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# **POLICY REFORMS AND POVERTY IN THE MEXICAN EJIDO SECTOR**

*Benjamin Davis, Alain de Janvry, Elisabeth Sadoulet, and Todd Diehl*

## **THE EJIDO SECTOR AND THE REFORMS**

The Mexican ejido sector is extraordinarily important in terms of both control over natural resources and social welfare. It contains approximately 60 percent of the rural population, half of the agricultural land, and half of the irrigated land. It is a major reservoir of rural poverty and an important source of migrants to the United States. This sector has been subjected to important reforms since 1990. This includes global reforms affecting the context where ejidatario households perform such as trade liberalization, NAFTA, and real exchange rate depreciation. It also includes reforms directly targeted at the sector such as introduction of individual property rights over land plots formerly in usufruct; descaling of credit, marketing, and technical assistance provided to the ejido by specialized state agencies; devolution of control over ejido affairs to the community; and greater freedoms for individual ejidatarios in making decisions about income strategies. One important objective of the reforms was to change entrepreneurial behavior in the ejido sector, expecting to induce greater efficiency in resource allocation and greater responses to changing market opportunities.

The reforms were accompanied by programs to compensate for the expected negative income effects that trade liberalization, the descaling of institutional services, and the removal of subsidies were to have on the producers of traditional crops. Thus the PROCAMPO program, a system of income support payments to producers, offered direct income transfers to farm households proportionately to the area historically planted in nine major staple crops, irrespective of the idiosyncratic levels of yield achieved. Among other objectives, this program was expected to shelter ejidatario incomes from declining product prices and rising input prices, and to give these households liquidity that they could use to adjust their income strategies to the new economic context.

This paper focuses on an analysis of the impact of the reforms on the incomes, poverty levels, and degrees of income inequality among ejidatario households. Other papers have focused on the impact which these reforms have had on production patterns (Cord, 1998, and Davis, 1998). We analyze in particular two questions central to the impact of the reforms. The first is how the reforms have affected household incomes and what the factors are that have made some households gain more than others. The second is whether the reforms have achieved their objective of stimulating entrepreneurial behavior, reflected in new income strategies and greater ability to derive income from given asset endowments in the new market, institutional, and macroeconomic context. The hypothesis is that, as in China following introduction of the individual responsibility system, greater freedoms have allowed households to make somewhat more efficient use of existing resource endowments. Given the particular economic conditions that were relatively unfavorable to agriculture, and the high degree of farm and off farm income sourcing (referred to as pluriactivity) among ejidatario households, this adjustment may or may not have occurred in agricultural activities.

The second part of the paper presents descriptive statistics to characterize the ejido sector in terms of income, poverty, and inequality, and how it has adjusted to the recent period of reforms. The third section analyses the determinants of income in 1997, both total household income and income by source, stressing the roles of an array of asset endowments and of the institutional and geographical context where households are located. The next section analyzes the determinants of change in income between 1994 and 1997. This analysis helps show how differential asset endowments across households have created differential income effects. We look in particular at the role that PROCAMPO transfers have had on income adjustments during the period, calculating the magnitude of multiplier effects of the transfers. In the last section, to see if the reforms have affected behavior, we decompose the relative roles that changes in asset endowments and changes in incentives and behavior have had on the observed adjustments in income.

## **POVERTY AND INEQUALITY IN THE EIJO SECTOR, 1994-97**

The following analysis of incomes and poverty is based on information derived from two nation-wide surveys of households in the ejido sector:

- A 1994 survey conducted by SRA (Secretariat of Agrarian Reform) and the University of California at Berkeley.
- A 1997 survey conducted by SRA and the World Bank (Louise Cord, Project Director).

These two surveys constitute a panel of 1017 households that allows analysis of changes in income over the period. The data cannot be used to characterize the absolute magnitude of poverty since information is on income, not on expenditures. Because agricultural income is highly erratic, there are negative incomes in each year. Data can, however, be used to analyze poverty on a comparative basis, both across

sub-groups of the ejido population and over time. The basic poverty line was set to achieve a headcount ratio similar to that of the National Institute of Statistics, Geography, and Information (INEGI) in the rural sector in 1994, namely 58 percent. This is the poverty line from which all subsequent comparative analysis is conducted.

The ejido sector is characterized by a high degree of heterogeneity of asset positions and sources of income across households. Even though all households are landed, there is a surprisingly high degree of participation in non-agricultural activities. Table 1 shows that 45 percent of household income was derived, on average, from non-agricultural and non-livestock activities in 1994. In 1997, this percentage had risen to 55 percent. The implication of heterogeneity is that shocks to output, price, wage, exchange rate, and employment created by markets or the reforms are transmitted through the ejido population in highly unequal fashion. Heterogeneity also implies that there are many potential roads out of poverty, relying on different asset endowments across households.

**Table 1: Sources of Income, Ejido Households, 1994 and 1997**

	1994	1997	% Change in Income	Test of Difference
All Households	Percentage of Total Income			
<b>Total Household Income</b>	100	100	7	
<b>Farm Income</b>	55	45	-11	
Agriculture	40	28	-26	*
Livestock	14	18	32	**
<b>Non-Farm Income</b>	45	55	28	*
Off-Farm Activities	45	43	2	
Wage Income	27	24	-3	
Self Employment	6	10	69	**
Remittances	2	6	244	**
Other Off-Farm Income	10	2	-76	**
Other Incomes	1	12	1797	**
Procampo	0	8		
Alianza	0	0		
Land Rent	0	1		
Garden Plot	0	0	260	**
Wood	0	0		
Ejido Income	1	2	272	**

Source: Authors' Calculations

\*\* 95% confidence that percentages are different

\* 90% confidence that percentages are different

The incidence of poverty in 1994, measured by the headcount ratio ( $P_0$ ), was associated with the following asset endowments and regional contexts (Table 2):

1. *Agricultural asset endowments:*  $P_0$  is 69 percent on small farms (less than 3ha of rainfed equivalent land), 58 percent on medium farms (3 to 7 hectares), and 48 percent on large farms (more than 7 hec-

tares).<sup>1</sup> Hence, low land endowments are an important determinant of poverty.

2. *Human asset endowments*: 69 percent of the households with low human asset endowments (measured in number of non-educated adult equivalent) are in poverty compared to 47 percent among those with high endowments. Human assets include both the number of adults in the households and the average educational levels achieved by adults.
3. *Migration asset endowments*: 59 percent of the households with no remittances in 1994 were in poverty in 1997 compared to 43 percent among those with remittances. Migration assets are better measured as the number of permanent migrants from the extended family (siblings of the household head) and from the household, plus the number of seasonal migrants from the household minus one. This shows that 65 percent of the households with no migration assets were in poverty in 1997 against 49 percent for those with migration assets. Endowment in migration capital is hence important to escape poverty.
4. *Social assets endowments (ethnicity)*: 74 percent of ethnic households live in poverty compared to 53 percent among non-ethnic households. Households are categorized as indigenous if at least one member of the household speaks an indigenous language. Ethnicity is thus very strongly associated with poverty in the Mexican rural sector.
5. *Region*: The incidence of poverty is 56 percent in the North, 23 percent in the Pacific North, 57 percent in the Center, 71 percent in the Gulf, and 68 percent in the South (excluding Chiapas which was not covered by the 1994 survey due to political disturbances at that time). Regional differences are thus very large. The highest incidence of poverty is found in the Southern states: the Gulf and the South.

The 1994-97 period which we analyze here corresponds to agricultural years 1993 and 1996. During this period, very strong macroeconomic shocks affected differentially particular sources of income. The consumer price index increased by 94 percent, and the real producer price of corn and beans (the major crops for the ejidatarios) fell by 28 percent and 59 percent respectively.

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<sup>1</sup> In measuring farm size, all land is adjusted for quality differentials (see de Janvry, Gordillo, and Sadoulet, 1997).

Table 2: Change in Poverty and Inequality Among Ejido Households, 1994-97

	Number of Households	Income 1994	Poverty $P_0^3$ 1994	Inequality $CV^4$ 1994	Inequality $MAD^5$ 1994	In Income 1994-97	% change 1994-97	CV 1994-97	% change 1994-97	MAD 1994-97	% change 1994-97	$P_0$ 1997
<b>All households</b>	1017	11296	57.9	4.2	1.1	6.9	-13.1	-51.5	-14.4	-14.4	-14.4	50
<b>By land assets endowments in 1994 (farm size)<sup>1</sup></b>												
Small	343	6518	69.4	2.9	1.0	21.0	-8.8	-34.5	-6.6	-6.6	-6.6	63
Medium	296	9152	57.8	2.9	0.9	26.0	-11.1	-14.0	-0.7	-0.7	-0.7	51
Large	378	17311	47.6	3.6	1.1	-5.9	-20.6	-58.4	-23.0	-23.0	-23.0	38
<b>By human assets endowments in 1994<sup>2</sup></b>												
Low assets	497	7986	69.2	6.9	1.1	21.2	-14.2	-64.9	-16.7	-16.7	-16.7	59
High assets	520	14460	47.1	2.9	1.0	-0.7	-11.5	-41.0	-12.7	-12.7	-12.7	42
<b>By migration assets endowments in 1994</b>												
No remittances 94	928	11032	59.4	4.4	1.1	6.0	-12.6	-55.6	-15.1	-15.1	-15.1	52
Remittances 94	89	14055	42.7	2.3	0.9	13.8	-21.1	-5.4	-9.6	-9.6	-9.6	34
No migration assets 94	577	9921	64.5	4.3	1.1	-6.0	-7.9	-55.9	-12.6	-12.6	-12.6	59
Migration assets 94	440	13100	49.3	3.9	1.0	19.6	-22.1	-53.9	-18.6	-18.6	-18.6	38
<b>By social assets endowments (ethnicity)</b>												
Ethnic	215	5869	74.4	2.7	1.0	19.7	-8.7	-13.8	-1.6	-1.6	-1.6	68
Non-ethnic	800	12780	53.4	3.9	1.1	5.1	-14.6	-52.7	-16.2	-16.2	-16.2	46
<b>By region</b>												
North	213	11435	56.3	3.1	1.1	37.6	-28.2	-36.6	-20.4	-20.4	-20.4	40
North Pacific	116	26199	23.3	2.4	0.8	-36.3	51.5	-33.8	2.0	2.0	2.0	35
Center	281	10058	56.9	4.7	1.0	4.5	-10.0	-64.6	-13.7	-13.7	-13.7	51
Gulf	173	5582	71.1	2.6	1.0	92.3	-23.6	-35.7	-15.0	-15.0	-15.0	54
South	234	9494	67.9	4.0	1.1	-1.9	-7.5	-37.2	-8.4	-8.4	-8.4	63
<b>By poverty status in 1994</b>												
Poor	589	1596	100	5.2	1.4	423.0	-36.0	-50.5	-33.6	-33.6	-33.6	64
Non-poor	428	24646	0	1.5	0.7	-30.2	NA	-10.5	12.2	12.2	12.2	32

<sup>1</sup> Small, medium, and large farms are defined as 0-3 ha, 3-7 ha, and more than 7 ha of rainfed equivalent land.

<sup>2</sup> Less and more than the medium level of 4.3 non-educated adult equivalent.

<sup>3</sup> PO=Headcount index, or percentage of households living in poverty.

<sup>4</sup> CV(x) = variance(x)/square of mean(x).

<sup>5</sup> MAD(x) = mean|x - mean(x)|/mean(x).

Source: Author's calculations.

In large part as a consequence of these price effects, agricultural incomes in the ejido fell by 26 percent (Table 1). The implication is that the ejidatarios most vested in agriculture, i.e., those with the largest land endowments in the best endowed regions, and in general the highest income levels in 1994, were hurt the most. As national GDP per capita (GDPpc) fell, wage income for ejidatario households also fared poorly with a 3 percent decline and so did income derived from remittances sent by family members in Mexico. The sources of income that fared well are livestock income which increased by 32 percent, remittance income received from the United States which increased by 244 percent (as the real exchange rate depreciated by 36 percent), income derived from self-employment which increased by 69 percent, and income derived from the government programs in support of farm income, namely PROCAMPO and Alianza para el Campo (Alliance for the Countryside) which did not exist in 1994.

Overall, the period was one of income stagnation, with an average annual growth rate in aggregate real income of only 0.2 percent. Hence, the analysis of income responses during the period is more one of differential abilities of coping with crisis than one of differential abilities of taking advantage of the dynamics of growth. Overall, the ejido sector was saved from the aggregate crisis in per capita incomes by the direct income transfers made through the PROCAMPO program that allowed a rise in household income (equal to 7 percent) roughly equal to the transfers (equal to 8 percent of total income).

The realignment of sources of income away from agriculture and toward self-employment, remittances from abroad, and government transfers had an often paradoxical effect on poverty and inequality. The fall in agricultural incomes was progressive on the distribution of income as it hurt most the better off among ejidatarios, namely those most vested in agriculture. This can be seen as follows (Table 2):<sup>2</sup>

1. *Change in income by farm size.* Small and medium holders gained in income while large holders lost out. Hence, the income change was progressive on the distribution of income. However, inequality fell most among the largest holders since the best-off were hurt the most. The result is that  $P_0$  fell more among the large holders than among the small, implying an unexpected regressive effect in terms of poverty reduction: poverty fell most among the large holders, even though their real income fell the most.
2. *Changes in income by human assets.* Households with low human assets had a gain in income of 20 percent compared to 0 percent for the high human asset households. Percentage reduction in  $P_0$  was the same in the two classes, leaving those with low human asset

<sup>2</sup> Because some households have negative incomes, we cannot use the Gini coefficient as a measure of inequality. Instead we use two indicators: the coefficient of dispersion (the ratio of the variance to the square of the mean) and the mean absolute deviation (measured as  $\text{mean}[x - \text{mean}(x)] / \text{mean}(x)$ ).

endowments with a  $P_0$  of 60 compared to 41 for the high asset households in 1997.

3. *Change in income by migration assets.* Households with remittances in 1994 and with migration assets gained more income during the period, and their incidence of poverty fell most. With remittances the most dynamic source of income over the period, the effect was regressive, with better-off households gaining most.
4. *Change in income by social assets (ethnicity).* Indigenous households had a real income gain of 20 percent compared to a 5 percent gain for non-indigenous. However, again inequality fell by more among the non-ethnic (who have access to significantly more land), with the result that  $P_0$  fell more among non-ethnic than ethnic populations.
5. *Change in income by region.* Here also there were progressive effects. The success story is the Gulf region which was by far the poorest region in 1994. The very strong income gains and poverty reduction effects are associated with livestock, self-employment, the beginning of migration, and, very importantly, government transfers. In the South, the next poorest region, aggregate income change was almost nil, but there was a lot of compensatory action by sources of income: agricultural income declined, livestock income rose, wage income fell, migration income rose, and income from government programs increased.
6. *Change in income by poverty status.* While households in poverty in 1994 experienced a 423 percent increase in income between 1994 and 1997, the non-poor saw their income drop on average by 30 percent. Part of these income movements are due to climate fluctuations, with those suffering bad weather in one period randomly different from those affected by bad weather in the subsequent period.

What is clear is that the more diversified households with less land assets were able to protect themselves better from the unfavorable terms of trade effects for agriculture. The Gulf in particular was able to gain most because of its low reliance on agriculture and diversified sources of income. The same applies to ethnic households and to the poor in general.

Different sources of income contribute differently to income inequality across households. Measures of inequality for total household income and by source are given in Table 3. They show that agricultural income is highly unequally distributed, with the result that the 1997 shock to agricultural income did hurt the richest most in 1994. Other sources of income that are unequally distributed across households are remittance income and self-employment income. Because sources of income are quite diverse across households, total income inequality is significantly less than income



inequality from any single source. The possibility of relying on such a diverse set of income sources is thus an important equalizing factor across ejido households.

An important feature of the period was rapid progress of PROCEDE, the program for individual land registration. An unexpected effect of this program was the uneven appropriation of lands held in common property resources. Overall, land held in individual plots increased by 22 percent. This gain was largest where individual plots were the smallest: 95 percent in small farms, 59 percent in medium farms, and 5 percent in the large farms. Hence, appropriation of CPR had a compensatory role for low initial allocations or for the eroding role of population pressure. Quite likely, much of this land was individually cultivated before PROCEDE even though it was located in the ejido's common property lands. Therefore, what the increase reflects may be largely the ratification of ownership rights over land that was individually cultivated in the commons more than a net increase in access to land.

**Table 3: Income Inequality by Source, 1997**

	Measures of Income Inequality	
	Coefficient of Variation	Mean Absolute Deviation
<b>Total Household Income</b>	2.0	1.1
<b>Sources of Income</b>		
Agriculture	12.6	1.7
Livestock	6.1	1.3
Wage	8.5	1.4
Remittances	24.7	1.7
Self-employment	10.8	1.6
Other Off-farm Activities	3.9	1.1

Source: Authors' calculations

Participation in off-farm activities rose sharply, with the share of households with at least one member engaging in off-farm activities rising from 41 to 57 percent. Increased off-farm involvement was permitted by greater flexibility of ejidatarios to freely allocate their time and land as a consequence of the ejido reforms, particularly renting land out so they can get more involved in income earning activities outside the farm.

Access to government transfer programs was remarkably egalitarian, even though these programs are tied to land. The PROCAMPO transfers were important as they represented, on average, 8 percent of household income in 1997. In dollar terms, this corresponds to \$270 per household and \$63 per hectare.

Finally, we should note that there had been a sharp decline in access to credit and technical assistance between 1990 and 1994 (de Janvry, Gordillo, and Sadoulet, 1997). This decline continued in 1994-97. The share of households with access to formal credit fell from 31 percent to 18 percent, and the share with access to technical assistance fell from 10 percent to a minimal 7 percent. Participation of ejidatario

households in Alianza Para el Campo, the main program in support of rural development, was only 13 percent. Hence, support of the competitiveness of ejidatarios in a period when they were expected to adjust to NAFTA and the economic reforms by modernizing and diversifying their farm operations is still lacking. Indeed, there was no recorded expansion in area planted in fruits and vegetables across categories of households. By contrast, land in corn continued to expand quickly, showing continued extensive use of the land.

## DETERMINANTS OF OVERALL INCOME IN 1997, BY SOURCE

We now turn to an analysis of the determinants of income and poverty among ejido households in 1997. The objective is to identify the role of heterogeneous assets positions across households. This in turn will provide policy guidelines for the design of anti-poverty programs for that sector.

### Total Household Income

Household income positions are explained by their asset endowments and by the regional and institutional context where they are located. Table 4 contains the results of econometric analysis of the determinants of total household income in 1997. We use median regressions instead of ordinary least squares (OLS) as estimated coefficients are less sensitive to outliers. This is because the estimated coefficients in median regressions minimize the sum of the absolute residuals rather than the sum of the squares of the residuals in OLS. The variables that affect positively the income levels achieved are as follows.

1. *Land assets.* In the ejido sector, land owned is exogenous since there are almost no land transactions. Land used is endogenous since the land rental market is active, particularly in ejidos where the PROCEDURE program has been completed (Olinto, 1998). For this reason, we use land owned as an exogenous determinant of household income. Ownership of irrigated land is a powerful determinant of income, while other forms of land endowments have no significant effects. Every additional hectare of irrigated land increases household income by 819 pesos, representing a 7 percent increment in total income and a 24 percent increment in agricultural income.
2. *Productive capital assets.* Ownership of one additional head of livestock in 1994 adds 160 pesos to household income.
3. *Human assets.*
  - Education matters in explaining total household income. Increasing the average number of years of education among adults by one raises household income by 741 pesos.

**Table 4: Determinants of Household Income and of Probability of Being in Poverty, 1997**

	Median Regression Household Income		Probit Pr(Poor = 1)	
	Coefficient	P-value	Marginal effect	P-value
<b>Land assets</b>				
Irrigated area owned in 1997	819	0.000	-0.020	0.002
Rainfed area owned in 1997	51	0.326	-0.003	0.162
Pasture area owned in 1997	20	0.465	-0.002	0.137
Forest area owned in 1997	35	0.162	-0.003	0.172
<b>Productive capital assets</b>				
Number of heads of cattle in 1994	160	0.000	-0.010	0.000
<b>Human assets</b>				
Gender of household head (man = 1)	463	0.820	-0.070	0.507
Age of household head	-27	0.427	-0.001	0.848
Average years of education among adults	741	0.000	-0.040	0.000
Number of adults	527	0.000	-0.046	0.000
No of members with ag wage labor experience in '94	-257	0.541	0.023	0.404
No of members with non-ag wage labor experience in '94	1296	0.083	-0.062	0.011
No of members with self-employed activities in '94	726	0.422	-0.038	0.421
Per capita Mexico migration assets	-3	0.948	0.005	0.186
Per capita US migration assets	456	0.003	-0.011	0.057
Used high yielding varieties in 1994 (dummy)	-766	0.466	0.004	0.931
Used chemicals in 1994 (dummy)	935	0.285	-0.068	0.080
Used advanced technological package in 1994 (dummy)	6104	0.078	-0.210	0.066
<b>Institutional assets</b>				
Used technical assistance in 1994 (dummy)	-495	0.755	0.057	0.474
Used formal credit in 1994 (dummy)	-790	0.262	0.075	0.066
<b>Social assets</b>				
Indigenous (at least one member speaks an indigenous language)	62	0.919	0.078	0.131
<b>Regional effects (base = North)</b>				
North Pacific	-935	0.641	0.022	0.773
Center	-1167	0.218	0.105	0.047
Gulf	-49	0.972	0.055	0.406
South	-1181	0.280	0.148	0.014
<b>Infrastructure assets</b>				
Ejido has paved road (dummy)	1065	0.002	-0.065	0.078
<b>Social welfare assets</b>				
PROCAMPO transfer (pesos)	1.2	0.005	0.000	0.010
Constant term	-2416	0.304		
Number of observations	992		992	
Pseudo-R squared	0.16		0.18	

Source: Authors' calculations

- The number of adults in the household is an important asset, with every additional adult contributing 527 pesos to household income.
- The number of family members with non-agricultural labor market experience in 1994 is even more important. Every member with this type of experience contributes 1296 pesos of household income.
- U.S. migration assets is defined as the number of permanent and temporary migrants in the household, where the household includes both that of the household head and his/her siblings. Every additional member in that network contributes 456 pesos to household income.

Finally, use of an advanced technological package, measured as the interaction between use of high yielding varieties (HYV), use of chemicals in production, and access to technical assistance in 1994 is important. Hence, there is an income premium to use of modern practices in agriculture.

4. *Region*. Regional effects are not significant on income after controlling for the role of all other assets.
5. *Infrastructure assets*. Ejido with a paved road have an income advantage of 1065 pesos per households. This indicates that rural development efforts investing in better roads have a payoff in raising rural incomes.
6. *PROCAMPO*. An additional one peso transfer through PROCAMPO generates 1.20 pesos of household income. Hence, households are able to use the cash transferred to generate an additional 20 centavos of income for every one peso received.

### Probability Of Being In Poverty

The same determinants of income can be used to predict the probability of being on one side or the other of the poverty line in 1997. Results of a probit analysis are given in Table 4. They show that the significant determinants of income are also significant determinants of being poor. Additional variables that are significant on poverty are:

1. *Human assets*. Having made use of chemicals in 1994 reduces the likelihood of being in poverty in 1997.
2. *Institutional assets*. Having had access to formal credit in 1994 reduces the likelihood of being in poverty in 1997.
3. *Social assets*. The role of ethnicity on the likelihood of being poor is significant at the 87 percent significance level.
4. *Regional effect*. With the North as the base, the likelihood of being in poverty is significantly higher in the Gulf and in the South.

These results confirm the robustness of the results obtained with the income equation.

### Household Income By Source

The role of asset endowments and of the geographical/institutional context where households are located is used to explain income levels by source of income in Table 5. We use median regressions for agricultural and livestock incomes since all households are engaged in these activities. Since many households do not derive income from wages, self-employment, and remittances, we use Tobits (a particular form of econometric model) for these other sources of income.

1. *Agricultural income.* Irrigated and rainfed area owned and technological indicators (except use of chemicals) have no predictive power on agricultural income. This distressing result suggests that ejidatarios have a hard time differentiating their agricultural income performances, in spite of observed differences in the levels of land endowments and technification. Undoubtedly, this reflects the relatively low profitability of the agricultural activity in that year, with better endowed and more technified farmers achieving income results not significantly better than those of others. The scope for income differentiation is thus not in agriculture, but in the other activities, principally wage income, self-employment, and migration.
2. *Livestock income.* For livestock income, the lagged (1994) livestock endowment is quite important. However, no other variable, besides PROCAMPO transfers, help explain livestock income. PROCAMPO transfers have contributed to the acquisition of livestock by recipient households and this livestock added 10 centavos of income for every 1 peso spent for their acquisition.
3. *Wage income.* The main result is that education and the number of adults in the household (human assets) are very important determinants of labor market earnings. Each one year increase in the household's average level of education contributes an extra 1,075 pesos while each additional adult adds 2,087 pesos. Rainfed land endowments and livestock play negatively since better endowed households are more vested in agriculture and livestock and participate less in the labor market. This is reinforced by the level of technification of these households in agriculture in 1994 (use of high yielding varieties and of technical assistance). The number of members with agricultural wage experience and with non-agricultural wage experience play positively on labor market earnings, reflecting the role of entry costs and experience in deriving income from these markets.

Table 5: Determinants of Household Income by Source, 1997

	Agricultural Income/Median Regression		Livestock Income/Median Regression		Wage Income/Tobit		Self-employment Income/Tobit		Remittance Income/Tobit	
	Coef't	P-value	Coef't	P-value	Coef't	P-value	Coef't	P-value	Coef't	P-value
<b>Land Assets</b>										
Irrigated area owned in 1997	29	0.883	2.0	0.695	-115	0.484	209	0.037	256	0.089
Rainfed area owned in 1997	-5	0.768	1.4	0.751	-161	0.032	44	0.302	177	0.006
Pasture area owned in 1997	-10	0.003	11.2	0.184	-14	0.724	-23	0.460	-21	0.561
Forest area owned in 1997	-13	0.525	9.9	0.729	26	0.620	26	0.216	-200	0.493
<b>Productive capital assets</b>										
Number of heads of cattle in 1994	23	0.011	151.5	0.000	-128	0.011	20	0.489	-68	0.150
<b>Human assets</b>										
Gender of household head (man = 1)	-279	0.579	-1.0	0.986	-1924	0.543	1586	0.459	-550	0.874
Age of household head	-2	0.955	1.4	0.841	-24	0.824	27	0.690	-282	0.333
Average years of education among adults	71	0.299	1.5	0.879	1075	0.000	469	0.005	-1195	0.001
Number of adults	23	0.666	-0.2	0.987	2087	0.000	423	0.042	564	0.142
No of members with ag wage labor experience in 94	19	0.898	-9.8	0.679	2366	0.002	-921	0.161	1496	0.070
No of members with non-ag wage labor experience in 94	-51	0.716	-1.4	0.916	2382	0.000	304	0.522	-433	0.621
No of members with self-employed activities in 94	-278	0.213	-9.2	0.835	391	0.780	5386	0.000	-1178	0.518
Per capita Mexico migration assets	-3	0.824	3.2	0.344	-79	0.505	35	0.653	70	0.593
Per capita US migration assets	19	0.705	2.1	0.833	152	0.389	72	0.537	1661	0.000
Used high yielding varieties in 94 (dummy)	196	0.547	-1.6	0.973	-4201	0.010	-1102	0.299	402	0.807
Used chemicals in 1994 (dummy)	306	0.033	32.1	0.386	1893	0.112	-788	0.326	823	0.516
Used advanced technological package in 1994 (dummy)	3,153	0.326	-61.3	0.672	3720	0.317	2535	0.311	-2104	0.581
<b>Institutional assets</b>										
Used technical assistance in 1994 (dummy)	446	0.567	69.4	0.664	-4350	0.080	-1265	0.475	2728	0.273
Used formal credit in 1994 (dummy)	-16	0.944	10.9	0.824	659	0.588	-245	0.765	-1414	0.307
<b>Social assets</b>										
Indigenous (at least one member speaks an indigenous language)	-107	0.528	42.1	0.244	-349	0.821	-166	0.873	-5186	0.021

Table 5: Determinants of Household Income by Source, 1997 (Continued)

	Agricultural Income/Median Regression		Livestock Income/Median Regression		Wage Income/ Tobit		Self- employment Income/Tobit		Remittance Income/Tobit	
	Coef't	P-value	Coef't	P-value	Coef't	P-value	Coef't	P-value	Coef't	P-value
<b>Regional effects (base = North)</b>										
North Pacific	-249	0.688	-80.7	0.286	-8328	0.001	-833	0.604	-3300	0.190
Center	10	0.969	41.1	0.373	-5824	0.000	1109	0.315	189	0.907
Gulf	569	0.013	-23.1	0.818	-3113	0.114	3106	0.022	-1468	0.533
South	527	0.027	11.2	0.857	-8065	0.000	317	0.804	183	0.927
<b>Infrastructure assets</b>										
Ejido has paved road (dummy)	270	0.092	-3.1	0.909	2354	0.038	723	0.346	-3331	0.005
<b>Social Welfare Assets</b>										
PROCAMPO transfer (pesos)	0.0	0.774	0.1	0.087	-0.7	0.223	-0.3	0.316	0.7	0.170
Constant term	-175	0.788	-76	0.384	-10963	0.004	-12942	0.000	-11675	0.005
Number of observations	992		992		992		992		992	
Pseudo-R Squared	0.02		0.24		0.02		0.01		0.06	

Source: Authors' calculations.

Region is extremely important for the income contribution of labor market activities. Using the North as the benchmark, all regions offer lower labor market earnings, particularly the North Pacific and the South. The North has evidently the most active labor markets to which rural households are able to participate. Finally, availability of good infrastructure, as represented by ejidos accessible by a paved road, is an important factor in participating in wage earning activities.

4. *Self-employment income.* It is principally explained by human assets, namely educational levels and number of adults in the household. The history of past self-employment evidently matters. Regionally, with the North as the benchmark region, it is the Gulf that is outstanding. Analyzing in detail how successful self-employment occurred in the Gulf should deserve special attention.
5. *Remittance income.* There are a number of surprises here. First, it is the households with relatively more irrigated and rainfed land endowments that have more involvement in migration. Hence, migration is not for the least endowed in natural resources, and consequently not an equalizer of opportunities relative to agricultural assets. Second, migration is not for the most educated since those tend to migrate less to the United States. Hence, migration is an equalizer of opportunities as far as human capital is concerned. This is also reflected in the observation that households with more agricultural wage labor experience receive more remittances. Hence, it is the households most vested in agriculture and in the agricultural labor market that migrate most. Finally, past migration history to the United States, measured by the size of the migration network to which a household has access, is fundamental in explaining migration, success in migration, and hence the level of remittances received. Importantly for rural development initiatives, public investment in local infrastructure reduces migration and the receipt of remittances, which might be expected because it promotes better opportunities in earning income locally.

## The Role Of Education

There has been considerable controversy about the role of education in raising farm household incomes. Lopez and Valdés (1997) concluded a study of the determinants of household income in six Latin American countries by observing that education has no, or very little, impact on farm output and rural incomes. The results show that the role of education is different across sources of income and that it, indeed, has no role in traditional agriculture and livestock activities. However, it is an important determinant of wage and self-employment income, and of total household income. Hence, the return from investing in education in rural areas, for as long as opportunities to modernize and differentiate in agriculture are absent, is to be



captured in off-farm and non-agricultural activities. When farm households have diversified sources of income as they have in Mexico, investing in education has positive income effects because of the existence of pluriactivity.

If, following the reforms, agriculture offers profitable opportunities to modernize and diversify, then education could play a positive role on agricultural and livestock incomes as well. For the moment, lack of contribution of education to income derived from agriculture and livestock reflects lack of profitability in these sectors. Educational levels reduce migration to the United States as the educated find better options in domestic migration. These results are, however, not a good justification for neglecting educational investments in the Mexican rural sector. These investments have immediate payoffs in off-farm incomes and will have pay-off in agriculture when it faces more attractive price incentives, creating returns to the modernization and diversification in agriculture for which education is important.

### **Determinants Of Change In Income Between 1994 and 1997**

Analyzing the determinants of change in income for each household between 1994 and 1997 allows control for unobservable household assets (e.g., land quality and entrepreneurial talent) and unobservable contextual variables that affect income. This cannot be done through cross-household analysis as in Tables 4 and 5 using the 1997 income data. Recall that the activities that did poorly in the period analyzed are agriculture, agricultural and non-agricultural wages, and migration to Mexico, while activities that did well are livestock and remittances. We present two alternative regressions to check on the robustness of the determinants of change in income: a median regression and a robust regression. Like median regression, robust regression gives estimates that are less sensitive to outliers than ordinary least squares analysis (OLS). Robust regression eliminates the most extreme outliers and proceeds iteratively to weight the other observations inversely proportionately to the absolute magnitude of the residuals. It has the advantage of giving smaller standard errors on the estimated coefficients than median regression. Hence, more explanatory variables are significant under robust than median regression.

Using the results from both regressions, we find in Table 6 that variables that affect the change in income negatively are variables associated with a greater commitment to agriculture and to the wage labor market, i.e., to the activities that fared poorly during the period analyzed, namely:

- Households which owned more irrigated and rainfed land in 1994.
- Households which owned more livestock in 1994.
- Households with more agricultural and non-agricultural wage experience in 1994.

Variables that affected income change positively are:

- The number of adults in the household.
- Educational levels.
- The endowment in U.S. migration capital.

**Table 6: Determinants of Change in Household Income, 1994-97**

	Median Regression		Robust Regression	
	Coef't	P-value	Coef't	P-value
<b>Land assets</b>				
Irrigated area owned in 1997	819	0.000	-0.020	0.002
Rainfed area owned in 1997	51	0.326	-0.003	0.162
Pasture area owned in 1997	20	0.465	-0.002	0.137
Forest area owned in 1997	35	0.162	-0.003	0.172
<b>Productive capital assets</b>				
Number of heads of cattle in 1994	160	0.000	-0.010	0.000
<b>Human assets</b>				
Gender of household head (man = 1)	463	0.820	-0.070	0.507
Age of household head	-27	0.427	-0.001	0.848
Average years of education among adults	741	0.000	-0.040	0.000
Number of adults	527	0.000	-0.046	0.000
No of members with ag wage labor experience in 94	-257	0.541	0.023	0.404
No of members with non-ag wage labor experience in 94	1296	0.083	-0.062	0.011
No of members with self-employed activities in 94	726	0.422	-0.038	0.421
Per capita Mexico migration assets	-3	0.948	0.005	0.186
Per capita US migration assets	456	0.003	-0.011	0.057
Used high yielding varieties in 94 (dummy)	-766	0.466	0.004	0.931
Used chemicals in 1994 (dummy)	935	0.285	-0.068	0.080
Used advanced technological package in 1994 (dummy)	6104	0.078	-0.210	0.066
<b>Institutional assets</b>				
Used technical assistance in 1994 (dummy)	-495	0.755	0.057	0.474
Used formal credit in 1994 (dummy)	-790	0.262	0.075	0.066
<b>Social assets</b>				
Indigenous (at least one member speaks an indigenous language)	62	0.919	0.078	0.131
<b>Regional effects (base = North)</b>				
North Pacific	-935	0.641	0.022	0.773
Center	-1167	0.218	0.105	0.047
Gulf	-49	0.972	0.055	0.406
South	-1181	0.280	0.148	0.014
<b>Infrastructure assets</b>				
Ejido has paved road (dummy)	1065	0.002	-0.065	0.078
<b>Social welfare assets</b>				
PROCAMPO transfer (pesos)	1.2	0.005	0.000	0.010
Constant term	-2416	0.304		
Number of observations	992		992	
Pseudo-R squared	0.16		0.18	

Source: Authors' calculations.

Regionally, using the North as the base region, all regions except the Gulf fared worse than the base. This indicates that the two regions that gained most during the period are the North and the Gulf. The Gulf did as well as the North in terms of rural household income gains during the period, despite high levels of poverty.

PROCAMPO cash transfers create positive externalities on income change. The marginal income effect of a one peso income transfer through PROCAMPO on beneficiary households is 1.7 pesos. This is a large multiplier, but not unexpected. Ejido households are endowed in productive resources that they received through the land reform of 1917. At the same time, they have been severely constrained from accessing credit due to lack of alienable ownership rights over the land they use, preventing them from taking full advantage of these assets for income generation. We saw that only 18 percent of these households have access to formal credit and 13 percent are serviced by Alianza para el Campo. The result is that the shadow value of capital is very high to them. This is what is captured by the multipliers. When asked what they did with PROCAMPO transfers, 69 percent of the households who received transfers declared having used them to purchase inputs.

An indication that PROCAMPO was relatively more favorable to the poor can be inferred from the contrasted roles of the PROCAMPO transfer variable in the 1997 income equation (where it has a coefficient of 1.2) and in the income change equation (where it has a coefficient of 1.7). The lower coefficient in the income equation indicates that there are unobserved household assets that are negatively correlated with PROCAMPO payments. Hence, this reveals that PROCAMPO transferred cash to households with lower levels of unobservable assets (particularly land quality, technological levels, and entrepreneurial skills) for a given level of observable assets. The selectivity bias in targeting households and in determining how much was transferred to each was hence progressive, disproportionately favoring the less well endowed households. This does not come as a surprise since PROCAMPO transfers do not discriminate by yield level. As a result, households with lower quality land, lower technological levels, and lower farming skills were more generously compensated on a per hectare basis for the expected loss in income associated with a falling price of staple crops.

## **CHANGES IN ASSETS AND CHANGES IN BEHAVIOR**

To better understand the origin of the changes in income ( $y$ ) between 1994 and 1997, the observed changes can be decomposed between what is due to changes in asset position and what is due to changes in prices and behavior. We have estimated the following equations:<sup>3</sup>

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<sup>3</sup> These equations are estimated by ordinary least squares since, to do the proposed decomposition, we need fits with zero expected residuals, which would not be the case with robust and median regressions.

$$\text{For 1994: } y_{94} = \beta'_{94} X_{94}$$

$$\text{For 1997: } y_{97} = \beta'_{97} X_{97}$$

Hence, the predicted change in income ( $\Delta y = y_{97} - y_{94}$ ) can be decomposed into:  $\Delta y = \beta'_{97} \Delta X + \Delta \beta' X_{94}$ .

The first term represents that part of  $\Delta y$  which is due to a change in access to assets ( $\Delta X = X_{97} - X_{94}$ ), for a given marginal income contribution of assets measured in 1997 by  $\beta'_{97}$ . The second term represents that part of which is due to a change in the marginal income contribution of assets ( $\Delta \beta' = \beta'_{97} - \beta'_{94}$ ), for a given level of assets measured in 1994 by  $X_{94}$ . The marginal income contribution of assets is due to prices and behavior. Hence,  $\Delta \beta'$  captures both the fact that the incentive context has changed and that behavior may have changed as well, in this particular case as a consequence of liberalization of individual decision making for ejidatarios and devolution of community decision making to the ejido. The results we obtain are given in Table 7.

Results show that the positive change in income (P\$763) observed during the period was due to an improved control over assets (P\$1,690), including PROCAMPO transfers (a social welfare asset), while the context and behavior overall played negatively (-P\$927). Among changes in assets that helped sustain an increase in income, the most important are increased land owned (which as we have seen came through appropriation of common property land in individual plots), an increase in migration networks to the United States, and very importantly the income transfer from PROCAMPO. Hence, we see again the fundamental role that PROCAMPO transfers played in sustaining incomes. Had there been no PROCAMPO transfers, the change in income due to changing control over assets would have only been P\$745, and the overall change in household income would have been negative, equal to -P\$182 instead of the observed positive income change of P\$763.

Changes in income due to  $\Delta \beta' X_{94}$  derive from changes in context (i.e., prices) and changes in behavior. The marginal income contribution of land assets fell by P\$2,151, reflecting the unfavorable change in incentives for agriculture. By contrast, the marginal contribution of U.S. migration networks increased markedly as the peso depreciated strongly against the dollar, giving increased value to remittances sent back to ejidatario households. Finally, the income generation value of human capital, principally the number of adults in the household, increased sharply. Since wages in effect fell during the period, this increase should principally reflect change in behavior, with more efficient use made of available adult labor as ejidatarios had increased freedom to allocate labor as they pleased, in particular to migration and off-farm activities. As in China under shift to the individual responsibility system, but not in Mexico in agriculture, increased freedoms for ejido households and devolution of control over community affairs to the ejido seem to have led to improved incentives and to increased efficiency in using available assets to derive income. The behavioral changes induced by the granting of greater freedoms on

decision-making resulted in ejidatarios deriving greater advantage from participation to off-farm activities.

**Table 7: Income Changes Due to Asset and to Context and Behavior Effects (Pesos)**

	Total income change	Income change due to changes in control over assets $\hat{\beta}_{97}\Delta X$	Income change due to changes in context and behavior $\Delta\hat{\beta}'X_{94}$
<b>Income change 1994-97</b>	763	1690	-927
<b>Sources of income change</b>			
Land owned		608	-2151
Human assets*		0	4827
Mexico migration assets		-11	349
U.S. migration assets		106	1180
PROCAMPO		945	0
Other assets		31	4205

\*Includes age of the household head, education, and number of adults.

Source: Authors' calculations.

## CONCLUSIONS

During the period analyzed, the ejido sector went through important property rights reforms, and in the ability of ejidatarios to develop more autonomously complex idiosyncratic income earning strategies. In the short run, however, these reforms have been only very selectively beneficial to agricultural incomes. This is because incentives for agriculture were unfavorable, and because support to agricultural productivity continued to decline or remained minimal. For example, ejidatarios with access to any source of credit declined from 34 to 30 percent and those with access to technical assistance from 10 to 7 percent during the period; only 13 percent of the ejidatarios were reached by the Alianza para el Campo program. The result has been a continuing shift to low productivity crops (corn, in particular on irrigated land) and minimal adoption of high value crops and technological change.

Liberalization of individual initiative in the ejido sector and adverse economic shocks to agriculture during the period have thus promoted household income strategies with increasing reliance on off-farm sources of income, particularly self-employment in non-agricultural activities and migration to the United States, as opposed to the expected modernization and diversification of agriculture. These adjustments have been helped by increased freedoms in resource allocation, allowing ejidatarios to make more efficient use of assets, particularly human assets (number of adults in the family and education). Ejido households have thus been highly responsive to changes in the incentive system. However, for liberalized behavior to result in the desired diversification and modernization of agriculture, there is an urgent need to repair the institutional gaps in credit, marketing, and technical

assistance that emerged from the reforms, adjust and stabilize the incentive system, and extend the reach of government programs in support of productivity gains in agriculture.

The PROCAMPO program has been effective in protecting household incomes from the decline in agricultural income. Cash transfers appear to be used productively and to generate significant multipliers on household incomes. The multipliers effects are large, reflecting the paradox of households with asset endowments that have been starved for access to credit due to incomplete property rights and institutional gaps for their access to capital markets. The multipliers could be further enhanced if transfers were accompanied by vigorous intervention in support of the modernization and diversification of agriculture, if they were better timed with the agricultural cycle, and if reliability of the transfers could make their use as pledges to access credit more attractive to lenders. While most of the benefits of the program were inevitably captured by those with larger areas planted in the designated crops, the program was progressive on the distribution of income in the ejido because of the way benefits are targeted toward lands historically in traditional (as opposed to high value) crops, and independently of yields achieved.

Participation in off-farm activities has been the main source of income gains during the period analyzed. However, very low educational levels (an average of only 4.6 years of schooling among adults) limit participation in non-agricultural labor markets and in self-employment activities where education has a high premium. Decentralization of non-agricultural employment opportunities is also important for rural household incomes, as demonstrated by the importance of wage income and successful income gains in the Gulf. Education and decentralization are consequently two important lines of action for poverty reduction among ejido households.

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