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**Trade Note 18**

## Mexican Corn: The Effects of NAFTA

One controversial aspect of the North American Free Trade Agreement (NAFTA) is its impact on Mexican agriculture, particularly on poor corn farmers. Several policy advocacy groups have argued that NAFTA has further impoverished Mexico's poor farmers. For example, Audley et al (2004) argue that NAFTA can be blamed for the loss of hundreds of thousands of agricultural jobs in Mexico, and Oxfam (2003) states that NAFTA allowed US agricultural subsidies to impoverish Mexican corn farmers. Yet neither of these reports have analyzed the most basic mechanism through which trade liberalization is supposed to affect domestic producers -- its effect on domestic producer prices. Few studies have asked the key question: Did removing restrictions on maize imports suddenly drive down the producer price of Mexican corn toward the cheaper US export price?

It could be argued that NAFTA's removal of Mexico's import tariffs and quotas might not have

adversely affected prices to Mexican producers. One reason is that government subsidy programs (PROCAMPO, ASERCA, etc.) might have insulated both domestic production and producer prices from the full impact of trade liberalization. Indeed, OECD calculations of the "producer-support estimate" (PSE) suggest that Mexico's government has been substantially more protectionist of its maize producers than the US or the European Union (OECD 2003). Furthermore, if differences in crop varieties produced in the US and Mexico mean that they are not substitutes, then trade liberalization need not reduce the producer prices in Mexico to the same extent as the reduction of the import tariffs and quotas affecting the domestic price of maize imported from the US. If subsidy programs did offset any price fall or if the corn varieties were in fact not competing, the declines in Mexican maize employment or production cannot be attributed to NAFTA, and policymakers should then seek solutions to Mexico's rural poverty or agricultural development that are unrelated to NAFTA.

We now have three studies that examine the price trends for Mexican corn in comparisons with US prices (Yúnez-Naude 2002; Yúnez-Naude and Becerrias 2003; and Puyana and Romero 2004). They all point to the same conclusion if from different angles: The decline of Mexican corn prices was a long term trend that preceded NAFTA, and the US-Mexico maize-producer price differential did not change significantly after 1994. Government producer-price subsidies actually kept such prices above what would have been the case under NAFTA without domestic price subsidies. Consequently, NAFTA can not be held responsible for the poverty that characterizes subsistence agriculture, and further protectionism might not help fight rural poverty in Mexico.

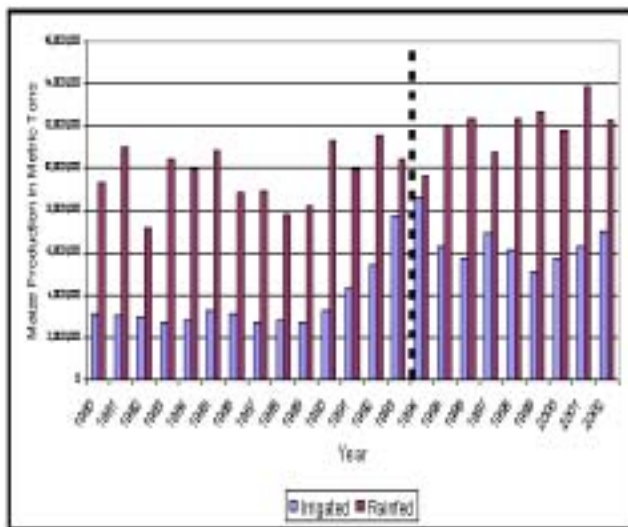


### Maize Production and Prices in Mexico since 1980 – Just the Facts

Any analysis of Mexican corn production has to begin with the distinction between irrigated and rainfed production (see Figure 1). Most experts of Mexican agriculture believe that irrigated production reflects the evolution of the modern commercial domestic producers, whereas rainfed production captures the performance of impoverished farmers, including subsistence farmers.

The performance of rainfed and irrigated maize production has been quite different since 1994. Rainfed production increased after 1994, while irrigated production fell. Since rainfed production has been much larger than irrigated production, the overall output of maize traces the evolution of rainfed production. *The total volume of Mexican maize production was actually higher after 1994 than in the previous fifteen years.* It is therefore difficult to support the claim that NAFTA caused an implosion of maize production in Mexico.<sup>1</sup>

**Figure 1. Mexican Maize Production, 1980-2002**  
(Tons, all varieties)



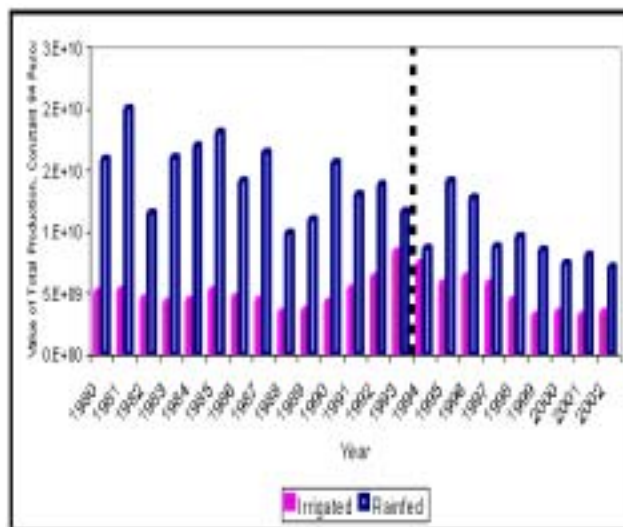
Note: Years are agricultural years  
Source: SAGARPA database.

The fact that maize production did not fall precipitously after NAFTA is not necessarily a desirable outcome if the relative price of maize fell. In fact, it might not be desirable that

production or even employment in import-competing agricultural commodities increase. If the relative price of maize fell during the period under analysis, then the economic value of this production might have declined, impoverishing maize producers. In other words, the purchasing power of maize production could be declining and thus an increase in production of maize could be associated with rising rural poverty.

Indeed, the real value or purchasing power of maize production actually fell after 1994 (Figure 2). This is because the decline in the relative price of each ton of maize outweighed the increase in the volume of production.

**Figure 2. The Real Value of Mexican Maize Production, 1980-2002.**  
(Constant pesos of 1994, all varieties)

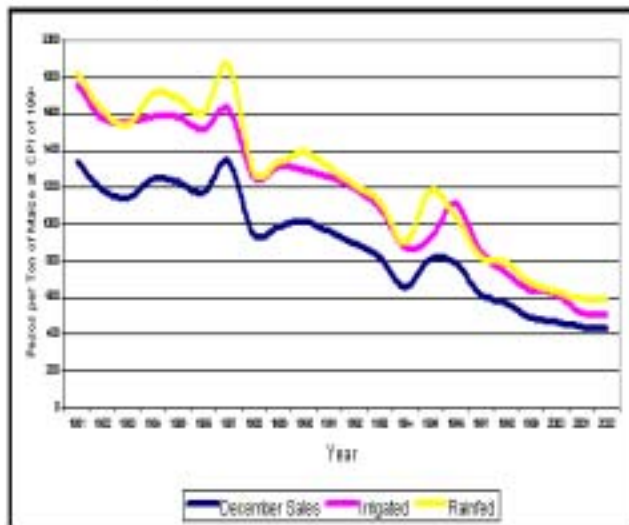


Source: Own calculations based on nominal values of production from SAGARPA and the Consumer Price Index (CPI) from the IMF, International Financial Statistics database. Note: Years are agricultural years.

The fact is that unit producer prices for both rainfed and irrigated Mexican maize have been falling since the early 1980s, a trend broadly consistent with global prices (Figure 3). Moreover, the prices of both rainfed and irrigated price moved closely together since the early 1980s. For additional information, this graph also contains the relative price of maize for December sales, derived from the average sales price collected from the SAGARPA database and converted into 1994 pesos.<sup>2</sup>



**Figure 3. Pesos per ton of Maize at 1994 Consumer Prices, 1981-2002**  
(All varieties)



Source: Authors' calculations based on data from SAGARPA. See text.

Taken together, the evidence is clear that Mexican maize production did not plummet after the implementation of NAFTA in 1994. Production generally held up despite the fact that imports from the US entered duty-free throughout this period. (This was because tariff-rate quotas in place until 2008 were not binding during 1994-2002.) More important for those concerned with poverty, maize production of rainfed farmers actually increased during this period. Finally, the relative producer price of maize in Mexico experienced a steady decline that started more than a decade prior to the implementation of NAFTA. This decline was only temporarily halted by the devaluation of the peso in late 1994 until about 1996. Since all of these trends could have occurred independent of NAFTA, a better understanding of how NAFTA might have affected maize producer prices warrants further analysis.

**Trade Reforms and Co-Movement of US and Mexican Corn Prices**

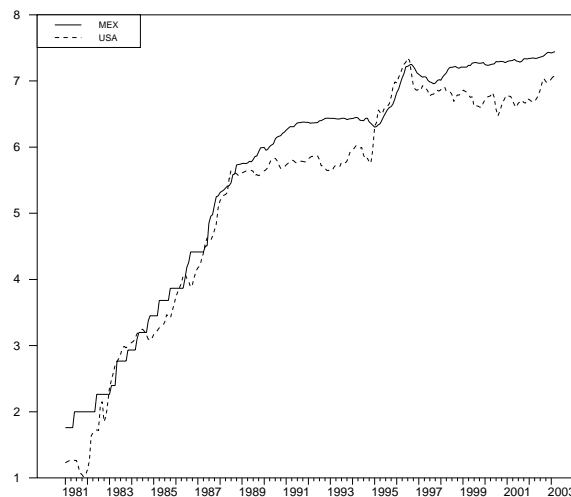
In a world of workably competitive markets where trade is efficient and arbitrage takes place, prices for the same good in geographically separated markets will tend to equalize, so that price differences in the different markets are always less

or equal to transport costs (what economists call the law of one price).<sup>3</sup> If a single price drives geographically separated markets, then markets are integrated as a single market. Export concentration, government intervention, and product differentiation all can prevent the emergence of a single market as they drive a wedge between cross-border prices.

One way to study price linkages between the US and Mexican corn market is to test for cointegration between US and Mexican monthly data on corn prices during 1981-2003.<sup>4</sup> We use monthly and annual producer price data for corn.<sup>5</sup>

In this context, evidence in favor of the market integration and the law of one price scenario requires that US and Mexican corn prices should share a common trend (be cointegrated), and that the direction of change should be the same. If the coefficients of the cointegration relationship are stable over time or do not change over time, this indicates that the US and Mexican corn markets are well integrated, and that trade and other policies have not affected this price differential.

**Figure 4. US and Mexican Corn Producer Prices in Log Terms (Mex Peso/Metric Ton)**



The analysis reveals that the co-movement of the US export price and Mexican producer prices was quite high until the late 1980s, broke down briefly and then resumed after 1994; then, the two price series tended to diverge after 1996 (Figure 4).<sup>6</sup> These patterns combined with the additional tests shown in the Appendix constitute strong evidence



for the law of one price with a constant and statistically significant price differential. This result seems to hold across various subsamples, including the pre- and post-NAFTA periods. In line with Figure 4, we find that Mexican producer maize prices are higher than US prices. Columns 5-6 of Table A1 further suggest that the price differential was rising towards the end of the 1990s.

Moreover, the comparison of the point estimate of the constant during 1986-1994 (column 4 Appendix table A1) suggests that the price wedge after 1994 was not statistically different from the one observed in the eight years prior to the implementation of NAFTA.

In a nutshell, Mexican corn prices fluctuated in tandem with US prices before and after NAFTA and the margins that separated the prices in the two markets were virtually constant. If NAFTA had been the culprit of declining prices to poor farmers, we would have expected to see evidence that imports were driving Mexican prices ever closer to the US price. They did not.

### Conclusions for Policy

Given this evidence, it would be a stretch to conclude that NAFTA was the force depressing incomes of poor corn farmers in Mexico. To be sure, farmers were afflicted by a severe decline in the purchasing power of maize – but it was a trend that pre-dated NAFTA by a decade or more, and only temporarily interrupted by the devaluation of the peso in late 1994. Moreover, Mexico's volume of maize production actually *rose* after NAFTA in 1994, and primarily because of the efforts of farmers – mainly poor and subsistence -- producing rainfed maize. Finally, the subsidized corn coming into Mexico from the US after NAFTA had no measurable impact on the Mexican price that was any different before NAFTA.

These findings do not give heart to those who would advocate that lavish subsidies and border

protections in the rich countries do not matter for poor countries. Evidence here suggests Mexico's own program may have been critical to preventing the more adverse consequences of trade with the US. If US subsidies and protection in corn – in the form of price supports, ethanol programs, and high fructose corn syrup subsidies -- were to be phased out, Mexican farmers would likely benefit, and some of the pressure on Mexico's own budgetary outlays would be relieved. One important policy implication is that Mexico -- and those advocating the cause of the world's poor -- should continue to press for a strong Doha outcome that sharply reduces trade distorting subsidies and border protection.

A second implication is for domestic policy in Mexico. Prices of corn and other basic commodities are projected to continue to fall in real terms over the long run. Programs that help Mexican farmers become more efficient and diversify into newer and higher valued-added crops can markedly increase their productivity and standard of living. Improving agricultural extension to expose farmers to the latest technology and information about prices can help; investing in agricultural research to help modify seed varieties to local growing conditions, test new varieties, and experiment with alternative crops in diverse climatic and soil conditions is also essential. Over the long run, programs that help integrate the steady stream of migrants from countryside to city into higher value added jobs in manufacturing and services are particularly important. For this, improving the educational system is fundamental.

In the meantime, analysts and policymakers must make a stronger effort to understand the fundamental causes of rural poverty and the resilience of low-productivity rainfed maize production. The evidence discussed above highlights the fact that Mexican corn prices are not behaving according to what is expected from a free-trade, workably competitive environment, at least not more so after 1994 than prior to the advent of NAFTA.



**Appendix A: A cointegration analysis of US-Mexican corn prices**

In line with other research on price linkages in commodity prices (e.g. Asche 1999, Goodwin 2001, Yunez-Naude and Paredes 2003, Bessler et al., 2003), we use cointegration analysis to study price linkages between the US and Mexican corn market.

In a cointegration framework, market integration and the law of one price implies that US and Mexican corn prices are (1) cointegrated (i.e. share a common trend) and (2) that the coefficient of this cointegration relationship can be restricted to (1,-1). If a constant is introduced in the cointegration space and if this constant proves statistically significant, this constant can be interpreted as the long-run spatial price differential between US and Mexican corn prices. If the coefficients of the identified cointegration relationship prove stable over time we take this as evidence that (1) the US and Mexican corn market are well integrated and (2) trade and export policies have not affected the spatial price difference between the US and NAFTA. At the time of implementing NAFTA, many observers

expected that NAFTA would lower the spatial price differential between US and Mexican corn producer prices.

Table A1 presents the cointegration test results for various sub-samples of the data. For the full sample, we find that a dummy that takes the value of 1 during 1995-1997 and zero otherwise is needed in order to pass the (1,-1) restriction implied by the law of one price. Readers should note that in 1996 Mexico suffered a severe drought and imported record amounts of US corn (USDA, 2002). Thus we can safely treat the period 1995-1997 as an anomalous period where Mexican prices were driven by unexpected weather conditions.

A cointegration analysis between US and Mexican corn producer prices finds evidence for one cointegration vector. As a (1,-1) restriction cannot be rejected we take this as evidence that the law of one price holds. As analyses of different subsamples and model specifications (see Table 1) indicate parameter stability, we take this as evidence that the spatial price differential between US and Mexican corn prices has not changed over time.<sup>7</sup>

**Table A1. Summary of Hypotheses Tests of (1, -1, \*) Restriction for Various Sub-samples and Model Specifications**

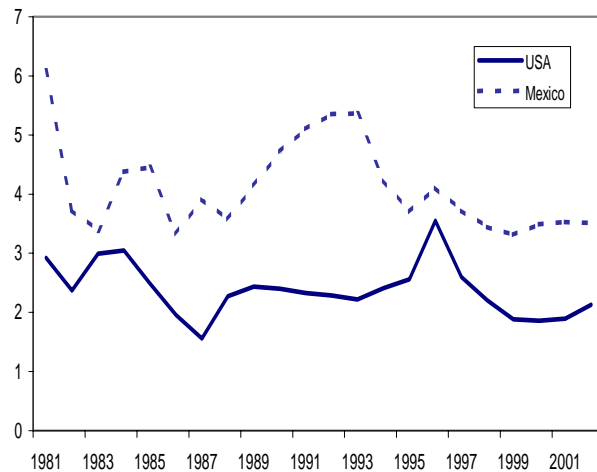
	1	2	3	4	5	6	7
Period	1981-2003	1986-2003	1981-1994	1986-1994	1994-2003	1998-2003	1999-2003
R=1 (c.v. 17.8)	67.64	51.55	41.37	29.11	28.43	17.7	21.0
Constant <sup>8</sup>	0.622 (0.044)	0.547 (0.038)	0.694 (0.079)	0.593 (0.067)	0.551 (0.034)	0.612 (0.033)	0.634 (0.028)
LR tests	CHISQ(1) = 3.32, p- value = 0.07	CHISQ(1) = 0.00, p- value = 0.94	CHISQ(1) = 7.29, p- value = 0.01	CHISQ(1) = 5.72, p- value = 0.02	CHISQ(1) = 1.20, p- value = 0.27	CHISQ(1) = 0.34, p- value = 0.56	CHISQ(1) = 1.41, p- value = 0.24

Source: Authors' calculations – see text. Notes: dummy 1994:12-1997:12 = 1. c.v.= 5% Critical Value of the Cointegration test statistic. Standard errors are in parentheses.





**Figure A1. US and Mexico Annual Producer Corn Prices in US\$ Per Bush**



Source: SAGARPA, USDA

<sup>1</sup> This was the prediction of a few academics prior to the implementation of NAFTA. See, for example, Levy and Van Wijnbergen (1992).

<sup>2</sup> The construction of the monthly series is explained further below, it is relevant at this point only to highlight the fact that it is also highly correlated with the implicit relative price series derived from the data on the values and volumes of maize production. Indeed, the devaluation of the peso in late 1994 and early 1995 was associated with a modest and transitory recovery of the relative price of maize during 1994-1996. The relative decline of the maize producer prices continued after 1997.

<sup>3</sup> When interpreting cointegration as support for the law of one price, lack of cointegration can also be caused by the non-stationarity of transportation costs (see Mohanty, Peterson and Kruse (1995)). In this case, the law of one price might still hold even though there is no evidence of cointegration.

<sup>4</sup> Building on other research on price linkages in commodity prices (e.g. Goodwin 1992, Asche et al. 1999, Yúnez-Naude and Barceinas 2003, Bessler et al., 2003), we use the cointegration approach of Johansen to test for cointegration between US and Mexican monthly data on corn prices during 1981-2003.

<sup>5</sup> Data for the US are period and season-average f.o.b. shipping point prices from the US Department of Agriculture. In the case of Mexico, the annual data is from the Mexican Ministry of Agriculture (SAGARPA), monthly data is derived from the

National Price Index of Producer Prices from the Bank of Mexico. We converted the index of monthly Mexican maize producer prices into a monthly series of prices by setting the 1981 season-average price from the annual SAGARPA data equal to the average of monthly prices for 1981 and applying the corresponding percentage changes observed in the monthly index.

<sup>6</sup> Figure A1 in the appendix displays annual price data from USDA and SAGARPA in US\$ per bushel.

<sup>7</sup> We can also not reject the law of one price and parameter constancy using annual data. Annual data (see Figure A1) supports the following long-run relationship, which is similar to the one for monthly data:

$$p_{mx} - p_{us} = 0.543, \quad \text{LR test:} \\ \text{CHISQ}(1) = 3.88, \quad p\text{-value} = 0.05 \\ (0.066)$$

<sup>8</sup> The constant measures the log of the US/Mexican corn price differential.

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### **Further Reading**

D. Lederman, W. Maloney and L. Servén. “Lessons from NAFTA for Latin America: A Summary of Research Findings.” World Bank: 2004

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