THE EFFECTS OF NAFTA AND DOMESTIC REFORMS IN THE AGRICULTURE OF MEXICO: PREDICTIONS AND FACTS

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Abstract *- We aim to study how economic policy reforms of the last 15 years have affected the agriculture of Mexico, taking into consideration the dual character of Mexican agricultural production. We will describe NAFTA and domestic reforms and then, taking an econometric approach, we will evaluate their predicted outcomes. We further consider policy shocks to rural households engaged in agriculture by applying a disaggregated rural economy-wide model (DREM) to simulated policy changes. Our analysis shows that NAFTA and Mexico's domestic reforms have not had the expected effects. We find that, among Mexico's major new post-reform agricultural policies, most have contributed to isolating large commercial producers of staples from foreign competition. As for rural subsistence households producing maize (the basic staple of the population of Mexico), our DREM demonstrates that lower maize prices could provoke more production of grain. The main conclusion that can be drawn from the Mexican experience is that economic liberalization results neither in market access, specialization and a more efficient use of scarce resources, nor in the development of agriculture.*

Key-words - COMMERCIAL AND SUBSISTENCE FARMERS, RURAL HOUSEHOLDS, STAPLES, POLICY REFORMS, ECONOMETRICS, GENERAL EQUILIBRIUM.

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The North American Free Trade Agreement (NAFTA) was adopted in 1994. More than ten years after NAFTA's implementation, its influence on Mexico's agricultural sector gives us generous information for beginning to evaluate the predictions and concerns NAFTA raised early on and to analyze its impacts as they emerge from village and marketplace studies.

The Mexican government's official position has been to view NAFTA as a pillar of modern Mexico's future economic success. Free trade proponents argued, even before NAFTA's inception, that, instituted along with domestic policies to promote production and further competition, NAFTA would create positive structural change in Mexico's agricultural sector.

Critics have viewed NAFTA as the road to deeper dependence on the United States and a hindrance to overcoming rural poverty. They point to Mexico's historically low production of basic crops (grains and oilseeds) and to the United State's high subsidies to its producers of those same crops and warn that imports will overtake Mexico's own valuable staples. NAFTA, they further argue, will keep the centuries-old subsistence-level existence as the norm for a high percentage of Mexico's rural farm families.

As debates over NAFTA continue to rage (see, for example, Casco and Rosenzweigh, 2000; Schwentesius and Gomez Cruz, 2003; Romero and Puyana, 2004; and Zahniser and Coyle, 2004), it is crucial to obtain an accurate picture of NAFTA's impacts on Mexico's farmers, Mexico's internal policies, and Mexico's strength as a partner in free trade.

In Section 1 of this paper, we describe NAFTA and domestic reforms and then, taking an econometric approach, we evaluate their predicted outcomes. We use findings from our econometric study of trends in prices, trade, migration, and the domestic supply of major agricultural products, before and since NAFTA. In Section 2, we further consider shocks to rural households engaged in agriculture by applying a disaggregated rural economywide model (DREM) to simulate policy changes.

Section 1 is divided into three parts. Part I summarizes agricultural trade liberalization under NAFTA and Mexico's own, simultaneous in many cases, agricultural reforms. Part 2 lists initial predictions for these reforms and, from an econometric perspective, determines whether NAFTA's implementation and domestic reforms have created the structural changes predicted for Mexico's agricultural sector. The sector itself is described as the context within which reforms are realized. Part 3 proposes hypotheses to explain why, contrary to expectations, the production of Mexico's primary staple, maize, has not failed under the pressure of imports encouraged by free trade.

Section 2, Part 1, introduces the disaggregated rural economywide general equilibrium model (DREM) and in Part 2 applies the model to evaluate how specific policy changes have played out and how future policies might affect Mexico's highly diversified rural economy.

We conclude with lessons from the Mexican experience that might translate to other countries facing free-trade issues.

1. EXPECTED EFFECTS OF REFORMS AND TRENDS

1.1. NAFTA and domestic reforms

Because Mexico's own agricultural reforms began before NAFTA and have continued through NAFTA's implementation and beyond, it is necessary to look at how domestic reforms and NAFTA together create change in Mexico's agricultural sector.

Mexico's agricultural sector began to privatize in the 1980s. By 1991 most domestic agricultural and trade policy reform was devoted to further privatization and increased competition. These changes coincided with negotiations for NAFTA, beginning in 1991, and continued well beyond NAFTA's adoption in 1994.

Reforms were aimed at all aspects of food production, from eliminating state enterprises related to agriculture, staple price supports, and subsidies, to trade liberalization. They reflected the government's commitment to helping its agricultural sector succeed in the world of NAFTA (Table 1).

1.1.1. Agricultural policy reforms pre-NAFTA

In 1991, with the reform of Agrarian Law, lands distributed to ejidos, or community rural groups, following the 1910 revolution gained the right to privatize.

CONASUPO (National Company for Popular Subsistence) was the primary agency of government intervention in agriculture. It acted as a state company which bought staples from farmers at guaranteed prices, then either processed these products or sold them at low prices to processors and consumers. In 1991, CONASUPO and its subsidiaries began to dismantle and privatize, and in 1999 the company was abolished (Yunez-Naude, 2003).

ASERCA (Support Services for Agricultural Marketing) was created in 1991 to help commercial farmers of staples face outside competition arising from trade liberalization. ASERCA provides marketing supports to farmers in regions where production of basic crops is higher than demand. The objective of these supports is to allow farmers to sell their products to processors at competitive prices (i.e., at prices which make buyers of basic crops indifferent to

import prices). ASERCA aids large farms, those with the capacity to produce surplus; therefore, most of its sponsorship goes to surplus-producing regions of the irrigated areas of northern states.

Also in 1991, to assist very poor rural households, PROGRESA (developed under the Ministry for Social Development (SEDESOL)) began to provide poor female heads of households' monetary assistance for education and in-kind assistance for nutrition and health services.

1.1.2. During NAFTA's consideration and with its implementation

In 1993, PROCAMPO (Program of Direct Support for the Countryside) was created as part of ASERCA. PROCAMPO gives grants to producers of basic crops to compensate them for the loss of input subsidies, price supports, and import protection formerly provided by CONASUPO. Its grants are distributed as direct payments per hectare to all producers who farmed during the previous years, and continue to farm, any of the nine identified staple crops. Unlike previous policies based on direct price supports to producers of basic crops, PROCAMPO is a program considered decoupled from production.

By 1994, NAFTA had opened the market in North America, lowering the prices of imports and creating greater competition between Mexico and its northern neighbors. The process of phasing out tariff protections began (full trade liberation under NAFTA is planned for 2008).

Several domestic programs were introduced post-NAFTA to support commercial farmers with productive potential.

The Alliance for the Countryside (Alianza) began in 1995 to provide a set of federal programs to help commercial farmers invest in operations and animal and plant health improvements and to promote efficiency, initially focused on the growth of export crops.

After the United States increased subsidies to its own farmers in 2002, Mexico increased support to its farmers. In 2003, the Fox administration responded to farmer demands by signing the National Accord for the Countryside (Acuerdo Nacional Para el Campo). The Accord's purpose is to define policies for rural development. So far, it has increased the benefits provided to farmers by PROCAMPO and given utilities subsidies to producers (see Yunez and Barceinas: 2003).

1.2. Predictions and econometric analysis of outcomes

The economic assumption underlying NAFTA and Mexico's trade liberalization policies was to affect relative prices. This would lead to changes in resource allocation and to increased efficiency as farmers adjusted their use of

resources in order to survive and thrive under free trade. This, in turn, would create a structural transformation reflected in trade and in the composition of production (i.e., from noncompetitive to competitive crops).

Because previous price and trade interventions in the basic crops noncompetitive subsector had resulted in higher prices to farmers, trade liberalization was expected to reduce the costs of imported crops. This would benefit the consumer, while Mexico's producers of staples would face increased competition from Canadian and US exporters, forcing them either to reduce production or to enhance the efficiency gains needed to produce for national markets. NAFTA was also expected to encourage Mexican farmers to substitute staples with exports, such as fruits and vegetables (however, for such already established exports, no major price change was expected, both because of their position as solid exports prior to NAFTA, and, more important, because fruits and vegetables had not been subject to major government intervention before or since NAFTA).

Eventually, NAFTA and internal reforms were expected to lead to the "law of one price", for the agricultural goods produced for internal use and export and for goods imported into Mexico. That is, prices paid to Mexican producers for basic crops such as grains and oilseeds would decline by closely following international or US prices. With free trade, Mexico and the US would see the same prices for goods. This prediction was based on the traditional economic expectation that without intervention, prices for the same goods equalize within and between countries.

An increase in employment related to exports was anticipated, but not one large enough to absorb all the workers who would be displaced by reduced staples production. The expected result: a sharp rise in rural out-migration (see Calva, 1995; Levy and van Wijnbergen, 1992; Robinson et al., 1991).

The above predictions assume macroeconomic stability, which Mexico did not have from 1994 to 1996 (Audley et al., 2003).

Econometric study allows us to evaluate whether or not the predicted structural effects of NAFTA and internal reforms have actually occurred. For purposes of econometric analysis, structural change is measured statistically, based on time-series data, and tells us if a change of model parameters between two periods of time (for, example, pre- and post-reforms) is significant (Yunez and Barceinas, 2003).

Below, we look at four important indicators of structural change: prices for tradables; the conduct, composition, and quantity of trade; domestic production and supply; and changes in local labor opportunities and migration.

1.2.1. Prices

Real prices of basic crops have declined since the beginning of the 1990s (Figure 1). However, the econometric evidence –not presented here– shows a tendency for Mexico's prices of these crops to mirror US prices both before and since NAFTA. In contrast to expectations, we found that NAFTA has not caused domestic prices of maize, barley, sorghum, and wheat to converge with international or US prices at a faster rate than was occurring before NAFTA.

1.2.2. Trade

As anticipated, overall agricultural trade has increased since NAFTA's implementation, for each of the major exported and imported crops, as reflected by the rise in weight of trade in national production (Figure 2). However, our econometric study shows that only Mexico's exports of fruits and vegetables have achieved structural change. That is, exported fruits and vegetables increased in a statistically significant manner during the first years of NAFTA and have remained high up to the present.

Supply/production

Domestic production, cultivated area, and yields of vegetables and fruits for export have grown. For some of them this change has been in a way that clearly indicates structural change, as defined above (table 2). Contrary to expectations, domestic supply of the major staple crops in competition with imports, taken together, has not declined. This trend is best illustrated by the evolution of some staple crops, particularly maize (Table 3 and Figure 3). As expected, yields of basic crops have increased, but only for those crops grown under irrigated conditions (Rosensweig, 2000).

Although the composition of Mexico's agricultural supply has not radically changed, there has been, as predicted, some tendency for some commercial farmers to substitute exportables for staples.

Migration

Rural out-migration, both within Mexico and to the US, grew significantly during the 1990s, which does not contradict initial predictions of NAFTA's effects. However, with no decrease in staple production, emigration is explained by three phenomena: increased agricultural productivity and urban growth in Mexico, and demands for unskilled labor in the United States.

Staple production under reform and the structure of Mexico's agricultural sector

As mentioned above, prices of basic crops such as maize have dropped since NAFTA, and imports of those crops have increased. However, domestic

production of these staples has not decreased. To fully explain this unpredicted phenomenon, we must take into account the coexistence of commercial farmers and rural subsistence households.

Peasant producers generally have limited land (plots under five hectares), often rent their land, and do not have access to irrigation. In addition, such small household farms face obstacles to access markets because of inadequate infrastructure-limited communication and transportation resulting in high transaction costs. Most often, these households survive by, in addition to farming, taking on wage work in the rural and urban sectors of Mexico and receiving remittances from family members employed in the cities of Mexico or in the US.

In contrast, entrepreneurial or commercial farmers in Mexico do business in the same way as farmers in the developed world. Because they are resource-wealthy, they produce for a profit and for the market in a context of no or low transaction costs. This means that commercial farmers react to price changes in their supply of agricultural goods and are in a better position to benefit from government supports. In fact, we maintain that large, commercial farmers of basic crops have most benefited from the new agricultural policies, which isolate them from competition under NAFTA. This position is based on data from surplus-producing states of northern Mexico, where most of the marketing assistance budget has been directed (for example, 89 percent during 2002). This has proved especially true for maize in the state of Sinaloa, sorghum in the state of Tamaulipas, and wheat in the state of Sonora (see De Ita, 2003, for the case of maize in Sinaloa).

Both peasant and entrepreneurial farmers producing basic staples have benefited from PROCAMPO's direct income transfers, which have reduced the negative effects of lower prices for Mexico's basic crops (Garcia Salazar, 2001). Commercial farmers producing basic crops have benefited from ASERCA, and commercial producers of both staples and exports have been aided by the Alliance for the Countryside.

ASERCA's market supports to commercial producers of staples in surplus-producing regions began in 1991, just as NAFTA came under consideration. Its marketing supports extended beyond wheat and sorghum to the coverage of maize in 1995, the year after NAFTA went into full effect.

1.3. The case of maize

Because of maize's particular importance to Mexico-white corn for human consumption and yellow corn primarily for animal feed-commercial producers of that grain have received price supports, first from 1994 to 1995 through

CONASUPO and then through ASERCA. During 2002, 46.4 percent of ASERCA's budget was used to support maize (Rosenweig, 2003).

We must look not only at the PROCAMPO and ASERCA supports, but at those subsidies granted to commercial farmers by Alliance for the Countryside to understand why an agricultural staple like maize has remained strong under free trade and why the structure of commercial farmers' supply has not transformed under NAFTA, that is, why very few commercial farmers have substituted exportables for basic crop production.

One of the original purposes of Alliance was to help commercial farmers substitute fruits and vegetables for staples. However, this was interrupted by the macroeconomic crisis of 1994 to 1996, which caused the collapse of rural credit markets. Alliance supports, helped commercial farmers meet credit requirements, allowing many to continue producing staples rather than switching to export production (FAO-SAGAR, 2000).

The evolution of demand offers another explanation as to why maize production has not sharply declined. Consumption of maize in Mexico increased from an average of 16.58 millions metric tons during the period of 1990 to 1993, to 22.15 million from 1994 to 2000. This rise is based on increased demand from animal feed processors and other agro-industry (Garcia Salazar, 2001; Anton et al., 2004). In addition, white maize, the preferred grain for consumption, is supplied primarily by producers within Mexico.

Another factor in the resilience of maize farming may be related to the differences in resources available to larger commercial operations and small farms. No nationwide time-series data exists to distinguish peasant from commercial producers of maize. However, we can deduce such information based on official historical data on the production of staples under irrigated lands (lands owned mostly by entrepreneurial farmers) and land that relies on rainfall (owned or rented by small farmers). Table 3 and Figure 3 show that maize production on rain-fed land has grown slightly during NAFTA while yields have remained practically the same.

This contrasts markedly from the increase in yields and decrease in cultivated area under irrigation and implies that the impact of agricultural reforms depends on the type of farmer. For example, entrepreneurial farmers have responded to trade liberalization policies by increasing productivity (maize yields) on irrigated land. Subsistence farmers, for reasons detailed in the next section, have continued to produce and even increase their maize production despite lower prices for the crop and access to fewer government supports.

2. DISAGGREGATED ANALYSIS OF POLICY IMPACTS IN RURAL MEXICO: A MICRO-ECONOMYWIDE APPROACH (DREM)

2.1. The model

To more thoroughly understand and predictthe impact of policy shocks on small farmers and the agricultural sector, we need a complex model that incurporates direct as well as indirect effects of exogenous policy changes.

Microeconomic studies focus on the behavior of rural households directly affected by policy shocks, but miss the interactions between households. Aggregate computable general equilibrium (CGE) models capture the interactions between sectors but not between and among households.

Because rural farm households tend to have highly diversified income activities, and because the interactions between these households and the market influences on them (whether an individual household directly participates in that market or not), we must be able to consider all of these factors to measure a policy's impact.

We have developed a disaggregated rural economywide model (DREM) that uses the strengths of both micro, agricultural household models and computable general equilibrium models. It allows us to study the impacts of policy reforms at the highly disaggregated level of small, rural farms as well as at the level of the rural economy in general (Taylor, Dyer and Yunez-Naude, 2005).

The analysis explicitly takes into account the heterogeneous nature of subsistence and small commercial producers in rural Mexico and the household and market linkages that transmit impacts from directly affected households to other households, thereby indirectly affecting those rural households, perhaps in a very different way but as a result of the same policy.

Signing as well as quantifying the total impacts of policy shocks, with so many interacting agricultural households each with its own technologies, market access, and consumption demands, cannot be done analytically. This requires a programming approach, such as the DREM.

Our DREM first reproduces the original data contained in social accounting matrices (SAMS) for each household group in the central and northwest regions of Mexico. The equilibrium structure of the models ensures that, once the models adjust to a policy or market shock, the new solution will in turn produce consistent sets of SAMS for all regions and households.

Our model uses data from Mexico's National Rural Household Survey (Encuesta Nacional a Hogares Rurales de Mexico, or ENHRUM) of the five regions that the Mexican Institute of Statistics, Geography, and Information

defines as rural [the survey was conducted by PRECESAM (http:///www.precesam.colmex.mx) during 2003 and the survey data is for 2002]. Because ENHRUM data are regionally representative, each regional model is representative of a typical or average village economy within the region.

One premise of our research is that even subsistence producers are likely to adjust their supply to changes in the market prices of agricultural goods. Subsistence households seemingly are not affected by the markets in which they do not participate. However, changes in the market prices affect subsistence households through other markets with which they interact (labor, land, etc). For example, a change in the market price of maize for commercial farms may affect the production of grain in subsistence households.

To identify the diversity of income sources for typical rural households, we distinguish five activities: maize, cash crop production, livestock, nonagricultural production (crafts, production of tortillas from maize, commerce, etc.), and migration of household members to the rest of Mexico and to the US We include two factors of production, labor and land, and incorporate household heterogeneity by distinguishing four household types: landless (some renting land for agricultural production), those with fewer than two hectares of land, those possessing between two and five hectares, and those with more than five hectares.

Households are assumed to maximize their utility from consumption goods, both home-produced and purchased, subject to cash income, technologies, time, access to migration, and self-sufficiency constraints (these set consumption equal to production for subsistence maize households). The solution yields a set of demands for labor and land inputs for each activity, including migration and consumption demands. For subsistence maize households, maize production and demand are guided by an internal shadow price that follows from the subsistence constraints. In contrast, commercial maize households base their maize production decisions on (exogenous) market maize prices (Singh, Squire and Strauss, 1986; De Janvry, Fafchamps and Sadulet, 1991).

We explicitly model interactions among households and add a third type of price, village prices exogenous to individual households but determined by the interaction of supply and demand in village markets. Endogenous village prices result when transaction costs are high outside but not within the village. In our model there are two such prices, land rents and wages.

These prices indicate significant activity in local labor and land rental markets. The high variation in the agricultural wage across the countryside suggests the existence of market imperfections generating local wages or at least wage rigidities. The ENHRUM revealed that daily agricultural worker wages in Mexico ranged from 50 to 140 pesos in summer 2002.

Endogenous local prices are incorporated into the model through general equilibrium constraints for village nontradables. These constraints equate the local supply and demand for land and hired labor. A nonbinding village market constraint would imply trade between the village and the outside world at a price exogenous to the village.

General-equilibrium closure equations at the household and village levels determine the net marketed surplus of tradable commodities as the difference between supply and demand. Prices for villages tradables are exogenous, village marketed surplus is endogenous, determined by markets outside the village or by policy. Prices of village nontradables are endogenous. If village markets exist, these prices satisfy local market-clearing conditions (village marketed surplus is zero), and participating individual households are price takers within the village (household marketed surplus is endogenous). For households that do not participate in village or outside markets, prices are unobserved household shadow prices (household-marketed surplus is zero).

The solutions yield, for each household group in each region, a set of core equations for outputs, input demands, migration, consumption demands, and either prices (for household nontradables) or marketed surplus (for household tradables). In the case of produced goods, marketed surplus is output minus household consumption. In the case of labor, it is the household's labor demand minus its labor supply, or net wage-labor supply. All of these variables are functions of the household characteristics used to construct the four household groups, as well as exogenous market and policy variables (prices of tradables, the peso-US dollar exchange rate and government transfers).

Our focus on the central region and the northwest of Mexico allows us to compare how policy affects very different rural systems. The central region has many smallholder and subsistence producers, while the northwest is characterized by households that produce maize for the marketplace.

Below, we discuss the results of four market shocks as they affect each region. We simulate a ten percent decrease in the market price of maize; a ten percent devaluation of the Mexican peso against the US dollar; a counterfactual removal of PROCAMPO transfers; and the counterfactual phaseout of PROGRESA.

2.2. Simulations

2.2.1. Reduction in the price of maize

The first experiment explores the impact of Mexico's phaseout of maize price supports. How lower maize prices affect rural households depends on those households' involvement in markets for maize. Table 4 shows Central Mexico, where most households do not produce a marketed surplus of maize. Table 5 is

for the northwest, where maize is dominated by commercial producers who farm irrigated lands.

In both regions, commercial production of maize contracts in response to this crop's decreased market price. Impacts are greatest in the northern regions, where maize is primarily a commercial crop. This is significant because the contraction in commercial maize output decreases demands for land and for labor. So far, this looks like the familiar NAFTA scenario found in earlier studies using aggregate general-equilibrium models. Those studies, which did not explicitly model rural diversification and the subsistence sector, predicted a sharp decrease in maize production and an increase in migration (Levy and van Wijinbergen, 1992; Robinson et al., 1991). The disaggregated model captures critical circumstances, not obtainable by earlier methods that are instrumental in understanding how policy impacts actually play out.

As commercial production falls, so do land rents and wages. Lower wages reduce subsistence households' incomes. This fact suggests that subsistence household demand for consumption goods, including maize, would fall, and with it, the shadow price or subjective valuation, of maize. This would reduce both subsistence and commercial production. However, as our disaggregated model reveals, because land and labor are inputs, lower rents and wages actually stimulate subsistence production. The result appears paradoxical –a positive subsistence supply response to lower market prices of maize. Especially in central Mexico, subsistence production of maize increases and so does production of the agricultural goods that benefit from cheaper inputs, particularly livestock.

Our results are consistent with the increase in maize production on rainfed (subsistence) lands that was actually observed in Mexico between 1994 and 2002 (Figure 3), when the market price of maize fell. Lower maize prices do have a negative effect on incomes of both commercial and subsistence producers. However, our study shows that for subsistence households, the income effects are small. This reflects the highly diversified character of Mexico's rural household economies, in which maize production constitutes only a small share of household incomes.

Reduced maize prices did increase internal and international migration from both rural regions, especially from the more commercial northwest. However, the migration response to maize is much smaller than earlier studies predicted, fewer than two percent from the northwest.

2.2.2. Ten percent peso devaluation

We carried out an experiment of a ten percent increase in returns from international migration, as might result from either employment or wage increases in the US or from a ten percent devaluation of the Mexican peso relative to the US dollar.

Our analysis shows that migration and agricultural production are sensitive to currency devaluations. Peso devaluations admittedly have multiple effects not represented in the model; but they do increase the value of dollars sent home to Mexico as remittances from migrant workers. Changes in economic returns from migration influence rural economies directly, through these remittances, and indirectly, through competition with local labor and expenditures by households with migrants.

Peso devaluations stimulate migration out of rural Mexico, driving up the cost of agricultural labor and negatively affecting local commercial production, with cash crop and commercial maize production both contracting (see Tables 6 and 7). However, the devaluation positively affects income in households that receive remittances. Expenditures by these households create positive demand linkages with others in the rural economy. Thus, there are winners (households that receive remittances or sell goods and services to remittance-receiving households) and losers (cash-crop producers who compete with migration for their labor needs).

Although migration puts pressure on local wages, remittance income stimulates consumption demands, driving up the shadow price of maize and thereby encouraging subsistence households to increase their maize production in an environment of peso devaluation. This finding is beyond the reach of earlier models but is consistent with the expanded maize production observed on rain-fed lands during the high-migration years from 1995 to 2002.

2.2.3. Elimination of PROCAMPO income transfers

The PROCAMPO program replaces price supports with direct payments to staple crop producers. PROCAMPO payments are income transfers (decoupled from production), but they are linked to land area cultivated in basic crops. PROCAMPO is scheduled to end by 2008, when full trade liberalization under NAFTA begins.

The exercise is a counterfactual simulation in which PROCAMPO is terminated. Tables 8 and 9 show the likely consequences.

Termination of PROCAMPO subsidies would have a negative impact on incomes, ranging from a one percent to a four percent loss for most household groups. In the northwest (Table 9), removal of PROCAMPO would have almost no impact on production. However, in the subsistence economies of central Mexico, maize production would fall because of lower incomes (Table 8). This simulation provides evidence that PROCAMPO payments may have provided some stimulus to maize production on subsistence farms.

2.2.4. Elimination of PROGRESA

While PROCAMPO payments are linked to area cultivated in basic crops, PROGRESA is a needs-based transfer program. We find the rural economywide impacts of PROGRESA's elimination and confirm its progressive effects on rural incomes by performing a counterfactual experiment that asks what Mexico's rural economy might look like without PROGRESA payments (Table 10 for central Mexico and Table 11 for the northwest).

Without PROGRESA payments, incomes in landless households would be more than seven percent lower, and incomes in smallholder households would fall by over four percent. Termination of PROGRESA would have little or no effect on commercial maize production in either region. However, subsistence production in central Mexico would fall by between 1.3 and 2.1 percent. PROGRESA payments stimulate subsistence production by raising incomes and thus increasing maize demand in poor smallholder households. Both wages and land rents would decrease without PROGRESA, although by a very small percentage. PROGRESA does not appear to affect migration in any appreciable way in either region.

3. CONCLUDING REMARKS

To evaluate how policy changes such as trade liberalization affect the agriculture of a less developed country (LDC) like Mexico, we must understand the country's farming structure. Previous empirical research on the impact of policy shocks either assumed that small agricultural producers would be affected by liberalization policies in the same way as commercial farmers, or that they would not be affected at all because of their isolation from the markets.

We have studied the effects of policy changes in LDC rural economies by using a disaggregated rural economywide modeling approach, or DREM. This approach is highly appropriate because it considers the basic features of rural economic life in LDCs: the coexistence of subsistence and commercial farming; that subsistence households are not necessarily isolated from all markets; and that rural households diversify their economic activities and income sources.

Our analysis shows that many predictions for NAFTA and Mexico's domestic reforms have not occurred. For the most part, Mexico's agricultural sector has not transformed under reforms but has evolved, with lower prices for basic crops, growth in agricultural trade, increased agricultural productivity in crops grown on irrigated land, and convergence of prices continuing at a pace similar to that prior to NAFTA. Structural change has occurred to some degree in rural out-migration and in an increase in exported fruits and vegetables.

Contrary to predictions, internal supply of staples, from all farming, has held fast under reform.

To understand this phenomenon we must consider the dual character of Mexico's agricultural production, or the coexistence of commercial farmers alongside subsistence farmers. From this perspective, we can also take into account divergences in the evolution of Mexico's agricultural supply since NAFTA and discrepancies in the market context where commercial and subsistence farmers make their economic decisions.

With regards to the domestic agricultural supply of staples, we identified a difference between staples produced on rain-fed lands (by small commercial farmers and rural subsistence households) and those grown under irrigation (by wealthy entrepreneurial farmers). The amount of rain-fed land under cultivation has increased, while its yields have not changed much from their pre-NAFTA levels. In contrast, irrigated area planted with staples has decreased since NAFTA, but yields have increased.

With the exception of PROCAMPO, most ASERCA marketing supports have been directed to commercial farmers producing staples from primarily irrigated on land in the north of Mexico. Some of these farmers have also received support from Alliance for the Countryside programs. We propose that such supports have served to isolate commercial farms from competition under NAFTA.

To understand why production of maize under rain-fed conditions has not decreased with NAFTA and domestic reforms (i.e., why small farms and households continue to produce maize), we used a DREM to estimate the likely impacts of policy reforms in two contrasting rural regions of Mexico. For central Mexico we found that, through local market linkages between households producing staples for the market and subsistence households, production of maize by subsistence farmers could increase, even when the price of this grain falls. By increasing household income and consumption of maize, the devaluation of the peso and PROCAMPO and PROGRESA government income transfers also increased maize production by subsistence households and by small farmers in central Mexico.

In summary, we find that, among Mexico's major new agricultural policies, most have helped to relatively isolate large commercial producers from foreign competition. As for rural subsistence households, our economywide model shows that lower staple prices do not necessarily lead to reduced maize production.

Mexico's experience with NAFTA and its own agricultural and market policies can provide lessons to other developing countries with similarly heterogeneous agricultural and rural sectors. Domestic and trade liberalization do not necessarily cause domestically produced foods to be overtaken by imports, even when foreign competitors enjoy high subsidies from their governments.

In part, the production of staples in Mexico has been sustained by government support, both to commercial producers and to small farmers and poor rural households.

In considering this approach to agricultural policy, one has to keep in mind that government supports require considerable public funds. In Mexico, part of this funding comes from the oil revenues that many developing countries do not have.

Finally, the experience of Mexico shows that economic liberalization does not necessarily lead to the rule of the market, specialization, and more efficient use of scarce resources that would result in rural development.

Faced with fewer opportunities in the rural economy, workers from less developed countries (LDCs) will emigrate to urban areas or to more developed countries. For less wealthy and more isolated communities, lack of infrastructure –transport and communications, for example– and lack of financial investment resources make it difficult for a country to fully develop national markets.

We are convinced that to understand the evolution of an LDC's agriculture sector under liberalization policies, it is necessary to understand the nature of its farming structure. Given the priorities of poverty alleviation and the globalization trends of agricultural markets, and given that most of the world's population and its poor are concentrated in rural areas, it is essential for policymakers to have a micro-level understanding of the economywide impacts of existing and proposed development policies.

ANNEX

Table 1: Policy Reforms and New Institutions for Agriculture and the Rural Economy of Mexico: 1985-2008

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 to 1999
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-USA	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.	1994-2008
PROCAMPO (Program of Direct Support for the Countryside), part of ASERCA	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.	From Winter 1993/94 to 2008
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 corn producers were abolished.	1991-1999
Creation of the Ministry for Social Development (SEDESOL)	PROGRESA: monetary and in kind transfers to poor rural female household heads for nutrition, school and health services (from 2001 the program is extended and called OPORTUNIDADES). DICONSA (rural shops, formerly part of CONASUPO) are transferred to SEDESOL.	1991 …
Alliance for the Countryside	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 …
Privatization of rural credit	Reduction of official credit and credit subsidies. Creation of *Financiera Rural* and abolishion of BARURAL.	1991-2003
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, 2003.

Table 2. Major exported Vegetables and Fruits: Production, Cultivated Areas and Yields (annual averages)

Period	Vegetables	Production (thousands of Mt. tons)	Cultivated Area (thousands of hectares)	Yields (tons/ cropped ha)	Fruits	Production (thousands of Mt. tons)	Cultivated Area (thousands of hectares)	Yields (tons/ cropped ha)
1983-90	**Asparagus**	31,09	9,60	4,63	**Avocados**	552,95	83,70	8,35
1991-93		33,15	11,76	3,40		738,07	92,48	8,75
1994-2001		52,29	14,39	4,04		869,27	93,78	9,44
1983-90	**Cauliflower and brocolli**	119,98	10,52	11,76	**Lemons and Limes**	780,52	83,27	10,69
1991-93		212,82	19,17	11,32		772,21	89,98	9,69
1994-2001		260,58	20,30	13,02		1 358,40	103,68	14,30
1983-90	**Carrots and Turnips**	157,40	6,82	23,65	**Mangoes and Guabas**	1 023,27	114,87	10,55
1991-93		239,20	9,57	25,99		1 115,00	138,13	9,40
1994-2001		319,24	13,54	23,93		1 412,64	138,25	10,90
1983-90	**Cucumbers**	251,24	15,64	17,01	**Cantaloupe**	394,57	36,55	12,48
1991-93		257,40	15,88	17,26		511,73	46,79	12,41
1994-2001		417,24	17,73	23,85		565,25	30,27	19,48
1983-90	**Garlic**	52,81	6,94	7,74	**Oranges**	2 014,14	211,32	12,62
1991-93		55,37	7,70	7,26		2 608,22	274,87	12,25
1994-2001		58,05	7,28	8,04		2 751,98	257,66	11,59
1983-90	**Onions**	593,36	37,01	16,78	**Papaws**	514,78	22,49	28,29
1991-93		715,50	40,19	18,24		363,15	18,72	24,13
1994-2001		932,56	42,40	22,91		320,28	12,17	30,14
1983-90	**Peppers**	593,06	72,75	9,06	**Pineapple**	288,94	8,82	41,48
1991-93		834,93	98,84	9,22		258,36	8,95	38,76
1994-2001		1 656,21	121,48	14,73		430,98	13,54	42,47
1983-90	**Tomatoes**	1 759,11	76,29	24,49	**Straw-berries (fresh& frozen)**	71,97	4,74	16,56
1991-93		1 655,43	84,36	21,46		86,47	7,13	13,79
1994-2001		1 882,21	71,30	27,33		121,96	6,76	19,02
					Water-melon	441,76	39,38	12,98
						426,43	39,59	12,63
						761,00	40,66	20,44
1983-90	**Total**	3 558,05	235,56	16,34	**Total**	6 082,90	605,12	12,40
1991-93		4 003,79	287,46	14,98		6 879,65	716,63	11,47
1994-2001		5 578,38	308,42	19,04		8 216,99	727,10	12,20

Sources: Exports, FAO's data base. Production, and cultivated and cropped areas, Mexican Ministry of Agriculture data bases (SAGAR SIACON) and "Anuario estadístico de la producción agrícola 1999-2000", and Yunez-Naude and Barceinas, 2003.

Table 3. Basic Crops: Production, Cultivated Areas, and Yields (annual averages)

Product	Period	Production (thousands of Mt. tons)			Cultivated area (thousands of hectares)			Yields (tons/cropped ha)		
		Total	Irrigated	Rainfed	Total	Irrigated	Rainfed	Total	Irri-gated	Rainfed
Barley	1983-90	520,64	185,39	335,25	303,04	53,39	249,65	1,89	3,66	1,49
	1991-93	536,15	213,48	322,67	295,87	51,93	243,94	1,99	4,19	1,47
	1994-2001	523,75	154,56	369,19	282,08	33,59	248,49	2,13	4,67	1,70
Beans	1983-90	997,53	269,87	727,66	2 163,85	226,80	1 937,05	0,55	1,28	0,45
	1991-93	1 128,22	375,68	752,54	2 070,25	298,59	1 771,66	0,64	1,42	0,50
	1994-2001	1 147,97	395,05	752,91	2 258,36	281,36	1 969,88	0,62	1,46	0,47
Maize	1983-90	12 472,19	2 932,05	9 540,13	8 076,36	994,49	7 081,86	1,79	3,13	1,58
	1991-93	16 435,37	5 792,44	10 642,93	7 993,44	1 438,16	6 555,28	2,28	4,15	1,83
	1994-2001	17 699,01	5 913,30	11 785,71	8 717,77	1 242,44	7 378,48	2,31	4,90	1,85
Sorghum	1983-90	5 566,17	2 548,40	3 017,77	1 950,09	579,53	1 370,56	3,25	4,55	2,62
	1991-93	4 080,70	1 806,38	2 274,32	1 313,81	377,25	936,56	3,32	4,99	2,64
	1994-2001	5 624,51	2 179,81	3 444,70	2 027,90	393,45	1 634,45	3,11	5,67	2,42
Soybeans	1983-90	704,05	604,64	99,41	401,09	317,02	84,07	1,84	1,97	1,40
	1991-93	605,36	536,23	69,13	305,51	253,00	52,52	2,02	2,14	1,42
	1994-2001	182,51	106,34	76,16	126,51	65,07	61,44	1,53	1,64	1,44
Wheat	1983-90	4 292,31	4 036,00	256,30	1 086,64	886,86	199,78	4,15	4,67	1,53
	1991-93	3 754,56	3 397,67	356,90	953,49	734,09	219,40	4,05	4,70	1,76
	1994-2001	3 207,30	2 864,48	342,82	789,01	553,00	230,68	4,33	5,25	1,73
Totals	**1983-90**	**24 552,89**	**10 576,37**	**13 976,52**	**13 981,07**	**3 058,09**	**10 922,97**	**2,02**	**3,61**	**1,52**
	1991-93	**26 540,36**	**12 121,87**	**14 418,48**	**12 932,38**	**3 153,02**	**9 779,36**	**2,28**	**4,00**	**1,68**
	1994-2001	**28 385,06**	**11 613,55**	**16 771,50**	**14 201,62**	**2 568,92**	**11 523,42**	**2,28**	**4,62**	**1,70**

Sources: Data Bases of FAO and of the Mexican Ministry of Agriculture: (SAGAR SIACON) and "Anuario estadístico de la producción agrícola 1999-2000" and Yunez-Naude and Barceinas, 2003.

Table 4: Percentage effects of a 10% decrease in the price of maize in Central Mexico

Variable	*Landless households**	*Households <2 ha*	*Households 2-5 ha*	*Households >5ha*
Production				
Maize	0,09	0,12	0,17	-11,76
Cash crops	2,21	0,51	0,48	0,5
Livestock	0,63	0,82	0,62	0,78
Nonag	0,34	0,2	-	0,2
Factors				
Wages	-0,19			
Land rents	-0,42			
Prices				
Maize	-0,28	-0,24	-0,22	-10
Cash crops	0	0	0	0
Livestock	0	0	0	0
Incomes				
Nominal	-0,02	-0,03	-0,01	-0,85
Real	-0,01	0,01	0,02	1,58
Migration				
Domestic	0,2			
International	0,22			

** Some of them rent land for crop production. Source: Own estimations.*

Table 5: Percentage effects of a 10% decrease in the price of maize in North-western Mexico

Variable	*Landless households**	*Households <2 ha*	*Households 2-5 ha*	*Households >5ha*
Production				
Maize	-46,63	-17,43	-20,1	-52,42
Cash crops	6,01	1,16	3,97	15,13
Livestock	4,82	1,92	65,23	2,59
Nonag	1,27	1,04	0	1,05
Factors				
Wages	-1,03			
Land rents	-0,88			
Prices				
Maize	-0,10	-0,10	-0,10	-10
Cash crops	0	0	0	0
Livestock	0	0	0	0
Incomes				
Nominal	-0,12	-0,22	-4,27	-1,41
Real	-0,05	-0,19	-2,17	1,8
Migration				
Domestic	1,42			
International	1,57			

** Some rent land for crop production. Source: Authors' estimations.*

Table 6: percentage effects of a 10% devaluation in Central Mexico

Variable	*Landless households**	*Households <2 ha*	*Households 2-5 ha*	*Households >5ha*
Production				
Maize	1,35	1,93	1,86	-0,45
Cash crops	-1,94	-0,49	-0,49	-0,51
Livestock	-0,6	-0,36	-0,57	-0,66
Nonag	-1,78	-1,01	-	-1,01
Factors				
Wages	1,02			
Land rents	-0,45			
Prices				
Maize	0,77	1,68	1,21	0
Cash crops	0	0	0	0
Livestock	0	0	0	0
Incomes				
Nominal	4,94	4,96	3,58	2,07
Real	4,9	4,7	3,39	2,07
Migration				
Domestic	-1,05			
International	10,12			

** Some rent land for crop production. Source: Authors' estimations.*

Table 7: Percentage effects of a 10% devaluation in North-western Mexico

Variable	*Landless households**	*Households <2 ha*	*Households 2-5 ha*	*Households >5ha*
Production				
Maize	0,43	-0,06	-0,08	-0,26
Cash crops	-0,21	-0,04	-0,13	-0,49
Livestock	0,59	-0,06	11,9	0,08
Nonag	-0,33	-0,27	0	-0,27
Factors				
Wages	0,27			
Land rents	-0,21			
Prices				
Maize	0	0	0	0
Cash crops	0	0	0	0
Livestock	0	0	0	0
Incomes				
Nominal	1,4	0,23	0,07	0,21
Real	1,4	0,23	0,07	0,21
Migration				
Domestic	-0,37			
International	14,97			

** Some rent land for crop production. Source: Authors' estimations.*

Table 8: Percentage effects of terminating PROCAMPO in Central Mexico

Variable	*Landless households**	*Households <2 ha*	*Households 2-5 ha*	*Households >5ha*
Production				
Maize	-0,12	-0,91	-0,57	0,02
Cash crops	0,14	0,03	0,03	0,03
Livestock	0,04	0,05	0,04	0,05
Nonag	0	0	0	0
Factors				
Wages	0			
Land rents	-0,04			
Prices				
Maize	-0,07	-0,77	-0,3	0
Cash crops	0	0	0	0
Livestock	0	0	0	0
Incomes				
Nominal	-0,43	-2,29	-1,02	-11,86
Real	-0,43	-2,18	-0,97	-11,86
Migration				
Domestic	0			
International	0			

** Some rent land for crop production. Source: Authors' estimations.*

Table 9: Percentage effects of terminating PROCAMPO in North-western Mexico

Variable	*Landless households**	*Households <2 ha*	*Households 2-5 ha*	*Households >5ha*
Production				
Maize	0	0	0	0
Cash crops	0	0	0	0
Livestock	0	0	0	0
Nonag	0	0	0	0
Factors				
Wages	0			
Land rents	0			
Prices				
Maize	0	0	0	0
Cash crops	0	0	0	0
Livestock	0	0	0	0
Incomes				
Nominal	-1,83	0	-4,63	-2,48
Real	-1,83	0	-4,63	-2,48
Migration				
Domestic	0			
International	0			

** Some rent land for crop production. Source: Authors' estimations.*

Table 10: Percentage effects of terminating PROGRESA in Central Mexico

Variable	*Landless households**	*Households <2 ha*	*Households 2-5 ha*	*Households >5ha*
Production				
Maize	-2,14	-1,87	-1,33	0,1
Cash crops	0,63	0,15	0,14	0,14
Livestock	0,18	0,25	0,18	0,23
Nonag	0,04	0,02	-	0,02
Factors				
Wages	-0,02			
Land rents	-0,16			
Prices				
Maize	0	0	0	0
Cash crops	0	0	0	0
Livestock	0	0	0	0
Incomes				
Nominal	-7,42	-4,72	-2,3	-3,53
Real	-7,38	-4,48	-2,41	-3,53
Migration				
Domestic	0			
International	0			

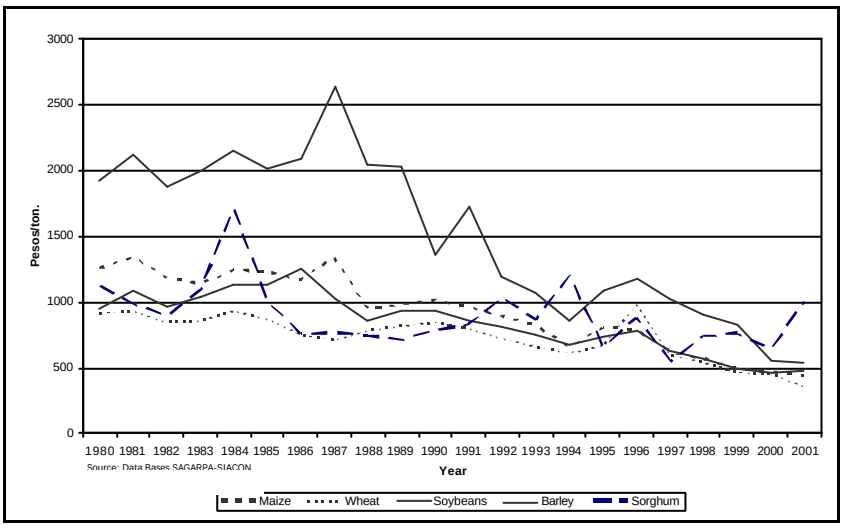
** Some rent land for crop production. Source: Authors' estimations.*

Table 11: Percentage effects of terminating PROGRESA in North-western Mexico

Variable	*Landless households**	*Households <2 ha*	*Households 2-5 ha*	*Households >5ha*
Production				
Maize	0	0	0	0
Cash crops	0	0	0	0
Livestock	0	0	0	0
Nonag	0	0	0	0
Factors				
Wages	0			
Land rents	0			
Prices				
Maize	0	0	0	0
Cash crops	0	0	0	0
Livestock	0	0	0	0
Incomes				
Nominal	-4,77	-1,01	-2,31	-0,15
Real	-4,77	-1,01	-2,31	-0,15
Migration				
Domestic	0			
International	0			

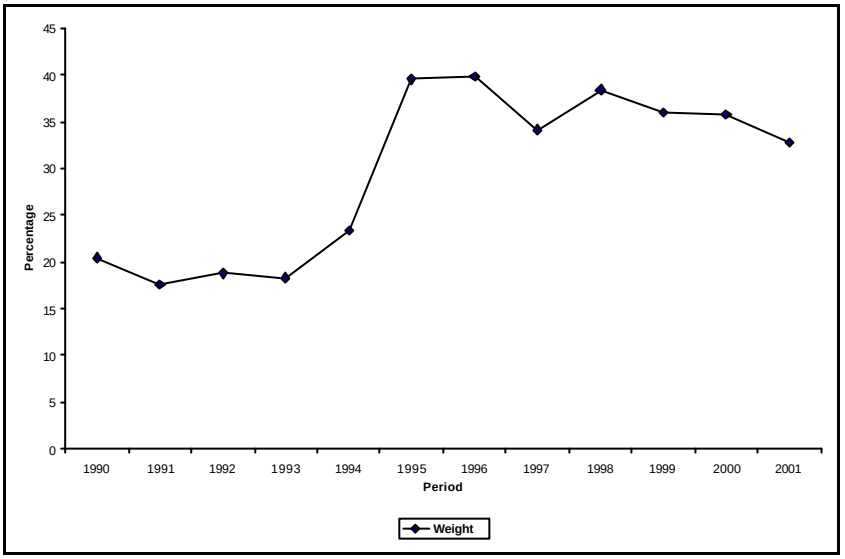
** Some rent land for crop production. Source: Authors' estimations.*

Figure 1: Mexico - average producers prices for selected basic crops



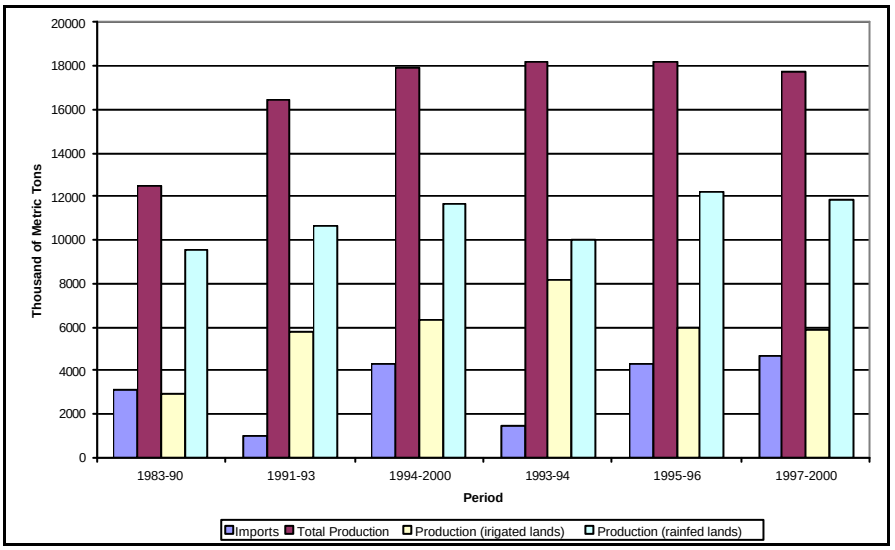
Source: Data Bases SAGARPA-SIACON.

Figure 2: Participation of agricultural trade on agricultural production of Mexico: 1990-2001



Source: Yunez-Naude and Barceinas, 2003.

Figure 3: Maize imports and domestic production, 1983-2000, annual averages



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LES IMPACTS DE L'ALENA ET DES RÉFORMES INTERNES SUR L'AGRICULTURE MEXICAINE : EFFETS ATTENDUS ET EFFETS CONSTATÉS

Résumé *- L'objet de cet article est d'étudier l'impact des réformes économiques des 15 dernières années sur l'agriculture mexicaine, en prenant en compte le dualisme de cette agriculture. Nous estimons notamment l'impact de ces réformes sur les ménages ruraux mexicains à l'aide d'un modèle déquilibre général calculable (MEGARUM). Notre analyse montre qu'une bonne partie des effets attendus de ces réformes ne s'est pas produite. Ceci tient au fait que certaines des politiques mises en œuvre ont protégé des grands producteurs de la concurrence internationale. En ce qui concerne l'agriculture de subsistance produisant du maïs (aliment de base du régime mexicain), les résultats de MEGARUM indiquent que la baisse constatée des prix du maïs tend à provoquer*

une croissance de l'offre. La conclusion principale que l'on peut déduire de l'expérience mexicaine est que la libéralisation économique ne conduit pas automatiquement à l'accès au marché, à la spécialisation ni à une utilisation plus efficiente des ressources rares, et, par conséquent, au développement de l'agriculture.

LOS IMPACTOS DEL TLCAN Y DE LAS REFORMAS ECONOMICAS INTERNAS EN LA AGRICULTURA MEXICANA: LAS PREDICCIONES Y LOS HECHOS

Resumen *- Nuestro objetivo es estudiar los impactos de las reformas en materia de política económica (aplicadas desde hace más de 15 años) sobre la agricultura mexicana, tomando en cuenta el carácter dual de la producción agrícola mexicana. A partir de estimaciones econométricas, evaluamos los efectos esperados de tales reformas (incluido el "NAFTA") con las tendencias recientes de la agricultura de México. También estimamos los impactos de cambios en las políticas sobre la economía de los hogares rurales de México; lo anterior mediante la aplicación de un modelo de equilibrio general micro económico y rural (MEGARUM). Nuestro análisis muestra que un buen número de los efectos esperados de las reformas no han ocurrido. Esto debido, en parte, a que algunas de las nuevas políticas hacia el agro han aislado a ciertos productores comerciales de cultivas básicos de la competencia internacional. En cuanto a los productores de subsistencia que producen maíz (el alimento básico en la dieta mexicana), los resultados de nuestro MEGARUM indican que la reducción observada en los precios del grano puede provocar un crecimiento en su oferta. La principal conclusión es que la experiencia de México muestra que la liberalización económica no conduce necesariamente a la creación de mercados, a la especialización, ni al uso más eficiente de los recursos escasos y, en consecuencia, al desarrollo económico.*