GROWTH AND POVERTY REDUCTION. The case of Mexico.

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Introduction

There has been a lively debate on agriculture's poverty alleviation role in recent years. Research outcomes vary, depending largely on methodology and data used. For example, Ravallion and Datt (1996) found that agricultural growth has a significant effect in reducing not only rural but also urban poverty in India. Similar findings were reported for the Ivory Coast (Kakwani, 1993) and Indonesia (Thorbecke and Jung, 1996). Some other evidence for India, however, points to weak poverty alleviating effect of agricultural growth in areas with high inequality in land distribution (Bardhan, 1985, Gaiha, 1987, 1995). Thus, differences in initial conditions alter findings.

There is therefore a strong justification for a systematic investigation of the agricultural growth-poverty relationship. This requires identification of the main channels through which agricultural growth impacts poverty and an understanding of the conditions under which these channels operate effectively. According to Lopez (2001), the main channels through which agricultural growth contributes to poverty reduction are:

(i) a general equilibrium effect through the increase of unskilled labour wage rate;

(ii) an increase in smallholders' income;

(iii) higher agricultural output leading to lower food prices; and

(iv) forward/backward linkage effects which spur non-farm income growth and investment in agro-industries and other downstream activities.

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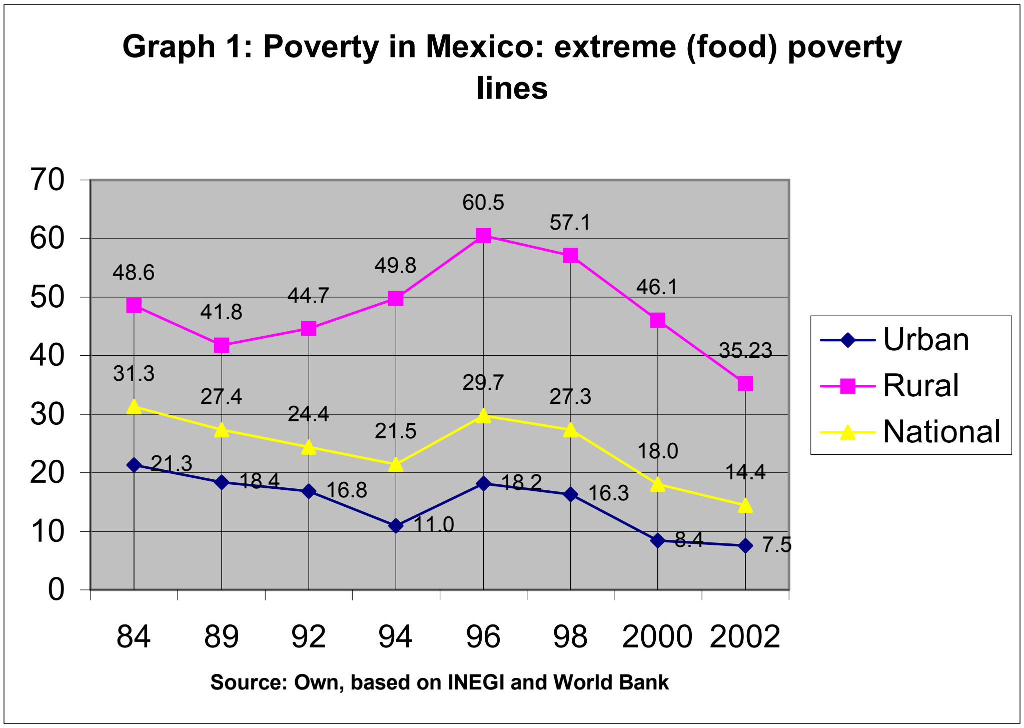
Whether these channels exist and their effectiveness when they do, are largely contextual issues. The measurement of agriculture's effectiveness in reducing poverty and the clarification of the nature of some of the agriculture-poverty linkages in Mexico is the main goal of this paper. Their knowledge will help policy makers in design a more comprehensive and effective poverty reduction strategy.

In the first part of the paper, we illustrate the evolution of poverty in Mexico, emphasizing its rural and urban components. The second part will focus on modeling the main links through which agricultural growth translates into reduction of rural and urban poverty. This part follows Lopez (2001) Methodological Notes. We applied the Ravallion and Datt (1996) methodology to regional data, and conducted a sensitivity analysis to check for the robustness of our results. The third part of the paper explores what are the channels by which agricultural growth impacts on poverty levels. The fourth part of the paper is devoted to a discussion of the empirical results and their policy implications.

PART I: Evolution of Poverty and other Statistical Indicators

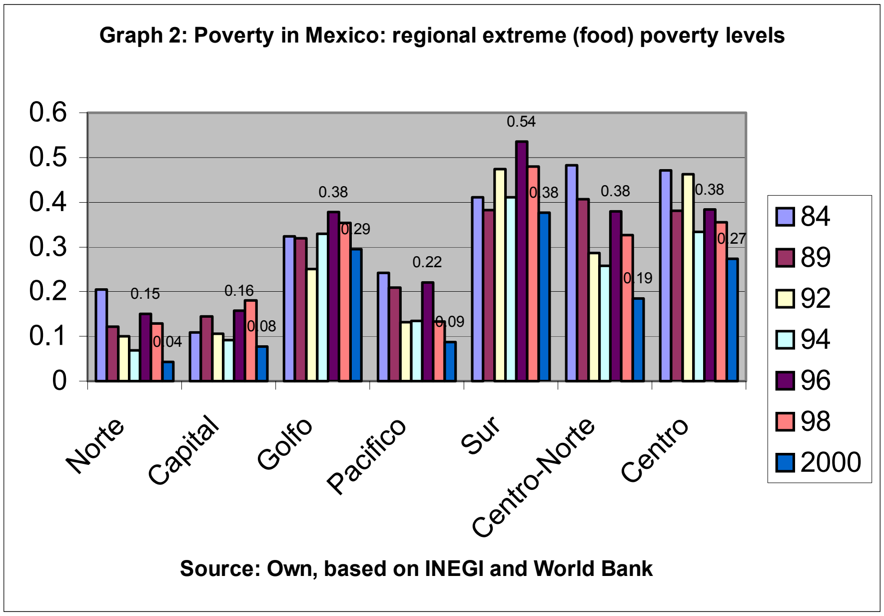
Poverty remains at high levels in Mexico. Although a clear negative trend was observed in the last 6 years, by the year 2000 about 18% of the population still falls below the food poverty line (see graph 1)[2]. Rural poverty (35.2%) is more than twice higher than the national level (14.4), while urban poverty is considerably lower (7.5%). From 1989 and up to 1994, urban and rural poverty levels followed different paths: while urban poverty levels fell by 6.5 percentage points (from 27% in 1989 to 21.5% in 1994) rural poverty increased by 8.4 percentage points (from 41.4% in 1989 to 60.5% in 1994). Since the 1995 macroeconomic crisis, urban and rural poverty followed similar paths. The impact of the crisis can be clearly seen: overall food poverty jumped from 21.5% in 1994 to 29.7% in 1996, whereas rural poverty rose to 60.5% (from 49.8% two years before), and urban poverty reached 18.2% in 1996, 7.2 percentage point higher than in 1994. Since 1996, the decrease in urban poverty was higher than the decrease in rural poverty rates.: while rural poverty fell to 35.2 urban poverty more than halved to 7.5%, whereas total poverty fell to 14.4%.

[2] See figures for other measures of poverty (P2 and P3) in Annex___



Poverty levels are not evenly distributed and rather vary a lot across the different regional areas of Mexico (see Annex I for the definition of geographic areas). Poverty levels are relatively low in the North, in the Pacific, and in Mexico City--between 10% and 14% on average since 1994--and high--between 29% and 45% on average since 1994--in the other four regions (Golfo, Centro, Centro-norte and Sur) (see graph 2)

There are also huge variations within each region. Graph 3 shows that rural poverty is always higher across all the regions: on average for all years in the sample and for all regions, rural poverty is about 3 times higher than urban poverty.



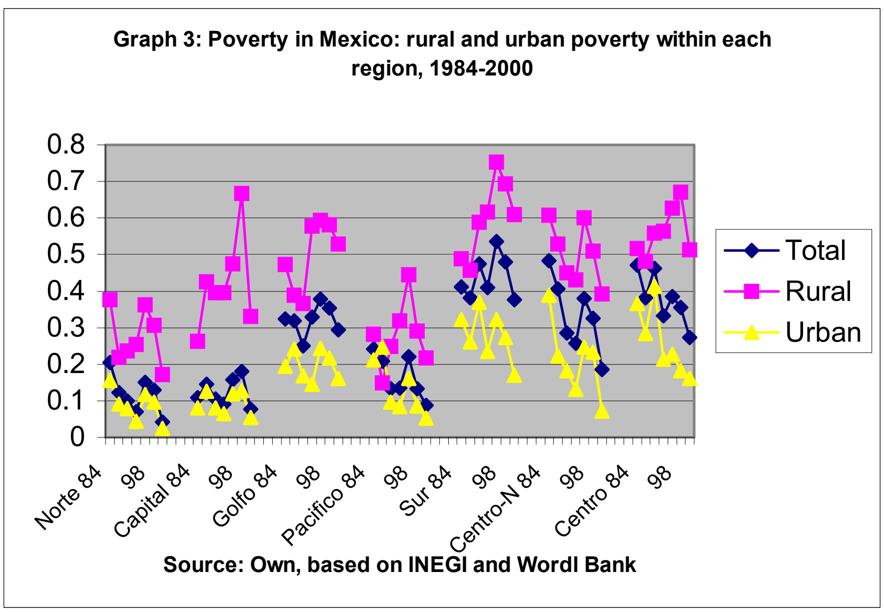


Table 1 shows by region the urban-rural composition of the population, of total consumption and of three measures of poverty. For Mexico as a whole (average 1984-2002) 32.1% of the population lives in rural areas, consumes only 19.5% of total Mexican consumption, and houses 54.3% of the total number of extreme poor people in Mexico. In the four regions with the highest level of poverty (Golfo, Sur, Centro and Centro-Norte), rural areas contribute with more than 60% or the total number of poor people, which means that poverty in those areas is, above all, rural poverty. The same situation can be found when considering other measures of poverty (FTG(1) and FTG(2).

By region, the highest incidence of rural poverty can be found in the South, where 50.3% of the population living in rural areas share only 32% of total regional consumption, and houses 69% of the region's poor people.

Table 1. Shares of population, consumption and poverty. Total Mexico and by region, average 1984-2002

	Share in total population		Share in total consumption		Share in headcount poverty FTG(0)		Share in Poverty Gap FT G(1)		Share in Squared Poverty Gap FTG(2)	
	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural	Urban	Rural
Total	**.679**	**.321**	**.805**	**.195**	**.457**	**.543**	**.393**	**.607**	**.345**	**.655**
Norte	.844	.156	.911	.887	.596	.404	.510	.490	.444	.556
Capital	.906	.094	.965	.035	.658	.342	.583	.417	.516	.484
Golfo	.586	.414	.764	.236	.352	.648	.292	.708	.256	.744
Pacífico	.736	.264	.797	.203	.520	.480	.457	.543	.393	.607
Sur	.497	.503	.679	.321	.310	.690	.250	.750	.219	.781
Centro-norte	.593	.407	.767	.233	.374	.626	.315	.685	.280	.720
Centro	.593	.407	.750	.250	.394	.606	.342	.658	.308	.692

Source: Own estimates.

This section addresses the nature of intra- and inter-sector effects of growth on poverty. We follow the approach presented in Ravallion and Datt (1996). They utilized a reduced-form econometric approach where agricultural and non-agricultural growth are used as explanatory variables of a poverty equation. Using series of consistent, consumption-based poverty measures spanning forty years, they assess how much India's poor shared in the country's economic growth, taking into account its urban-rural and output composition. An important feature of their methodology is that the estimated growth-poverty elasticities incorporate *all* direct and indirect effects of growth on poverty, including the income distribution and general equilibrium effects.

Their main findinds are: i) rural consumption growth reduced poverty in both rural and urban areas; ii)urban growth brought some benefits to the urban poor, but had no impact on rural poverty; iii) rural-to-urban population shifts had no significant impact on poverty. Decomposing growth by output sectors, they found that ouput growth in the primary and terciary sectors reduced poverty in both urban and rural areas but that secondary sector growth did not reduced poverty in either.

Ravallion and Datt's methodology uses Foster, Greer and Thorbecke (FTG) decomposable measures for poverty and considers two sectors, urban and rural. We extent their model to capture the regional dimension of the data set we will use here.The average level of poverty in region *i* in period *t* is given by[3]:

(1) $$P_{it} = n_{it}^{u} P_{it}^{u} + n_{it}^{r} P_{it}^{r}$$

[3] We follow closely their presentation.

where n^k and P^k are the population shares and poverty meassures respectively for sectors $k = u, r,$ (urban and rural). Similarly, mean consumption can be written as:

$$\text{(2)} \qquad \mu_{it} = n_{it}^{u}\mu_{it}^{u} + n_{it}^{r}\mu_{it}^{r}$$

where μ^k is the mean for sector k. Let $s_k^P = n_k P_k / P$ and $s_k^{\mu} = n_k \mu_k / \mu$ be the sector shares of total poverty and total consumption. The growth rate in the poverty measure can be decomposed by taking the total differential of equation (1):

$$\text{(3)} \qquad d\ln P_{it} = s_{uit}^{P} d\ln P_{it}^{u} + s_{rit}^{P} d\ln P_{it}^{r} + (s_{uit}^{P} - s_{rit}^{P} n_{it}^{u} / n_{it}^{r})\, d\ln n_{it}^{u}.$$

Ecuation (3) shows that the average rate of poverty reduction is made up of the intrasectoral gains to the poor, given by the share-weighted rates of poverty reduction within each sector ($s_k^P d\ln P^k$), and the independent contribution of the rate of urbanization. The second term can be interpreted as poverty reduction attributable to the "Kuznets process", where population shifts from the "traditional" rural sector to the "modern" urban.

Note that the coefficient $d\ln n_u$ can also be written as $(P^u - P^r) n^u / P$, indicating that urbanization under the Kuznets process will reduce poverty only if poverty is greater in rural areas than urban areas. Similarly, the differential of equation (2) gives:

$$\text{(4)} \qquad d\ln \mu_{it} = s_{uit}^{P} d\ln \mu_{it}^{u} + s_{rit}^{P} d\ln \mu_{it}^{r} + (s_{uit}^{P} - s_{rit}^{P} n_{it}^{u} / n_{it}^{r})\, d\ln n_{it}^{u}.$$

By combining (3) and (4 Ravallion and Datt tested whether the composition of growth matters for poverty reduction.

$$\Delta \ln P_{it} = \pi_u s^{\mu}_{uit-1} \Delta \ln \mu_{uit} + \pi_r s^{\mu}_{rit-1} \Delta \ln \mu_{rit}$$

(5) $$+ \pi_n (s^{\mu}_{rit-1} - s^{\mu}_{uit-1} n_{rit-1} / n_{uit-1}) \Delta \ln n_{rit} + \Delta \varepsilon_{it}$$

(t = 2,..,T)

where the π's are parameters to be estimated, Δ is the discrete time difference operator, and ε is the error term that accounts for other --not controlled for factors-- that influence measured poverty. Notice that by using first differences time-invariant region-specific effects are being eliminated.

π_u y π_r coefficients can be interpreted as the impact of (share weighted) growth in the urban and rural sectors respectively, while π_n shows the impact of the population shift from rural to urban areas.[4]

What we would like to test is whether economic growth in one sector affects distribution in other sectors. We can use equation 3 to decompose the rate of growth in average poverty, and estimate the following system of equations:

(6) $$s^{P}_{uit} \Delta \ln P^{u}_{it} = \pi_{u1it} s^{\mu}_{uit} \Delta \ln \mu^{u}_{it} + \pi_{u2it} s^{\mu}_{rit} \Delta \ln \mu^{r}_{it} + \pi_{u3it} (s^{\mu}_{rit} - s^{\mu}_{uit} n^{r}_{it} / n^{u}_{it}) \Delta \ln n^{r}_{it} + \Delta \varepsilon_{uit}$$

(7) $$s^{P}_{rit} \Delta \ln P^{r}_{it} = \pi_{r1it} s^{\mu}_{uit} \Delta \ln \mu^{u}_{it} + \pi_{r2it} s^{\mu}_{rit} \Delta \ln \mu^{r}_{it} + \pi_{r3it} (s^{\mu}_{rit} - s^{\mu}_{uit} n^{r}_{it} / n^{u}_{it}) \Delta \ln n^{r}_{it} + \Delta \varepsilon_{rit}$$

4 If what only matters is overall growth, then $\pi_u = \pi_r = \pi_n = \pi$ and equation (17) reduces to:

$$\Delta \ln P_{it} = \pi \Delta \ln \mu_{it} + \Delta \varepsilon_{it}$$

$$(8)\quad (s^{P}_{rit} - s^{P}_{uit} n^{r}_{it} / n^{u}_{it}) \Delta \ln n^{r}_{it} = \pi_{n1it} s^{\mu}_{uit} \Delta \ln \mu^{u}_{it} + \pi_{n2it} s^{\mu}_{rit} \Delta \ln \mu^{r}_{it}$$
$$+ \pi_{n3it} (s^{\mu}_{rit} - s^{\mu}_{uit} n^{r}_{it} / n^{u}_{it}) \Delta \ln n^{r}_{it} + \Delta \varepsilon_{nit}$$

where $\pi_j=\pi_{uj}+\pi_{rj}+\pi_{nj}$, j=1, 2, 3. If we sum equations 6, 7 and 8 we obtain equation 4. Equation 6 shows how the composition of growth and population shifts affect urban poverty. In turn, equation 7 shows how rural poverty is being affected, and equation 8 shows the impact on the population shift component of $\Delta \ln P$. From the last three equations only two of them needed to be estimated, the third coming from using the additive restriction $\pi_{nj}= \pi_j - \pi_{rj} - \pi_{uj}$, j = 1, 2, 3.

The elasticities of the poverty measures to the sector means can be readily obtained by multiplying the regression coefficients by the relevant consumption or income shares.

In this paper we apply Ravallion and Datt's approach to Mexican data. Lacking a long panel of poverty measures, we estimate equations (5) ,(6) and (7) using combined regional and time series household data. That is, we estimate total rural and urban poverty changes *by region* instead of for the whole country. This allows us to sufficiently increase the number of observations to perform econometric analysis[5].

Our dependent variable is the FTG index of poverty (1, 2, and 3) [6]. For our sensitivity analysis we have taken three indicators: i)"food-consumption poverty", where the poverty line is equivalent to the income needed to satisfy a specific minimum caloric intake per capita; ii) "moderate poverty", where the poverty line is equivalent to the previous one *plus* the income

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[5] The costs is that inter-regional migration is not taken into account. Since poverty rates are very different among Mexican regions, incorporating inter-regional migration would provide complementary information by measuring how sectoral growth affect poverty as poor people migrate from say high poverty regions to lower poverty regions. Lack of data forbid us to take into account migration flows, although below we discuss its likely impact on our results.

needed to develop certain activities (food poverty line times 2 in urban areas, food poverty line times 1.75 in rural areas); and iii) poverty levels of people situated between the “food consumption” poverty and the “moderate poverty”.

By its nature, FTG(i) indexes cannot capture non-income measures of well being and we say nothing here about how responsive these dimensions may be to growth. Regarding the choice of consumption versus income, there are indications that current consumption is a better indicator of current level of living than current income (Ravallion, 1994), and this is the metric we use for our measures.

DATA

We use comparable household data coming from the National Institute for Statistics, Geography and Informatic (its acronym in Spanish is *INEGI,* which stands for *Instituto Nacional de Estadistica, Geografia e Informatica*) for years 1984, 1989, 1992, 1994, 1996, 1998, 2000 and 2002. Each INEGI household survey (its acronym in Spanish is *ENIGH* wich stands for *Encuesta Nacional de Ingreso Gasto de los Hogares*) is representative at three levels: i)national level, ii)for “urban” areas (i.e. localities with population above 2500 inhabitants), and iii)for “rural” areas (i.e. localities with population below 2500 inhabitants).

The poverty lines and poverty levels used in this paper are the same as those used by the World Bank in its Poverty studies on Mexico, and are presented in Table 2. To make comparison with results from other countries feasible, we also converted those lines to dollar term using the average official exchange.

Table 2. Poverty lines

[6] The FTG(0) (Head Count) measures the proportion of people below the poverty line; FTG(1) (Poverty Gap) includes the distance between the poverty line and the average consumption of the poor; FGT (2) accounts for

	1984	1989	1992	1994	1996	1998	2000	2002
Rural (Mexican $ per month)	4.233	68.81	124.75	163.89	313.33	390.30	443.22	473.71
Urban(Mexican $ per month)	4.969	86.40	167.96	170.28	317.77	445.47	484.80	520.61
Exchange rate	4.89	2.551	3.098	3.394	7.56	9.46	9.3683	9.889
Rural in US$ per day	0.88	0.90	1.34	1.61	1.38	1.38	1.58	1.60
Urban in US$ per day	1.02	1.13	1.81	1.67	1.40	1.57	1.72	1.75

Source: Up to 2000 López Acevedo *et al* (1999), and World Bank Country Assistant Strategy for Mexico (2001). The poverty lines for 2002 were obtained by inflating figures for 2000 with the implicit prices used in SEDESOL's rural and urban poverty lines for 2000 and 2002 respectively.

As mentioned above, to get enough degrees of freedom we use the regional estimates of poverty done in Soloaga and Torres (2003)[7]. They estimated poverty levels at the estate level (32 in Mexico) as well as at the regional level (7 regions in Mexico following INEGI's regionalization). The complete set of estimates and their corresponding standard errors are available from the authors upon request. It turned out that estimates at the State level showed to have "too high" standard errors (see table 3). Thus, in what follows we present estimates using data at the regional level.

Table 3. Coefficient of variation for poverty indicators

income distribution within the poor.

[7] To calculate the FTG class of poverty indicators and their standard errors Soloaga and Torres (2003) used the SEPOV command from STATA (Jolliffe y Semykina, 1999). This command follows Howes y Lanjouw (1998) methodology, and allows for the statistical sampling design of each ENIGH to be incorporated into the estimates for the standard errors,.

	Coefficient of variation for Head Count Poverty Index (H): Standard Error of H/Mean H, average over 1984-2002		
	At National Level (*)	At Regional level (**)	At State level (**)
Total Poverty	0.0476	0.1234	0.3043
Urban Poverty	0.0835	0.1951	0.384
Rural Poverty	0.0502	0.1334	0.247

(*) By design, the ENIGH surveys are statistically representative only at national levels.

(**) Estimates following Howes and Lanjow (1998)

Source: Soloaga and Torres (2003)

Econometric results

For each poverty measure we have estimated two sets of regressions in first differences, one by OLS and the other by instrumental variables (IV). The IV approach was needed because the dependent and the independent variables are estimated from the same survey data. This can produce a bias because measurement errors in the survey can be passed on both variables; if the mean is underestimated, poverty will tend to be overestimated. The whole set of instrument used are listed in Annex II. Most of the cases the Durbin-Wu-Hauman (DWH) tests of exogeneity of independent variables indicated that the OLS approach would bring consistent estimates. Nonetheless, we report here both set of results.

Table 4 resumes our estimations for FTG(0) poverty measures. The upper panel shows the impact of urban and rural growth on total poverty (columns 3 and 4), on urban poverty (columns 5 and 6) and on rural poverty (columns 7 and 8). The first line in each panel indicates the value of the coefficient, the second its *t* statistic and the third the elasticity computed at mean value levels. To help reading the table, the gray shading indicates statistically significance.

Following column 4 (IV estimation is indicated by the DWH test. Also, the Sargan test for exogeneity of instrument indicates that they are appropriated. Full set of results are in Annex II) , we find that growth in both sectors, urban and rural, impacted negatively on total poverty levels, although growth in rural areas seems to have a stronger impact. Following column 5 and 7 (the DWH test indicates this is appropriated) shows that, contrary to Ravallion and Datt findings for India, there are no inter-sectoral effects: urban growth impacts only urban poverty (elasticity 1.35) and rural growth impacts only rural poverty (elasticity 0.82).

When considering the poverty level of people between the food poverty line and the moderate poverty line, we find that , while urban or rural growth had no impact on overall poverty, urban and rural growth impacted negatively on urban poverty (elasticities of 0.25 and 0.28 respectively), and had no impact on rural poverty. Un rural areas, only migration from the countryside to urban areas reduced poverty.

Finally, when considering moderate poverty, we find that urban and rural growth reduced total poverty with about equal power (similar elasticities), and, again, that there are no inter-sectoral effects: urban growth only reduces urban poverty (elasticity of 0.58) and rural growth only reduces rural poverty (elasticity of 0.53). Population shifts from rural to urban areas do reduced poverty in rural areas.

When considering other measures of poverty, the rural growth impact on poverty is stronger. For instance, for food poverty, the impact of rural growth on FTG(1) doubles that of urban growth (see table 5) . Clearly, rural growth has more power than urban growth in impacting the poorest among the poor people

This set of estimates suggests that there is an important role for rural growth when considering the goal of poverty reduction. Urban and rural growth have about equal power in reducing total food and moderated poverty at the country level. Importantly for policy implications, rural growth has inter-sectoral impact on that part of the population that is situated between the food poverty line and the moderate poverty line, reducing the proportion of poor people not only in rural areas but also in urban areas. Also, judging for the elasticities of the Poverty Gap and of the Squared Poverty Gap indexes of poverty, rural growth seems to be more powerful than urban growth in impacting the poorest among the poor people

Table 4. Condensated results from estimations. Dependent variables: First panel Food poverty FTG(0), second Panel: FTG(0) between food poverty and moderate poverty lines. Third panel: Moderate FTG(0)

		total poverty (3)	**total poverty(4)**	**urban poverty(5)**	**urban poverty(6)**	**rural poverty(7)**	**rural poverty(8)**
Food poverty		OLS	IV	OLS	IV	OLS	IV
Urban growth π_1	coeff	**-0.95**	**-1.09**	**-0.77**	**-0.88**	-0.14	-0.15
	t-statistic	**(-4.21)**	**(-2.89)**	**(-4.53)**	**(-3.31)**	(-1.16)	(-1.01)
	elasticity	**-0.76**	**-0.88**	**-1.35**	**-1.55**	-0.21	-0.22
Rural growth π_2 (*)	coeff	**-2.80**	**-6.78**	-0.59	-2.11	**-2.43**	**-4.24**
	t-statistic	**(-2.61)**	**(-2.50)**	(-0.68)	(-1.11)	**(-2.91)**	**(-2.74)**
	elasticity	**-0.55**	**-1.32**	-0.25	-0.90	**-0.87**	**-1.52**
Population Shift π_3	coeff	0.04	-0.46	-0.33	-0.17	**0.42**	**0.36**
	t-statistic	-0.05	(-0.36)	(-0.59)	(-0.19)	**-2.71**	-0.84
		total poverty	total poverty	urban poverty	urban poverty	rural poverty	rural poverty
Population between food poverty and moderate poverty		OLS	IV	OLS	IV	OLS	IV
Urban growth π_1	coeff	-0.14	-0.21	**-0.22**	**-0.30**	0.07	0.08
	t-statistic	-1.18	-1.16	**-2.34**	**-2.14**	1.56	0.97
	elasticity	-0.11	-0.17	**-0.25**	**-0.34**	0.20	0.23
Rural growth π_2 (*)	coeff	-0.73	-0.16	**-1.00**	-1.07	0.29	0.86
	t-statistic	-1.20	-0.12	**-2.08**	-1.05	0.63	1.21
	elasticity	-0.14	-0.03	**-0.27**	-0.29	0.20	0.59
	coeff	0.08	0.54	0.24	0.45	**-0.36**	-0.19

Population Shift π_3	coeff	0.08	0.54	0.24	0.45	**-0.36**	-0.19
	t-statistic	0.21	0.86	0.77	0.92	**-1.74**	-0.76
		total poverty	total poverty	urban poverty	urban poverty	rural poverty	rural poverty
Moderate poverty		OLS	IV	OLS	IV	OLS	IV
Urban growth π_1	coeff	**-0.47**	**-0.60**	**-0.44**	**-0.55**	-0.03	-0.04
	t-statistic	**(-4.21)**	**(-2.89)**	**(-4.53)**	**(-3.31)**	(-1.16)	(-1.01)
	elasticity	**-0.38**	**-0.48**	**-0.58**	**-0.73**	-0.06	-0.08
Rural growth π_2 (*)	coeff	**-2.02**	**-2.88**	-0.89	-1.30	**-1.06**	**-1.52**
	t-statistic	**(-2.61)**	**(-2.50)**	(-0.68)	(-1.11)	**(-2.91)**	**(-2.74)**
	elasticity	**-0.39**	**-0.56**	-0.29	-0.42	**-0.53**	**-0.75**
Population Shift π_3	coeff	0.10	0.20	-0.32	0.26	**-0.08**	0.14
	t-statistic	-0.05	(-0.36)	(-0.59)	(-0.19)	**-2.71**	-0.84

Source: Own estimates

(*)The elasticity of regional rural consumption growth to regional agricultural GDP growth is high. Depending on model specifications it varies from 0.75 to 0.87.

Table 5. Impact of growth on Poverty. Estimates, t statistics and elasticities.

Poverty Index	Impact on Total Poverty		Impact on Urban poverty		Impact on Rural Poverty	
	OLS(1)	IV(2)	OLS(3)	IV(4)	OLS(5)	IV(6)
Impact of Urban Growth						
FTG(0)	-0.95	-1.09	-0.77	-0.88	-0.141	-0.151.11
	(-4.21)	(-2.89)	(-4.53)	(-3.31)	(-1.16)	(-1.01)
	-0.76	-0.88	-1.35	-1.55	-0.21	-0.22

FTG(1)	-1.18	-1.26	-0.84	-0.92	0.18	-1.49
	(-4.02)	(-2.48)	(-4.69)	(-3.27)	(-0.2)	(-0.74)
	-0.95	-1.01	-1.72	-1.89	0.23	-1.97
FTG(2)	-1.29	-1.29	-0.34	-0.39	0.15	-0.35
	(-3.55)	(-2.06)	(-4.16)	(-3.25)	(-0.38)	(-0.41)
	-1.03	-1.04	-0.78	-0.91	0.19	-0.43
Impact of Rural Growth						
FTG(0)	-2.80	-6.78	-0.59	-2.11	-2.43	-4.24
	(-2.61)	(-2.50)	(-0.66)	(-1.11)	(-2.91)	(-2.74)
	-0.55	-1.32	-0.25	-0.90	-0.87	-1.52
FTG(1)	-3.19	-8.63	-0.29	-0.27	-3.73	-6.50
	(-2.13)	(-2.38)	(-1.52)	(-1.11)	(-3.32)	(-2.95)
	-0.62	-1.68	-0.14	-0.13	-1.20	-2.09
FTG(2)	-4.14	-10.93	-0.17	-0.19	-2.24	-3.62
	(-2.25)	(-2.44)	(-1.68)	(-1.42)	(-3.56)	(-3.02)
	-0.81	-2.13	-0.10	-0.11	-0.67	-1.08

Note: first line for each FTG index shows coefficients from regressions from Annex II

Second line shows the t statistics. Third line shows elasticities at mean points. The upper panel shows the impact of Urban growth on total, urban and rural poverty, the lower panel the impact of rural growth on total, urban and rural poverty.

The Durbin-Wu-Hausman (DWH) test for endogeneity for IV estimates showed that for Total poverty (first two columns) IV is indicated. For Urban poverty (third and fourth columns) OLS give consistent estimates, whereas for Rural Poverty (fith and sixth columns) OLS's consistency is not rejected at 95% confidence level, but is rejected at 90% confidence level (p value of the WDH test was .092). The main difference in results for these last two columns is the impact of urban growth on rural poverty (it is not statistically significant in OLS estimates but it is significant unde IV estimates). Full set of results and tests are presented in Annex II

The gray shading indicates by column, which one is the appropriated model (IV or OLS), and by line, which parameters are statistically significant in the appropriated model. See table __ for mean values of consumption and poverty used to construct the elasticities. At mean values, urban consumption is 85.6% of total consumption, urban share of total poverty (FTG(0) is 41.8%, 34.3% of FTG(1), and 0.297 of FTG(2).

Source: Own estimates.

Table 6 shows results by region for FTG(0). While the impact of urban growth on total poverty is within a relatively small range (lowest elasticity of 0.74 in Sur region, and highest elasticity of 1.06 in Capital region), the impact of rural growth showed more variation. Not surprisingly, the impact follows the share of rural population in each region (see table 1 above for population and consumption shares by region): higher elasticity in the three poor and relatively more rural regions of Sur, Golfo , Centro, and Centro-Norte—between 1.58 and 2.17—and lower elasticities in the other less poor and more urbanized Norte, Capital and Pacifico regions—elasticites between 0.24 and 1.38. As mentioned above, regression results did not show inter-sectoral effects (i.e. urban growth only affected urban poverty and rural growth only affected rural poverty). Interestingly, both, urban and rural growth had a bigger impact on urban and rural poverty respectively, in those areas where the share of urban population is relatively smaller (Sur, Golfo , Centro, and Centro-Norte).

Tabla 6. Impact of urban-rural growth on Poverty:1984-2002. Elasticities by region

	Poverty-region total		Poverty-region urban		Poverty-region rural	
	OLS(1)	IV(2)	OLS(3)	IV(4)	OLS(5)	IV(6)
Urban Growth						
Total effect	-0.76	-0.88	-1.35	-1.55	-0.87	-3.13
Norte	-0.86	-1.00	-1.18	-1.34	-0.02	-0.02
Capital	-0.91	-1.06	-1.13	-1.29	-0.01	-0.01
Golfo	-0.72	-0.84	-1.67	-1.91	-0.10	-0.10
Pacífico	-0.75	-0.87	-1.18	-1.35	-0.06	-0.06
Sur	-0.64	-0.74	-1.68	-1.92	-0.15	-0.16
Centro-Norte	-0.72	-0.84	-1.58	-1.80	-0.09	-0.09
Centro	-0.71	-0.82	-1.46	-1.67	-0.09	-0.10

Rural Growth						
Total effect (*)	-0.55	-1.32	-0.06	-0.06	-0.87	-1.52
Norte	-0.25	-0.60	-1.32	-4.76	-0.54	-0.93
Capital	-0.10	-0.24	-1.66	-5.95	-0.25	-0.43
Golfo	-0.66	-1.60	-0.69	-2.49	-0.89	-1.54
Pacífico	-0.57	-1.38	-0.97	-3.50	-1.03	-1.79
Sur	-0.90	-2.17	-0.58	-2.08	-1.13	-1.97
Centro-norte	-0.65	-1.58	-0.72	-2.59	-0.90	-1.58
Centro	-0.70	-1.69	-0.73	-2.61	-1.00	-1.75

Source: Own estimates based on table 9. (*) First line from Table 9

The gray shading indicates by column, which one is the appropriated model (IV or OLS), and by line, which parameters are statistically significant in the appropriated model. For the impact of rural growth on rural poverty (fith and sixth columns) OLS's consistency is not rejected at 95% confidence level, but is rejected at 90% confidence level (p value of the WDH test was .092). See full set of results and test in Annex __.

Part III. Exploring the channels

a) Income distribution

To explore plausible channels for the effects found in our regressions, we regress the change between surveys in the logs of Gini index on the growth rates in both urban and rural means. Results suggest that growth in rural areas decreases the Gini coefficient at the *national and urban* levels Interestingly, it has no effect on the Gini in *rural areas* (i.e., rural growth is distribution neutral in rural areas)

$$\Delta Gini_{total} = 0.25\Delta \ln mean(urban) - 0.22\Delta \ln mean(rural) \quad (9)$$

$$\Delta Gini_{urban} = 0.23\Delta \ln mean(urban) - 0.21\Delta \ln mean(rural) \quad (10)$$

In both regressions, coefficients are statistically significant at 1% with Rsquared of 0.37 and 0.24, respectively.

Rural consumption growth has been decreasing inequality in urban areas, while urban growth has been worsening it. This suggest that rural growth has a general equilibrium effect on urban areas, derived perhaps from a Harris-Todaro like effect by deterring migration.

b) Relative wages effect [8]

We postulate that producers minimize the cost of production. There are two outputs being produced, agriculture(Qa) and non-agriculture products (Qn). These outputs are being produced in competitive markets using three variable factors of production, unskilled labor (Lu), skilled labor (Ls), and Capital (K). The three factors of production are supposed to be mobile across the two productive sectors and are allocated efficiently.

We specified Generalized Leontieff cost function which, using Shephard's lemma, brings the implicit demand equations for unskilled and skilled labor:

$$L_s = \sum_j b_{sj}(w_j / w_s)^{1/2} Q_a + \sum_j c_{sj}(w_j / w_s)^{1/2} Q_n + b_s t Q_a + c_s t Q_n + d_s Q_a Q_n \qquad (11)$$

$$L_u = \sum_j b_{uj}(w_j / w_u)^{1/2} Q_a + \sum_j c_{uj}(w_j / w_u)^{1/2} Q_n + b_u t Q_a + c_u t Q_n + d_u Q_a Q_n \qquad (12)$$

The demand for capital is not derived. Equations (11) and (12) can be jointly estimated after imposing the symmetry conditions, $b_{ij}=b_{ji}$ and $c_{ij}=c_{ji}$

Estimation procedures

The labor demand equations (11) and (12) are estimated using data from Encuesta Nacional de Hogares Survey (ENE) for the period 1996-2001. We constructed data for the seven INEGI regions for all 6 years for all the variables in equations () and () except for the rental price

[8] We follow closely López and Anriquez (2003) presentation for the Chilean case.

of capital, for which we used the annual price of capital goods for the whole country. We have data for total unskilled and skilled labor used in each region over the period, and, from the same ENE surveys, we estimated wages for each one of the two types of labor. Workers with schooling less than 8 years were considered as "unskilled" labor, while workers with greater schooling were considered "skilled". From INEGI, we have also calculated regional GDP separated between agriculture and non-agricultural industries.

Table 7. shows the estimated coefficients for equations (11) and (12). We have used a SUR approach to gain efficiency.

Table 7. Estimates of the Multioutput Cost Function. Restricted SUR approach.

parameter	coefficient	standard errors	significance
Skilled labor demand equation			
b11	-0.039	0.036111	
b12	-0.02	0.025974	
b13	0.217	0.131515	
c11	0.004	0.002198	
c12	0.004	0.002685	*
c13	-0.005	0.009434	*
b1	0.0024	0.001644	
c1	-0.0001	0.000197	
d1 (a)	0.0037	0.004933	
constant ls	19835	19446.08	
Unskilled labor demand equation			
b21	-0.02	0.025974	
b22	-0.18	0.036437	***
b23	0.575	0.130682	***
c21	0.004	0.002685	

c22	-0.005	0.004386
c23	0.013	-0.01182
b2	0.008	0.001914 ***
c2	0.001	0.001493
d2 (a)	0.35	0.072917 ***
Constant	125776	11518***

(a) coefficients for d1 and d2 were multiplied by 1000000 to fit the table.

(b) Significance levels: *** 1%, **5%, * 10%

Source: own estimates

Elasticities: Effects of Changes in Agricultural Output Level

Table 8 shows the elasticities of demand for unskilled and skilled labor implicit in the estimated coefficients and evaluated at sample means. It also presents the standard errors of these elasticities (note that elasticities are functions of several coefficients) and their degree of statistical significance. The two labor demand equations are downward sloping, with unskilled labor demand being relatively more elastic (-1.3) to its own price than the skilled labor demand equation (-0.55). Unskilled and skilled labor are substitutes (cross elasticities are both positive: 0.28 and 0.42 respectively). Almost all demand elasticities are statistically significant at least at 10%. Only the response of skilled labor to agricultural output turned out to be not statistically significant. Both types of labor appear to be substitute with capital.

We have run this model to see what the impact of agricultural/non agricultural growth is on the demand of skilled/unskilled workers. Results show that growth in the agricultural output impacts the demand for unskilled workers, whereas growth in the non-agricultural sector increases demand for both types of labor with a higher elasticity for the demand of skilled workers (0.88 *versus* 0.57, the differences being statistically significant)[9].

[9] This issue may explain the positive impact of urban growth on the Gini coefficient: urban growthas a greater impact on skilled labor demand than on unskilled labor.

For the purpose of this paper, it is worth to remark that agricultural growth seems to impact unskilled labor demand. Higher demand for unskilled labor would presumably have a quantity effect on poor people, taking into account that this is their relative abundant resource. If this higher demand for unskilled workers is translated into higher wages for unskilled workers, this would also add a price effect for the agricultural growth impact on the standard of leaving of poor people.

Table 8.**Estimated Labor Demand Elasticities (evaluated at sample means)**

	prices			growth	
	Unskilled labor	Skilled Labor	Capital	Agricultural Output	Non-Agricultural Output
Unskilled Labor demand	-1.30*** (0.1253)	0.28*** (0.0024)	1.05*** (0.1246)	0.22* (0.1130)	0.57*** (0.0086)
Skilled Labor demand	0.42*** (0.0242)	-0.55*** (0.1309)	0.27** (0.1265)	0.06 (0.1349)	0.88*** (0.0072)

Note: Standard errors in parentheses. Level of significance: *** at the 1% ** at 5% and * at 10%

In this section we examine the hypothesis that agricultural growth helps reducing the real price of food products. To determine the marginal effect of agricultural growth on food prices we explain the path of the real food price index (RFP, measure as the Food, Beverage and Tobacco

CPI index divided by the GDP implicit price index) as a function of external factors, real exchange rate (RER, measure as the current exchange rate inflated by US WPI and deflated by Mexican GDP implicit price index) and average nominal tariffs, and internal factors, agricultural output (Qa, from Mexican National Accounts) and non agricultural output (Qn, from Mexican National Accounts)

$$RFP_t = \alpha + \delta t + \beta_1 RER_t + \beta_2 \ln Q_{at} + \beta_3 \ln Q_{nt} + \mu_t \qquad (13)$$

Several econometric issues arise in estimating this equation. Some or all the variables in equation (13) are expected to be non-stationary and could lead to spurious correlation results. Thus, we run a battery of unit root tests to detect the presence of integrated time series. It turned out that all variables in (13) are integrated of order 1—I(1). We then run then the Phillips and Oularis single equation procedure to explain variation in RFP. The DF test for cointegration gives a value of –3.26 is below the asymptotic critical value at 5%---2.986—(the critical value at 1% is –3.716). Therefore we conclude that the residual of (13) is stationary, and equivalently the time series cointegrate, with [1 *B*] as a cointegrating vector. This means that in the long run the four variables move together.

For the case of Mexico, the RER seems to have the most important role in determining relative food prices. See table 9 for long run effects.

Table 9. Estimated long run effects. Dependent variable Real Food Prices. 1970-2001

Variable	**Coefficient**	**Std Error**	**Statistical significance**
RER	0.146	0.038	***
lnQa	-0.021	0.399	Non Significant
lnQna	0.047	0.206	Non Significant

Statistical significance: *** 1%, ** 5%, * 10*. R_squared 0.45. Nuber of obs. 32.

Source: Own estimates.

For this and other specifications we tried, results strongly suggest that what only matters for the Real Food Prices behavior is the Real Exchange Rate movements[10]. The coefficient for agricultural growth although has the expected negative sign, turned out to be statistically not different from zero. We have also estimated the short run relationships by way of an error correction representation, with the same outcome: no impact of agricultural growth on Real Food Prices.

In summary, we conclude this section by stating that all the price-growth relationships investigated showed that it is not through lowering food prices that agricultural growth impact on poverty levels.

d) Sources of income of poor people

Finally, we describe here the sources of income of the different categories of people . Table 10 shows that for the moderate poor people, 21% of income is coming from agricultural sources (e.g., from wages or from self employment in agricultural activities) and the remaining 79 from urban sources. For the people under food poverty, the share of income from agricultural sources rises to 36%, whereas for the people that are between both poverty lines, the share of agricultural income is 14%.

Agricultural income is about 46% of total income of the rural food-poor people, whereas is only 18% in urban areas for the same group of people. For people below the moderate poverty line, the share of agricultural income on total income is 40% in rural areas and 8% in urban areas.

[10] We tried other formulations. For instance, we have included dummy variables for the 1982 and 1995 macroeconomic crises. We have included non-agricultural prices in the right hand side of the equation. We have also shorten the period to 1980-2001 to be able to use the average tariff information available. Results were consistent: what only matters is the Real Exchange Rate.

For people between both poverty lines, the share of income coming from agriculture in total income is 32% in rural areas, and it is only 6% in urban areas.

Table 10. Agricultural income in total income and number of people in each category.

	Share of agricultural income in total income	number of people in each category (in millions of persons)
Food poverty	**0.35**	**14.6**
--Rural areas	.46	8.8
--Urban areas	0.18	5.7
Moderate poverty	**0.20**	**42.7**
--Rural areas	0.39	16.7
--Urban areas	0.08	26.0
Poverty between both lines	**0.14**	**28.1**
--Rural areas	0.33	7.9
--Urban areas	0.06	20.2

Source: Own estimates.

PART IV: Conclusions

Poverty levels have been diminishing in Mexico since the late 90's, although several regions still show high levels of poverty, and they are extremely high in some rural areas. This paper have addressed the issue of the linkages between sectoral growth (urban/rural) and poverty levels. It was found that although both types of growth impacted negatively on poverty levels in Mexico, rural growth seems to have a higher power in improving consumption per capita of the poorest among the poor people. Moreover, the only inter-sector linkage found was the one that connects rural growth with urban poverty for those people above the food-poverty line but below the moderate poverty line.

Exploring plausible channels, we have found that rural growth enhances equality of income distribution at total and urban levels, while urban growth does exactly the opposit. But this is still a general equilibrium effect. Thus, we further explored labor market issues. We found that rural growth impacted positively on labor demand for unskilled worker: on this base, *ceteris paribus* it is better for poverty alleviation to have rural growth . We have also explored the issue of relative prices, although no impact of rural/urban growth was found here. Everything seems to be driven by the real exchange rate behavior. The share of agriculture in total income is relatively more important for poor people in rural areas, and most of the food poor people live in rural areas. This may be at the root of our findings.

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ANEXO 1

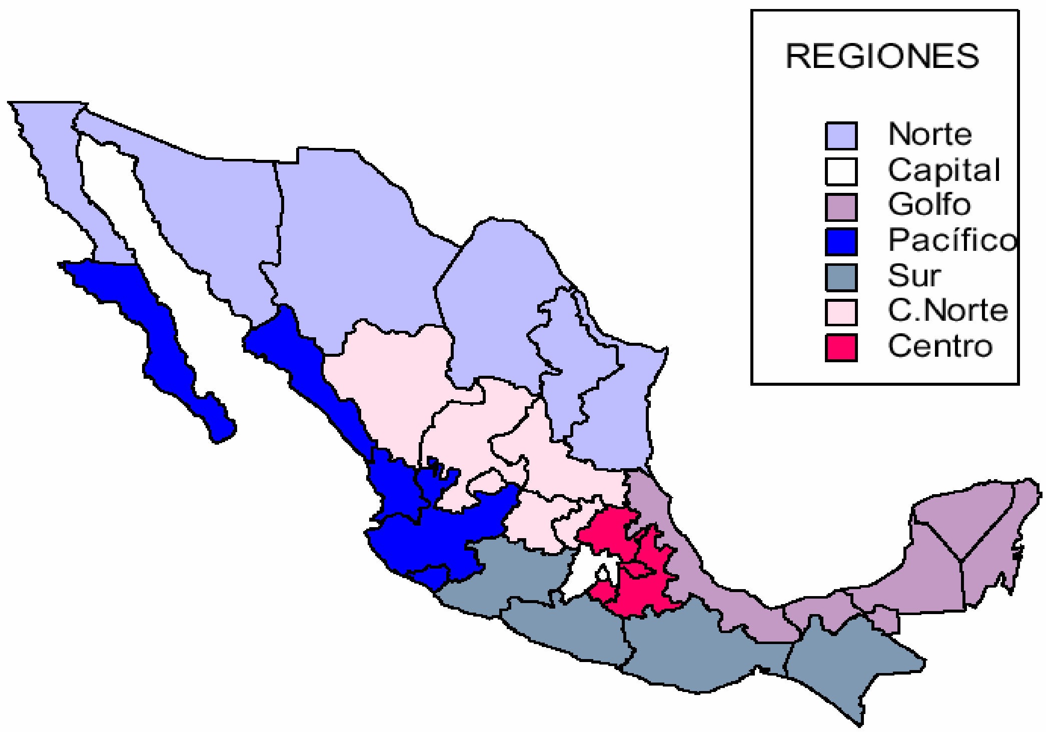

Figure 1

Las regiones corresponden a los siguientes estados:

1 Norte: BC, SON, CHIH, COAH, NL, TAMPS

2 Capital: MEX, DF

3 Golfo: VER, TAB, CAMP, YUC, QROO

4 Pacífico: BCS, SIN, NAY, JAL, COL

5 Sur: MICH, GRO, OAX, CHIS

6 Centro Norte: DGO, ZAC, SLP, AGS, GTO, QRO

7 Centro: HGO, PUE, TLAX, MOR

Annexo II

In tables 5, 6 and 7, the dependent variable is the first difference of the log poverty measure against the first difference of log mean consumption. All the regressions of equation 5,6 and 7 fitted well and passed various standard statistical tests.

Poverty Impact of sectoral growth. Estimates with regional data.

Change in Head Count Poverty -FTG(0)-, 7 Regions 1984-2002.

	Change in national poverty		Components of change in national poverty			
			Urban		Rural(*)	
Variable or statistic	OLS	IV	OLS	IV	OLS	IV
Urban growth π_1	**-0.945**	**-1.094**	**-0.769**	**-0.878**	**-0.143**	**-0.151**
	(-4.21)	(-2.89)	(-4.53)	(-3.31)	(-1.16)	(-1.01)
Rural growth π_2	**-2.799**	**-6.775**	**-0.587**	**-2.110**	**-2.430**	**-4.237**
	(-2.61)	(-2.50)	(-0.68)	(-1.11)	(-2.91)	(-2.74)
Population Shift π_3	**0.038**	**-0.464**	**-0.326**	**-0.168**	**0.423**	**0.363**
	(0.05)	(-0.36)	(-0.59)	(-0.19)	(2.71)	(0.84)
Adjusted R^2	0.3243	0.184	0.2837	0.2054	0.4019	0.1689
Durbin-Wu-Hausman $\chi^2(3)$		7.367		1.30		2.29
		[0.061]		[0.284]		[0.092]
Prueba de Sargan $\chi^2(8)$		11.238		13.43		14.156
		[0.189]		[0.098]		[0.08]
Heteroscedasticidad $\chi^2(9)$	4.56		3.81		26.1	
	[0.871]		[0.923]		[0.002]	
Wald $\pi1=\pi2=\pi3$ F(2,45)	2.22	1.44				
	[0.120]	[0.250]				
Wald $\pi1=\pi2$ F(2,45)	2.98	2.15				
	[0.091]	[0.151]				

Note: t statistics between parentheses, p value bewtween brackets. (*) For Rural, we estimated robust standard errors due to heteroscedaticity. The Durbin-Wu-Hausman (DWH) test for endogeneity for IV estimates showed that for Total poverty (first two columns) IV is indicated. For Urban poverty (third and fourth columns) OLS would give consistent estimates, whereas for Rural Poverty (fith and sixth columns) OLS's consistency is not rejected at 95% confidence level, but is rejected at 90% confidence level (p value of the WDH test was .092). For Rural Poverty, the story that

each column (OLS or IV) tells is similar, although the coefficient for rural growth is higher in the IV estimates. The Sargan test for overidentifying restrictions shows that for Total poverty the instruments used are valid (p value of 0.189), and for Urban and Rural poverty this hypothesis can not be rejected at 95% (p values of .098 and .08 respectively).
Source: Own estimates.

Table __. Change in Poverty Gap FTG(1), 7 Regions 1984-2002.

	Change in national poverty		Components of change in national poverty			
			Urban		Rural(*)	
Variable or statistic	OLS	IV	OLS	IV	OLS	IV
Urban growth π_1	**-1.182**	**-1.259**	**-0.838**	**-0.921**	**-0.292**	**-0.267**
	(-4.02)	(-2.48)	(-4.69)	(-3.27)	(-1.52)	(-1.11)
Rural growth π_2	**-3.189**	**-8.629**	**0.177**	**-1.485**	**-3.726**	**-6.503**
	(-2.13)	(-2.38)	(0.20)	(-0.74)	(-3.32)	(-2.95)
Population Shift π_3	**-0.313**	-1.247	**-0.133**	**-0.560**	**0.603**	**0.524**
	(0.33)	(-0.72)	(0.23)	(-0.50)	(2.09)	(0.78)
Adjusted R^2	0.2842	0.097	0.2863	0.196	0.3732	0.1694
Durbin-Wu-Hausman $\chi^2(3)$		2.425		1.480		1.673
		[0.079]		[0.25]		[0.187]
Prueba de Sargan $\chi^2(8)$		13.721		13.57		18.76
		[0.089]		[0.094]		[0.02]
Heteroscedasticidad $\chi^2(9)$	4.96		6.63		16.9	
	[0.837]		[0.675]		[0.049]	
Wald $\pi 1=\pi 2=\pi 3$ F(2,45)	1.17					
	[0.319]					
Wald $\pi 1=\pi 2$ F(2,45)	1.69					
	[0.200]					

Note: t statistics between parentheses, p value bewtween brackets. (*) Robust standard errors were estimated due to heteroscedasticity .
The Durbin-Wu-Hausman (DWH) test for endogeneity for IV estimates showed that for Total poverty (first two columns) IV is indicated. For Urban poverty (third and fourth columns) OLS would give consistent estimates, whereas for Rural Poverty (fith and sixth columns) OLS's consistency is not rejected even at the 95% confidence level. The Sargan test for overidentifying restrictions shows that for Total and for Urban this hypothesis can not be rejected at 95% (p values of .089 and .09 respectively). For Rural poverty, the instruments were not statistically appropriate (p value for the Sargan test of 0.02).
Source: Own estimates.

Table __. Change in Squared Poverty Gap FTG(2), 7 Regions 1984-2002.

	Change in national poverty	Components of change in national poverty	
		Urban	Rural

Variable or statistic	OLS	IV	OLS	IV	OLS	IV
Urban growth π_1	**-1.285**	**-1.289**	**-0.801**	**-0.874**	**-0.392**	**-0.304**
	(-3.55)	(-2.06)	(-4.00)	(-3.07)	(-1.91	(-0.93)
Rural growth π_2	**-4.142**	**-10.934**	**0.327**	**-1.10**	**-5.010**	**-8.720**
	(-2.25)	(-2.44)	(0.27)	(-0.64)	(-4.79)	(-3.01)
Population Shift π_3	**-0.328**	-1.545	**0.169**	**-0.583**	**0.810**	**0.721**
	(0.28)	(-0.72)	(0.30)	(-0.55)	(1.21)	(0.73)
Adjusted R^2	0.2499	0.046	0.286	0.217	0.386	0.210
Durbin-Wu-Hausman $\chi^2(3)$		2.181		1.471		1.34
		[0.104]		[0.2360]		[0.22]
Prueba de Sargan $\chi^2(8)$		14.072		14.343		20.16
		[0.080]		[0.073]		[0.01
Heteroscedasticidad $\chi^2(9)$	4.50		13.83		9.5	
	[0.875]		[0.1284]		[0.4325]	
Wald $\pi1=\pi2=\pi3$ $F(2,45)$	1.38					
	[0.261]					
Wald $\pi1=\pi2$ $F(2,45)$	2.27					
	[0.138]					

Note: t statistics between parentheses, p value bewtween brackets.
The Durbin-Wu-Hausman (DWH) test for endogeneity for IV estimates showed that for all three poverty areas (total, urban and rural) the consistency of OLS could not be rejected. Nonetheless (at least marginally) for Total poverty this hypothesis was marginally rejected at the 90% (p value of 0.104) The Sargan test for overidentifying restrictions shows that for Total poverty the instruments used are valid for Total and for Urban poverty at the 95% confidence level. For rural poverty this hypothesis was rejected with a 99% confidence (p values of .001).
Source: Own estimates.