Liberalization of Staple Crops: Lessons from the Mexican Experience in Maize

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Abstract. In this paper we inquire why after more than 25 years of domestic agricultural reforms in Mexico and 15 years of trade liberalization of maize under NAFTA –a non-competitive crop and the major staple in Mexico–domestic production of this field crop has increased. We present new empirical evidence showing that, as expected, maize prices in Mexico dropped until 2006 and have experienced a process of convergence with USA prices, and maize imports from the USA increased. However, despite lower prices, maize production in Mexico rose and has experienced a positive structural change since 1992, two years before the beginning of NAFTA's implementation. Based on the heterogeneity of maize production in Mexico, three possible explanations are proposed to explain this unexpected outcome: government supports to big commercial farmers in the agriculturally rich North of Mexico; the persistence of maize production by subsistence farmers; and to a lesser degree, increasing yields on some irrigated maize farms. We finish the paper by drawing lessons from the experience of Mexico for other Less Developed Countries.

Key Words: Domestic and Trade Liberalization, Price Convergence, Structural Change.

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1. Introduction

Mexico is an extraordinary laboratory in which to study agricultural development policies and trends under trade liberalization. In the 1980s, the Mexican state began a process of deep economic reform. It culminated in January 2008, with the end of the transitional period and "full" implementation of agricultural trade liberalization with Canada and the United States of America (USA) under the North American Free Trade Agreement or NAFTA. (This agreement was the first one signed between a less developed country (LDC) and highly industrialized economies.) NAFTA critics in Mexico expected that the agreement would sharply reduce the country's production of non-competitive staple crops. The greatest concern was maize, the main crop consumed by Mexicans (see for example Randall, 1996). After more than 15 years of NAFTA's implementation, and notwithstanding the decline of maize prices up to 2006 and a continuous growth of imports, production of maize in Mexico has increased. As well as contrasting with NAFTA critics´ expectations, this trend differs from the predictions of applied general equilibrium models for the Mexican economy built in the early 1990s to estimate the effects of NAFTA on Mexico´s agricultural sector (Levy S. y S. Van Wijnbergen 1994 y Robinson, *et al*, 1993).

An analysis of the characteristics of Mexican maize prices, production and imports during the last 27 years is relevant not only for Mexico but also for other LDCs that have liberalized their staple sectors through bilateral free trade agreements. Examples include Central America and the Dominican Republic under the Central American Free Trade Agreement with the USA (CAFTA), as well as new agreements between the USA

and Peru and, in the near future, probably Colombia. Furthermore, Mexican maize supply is an important case to consider in the Doha Round discussions on agricultural trade liberalization under the World Trade Organization.

In Part 2 we summarize domestic reforms in Mexico and agricultural trade liberalization under NAFTA, with reference to maize. After revising the tendencies in maize prices, production and imports, in Part 3 we present our main econometric results on price convergence and on structural change in maize imports, production and yields. Part 4 advances hypotheses intended to explain why maize production in Mexico has not declined. We end in Part 5 with a reflection about lessons provided by the Mexican experience.

2. Reforms and NAFTA

In order to modernize and promote efficiency in agriculture, the Mexican government began in the mid-1980s to dismantle state enterprises involved in the food chain and to eliminate agricultural production and consumption subsidies. This process was deepened at the beginning of the 1990s and culminated with NAFTA's implementation from 1994 to 2008.

One major player of government intervention in agriculture prior to reforms and NAFTA had been the National Company of Popular Subsistence (with the Spanish acronym of CONASUPO). By supporting prices for the producers of "basic crops" (maize, among other ten field crops), storing, and distributing these crops at subsidized prices and by regulating their trade through direct imports, CONASUPO exerted control over an important component of Mexico's food chain.

Beginning in 1991, a major reform in Mexican state intervention in staple production consisted of the elimination of guaranteed prices that CONASUPO had traditionally awarded to the producers of basic crops all over the country. By 1999, all of these price supports were eliminated, and CONASUPO was abolished. (Subsidies for *tortillas* (flat maize bread) ended in 2001.)

During the process to reform the agriculture of Mexico, agencies and programs were created to support the farmers of basic crops in order to ease their transition to a liberalized agricultural sector.

In 1991, an agricultural marketing agency, Support Services for Agricultural Marketing (ASERCA is its acronym in Spanish), was created. ASERCA is independent of CONASUPO but, like CONASUPO, is part of the Agricultural Ministry. ASERCA was a key element in the process of eliminating CONASUPO interventions in the markets for the crops that had been under CONASUPO control, including maize. Similar to the deficiency payment program in the USA, the main functions of ASERCA have been directed towards marketing supports for commercial producers of cereals and oilseeds for designated surplus regions. ASERCA also assists beneficiary farmers in negotiating contracts with purchasers, and it supports contracts to cover the risk of price changes. ASERCA is also in charge of a program of direct income transfers to farmers. This program, called PROCAMPO (Program for Direct Supports to the Countryside), was created in the Autumn/Winter agricultural season of 1993, some months before the beginning of NAFTA's implementation. In contrast with ASERCA´s marketing supports, PROCAMPO is decoupled from production, since the transfer is based on farmers' areas cultivated in basic crops prior to the program, its amount is independent of yields, and farmers who receive PROCAMPO are free to change their land use. In

2003 pesos, using a conversion rate of 10 pesos per USD, the transfers have been around 100 USD per hectare (Ha.) PROCAMPO was programmed to last until 2008, when full liberalization under NAFTA would be reached. However, the present Administration (2007-2012) has decided to continue it, with some modifications. PROCAMPO covers almost all landowners who used their land to grow basic crops a couple of years before NAFTA's initiation, around 3 million beneficiaries in all).[1]

3. Effects of the reforms and NAFTA on Mexico´s maize sector

Prior to the reforms, Mexico's guarantee price (*precio de garantía*) had supported the maize price. As expected, from the beginning of the reforms and especially during NAFTA's implementation, the price of maize received by Mexican producers decreased (up until 2006) and imports—most from the USA, Mexico´s major trade partner—increased. However, domestic production of maize experienced high growth rates (see Table 1).[2]

Maize from the USA entered practically tariff-free during the NAFTA transitional period (1994 to 2007).[3] Declining maize prices both in Mexico and in the USA and worldwide suggests that there was a process of convergence between Mexico and USA

[1] A third major program created by the Mexican State during this period was the Alliance for the Countryside (*Alianza para el Campo*). Alliance has a rural coverage that is not directly related to maize production.

[2] With the exception of prices, the figures in this Table come from the data used in the econometric estimations presented below.

[3] During the NAFTA transition period, the agreed Tariff Rate Quotas between Mexico and the USA were not applied when maize imports exceeded the quota. Based on empirical evidence, we consider here that imported yellow maize is a substitute for domestically produced white corm in production and consumption.

maize prices. We test the convergence hypothesis below. We also inquire empirically whether structural change in Mexico´s maize production and in imports occurred during the agricultural reform and NAFTA phase-in period. Finally, we test for structural change in maize yields, inasmuch as their observed rise—together with rising domestic demand for maize—may explain why domestic production increased in the face of lower prices and higher imports.

Table 1. Evolution of the maize sector: 1980-2006
(annual averages)

Period	Prices (pesos/mt. Ton.) *	Imports (mt. tons)	Production (mt. tons)	Yields (mt. Tons/Ha.)
1980-86	8,738	2,549,897	12,638,873	1.83
1987-1993	7,083	2,543,807	13,870,518	1.98
1994-2006	3,814	5,134,009	19,156,933	2.55

* Producer prices in 2002 pesos (consumer price index, Bank of Mexico)
Sources: Prices, production and yields, 1980-2005, Sistema de Información Agroalimentaria de Consulta, SIACON; 2006, Servicio de Agroalimentaria y Pesquera, SIAP (http://www.siap.gob.mx). Imports: FAO, http://faostat.fao.org

Price Convergence

What is the short and long run relationship between maize prices in Mexico and the USA? Do maize prices in Mexico have a tendency to converge with USA prices? We consider USA prices because almost all of Mexico´s imports come from this country and because the USA is a global price leader in this crop.

We used monthly price data from January 1981 to April 2008. The data for Mexico is based on the price index received by maize producers valued at the nominal peso/USD exchange rate. For the USA, two price time series were considered separately: farm

gate prices and FOB shipping-point prices. (Both are available on the website of the US Department of Agriculture, National Agricultural Statistics Service).

The price convergence analysis was based on the theory of Purchasing Power Parity, following the econometric error correction model of Engle and Granger (see for example, Maddala, G.S. and Kim, I., 1998, and Enders W., 2004).

The model used for the estimation is:

$$\Delta p_t = \alpha_1 + \alpha_2 \Delta f_t + \alpha_3 [p_{t-1} - \beta_1 f_{t-1}] + \varepsilon_t$$

Where p_t is the price of maize in Mexico; coefficient α_2 indicates price transmission during the first period to the Mexican price p_t coming from a change in the USA price, adjusted by the exchange rate f_t (short run effect); and coefficient α_3 is the rate of adjustment of the Mexican price in consecutive periods (long term effect).

Our findings are summarized in Table 2. They show that the error correction coefficient, α_3, is statistically different from 0 when using either USA maize farm gate prices or FOB prices. These results show evidence of the existence of convergence between Mexico and USA maize prices, and so, they indicate the following: 1) If the price in Mexico is 1% higher than the USA farm gate price, the former will drop by 0.07% in the following month (0.03% if the Mexican price is 1% higher than the USA FOB price); 2) After 5 months the adjustment of the price in Mexico would reach 31% of the change in the US farmgate price (15% for the FOB price); and 3) it takes 41 months for the price in Mexico to reach a 95% adjustment to the US farm gate price (92 months using the FOB US price).

Table 2. Results, Cointegration between Mexican and US maize prices

	α1	α2	α3	R^2	DW	t=5	n for k = .95
Maize	0.021	-0.013	-0.069	0.117	1.778	0.311	41.419
(farm gate)	(6.62)	(-0.29)	(-6.56)				
Maize	.0201926	-.0036427	-.031896	0.041	1.726	0.153	92.303
(fob)	(6.50)	(-0.27)	(-3.43)				

Notes: "t" is the percentage of adjustment in period 5
"n" is the number of periods (months) for Mexican prices to reach a 95% adjustment
t statistics are in parentheses
Source: Own estimation

The results from previous studies do not contradict our findings. Using the same methodology and price series for Mexican and USA producers for a shorter period (January 1981 to March 2003), we found evidence indicating a 38% adjustment of the Mexican price of maize to the USA price over five months, and a 95% adjustment in 37 months. The differences between these and our updated results is that price adjustment takes longer when we include the more recent period. This could be explained by a change in policy implemented in 2003 by the Mexican government. It consisted of giving surplus commercial farmers of basic crops, rather than buyers, most of the subsidies in ASERCA´s marketing support program. In addition, since then ASERCA´s budget for this purpose has increased.

Our results also support those of Fiess, R. y D. Lederman (2004), who use a different estimation methodology (one proposed by Johansen). They found evidence that the "Law of One Price" has ruled for maize prices in Mexico and in the USA. They divide the period under study into two, before and after NAFTA's implementation, and present empirical evidence that NAFTA has not affected the relationship between Mexico and USA maize prices.

Structural changes in maize imports, production and yields

For the analysis of structural change we used time series data from 1970 to 2006 for Mexico´s volume of imports and production of maize, as well as yields (Mt. Tons per Ha.). Following Vogelsang (1999) we first tested the existence of unit root in the series and then, using the approach of Zivot and Andrews (1992), we tested for the presence of structural change for the stationary series. For the case of a non-stationary series we also inquired into the presence of sudden or temporary shocks, following Vogelsang.

The estimation model is the following:

$$y_t = u + \theta DU_t + \beta t + \gamma DT_t + \alpha y_{t-1} + \sum_{j=1}^{k} c_j \Delta y_{t-j} + \varepsilon_t$$

Where y_t is the variable subject to test for structural change. DU is a dummy variable: DUt = 1 if t> TB and 0 otherwise; DTt = t if t>TB , and 0 otherwise. The equation is estimates sequentially for values T_B = 2,...,T-1, where T is the number of observations once the difference of the variables are applied. The period of rupture is elected when the value of the Dick Fuller statistic t of α is maximized. The null hypothesis is that variable y presents a unit root and the alternative hypothesis is that it is stationary with a rupture in its tendency. (Details of the econometric procedures are available upon request.)

The results show that time series for maize volume of imports is not stationary (Table 3). However, there is weak evidence of structural change in 1991 and evidence of the presence of a temporary shock in 1993. A look at the data suggests the meaning of these results: Mexico's maize imports declined from 4.124 million metric tons in 1990 to 1.449 million in 1991, 1.343 in the following year and 0.293 in 1993. After 1994,

however, maize imports increased. They reached an average of 2.782 million during 1994-1995 and 5,134 million in1994-2006 (Table 1).

Results on maize production provide evidence that maize supply in Mexico experienced a structural or "permanent" change in 1992 (Table 3). The change was positive, contrasting with the expectation that agricultural liberalization and NAFTA would negatively affect maize production in Mexico.

As in the case of imports, there is no evidence that the series for maize yields is not stationary, but there is weak evidence that yields suffer a positive structural change beginning in 1986.

Table 3. Results, temporal and structural change in production and maize imports

	Unit Root	Temporary Schock	Structural Change	Sign **
Imports *	Not rejected	1993	1991	(+)
Production *	Rejected	None	1992	(+)
Yields *	Not rejected	None	1986	(+)

* Tests at a 5% significance level
** Signs obtained by comparing average of the data series before and after the detected change
Sources: own estimations. Data for imports, same as Table; data for production and yields, 1970-1979, from *Nacional Financiera*, and 1980-2006, same as Table 1.

4. Why Has Maize Production in Mexico Not Declined?

To understand why maize domestic supply in Mexico has not declined under liberalization measures we start with the following premise: any study of production decisions has to consider the heterogeneity of Mexican maize famers. (This premise also applies to agricultural production in other LDCs.) We refer to the coexistence of commercial maize producers with family farming, that is, with rural households

producing maize for their own consumption while engaged in other family activities to diversify their income sources: e.g. production of other crops, livestock, migration and remittances, local nonfarm as well as farm wage work, etc.

Whereas commercial producers of maize respond directly to price changes, family farmers may not; i.e. subsistence maize producers are price inelastic, either because of the presence of high transaction costs, or because they react in apparently unexpected ways to changes in maize output market prices. For the first hypothesis see de Janvry *et. al.* 1995. With respect to the second hypothesis, using a microeconomic computable general equilibrium model (MCGE), Dyer, Boucher and Taylor (2006) find for a Mexican village that a maize market price shock is indirectly transmitted to subsistence producers through interactions in factor markets. They conclude that a drop in the market price of maize reduces local wages and land rents, stimulating maize production by subsistence households. (They also find that the real income of subsistence households falls.)

Based on these results and on similar findings for Mexico's rural regions using a similar MCGE and data provided by a representative rural household survey for 2002, we propose that subsistence farmers reactions to the observed reduction of maize market prices is one explanation for maize production in Mexico not declining.

With respect to commercial medium and big maize farmers, we propose the following hypotheses: some of these farmers have reacted to price reductions by increasing productivity/yields; others have changed their land use for other purposes; and the remaining have been isolated from USA competition through government supports. No time series are available to test these three hypotheses. However, existing figures do not contradict them.

We have some evidence that maize yields experienced structural change in 1986. Available data on maize yields that distinguish irrigated from rain-fed lands show that increasing yields are concentrated on irrigated lands farmed by commercial producers. (Maize yields in irrigated land increased from around 3 Mt. tons per hectare in the 1980s to 6 Mt. tons in the present century.) By contrast, maize yields on rain-fed lands – where small and subsistence farm production is concentrated—have remained low (from 1.5 Mt. tons per hectare during the 1980s to just 2 Mt. tons during the first years of the 2000s, according to the Mexican Ministry of Agriculture's on-line database).

With respect to government supports, income subsidies for marketing from ASERCA (Target Income, or *Ingreso Objetivo*) have been channeled to commercial maize farmers, most in the northwest state of Sinaloa and with access to irrigation. Excluding PROCAMPO, around 70% of ASERCA's budget is used to support the income of surplus farmers of basic crops (between 430 and 600 million USD per year). 50% of this subsidy goes to this type of maize producer, of which 70% is for farmers in a single northwestern state, Sinaloa.

Sumner and Balgatas (*op. cit.*) provide evidence that the Target Income program has promoted maize production by its beneficiaries. The program thus is coupled and has isolated some maize surplus producers from foreign competition.

Regional data on maize production show that Sinaloa has displaced other states as the major producer of this cereal: Sinaloa's share in the volume of total domestic supply was less than 0.7% at the beginning of the 1980s and increased to more than 10.5% during 1991-2007. In contrast, the southeastern state of Chiapas, the major state producing maize during the 1980s, saw its share of domestic supply fall from more than 9.6% to 6.2% during these periods (the same applies to other states of the South and

center of Mexico that have been traditional maize producers). Both area planted and yields by maize producers in Sinaloa have increased, but the area planted in maize has increased more than yields (Mexico´s Ministry of Agriculture, on-line database).

In addition to Target Income, PROCAMPO's direct income and decoupled transfers to maize producers may also help explain why maize production in Mexico has not collapsed (see de Janvry *et. al. op. cit*).

5. Lessons from the Mexican Experience

The increase in maize production in Mexico during the period of agricultural reforms and trade liberalization may be taken as a success story by those who worry about food security in LDCs. However, growth in the domestic supply of maize has been mainly based on subsidizing big commercial farmers in the northwest of Mexico. By isolating these producers from competition, this type of policy conflicts with the efficiency goals of trade liberalization, and hence is inefficient and costly. At the other extreme, small-scale agricultural households have not benefited from government supports, with the exception of PROCAMPO´s direct income transfers. The minority of small producers whose maize production was oriented largely for sale in markets were negatively affected by declining maize prices following the reforms. Meanwhile, production in subsistence households increased. Both types of households suffered income drops.

Agricultural programs in contemporary Mexico are not only costly and inefficient; they have been regressive and high. The most regressive policy has been the ASERCA Target Income program (*Ingreso Objetivo*; see OECD, 2006). In addition, Gonzalez A. and Orrantia (2006) show that Mexico's relative level of subsidies to its agriculture is similar to those in the USA and Canada. Furthermore, this type of policy has promoted

interest groups amongst big farmers with political power to press the government for the continuation of the subsidies channeled to them. An example is the Target Income subsidies, which have continued to climb despite the increase in food prices over the last two years.

Government actions have to focus on rural households in developing countries concerned about equity and securing a food supply based partially on domestic production. LDC governments have to know which rural households have the productive potential to make the transition to an increasingly globalized economy while designing effective policies to solve the problems of small scale production and commercialization (assisting the creation of cooperatives and/or associations, contract farming, etc.); enhance rural financial and land markets; and invest in public goods (research and development, extension programs and public infrastructure). In this respect, the successes and failures of Mexico's recent agricultural policies, from decoupled income transfers to highly coupled production subsidies, offer valuable lessons for other transition and less-developed countries.

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