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**Adjustment in Mexico's Crop Sector to Some Policy Changes
Implemented in the 1990's**

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Adjustment in Mexico's crop sector to some policy changes implemented in the 1990's

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Summary: This paper contains analysis of potential effects of changes in the structure of farm support resulting from policy change in Mexico undertaken over the period 1989 to 2002. The analysis is based on observed changes in the level and composition of support as measured for the PSE. This information is used together with a model of Mexico's crop sector, the PEM, to derive predictions of policy effects and their implications for adjustment. These predictions are then compared with data revealing trends in crop production, yields, farm employment and purchased input use. The paper concludes that policy changes were a significant contributory factor to crop sector adjustment, but that other factors must have been at play as well.

¹ The views expressed in this paper are those of the author and are not those of the OECD or of its member governments.

1. Introduction and scope

In the late 1980's Mexico launched a series of agricultural policy changes the net effect of which has been to alter substantially the structure of government support to farmers. Throughout most of the 1980's, producer prices for major agricultural products were set (or strongly influenced) by government purchases of basic commodities, export and import controls, including import licensing, and direct subsidies to private and public sector food processors.

Concurrent with the negotiations leading up to the implementation of the NAFTA in 1994 Mexico's agriculture and trade policy framework changed fundamentally. The most important of the reforms was the replacement of the system of guaranteed prices and state purchases by a system of land-based direct payments.

This paper uses a model of crop production, consumption and trade to develop hypotheses about the nature and magnitude of pressures for structural adjustment in the Mexican crop sector created by that switch. The validity of some of those hypotheses is then evaluated using information on crop output and factor use trends that have been identified in recent data. The analysis focuses mainly on national aggregates or on indicators based on survey data but possibly indicative of national trends. Moreover, the commodity focus is on those crops covered in PSE calculations that were most directly affected by the policy changes observed – maize, sorghum and wheat.

There are two dimensions of the economic structure of agriculture that need to be addressed in evaluating policy effects. One concerns the distribution of the value of farm production amongst productive factors without regard to who owns or supplies those factors, i.e., the factor composition of production. The other concerns the characteristics of economic agents that own and supply those factors. Especially important in the latter case are the economic characteristics of households who supply their human capital and land to farming. This paper focuses rather more on the effects of Mexico's policy change on indicators measuring the factor composition of production - the first dimension. Ongoing analysis at the OECD addresses policy effects for different categories of representative farm households distinguished by a range of economic characteristics including, e.g., economic class and size of farm.

2. Evolution of policy and support

Before the policy reforms undertaken during the 1990's government intervention in markets for most farm commodities produced in Mexico was pervasive. Market prices for most staple commodities prices were set administratively and defended through purchases and storage by parastatal marketing organisations and by import licenses and tariffs. Farmers also benefited substantially from subsidized prices of seeds, fertilizer, pesticides, machinery and diesel fuel.

Policy reforms initiated in conjunction with Mexico's joining the GATT and the negotiations NAFTA led ultimately to the dismantling of most of the parastatals and the near complete withdrawal of the state from procurement and marketing functions. Guaranteed prices were eliminated in 1988/89 for wheat, sorghum, barley, rice and oilseeds and most trade barriers were lowered or eliminated. Likewise, there were substantial reductions or elimination of subsidies to purchased inputs. (World Bank, 1999) Complementing those market reforms were extensive land reforms, implemented in 1992. Importantly, these latter reforms included the elimination of restrictions on land transactions which had previously constrained the sale, rental or financing of land.

One vestige of the former system of government market intervention remains. An agricultural marketing board administers a program of deficiency type direct payments that, in effect, gives some crop producers prices somewhat higher than the market would otherwise provide them. The subsidies, which may vary by

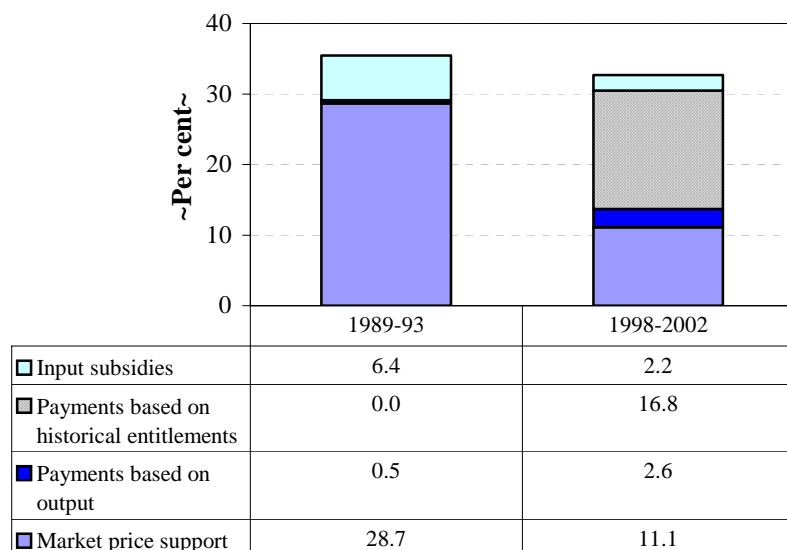
region, are based on a comparison between an administered price and the hypothetical delivered price based on international market conditions. Farmers sell their crop to processors at the international price and the government makes up the difference. In the PSE classification these payments are in the category 'payments based on output'.

The most important policy development following the reduction in trade protection and the elimination of input subsidies was the introduction, in 1993, a major program of direct payments called PROCAMPO. Farmers, who had an established history of production of eligible crops (barley, dry beans, maize, cotton, rice, sorghum, soybeans, sunflower and wheat) received payments partially based on their historical plantings. Per hectare payments are the same for all farmers, require agricultural production or that the land be used in an approved environmental program but are granted without regard to the agricultural use to which the land is put. The link to plantings history places these payments in a category of the PSE called 'payments based on historical entitlements', a category shown in previous research to be among the least distorting to production and trade. (OECD, 2001)

The payments are per hectare of base period plantings but given for the minimum of 1 hectare regardless of the actual size of the farm and for a maximum of 100 hectares. The minimum entitlement is significant as it is estimated that 1.2 million maize farms have less than one hectare of maize plantings. Those farms constitute approximately 36 percent of the total number of farmers receiving payments, but less than 10 percent of total area planted. (DeGorter and Short, 2002)

Yunez-Naude (2001) and Appendini (2003) contain comprehensive accounts of all these policy changes and the political context in which they occurred. Here the focus is on what these reforms may have meant for the structure of farm support and the implications for adjustment by those impacted most by them. Figure 1 shows the change in the composition of the PSE by comparing 5-year averages of the components of the percent PSE between the pre-reform period 1989-93 and the most recent 5-year period for which such data are available 1989-2002. The numbers in Figure 1 and in all subsequent Figures and tables refer to the same 5-year averages and have been aggregated across three crops: maize, sorghum and wheat. This was done both to simplify the analysis and in light of the fact that the most important category of support provided currently is historical entitlement payments, payments made without regard to which of those crops is actually produced.

Figure 1. Level and composition of crop PSE



Source: PSE/CSE database, OECD, 2002.

The height of the two histograms in the Figure corresponds to the level of the overall PSE. Pair wise comparisons of the components reveal changes in the extent of support by category. These data reveal a slight reduction in the PSE between the periods but a substantial switch in the composition of support consistent with the move from market based policy measures towards the historical entitlement payments. There was as well a small reduction in the contribution to the total PSE of input subsidies, mainly due to a reduction in subsidised credit. Finally there is a small increase in the amount of money given in the form of output subsidies. The next section considers the adjustment pressures these developments may have engendered.

3. Model and simulation results

The reduction the overall level of support and the switch from market price support to historical entitlement payments revealed in Figure 1 suggest a possibly significant change in production and factor use incentives. In this connection it is helpful to recall that one way of interpreting market price support is as a subsidy uniformly distributed amongst all inputs. On the other hand, historical entitlement payments constitute a subsidy targeted, but only weakly linked, to the use of land in cropping.

The potential magnitude of policy effects associated with the observed changes in support measures are to be investigated using the PEM model of crop production, consumption and trade. PEM is a multi-market policy model of the grains and oilseeds sectors of OECD countries including Mexico. The model is comprehensively documented in OECD (2001).

Commodity supply in the PEM is represented in terms of an aggregate production function and the associated factor demand and factor supply functions. PEM factor market coverage for Mexico includes labour (an aggregate of family and hired), land, fertilizer and an aggregate of other purchased inputs. Supply and demand equations for all crops in the model and for all the factors used to produce those crops relate quantities and prices at the farm level. Policy is represented in terms of price wedges that either boost the price producers receive for their output or reduce prices they pay for factors. Commodity price wedges appear in price equations in the model that link domestic prices to world market reference prices.

Land, labour and purchased inputs are assumed non-tradable and thus the price distortions in those markets are represented as price wedges in equations linking supply and demand prices.

The price wedges are calculated from data in the PSE database and measured as percentages of the supply inducing prices of crops and factors. The supply inducing price for a crop is the price the producer receives, inclusive of market and output price support. The supply inducing price for a factor is the price (may be an implicit or 'shadow' price) a factor supplier receives, inclusive of subsidy. Table 1 compares 5-year averages of these percentages for 1989-93 and 1998-03. Bear in mind when comparing these percentages with those shown in Figure 1 that the numbers in the latter measure support for each category as a *percent of total producer receipts* while the numbers in Table 1 measure support for each category as a *percent of supply inducing prices*.

Table 1 – Price support and factor subsidies

	1989-93	1998-03
Category of support:	<i>Percent of supply inducing price</i>	
Market price support	31%	14%
Output price support	0%	3%
Input subsidy	11%	5%
Historical entitlement payments	0%	43%

Underlying structural characteristic of Mexico crop sector are reflected in the parameter assumptions characterizing factor supply and demand in PEM - factor shares and the elasticities of factor substitution and factor supply. Factor share assumptions were developed from cost and return data obtained in producer surveys. PEM elasticities of factor substitution and supply were based on extensive reviews of published studies of agricultural supply response in OECD countries reported in (Abler, 2001) and in (Salhofer, 2001). All-crop averages of these parameters are in Table 2. Further detail on these and all other parameters in the PEM model are in OECD (2001).

Table 2 – Economic parameters in the Mexico PEM model

Factor:	Cost share	Supply elasticity	Elasticity of substitution*
Land	0.20	0.10	
Labour	0.15	0.50	0.50
Fertiliser	0.15	2.50	
Other Purchased	0.50	2.50	

* The elasticities of factor substitution in the PEM crop model for Mexico (but not for other countries) are the same for all factor pairings and for all crops.

In doing policy simulation analysis with the PEM the supply and demand equations in the model are combined with the equilibrium requirements that supply must equal demand to simultaneously clear all output and factor markets. This system of equations is then calibrated to replicate a given market situation, typically actual prices and quantities in a given base period. In this case the base period chosen corresponds to the 1989-93, 5-year average of quantities and real prices. The policy simulation then comprised changing the values of the various price wedges shown in Table 1 from their 1989-93 base values to their 1998-03 averages and re-solving the model. Main results summarised in terms of percent changes are presented in Table 3.

Table 3 – Main results from simulation

	Prices/unit returns <i>% change from base period</i>	Quantities
Crop production	-15.0	-10.0
Land	+10.0	+1.0
Labour	-15.0	-10.0
Purchased inputs	-2.0	-15.0
Net farm income	-10.0	-8.0

The results summarised in Table 3 suggest the combined effect of the changed support structure in Mexico's cropping sector was negative for production and for all factors except land. For the latter, simulation results imply that the increase in historical entitlement payments was enough to offset the reduced demand for land coming from the reduction in price support. Qualitatively, these results are generally consistent with results obtained from general equilibrium analyses undertaken in the lead up to the NAFTA negotiations (e.g. Burfisher, Robinson and Thierfelder, 1992). In particular, similar predictions of a reduction in returns to farm labour and an attendant reduction in employment in Mexican agriculture captured much attention in NAFTA discussions.

How do the results in earlier studies and in Table 3 compare with what has actually transpired in Mexico's crop sector in recent years? This is a question that can not be satisfactorily answered based only on easily accessible data. The next section reviews some trends in data that, though providing no scientifically rigorous proofs, hint at some interesting developments.

4. Trends in production and factor use in Mexico's crop sector

All results in Table 3 have to be interpreted as '*all other things equal*' predictions of changes in crop production and factor use over the ten year study period. Of course, not all other things were equal - far from it. The Mexican economy underwent the trauma of yet another devaluation of the currency and another phase of rapid price inflation. Moreover, it would be expected that underlying trends in productivity growth due to exogenous technical progress and expanded adoption of new production techniques would have continued. (Maize yields grew at roughly 2.5% per year during 1970 to 2002. That trend seems unrelated to the pattern of price movements or other economic developments over that period.)

...Crop production trends

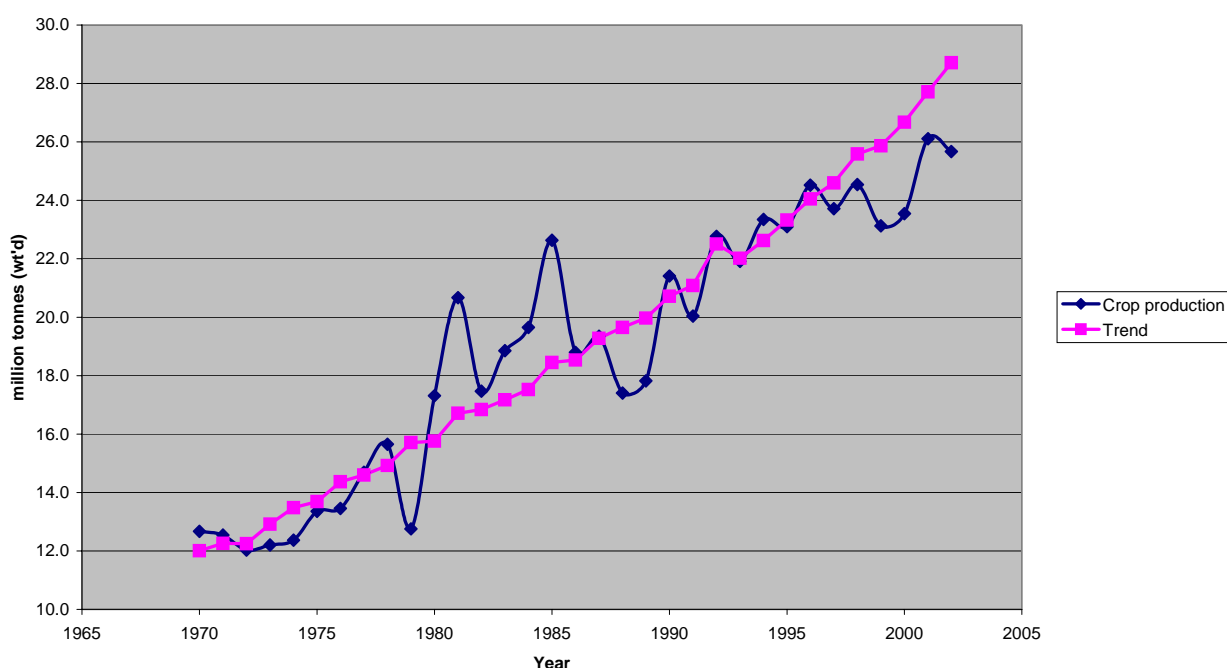
The reduction in market price support following the reforms would certainly have been expected to cause some reduction in market prices paid crop producers in Mexico. In fact, real prices of most crops over the period 1989 to 2002 dropped by more than results in Table 3 suggest. For example, the 5-year average of real maize prices 1998 to 2002 was 42% below that of 1989 to 1993. The predicted reduction in crop production in Table 3 is 10%, a reduction not too far out of line with pre-reform predictions obtained in general equilibrium analyses. In fact however, crop production in Mexico (all but wheat) continued to rise throughout the post reform period. But, given the '*all other things equal*' character of PEM predictions mentioned above, the appropriate comparison is perhaps not with respect to actual production but with respect to production trends. (An even better comparison would be with respect to a prediction from an economic model in which all important contributing factors could be somehow acknowledged or controlled for.)

Production trends are graphed in Figure 2. In this and all Figures to follow the trend line is based on data for the period 1970 to 1993. Trend values for subsequent periods were obtained by extrapolation of that

trend line. Also, the data are in all cases aggregates of maize, sorghum and wheat. In aggregating two kinds of weights were applied: a relative price weighting and a volume (production or harvested acres depending on the indicator). The relative price weighting was calculated as 1970 to 2002 averages of the ratios of each of the individual crop prices to those for wheat (i.e. using wheat price as the base).

The comparison to trend in Figure 2 suggests that crop production did not continue on trend after the reforms were introduced. However that reduction from trend was not as great as the predicted reduction shown in Table 3. Crop production was, on average, only about 5% below trend for 1998 to 2002. Furthermore, one can not be sure how much of the departure from trend was due to the changed support structure as opposed to other factors.

Figure 2 - Crop production trends

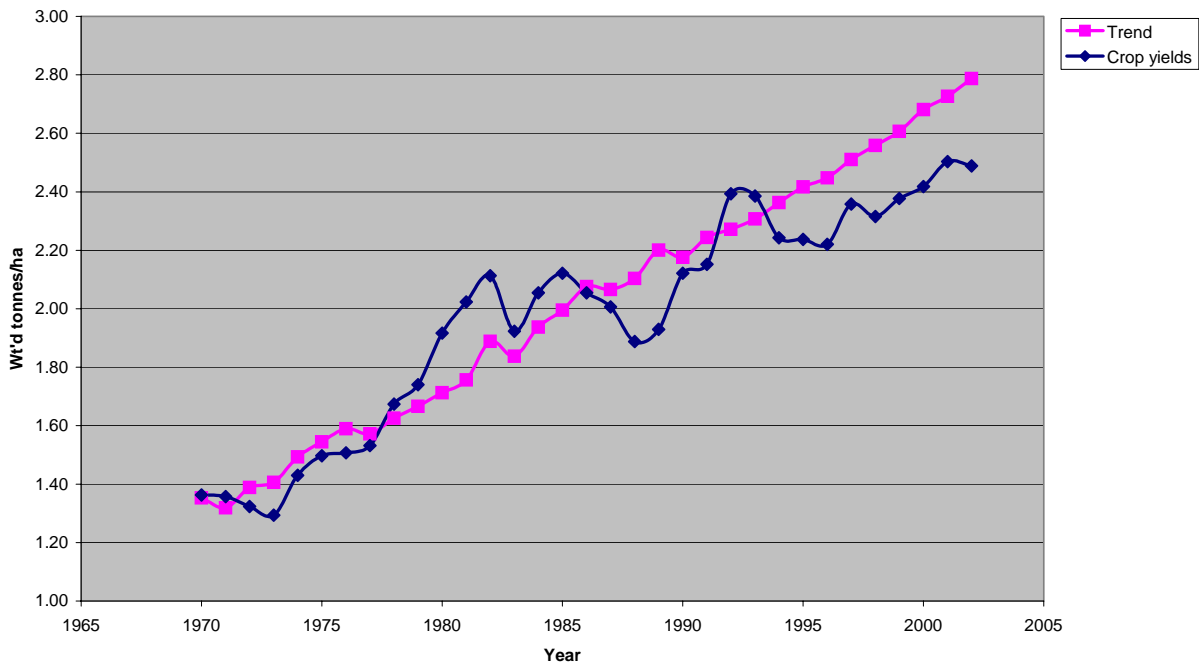


...Yield and area trends

As noted above the changed structure of crop support in Mexico in the past ten years or so has favoured land relative to other factors. Accordingly the PEM model predicted a shift in the production mix away from purchased inputs and labour towards land, i.e. an extensification of crop production. This would imply a reduction in average yields and some increase in land use. Indeed, the average annual total of maize, sorghum and wheat land harvested in 1998 – 2003 was higher, by about 0.5%, than the corresponding average 1989-1993 and 1.5% higher than the average trend level for 1998 – 2003 (Evidently, the trend in harvested area over the period 1970 to 1993 was a declining one.)

If, relative to trend, crop production declined while harvested area increased then yields must have declined. Figure 3, contains the results.

Figure 3 - Crop yield trends



...*Employment in Mexico's crop sector*

The potential employment effects of policy changes initiated in Mexico in the context of NAFTA were a highly politically sensitive issue in the debates in both Mexico and the United States prior to the signing of those accords. In a famous analysis Burfisher, Robinson and Thierfelder (1992) predicted that, in the absence of offsetting agricultural policy changes in Mexico, some 600 thousand workers would leave agricultural employment and 500 thousand of those would migrate to the United States. A recent article by Martin contains estimates of actual rates of Mexico to US migration over the 90's that would seem to confirm such predictions.

The PEM model predictions in Table 3 show a 15% drop in employment in the crop sector. This figure can be interpreted as a prediction of the reduction in numbers of full-time equivalent workers employed in the crop sectors who were directly affected by the policy changes. For purposes of this discussion we shall assume that all farm labour in the affected sectors is supplied by farm families. Two important considerations to take into account when interpreting this figure are: 1) how many farmers were directly affected by the policy changes and 2) how did those who were affected respond?

Approximately 3 million crop farmers receive PROCAMPO payments in Mexico, one indicator of the total population of workers directly affected by the change in the structure of farm support. Of course not all those farmers, in fact not very many of them, are employed full time producing the crops in question. Moreover some of them may have been benefited from the increased direct payments under PROCAMPO but would not have been directly affected by the reduction in market price support. As was noted earlier, over one third of the beneficiaries of PROCAMPO payments, some 1.2 million farmers, have plots of maize of less than one hectare. Undoubtedly most of the production from those plots would be for self-consumption not for sale on markets. Moreover, a plot of maize of less than one hectare would hardly be enough to keep a farmer fully employed. It seems unlikely therefore that this group of farmers would have contributed at all to the employment adjustment occasioned by the changed structure of support.

Now we can turn to the question of possible responses by those farmers who were impacted by all the changes in support shown in Figure 1, i.e. a reduction in market price support and subsidies to purchased inputs and an increase in historical entitlement and output payments. A large number of such farmers, perhaps the majority, operate farms of less than 5 hectares. For example, according to survey results reported by Appendini (1994), 90 percent of Mexico's 2.4 million maize producers in 1991 worked landholdings of 5 hectares or less. That group accounted for two thirds of maize area harvested in that year.

Undoubtedly, average plot sizes have grown some since then but it still seems to be the case that the majority of maize producers have plots of less than 5 hectares. (Davis, et al) Not surprisingly then amongst this group of producers off-farm income constitutes an important contribution to total farm household income. In the ejido sector (accounting for approximately half of Mexico's farmland and three quarters of its farmers), 60 percent of farm households participate in off-farm activities up from only 40% in 1994. Correspondingly, the contribution to total farm household income from off-farm activities rose sharply over that period with the income from those activities accounting for an average 55 percent of total farm household income in 1997, up from 46% in 1994. Appendini (2003) and World Bank (1999)

The generally small size of farms and the increased importance of off-farm activities by farm households suggest one avenue of employment adjustment by farm households impacted by the change in structure of farm support over the 90's. Some of these households would have adjusted to those reforms by reducing time spent in on-farm work, increasing the amount of time allocated to off-farm work while remaining in the community. Of course even among these households some family members would have left the farm altogether. However, at least from the ejido community, permanent migration during the period of the policy change was limited. (World Bank, 1999)

There seems to be no data available to help quantify how much the NAFTA related policy reforms contributed to the fall in the overall level of employment in Mexico and migration to the US during the 90's. Other factors may well have been much more contributory. This was a period of rapidly rising real wage rates in the US and falling real wage rates in Mexico. The Mexico to US migration statistics strongly suggest that the level of employment fell but the estimates of numbers of workers migrating is considerably larger than would be implied by the above discussion of farm policy changes.

For illustration, assume that only roughly $(3.0 - 1.2 = 1.8)$ million farmers were directly affected by both market price support reductions and PROCAMPO payments. Assume further that, as seems the case in the ejido sector, shifting from on-farm to off-farm work with no migration either within Mexico or to the US accounted much of the adjustment. For argument sake let us suppose such adjustments accounted for one half of the 15% reduction in crop sector employment predicted in Table 3. That would leave a reduction of 7.5% in crop sector employment to be accounted for by migration – both within Mexico and to the US. That would amount to a likely maximum of only 135,000 full-time equivalent workers migrating within Mexico migration or to the United States.

...Use of purchased inputs

There is even less easily available data for documenting reform induced adjustments in input use in Mexico's crop sector than for production or employment. The fall-off from yield trend shown in Figure 3, and considering that harvested acreage grew by only a fraction over that period strongly indicates that purchased factor use must have declined some.

The World Bank's ejido survey results do not contradict this inference but provide no convincing indications one way or another. There was a sharp reduction in the proportion of farm households using credit which mostly seems due to the decline in credit provided through a government sponsored credit program – PRONASOL. (World Bank) However, in that same survey there was evidence that more ejido

households increased their use of fertilizer, chemicals and improved seeds after policy reforms were implemented. Likewise there was an increase in investment, especially in livestock herds but more generally – increases that have been attributed to PROCAMPO payments. (Sadoulet, de Janvry and Davis, 2002) These authors argue that PROCAMPO payments allowed profitable investments by farmers who could not borrow money for investment because of imperfections in rural credit markets.

5. Conclusions

The structure of farm support in Mexico underwent substantial change in the 1990's with undoubted implications for structural adjustment in the sector in the medium and in the longer term. Some of these implications were illustrated by combining PSE data showing changes in the level and composition of farm support with a model of Mexico's crop sector – the PEM. Sorting out the influence of the changed support structure as compared to other forces driving agricultural adjustment is, as always, difficult.

However, some trends observed in the data do not contradict predictions of structural adjustment obtained with the model. Crop production has fallen somewhat relative to trend, has become more land intensive and less labour intensive, seemingly less purchased input intensive as well. Although crop policy changes probably contributed to the reduction in employment in Mexico's farm sector during the 1990's it seems other factors may have been much more important.

It was not possible to test some of the model predictions using only the data at hand. Further work aimed at characterizing the nature of adjustment on a more disaggregated basis is needed to complete the story.

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