dry edible

[3] However, renting *ejidal* land was done before the reform. Since this practice was illegal, there is not reliable data about its extent.

beans, maize and powdered milk. The US imposed seasonal tariffs as well as TRQs for several fresh vegetables and fruits imported from Mexico.

Quota levels were established based on 1989-91 trade flows between Mexico and its two North American partners. In 1994, the TRQs were set at 2,500,000 metric tons (Mts.) for U.S. maize and 1,000 Mts. for Canadian maize, and the above-quota base or consolidated tariff on maize from both countries was fixed at 215 percent (or 206.4 US$/Mt.). In January 1994, the quota for dry edible beans was 50,000 Mts. for the U.S. and 1,500 for Canada, and the above quota tariff was 139 percent (480 U.S.$/Mt.). For both grain and malt barley, the 1994 quota was set at 120,000 Mts. for imports from the U.S. and 30,000 Mts. for imports from Canada, and the above-quota *ad-valorem* tariffs were 128 percent for grain barley and 175 percent for malt barley. Beginning in 1995, the quotas for these three crops and for milk powder have been growing each year, and the above quota tariffs have been progressively reduced as protection is gradually phased out (Yunez-Naude and Barceinas, 2002).

NAFTA does not imply specific commitments with regard to domestic marketing support reductions or export subsidies. It allows its members to use safe-wards and includes dispute settlement mechanisms in its Chapters 19 and 20.[4]

SOCIAL PROGRAMS

Parallel to economic liberalization, specific policies to attend to the rural poor were created. The first one was the Program of National Solidarity or PRONASOL founded in 1988, followed by the creation of the Ministry for Social Development or SEDESOL. One of the most important programs of SEDESOL was PROGRESA (Program for rural education, health and nutrition), created in 1997.

PROGRESA´s objective was to contribute to human capital formation, focusing in the poorest rural families, providing monetary and in kind transfers to poor rural female household heads conditional upon sending their children to school, caring about their nutrition and bringing them to health centers on a regular basis.

In the National Program for Social Development (2001-2006), the current Administration adopts the notion of human development and calls its social strategy CONTIGO. The purpose of CONTIGO is to bring together governmental efforts to enhance human development by promoting the capacities of the people (education, health and nutrition); by generating income opportunities (infrastructure, credit and employment); by helping the poor in acquiring assets (housing, savings and property titles); and by providing them social protection (insurance, social prevision and attention to collective risks). CONTIGO extends the objectives of the previous administrations by expanding the activities of PROGRESA (now called OPORTUNIDADES) to the urban sector (PNUD, 2003).

[4] In this later respect, and given the strong US opposition to exempt NAFTA countries from each other's antidumping and countervailing duties actions or AD/CVD, a compromise was reached in the Canadian-US Free Trade Agreement or CUSTA –and followed in NAFTA— to establish bi-national panels to review AD/CVD actions between two countries when requested by an involved party. The role of these bi-national panels is limited to determine whether a country appropriately follows its own national AD/CVD laws in making a particular determination (i.e. an AD/CVD action). National AD/CVD laws of the US were not changed, and Mexico adapted them to be in accordance to its trade liberalization policies. Although national AD/CVD laws cannot be questioned by the review panels, the process provides an alternative to having national courts handle appeals of AD/CVD decisions. This provides the possibility of greater impartiality of the review. (Leycegui, B. and M. Ruiz Cornejo, 2002, and Perry, G. *et.al.*: March 2003, Chapter 3).

PREDICTED IMPACTS OF POLICY REFORMS

Predictions of the effects of internal liberalization and NAFTA on Mexico's agriculture are based on price movements caused by these policy changes. In particular, with the elimination of producer price supports for basic crops in Mexico and with trade liberalization in North America, prices of imported crops by Mexico were expected to decrease. With this change, Mexican producers of importables would be forced to compete with Canadian and US farmers. Greater competition would increase productivity and/or reduce Mexico's supply of importables. Its farmers were expected to substitute the production of exportables for importables. Under this scenario, NAFTA and internal policy reforms would provoke considerable growth in agricultural trade in North America (for Mexico, particularly with the US).

It was also predicted that employment created by increasing production of exportables would be insufficient to absorb the displaced workers from the importables sector, leading to a rise in rural out-migration.

The above expectations implicitly assume macroeconomic stability, a condition that the Mexican economy did not enjoy from the end of 1994 to 1996 (Audley, J. *et al.*: 2003, pp. 18-19). So, in reviewing the evolution of Mexico during NAFTA one has to keep in mind the macroeconomic crisis that this country suffered during the above mentioned period.

TENDENCIES AND ECONOMETRIC ANALYSIS OF STRUCTURAL CHANGE [5]

Here we review trends in agricultural prices, trade and production and summarize findings from our econometric analyses.

Prices

There has been a general tendency for Mexico's prices of major exported and imported crops to follow US prices more closely in the wake of reforms (see Yunez and Barceinas: 2002). Of particular interest here are domestic prices of major crops imported by Mexico. The data show that these have been diminishing (Figure 1). However, with the exception of a rise during the macroeconomic crisis of 1994-6, this trend appears to have been present since 1987. Hence, econometric analysis is required to study the nature of price changes for major imported crops.

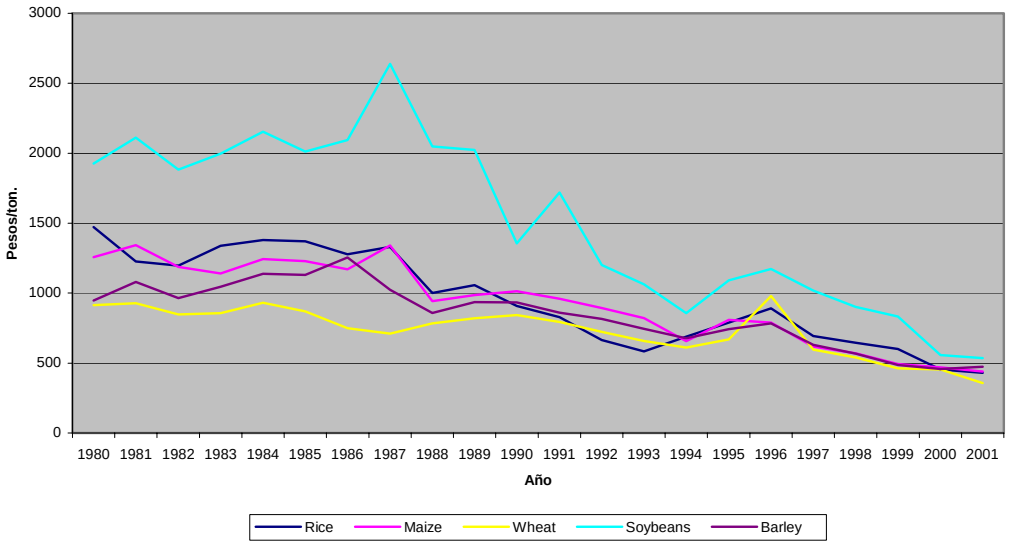
We used an Error Correction Model (ECM) to test whether or not the internal price of major agricultural traded commodities has followed the foreign (US) price and whether there have been changes in the speed of adjustment of these two prices before and after NAFTA. The analysis was applied to major crops imported by Mexico from the USA (barley, maize, sorghum, soy beans and wheat) and covers the period from January 1981 to March 2003.[6]

Our findings indicate that during the last 22 years there is a tendency for the internal price of barley, maize, sorghum and wheat to follow the USA price, and that this price convergence was present before and during NAFTA. However, the adjustment takes a long time (at least 20 months), and the periods of adjustment did not decrease during NAFTA.

[5] The notion of structural change used in this section is statistical. It is based on time-series data and tells us if a change of model parameters between two periods is permanent or not.

[6] The econometric estimates of the ECM were done for the whole period as well as separately for the pre-NAFTA and NAFTA periods (the exception is soy, because the available data series begins in January 1994). We also studied the evolution of relative prices of major exported vegetables and fruits. The results show that since NAFTA, there has been a tendency for domestic and US prices of these crops to converge (see Yunez and Barceinas: 2003).

Figure 1. Mexico. Average Producers Prices of Selected Basic Crops (1994=100)



Sources: Mexico Ministry of Agriculture data base (SIACON) deflated by the National Consumer Price Index from Bank of Mexico

These results contrast with accepted wisdom in two ways. First, they are inconsistent with the view that, before the elimination of producer price supports for basic crops, prices of grains in Mexico moved independently of international prices. Second, they do not support the contention that price convergence of these crops began with NAFTA. As we will discuss below, these tendencies could be one of the reasons explaining why production of basic crops in Mexico has not collapsed during NAFTA's implementation.

Trade

The share of agricultural trade in Mexico's total agricultural supply has almost doubled during the last 13 years, from an average of 18.7% during the four years prior to NAFTA to an average of 35% from 1994 to 2002. This share was even higher during the macroeconomic crisis of 1995-96 (39%), and has remained high since then (35% during 1997-2002).[7]

Agricultural trade between Mexico and the US has also increased during NAFTA. Value of exports in constant US dollars increased by an average of 49% from 1994-2003 compared with 1989-93, and imports rose 53% during the same period. As a consequence Mexico's agricultural trade deficit with the US has widened.

The volume of Mexican exports of major fresh vegetables and fruits has grown considerably under NAFTA: by 75% and 100%, respectively, in 1995-2002 compared with 1983-94. This jump is also shown by the share of exports in the domestic production of these crops, which rose from 14.1% to 20.8% during the same period. Imports of the six major basic crops also grew, by 88% in physical terms.

[7] The shares include forestry and are calculated with trade data from the Mexican Ministry of Economics and with production data from the Mexican Institute of Statistics, available on their web sites. The data were deflated using the US consumer price index from the US National Bureau of Labor Statistics.

The latter trend has meant that the ratio of imports to total national production of these crops has increased continuously during the reforms and NAFTA. The combined volume of imports of barley, beans, maize, sorghum, soybeans and wheat accounted for 27.5% of domestic production during 1983-90, 29.8% in the following 4 year period, 34.7% during 1995-96 and almost 50% from 1997 to 2003 (Yunez and Barceinas: 2004).

The evolution of Mexico agricultural trade indicates that, as expected, it has increased during NAFTA. However, this trend could have been present before NAFTA. We conducted an econometric study to test if the agreement caused structural change in agricultural trade.[8]

Our results show that there is a contrast between agricultural exports and imports. As expected, agricultural exports have experienced structural change, but imports have not. Total-agricultural and tomato exports experienced structural change in the last month of 1994. Fresh vegetables, melons and watermelons, as well as "other fresh fruits," also experienced structural change, but in different periods (in November 1994, September 1994 and June 1995, respectively). In contrast, we find no evidence of structural change in total agricultural imports nor in any of the major imported crops considered in the analysis (maize, sorghum, other oilseeds and seeds and wheat).

The dates of structural change for exports make us suspect that this could have been due to the sharp devaluation of the peso at the end of December 1994 and beginning of 1995 (our findings on trends in Mexico's agricultural trade are similar to those expressed by the Economic Research Service of the US Department of Agriculture, ERS: 1999 and 2000).

Production and Productivity

As expected, the volume of production of major exported vegetables and fruits has grown continuously since the early 1990s and during NAFTA. This is explained by an increase in both total area planted and yields for each of the major exported crops (Tables 2 and 3).[9]

What is striking is that, in contrast with expectations, national production of the most imported and important basic crops grown in Mexico (barley, beans, maize, sorghum, soybeans and wheat) also increased during the 1990s and the first years of the new millennium—that that is, during the deepening of internal reforms and NAFTA (Table 4). This is explained by a continued increase in crop yields. For example, during 2001-03, the production of these six basic crops was 36% higher than in 1983-90, yields increased 21%, and cultivated area remained practically the same.

There are different trends when we distinguish production of major basic crops under irrigated conditions from production on rain-fed lands. Supply from irrigated lands increased sharply during 1991-94 with respect to the previous 8 year period (19.5%), but it remained practically the same from 1995 to 2003 (around 14 million metric tons). Parallel to this, cultivated area decreased (by more than 20%), meaning that yields increased for crops under irrigation. Production under rain-fed conditions followed a different trend, expanding over the whole period under study (for example, average production during 2001-2003 was 40% higher than in 1983-90). This trend is based on an increase in planted area and, to a lesser

[8] The model we applied is convenient for our purposes, because if structural change is detected, the date when this happens is determined endogenously. The variable for estimating the equation of structural change in agricultural trade was the value of agricultural monthly exports and imports (totals and per crop) in constant pesos using the real exchange rate index for 1990. For the case of total agricultural exports and imports the period we considered was from January 1980 to August 2002. Due to data restrictions, the period considered for specific crops or groups of crops was from January 1991 to August 2002 (details are in Yunez and Barceinas: 2004).

[9] The exceptions are garlic in 2001-03 compared with 1997-2000 and in the area cultivated in tomatoes during the same periods. However, tomato yields rose.

extent, in yields. Whereas production and cultivated area under irrigation declined during the macroeconomic crisis of 1995-96 compared to the previous 4-year period (5.7% and 15%, respectively), supply and cultivated area under rain-fed conditions increased during the same period (by 21.8% and 15.7%). These contrasts suggest a different reaction by farmers producing basic crops depending on their access to water (a question that is discussed in the next section, with special reference to maize).

Table 2. Major Exported Vegetables. Volume of Production, Cultivated Area and Yields (simple averages)

Period	Commodity	Production (Mt. Tons)	Cultivated Area (Hectares)	Yields (Tons/Cropped Ha.)	Commodity	Production (Mt. Tons)	Cultivated Area (Hectares)	Yields (Tons/Cropped Ha.)
1983-90	**Cauliflower**	40,007	2,763	14.3	**Garlic**	52,813	6,943	7.7
1991-94		52,835	3,717	14.6		54,168	7,399	7.4
1995-96		43,048	2,920	15.3		54,509	7,120	7.7
1997-00		58,068	3,539	16.8		64,079	8,580	7.6
2001-03		57,670	3,047	19.4		47,019	5,619	8.4
1983-90	**Brocolli**	79,909	7,755	10.7	**Onions**	593,361	37,011	16.9
1991-94		149,755	14,552	10.4		703,540	38,513	18.7
1995-96		143,524	13,476	10.7		682,326	34,356	20.1
1997-00		215,883	18,470	12.1		957,957	43,719	22.6
2001-03		236,983	19,019	12.7		1,106,462	45,709	25.3
1983-90	**Carrots**	157,398	6,820	23.6	**Tomatoes**	1,759,108	76,287	24.56
1991-94		227,360	9,098	25.8		1,583,647	80,282	21.34
1995-96		209,544	8,988	23.4		1,941,775	74,159	27.09
1997-00		341,724	14,936	23.4		1,940,435	71,955	27.89
2001-03		355,655	14,596	25.1		1,963,828	68,579	29.74
1983-90	**Cucumbers**	251,236	15,637	17.0	***Totals***	*2,933,829*	*153,216*	*19.1*
1991-94		258,556	15,436	17.7		*3,029,861*	*168,997*	*17.9*
1995-96		322,034	15,910	20.6		*3,396,760*	*156,928*	*21.6*
1997-00		428,194	18,088	24.1		*4,006,340*	*179,288*	*22.3*
2001-03		441,938	17,741	25.4		*4,209,555*	*174,311*	*24.1*

Sources: Mexico Ministry of Agriculture Data Bases (SIACON) and "Anuario estadístico de la producción agrícola 1999-2000" (preliminary data for 2003).

Yields from irrigated lands are much higher than yields under rain-fed conditions, and the disparity has deepened since the second half of the 1990s. For the six basic crops we studied, in 1983-90 and 1991-94 average metric tons per hectare under irrigation were 2.9 higher than yields obtained under rain-fed conditions. The difference increased to more than 3.4 times after 1997.

The same result obtains when we consider basic crops separately. Of particular interest is maize. This grain has been the major crop produced in Mexico, overall an in terms of Mexico's supply of staples. During 1983-90 it accounted for almost 48% of total supply of the six major basic crops and 57% of total cultivated area in these crops. Surprisingly, these percentages have increased during the period of reforms and NAFTA: during 2001-2003 the contributions of maize production and cultivated area to the respective totals for the six basic crops were around 56% and 60%. After a sharp rise in maize production and cultivated area under irrigated lands during 1991-94 (121% and 56%, respectively, compared with 1983-90), these contributions remained practically the same in 1995-96 and 2001-03. For rain-fed maize, the situation during the period of reforms and NAFTA has remained similar to that prevailing during 1983-90 (we propose below hypotheses intended to explain these unpredicted trends).

Table 3. Major Exported Fruits. Volume of Production, Cultivated Area and Yields (simple averages)

Period	Commodity	Production (Mt. Tons)	Cultivated Area (Hectares)	Yields (Tons/Crop-per Ha.)	Commodity	Production (Mt. Tons)	Cultivated Area (Hectares)	Yields (Tons/Crop-per Ha.)
1983-90	**Avocados**	552,952	83,699	8.4	**Oranges**	2,014,141	211,316	12.6
1991-94		753,538	92,464	8.8		2,753,953	281,757	12.3
1995-96		813,942	92,199	9.1		3,778,075	335,409	12.9
1997-00		856,370	93,705	9.5		3,651,931	328,361	11.7
2001-03		934,400	97,064	9.8		4,053,263	342,578	12.2
1983-90	**Lemons**	762,074	80,973	10.7	**Papaws**	510,149	22,335	28.3
1991-94		758,177	88,784	9.6		394,615	19,157	24.7
1995-96		1,021,073	102,038	11.1		489,909	21,007	31.6
1997-00		1,313,145	119,366	12.1		602,825	20,979	32.7
2001-03		1,719,266	137,035	13.1		817,312	21,353	40.5
1983-90	**Mangoes**	1,023,273	114,866	10.6	**Strawberries**	70,557	4,600	16.7
1991-94		1,115,717	139,492	9.2		80,233	6,086	16.6
1995-96		1,266,043	151,364	9.3		95,055	4,635	20.5
1997-00		1,510,776	159,736	9.9		91,840	4,160	22.6
2001-03		1,565,827	170,418	9.5		113,901	4,318	26.9
1983-90	**Guavas**	150,257	14,915	12.4	**Watermelons**	441,759	39,381	13.0
1991-94		190,540	15,764	13.1		426,815	37,953	13.1
1995-96		205,963	17,237	12.3		509,271	35,172	16.3
1997-00		198,101	20,614	11.7		842,324	42,858	21.2
2001-03		285,368	22,093	13.2		923,732	44,050	22.2
1983-90	**Cantaloupes**	394,566	36,546	12.5	***Totals***	*5,919,728*	*608,631*	*9.7*
1991-94		495,472	42,996	12.9		*6,969,059*	*724,453*	*9.6*
1995-96		448,011	30,152	16.0		*8,627,342*	*789,212*	*10.9*
1997-00		598,010	30,277	20.6		*9,665,322*	*820,057*	*11.8*
2001-03		512,701	23,236	22.7		*10,925,770*	*862,145*	*12.7*

Sources: Mexico Ministry of Agriculture Data Bases (SIACON) and "Anuario estadístico de la producción agrícola 1999-2000" (preliminary data for 2003)

Whether or not the evolution of the Mexican supply of major basic crops during the last 13 years signifies a structural change is an empirical question. Crop production is the result of cultivated area and yields. We tested econometrically whether structural changes in the effects of prices and trade on Mexico's supply of the most important imported and exported crops took place beginning with NAFTA's implementation (Table 5).[10]

Our results show that out of the seven major exported vegetables for which we applied the test, tomatoes experienced a (negative) structural change in cultivated area, and broccoli a significant (positive) rise in yields. These structural changes are due to trends in supply under irrigation.[11] For the case of exported fruits, data availability limited us to study only melons and watermelons, and our findings indicate that both goods show significant positive changes in yields but not in cultivated area.

[10] The proof is known as the Chow test, and the period covered is from 1980 to 2002. We used planted area instead of cropped area since the latter depends heavily on climate and can hence be taken as exogenous to farmers' decisions.

[11] Notwithstanding that most exported vegetables are produced on irrigated lands, our analysis shows that area cultivated in broccoli and cucumbers had a positive increase under rain-fed conditions. This result is interesting and could be the basis to study whether farmers producing these two crops under good rain-fed conditions may have reacted to liberalization policies.

Table 4. Major Basic Crops: Volume of Production, Cultivated Area and Yields (simple averages)

Product	Period	Production (Thousand of Mt. Tons)			Cultivated Area (Thousand of hectares)			Yields (Tons/Cultivated Ha.)		
		a. Total	b. Irrigated	c. Rainfed	a. Total	b. Irrigated	c. Rainfed	a. Total	b. Irrigated	c. Rainfed
Barley	1983-90	690	317	373	325	64	260	2.1	4.9	1.4
	1991-94	651	305	346	282	59	223	2.3	5.1	1.5
	1995-96	713	281	433	318	48	270	2.2	5.8	1.6
	1997-00	699	229	470	342	41	301	2.0	5.6	1.6
	2001-03	973	383	529	372	63	301	2.6	6.1	1.8
Beans	1983-90	998	270	728	2,164	227	1,937	0.5	1.2	0.4
	1991-94	1,187	399	788	2,149	302	1,847	0.6	1.3	0.4
	1995-96	1,310	399	911	2,275	277	1,998	0.6	1.4	0.5
	1997-00	1,043	407	637	2,306	302	2,003	0.5	1.3	0.3
	2001-03*	1,341	403	903	2,073	258	1,832	0.6	1.6	0.5
Maize	1983-90	12,472	2,932	9,540	8,076	994	7,082	1.5	2.9	1.3
	1991-94	16,885	6,488	10,397	8,294	1,553	6,741	2.0	4.2	1.5
	1995-96	18,189	5,997	12,192	8,859	1,343	7,516	2.1	4.5	1.6
	1997-00	17,844	5,957	11,886	8,649	1,175	7,474	2.1	5.1	1.6
	2001-03*	19,846	6,661	13,055	8,285	1,121	7,213	2.4	5.9	1.8
Sorghum	1983-90	6,890	3,607	3,283	2,009	618	1,391	3.4	5.8	2.4
	1991-94	5,612	2,895	2,717	1,423	395	1,028	3.9	7.3	2.6
	1995-96	7,419	3,548	3,871	2,059	468	1,591	3.6	7.6	2.4
	1997-00	9,292	4,455	4,837	2,320	479	1,841	4.0	9.3	2.6
	2001-03*	10,052	4,304	5,215	2,329	459	1,877	4.3	9.4	2.8
Soybeans	1983-90	704	605	99	401	317	84	1.8	1.9	1.2
	1991-94	585	504	81	304	250	54	1.9	2.0	1.5
	1995-96	123	70	53	103	50	53	1.2	1.4	1.0
	1997-00	142	62	80	108	38	70	1.3	1.7	1.1
	2001-03*	111	37	67	69	21	47	1.6	1.8	1.4
Wheat	1983-90	4,292	4,036	256	1,087	887	200	4.0	4.6	1.3
	1991-94	3,854	3,474	379	970	730	240	4.0	4.8	1.6
	1995-96	3,422	2,966	455	911	611	300	3.8	4.9	1.5
	1997-00	3,351	3,072	279	765	565	200	4.4	5.4	1.4
	2001-03*	3,151	3,012	244	664	531	146	4.7	5.7	1.7
Totals	1983-90	*26,046*	*11,767*	*14,280*	*14,061*	*3,107*	*10,954*	*1.9*	*3.8*	*1.3*
	1991-94	*28,774*	*14,066*	*14,708*	*13,422*	*3,290*	*10,133*	*2.1*	*4.3*	*1.5*
	1995-96	*31,177*	*13,260*	*17,916*	*14,525*	*2,797*	*11,728*	*2.1*	*4.7*	*1.5*
	1997-00	*32,371*	*14,182*	*18,189*	*14,489*	*2,599*	*11,890*	*2.2*	*5.5*	*1.5*
	2001-03*	*35,474*	*14,799*	*20,013*	*13,793*	*2,453*	*11,416*	*2.6*	*6.0*	*1.8*

* The data for irrigated and rain-fed lands are for the period of 2001-02

Sources: FAO and Mexican Ministry of Agriculture: Data Bases (SAGAR SIACON) and "Anuario estadístico de la producción agrícola 1999-2002"

Table 5. Structural Change in cultivated area and yields of major traded crops: 1980-2002

	Cultivated area			Yields		
	Total	**Under irrigation**	**Rainfed**	**Total**	**Under irrigation**	**Rainfed**
Exportables						
Broccoli	NO	NO	*YES*	*YES*	*YES*	NO
Carrot	NO	NO	NO	NO	NO	NO
Cauliflower	NO	NO	NO	NO	NO	NO
Cucumber	NO	NO	*YES*	NO*	NO*	NO
Garlic	NO	NO	*YES*	NO	NO	NO
Onions	NO	NO	NO	NO*	NO	NO
Tomatoes	*YES*	*YES*	NO	NO	NO	*YES*
Melons	NO	NO	NO	*YES*	*YES*	NO
Watermelon	NO	NO	NO	*YES*	*YES*	NO*
Importables						
Beans	NO	NO*	NO	NO	NO	NO
Barley	NO	NO	NO	NO	*YES*	NO
Maize	NO	NO	NO*	NO	NO	NO
Wheat	NO*	NO	NO	NO	NO	NO
Soybeans	NO	NO	NO	*YES*	*YES*	NO
Sorghum	*YES*	NO	*YES*	NO	NO	NO

*Significant at 10% level
Source: Own estimations

The only basic crop that experienced structural change in cultivated area beginning with NAFTA is sorghum produced on rain-fed lands. The direction of the change is towards increasing planted area and is significant enough to produce a positive structural change in total (including irrigated) area in this grain.[12] With respect to yields, barley produced under irrigation is the only basic crop that experiences a positive structural change, and yields for soybeans show structural change in the opposite direction.

The above econometric results do not contradict previous observations regarding trends in the production of major exported and imported crops. Furthermore, they indicate that, overall, no structural change is apparent in Mexican agriculture after more than 10 years of reforms and NAFTA.

Trends in other relevant variables related to the rural economy

Econometric tests of structural change in relevant rural and agricultural variables for Mexico other than prices, trade and production are lacking (as we will see below, the exception is migration). Notwithstanding this, for the purposes of this Workshop, we now discuss the evolution of labor productivity and wages, rural out-migration, credit, land property rights and poverty).

[12] The result is interesting if we take into account that sorghum production is a close substitute for maize production. An analysis of this issue is lacking but fundamental to study the effects of NAFTA and policy reforms on Mexico's supply of staples.

Labor Productivity

Concurrent with the trends in yields, labor productivity in crop production—measured as value added divided by employment—increased continuously from the late 1980s to 2001. Agricultural real wages have experienced a different evolution: they decreased from 1980 to 1997 (especially during the macroeconomic crisis of 1995-96) and rose slightly from 1997 to 2001 (Puyana and Romero: 2004, pp. 17-21).

Rural employment and out-migration

Employment in the agricultural sector of Mexico has decreased, and this is reflected in a drop by almost 2% in total employment in the primary sector (agriculture and mining) during 1993-2002 versus 1984-1993, according to estimates by Audley, *et al.* (*op. cit.*), based on Mexico National Employment Surveys. Although this is in accordance with expectations, a critical question is where these displaced workers from the "primary sector" have found alternative jobs. Answering this question is complicated by the nature of official data; for example, employment figures are based on a sectoralization of the Mexican economy by major production activities, ignoring the complexity of rural households' economic life. That is, the data abstract from the fact that a typical rural household in Mexico is a diversified production unit whose members are engaged in crop, cattle, and other household production activities as well as in local, domestic-migrant and international labor markets (see next section).

Preliminary results from the Mexico National Rural Household Survey of 2003 offer some insight into where the displaced workers from the primary sector may be located.[13] These results show statistical evidence that rural out-migration (both internal and to the US) rose significantly during the 1990s compared to the previous decade. The increase has been most pronounced for migration to the US during the second half of the 1990s through 2002. The number of migrants from Mexican villages in the rest of the country was 182% higher in 1994 than in 1980, but it was 352% higher in 2002. The number of migrants from rural Mexico in the US rose more slowly during the first period (it grew 92% between 1980 and 1994). However, it was 452% higher in 2002 than in 1980.

If we consider that most rural migrants in the rest of Mexico go to cities, we can link the above finding with the official data on agricultural employment and propose that increasing numbers of people born in rural Mexico are working in non-agricultural activities. We can add to this the argument of Polack (Audley, *op. cit.*, Chapter One) that insufficient growth in manufacturing employment during the 1990s meant that many of these rural migrants work in urban informal services, and many others with networks in the US decided to migrate to the north.

Credit

Credit subsidies and official credit coverage for working capital given to farmers by public financial institutions for rural development declined sharply during the 1990s. During and prior to the deepening of reforms in the 1980s, the government granted credit subsidies to farmers and provided 55% of total credit given to the agricultural sector. Since 1990, official credit has been sharply reduced, and the private credit percentage increased to more than

[13] *Encuesta Nacional a Hogares Rurales de Mexico – ENHRUM*. The survey is statistically representative of households living in towns and villages with 500 to 2,500 people all over Mexico and gathered data on migration from 1980 to 2002 (see http://precesam.colmex.mx, and Taylor and Dyer (2003).

73%. The amount of credit channeled to agriculture grew during the first four years of the 1990s (11% in constant pesos), but it has decreased sharply since the financial crisis of 1995 (total credit granted to agriculture was 21% higher in 1983-90 than in 1996-2000; Yunez and Barceinas: 2002). In addition, the proportion of agricultural credit in total credit granted in Mexico has been declining; it fell from 5.9% in 1994 to 2.8% in 2002 (Puyana and Romero: 2004).

The above trends suggest that the banking crisis of 1994-95 was a major factor impeding the flow of private credit to agriculture that was expected to occur after economic and *ejido* reforms.

Lower credit access may have forced commercial farmers to use decoupled supports (PROCAMPO and Alliance for the Countryside) as a substitute for credit in order to continue production. Credit constraints may have limited the options that liberalization provided to farmers to switch production to competitive crops after policy reforms and NAFTA (see below). The credit crisis limited domestic investment in agriculture, and US investment in Mexico's field crops has remained low (Bolding, *et al.*: 1999 and Casco and Rosensweig: 2000).

The Ejidal Reform

Certification of *ejido* lands to individual *ejidatarios* is a prerequisite for the development of land markets in Mexico. The Salinas Administration expected that the process of issuing individual certificates of title to *ejido* land parcels, conducted by PROCEDE, would conclude in a couple of years. This did not happen, and the process of certification is still under way.

One reason for the slow pace of certification is that, in order to assess ownership rights, PROCEDE has to confirm the boundaries of *ejidos* and individual parcels, resolve internal disputes, and distribute titles. PROCEDE has given new life to boundary disputes, particularly conflicts with absentee *ejidatario*s, over the inheritance right of non-*ejidatario* women or children, and over the rightful ownership of land that has been illegally used for loan collateral (Saldivar, *op.c it.*).

Once land is certificated, it can be transferred to someone else within the family or within the *ejido* by way of sale. Then the certificate can be converted to a private property title; a request to this effect has to be submitted to the entire *ejido* assembly and majority approval (50 % and one vote) obtained. If permission is granted and a title issued, the proprietor of the land has a "complete right" to the land (*derecho pleno*) and can then sell it to anyone, inside or outside the *ejido*, as private property.

The process of certification of *ejidal* lands is now almost complete: in 2002, 76% of the *ejidal* lands were certified. However, in the same year, only 3.86% of the ejidal lands had a "complete right" (Ministry of Agrarian Reform: 2003).

Leasing-out *ejidal* lands has increased since the reform. According to the 1997 National *Ejido* survey, from 1994 to 1997 there was a 19% increase in rental transactions by *ejidatario*s (Saldivar: 2004). By 1999, 51.4% of the rural territory was still under *ejido* regime and just 5% of *ejidatario*s had sold their land (Appendini, 2001). Jones and Ward argue that changes in ownership patterns have been much more modest than expected under the *ejidal* reform, partly because of the slow pace of individual land titling under the PROCEDE program and the limited productive value of the land except in urban and suburban *ejidos*, where land is coveted by private real estate developers, and irrigated land where productivity is assured.

Rural Poverty

Poverty incidence has been greater in rural than in urban Mexico, and the difference has not changed appreciably during the last ten years. The incidence of extreme rural poverty has been around 30 points higher in rural than urban areas, whereas the rural-urban difference in moderate rural poverty has decreased from around 30 points in 1992 to 25 points in 2002. Rural (and urban) poverty—moderate and extreme—increased during the macroeconomic crisis that Mexico suffered in 1995-6 and has been decreasing since then, returning in 2002 to the levels of 1992 (Caballero: 2004).

THE STRUCTURE OF THE MEXICO'S RURAL ECONOMY

Overall, our studies of the evolution of the rural and agricultural economy of Mexico indicate that, rather than a sudden structural transformation during the policy reforms and NAFTA, this sector has experienced year-to-year cumulative changes since the 80s (the exception being the effects on agricultural exports and rural out-migrations caused by the macroeconomic crisis of 1995-96).

One feature of this process that is particularly worthy of attention is that the structure of crop production in Mexico has not radically changed, and in particular, production of basic crops other than soybeans has not collapsed. We propose that government policies and the dual character of agricultural production in Mexico are two phenomena that could explain this surprising outcome.

The heterogeneity of the Mexican agricultural sector is reflected in the coexistence of entrepreneurial farmers with peasant or family producers. The later are rural households engaged jointly in production and consumption of staples, agriculture representing only a part of their "portfolio" of income-earning activities. In general, peasant producers have limited land (typically with plots no larger than 2 to 2.5 hectares) and do not have access to irrigation and credit. In addition, due to poor communications and transportation, these producers face high transaction costs in some markets. These characteristics of rural households imply a supply response for staples that is inelastic with respect to market prices.

By contrast, entrepreneurial or commercial farmers´ decision making process is the same as that of any other farmer in the developed world: their production is specialized, for profit, and for the market in a context of low transaction costs. These characteristics enable commercial farmers to react to price changes by altering their supply of agricultural goods.

Both commercial and peasant farmers producing basic staples have benefited from PROCAMPO, and there is evidence that direct income transfers may have promoted domestic production of major crops imported by Mexico, particularly on small farms (see Garcia Salazar: 2001 and Taylor *et.al.*, 1999 for the case of maize).

We propose that—together with productivity increases and direct income transfers (PROCAMPO)—new governmental programs and policies directed towards commercial or entrepreneurial farmers can explain why the production of some basic crops has not collapsed during the reforms, and also why the prices of staples have not followed US prices more closely during the same period. These policies include the marketing subsidies granted through ASERCA and other supports related to Alliance for the Countryside.

ASERCA offers marketing supports to commercial producers of basic crops in surplus regions.[14] Until the spring-summer season of 2000 the government and surplus producers

[14] This is the case of the northern Mexico surplus producing States, where most of the marketing assistance budget has been directed to (for example, 89% during 2002). This has been specially so for maize in the State of Sinaloa; sorghum in the State of Tamaulipas and wheat in the State of Sonora (see de Ita: March 2003 for the case of maize in Sinaloa).

negotiated a certain price. Then, in a public bid, interested buyers asked for a subsidy in order to commit themselves to buy a certain amount of the crop in question at the negotiated price. Hence, marketing supports of ASERCA are not decoupled and they could have helped maintain or even promote the commercial production of these crops, notwithstanding competition from the US under NAFTA.

Subsidies granted to commercial farmers by Alliance for the Countryside have to be added to the PROCAMPO and ASERCA supports as explanations for why the production of staples by entrepreneurial agriculture has not collapsed and/or why the structure of commercial farmers' supply has not changed more significantly under market reforms and NAFTA. There is evidence that, instead of substituting staples for competitive crops, commercial farmers have used Alliance supports to respond to the credit crisis from which they have suffered since the macroeconomic crisis of 1994-96 (FAO and SAGAR: 2000).

In relation to peasant agriculture, the relevant crop is maize, the major basic staple for human consumption in Mexico. A considerable portion of the production of maize by family farmers is used for own consumption. Due to the lack of disaggregated time series data, an approximation is required distinguish peasant from commercial production of maize. This can be done by using maize output on irrigated land to approximate commercial production and output on non-irrigated lands as peasant production.

Table 4 shows that maize production and cultivated area on rain-fed lands increased since 1995-6 (note that, in contrast with irrigated maize, yields on rainfed lands have remained practically unchanged).

There are two alternative hypotheses that have been proposed in the literature to explain why peasant production of maize has not collapsed in the wake of policy reforms and NAFTA. The first one is that, due to high transaction costs, peasant agriculture is relatively isolated from maize markets. In addition to cultivating the grain for home consumption, this means that, as producers of maize, the peasantry is not directly affected by price changes (see for example, de Janvry *et. al.*: 1991). The alternative hypothesis, by Dyer and Taylor (2003), is that economic linkages among commercial and subsistence households have shaped the outcomes of policy and market shocks in surprising ways (see next section).

The agrarian structure of Mexico can also provide an explanation for why the *ejidal* reform has not led to the expected radical increase in the size of agricultural units. Although research on this theme is needed, we propose that the development of the market for *ejidal* lands has taken place in areas located near urban and tourism centers and in zones with high-quality lands for agricultural production and developed transportation, communications and marketing infrastructure.

A RURAL MICRO ECONOMY-WIDE PERSPECTIVE

Throughout modern history, marked heterogeneity among producers has characterized agriculture in Mexico, where a majority of land-poor, subsistence households coexists in more or less isolated markets with a small number of land-rich commercial (i.e., surplus) growers (Hewitt, 1976; Esteva, 1982; Appendini, 1993). The extent of their interaction is such that social scientists often explain each group's actions in relation to those of the other group (see Bartra, 1982; Fox, 1992). This has not been the case in the economics literature. Mexican maize agriculture is also marked by panoply of market failures. Transaction costs have been described in relation to maize markets (de Janvry et al., 1995; Key et al. 2000), and a diversity of crops and services associated with maize are typically non-tradable (see Clawson, 1985; Hernández, 1985; Martínez et al., 1995; Evangelista, 1998; Faust, 1998;

González, 2001).[15] However, enormous geographical heterogeneity suggests that the particular combination of market failures affecting this sector varies widely.

Table 6. Percentage effects of a 10% decrease in the market price of maize, Zoatecpan, Mexico.

Variable	10% decrease in the price of maize (a) Closed labor market (endogenous wage)	(b) Open labor market (fixed wage)
Production activities[1]		
Maize (aggregate)	-4.89	-14.22
(commercial hhs)	-28.52	-47.65
(subsistence hhs)	4.77	-0.56
Other agriculture	4.45	0.00
Livestock	-0.64	0.64
Non-ag activities	-18.98	-9.49
Commerce	-36.19	-18.45
Labor wage	-9.60	0.00
Rental rate	-14.05	-14.25
Village GDP	-7.26	-3.77
Household income[1]	-1.69	-0.87
(commercial hhs)	-3.97	-3.04
(subsistence hhs)	-1.57	-0.75
Maize household surplus[1]	-57.20	-100.00
Demand[1]		
Homegrown maize	5.30	-0.45
(commercial hhs)	5.37	0.40
(subsistence hhs)	5.29	-0.62
Market maize	4.52	6.72
(commercial hhs)	-4.31	0.94
(subsistence hhs)	4.54	6.73
Animal products	-4.10	-1.85
Non-Ag. goods	-4.57	-2.29
Other food	-10.33	-5.27
Manufactured goods	-9.53	-5.20
Village maize imports	15.50	23.69

1. Village aggregate.

The ability to predict supply response (or lack of response) in less-developed rural economies is limited by the lack of an integrated macro-microeconomic analysis that

[15] Non market benefits of maize include economic, social and ritual services; *e.g.*, food security, income diversification and social standing.

accounts for interactions among heterogeneous rural households. Countrywide models capture aggregate general-equilibrium effects, but (as pointed out by de Janvry *et al*., 1995) they necessarily neglect heterogeneity across rural households revealed in microeconomic analysis. Microeconomic models have their own limitations. In order to predict aggregate responses, it is not sufficient to add up responses estimated from representative micro-household models. One must also account for interactions among heterogeneous households in local markets.

Drawing from Dyer and Taylor (2003), we can use a disaggregated economy-wide model to demonstrate how interactions among surplus and subsistence households in local markets shape the outcomes of a nationwide change in the price of maize and the effectiveness of compensatory policies. Our model allows for heterogeneous household responses to market signals by incorporating household-specific shadow prices for subsistence maize production. A series of individual household-farm models is embedded within a village model. This makes it possible to link micro responses with aggregate outcomes in a manner not possible using conventional computable general equilibrium approaches.

We use the model to explore the implications of changes in the market price of maize (reflecting recent price reforms). Wages, like land rents, are assumed to be locally endogenous. [16] We believe that this assumption is realistic. Although the Mexican rural labor force is relatively mobile, significant variation in the agricultural wage across the country suggests the existence of market imperfections generating local wages or some rigidities in wages at the very least. Nevertheless, we test the sensitivity of our results to the endogenous-wage assumption.

Table 7. Effects of a change in the market price of maize, Zoatecpan, Mexico.

	Original	After Maize Price Change	
Variable		13% Increase	13% Decrease
Gini coef. For real income	0.356	0.362	0.353
Gini coef. For land use	0.562	0.606	0.502
Number of plots per hh[1]	1.64	1.48	1.83
Hh giving-up plots[2]	-	14.58	4.17
Hh taking-up plots[2]	-	2.08	23.00
Households leaving agr. [2]	-	4.17	0.00

1. Average.
2. Percentage.

The experiment simulates the village-wide and household-specific impacts of a 10-percent decrease in maize price for Zoatecpan, a village located in the Sierra Norte de Puebla. [17] The simulation is done under both endogenous and exogenous wage scenarios. In each simulation, the model yields estimated impacts of the simulated changes on every household in the sample. This distinguishes the present model from previous village-wide models and is critical for estimating differential impacts of staple price shocks across households. Table 6

[16] Despite legal restrictions on *ejido* land, rental was already common throughout rural Mexico prior to the recent reform of land tenure laws (Dewalt and Rees, 1994).

[17] A 10-percent decrease is chosen for convenience. Maize prices actually dropped 13% between 1994—the start of NAFTA—and 1999—the year of our survey (INEGI, 2003). Although the international price of maize is expected to drop 9% before maize trade is completely liberalized (FAPRI, 2003); however, it is impossible to predict the drop in the domestic price due to uncertainty in Mexican agricultural policy and politics (see below).

reports village-wide aggregate impacts of the price change. Table 7 reports distributional effects, as measured by Gini coefficients estimated from individual-household outcomes.[18]

The initial impact of the decrease in the market price of maize is felt only by commercial households. The price decrease creates a direct incentive for surplus growers to scale back their maize production. Maize output on commercial farms decreases by more than 28 percent in the endogenous-wage scenario (Column (a)). In the fixed-wage scenario, commercial farm output in this village decreases by 48 percent, as commercial farms actually withdraw from the market.

As commercial production contracts, the demand for land and labor on commercial farms decreases substantially, forcing local rental rates and (in the endogenous-wage scenario) wages downward by 14% and 10%, respectively. Land rents and wages represent costs of production for both commercial and subsistence households. A decrease in these input prices partially compensates commercial households for the lower output price; this is why the negative output shock is smaller (i.e., the elasticity is closer to zero) in Column (a) than in Column (b). When both rental and wage rates are endogenous, all subsistence growers increase their scale of production. Although commercial maize production falls, subsistence maize production increases in the endogenous-wage scenario (by just under 5 percent). When wages are fixed, subsistence production is almost unchanged.

In both scenarios, household incomes fall. The income drop is larger in commercial than in subsistence households, and it is larger in the endogenous wage than in the fixed-wage scenario, due to a negative effect on wage income. With lower maize prices, despite lower incomes the demand for market maize increases and the demand for home-grown maize rises in most cases. Due to the rental of land to subsistence households, consumption of homegrown maize rises by 5.3 percent in Scenario (a). A contraction in commercial output and a higher local demand for maize result in a 57- percent decrease in total household marketed surplus of maize in the endogenouse-wage case and a complete disappearance of marketed surplus in the exogenous wage case. As a result, village maize "imports," or purchases from outside markets, rise by 15 to 24 percent, reflecting a higher village maize deficit.

Lower household incomes decrease the demand for non-maize goods and services. Since the price of village non-tradables falls, the demand for fixed-priced imports decreases the most, leading to a contraction of the formal-commerce sector. Nonetheless, demand for non-tradables also adversely affects local activities that do not use land or male labor, such as non-agricultural activities and, in some households, livestock. As a result, the village's GDP decreases by 4 to 7 percent. Although every household experiences a nominal decrease in income, changes in real income are positive for some households; 3 out of 10 households experience a real-income increase. Households engaged in formal commerce experience the greatest decreases, even greater than those of commercial maize growers.[19] Households whose chief income source is migrant remittances, as well as those dependent on public welfare, experience increases in real income as they consume cheaper local goods but do not lose from the decrease in local wages.

The maize price decrease results in a more egalitarian distribution of land, as land previously used by a few commercial growers is distributed among a large number of subsistence households; the Gini coefficient for land decreases from 0.562 to 0.502. A sensitivity analysis suggests that most of these changes are gradual. As price changes go from 5% to 10% to 13%, household responses intensify with a cumulative effect on village aggregates.

[18] These are not obtainable from previous village or aggregate CGE models.
[19] This is true in absolute terms, but not as a percentage.

It should be noted that the simulations presented above do not take into account other policy changes that were concurrent with the decrease in the market price of maize, e.g., PROGRESA, PROCAMPO, etc. They also ignore technological changes that appear to have accompanied trade liberalization, increasing productivity on commercial farms and buffering commercial farms from the negative effects of lower staple prices.

Nevertheless, the simulation results suggest a local explanation for the unexpected supply response to maize-price liberalization seen across Mexico. In Zoatecpan's largely subsistence economy, the decline in the price of maize induced commercial maize growers to scale back production, reducing their demand for land and labor. Subsistence growers that must buy maize (94% of the population) benefited directly from the price drop but suffered from lower wages and fewer jobs. Although some of these households experienced increases in real income, most experienced declines. As incomes dropped, so did expenditures, which resulted in a contraction of demand for local goods and village imports. On balance, the village became more self-reliant, as households substituted local goods for imports they could no longer afford and homegrown goods for purchased goods. In the end, a lower maize price was deleterious for seven out of ten households in a mostly subsistence community that purchases three quarters of its maize. Thus, the decline in maize price did not trigger a shift away from subsistence maize cultivation—as experts predicted (Levy and van Wijnbergen, 1991)—but rather, stimulated all subsistence activities including maize and other goods and services.

SUMMARY AND FINAL REFLECTIONS

The results of our analyses of the evolution of Mexico's agricultural sector during the last two decades indicate that, instead of structural change, this sector has experienced a process of gradual change characterized by: lower prices for Mexican producers of basic crops; a growth in agricultural trade and trade deficits; and productivity increases in some traded crops produced under irrigated lands. The exceptions are structural changes in rural out-migration to the US and in cultivated area and yields of some agricultural exportables that occurred during the peso devaluation of the mid 1990's.

Increases in agricultural labor productivity and the development of private property rights appear to have experienced a relatively gradual process of change, whereas the problems of rural credit, employment and poverty remain. In addition, it is plausible that a process of "retrogression" has been present in the production of maize by small farmers (i.e., from producing the staple for market to producing it for subsistence).

Despite the macroeconomic stability Mexico has experienced since the last quarter of the 1990's and the steadiness of the process of change in some basic components of agriculture and in the rural economy, the country witnessed political unrest during late 2002 and beginning of 2003, spearheaded by farmers and peasant organizations. The farmer and peasant movement (called *El Campo no Aguanta Más*) ushered in a new political context that could be dated to 2000, with the election of President Fox. The main motivation for this movement was the perception that the state of affairs in the countryside had worsened under policy reforms and NAFTA (see Dyer, G. and D. Dyer: 2003).

In relation to NAFTA and agriculture, the following three events were taken by farmers as the basis for their political actions: 1) the increase in imports of basic foods and maize in particular; 2) the US Farm Security and Rural Investment Act of 2002 (or US Farm Bill); and 3) the deepening of the process of agricultural trade liberalization with the US beginning in January 2003. Negotiations between these organizations and the Fox Administration led to policy changes, crystallized first in what is called the "Agro-food

Armour" (AFA) and later in the National Accord for the Countryside (*Acuerdo Nacional para el Campo*).

The Agro-food Armour was designed to mirror the US Farm Bill; it includes: an income safety net scheme for the producers of basic grains and oilseeds on a multi-year basis; energy subsidies to equalize the costs of electricity and diesel that Mexican farmers pay with the costs paid by their Canadian and US counterparts; and a commitment to increase access to credit at lower interest rates for Mexican farmers. The AFA also meant changes in Mexico Trade Law to create an effective framework to face unfair competition from dumped imports (see Knuston and Ochoa: 2003, Hobbs, J. .E.: 2003 and Rosenzweig, A.: 2003).

The National Accord for the Countryside (NAC) was signed in April, 2003 by the government and farmer and peasant organizations. The NAC expands the coverage of the AFA to the rural economy and includes several principles, ranging from acknowledgment that rural sustainable development is a fundamental component of national development, to food self-sufficiency, food security and the implementation of differentiated support policies by type of rural producer. [20]

For our purposes, of particular interest in the NAC is its treatment of maize. There is a controversy as to whether or not imports of the grain from the US have competed with Mexican maize production under NAFTA.[21] The disagreements stem from the fact that most maize imports are of the yellow variety, whereas most of the production in Mexico is of white maize. Farmers and some authors argue that the two types of maize are substitutes for processing (Puyana and Romero: 2004), whereas the Mexican government and other analysts argue that they are not (Zahniser and Coyle: 2004).

Settling this question is fundamental since, if the second interpretation is valid, imported yellow maize does not pose serious competition for Mexican farmers, and hence the government decision to allow maize over-quota imports without charging the established tariff under NAFTA could be justified on the grounds that these over-quota imports promote Mexico's agro-industry and livestock production without harming maize producers. However, if this is the case, the following question emerges: why did the Salinas Administration negotiate a transitional tariff rate quota regime for maize with the US?

Keeping in mind the question about uses of national and imported maize, the NAC could provoke other uncertainties, since its goal of attaining food self-sufficiency does not consider the implications on trade policy of the prospect that both maize and livestock demand in Mexico will increase with income growth.

It is likely that the commitments of the Fox Administration under the NAC will, at most, be put into practice only partially. However, as Aceves (2003) argues, the relevance of the accord is that it reflects a serious effort to reconsider some former public policies towards the rural sector of Mexico. The problem is that policy changes require rigorous diagnoses of the present situation and of the effects of liberalization on the rural economy, a requirement that has not yet been satisfied.

[20] In practice, the ANC meant 1,580 million of pesos of fresh resources, over and above the 116,100 millions of the budget approved by Congress for 2003; additional 100 pesos per hectares of PROCAMPO to producers with less than five hectares; and the expansions of several programs benefiting the poorest sections of the rural society (Aceves: 2003 and Dyer and Dyer: 2003)

[21] Amongst other reasons, the debate is rooted in the lack of detailed studies on the characteristics and evolution of maize demand in Mexico.

REFERENCES

Aceves Davila, R.: 2003, "Tres años de gobierno de Vicente Fox: Una evaluación de las políticas públicas y el Acuerdo Nacional para el Campo", paper presented at the Seminar, "Los primeros tres años del gobierno de Vicente Fox: Una evaluación", El Colegio de Mexico and Konrad Adenauer Foundation, Mexico, 4th and 5th, December.

Appendini K. : 2001. "The Challenges of Rural Mexico in an Open Economy", in Tulchin, Joseph S. and Andrew Selee (ed) *Mexico at the Millenium*. Wooddrow Wilson Center.

Audley, J. *et al.*: 2003, *La promesa y la realidad del TLCAN: Lecciones de México para el Hemisferio*, Carniege Endowment for Internacional Peace.

Bolding Ch., J. Calderon J. and Ch. Handy: 1999, "U.S. invests in Mexico's processed food industry", Food Review, ERS, Vol. 22 Issue 2.

Caballero, Jose Maria: 2004, "Mexico Rural Poverty Study", *Concept Note, World Bank*, March.

Casco, A. and A. Rosensweig: 2000, *La política sectorial agropecuaria en México: Balance de una década*, Instituto Interamericano de Cooperación para la Agricultura (IICA), Mexico, D.F.

Dyer, G. and D. Dyer: 2003, "Policy, politics and projections in Mexican agriculture", Comment presented at the *9th Policy Disputes Information Consortium Workshop*, Montreal, April.

Dyer, G. and J. E. Taylor: 2003, "Rethinking the Supply Response to Market Reforms in Agriculture: Household Heterogeneity in Village General Equilibrium Analysis from Mexico" *Working Paper*, Department of Agricultural and Resource Economics, University of California, Davis.

ERS: 1999, "ERS NAFTA Report", WRS-99-1, in www.econ.ag.gov, August.

ERS: 2000, "ERS Commodity report (NAFTA)", en www.econ.ag.gov , March.

FAO and SAGARPA (2000), *Evaluación de la Alianza Para el Campo: Informe Global*, http://www.rlc.fao.org/prior/desrural/document/alianza.htm.

Garcia, Salazar, J. A.: 2001, "Efecto de PROCAMPO sobre la Producción y Saldo de Comercio Exterior de Maíz, *Agrociencia*. 35(6):671-683.

Hobbs, J. E.: 2003 "Traceability and Country of Origin Labeling", Paper presented at the 9*th Policy Disputes Information Consortium Workshop*, Montreal, April.

de Ita, A.: 2003, "Los impactos socioeconómicos y ambientales de la liberación comercial de los granos básicos en el contexto del TLCAN: El caso de Sinaloa", Paper presented at the *Second North American Symposium on Assessing the Environmental Effects of Trade*, Mexico City, March.

De Janvry, A., M. Fafchamps, and E. Sadoulet: 1991, "Peasant household behavior with missing markets: some paradoxes explained", *The Economic Journal*, 101:1400-1417.

Knuston, R. and R. Ochoa: 2003, "Convergence, Harmonization and Compatibility under NAFTA: a 2003 Status Report", Paper presented at the *9th Policy Disputes Information Consortium Workshop*, Montreal, April.

Levy, S. and S. van Wijnbergen: 1991. "Mexican agriculture in the free trade agreement: Transition Problems in Economic Reform", OECD Development Centre, Technical Papers No. 63, 1992.

Leycegi, B. and M. Ruiz Cornejo: 2002, "Treading Remedies to Remedy Trade", paper presented a the Eight Agricultural and Food Policy Information Workshop: *Keeping the borders open*, Puerto Vallarta, revised version.

Ministry of Agrarian Reform: 2003, *Colección de Cuadernillos de Información Agraria Básica*, Mexico.

Perry, G., D. Lederman, L. Serven and W. Maloney: 2003, "Lessons from NAFTA for Latin America and the Caribbean" http://lnweb18.worldbank.org/external/lac/lac.nsf/, Chapter 3.

PNUD: 2003, *Informe sobre desarrollo humano. México 2002*, Mundi Prensa Mexico, SA de CV.

Puyana, A. and J. Romero: 2004, *Evaluación integral de los impactos e instrumentación del Capítulo agropecuario del TLCAN"*, Módulo: "Antecedentes y desempeño del sector agropecuario a partir del TLCAN"**,** mimeo, Feb. 25th.

Rosenzweig, A.: 2003, "Changes in Mexican Agricultural Policies: 2001-2003", Paper presented at the *9th Policy Disputes Information Consortium Workshop*, Montreal, April.

Saldivar Tanaka L.: 2004, "A reforma agrária mexicana: do ejido à privatização", in Dias Martins (editor), *Ofensiva e resistência na América Latina, África e Ásia, Boitempo*, Brasil (in press).

Schwentesius, R., M. A. Gómez Cruz, J. L. Calva Téllez and L. Hernández Navarro: 2003 (Coordinadores), *¿El Campo no Aguanta Más?* Universidad Autónoma de Chapingo.

Taylor, J. E. and G. Dyer: 2003, "NAFTA, Trade and Migration", unpublished paper prepared for the *Migration Policy Institute Project*, The Carniege Endowment for International Peace, NAFTA@10, July.

Taylor, J. E., A. Yunez-Naude, and Steve Hampton: 1999, "Agricultural Policy Reforms and Village Economies: A Computable General Equilibrium Analysis from Mexico", *Journal of Policy Modeling*, 21(4):453-480.

Yunez-Naude, A.: 2003, "The Dismantling of CONASUPO, a Mexican State Trader in Agriculture", *The World Economy*, Vol. 26, No. 1, pp. 97-122.

Yunez Naude, A. and F. Barceinas Paredes: 2002, "Lessons from NAFTA: The Case of Mexico's Agricultural Sector", *Report to the World Bank*, http://lnweb18.worldbank.org/external/lac/lac.nsf/

Yunez Naude, A. and F. Barceinas Paredes: 2003, "The agriculture of Mexico after ten years of NAFTA implementation", elaborated for the preparation of the Report: *NAFTA'S Promise and Reality: Lessons for the Hemisphere*, Carniegie Endowment for International Peace, July.

Yunez Naude, A. and F. Barceinas Paredes (2004), "El TLCAN y la agricultura mexicana", in Sobarzo, H. and E. Casares (compiladores), Diez años del TLCAN en México, Lecturas No 95, El Trimestre Economico, Fondo de Cultura Economica, Mexico, pp. 61-98.

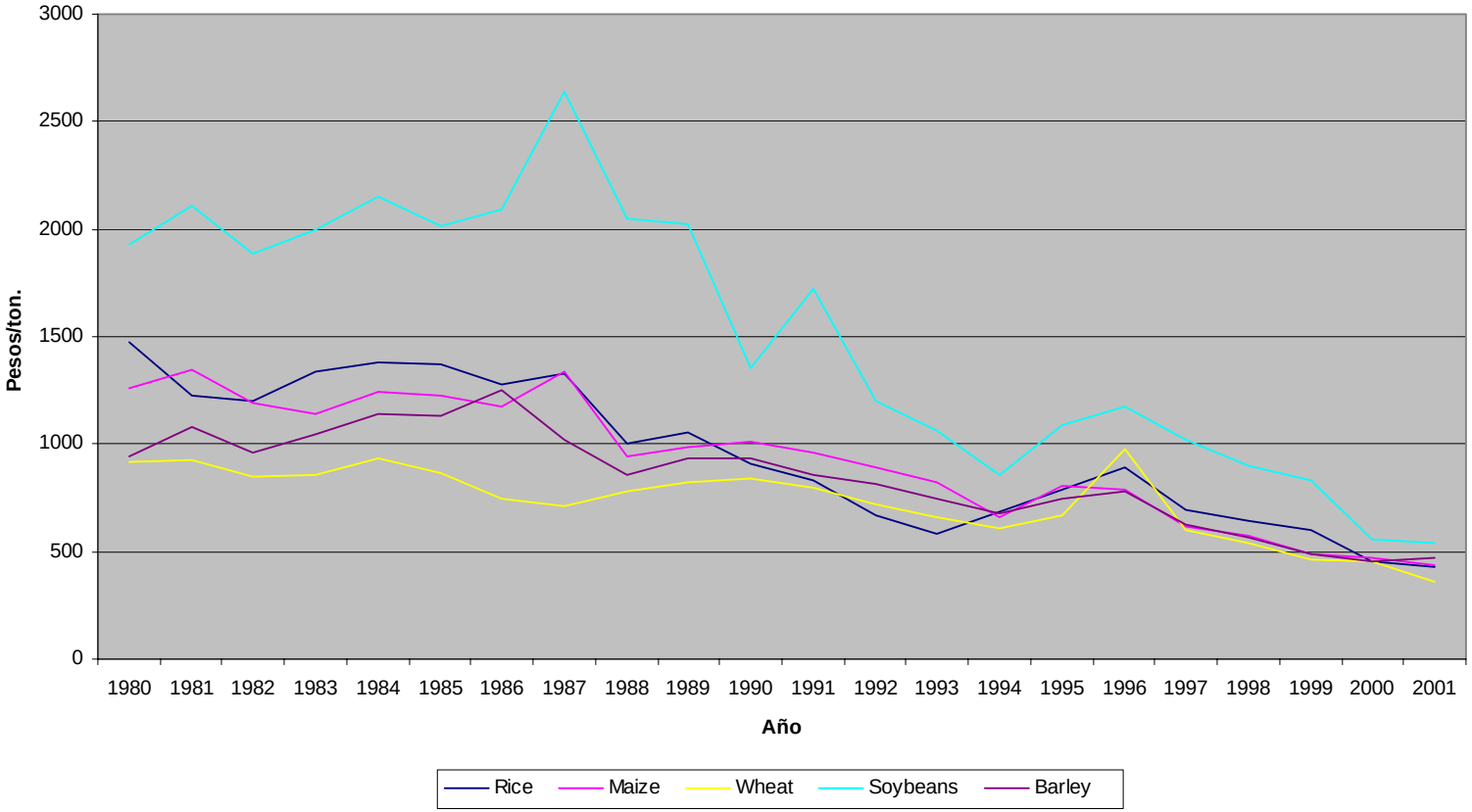
Zahniser, S. and W. Coyle (2004), "US-Mexico Corn Trade During the NAFTA Era: New Twists to an Old Story", http://www.ers.usda.gov/.

Table 1. Agricultural Policy Reforms: 1985-2003

POLICY	DESCRIPTION	YEARS
Mexico joins GATT	By 1990/1, most licenses to import agricultural products were abolished. In 1991-1994 most agricultural commodities were subject to tariffs fluctuating between 0% and 20%.	1986/94
Institutional reforms and the government's new role	Privatization of State companies: seed and production of fertilizer, grain storage and marketing of coffee, sugar and tobacco ASERCA (1991) was created to give marketing support and services to producers	From 1988/99
Reform of the Agrarian Law	Land redistribution ends. Recognizes the individual rights of each ejido.	1992
North American Free Trade Agreement (NAFTA) two separate agricultural agreements: Mexico-Canada and Mexico-US	Defines which are the obligatory conditions for market access and for export subsidies. Each country has the right to choose its own internal subsidies, phytosanitary measures, rules of origin and regulations for packing and tagging products. Consistency with the World Trade Organization and with the Uruguay Round. Import and export licenses are abolished and substituted by tarification. In Jan. 2008 all tariffs will be eliminated by NAFTA members.	1994
PROCAMPO (Program of Direct Support for the Countryside), part of ASERCA (see below)	Direct payments to the producers of basic crops that compensate producers for the loss of input subsidies, price supports and import protection. Grants annual direct payments per hectare to those producers who continue to produce, based on historical acreage for nine crops.	Winter 1993-1994
Elimination of producer price supports, abolition of CONASUPO	In 1991 guaranteed prices for wheat, sorghum, soy beans, rice, barley, safflower, sesame seed and sunflower were eliminated, and in 1999 support prices for beans and maize producers were abolished.	1991-1999
Creation of the Ministry for Social Development	PROGRESA: monetary transfers to poor rural female household heads for nutrition, school and health services (from 2001 the program is extended and called OPORTUNIDADES	1991
Alliance for the Countryside (Alianza para el Campo)	A set of programs designed to support farmers with productive potential in an open economy. Federalized. Each state is responsible for the application of Alliance's programs. Farmers in the programs have to contribute to its financing.	1995
Agri-food Armour	To protect Mexican farmers from impacts of US Farm Bill of 2002	2002
Privatization of rural credit	Reduction of official credit and credit subsidies. Creation of Financiera Rural and abolishion of BARURAL	1990-2003
National Accord for the Countryside	An agreement between the Fox Administration and farmer and peasant organizations to define policies for rural development	2003

Source: Yunez-Naude and Barceinas: 2004 (in press)

Figure 1. Mexico. Average Producers Prices of Selected Basic Crops (1994=100)



Sources: Mexico Ministry of Agriculture data base (SIACON) deflated by the National Consumer Price Index from Bank of Mexico

Table 2. Major Exported Vegetables. Volume of Production, Cultivated Area and Yields (simple averages)

Period	Commodity	Production (Mt. Tons)	Cultivated Area (Hectares)	Yields (Tons/Crop-ped Ha.)	Commodity	Production (Mt. Tons)	Cultivated Area (Hectares)	Yields (Tons/Crop-ped Ha.)
1983-90	**Cauliflower**	40,007	2,763	14.3	**Garlic**	52,813	6,943	7.7
1991-94		52,835	3,717	14.6		54,168	7,399	7.4
1995-96		43,048	2,920	15.3		54,509	7,120	7.7
1997-00		58,068	3,539	16.8		64,079	8,580	7.6
2001-03		57,670	3,047	19.4		47,019	5,619	8.4
1983-90	**Brocolli**	79,909	7,755	10.7	**Onions**	593,361	37,011	16.9
1991-94		149,755	14,552	10.4		703,540	38,513	18.7
1995-96		143,524	13,476	10.7		682,326	34,356	20.1
1997-00		215,883	18,470	12.1		957,957	43,719	22.6
2001-03		236,983	19,019	12.7		1,106,462	45,709	25.3
1983-90	**Carrots**	157,398	6,820	23.6	**Tomatoes**	1,759,108	76,287	24.56
1991-94		227,360	9,098	25.8		1,583,647	80,282	21.34
1995-96		209,544	8,988	23.4		1,941,775	74,159	27.09
1997-00		341,724	14,936	23.4		1,940,435	71,955	27.89
2001-03		355,655	14,596	25.1		1,963,828	68,579	29.74
1983-90	**Cucumbers**	251,236	15,637	17.0	***Totals***	*2,933,829*	*153,216*	*19.1*
1991-94		258,556	15,436	17.7		*3,029,861*	*168,997*	*17.9*
1995-96		322,034	15,910	20.6		*3,396,760*	*156,928*	*21.6*
1997-00		428,194	18,088	24.1		*4,006,340*	*179,288*	*22.3*
2001-03		441,938	17,741	25.4		*4,209,555*	*174,311*	*24.1*

Sources: Mexico Ministry of Agriculture Data Bases (SIACON) and "Anuario estadístico de la producción agrícola 1999-2000" (preliminary data for 2003).

Table 3. Major Exported Fruits. Volume of Production, Cultivated Area and Yields (simple averages)

Period	Commodity	Production (Mt. Tons)	Cultivated Area (Hectares)	Yields (Tons/Crop-per Ha.)	Commodity	Production (Mt. Tons)	Cultivated Area (Hectares)	Yields (Tons/Crop-per Ha.)
1983-90	**Avocados**	552,952	83,699	8.4	**Oranges**	2,014,141	211,316	12.6
1991-94		753,538	92,464	8.8		2,753,953	281,757	12.3
1995-96		813,942	92,199	9.1		3,778,075	335,409	12.9
1997-00		856,370	93,705	9.5		3,651,931	328,361	11.7
2001-03		934,400	97,064	9.8		4,053,263	342,578	12.2
1983-90	**Lemons**	762,074	80,973	10.7	**Papaws**	510,149	22,335	28.3
1991-94		758,177	88,784	9.6		394,615	19,157	24.7
1995-96		1,021,073	102,038	11.1		489,909	21,007	31.6
1997-00		1,313,145	119,366	12.1		602,825	20,979	32.7
2001-03		1,719,266	137,035	13.1		817,312	21,353	40.5
1983-90	**Mangoes**	1,023,273	114,866	10.6	**Strawberries**	70,557	4,600	16.7
1991-94		1,115,717	139,492	9.2		80,233	6,086	16.6
1995-96		1,266,043	151,364	9.3		95,055	4,635	20.5
1997-00		1,510,776	159,736	9.9		91,840	4,160	22.6
2001-03		1,565,827	170,418	9.5		113,901	4,318	26.9
1983-90	**Guabas**	150,257	14,915	12.4	**Watermelons**	441,759	39,381	13.0
1991-94		190,540	15,764	13.1		426,815	37,953	13.1
1995-96		205,963	17,237	12.3		509,271	35,172	16.3
1997-00		198,101	20,614	11.7		842,324	42,858	21.2
2001-03		285,368	22,093	13.2		923,732	44,050	22.2
1983-90	**Cantaloupes**	394,566	36,546	12.5	***Totals***	*5,919,728*	*608,631*	*9.7*
1991-94		495,472	42,996	12.9		*6,969,059*	*724,453*	*9.6*
1995-96		448,011	30,152	16.0		*8,627,342*	*789,212*	*10.9*
1997-00		598,010	30,277	20.6		*9,665,322*	*820,057*	*11.8*

2001-03		512,701	23,236	22.7		*10,925,770*	*862,145*	*12.7*

Sources: Mexico Ministry of Agriculture Data Bases (SIACON) and "Anuario estadístico de la producción agrícola 1999-2000" (preliminary data for 2003)

Table 4. Major Basic Crops: Volume of Production, Cultivated Area and Yields (simple averages)

Product	Period	Production (Thousand of Mt. Tons)			Cultivated Area (Thousand of hectares)			Yields (Tons/Cultivated Ha.)		
		a. Total	b. Irrigated	c. Rainfed	a. Total	b. Irrigated	c. Rainfed	a. Total	b. Irrigated	c. Rainfed
Barley	1983-90	690	317	373	325	64	260	2.1	4.9	1.4
	1991-94	651	305	346	282	59	223	2.3	5.1	1.5
	1995-96	713	281	433	318	48	270	2.2	5.8	1.6
	1997-00	699	229	470	342	41	301	2.0	5.6	1.6
	2001-03	973	383	529	372	63	301	2.6	6.1	1.8
Beans	1983-90	998	270	728	2,164	227	1,937	0.5	1.2	0.4
	1991-94	1,187	399	788	2,149	302	1,847	0.6	1.3	0.4
	1995-96	1,310	399	911	2,275	277	1,998	0.6	1.4	0.5
	1997-00	1,043	407	637	2,306	302	2,003	0.5	1.3	0.3
	2001-03*	1,341	403	903	2,073	258	1,832	0.6	1.6	0.5
Maize	1983-90	12,472	2,932	9,540	8,076	994	7,082	1.5	2.9	1.3
	1991-94	16,885	6,488	10,397	8,294	1,553	6,741	2.0	4.2	1.5
	1995-96	18,189	5,997	12,192	8,859	1,343	7,516	2.1	4.5	1.6
	1997-00	17,844	5,957	11,886	8,649	1,175	7,474	2.1	5.1	1.6
	2001-03*	19,846	6,661	13,055	8,285	1,121	7,213	2.4	5.9	1.8
Sorghum	1983-90	6,890	3,607	3,283	2,009	618	1,391	3.4	5.8	2.4
	1991-94	5,612	2,895	2,717	1,423	395	1,028	3.9	7.3	2.6
	1995-96	7,419	3,548	3,871	2,059	468	1,591	3.6	7.6	2.4
	1997-00	9,292	4,455	4,837	2,320	479	1,841	4.0	9.3	2.6
	2001-03*	10,052	4,304	5,215	2,329	459	1,877	4.3	9.4	2.8
Soybeans	1983-90	704	605	99	401	317	84	1.8	1.9	1.2
	1991-94	585	504	81	304	250	54	1.9	2.0	1.5

	1995-96	123	70	53	103	50	53	1.2	1.4	1.0
	1997-00	142	62	80	108	38	70	1.3	1.7	1.1
	2001-03*	111	37	67	69	21	47	1.6	1.8	1.4
Wheat	1983-90	4,292	4,036	256	1,087	887	200	4.0	4.6	1.3
	1991-94	3,854	3,474	379	970	730	240	4.0	4.8	1.6
	1995-96	3,422	2,966	455	911	611	300	3.8	4.9	1.5
	1997-00	3,351	3,072	279	765	565	200	4.4	5.4	1.4
	2001-03*	3,151	3,012	244	664	531	146	4.7	5.7	1.7
Totals	1983-90	*26,046*	*11,767*	*14,280*	*14,061*	*3,107*	*10,954*	*1.9*	*3.8*	*1.3*
	1991-94	*28,774*	*14,066*	*14,708*	*13,422*	*3,290*	*10,133*	*2.1*	*4.3*	*1.5*
	1995-96	*31,177*	*13,260*	*17,916*	*14,525*	*2,797*	*11,728*	*2.1*	*4.7*	*1.5*
	1997-00	*32,371*	*14,182*	*18,189*	*14,489*	*2,599*	*11,890*	*2.2*	*5.5*	*1.5*
	2001-03*	*35,474*	*14,799*	*20,013*	*13,793*	*2,453*	*11,416*	*2.6*	*6.0*	*1.8*

* The data for irrigated and rain-fed lands are for the period of 2001-02

Sources: FAO and Mexican Ministry of Agriculture: Data Bases (SAGAR SIACON) and "Anuario estadístico de la producción agrícola 1999-2002"

Table 5. Structural Change in cultivated area and yields of major traded crops: 1980-2002

	Cultivated area			Yields		
	Total	**Under irrigation**	**Rainfed**	**Total**	**Under irrigation**	**Rainfed**
Exportables						
Brocolli	NO	NO	*YES*	*YES*	*YES*	NO
Carrot	NO	NO	NO	NO	NO	NO
Cauliflower	NO	NO	NO	NO	NO	NO
Cucumber	NO	NO	*YES*	NO*	NO*	NO
Garlic	NO	NO	*YES*	NO	NO	NO
Onions	NO	NO	NO	NO*	NO	NO
Tomatoes	*YES*	*YES*	NO	NO	NO	*YES*
Melons	NO	NO	NO	*YES*	*YES*	NO
Watermelon	NO	NO	NO	*YES*	*YES*	NO*
Importables						
Beans	NO	NO*	NO	NO	NO	NO
Barley	NO	NO	NO	NO	*YES*	NO
Maize	NO	NO	NO*	NO	NO	NO
Wheat	NO*	NO	NO	NO	NO	NO
Soybeans	NO	NO	NO	*YES*	*YES*	NO
Sorghum	*YES*	NO	*YES*	NO	NO	NO

*Significant at 10% level
Source: Own estimations

Table 6. Percentage effects of a 10% decrease in the market price of maize, Zoatecpan, Mexico.

Variable	10% decrease in the price of maize (a) Closed labor market (endogenous wage)	(b) Open labor market (fixed wage)
Production activities[1]		
Maize (aggregate)	-4.89	-14.22
(commercial hhs)	-28.52	-47.65
(subsistence hhs)	4.77	-0.56
Other agriculture	4.45	0.00
Livestock	-0.64	0.64
Non-ag activities	-18.98	-9.49
Commerce	-36.19	-18.45
Labor wage	-9.60	0.00
Rental rate	-14.05	-14.25
Village GDP	-7.26	-3.77
Household income[1]	-1.69	-0.87
(commercial hhs)	-3.97	-3.04
(subsistence hhs)	-1.57	-0.75
Maize household surplus[1]	-57.20	-100.00

Demand[1]		
Homegrown maize	5.30	-0.45
(commercial hhs)	5.37	0.40
(subsistence hhs)	5.29	-0.62
Market maize	4.52	6.72
(commercial hhs)	-4.31	0.94
(subsistence hhs)	4.54	6.73
Animal products	-4.10	-1.85
Non-Ag. goods	-4.57	-2.29
Other food	-10.33	-5.27
Manufactured goods	-9.53	-5.20
Village maize imports	15.50	23.69

1. Village aggregate.

Table 7. Effects of a change in the market price of maize, Zoatecpan, Mexico.

Variable	Original	After Maize Price Change	
		13% Increase	13% Decrease
Gini coef. For real income	0.356	0.362	0.353
Gini coef. For land use	0.562	0.606	0.502
Number of plots per hh[1]	1.64	1.48	1.83
Hh giving-up plots[2]	-	14.58	4.17
Hh taking-up plots[2]	-	2.08	23.00
Households leaving agr. [2]	-	4.17	0.00

1. Average.
2. Percentage.