Explaining the Resilience of Maize Production in Post-NAFTA Mexico

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Abstract:

Computable general equilibrium models predicted that maize production in Mexico would fall substantially after the implementation of NAFTA due to greater maize imports from the US. Despite these predictions, Mexican maize production levels remained high after NAFTA. To investigate the reasons for the resiliency of Mexican maize production, I conducted semi-structured interviews with campesinos in Oaxaca, Mexico in August of 2007. For an analytical framework, I used the concept of shadow price, the notion that a product may have a subjective value for the household that is greater than its market price.

I found that campesinos persisted in cultivating maize because they receive non-market benefits from maize production and they encountered barriers to switching to more profitable. The incentives that lead campesinos to continue cultivating maize include culinary preference for their own maize, the cultural importance of maize production, the value of the husks and stalks as fodder, a government program that gives cash for cultivating land, and the diversification of household risk. The barriers to changing crop type include a lack of access to credit, technical assistance, and a capacity to bring produce to market.

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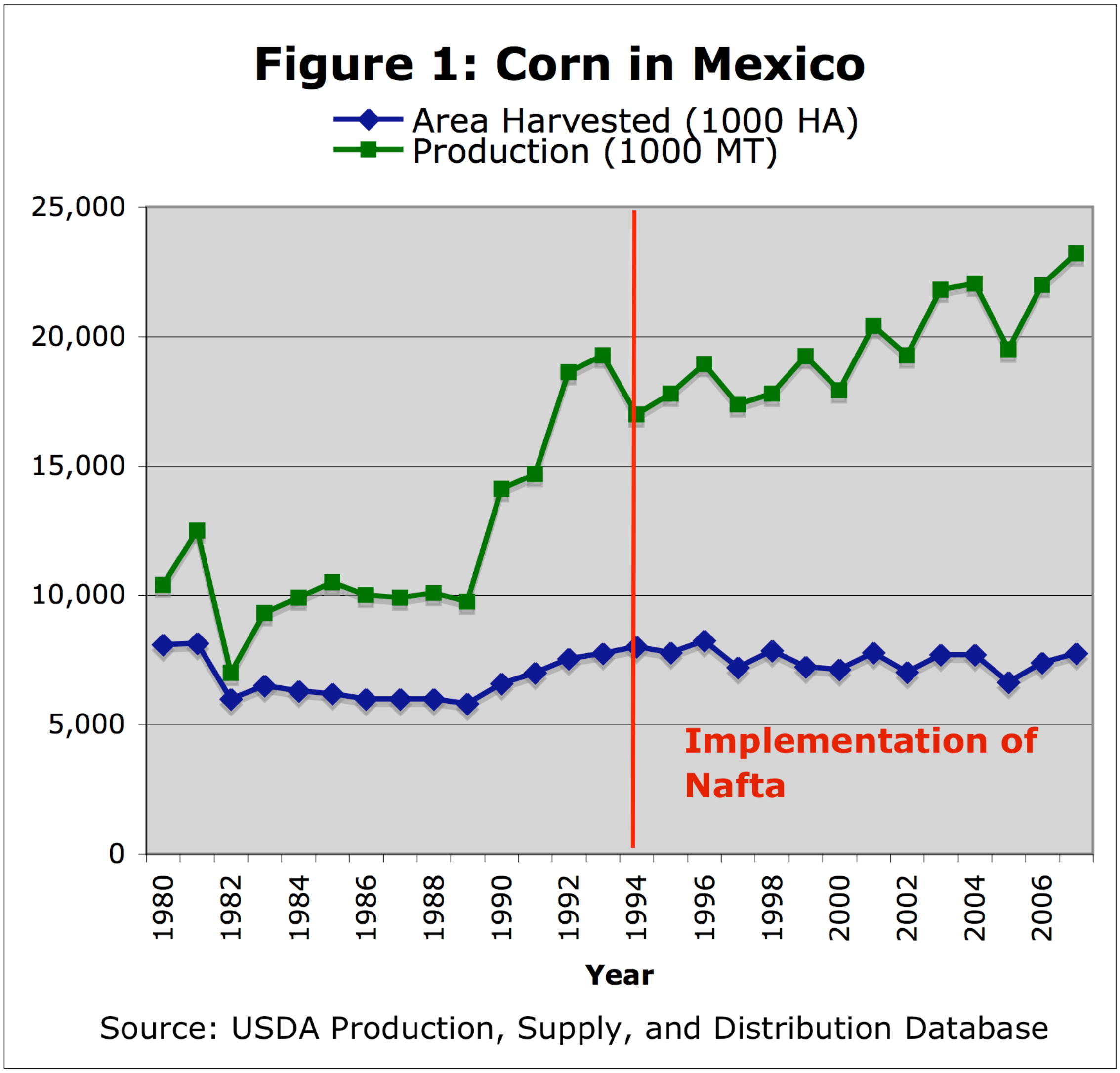
Ex-ante Computable general equilibrium models of the effects of NAFTA predicted that small-scale Mexican corn farmers would be devastated by the massive influx of US corn triggered by NAFTA's removal of trade barriers. One study estimated that up to 30 percent of Mexico's total agricultural labor force, or 2 million people, would be displaced by the drop in corn prices below the cost of production, many of them subsequently seeking employment in the US (Cornelius and Martin 1993). Another study found that total corn production in Mexico would decline by 25 percent due to lower prices (Janvry, Sadoulet, and Davis 1995). The opportunity cost of producing corn would rise relative to other activities like wage labor and migration, and farmers would exit the market.

After the implementation of NAFTA, economists were perplexed by the data they began to see on Mexican corn production, in spite of the steadily declining price of corn in Mexico. Imports of US corn into Mexico skyrocketed from 311,000 metric tons in 1993 to 5,600,000 metric tons in 2003 (Hufbauer and Schott 2005). The price of corn in Mexico declined by 33 percent from $4.84 per bushel in 1993 to $3.75 per bushel in 2003 (Hufbauer and Schott 2005). In spite of this collapse in prices, Mexican corn production initially remained stable after NAFTA came into effect, and then gradually increased. Between 1993 and 2003, corn production in Mexico increased by 17 percent from 18.6 million metric tons to 21.8 million metric tons (Hufbauer and Schott 2005). Little of this increased production was due to a rise in corn yields. As Figure 1 indicates, the area under corn cultivation did not decline during the period under study. Furthermore, household surveys conducted by the Mexican government reveal that



Mexicans did not abandon corn growing in droves as expected. Between 1993 and 1999, the proportion of rural dwellers in Mexico that considered themselves corn farmers only decreased from 15 percent to 14 percent (McMillan, Zwane and Ashraf 2005).

This absence of significant response from campesino households was startling to economists, particularly since the effect upon maize farmers of NAFTA was one of the most hotly debated topics in Mexico at the time of implementation. One of the first hypotheses was presented in *NAFTA Revisited* by Gary C. Hufbauer and Jeffrey J. Schott. The argued that Mexican maize farmers were not much affected by US imports because the distinction between yellow maize, which accounts for most of US maize production, and white maize, which accounts for most of Mexican production (Hufbauer and Schott 2005). Mexicans use only white maize for food; yellow maize is reserved for livestock as feed. In addition, the price of white maize generally runs about 25 percent higher than the price of yellow maize (Hufbauer and Schott 2005). Thus, the implementation of NAFTA and the inflow of US yellow maize into Mexico that followed it did not have any appreciable effect on Mexican maize prices, so Mexican farmers produced maize at the same level as before NAFTA.

Supplementing this argument, Fiess and Lederman contend that NAFTA's trade liberalization did not cause the observed drop in Mexican maize prices (Lederman and Feiss 2004). They claim that the decline in Mexican maize prices was a long-term trend that preceded NAFTA. They use a model to determine if US and Mexican maize prices moved together more closely after 1994 than before 1994. They find that US and Mexican maize prices move together equally as close before and after NAFTA, which apparently proves that NAFTA did not have a direct effect on Mexican maize prices (Lederman and Feiss 2004).

Questions of methodology challenge the claim of Fiess and Lederman that NAFTA does not account for the decline in the Mexican price of maize. McMillan, Zwane, and Ashraf criticize their paper since their model uses nominal prices instead of real prices, which is a relevant issue with the peso devaluation in 1995 (McMillan, Zwane, and Ashraf 2005). In addition, Fiess and Lederman inexplicably use dummy variables for 1995, 1996, and 1997 to compensate for a draft that occurred only in 1996. This dummy variable covers half of the post-NAFTA period under study. McMillan Zwane, and Ashraf correct these perceived shortcomings in their own model and conclude that Mexican maize prices moved more closely with US maize prices after NAFTA than before.

Yunez-Naude and Paredes, on the other hand, acknowledge that NAFTA affected the Mexican national price of maize, but challenge the assumption that the changes in price were transmitted to the campesino (Yunez-Naude and Paredes 2004). They hold that the change in the market price of maize in Mexico did not affect the incomes of Mexican small maize farmers because they are isolated from the broader market price due to high transaction costs to sell and transport maize in rural infrastructure (Yunez-Naude and Paredes 2004). The transportation network is so poor that it is three times more costly to ship maize to Mexico City from Sinaloa state in northwestern Mexico than to ship maize from New Orleans to Mexico City, for example (Hufbauer and Schott 2005). According to Dyer and Taylor, though, their explanation is unconvincing because the public agricultural marketing network DICONSA, which buys maize at an equal price across Mexico exists in almost 23,000 rural communities and reduces transactions costs to almost zero (Dyer and Taylor 2003). Maize is also rarely shipped far from the producer because food processing such as tortilla production is decentralized. Therefore, the price that small maize farmers receive is not very much isolated from the national market price, which might be expected due to high transportation costs (Dyer and Taylor 2003). In addition, maize growers that do not sell outside of their local communities are affected because the large growers in each community effectively transmit the national price of maize to the local level (Dyer and Taylor 2003).

Another hypothesis claims that the explanation for NAFTA's paradoxical effect on maize production lies in the fact that there are low, not high, transactions costs in the market for landing Mexico. It tries to explain involves the effect of low maize prices on the market value of agricultural land, which is assumed to be easily traded. The drop in maize prices due to the implementation of NAFTA decreased the profitability of any given piece of land in the areas of rural Mexico where maize is produced because growers could only fetch a lower price for their maize with the same production costs as before liberalization. This lower profitability decreased the value of land and increased the relative benefit of leasing out land as opposed to growing maize or another crop on the land. Small maize farmers therefore found that the price of leasing in land fell with the fall in price of maize. Dyer and Taylor claim that decreased land prices due to low maize prices encouraged subsistence farmers to lease in more land for cultivation, increasing their maize production, but not making up for the loss of income due to lower prices (Dyer and Taylor 2003). This is the one other hypothesis besides the effect of PROCAMPO that plausibly helps explain the resilience of Mexican maize production.

In 1994 the Mexican government initiated a cash transfer program called PROCAMPO. The program was designed to handle issues that Mexican policymakers believed would arise with the advent of NAFTA. When conceived, PROCAMPO had several objectives: "political (to manage the political acceptability of the free trade agreement among farmers), economic (to provide farmers with liquidity to adjust production to the new set of relative prices), and social (to prevent an increase in already extensive levels of poverty among smallholders and a rapid process of outmigration to the cities and the border in the North)" (Saduolet, Javry, and Davis 2001).

Under PROCAMPO, the Mexican government gives a sum of money to farmers each growing season based on their cultivation of certain crops that are endangered by liberalization (maize, beans, rice, wheat, sorghum, barley, soybeans, cotton, and cardamom) during the three years prior to NAFTA's implementation. These crops were targeted by PROCAMPO since they can be produced at lower cost in the US and Mexican farmers of the crops would be quickly driven out of business For each hectare of the designated crops grown prior to NAFTA, farmers received US$68 per year, with the average farmer receiving US$329 per year (Saduolet, Javry, and Davis 2001). PROCAMPO gives about US$900 million each year to three million farmers (Saduolet, Javry, and Davis 2001). To continue receiving PROCAMPO payments, farmers must use their land for cultivation (not necessarily of the original grain crop), livestock, forestry, or an approved environmental program. As originally designed, the program would give constant payments each year for the first ten years of the program and gradually phase out payments for the remaining five years of the program.

Overall, the effect of PROCAMPO has been to encourage small Mexican maize farmers to continue cultivating maize. Yunez-Naude and Paredes report that PROCAMPO was the major factor in the increase of the Producer Support Equivalent (PSE) for maize, or the monetary value of government transfers to farmers divided by the value of receipts from the farmers' sale of commodities, from 28% in 1995 to 50% in 2001 (Yunez-Naude and Paredes. 2004). The rise in the PSE has maintained maize cultivation as a viable economic activity, which has resulted in a boost in overall maize production. One study estimated that without PROCAMPO, the annual production of maize during 1994-1996 would have been 2.86 million metric tons less than the actual production (Salazar 2001).

Sadoulet, de Janvry, and Davis' analysis of Mexican government survey data reveal that small maize farmers are using PROCAMPO to reinforce and improve traditional economic activities instead of diversifying. Seventy percent of maize farming households report that they spend the money they receive from PROCAMPO on inputs for maize cultivation Sadoulet, de Janvry, and Davis 2001. In the survey, these farmers have indicated that the money that PROCAMPO provides them is insufficient "to induce changes in cropping patterns or in the extent of areas planted," (Sadoulet, de Janvry, and Davis 2001). Indeed, there is "no evidence of technological change or of the introduction of new activities" among small-scale Mexican maize farmers (Sadoulet, de Janvry, and Davis 2001).

Inadequate payments from PROCAMPO only partly explain the inability of small maize farmers to switch into high-value crops. The necessary conditions for transitioning to capital-intensive horticultural crops are scarce in rural Mexico today. Firstly, small farmers have very little access to credit. The macroeconomic crisis of 1995 severely curtailed existing credit schemes and they have been unable to properly recover (Yunez-Naude and Paredes 2004). Currently, only 18 percent of the ejido dwellers have access to formal credit (Sadoulet, de Janvry, and Davis). Credit is necessary to construct irrigation systems for fruit and vegetable production. Rains are not enough to grow horticultural crops in the relatively dry climates of Mexico.

Due to the generalized retreat of the state from agriculture, technical assistance is also lacking. Faced with these conditions, small maize farmers can only use their PROCAMPO payments to meet their immediate concerns of purchasing adequate inputs to cultivate maize like they have been doing for decades. They cannot attempt anything more ambitious than that and thus they are stuck in the cycle of poverty.

Overall, hypotheses concerning the perverse response of campesinos to changes in the price of maize have drawn much on economic theory, but they have not driven to the heart of how Mexican rural households make decisions concerning maize production; campesino households take note of much more than just the market price of maize. These also have been largely devoid of detailed household-level data about non-market factors that could affect production decisions. My preliminary research trip to Oaxaca, Mexico was intended to collect this elusive and shed some more light upon this paradoxical phenomenon.

Statement of Research Question:

I am studying the factors that affect campesinos' decisions to continue cultivating traditional crops like maize instead of to switch to cash crops like tomatoes because I want to find out under what conditions campesinos will change their crop under production.

Model:

The concept of shadow price was developed to measure the value of products or factors of production that, due poorly functioning markets, are not traded on the market. The value of these nontradables must be investigated because they affect the household production and consumption functions. The most well-known example of the use of shadow price is the shadow price of family labor (Arslan 2006). Since family members are the direct beneficiaries of their labor, there is no principal-agent problem and little shirking. The value of the marginal product of family labor is greater than the value of the marginal product of hired labor because there is little shirking. The price of the family labor would be greater than the price of hired labor for this reason. There is a missing market for family labor, however, since the family cannot be expanded by hiring other people. Since there is no wages pad to family labor per se, we cannot directly observe the value of this labor.

Aslihan Arslan argues, as I do, that the market for home-produced maize for home consumption is a special type of missing market (Arslan 2006). This maize has "byproducts" that cannot be purchased on the open market, such as fodder, collection of PROCAMPO payments, and diversification of risk. This maize therefore has a high shadow value compared with the market price of maize in Mexico.

Arslan mentions some possible sources for the high shadow price of maize, but I would like to dissect the shadow price into its component parts, which I believe are:

I will use a household utility model employed by Arslan in which the campesino household maximizes utility by choosing to consume amounts of home-produced subsistence crop (X_a^h), cash crop (X_c), market goods (X_m), and leisure (X_l), taking into consideration each household's individual characteristics (Z):

(1) $U_{max} (X_a^h, X_c, X_m, X_l ; Z)$

Subject to:

For all consumed goods Xi: $UX\ i = \lambda p_i - \gamma_i$

For all produced goods Q_j: $C_{Qj} = p\ j - \gamma_i / \lambda$

Letting λ denote income and,

Letting γ_i denote the market constraints for the good

Due to poorly functioning land markets, the amount of land that a household can put into production is fixed, so the amounts of subsistence crops and cash crops produced are inversely related. L is labor and I is inputs. The production function for subsistence crops is:

(2) $Q_a = q_a (L_a , I_a)$

And the production function for cash crops is:

(3) $Q_c = q_c (L_c, I_c)$

To model the households' decision of what mix of cash crops and maize to produce, I will use a graphical model that is based on the Production Possibilities Frontier (PPF), or budget constraint, developed by M. Eric Van Dusen and J. Edward Taylor (Dusen and Taylor 2005). This model estimates the quantity supplied of two goods, one with a perfect market (Q_b) and one with a missing market (Q_a)

516 *M. Eric Van Dusen and J. Edward Taylor*

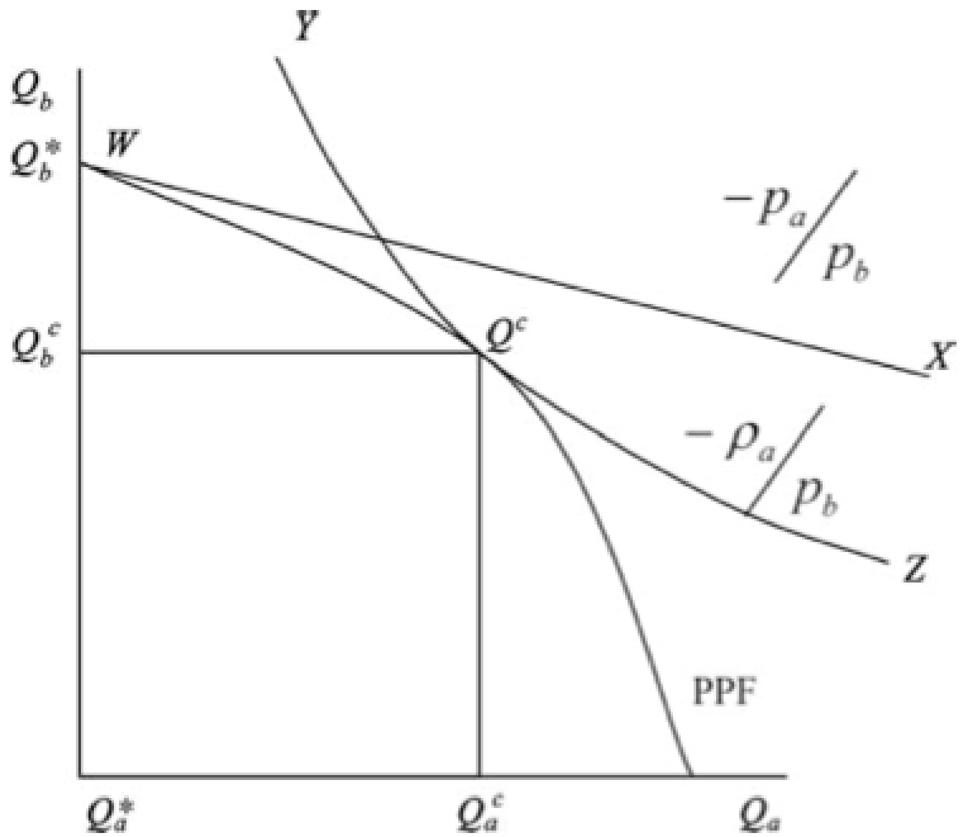


Figure 2. *PPF for two goods with outputs Q_a and Q_b, with a missing market for good a.*

Where p_a is the market (exogenous) price of good A

p_b is the market (exogenous) price of good B

ρ_a is the shadow (endogenous) price of good a

(4) WX is the price line where households do not consider shadow prices, the slope of which is equal to $- p_a / p_b$

(5) YZ is the price line where households consider shadow prices, the slope of which is equal to $- \rho_a / p_b$

Q_a^* is the quantity supplied of good A by the household if WX is in effect

Q_b^* is the quantity supplied of good B by the household if WX is in effect

Q_a^c is the quantity supplied of good A by the household if YZ is in effect

Q_b^c is the quantity supplied of good B by the household if YZ is in effect

In Dusen and Taylor's model, with perfectly functioning markets for both goods, price line WX predicts the output of both goods. Q_b is equal to Q_b^* and Q_a is equal to zero where the PPF and WX are tangent. In other words, when a household obeys WX, all of its productive resources are employed in producing good B and it produces no quantity of good A.

The price line appears like an indifference curve . Making the traditional assumption that there is diminishing marginal utility for each good, the curve is convex to the origin

Dusen and Taylor assert that "[t]he household's subjective valuation of good A is reflected in a shadow price, ρ_a, which is shaped by the household's marginal utility of the good… .The curvature of this price line reflects diminishing marginal utility of household consumption of the non-market crop."(517) Therefore, the line YZ is convex to the origin, appearing in the graph like an indifference curve.

Dusen and Taylor's model can be used to predict campesinos' response to changing in prices of the two goods. When the prices change, the slopes of the price lines will change, and the output of each good will change.

p_a^1 is the market (exogenous) price of good A in 1993

p_b^1 is the market (exogenous) price of good B in 1993

p_a^2 is the market (exogenous) price of good A in 2005

p_b^2 is the market (exogenous) price of good B in 2005

WX^1 is the price line without shadow prices in 1993

WX^2 is the price line without shadow prices in 2005

In Scenario A, then,

$p_a^2 = 3$ pesos/kg[i]

$p_b^2 = 7$ pesos/kg[ii]

$WX^2 = -0.429$

To estimate tomato and maize prices in Santiago Amoltepec in 1993, I will multiply the 2007 observed prices by the percent change in real prices of the two commodities in Mexico between 1993 and 2006, according to the FAOSTAT price database.[iii]

$p_a^1 = 3.8$ pesos/kg

$p_b^1 = 6$ pesos/kg

$WX^1 = -0.645$

(6) Δ_{WX} is the percent change in the slope of WX, 1993-2005, which produces a correspondingly proportional downward shift in maize production.

$\Delta_{WX} = (WX^1 - WX^2)/WX^1$

Δ_{WX} = (-0.645 – (-0.429))/0.645 = -0.335

Scenario B:

See Appendix A for how I derive ρ_a^1 and ρ_a^2

ρ_a^1 is the shadow (endogenous) price of good A in 1993

p_b^1 is the market (exogenous) price of good B in 1993

ρ_a^2 is the shadow (endogenous) price of good A in 2005

p_b^2 is the market (exogenous) price of good B in 2005

YZ^1 is the price line with shadow prices in 1993

YZ^2 is the price line with shadow prices in 2005

ρ_a^2 = 10.40 pesos/kg[iv]

p_b^2 = 7 pesos/kg[v]

YZ^2 = -1.49

ρ_a^1 = 10.47 pesos/kg[vi]

p_b^2 = 6 pesos/kg[vii]

YZ^1 = -1.75

Δ_{YZ} is the percent change in the slope of YZ, 1993-2005, which produces a correspondingly proportional downward shift in maize production.

(7) $\Delta_{YZ} = (YZ^1 - YZ^2)/YZ^1$

$\Delta_{YZ} = (-1.75 - (-1.49))/1.75 = -0.146$

Conclusion:

The calculations show that Δ_{WX} is over twice as large as Δ_{YZ}, indicating that Scenario A predicts a large decrease in the amount of corn supplied by households and a large increase in the amount of tomatoes supplied compared with Scenario B. Since the observed result was very little change in the area of maize under production, the null hypothesis is invalid and the alternative hypothesis appears correct. A model that include shadow price in its analysis has greater predictive value than a model that only considers market price. The large shadow price of maize seemed to have diluted the effects of the change in market price.

Appendix A: Composite of ρ

The value of traditional crops is a composite of the market value of the crop plus the value of the shadow prices:

(A1) $\rho = p_a^m + p_a^t + p_a^s + p_a^f + p_a^g + p_a^r$

Where:

p_a^m is the price of the maize on the open market

p_a^t is the premium campesinos place on home maize production due to their culinary preference for landrace maize varieties

p_a^s is the value campesinos place on home maize production due to is function in maintaining social bonds both within the household and between families within a community

p_a^f is the price on the local market for the husks and stalks of the maize plant can be sold as fodder for livestock or as tamale ingredients;

p_a^g is the value of the PROCAMPO payments for cultivating land with maize

p_a^r is the value to the household of producing maize for the purpose of diversifying risk to protect against exogenous shocks to other income sources.

Open Market Price: p_a^m

In 2005 the domestic producer price of maize was about 3000 pesos per metric ton, or 3 pesos per kilogram. According to INEGI, the average maize yield per hectare in Santiago Amoltepec in 2005 was .85 tons per hectare.

Culinary Preference: p_a^t

Oaxaqueno campesinos claim that the maize that they grow themselves tastes better than the maize flour they can get at the local Diconsa store. Having tasted tortillas in Santiago Amoltepec, I have to say that I agree with them.

The value of this variable's contribution to the shadow price is difficult to determine.

Social Value: p_a^s

Using language-based definitions of ethnicity, about 40 percent of Oaxaca's population is indigenous, one of the highest densities in Mexico. The ancestors of Mexico's indigenous peoples were the agriculturalists who developed maize itself over millennia to become the nutritious grain that we know today. A resident of Oaxaca City explained that the statues and embellishments on the inside of the Church of Santo Domingo had double meanings, one honoring the Christian religion, the other honoring indigenous traditions, such as the dual role of a statue representing Mary and Centéotl, the Goddess of Maize and Agriculture.

Similarly, my host in Santiago Amoltepec took me on a tour of his family's maize field and explained to me that they followed an ancient tradition to determine when to plant maize. He explained that a certain insect will make a distinctive chirping noise in the spring when good rains are soon to arrive. Corn production is a way to maintain a link to their tradition. Indeed, Santiago Amoltepec has a bilingual (Spanish and Mixtecu) primary school to ensure that the children of the community do not forget their roots.

Home maize production also plays a very concrete, present-day role in rural Oaxaqueno social life. Many ethnic groups in Oaxaca engage in mutual aid or cost-sharing practices that revolve around landrace maize. Gozonas among the Zapotec communities is one such system. Gozonas are typically held for weddings, funerals, house-raisings, and religious fiestas. One household within the community invites households for the event with the expectation that they will bring food, especially tortillas. The contribution of each family is often noted in a ledger. The inviting family is then expected to pay back that "loan" to each family in tortillas (Gonzalez 2001).

I also witnessed the intra-household bonding function of home maize production and tortilla production. The converse of Mexican machismo in the fields and streets is matriarchy in the home. The three generations of women in the house where I stayed woke up early to produce tortillas on a wood-fired tortilla basin, despite the fact that the house had a gas stove. Every time I simply walked through the kitchen during the day, the grandmother of the house would urge me to "eat, eat," which suggested to me that in some way the women of the house found their purpose and place in the family as providers of food for the family with the use of landrace maize.

The value of this variable's contribution to the shadow price is difficult to determine.

Due to the nature of benefits, I was unable to collect direct quantitative data on the value added to shadow price based on consumer taste preference and social benefits. One technique to help economists measure shadow prices is a measurement of "willingness to pay," or the income that an individual will forgo to continue producing or consuming the good. One way to determine the “willingness to pay” is the expenditure on capital goods for the production of the commodity in question. The major capital expenditure for the production of maize in Santiago Amoltepec was herbicide (“liquido”). For one hectare for one season:

Number of liters	Price per liter	Total cost
12 liters	100 pesos (10 USD)	1,200 pesos (120 USD)

Value as Fodder: p_a^f

Livestock husbandry in Oaxaca is both a capital good as well as an income-smoothing strategy. In the mountainous regions of Oaxaca, draft animals are often more effective than vehicles in moving goods to market and tilling the soil. Additionally, livestock can be sold at market when a household falls on hard times. Cows and goats were called better than banks because “you can’t eat money.”

Since livestock are very valuable in Oaxaca, potential sources of feed also have value. The “waste” organic matter of the maize plant is very suitable for this purpose. Store-bought feed cannot be transported to remote pueblos in a cost-effective manner. Typically, an owner of livestock pays a neighbor to “clean” his neighbor’s field after harvest. The fodder is fed to the livestock during the dry season (tiempo seco), which is typically December through April, when the animals have no grass to graze upon. Presumably, the value of the maize fodder would be greater in more remote areas where access to other forms of animal feed is limited.

Pueblo	Transactions cost characteristics of pueblo	Price per bundle of maize fodder	Number of bundles per hectare per harvest	Fodder revenue from harvest of one hectare
Tlanichico	45 minutes drive from Oaxaca City; accessible by paved highway.	10 Pesos	100	1,000 pesos (100 USD)
Santiago Amoltepec	12 hour drive from Oaxaca City, mostly by dirt roads. High in the Sierra Madre del Sur.	10-15 Pesos	80	800-1,200 pesos (80-120 USD)

Distortion due to PROCAMPO: p_a^g

PROCAMPO was originally intended to have a minimal impact upon the type of crop produced. The payments were not linked directly to the amount of a certain crop produced; SAGARPA merely required that something be planted on the land that was registered in the program. It was thought that this design would "decouple" production decisions from the transfer payments, avoid the market distortion and inefficiency that can occur when farmers from supply more maize than the free market would dictate. There is theoretical and anecdotal evidence that questions this assumption

The type of decoupling that SAGARPA devised for PROCAMPO is effective in contexts where production and consumption decisions of firms and households are considered separately, such as in the United States. In rural Oaxaca, however, production and consumption outcomes are determined by the same decision matrix. The firm and the household are one in the same.

Furthermore, PROCAMPO promotes a certain rigidity in the labor market. Heads of the household are unable to take time away from their land to earn wages urban areas, Northern Mexico, or the US. If these individuals miss a planting season, they are dropped from the program. Thus, PROCAMPO provides an incentive for continuing to plant maize instead of engaging in potentially more profitable and efficient activities like urban wage earning.

In Tlanichico, Maria, the community liaison for PROCAMPO, took me on a brief tour of some of the fields in her pueblo. She pointed to one of the fields in the distance and said that the owner of the field had been troublesome for her monitoring efforts. While recently checking to make sure that all the lands in the program were actually being cultivated, she noted that that field was not planted. She brought up the breach with the owner of the land and said that he would be taken off the PROCAMPO payment list if he did not comply with the conditions. According to Maria, the land was tilled and planted with maize within a few days of her warning. Hearing this anecdote confirmed to me that PROCAMPO induced people to cultivate more maize than they would if the program did not exist.

Measurement of intangible factors

To measure the intangible factors that compose the shadow value of maize, I considered the willingness of the average campesino to forgo potential income from tomatoes in order to continue planting tomatoes. Most campesinos were not willing to begin to plant tomatoes without government assistance. Once offered assistance, they would be willing to cultivate tomatoes, though. I deduced that the threshold for beginning to plant tomatoes is somewhere between the incomes derived from non-government-assisted tomato cultivation and government-assisted tomato cultivation. That threshold is equal to the willingness to forgo income to plant maize, which is equal to the intangible factors that compose the shadow price. For the non-government-assisted tomato income, I considered the tomato income of one farmer who had decided to plant without government assistance. For government-assisted tomato income, I considered the tomato income. To simplify matters, I assumed that the threshold lay directly between the two income values.

Table 1: **Would you plant tomatoes if you received government technical assistance?**

Respondent	Type of crops	Number of Hectares owned	Age	Would plant tomatoes?

		by family		
Respondent A	Maize, beans, squash	2	23	Yes, part of land
Respondent B	Maize, beans	2.5	28	No
Respondent C	Maize, beans, squash	3	23	Yes
Respondent D	Maize, beans	5	22	Yes

Table 2: **Tomatoes grown by entrepreneurial campesino:**		
Yield	1,000	kilograms of tomatoes hectare per season
Seasons	× 1	growing seasons
Price	× 7	pesos per kilogram (lower quality tomato)
Inputs	- 2,000	pesos for purchase of tomato plants
Profit	**5,000**	**pesos per year per hectare**

Table 3: **2005 Shadow price from maize cultivation:**		
Market price (p_a^m)	3	Pesos/kg
Fodder value (p_a^F)	+ 1.16	Pesos/kg
PROCAMPO payments (p_a^g)	+ 0.8	Pesos/kg
Intangible factors ($p_a^t + p_a^s + p_a^r$)	5.44	Pesos/kg
Total	**10.40**	**Pesos/kg**

Table 4: **1993 shadow price from maize cultivation:**		
Market price (p_a^m)	3.87	Pesos/kg
Fodder value (p_a^F)	+ 1.176	Pesos/kg
PROCAMPO payments (p_a^g)	+ 0	Pesos/kg
Intangible factors ($p_a^t + p_a^s + p_a^r$)	1.9	Pesos/kg
Total	**10.47**	**Pesos/kg**

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[i] Respondent E, interview by author, 21 August 2007, Santiago Amoltepec, Oaxaca, Mexico, tape recording.

[ii] Respondent D, interview by author, 20 August 2007, Santiago Amoltepec, Oaxaca, Mexico, tape recording.

[iii] FAOSTAT Database. Rome, Itay: FAO. Available from http://faostat.fao.org/site/351/default.aspx Accessed December 5, 2007.

[iv] Respondent E, interview by author, 21 August 2007, Santiago Amoltepec, Oaxaca, Mexico, tape recording.

[v] Respondent D, interview by author, 20 August 2007, Santiago Amoltepec, Oaxaca, Mexico, tape recording.

[vi] Respondent E, interview by author, 21 August 2007, Santiago Amoltepec, Oaxaca, Mexico, tape recording.

[vii] Respondent D, interview by author, 20 August 2007, Santiago Amoltepec, Oaxaca, Mexico, tape recording.