POVERTY IN MEXICO: THE EFFECTS OF ADJUSTING SURVEY DATA FOR UNDER-REPORTING*

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Resumen: Este trabajo estima los cambios en ios niveles de pobreza en México entre 1984 y 1989. La incidencia de la pobreza se estimó con base en la información de las encuestas de ingreso-gasto sin ajustar y ajustando los datos por subdeclaración de ingresos y consumo. El trabajo ilustra la sensibilidad de las estimaciones sobre incidencia de la pobreza en México tanto al ajuste o corrección de la información como al procedimiento específico seguido para realizar dicho ajuste. Mientras no se disponga de mayor información sobre la distribución de la subdeclaración, no será posible obtener una estimación definitiva sobre el orden de magnitud de la pobreza y su incremento.

Abstract: This paper estimates changes in poverty in Mexico between 1984 and 1989. Poverty is estimated using uncorrected data from the household surveys and estimation is repeated after the data is adjusted for under-reporting using National Accounts totals as benchmarks. The paper illustrates the sensitivity of poverty estimates in Mexico both to the adjustment itself and the specific procedure used to adjust the survey data for under-reporting. Until more information is available on the distribution of under-reporting it will not be possible to give a final verdict on the order of magnitude of the rise in poverty.

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1. Introduction

During the 1980's Mexico experienced difficult economic times. Sharp domestic macroeconomic imbalances, combined with high world interest rates, falling oil prices[1] and the drying up of foreign commercial lending, led to a major economic crisis in mid-1982. The crisis was followed by several stabilization programs and adjustment policies which began to show success only several years later when inflation subsided and growth began to recover.[2] In the meantime income per capita and real wages fell at a pace of close to 5.1 and 7 percent per year, respectively, between 1982 and 1988.

How did the incidence of poverty change during this period? This paper estimates changes in poverty between 1984 and 1989, the two points in time for which country-wide household surveys are available.[3] The year 1984 is not the best benchmark for a "before/after" the crisis analysis because a considerable portion of the downward adjustment in wages and total income had already occurred in 1983. However, both continued to decline between 1984 and 1989 (Table 2), as the country faced another external shock in 1986 which was followed by a real devaluation of the currency and more fiscal austerity.

Using both income and consumption as measures of individual welfare, and based on poverty lines developed by other authors, the results show that both extreme and moderate poverty *declined* between 1984 and 1989. The robustness of the results was tested following the approach suggested by Atkinson (1987) and Foster and Shorrocks (1988a). Using a range of poverty lines, which encompasses all readily available extreme and moderate poverty lines, for a large range of these poverty lines poverty was lower in 1989 than in 1984. For a small set of

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[1] Oil had become Mexico's principal export.

[2] For an analysis of the Mexican economy during the 1980's, see Lustig (1992) and Aspe (1993).

[3] The data used are from INEGI's Household Income and Expenditure Surveys for 1984 and 1989. See the Appendix for a description of the surveys.

poverty lines located at the bottom of the distribution, poverty in 1989 was found to be higher.[4]

The finding that poverty in Mexico fell between 1984 and 1989 for a large range of poverty lines seems contrary to much of the other evidence on economic performance and the evolution of living standards during the period. For example, total consumption per capita, real wages, average remunerations in agriculture, corn production, and the price of corn fell between 1984 and 1989 at the same time that the distribution of income became more concentrated.[5]

One explanation for this apparent paradox may be that, while under-reporting of income and consumption is likely to have occured in both surveys, the degree of under-reporting may have been higher in 1984 than in 1989. Comparing survey totals with National Accounts one finds that the difference between survey totals and National Accounts both for consumption and income are higher for 1984 than 1989. If one assumes that the totals for income and consumption obtained from the National Accounts are correct, one could proceed to "gross-up" the survey data to match the National Accounts totals. In all the cases in which authors have "corrected" (adjusted) the data to account for under-reporting the results are the opposite of those found with the "uncorrected" survey data: i.e., poverty rises for all the poverty lines available.[6] Using our own "correction" method we find that these results are robust to changes in the poverty lines.

2. The Incidence of Poverty in Mexico

Several authors have estimated extreme and moderate poverty for Mexico using different poverty lines.[7] These lines were calculated following alternative definitions of what should be included in the consumption baskets of the extremely poor and the moderately poor. These normative differences explain the large discrepancy between, for example, the extreme poverty line used by Hernández-Laos (1990), and

[4] This is true both using consumption and particularly income per capita. See Graphs 1 and 2.

[5] Based on data from INEGI in the *Cuarto Informe de Gobierno, 1992.*

[6] From now on the terms "correcting" and "adjusting" will be used indistinctively.

[7] For a survey see, Lustig (1992).

those used by Levy (1991) and CEPAL (1990), shown in Table 1. A conventional distinction between extreme and moderate poverty is that the extreme poverty line is the income or consumption level below which a household is unable to "purchase" a minimum nutritional *food* basket, whereas the moderate poverty line is the income or consumption level below which a household is unable to "purchase" a basket of goods that satisfy what, at the given stage of the country's development, are considered basic needs. As is described in more detail in the Appendix, however, the amounts of non-food items included in each minimum consumption basket varies substantially across authors.

2.1. *Poverty Measure Estimates*

In Table 1 we present estimates of the head-count ratio, the per capita poverty gap and the "distribution sensitive" FGT poverty index[8] for 1984 and 1989 using the selected set of poverty lines. Poverty estimates were calculated using both household income and consumption per capita as the measure of individual welfare. We have chosen to use both income and consumption because there is no consensus as to which one is a more adequate measure of welfare.[9] In addition, since both are subject to measurement errors that may be independent, having separate measures of poverty using both variables may provide an additional check on the robustness of the results. Household total income and total consumption both include non-monetary items such as auto-consumption, payments in kind, gifts and imputed rent for owner-occupied housing and were corrected for the inflation present during the surveys' reference period. (For more details on the methodology used to calculate poverty estimates see the Appendix.)

Because the differences in poverty indices between the two years is so small, especially for the lowest poverty lines, we tested the statistical significance of the poverty differences using the methodology proposed by Kakwani (1993).[10] According to the results in Table 1, the decline in

[8] The FGT was named after its authors. See Foster, Greer, and Thorbecke (1984).

[9] See Atkinson (1987) and Ravallion (1992) for a discussion of both concepts.

[10] Kakwani (1993) derives the formulas for the standard errors for each of the Foster, Greer, and Thorbecke class of poverty measures and for the test statistic, which can be used to test the null hypothesis that the observed poverty differences between any two samples is statistically insignificant.

Table 1

Poverty Measure Estimates for Selected Poverty Lines 1984-1989

Poverty Lines[1]		Income[2]									Consumption[3]								
		Head-count			PC Income Gap			FGT			Head-count			PC Income Gap			FGT		
in US$	*in pesos*	*84*	*89*	*t-stat*	*84*	*89*	*t-stat*	*84*	*89*	*t-stat*	*84*	*89*	*t-stat*	*84*	*89*	*t-stat*	*84*	*89*	*t-stat*
Extreme poverty																			
Psach. *et al.* (1993)																			
US$34.20	Mex$6 338	6.8	6.4	-0.99	1.76	1.99	1.56	0.77	0.92	1.58	7.5	6.7	-1.82	2.01	1.83	-1.20	0.77	0.76	-0.11
Levy (1991)																			
US$50.61	Mex$9 372	15.1	14.0	-1.84	4.68	4.58	-0.43	2.10	2.20	0.69	19.1	15.8	-4.87*	5.55	4.84	-2.86*	2.39	2.16	-1.67
CEPAL (1990)																			
US$56.49	Mex$10 461	18.9	16.8	-3.16*	5.98	5.70	-1.05	2.74	2.78	0.26	22.7	19.0	-5.19*	7.13	6.15	-3.52*	3.17	2.82	-2.20*
Hernández-Laos (1990)																			
US$141.5	Mex$26 219	58.4	54.9	-4.10*	27.12	24.91	-4.43*	15.83	14.46	-3.73*	63.1	59.1	-4.85*	30.32	27.21	-6.10*	18.02	15.88	-5.64*
Moderate poverty																			
Psach. *et al* (1993)																			
US$68.50	Mex$12 676	26.6	23.2	-4.58*	8.87	8.19	-2.10*	4.24	4.12	-0.63	30.2	26.5	-4.81*	10.51	9.06	-4.31*	4.99	4.35	-3.14*
Szekely (1993)																			
US$75.30	Mex$13 953	30.8	26.8	-5.15*	10.68	9.75	-2.67*	5.21	4.96	-1.11	35.2	30.2	-6.16*	12.53	10.82	-4.71*	6.13	5.33	-3.55*
CEPAL (1990)																			
US$108.6	Mex$20 116	46.5	42.9	-4.21*	19.38	17.56	-4.10*	10.48	9.59	-2.92*	51.1	46.1	-5.86*	22.06	19.36	-5.86*	12.12	10.55	-4.96*
Levy (1991)																			
US$211.9	Mex$39 215	74.0	72.3	-2.19*	40.32	37.96	-4.34*	26.18	24.25	-4.34*	79.1	76.0	-4.45*	44.04	40.87	-5.91*	29.08	26.37	-6.00*
Hernández-Laos (1990)																			
US$238.8	Mex$44 228	78.7	76.7	-2.89*	44.42	42.11	-4.25*	29.66	27.64	-4.37*	83.1	79.6	-5.32*	48.26	45.07	-6.00*	32.75	29.94	-6.04*

Source: Author's estimates based on INEGI's Income and Expenditure Surveys for the third quarters of 1984 and 1989.

[1] Poverty lines are per person per quarter in June 1984 prices. Poverty lines were converted to US$ using the average free exchange rate for 1984 of mex$185.19 per dollar.

[2] Based on quarterly household monetary plus non-monetary income per capita in June 1984 pesos as the welfare measure.

[3] Based on quarterly household monetary plus non-monetary consumption per capita in June 1984 pesos as the welfare measure.

*Indicates that the difference between the 1984 and 1989 poverty measure estimates is statistically significant at the 5 percent level.

Note: The definitions of "extreme" and "moderate" poverty lines are those given by respective authors.

moderate poverty observed between 1984 and 1989 is statistically significant for all the considered moderate poverty lines whether income or consumption is used. Using *consumption*, the reduction in extreme poverty was statistically significant for all but the lowest extreme poverty line.[11] When *income* is used instead, the increase in poverty found when using the lowest extreme poverty lines is not statistically significant. These results suggest that with the available poverty lines and using the uncorrected survey data the incidence of poverty in Mexico fell between 1984 and 1989.

3. Are the Results Robust?

In order to check the robustness of the results we follow the approach suggested by Atkinson (1987) and Foster and Shorrocks (1988a) and use a range of (almost continuous) poverty lines going from zero[12] to the maximum available poverty line used in other studies for Mexico.[13] Again, poverty estimates are obtained using both income and consumption per capita as the welfare measure. The use of a range of poverty lines permits one to differentiate cases in which ranking reversals between distributions occur, from those in which they do not. When there are no ranking reversals at *any* poverty line, it is reasonable to conclude that one distribution has unambiguously less (or more) poverty than another. Otherwise, the poverty comparison is, strictly speaking, ambiguous or inconclusive.[14]

[11] This result obtains when based on the head-count ratio and the per capita poverty gap and for the two lowest poverty lines when based on the FGT index.

[12] Actually, the lowest poverty line is slightly above zero, since there were too few observations at zero income for the exercise to be valid.

[13] No precise formula was used to determine the size of the interval between poverty lines. Poverty measures were calculated for poverty lines set at 1 000 pesos intervals ranging from Mex$1 000 to almost Mex$45 000, as well as for each of the poverty lines used in other studies on poverty in Mexico. The difference in the head-count ratios between consecutive poverty lines was never more than about 3 percentage points.

[14] Foster and Shorrocks (1988a) show that when using a range of poverty lines the ranking of any two distributions given by the head-count ratio (or the P_1 index) is dominant in the class of P_α indices with $\alpha > 1$. In other words, if poverty is unambiguously lower over the entire range of poverty lines based on the head-count ratio, this ordering cannot be reversed by the other P_α indices with $\alpha > 1$, such as the per capita

Graphs 1 and 2 depict the head-count ratio orderings for individuals in 1984 and 1989 using household consumption and income per capita respectively, as the measure of individual welfare. From the graph it is evident that the first-order dominance criterion is not satisfied, because poverty measured by the head-count ratio was found to be higher in 1989 than in 1984 for some poverty lines. However, using consumption per capita, these increases were not found to be statistically significant.[15] In contrast, using income per capita, the rise in poverty *was* statistically significant at several poverty lines indicating that at the lower end of the distribution some individuals were worse off income-wise in 1989.[16] Since the head-count ratio did not yield unambiguous results for the pair-wise comparison, the orderings were repeated using the per capita poverty gap and then the FGT index. The second and third-order dominance criteria were not satisfied either.

Using uncorrected survey data, therefore, one can conclude that poverty in Mexico declined between 1984 and 1989 for the entire range of poverty lines used in the literature.[17]

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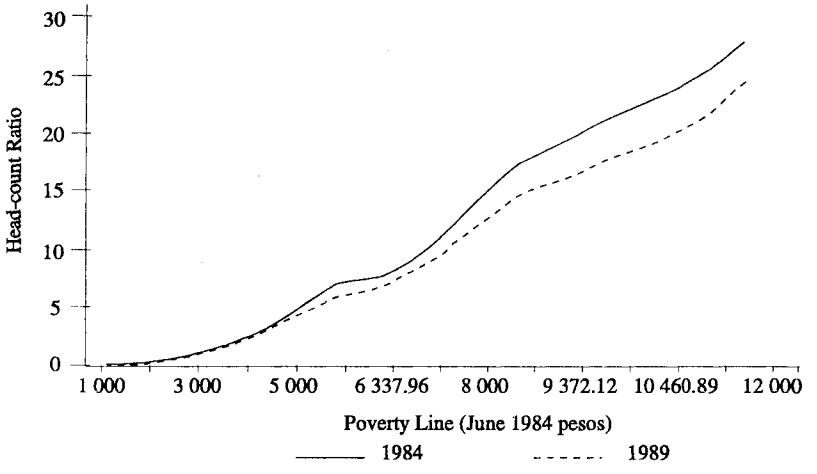
income gap or the FGT index. When the ordering provided by the head-count ratio *is* ambiguous, one can proceed to sequentially use P_α indices with $\alpha > 1$ to determine whether the distributions can be unambiguously ranked under weaker ordering conditions. Each subsequent poverty verdict based on a $P_{\alpha>1}$ index will be dominant in the class of $P_{\alpha>1+t}$ indices.

[15] Specifically, based on consumption there was an increase in poverty measured by the head-count ratio between 1984 and 1989 for poverty lines of Mex$1 000, Mex$2 000 and Mex$4 000. The head-count ratio for the poverty line of Mex$4 000 was 2.1 percent in 1989 and 2.0 percent in 1984. The poverty line of Mex$4 000 is 63 percent of the lowest extreme poverty line used by other authors. However, the increase was statistically significant only at the lowest poverty line. At $1 000 the head-count ratios was close to zero. Hence it is practically irrelevant.

[16] For the majority of the poverty lines, poverty measured by income was lower in 1989 than in 1984, but for poverty lines between Mex$2 000 and Mex$6 000 the head-count ratio was higher in 1989 than in 1984. For poverty lines of Mex$2 000, Mex$4 000 and Mex$5 000 the increase in poverty was found to be statistically significant. At Mex$5 000 the head-count ratio was 3.3% in 1984 and 4.1% in 1989.

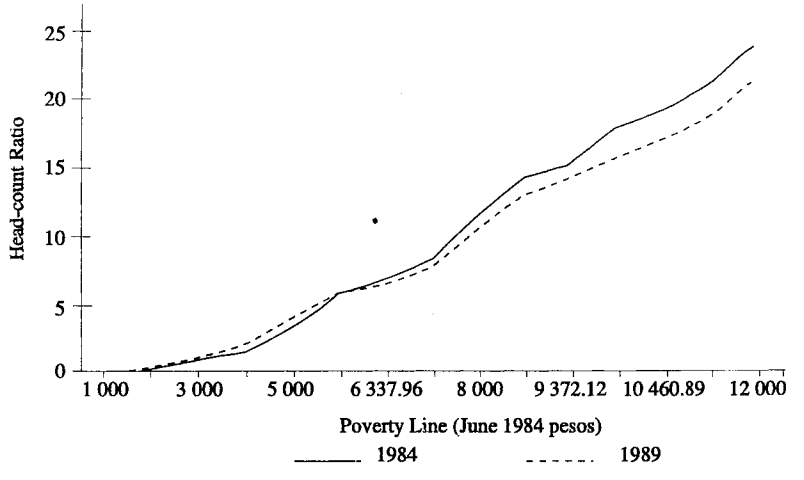
[17] However, if the poverty lines used are smaller than these used in the available studies, there is a range for which poverty increases when per capita income is used as the welfare measure. This reversal occurs at approximately the bottom 4 percent of the population.

Graph 1
Consumption Per Capita



Note: There are no other crossing for poverty lines greater than 12 000 pesos.

Graph 2
Income Per Capita



Note: There are no other crossing for poverty lines greater than 12 000 pesos.

4. Are the Results Credible?

The finding that poverty in Mexico fell between 1984 and 1989 on the surface seems inconsistent with much of the other evidence on economic performance between those years. Figures on income, consumption, wages and corn production and prices, presented in Table 2, show a decline between 1984 and 1989. For example, between 1984 and 1989 the average remunerations per employed person in agriculture fell by almost 25 percent and the value of corn production, especially important for the rural poor, fell by 32 percent. Based on this information, one would expect both extreme and moderate poverty to be higher in 1989 than in 1984, because the poor receive a significant portion of their income from wages and the rest is non-wage income or auto-consumption derived from growing corn.[18]

One possible explanation for the apparently contradictory results is that if surveys under-report income and consumption, the degree of under-reporting could have been higher in 1984 than in 1989.[19] A common procedure used in the literature is to measure under-reporting by the difference between the survey totals and the figures in the National Accounts.[20] A comparison of per capita wage and non-wage income and consumption by type of good from the National Accounts and from the household survey is presented in Table 2.

The magnitude of under-reporting implied by the comparison of the survey data with the National Accounts is substantial *and* changed in the two survey points. For example, as shown in Table 2, per capita wage income was 1.6 times greater in the National Accounts than in the survey in 1984 and about 1.1 times greater in 1989. Hence it is conceivable

[18] See Lustig (1990).

[19] Another possible explanation is that, although per capita wage income measured by the National Accounts fell, households compensated for falling incomes by increasing the number of household members who were working and by engaging in economic activities in the informal market. In this case, instead of there being a reduction in the degree of under-reporting in the survey between 1984 and 1989, the 1989 National Accounts data may underestimate the true level of economic activity due to an expansion in the informal sector. In this case adjustment to the National Accounts would lead to spurious results regarding the change in poverty.

[20] See Bergsman (1980), CEPAL (1990), Hernández-Laos (1990) and Psacharopoulos *et al.* (1993).

Table 2

Comparison of Inflation Adjusted Quarterly Income and Consumption Per Capita from the INEGI *Survey and the National Accounts (June 1984 pesos, except where noted)*

	1984			1989			% Change 1984-1989	
	Survey[1]	National Accounts	NA/Survey	Survey	National Accounts	NA/Survey	Survey	National Accounts
Income								
Wage	15 754	25 917	1.645	18 324	19 820	1.082	16.3	-23.5
Non-wage	17 257	42 683	2.473	20 836	41 842	2.008	20.7	-2.0
Total	33 012	68 600	2.078	39 161	61 662	1.575	18.6	-10.1
Consumption								
(1) Food, bev., tobacco	11 922	23 983	2.012	12 129	23 067	1.902	1.7	-3.8
(2) Clothes & shoes	1 842	5 937	3.223	2 174	5 021	2.310	18.0	-15.4
(3) Housing, fuel, electricity	5 054	5 484	1.085	7 284	6 407	0.880	44.1	16.8
(4) Furniture & household goods	1 895	8 474	4.472	2 572	7 949	3.091	35.7	-6.2
(5) Health care	1 177	2 573	2.186	1 609	2 336	1.452	36.7	-9.2
(6) Transport & communications	3 219	5 652	1.756	3 488	6 008	1.723	8.3	6.3
(7) Entertainment, culture, education	2 268	3 359	1.481	2 839	3 251	1.145	25.1	-3.2
(8) Other	1 848	8 170	4.421	2 470	9 063	3.669	33.7	10.9
Total	29 226	63 633	2.177	34 565	63 102	1.826	18.3	-0.8
Population[2]	76 766 930	72 911 672		79 552 522	79 714 168		3.6	9.3
Memo:								
Corn Production ('000 tons)		12 788			10 953			-14.3
Value of Corn Production (Millions of 84 pesos)[3]		431 567			292 922			-32.1
Guaranteed Corn Price (1984 pesos per ton)								
Autumn-Winter		25 500			21 139			-17.1
Spring-Summer		33 450			24 880			-25.6
Avg. Wage Remum. in Agriculture (1984 pesos)		86 367			65 101			-24.6

Source: National Accounts data are from the *Cuarto Informe de Gobierno, 1992*, pp. 139, 148, 157. Survey figures calculated by authors based on INEGI's Income and Expenditure Surveys for the third quarters of 1984 and 1989.

[1] Definitions of each of the income and expenditure categories for the survey data and for the National Accounts data are given in the Appendix. All survey and National Accounts data were converted to June 1984 pesos using the CPI.

[2] Population levels for the National Accounts are based on population growth rates in Ordorica (1990), which where calculated based on census data.

[3] The 1989 values of corn production and the corn prices were converted to 1984 pesos using the CPI.

Note: Total income from National Accounts is net of direct taxes and social security contributions (to be consistent with survey data).

that the results which show that poverty fell between 1984 and 1989 are only capturing the improvement in data collection in the second survey.

In the remainder of this section we present some of the arguments for ad against adjusting survey data for under-reporting and discuss the methods which have been used to adjust for under-reporting. We then describe our own methodology and present poverty measure estimates based on the data adjusted for under-reporting.

4.1. *The Adjustment of Survey Data for Under-reporting*

The main argument for adjusting survey data for under-reporting is that one believes that surveyed individuals did not state their true incomes or expenditures in the survey due to oversight or intentionally, for example, to hide tax evasion. If one suspects that under-reporting is a serious problem then first one must obtain some benchmark against which to compare income and consumption totals supplied by the survey and then devise a method for adjusting the survey data. It is generally argued that National Accounts data provide good comparison totals because they are usually subject to a system of cross-checking, and therefore contain the most accurate figures available for the country.[21]

Several problems, however, should be noted. The first is that the National Accounts themselves may not be accurate[22] and the concepts used in the National Accounts may not be comparable with those in the household survey.[23] Second, even if the totals given by the National Accounts are correct, there is no exogenous information that can be used to determine how the difference in the National Accounts figures and those of the survey should be allocated across households. Researchers generally assume either that under-reporting is more closely related to the *type* of income (e.g., wage income, non-wage income) and make adjustments separately for each income type,[24] or they assume

[21] See, for example, Altimir (1987).

[22] Heston (1994) describes numerous problems developing countries face in measuring both income and expenditures in the National Accounts.

[23] Ruggles (1994) argues that the concepts used in household surveys are not currently integrated with those of the household sector in the National Accounts and this harmonization is an important area for improvement of the United Nations System of National Accounts.

[24] CEPAL (1990), for example, make separate adjustments for under-reporting for each type of household income.

that it is more closely related to the *level* of income (i.e., the household's position in the distribution) and distribute the under-reported income differentially across households at different points in the distribution.[25] In either case the adjustment alters the distribution of income (or consumption). Despite all these problems with the procedure, safe re-surveying a sub-sample of households, there are no clear better alternatives than using National Accounts and distributing the difference following specific assumptions.

Several authors have calculated poverty estimates for Mexico using income and consumption "corrected" for under-reporting using the National Accounts. The methodology used by these authors was to "gross-up" household income and/or consumption such that the per capita figures from both sources were equal.

For example, the methodology used by CEPAL (1990) was based on the assumption that the under-reporting of income is more closely related to the type of income earned. Specifically, CEPAL adjusted each type of income earned by each household by multiplying by the ratio of per capita total income for that category of income in the National Accounts to the level of per capita income in the survey.[26] Two additional assumptions were made. First, if the total for any category of income in the survey was greater than the corresponding figure in the National Accounts, then it was assumed that the figure in the survey was more precise than that given in the National Accounts, and this category of income was not adjusted. Second, the under-reported amount of monetary income from property was distributed only to the top two deciles of the distribution, because it was argued that the underestimation of this type of income is known to be more heavily concentrated among upper income groups.

The methodology for adjusting for income under-reporting used by Psacharopoulos *et al.* (1993) was based on the income adjustment coefficients developed by CEPAL. For 1984 the Psacharopoulos *et al.* study used separate adjustment coefficients for urban and rural areas, which were equal to the ratio of the value of total income adjusted for under-

[25] Bergsman (1980) distributed "under-reported" income differently across households depending on their income decile.

[26] The income categories wages and business profits were further disaggregated into agricultural and non-agricultural and separate adjustment coefficients were used for each.

reporting in each area calculated by CEPAL to total income in each area in the survey. For 1989, since CEPAL's adjustment coefficients were not available, the adjustment coefficients for 1989 were obtained by multiplying the 1984 adjustment coefficient by the change in the degree of income under-reporting between the two periods. By using a single adjustment coefficient for all households, the Psacharopoulos *et al.* estimates assume a uniform degree of under-reporting by all households, and therefore the distribution of income (in urban and rural areas, separately) is unchanged.

Any correction procedure will, inevitably, always involve some degree of arbitrariness. Ideally, one would like to disaggregate both the survey and the benchmark data in the smallest possible homogeneous units.[27] For example, use agricultural production-based income by region, state —or even better— municipality from an external source to correct that observed in the surveys. In the case of Mexico, however, this procedure is not feasible because the National Accounts are not collected for distinct geographic areas and other data sources which have these variables are not available for the survey years.

The closest second best is the disaggregate income in wage and non-wage income and consumption in those consumption categories available in the National Accounts. Because neither CEPAL nor Psacharopoulous *et al.* follow this procedure straightforwardly, we calculate the poverty estimates with the survey data corrected along these lines.

Specifically, the method we used to adjust the survey data for under-reporting was to assume that under-reported wage and non-wage income was equal to the difference between the per capita level in the survey and that in the National Accounts. This difference was then distributed proportionally across households. An analogous procedure was followed for the eight consumption categories.

[27] This method was proposed by Professor Donald B. Rubin in a workshop on survey data correction methods, Inter-American Development Bank, Washington, D.C., July 1994.

5. Poverty Estimates Using Data Adjusted for Under-reporting

The poverty head-count ratio estimates obtained using our method to adjust the survey data to match the National Accounts are presented in Table 3. As expected, extreme and moderate poverty rates based on both consumption and income corrected for under-reporting dropped markedly in both 1984 and 1989 relative to the levels based on the "uncorrected" data.

Table 3
Comparison of Head-count Ratio Estimates Using Income and Consumption Adjusted and Unadjusted to the National Accounts, 1984-1989

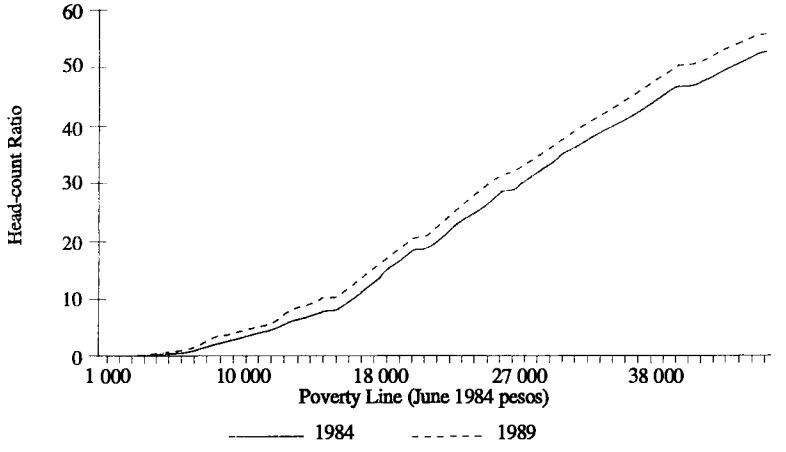
		Income				*Consumption*			
		Unadjusted [2]		*Adjusted* [3]		*Unadjusted* [4]		*Adjusted* [5]	
Poverty Lines [1]		*1984*	*1989*	*1984*	*1989*	*1984*	*1989*	*1984*	*1989*
Extreme Poverty									
Psach. *et al* (1993)	US$34.20	6.8	6.4	0.9	2.2*	7.5	6.7	0.5	1.0*
Levy (1991)	US$50.61	15.1	14.0	2.2	6.4*	19.1	15.8*	2.7	3.9*
CEPAL(1990)	US$56.49	18.9	16.8*	3.2	7.6*	22.7	19.0*	4.1	5.2*
Hernández-Laos (1990)	US$141.58	58.4	54.9*	26.9	37.6*	63.1	59.1*	28.6	31.8*
Moderate Poverty									
Psach. *et al* (1993)	US$68.50	26.6	23.2*	5.8	11.9*	30.2	26.5*	6.5	8.5*
Szekely (1993)	US$75.30	30.8	26.8*	6.9	14.3*	35.2	30.2*	7.9	10.4*
CEPAL (1990)	US$108.63	46.5	42.9*	16.1	26.3*	51.1	46.1*	18.4	20.5*
Levy (1991)	US$211.95	74.0	72.3*	44.4	55.9*	79.1	76.0*	46.4	50.0*
Hernández-Laos (1990)	US$238.83	78.7	76.7*	49.6	61.0*	83.1	79.6*	52.3	55.5*

Source: Authors' estimates based on INEGI's Income and Expenditure Surveys for 1984 and 1989.
[1] Poverty lines are per person per quarter in June 1984 pesos converted to US$ using the average free exchange rate of Mex$ 185.19 per dollar.
[2] Based on household income per capita.
[3] Based on household income per capita adjusted for under-reporting.
[4] Based on household consumption per capita.
[5] Based on household consumption per capita adjusted for under-reporting.
*Indicates that the difference between the 1984 and 1989 poverty measures is statistically significant at the 5 percent level.
Note: The definitions of "extreme" and "moderate" porverty lines are those given by respective authors.

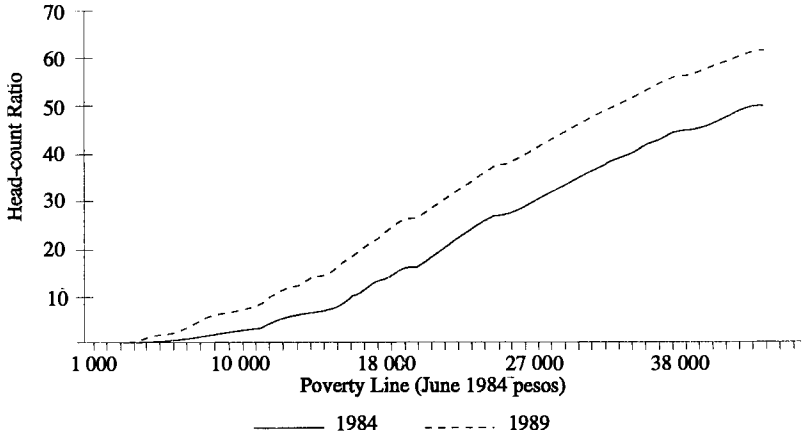
Using the "corrected" data poverty is unambiguously *higher* in 1989 than in 1984. Graph 3, which presents the poverty head-count ratio estimates for the range of poverty lines based on consumption corrected for under-reporting, and Graph 4, which presents the estimates based on income corrected for under-reporting, show that for both in-

come and consumption there is first-order dominance, indicating that there was an unambiguous increase in poverty between 1984 and 1989.

Graph 3
Consumption Per Capita
"Corrected" for Under-reporting



Graph 4
Income Per Capita
"Corrected" for Under-reporting



Alternative methods of adjustment for under-reporting were also considered. Poverty estimates, for example, were recalculated using income and consumption "corrected" for under-reporting using *aggregate* adjustment coefficients (i.e., not using separate wage and non-wage adjustment coefficients on the income side and separate coefficients for each consumption category on the consumption side). Note that this adjustment method does not alter the distribution of income and consumption, but only the levels of each. As with the alternative adjustment method, poverty was found to be higher in 1989 than in 1984 for the entire range of poverty lines.

These results are consistent with those found by other studies which use the adjusted survey data to match the National Accounts.[28] Both found that poverty between 1984 and 1989 increased. Their head-count ratios, however, are quite different from ours (between two and three times higher) due to differences in the methodologies used to adjust for under-reporting. Until more external information exists as to the distribution of under-reporting among different households, it is difficult to establish which *levels* of poverty are correct.

6. Concluding Remarks

The preceding discussion illustrates the sensitivity of poverty estimates in Mexico to the adjustment of the survey data for under-reporting. Using the unadjusted survey data, the results show that both moderate and extreme poverty in Mexico declined between 1984 and 1989 based on the poverty lines developed by other authors.[29] When the poverty estimates were recalculated using the survey data adjusted for under-reporting the results were reversed. Based on the "corrected" data both extreme and moderate poverty were found *to rise* systematically between 1984 and 1989. These results were found to be both statistically significant and robust to changes in the poverty line.

[28] INEGI-CEPAL (1993) and Psacharopoulos *et al.* (1993).

[29] The first-order dominance criterion, however, was not satisfied because poverty measured by the head-count ratio was found to be higher in 1989 than in 1984 for a small set of poverty lines at the bottom end of the distribution.

Given the shortcomings of the methods available to adjust for under-reporting, estimates based on the corrected data should be taken with great caution. Nonetheless, in the case of the Mexican data there are strong reasons to believe that poverty should have risen between 1984 and 1989. Also, the application of different "correction" methods yield systematically the same outcome: i.e., both extreme and moderate poverty rise. Two other studies that have calculated the change in poverty using "corrected" data find that poverty rose independent of the method which was used to make the correction.[30] However, until more information is available on the distribution of under-reporting it will not be possible to give a final verdict on the order of magnitude of the rise in poverty.

Appendix

A.1. *The Data*

The poverty measures were based on data from the third quarter of the 1984 and the 1989 Income and Expenditure Surveys carried out by the National Institute of Statistics, Geography and Informatics (INEGI).[31] The numbers of observations in the 1989 and 1984 surveys are 11 531 and 4 735, respectively. When weighted by the corresponding expansion factors these are converted to 15 955 536 households (or 79 552 522 individuals) for the 1989 survey and 14 988 551 households (or 76 766 930 individuals) for the 1984 survey.[32] Both surveys were undertaken during the same period of each year (August 21st through November 17th),

[30] For example, Psacharopoulos *et al.* (1993) found that extreme poverty rose from 3 percent in 1984 to 7 percent in 1989 and that moderate poverty rose from 17 percent to 23 percent. A recent study by INEGI and CEPAL (1993) found an increase in extreme poverty from 15 to 19 percent and in moderate poverty from 43 to 48 percent between 1984 and 1989.

[31] There were four independent surveys during the four quarters of 1984. Only the data for the third quarter is used here, because it is the only one that is strictly comparable with the 1989 survey.

[32] These population levels differ substantially, especially in 1984, from population levels implied by census data. Yearly population levels calculated based on population growth rates from Ordorica (1990), pp. 4-6, were 72 911 672 in 1984 and 79 714 168 in 1989.

based on the same sampling techniques, and using identical procedures for data collection.[33]

The surveys were drawn using a stratified and multi-stage sampling method.[34] They are representative samples for the population as a whole and for high and low density areas. Further disaggregation may not be statistically valid.

A.2. *The Measurement of Total Household Income and Expenditures*

In order to make income and expenditures comparable between years and between households (which were interviewed at different times during the 3rd quarter of each year), all nominal values of income and expenditures were converted to June 1984 pesos. Poverty lines were converted to June 1984 pesos per quarter per individual.[35]

A.2.1. *Income*

Total household income equals the summation of monetary plus non-monetary income. Separate inflation adjustment procedures were used for monetary and for non-monetary income because of differences in the reference time period for each type of income.

(1) The value of current *monetary* income for each of the preceding 6 months was calculated as the summation of income categories 1 through 27, except category 6 (category 6 = payment in kind for work, which is included under non-monetary income).

(2) Monthly price deflators were calculated based on the value of the variable MES_P, which indicates the number of the month preceding the survey (e.g., if MES_P = 8 then the month preceding the survey was August). Based on the value of this variable separate price deflators were calculated for each of the preceding 6 months.[36]

[33] The accuracy of the data obtained in electronic format was confirmed by comparing it with the figures published by INEGI (1989 and 1992).

[34] For a complete discussion of the sampling procedure and characteristics of the surveys see INEGI (1989 and 1992).

[35] All adjustments for inflation were based on the CPI from the Bank of Mexico presented in the *Cuarto Informe de Gobierno, 1992*.

[36] For the 1984 survey, the variable MES_P was found to equal 99 for all households. The variable MES_1, which equals the number of the month 1-month period to the survey

(3) Total quarterly household monetary income was then obtained by deflating the household's income for each month by the corresponding monthly price index, summing over the six months and dividing by 2.

(4) Total quarterly household *non-monetary* income was more difficult to calculate because each type of non-monetary income (autoconsumption, payment in kind, gifts received, and the imputed value of owner-occupied housing, free rent, and rent as payment in kind) has four different components, each referring to a different period of time (e.g., weekly, monthly, quarterly or semestral). The value of each type of non-monetary income was converted to June 1984 pesos by deflating each of the 4 components of each type of non-monetary income by the corresponding price index.[37]

(5) Each category of weekly, monthly and semestral non-monetary income was then converted to a quarterly basis by multiplying by the adjustment factor provided by INEGI. The adjustment factor for monthly and semestral data varies across households depending on the value of the variable DECENA, which indicates the 10 day period during which the survey was undertaken, while the weekly adjustment factor is the same for all households.[38]

An additional assumption was made in calculating household income. For both 1984 and 1989 *capital* non-monetary income could not be subtracted from total non-monetary income because the survey data does not provide non-monetary income disaggregated between current and capital. However, the effect of this should be relatively small given that total capital non-monetary income summed over all households

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was used instead to determine the month for the inflation deflator. For example, if MES_1 = .06 then the month preceding the survey was assumed to be July (i.e., the 7th month). In addition, .2 percent of the expanded households in the 1984 survey had MES_1 = 0. For those households the deflators were arbitrarily set equal to those for MES_1 = .08, because that was the mode of the variable MES_1.

[37] Weekly and monthly categories were deflated by the deflator for the month preceding the survey (i.e., CPI of month preceding survey/CPI of June 1984), quarterly categories by the quarterly deflator (i.e., average of the monthly CPI for the three months preceding the survey/CPI of June 1984), and the semestral categories by the semestral deflator (i.e., average of the monthly CPI for the six months preceding the survey/CPI of June 1984).

[38] Note that unlike other types of non-monetary income, each of the four types of non-monetary rental income are monthly figures, so they were deflated by the monthly prices indices and the monthly adjustment factor.

represented less than one percent of total non-monetary income (.26 percent in 1984 and .73 percent in 1989).[39]

A.2.2. *Expenditures*

Total household expenditures were calculated as the sum of monetary and non-monetary expenditures. Non-monetary expenditures are equal to non-monetary income (described above under income) by definition. The procedures used to determine current monetary expenditures in June 1984 pesos is similar to that used for non-monetary income.

(1) For each category of good (e.g., food, beverage and tobacco) the survey provides data on the value of total expenditures in current pesos for a given reference period (e.g., weekly, monthly, quarterly, semestral). The reference period varies across goods depending on the frequency at which the good is generally purchased (e.g., weekly for food, beverage and tobacco and semestral for furniture and household durable goods). The value of expenditures on each type of good was converted to June 1984 pesos using the specific price deflator for the time period to which the expenditure category refers (as described above for non-monetary income).

(2) This amount was then converted to a quarterly figure using the adjustment factor provided by INEGI (as described above for non-monetary income).

(3) Total quarterly monetary expenditures in June 1984 pesos were then obtained by summing monetary expenditures over all categories of goods.

A.3. *Definitions of Poverty Lines*

The poverty lines used by Levy (1991), Hernández-Laos (1990), and Szekely (1993) were all based on the COPLAMAR (1983) study on basic needs. This study provides information on the annual cost of a "basket of necessities" for an average family.[40] The cost of this basket of necessities[41]

[39] See INEGI (1989), p. 125, and INEGI (1992), p. 226.

[40] The average family of 4.9 members is comprised of 2.7 adults (over 15 years of age), 1.66 children (between ages 3 and 14) and 0.47 babies.

[41] The items included in the basket were based on the expenditure patterns of households in the seventh income decile of the 1977 INEGI Income and Expenditure Survey.

was calculated as the sum of: *(i)* the cost of a "nutritional food basket" composed of 34 food items that provide a minimum of 2082 calories and 35.1 grams of protein per day for an adult;[42] *(ii)* the cost of other food items consumed by households in the seventh decile of the distribution; and *(iii)* the cost of essential expenditures on housing, health, education, culture and entertainment, transport and communications, clothing, and personal needs.[43]

Levy's extreme poverty line equals the cost of the "nutritional food basket," scaled up by 25 percent to account for essential expenditures on non-food items.[44] Both Levy's and Hernández-Laos's moderate poverty lines equal the cost of the "basket of necessities."[45]

The extreme poverty line used by Hernández-Laos and the single poverty line used by Szekely (1993) both were based on the cost of a "sub-minimum" basket estimated by COPLAMAR.[46] This basket contains a subset of the items contained in the "basket of necessities," comprising only the expenditures on food, housing, health and hygiene, and education. Because both Hernández-Laos's and Szekely's poverty lines include items well beyond the conventional definition of extreme poverty, we have included them among the moderate poverty lines.

CEPAL used a different methodology to calculate its extreme and moderate poverty lines. First, it calculated separately for urban and for rural areas the cost of a basic food basket whose composition satisfied: *(i)* the basic nutritional necessities of the population based on the FAO/WHO/UN recommended nutritional requirements adjusted to take into account Mexico's socio-demographic characteristics; *(ii)* local tastes by including in the basket the food items typically consumed by households in the second through fifth deciles as given by the INEGI

[42] Initially, 15 different food baskets were constructed, all satisfying this requirement, but varying in the number and origin (animal versus vegetal) of items. The chosen basket exceeded the least cost diet by 36 percent.

[43] The COPLAMAR (1983) study initially distinguished between urban and rural baskets, but found insignificant cost differences. Therefore, in contrast with the CEPAL study (discussed below), only one basket was used for the entire population.

[44] This "scaling factor" is based on evidence presented by Streeton and Lipton, cited in Levy (1991), that the minimum non-food expenditure share is about 20 percent.

[45] It is not clear why Hernández-Laos's moderate poverty line is over 10 percent higher than Levy's since they are based on the same consumption basket and each converts the values to prices of the relevant time period using the CPI.

[46] The large discrepancy between these two poverty lines also cannot be explained.

survey; and *(iii)* the prices of each food item based on the consumer prices used to construct the CPI.

CEPAL's extreme poverty lines for urban and for rural areas equal the values of the basic food basket for each area. The rural extreme poverty line is more than 20 percent lower than the one for urban areas. The moderate poverty line for urban areas was set equal to twice the extreme poverty line. For rural areas the moderate poverty line equals the extreme poverty line times a coefficient of 1.75. The extreme and moderate poverty lines presented in Table 1 are a weighted average of CEPAL's rural and urban poverty lines using population shares as weights.

The moderate and extreme poverty lines used by Psacharopoulos *et al.* (1993) equal US$60 and US$30, respectively, per individual per month in 1985 purchasing power parity dollars. Since the Psacharopoulos, *et al.* study compared poverty rates across Latin America, the primary objective in setting the poverty line was to determine a uniform value (in terms of local purchasing power) that would balance the conditions of both the poorest and richest countries. This poverty line was based loosely on a comparison of the nutritional requirement based poverty lines calculated by CEPAL.[47]

A.4. *Adjustment for Under-reporting Using the National Accounts*

Separate procedures were used to adjust income and expenditures for under-reporting.

A.4.1. *Income*

Wage income and *non-wage* income were adjusted separately for under-reporting by comparing the total household wage income *per capita* in

[47] The extreme (moderate) poverty line presented in Table 1 was obtained by inflating the extreme (moderate) poverty line in December 1983-February 1984 pesos of 1 719.09 (3 438.19) per individual per month presented in Annex 12 of Psacharopoulos *et al.* (1993) to June 1984 pesos using the CPI and then multiplying by three to obtain the quarterly poverty line. The extreme poverty line of US$30 per individual per month in 1985 purchasing power parity dollars (or $90 per individual per quarter) appears to be so low when converted to US$ using the market exchange rate at only $34.23 per individual per quarter, because the ratio of the PPP exchange rate to the market exchange rate is only about .38.

June 1984 pesos from the INEGI survey with the quarterly estimates of wage and non-wage income from the National Accounts. This comparison is summarized in Table 3.

(1) Aggregate per capita *wage* income (the summation of survey income categories 1 through 6) and *non-wage* income (the summation of survey income categories 7 through 27 plus total non-monetary income net of wage remunerations as payment in kind) were obtained by summing each type of income over all households and dividing by the expanded survey population size (76 766 930 in 1984 and 79 552 522 in 1989).

(2) Wage income from the National Accounts equals remunerations of wage earners plus wage remunerations coming from abroad minus direct taxes on wages and social security contributions. Non-wage income from the National Accounts equals the summation of total operating surplus, net rental income from property coming from abroad, and other current transfers from abroad minus direct non-wage taxes and social security contributions.[48] The National Accounts totals were then converted to June 1984 pesos using the CPI. The National Accounts totals were then converted to quarterly amounts by dividing by 4. Per capita wage and non-wage income were then obtained by dividing by population estimates from Ordorica (1990).

(3) The conversion factors for each type of income were set equal to the ratio of per capita income in the National Accounts to per capita income in the survey. In other words, since 1989 wage income from the household survey represented 80.5 percent of wage income given in the National Accounts, the wage income of each household was adjusted upward by multiplying by its reciprocal (i.e., 1.24). The adjusted survey values of per capita wage and non-wage income equal the values of per capita wage and non-wage income, respectively, in the National Accounts.

$$\text{National Accounts Conversion Coefficient} = \frac{\text{Per Capita Value in National Accounts}}{\text{Per Capita Value in Survey}}$$

$$\text{Adjusted Survey Value of Household } i = \text{Conversion Coefficient} \times \text{Value in Survey of Household } i$$

[48] All National Accounts data are from INEGI as presented in the *Cuarto Informe de Gobierno, 1992*.

A.4.2. *Expenditures*

Similar procedures were used to adjust expenditures for under-reporting, except that separate coefficients were determined for each of eight categories of expenditures.

(1) Quarterly *monetary* expenditures in June 1984 pesos for each of the 8 categories of goods (shown in Table 4) were obtained by converting each item of expenditures into quarterly expenditures in June 1984 pesos (as described above) and summing across goods in each category. The same definitions of expenditure categories were used as are given in INEGI (1989), p. 61 and INEGI (1992), p. 115. Because the raw data on *non-monetary* expenditures does not include a disaggregation by category of good, it was assumed that, for each household, each of the categories of non-monetary expenditures (auto-consumption, payment in kind and gifts) was allocated across types of goods in the same proportion as for the whole population, as shown in INEGI (1989), p. 61 and INEGI (1992), pp. 117-118. For example, if 80 percent of total auto-consumption was for food, beverage and tobacco items then it was assumed that 80 percent of each household's auto-consumption was for that category of good. The only exceptions were the imputed value of owner-occupied housing, free rent and rent as payment in kind which were allocated to expenditure category 3 (housing, fuel and electricity). Total per capita expenditures by category were then obtained by summing expenditures across all households and dividing by the expanded survey population size (76 766 930 in 1984 and 79 552 522 in 1989).

(2) Consumption categories from the National Accounts are equal to total private consumption by consumption category. Each of the consumption totals was then converted to June 1984 pesos using the CPI and converted to a quarterly figure by dividing by 4. Per capita consumption for each category were then obtained by dividing by the population estimates from Ordorica (1990).

(3) The conversion coefficient for each category of goods equals the ratio of quarterly per capita consumption in the National Accounts to quarterly per capita expenditures in the survey. The adjusted level of expenditures by category of goods for each household were then obtained by multiplying by the type-of-good specific conversion coefficient.

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