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Luis Rubalcava Peñafiel

LIVING STANDARDS IN MEXICO: SHOULD WE RELY ON A POVERTY LINE?

Abstract

Using household survey data from Mexico, this paper analyses the change in the standards of living over the period of 1984 through 1994. Instead of applying conventional measures of welfare that rely on arbitrary poverty line definitions, we apply stochastic dominance to analyze changes in the welfare distribution. This study includes measures of sampling variation in the analysis and tests the significance of changes in household expenditures *per capita* using non-parametric statistical inference. Results show that Mexican families increased (on average) their purchasing power during this period, and that households with higher educational attainment of the head are relatively more sensitive to the business cycle.

Resumen

Este artículo utiliza la Encuesta Nacional de Ingreso Gasto de los Hogares (ENIGH) para analizar los cambios en los niveles de vida de los hogares mexicanos durante el periodo de 1984 a 1994. El análisis toma distancia de las medidas tradicionales de bienestar que dependen de la definición de una línea de pobreza, y basa sus conclusiones en la metodología de dominancia estocástica para estudiar la dinámica del bienestar sobre toda la población. El análisis incorpora mediciones de variación muestral y prueba la significancia de los cambios en el consumo *per capita* del hogar a través de inferencia estadística no paramétrica. Los resultados sugieren un incremento en el poder de compra de los hogares mexicanos durante el periodo bajo investigación; siendo los hogares con un nivel educativo mayor, por parte del jefe del hogar, quienes presentan una mayor sensibilidad a los ciclos económicos del país.

*Introduction**

Since the early 1980's Mexico has experienced important economic and political changes that have challenged social institutions and economic forms of organization. These structural changes have allowed the country to transform from a nearly closed economy in 1983 to an open economy in less than 15 years. Despite the success of the economic reforms, the country has been unable to overcome periodic economic crises which have weakened people's ability to improve their purchasing power and standards of living.

Using the 1984,1989,1992 and 1994 cross-section of the National Survey of Household Income and Consumer Expenditure (ENIGH)[1], this paper analyzes changes in the standards of living of Mexican households during the peak of the economy's transition. We depart from the traditional poverty literature and adopt a different perspective to the analysis of the population's welfare:

First, instead of defining exclusive an a *priori* poverty line, we think of "poverty" as being continuously distributed. Graphical analysis using stochastic dominance allows us to rank changes in the distribution of living standards for all levels of household per capita expenditure across the ten-year period of analysis. We include the notion of the deficit curve and analyzed the area beneath the cumulative distribution to understand changes in the depth of "poverty". In addition, we look at changes in inequality within the poverty depth by looking at the mass below the deficit curve.

Second, special attention is placed on changes in family demographic composition as an effort to avoid reliance on an *ad hoc* of equivalence scales.

Third, we include measures of sampling variation in the analysis and test the statistical significance of changes in the welfare distribution using simultaneous non-parametric statistical inference.

Both the graphical and the hypothesis testing analyses suggest improvements in the purchasing power of the population for the period under investigation. These changes in *per capita* expenditure are far from homogenous across years, and among households with different characteristics or economic opportunities. In order to understand the dynamics of poverty and inequality, we would like to have longitudinal data. Unfortunately, they are not available. However, we can follow the same subgroup of people stratifying on time invariant characteristics. We focus on educational attainment of the household's head. There are different patterns in the changes of living standards from 1984 to 1994 for household with no education,

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[1] Encuesta Nacional de Ingreso Gasto de los Hogares.

elementary schooling and high school levels. Specifically we find that households with well educated heads are much more sensitive to the business cycle in Mexico relative to households with heads that have little of no education.

This paper is divided into eight sections. The second section provides a brief overview of traditional measures of poverty emphasizing their advantages and disadvantages. Part III introduces the concept of stochastic dominance as a framework for ranking welfare distributions over different levels of standards of living. Emphasis is placed on the analysis of welfare cumulative functions, deficit curves and third-order stochastic dominance, and their relation to the poverty indices discussed in part II. Section IV analyzes the data; the implications of using expenditure over income with respect to measurement error and consumption smoothing; and in particular the use of household expenditure *per capita* in the presence of economies of scale in consumption and changes in family demographics. Section V of the paper applies the concept of stochastic dominance to graphical comparisons of different welfare distributions over the period of analysis. Section VI derives the non-parametric hypothesis testing framework, and part VII presents the results of changes in welfare and their statistical significance. Conclusions are discussed at the end of the paper.

Poverty Measures

Poverty is perhaps the defining characteristic of underdevelopment, and its elimination has been the primary objective of economic development. Consequently, a main concern of the standards of living literature has been to measure to what extend a certain population or subgroup lives under deprived conditions. The poverty line, below which people are defined as poor, and above which they are not poor, is one of numerous poverty measures that have been proposed as indicators of poverty. While these indices vary in their sensitivity as measures of poverty among the poor, they all assign zero social welfare gains to marginal benefits to people above the poverty line. The discontinuity in the distribution of welfare, with poverty on one side and lack of it on the other, imposes serious limitation when it comes to a broader discussion of living standards. We will focus our analysis on this concern in the empirical analysis. In this section we confine ourselves to a brief discussion of the most commonly used poverty measures.[2]

We start with the headcount ratio, the simples measure of poverty. This (relative frequency) index counts the number of people living below the poverty line (n_p), as a fraction of the total population (N):

$$P_0 = \frac{n_p}{N} \tag{1}$$

[2] See Foster (1984), for a survey poverty measures.

The headcount ratio is perhaps the most popular measure of poverty, yet it suffers from a major drawback: it takes no account of the *degree* of poverty. The headcount ratio is the same if all the poor consume at a value which is marginally below the poverty line, or if there are some who are consuming much less. Thus, for example, the headcount ratio will fall if income is transferred from the poor to those who are less poor if only the transfer lifts the recipients out or poverty.

To overcome this problems, a measure of poverty would need to be sensitive to the shortfall of individual welfare levels below the poverty line. this is the case of the poverty gap, to which the contribution of an individual *i* to aggregate poverty (*z*) becomes larger as *i* becomes poorer:

$$P_1 = \frac{1}{N}\sum_{i=1}^{N} 1(x_i \leq z)[1 - \frac{x_i}{z}]^3 \qquad (2)$$

Consequently, the level of poverty measured by the poverty gap will increase if the overall welfare of the poor decreases, whenever a regressive transfer from a poor individual to nonpoor person takes place or, whenever transfer go from the poor to the less and lifts the latter out of "poverty". One should note that equation (2) is insensitive to transfers made among the poor that do not change the number of deprived individuals. This is a major concern if one is interested in having a poverty measure that weights inequality among the poor.

Concerned about this drawback, Sen (1976) has enumerated three axioms that he considers essential for any poverty measure to capture. The first axiom is known as the *focus* axiom and requires that the poverty measure depends on the welfare of the poor and not on the nonpoor. Both the headcount ratio and the poverty gap satisfy this condition. The second axiom is known as the *monotonicity* axiom and requires the measure of poverty to increase whenever, *ceteris paribus*, the overall welfare of a poor individual falls. Of the two measures, only the poverty gap meets this axiom. Finally, the *weak* transfer axiom requires that poverty increases whenever inequality among the poor increases. In other words, poverty will increase when, *ceteris paribus*, a poor person gives a small sum of her income to a richer person who remains poor after the transfer.

Foster, Greer and Thorbecke (1984) present a generalized poverty gap index (FGT), which complies with the three axioms:

$$P_a = \frac{1}{N}\sum_{i=1}^{N}[1 - \frac{x_i}{z}]^a 1(x_i \leq z), \qquad \text{for} \qquad a \geq 0 \qquad (3)$$

[3] 1(*) is an indicator function that takes the value of one (zero otherwise), when the individual's level of welfare (x_i) is below the poverty line (z). In practice , x_i represents the individual's income or expenditure level, or any related measure of welfare.

where 1(*) is an indicator function that takes the value of one if the welfare of individual *i* is less than equal to the poverty line z, zero otherwise.

Note that the FGT index weights more heavily the poverty gap the larger is the value of α, so that the headcount ratio (1) and the poverty gap (2) indices are special cases that correspond to values for α of zero and α of one, respectively.

Stochastic Dominance

Section II centered the discussion on how important it is to count with poverty measures that are sensitive to the distribution of welfare among the poor. Nevertheless, regardless of the refinement of these indices, they often provide ambiguous conclusions depending on the researcher's definition of poverty. This is a serious concern to the analysis of standards of living when one wishes to analyzed the change in welfare for all the individuals in the population.

A better approach to analyzing changes in standards of living is to think of poverty as being continuously distributed and consider analyzing the entire distribution. An initial way to proceed is to look at changes in the cumulative distribution function (cdf). The cdf measures the number of individuals at different leves of welfare, therefore an entire shift in the distribution to the right would imply that all individuals in the population were able to improve their welfare under the assumption that more is always better than less. One can therefore rank one cdf distribution, say $F_1(x)$, above another, $F_2(x)$, in terms of levels of welfare if for all levels of welfare x,

$$F_2(x) \geq F_1(x) \tag{4}$$

This is parallel to applying the headcount ratio for the entire "poverty" domain.

Notwithstanding, as suggested by the poverty gap index, looking at the number of individuals at different levels of welfare does not allow one to examine whether the depth in poverty is increased with respect to different levels of consumption. To analyze changes in poverty depth one should look at the area beneath each cdf, also known as the deficit curve:

$$D_2 \equiv \int F_2(x)dx \geq \int F_1(x)dx \equiv D_1 \tag{5}$$

Following the previous logic, one can rank distribution 1 above distribution 2 in terms of poverty depth reduction, if for all levels of welfare (x), the mass beneath distribution 1 is smaller than that observed for distribution 2.

The ranking of distributions in terms of changes in welfare level (4) is also known as *first*-order stochastic dominance, and that based on deficit curves (5), as *second* order dominance. Both concepts were developed in the theory of financial portfolios[4], and introduced to the analysis of welfare by Foster and Shorrocks (1988)

Of course if one cumulative distribution lies below the other for the entire welfare domain, so will its deficit curve be with respect to its counterpart. This is the same as saying that first-order dominance implies second-order dominance. The intuition is that if every single individual in the population improves her welfare, it is also true that the depth in poverty will decrease to any definition of poverty line. However the reverse conclusion may not be true: second-order stochastic dominance does not necessarily imply first-order dominance. This is the case when the shift in the welfare is not sufficiently large to prevent the distributions from crossing. Figures 3.0a and 3.0b in the appendix illustrate the idea:

Let us assume that as a response to a public policy program, individuals in the bottom 30 percentile of the distribution increased their welfare and, at the same time, those in the top 90 and 100 percentiles decreased their well being forming distribution. (See Figure 3.0a distributions 1 and 2 respectively). Under this scenario not all individuals in the population have increased their level of welfare, causing the cumulative distributions to cross each other (figure 3.0b).[5] This prevents us to rank distribution 1 above distribution 2 using first-order dominance despite the improvement in welfare of the most deprived. However it can be the case that the depth in "poverty" is significantly reduced for those individuals lying below the crossing welfare level, so that it overcompensates the increase in "poverty" depth of the top welfare level individuals (See figure 3.0b, area "A" and "B", respectively) Under this scenario the deficit curve of distribution 1 (D1) will entirely shift to the right of distribution's 2 deficit curve (D2) allowing us to rank distribution 1 above distribution 2 via second-order dominance analysis. (See Figure 3.0c).

One should note that second-order dominance analysis may still not be enough to rank welfare distributions in the event that the change in the poverty depth of the population is not sufficiently large to prevent the deficit curves from crossing. Figure 3.0c shows, indeed, this scenario which despite the fact the poorer have decreased their poverty depth and *overall inequality is being reduced*, deficit curves do (marginally!) cross. (See figure 30c). We need therefore, a higher-order dominance ranking that incorporates inequality changes into welfare analysis.[6] Third-order dominance provides the solution by comparing the area beneath each deficit curve, such that for all x:

$$\int D_2(x)dx \geq \int D_1(x)dx.^7 \qquad (6)$$

[4] See Hadar J. and R. William (1971).

[5] For illustrative purposes we will assume continuous cdf's.

[6] Parallel to the poverty gap index, second-order dominance analysis does not consider inequality changes when ranking standards of living.

[7] See Tesfatsion (1976) for a formal proof.

Ranking distributions in terms of the mass below the deficit curve, implicitly places more weight to the change in the depth of poverty among the poor than that among the less poor, allowing one to incorporate inequality changes.[8] To see this, figure 3.0d of our example, depicts the decrease in distribution's 1 poverty depth mass (M1) relative to the poverty depth mass (M2) of distribution 2. the shift in poverty depth "dispersion curve" over all levels of welfare, suggests that distribution 1 third-order dominates distribution 2.

Note that second-order stochastic dominance implies third-order in the same way that first dominance implies second-order. This means that when interpreting our results, higher order dominance will only be required if changes in the welfare of the population cannot be ranked with lower order dominance analysis. We now proceed with the description of the data set.

The Data

The Mexican National Institute of Statistics, Geography and Informatics (INEGI)[9] has conducted over a decade period, the National, representative[10] cross-sectional survey is to date the most extensive source of information regarding standards of living and dwelling characteristics of Mexican households. The data set identifies the household in which each sample member lives and her relationship to the household head. Although no information on assets is available, each cross-sectional wave provides information on family members' characteristics, total household and individual income, and household consumption expenditure. Detailed data on consumption in terms of its source and use allows one to classify each household consumption composition in monetary expenditures, in-kind transfer and auto-consumption expenditure. We rely on information collected from August to November for the years of 1984, 1989, 1992 and from September to December for 1994 to analyze changes in Mexican households' living standards for more than a decade using household expenditure. The 1984 sample consists of 4,766 households, the 1989 of 11,398, and 1989 and 1994 of 10,379 and 12,672 households, respectively.

Measuring welfare.

It is difficult and not at all resolved in the literature how to best measure the well being of the population. The use of consumption, income, nutritional requirements or any combination between them, has been widely proposed to measure standards of living. Levy (1984, 1991), INEGI-CEPAL (1993) and

[8] Third-order dominance ranks distributions in accordance with the FGT index for an $\alpha = 2$ Deaton (1997)

[9] Abbreviated after its Spanish name.

[10] The survey has been designed such that results are representative of the urban and rural regions only at the national level; unfortunately, the sample is not representative at the state level.

Lusting, Székely (1997) estimate the magnitude of poverty in Mexico by comparing the income of the household with the cost of a nutritional basket representing the basic needs of the household, according to protein and caloric intake international standards. Thereupon poverty lines are estimated, as the minimum level of income that a household would require in order to satisfy the "basic" needs of its members.

We avoid the problem of imputing *ad hoc* nutritional requirements nor to mention converting those to monetary values. We prefer to rely on household expenditure as our welfare measure. There are at least two reasons to prefer the use of consumption over income:

A major concern in the choice of expenditure over income as our welfare measure is the issue of measurement error that may seriously mislead our results. Especially those of higher order stochastic dominance where the mass of the distribution exacerbates the error. It has been well documented in the analysis of household surveys (Deaton 1997) that data sets, in general, present higher measurement error in income than in consumption. Income is often a more sensitive topic than is consumption, especially since the latter is more obvious to the individual than the former. Accurate estimates of income require precise knowledge of individual or household assets and the returns to those assets. This is an issue always likely to be difficult, and often understated by the respondents. The ENIGH is not the exception, Teruel (1998a) reports that income is measured with greater error than consumption.

Second, failing to control for every source of transitory income may overstate the decline of the individual's well being during periods of uncertainty or economic downturn, when the use of transfers and the choice to dis-save in order to smooth current consumption is a general practice for less deprived people. This is especially important given that 1984 was a year of economic crisis for the Mexican economy.

In the construction of our consumption measure, we use information on more than 400 items including durables and non-durable goods, as well as, monetary in-kind and auto-consumption goods. Thereupon, all expenditure figures are normalized to an equivalent monthly basis. We exploit the fact that information on expenditure was gathered during the last quarter of each year/wave to avoid seasonality problems; and in order to correct for nominal variation during the 10-year high inflationary period of analysis, each category of goods is deflated using desegregated consumer price indices.[11]

Following the lead of Engel (1857) and Rothbarth (1943), the literature on equivalence scales recognizes that consumption is different across household members with distinct demographics, and weights household expenditure accordingly (*e.g.*, adults *vs.* children). Nevertheless, this scheme relies on arbitrary equivalent weights, and is equally disputable as any other weighting scheme, such as the use of *per capita* measures. (See Pollak and Wales 1979). Moreover, the

[11] See *Banco de Mexico's Indicadores Económicos*. All expenditure variables are assumed to be uniformly distributed within each year/wave quarter period.

literature on equivalent scales assumes these weights are invariant across time, but Teruel (1998b) shows costs of demographic groups fluctuate over time for the case of Mexican households.

Atkinson and Bourguignon (1987) have developed an ordinal approach to the use of equivalent scales that consists of the ranking of family types such that stochastic dominance holds for the "most deserving group", for this and the next deserving group, and so forth, until stochastic dominance holds for all household types including the least deserving group.[12] This framework, while innovative, can be applied only if there are a limited number of types in order to unambiguously classify one group as "more deserving" than the other.

As a pragmatic strategy, we choose total household expenditure *per capita* as our "individual" measure of welfare. Thereupon, as an effort to recover the analysis to an *individual* level, we compute the empirical cumulative distribution functions ($F_j(x)$),[13] by weighting each household expansion factor *times the household* size:[14]

$$F_j = \frac{\sum_{h=1}^{H} 1(PCE_h \le c_j) * N_h W_h}{\sum_{h=1}^{H} w_h N_h} \qquad \text{for all PCE levels.} \qquad (7)$$

F_j is the empirical relative frequency that corresponds to the household total expenditure *per capita* (PCE) interval c_j; n_h and w_h are the household's size and expansion factor, respectively.[15]

Table 3.1 indicates the evolution of household total expenditure for the period of 1984 to 1994.[16] Means of *per capita* expenditure previously converted to an "individual" basis show that the trend in consumption has consistently increased over the period of analysis. In 1984 households spent on average $350 (1992 new-pesos) per family member, whereas by 1994 their average consumption was increased to $485 in real terms. The off-diagonal elements of the table also suggest that average consumption per capita monotonically increased year to year, except for the year of 1994 when households, on average, reduced their spending in the order of 2 percent. This decline in consumption although not statistically significant when comparing household means, will become important in section VI when we analyze the whole welfare distribution behavior.

[12] Examples of household orderings are: single, couple, single + 1 child, single + 2 children, etc.

[13] Refer to section V and VI.

[14] The ENIGH provides each family's expansion factor to make the sample representative at a national household level only.

[15] It must be kept in mind that it does not take into account any difference in family composition further than size, and possible economies of scale in consumption at a household level are not taken into account.

[16] All summary statistics where computed using expansion factors time household size.

In the presence of economies of scale in household consumption, Datta and Meerman (1980), and Visaria (1980) have found that household expenditure tends to be positively, but less than proportionately correlated with household size. This could lead us to over-represent large households among the poor and associate small households to low poverty levels, when using *per capita* consumption as welfare measure. If household demographics remain relatively constant through time, bias associated with our ignoring these effects can be absorbed by a "fixed effect" if we focus on *changes* in standards of living overtime

Table 3.2 offers some insight with how sensitive our results may be in the presence of economics of scale. Section one of the tables shows that Mexican household have, on average, experienced a reduction in their family size of the order of 6 percent during the ten-year period between 1984 to 1994. For example, in 1984 an average family had 5 members living in the same household, whereas in 1994 an average household contained 4.7 members.

While this trend will have important implications for the long run demographic dynamics of Mexico (should it persist), is less important in our analysis spanning a decade. Sections II and III of the table, show that the reduction in household size is primarily due to a decrease in the average number of children (2.5 in 1984 *vs* 2.0 in 1994) and not due to a reduction in the number of adults living en the household, (*e.g.*, 2.56 in 1984 *vs* 2.62 in 1994). We should keep this in mind when interpreting our results since *per capita* consumption may, over time, overestimate improvements in the living standards of the population.[17]

Per capita welfare measures do not take into account differences in needs between males and females. This is a potential problem for our analysis of living standards if Mexican families experience drastic changes in their gender composition during the period of analysis. Table 3.3 indicates that the average number of total adult males (1.21 in 1984 *vs* 1.24 in 1989) relative to females (1.34 in 1984 *vs* 1.38 in 1989) has remained constant overtime.

Table 3.4 displays the average education attainment, as well as the average age of the head of the household during the period of analysis. The age of the household head remains constant at 45 over the decade, except for the year 1992, when the average age is 44. This suggests that during the 1992 survey some younger members of the household were identified as heads of households. In terms of education, the levels of human capital remain relatively constant, except for those households with 6 to 12 years of schooling that in 1984 represented the 20 percent of the sample, but for the following years were in the order of 29 percent. This sample selection problem will limit the analysis of poverty dynamics across household subgroups in sections V and VI.[18]

[17] This might not be true on a two-yearly basis comparison.

[18] Although households with 6 to 12 years of schooling are excluded from the analysis for the period of 1984-1989 to minimize misleading conclusions, results on other household educational level subgroups should be taken with caution in the event that the reduction of 6 to 12 years of schooling households inflate other educational subgroups for the year 1984.

Graphical Analysis

This section employs graphical methods to provide a descriptive analysis of changes in standards of living for the period 1968 to 1994. In order to look at any shift in the distribution of *per capita* expenditure that relates to the level of standards of living as well as to the depth in poverty, empirical cumulative distribution functions and poverty deficit curves are calculated for each year, respectively. The graphs we present in this sections have been constrained to the bottom 95 and 50 percentiles of the sample distribution to provide greater resolution of differences at low expenditure levels. Vertical cut-offs characterizing decile intervals for the entire population have been drawn on each chart.

Figure 3.1 (A) and 3.1 (B) show that standard of living in Mexico at a 95 and 50 percentile level have increased over time from 1984 to 1994. Changes in cumulative distributions (*e.g.*, first-order dominance analysis), suggest that standards of living have increased monotonically at all levels of *per capita* household total expenditure from 1984 to 1989 and the year 1989 to 1992. Nonetheless, we cannot conclude the same for the period of 1992 to 1994 given that the distributions intersect. During this two-year period (as shown in figure 3.1 (B)) only those people falling at bottom ten percent of the distribution managed to improve their welfare. This is not the case for the rest of the population, which independently of whether we look at changes in level of *per capita* expenditure (changes in the cdf's) or at the depth in those changes (changes in deficit curves), their living standards remain stagnant if not decreased.

We now analyze the dynamics of living standards across subgroups with different educational attainment of the household head. Human capital formation is a good predictor to the individual's long-term income profile and corresponds to the least variant household characteristic of our (cross-sectional) sample. We exclude 1984 from the analysis for households with 6 to 12 years of schooling due to the sample selection problem of section IV. Figures 3.2 (A), 3.2 (B), 3.3 (A), 3.3 (B) and 3.4 (B) display changes in the cumulative distribution and deficit curves of household expenditure for households whose head has no education, 1 to 6 years and 6 to 12 years of schooling, respectively. In general, households at all levels of education and household consumption, have managed to increase (or at least nor reduce) their well-being from 1984 to 1992. Those with least education [no education, (figs.3.2(A) - 3.2(B))] are the ones who benefited most. For them, each year dominates its predecessor, including the "stagnant" period from 1992 to 1994 if one considers the alleviation of poverty depth levels (*e.g.* deficit curves). Households with 1-6 years of education (fig. 3.3(A) - 3.3(B)) have also experienced an increased in their welfare if one compares 1984 with 1994. Nevertheless, as opposed to those who have no education, the two year period 1992-1994 is characterized as a stagnant period with respect to welfare improvement. Households at this category do suffer a small reduction in their welfare if we consider depth in the change in welfare for the least favored.

Households with the highest educational attainment (7-12 years) have also managed to improve their welfare from 1989 to 1994 (figures 3.4(A) - 3.4(B)).[19] Nonetheless they also suffer an even stronger reduction in their purchasing power from 1992 to 1994. The negative shift in the distribution is of such magnitude that 1994 was, by all means, a relatively bad year with respect to all orders of stochastic dominance. We conclude therefore that households, generally experienced a rise in their well-being over the ten year period of analysis, with the exception of 1994 for household whose head's years of schooling are the highest.

Statistical Analysis

We have avoided defining an *ad hoc* poverty line by looking at changes in the well-being of the households at all sample levels of *per capita* expenditure using graphical analysis. However, it is the changes in the standards of living of the population that we should care about. We need a hypothesis testing framework that tests the statistical significance of the dynamics on living standards.

This section develops the hypothesis testing method, proposed by Anderson (1996), based on stochastic dominance with respect to changes in poverty *levels*, poverty *depth* and poverty *inequality* for households with different levels of consumption.

The hypothesis testing is based upon partitioning the range of each sample distribution function into k dependent mutually exclusive and exhaustive percentiles p_j, so that each sample distribution shares the same cut-offs in terms of household total expenditure *per capita*. Thereupon, at every distribution's percentile (decile in our case), the empirical *relative* frequency of the welfare measure (*e.g.*, PCE) is computed. In doing so, we transform each empirical distribution into a discrete frequency vector version composed of 10 decile frequency cells. Anderson (1996) shows that comparisons of two distributions (*e.g.*, A&B) can be made by looking at the difference of their respective sample empirical frequency vectors $V = (P_A - P_B)$. This difference (V) is shown to be, under a null of a common population and the assumption of independence of the two samples, asymptotically normally distributed with mean zero and known variance covariance matrix structure.[20] Having this result at hand and with the help of some matrix algebra, one can proceed to test discrete analogs of stochastic order dominance for any pair sample cumulative distributions (A&B).

[19] The 1984 cdf. is excluded from the graphical analysis for the sample selection reasons previously stated. Nevertheless if included, it would ratify other households' changes in welfare trend from 1984 to 1992.

[20] See Anderson (1996) and Kendall and Stewart (1987) for the assumptions underlying the variance covariance matrix. It is assumed that under the null of a common population, cell relative frequencies should be identical, both within and across samples. Thereupon, the difference between samples of the within-sample-cell relative frequency differences provides the basis of the test.

Since stochastic dominance is based on comparing distributions in terms of their cumulative counterparts, we define a matrix that allows one to test differences in empirical cdfs. This is the case of the matrix I_f, a (k x k) matrix that converts the discrete distribution vectors P_A and P_B into *cumulative* distribution vectors by pre-multiplying the vector V.[21]

$$I_f = \begin{bmatrix} 10 & . & & 0 \\ 11 & 0 & . & 0 \\ . & . & . & . \\ 11 & 1 & & 1 \end{bmatrix} \tag{8}$$

K corresponds to the number of rows (*e.g.*, 10 deciles) of the empirical frequency vectors P_A and P_B. Further, in order to compute differences in deficit curves and third-order dominance analysis an additional matrix (I_F) is defined which discretly sums the area under the curves:

Let d_j be the jth decile interval length corresponding to A's and B's pooled household expenditure *per capita* such that a (k x k) dimension I_F matrix is defined as:

$$I_F = \begin{bmatrix} d_1 & 0 & 0 & & 0 \\ d_1+d_2 & d_2 & 0 & . \; . & 0 \\ d_1+d_2 & d_2+d_3 & d_3 & . \; . & 0 \\ d_1+d_2 & d_2+d_3 & d_3+d_4 & . \; . & 0 \end{bmatrix} \tag{9}$$

Then,

<u>First-order Stochastic Dominance</u> of distribution A over B implies rejecting

$$H_0 : I_f(P_A - P_B) = 0 \quad \text{against} \quad H_1 : I_f(P_A - P_B) \leq 0; \tag{10}$$

<u>Second-order Stochastic Dominance</u>:

$$H_0 : I_F I_f(P_A - P_B) = 0 \quad \text{against} \quad H_1 : I_F I_f(P_A - P_B) \leq 0; \tag{11}$$

and,

<u>Third-order Stochastic Dominance;</u>

$$H_0 : I_F I_F I_f(P_A - P_B) = 0 \quad \text{against} \quad H_0 : I_F I_F I_f(P_A - P_B) \leq 0. \tag{12}$$

For each test the alternative requires a strict inequality to hold for at least one element of the vector.

These hypotheses can be examined in the context of $V_f \equiv I_f V$, $V_F \equiv I_F I_f V$ and $V_t \equiv I_F I_F I_f V$, which for suitably specified partitions, have well defined

[21] See equation (10).

asymptotically normal distributions (Anderson, 1996). However, they do involve multiple comparison procedures (across vectors cells) which have been derived by Richmond (1982), and employed in the context of Lorenz Curve ordinate confidence regions by Beach an Richmond (1985).

In particular, we follow the method employed by Bishop, Chakraborti and Thistle (1989) to test stochastic dominance.[22] Their procedure, which consists of a multiple finite induced hypothesis test,[23] requires that for distribution A to stochastically dominate distribution B [eqs. (10), (11) and (12)], no element of the appropriate vector V be significantly greater than zero, while at least one element be significantly less.[24] In other words, H_0 is accepted if and only if, all individual equivalent H_0 hypotheses for each element of vector V are accepted.

Because the acceptance H_0 is conducted by simultaneously testing the individual nulls, the size of their composite tests has to be adjusted accordingly for a predetermined overall Ho δ level. This implies having to define a k-dimensional multivariate studentized distribution function. However, Bonferroni's inequality provides a simpler framework in defining the simultaneous hypothesis critical region. Bonferroni's inequality provides a safe upper bound probability (δ) of committing a Type I error as a function of each individual critical value:

$$P\left[max(|t_1|,\ldots,|t_k|) \leq t_{\delta/2k}\right] \geq 1-\delta \qquad \text{for } i = 1,\ldots.k \quad (\text{here } k = 10). \tag{16}$$

$t_1 \ldots t_k$ constitute the t-values of the composite hypotheses, and $t_{\delta/2k}$ the selected critical value for a predetermined Ho δ level. Note that because Bonferroni's inequality is indeed an inequality, the overall probability of committing Type I error by choosing critical t-values of magnitude $t_{\delta/2k}$, is in fact smaller than δ, instead of being equal to it.

To clarify, suppose one has decided to reject H_0 at a significance level δ of 0.05 by looking at each composite hypothesis simultaneously. Further, suppose that the vector V has been partitioned in deciles (k=10). Then, Bonferroni's inequality suggests that choosing to reject each composite hypothesis δ=0.05/[(2)10] provides an upper bound Ho size less than or equal to 0.05.

Using multiple induced hypothesis testing, provides great flexibility when testing stochastic dominance at different *per capita* expenditure levels. Suppose that the change in welfare is not sufficiently large so that one fails to reject (10)[25] for all levels of living standards, yet one wishes to test whether at a significance level of

[22] See Wolak (1987,1989) for an alternative multiple hypothesis testing framework with inequalities.

[23] Savin (1984) provides an excellent survey of multiple hypothesis testing.

[24] Since the test is perfectly symmetric, dominance of B over A requires that no element of V be significantly less than zero, while at least one is significantly greater. Note that as first-order stochastic dominance implies second-order dominance which in turn implies third-order dominance, the respective tests are correspondingly stronger.

[25] The same exercise can be made for (11) and/or (12).

δ=0.05, the well being of the bottom 20 percent of the population did not improve. Because now k=2 and by (13), it suffices to show that neither the first nor the second decile elements of V are significantly greater than zero, while at least one is significantly less for a t-critical value of δ=0.05/(2)2, to conclude that distribution A stochastically dominates distribution B. In other words, rejecting H_0 in favor of H_1 would imply that for the bottom 20 percent of the population, the level of welfare improved in situation A.

The only difficulty posed by the application of Bonferroni's t-statistics is the necessity for critical points $t_{\delta/2k}$ at different k (percentile) values.[26] Fortunately, Bailey (1977) has produced a number of tables of the t deviate, for δ=0.05 and δ=0.01 and k ranging from k=1 to 190. We take those of δ=0.05 and k equal to 10 to test stochastic dominance at each possible decile of the population.

Results

Test of stochastic dominance are performed by partitioning the vector V into decile groups with respect to the pooled 1984, 1989, 1992 and 1994 sample. More specifically, we test changes in the standard of living for any pair of distributions (*e.g.*, 1984 *vs.* 1989) by contrasting each decile difference t-value with the appropriate Bonferroni t-*critical* value that permits an overall significance level of δ=0.05. Since our main objective is to analyzed changes in welfare for the entire population, pairwise comparisons across 10 deciles are tested using a Bonferroni t-*critical* value of $t_{\delta/2(10)}$ =2.7729.[27] Tables 3.5-3.6 to 3.11 present test results regarding changes in the cdf's level of *per capita* expenditure, the depth in those changes via deficit curves, and those that combine the level of welfare with changes in inequality. The first corresponds to first-order stochastic dominance analysis (V_f) and third-order (V_c) dominance, respectively.

Table 3.5 compares 1984 standards of living with the levels of all other years. The shift in the welfare distribution of 1989 with respect to 1984 is of such magnitude that the purchasing power of the population in 1989 improves at all levels of expenditure in relation to that observed in 1984. To see this, column (1) of the table shows that the cumulative frequency of the 1984 distribution is significantly greater than that of 1989 for every decile group. column (2) shows that the improvement in the well being of the households is significantly greater than zero at all welfare levels, except for those households with *per capita* expenditures in the top 90th percentile whose purchasing power remained statistically stagnant. This is

[26] Note that for k=1 the critical values correspond to those of a regular textbook t-distribution table.

[27] In the case that the shift of one distribution with respect to another were not sufficiently large to declare statistical dominance of one over the other along all *per capita* expenditure levels, a different Bonferroni t-*critical* value would have been chosen for the comparison across a reduced set of deciles. As it will become clear from our results, such procedure was not necessary.

so, because the corresponding t-value of the difference (2.170) is of lower value than the Bonferroni's critical value (2.77). We reject (14) at a significance level of less than 0.05, and conclude, therefore, that 1989 living standards (weakly) first-order stochastically dominate those of 1984. Higher order dominance analysis is, consequently, not needed to rank 1989's welfare above 1984's.

If we carry out the same analysis for the remaining year-pairwise comparisons (table 3.5 through 3.6), we reach the same conclusion of section III. We find that the change in the well being of the population is sufficiently and significantly large to see improvements in the level of welfare, poverty depth and inequality for each year. This is the case because we see that each year first-order stochastically dominates its predecessor. The exception again is 1994 with respect to 1992's welfare levels. For the vast majority of households that correspond to the 5th and 7th decile, who saw their purchasing power worsen in 1994.[28] We conclude therefore, that 1994 was the only year where households in general did not see their welfare improve.

Tables 3.7-3.8 through table 3.11 display the analysis for households with different educational attainment of the head. This time, we also exclude 1984 from the analysis for households between 7 and 12 years of schooling. Statistical testing supports the conclusions reached using graphical analysis. Households without education benefit the most during the ten-year period of analysis. Comparisons regarding changes in the cdf's level of *per capita* expenditure from 1984 to 1989 (table 3.7, columns 1 and 2) show that households in the bottom 60 percentile of the expenditure distribution managed to increase their purchasing power significantly for the same period (column 3 and 4),[29] we conclude that improvements in inequality along with increments in the purchasing power made households with no education increase their welfare independently of their level of expenditure. The same pattern arises for the period 1989 to 1992 when improvements were the highest (Table 3.8). 1994 appears to be a year with no significant changes relative to its predecessor, and yet households with no education in the bottom 60 percentile of the distribution were able to increase their welfare if one considers improvements in inequality as well. (Table 3.8, columns (5) (6)). We find this result remarkable since, as we will see, no other education subgroup managed to increase their welfare for the period of 1992 to 1994 at any level of *per capita* expenditure even after controlling for inequality changes.

Tables 3.9-3.10 through table 3.11 suggest that households with higher education also increased their wellbeing. Households with 1 to 6 years of schooling at the bottom 40 percent of the distribution saw their expenditure increase from 1984 to 1989, yet those between the 50 and 60 percentiles saw no improvement as was the case of the households with no education.

Standards of living grew significantly at any level of *per capita* expenditure between 1989 and 1992. During this three year period, households with less than

[28] Note that rigorously speaking, 1992 first-order stochastically dominates 1994.

[29] (*e.g.*, third-order stochastic dominance).

elementary education (1-6 years) were able to consolidate their well being growth (table 3.10 columns (1) and (2)); and those with high school education (7 to 12 years) saw their welfare increase independently of the level of consumption. (See table 3.11 columns (1) through (4)).

Once more, 1994 coincides with a stagnant, if not bad year, for households with elementary or higher education. During this year, changes in the cdf's level of *per capita* expenditure for households with 1 to 6 years of schooling, show that standards of living remained constant for the vast majority of families. (See table 3.10, columns (1) and (2)). If we include in our analysis of welfare during this period, columns ((5) and (6)) suggest a slight improvement in inequality, provided that we cannot reject that 1994 is third-order stochastically identical to the 1992 *per capita* expenditure distribution.

This, however, is a much smaller improvement than that faced by households with no education.

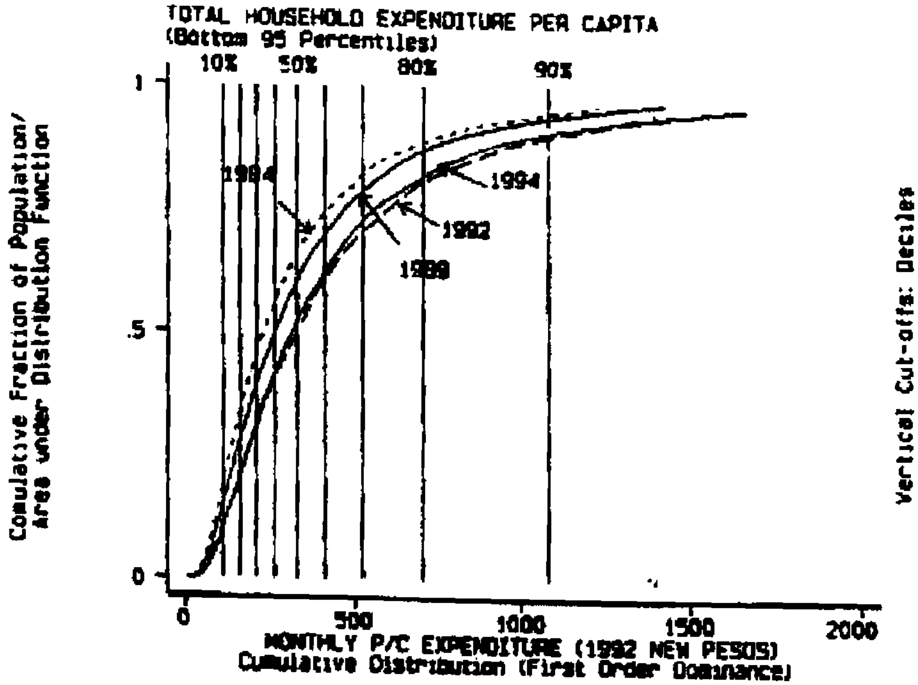
Results based on table 3.11 suggest that households with the highest level of schooling (7 to 12 years) suffered the most among all other household types during 1994. It strikes us that after controlling for changes in inequality there is no improvement in welfare. Third-order stochastic dominance of 1992 over 1994 (columns (3) and (4)) suggests standards of living not only declined for high educated households, but inequality also increased.

Conclusions

The notion of welfare requires a multidimensional analysis that ranges from the study of human capital formation in terms of health and education, to the ability of individuals to satisfy their needs, to many other social and psychological factors that interact with well being. Yet, the concept of welfare is relative to space, time and social values. Not suprisingly, any study of living standards opens, in the best of worlds, a miniature window of what the level of well being truly represents. This paper follows the evolution of expenditure levels at a household level and provides insights to the direction of the purchasing power of the population over the period of 1984 to 1994.

Results based on graphical and statistical analyses suggest increments in *per capita* expenditure levels for the majority of Mexican household for the period of reference. Yet they are far from being homogenous across years and among households with different educational attainment. The evolution of standards of living suggests a correlation of the well being of the population with the business cycles of the economy. While we do not test this hypothesis directly, large living standards improvements occur during years of economic and domestic credit expansion (1989-1992), while household expenditure decreases during periods of economic deceleration (1992-1994). These finding suggest the need for longer and sustained periods of economic growth with well-defined long term social policies if improvements in standards of living are to consolidate.

Figure 3.1(A): Total Household Expenditure Cumulative Distributions and Deficit Curves. *All Households*. Graphic detail level: 95th percentile.



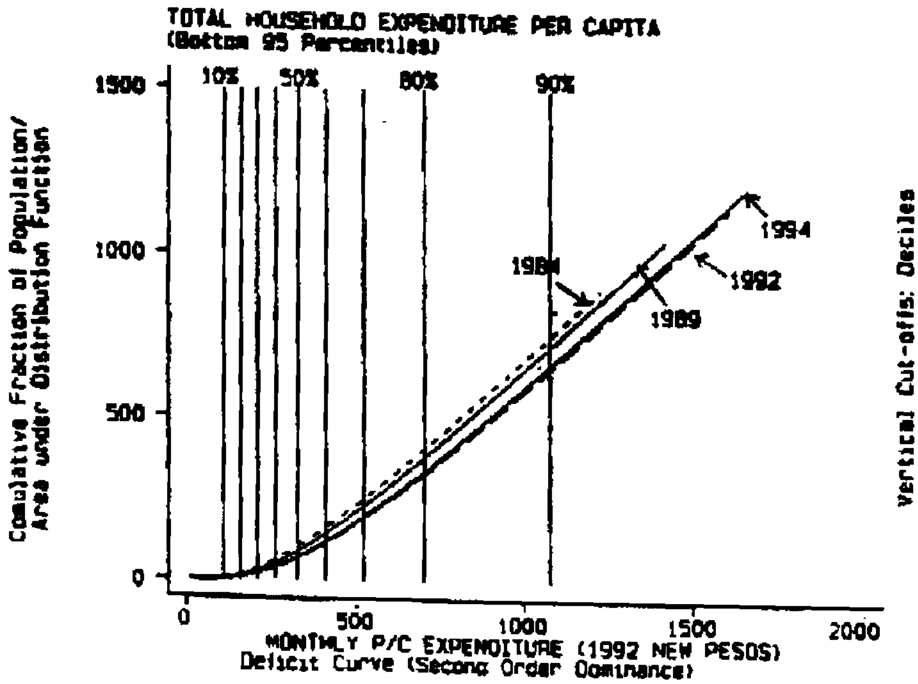
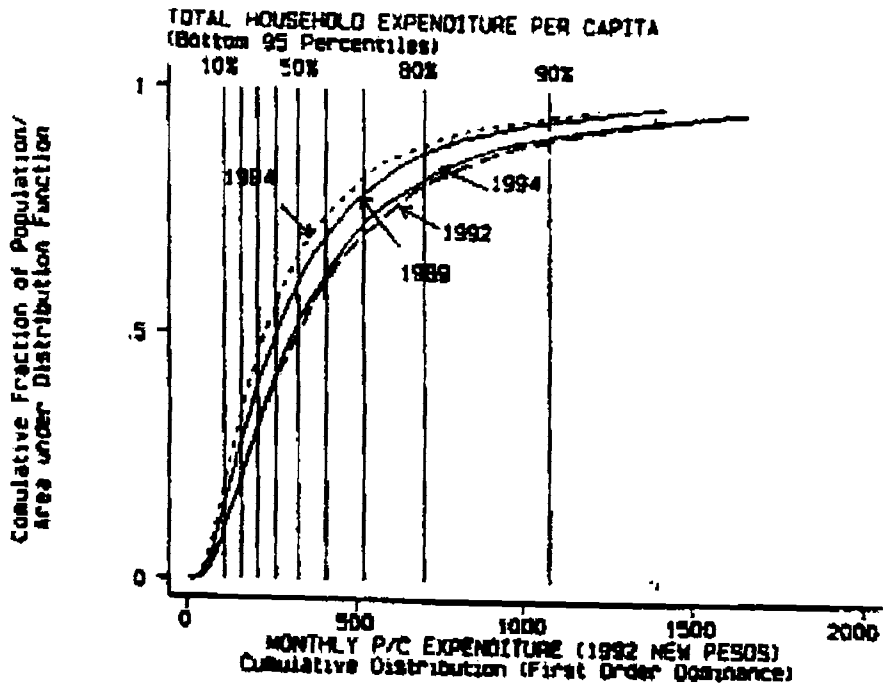


Figure 3.1(A): Total Household Expenditure Cumulative Distributions and Deficit Curves. *All Households.* Graphic detail level: 95th percentile.



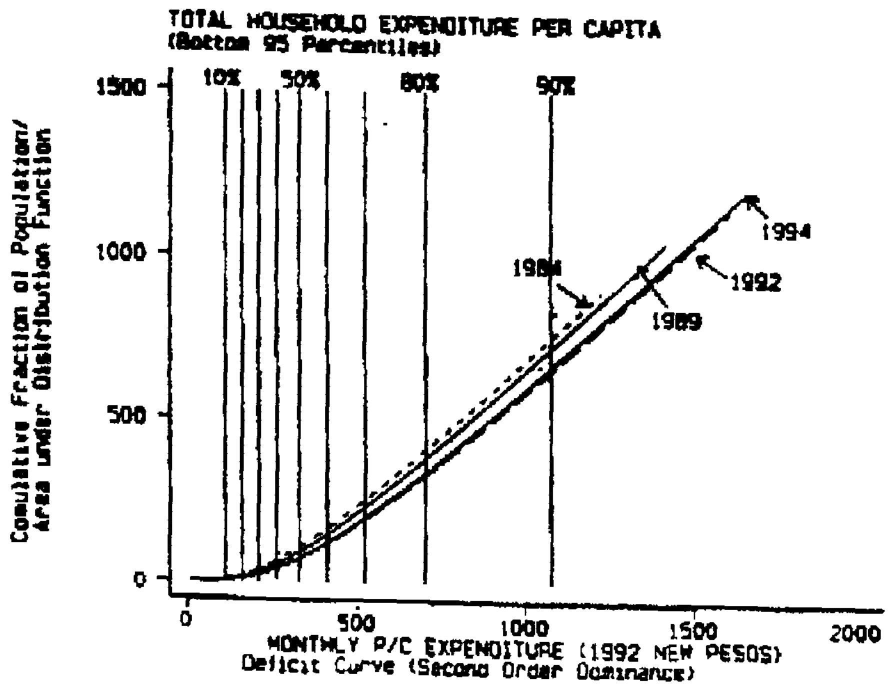


Figure 3.2(A)
Total Household Expenditure Cumulative Distributions and Deficit Curves.
Households with no education. Graphic detail level: 95th percentile.

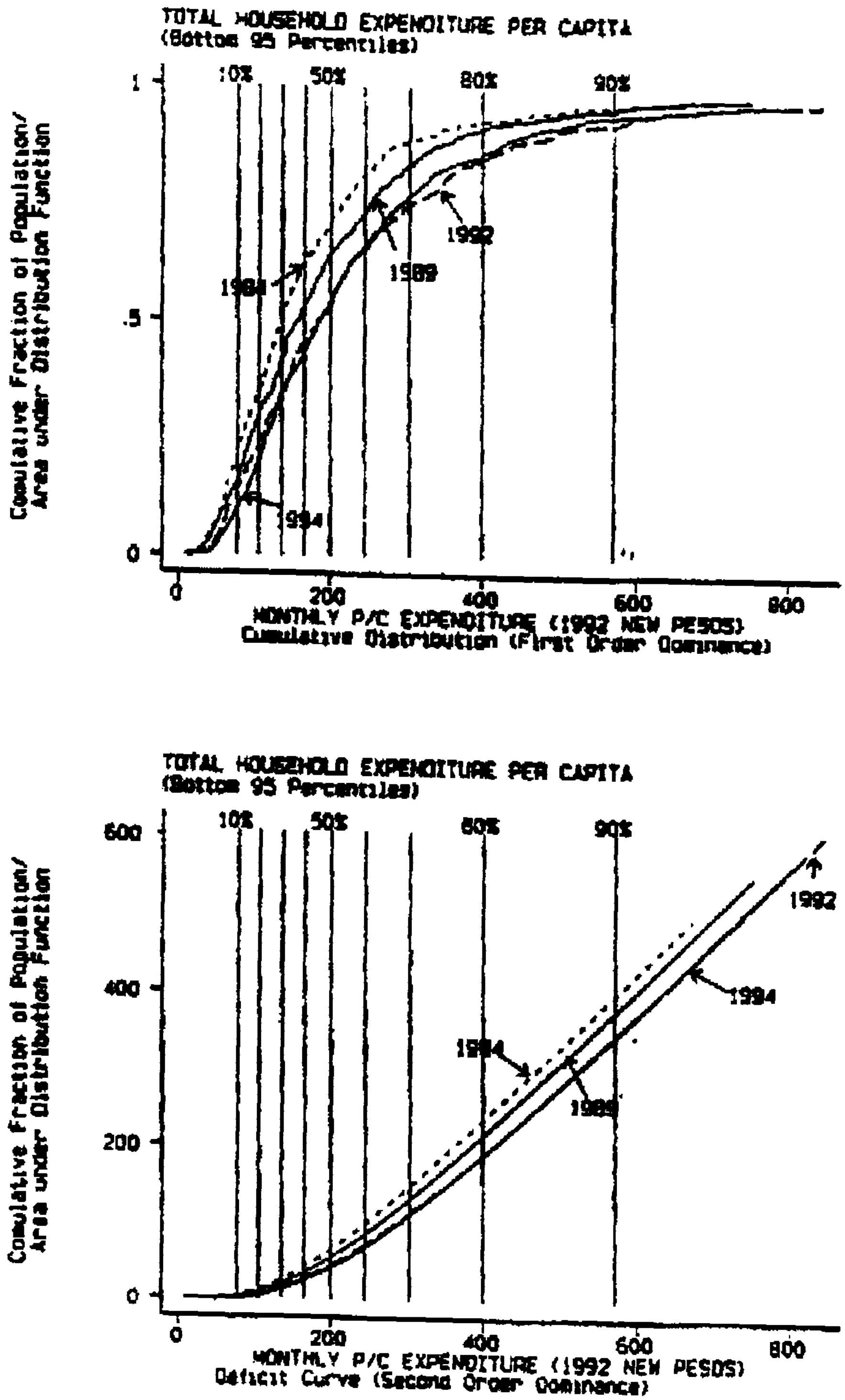
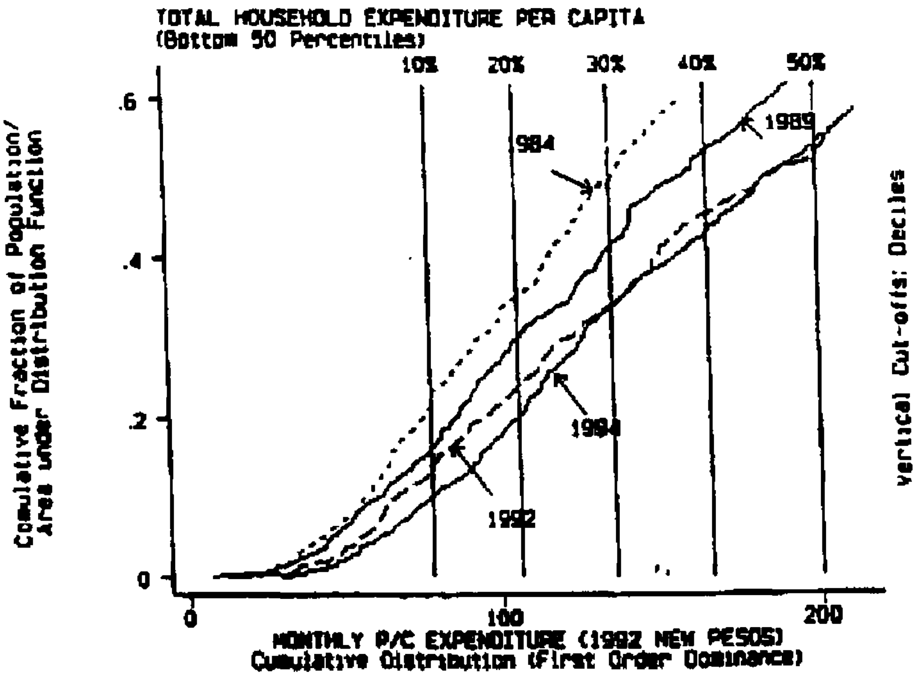


Figure 3.2(B)
Total Household Expenditure Cumulative Distributions and Deficit Curves.
Households with no education. Graphic detail level: 50th percentile.



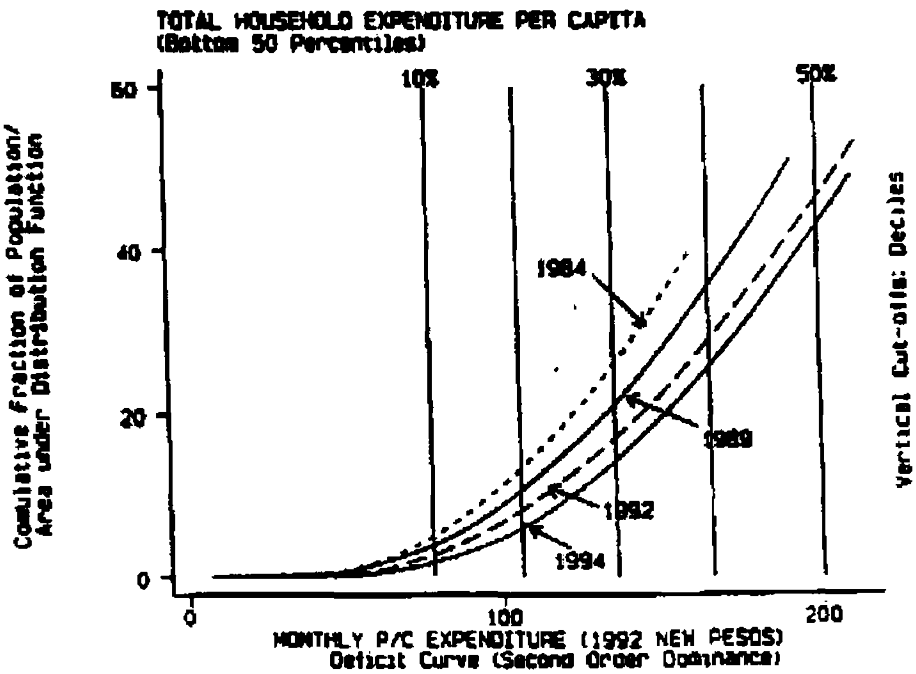


Figure 3.3(A): Total Household Expenditure Cumulative Distributions and Deficit Curves. *Households with 1-6 years of schooling.* Graphic detail level: 95th percentile.

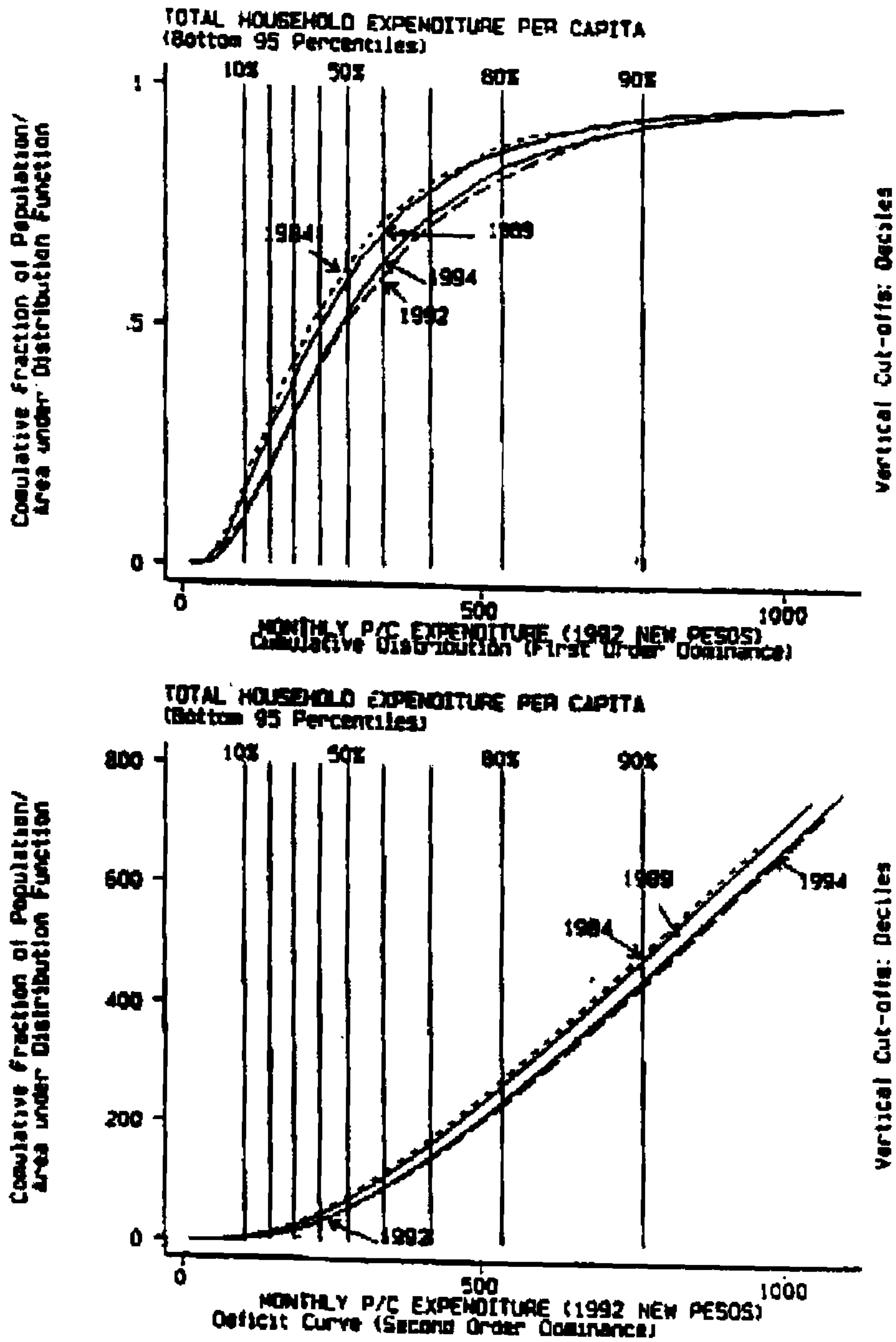


Figure 3.3(A):Total Household Expenditure Cumulative Distributions and Deficit Curves. *Households with 1-6 years of schooling.* Graphic detail level: 95th percentile.

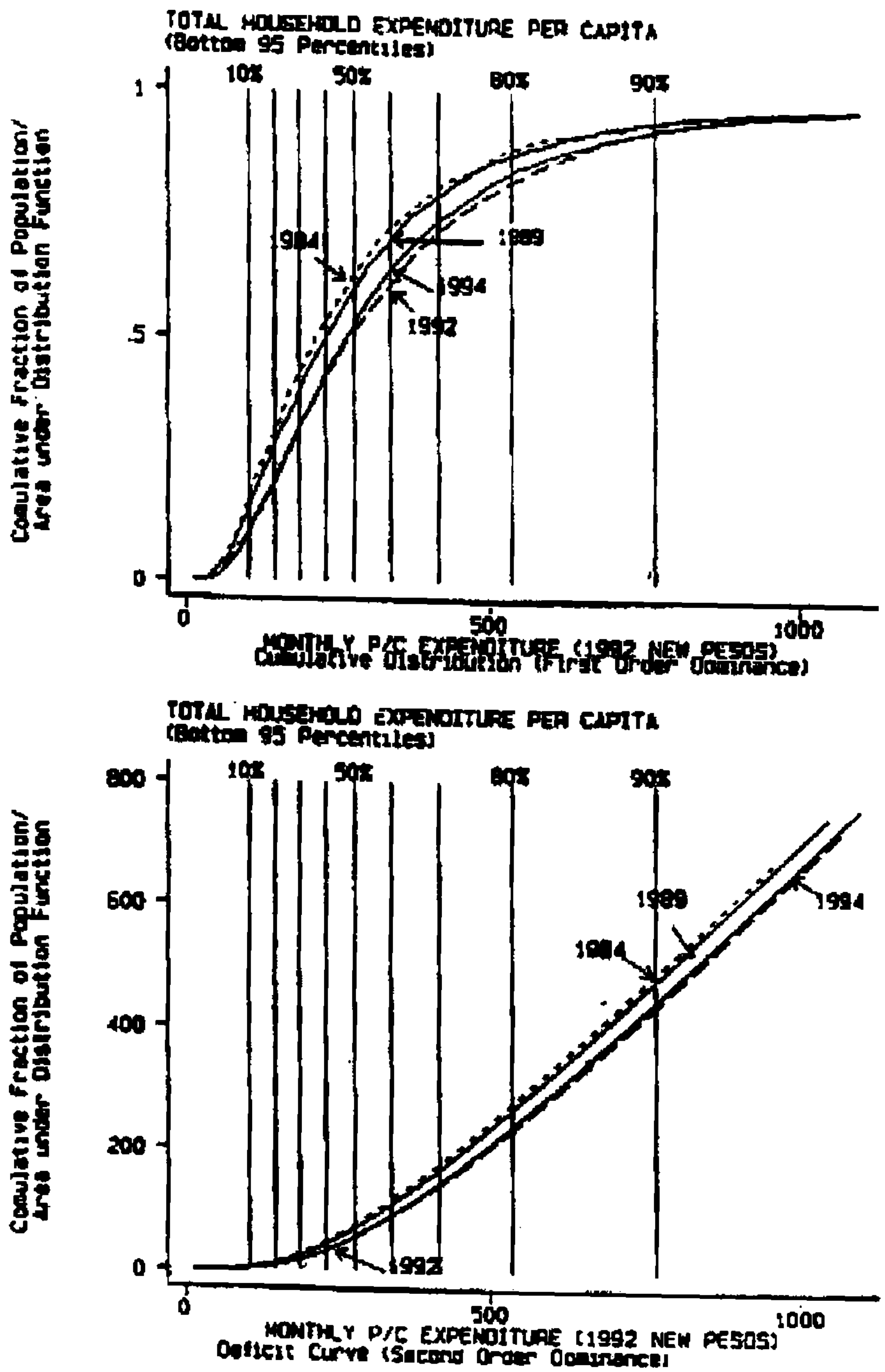


Figure 3.4(A)
Total Household Expenditure Cumulative Distributions and Deficit Curves.
Households with 7-12 years of schooling. Graphic detail level: 95th percentile.

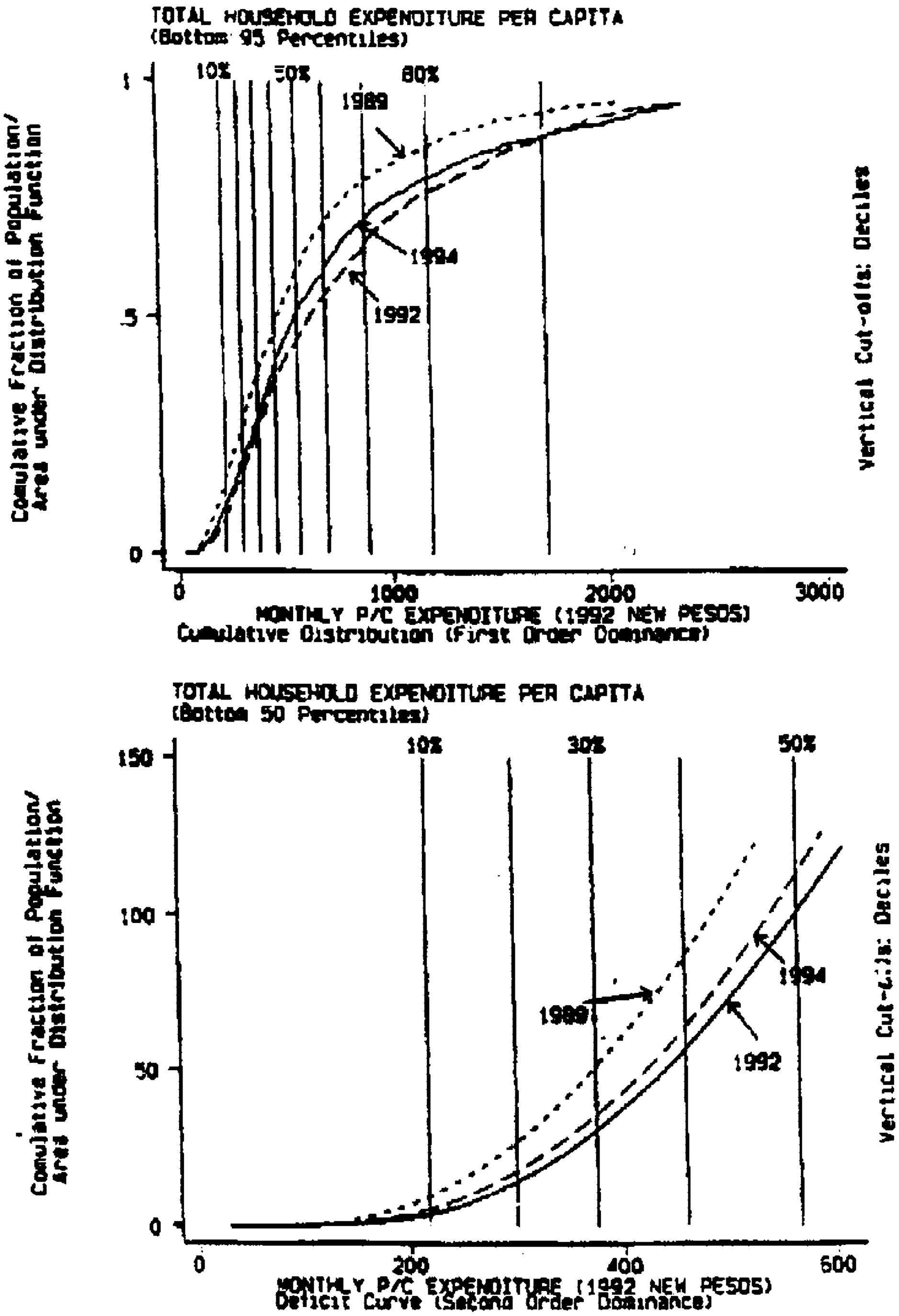
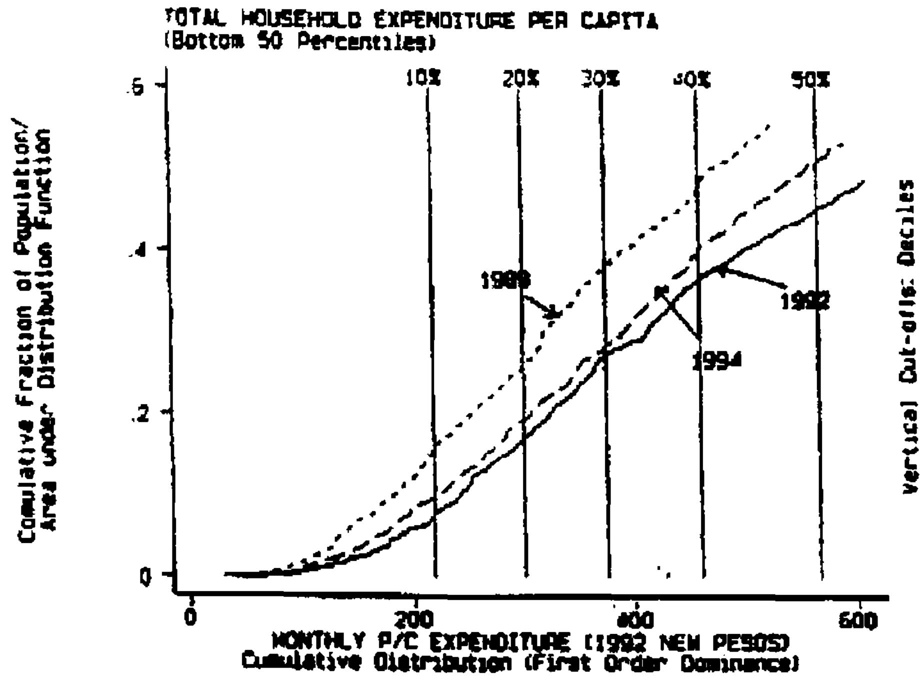


Figure 3.4(B)
Total Household Expenditure Cumulative Distributions and Deficit Curves.
Households with 7-12 years of schooling. Graphic detail level: 50th percentile.



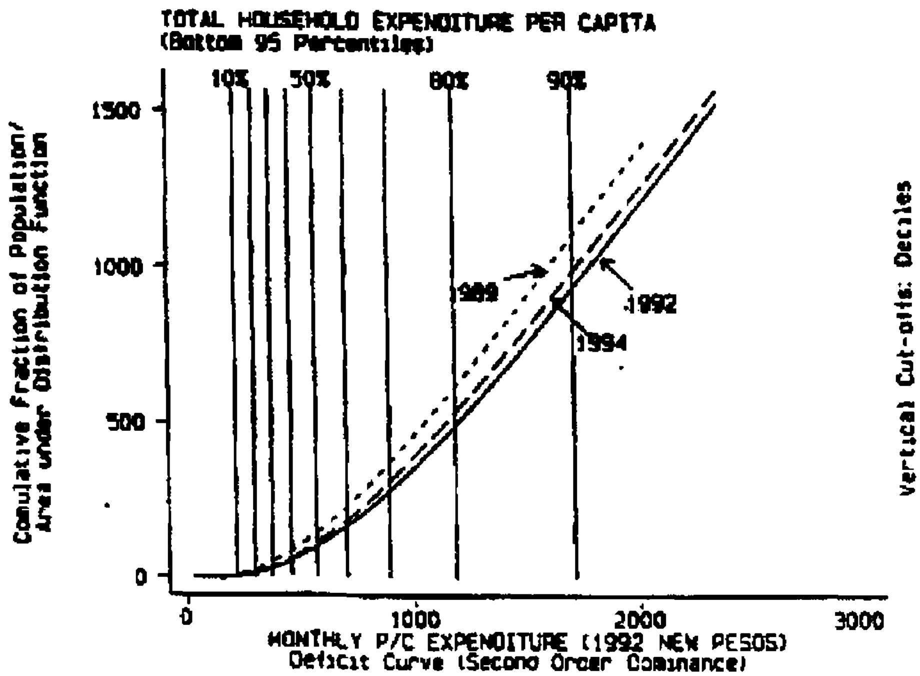


TABLE 3.1
Summary Statistics

Household Expenditure *per capita* in 1992 new-pesos				
	Wave **1984**	**1989**	**1992**	**1994**
Weighted Average Expenditure *Per Capita*				
1984	350.181	-46.309	-144.823	-134.488
	(9.381)	[0.000]	[0.000]	[0.000]
1989		396.490	-98.514	-88.179
		(5.719)	[0.000]	[0.000]
1992			495.004	10.335
			(7.812)	[0.167]
1994				484.669
				(7.288)
Number of Households	4,766	11,398	10,379	12,672

Sample means along the diagonals. Difference in means off the diagonals. Values weighted by household expansion factors times household size. [P-values] below mean differences, (standard errors) bellow means. Number of households: 4,766 in 1984; 11,398 in 1989; 10,379 in 1992; 12,672 in 1994.

TABLE 3.2
Summary Statistics

Household Demographics Mean Statistics				
	Wave 1984	**1989**	**1992**	**1994**
Household Size				
1984	5.098	0.115	0.312	0.444
	(0.055)	[0.040]	[0.000]	[0.000]
1989		4.984	0.197	0.330
		(0.036)	[0.000]	[0.000]
1992			4.787	0.133
			(0.035)	[0.003]
1994				4.654
				(0.034)
Total Minors in the Household				
1984	2.537	0.218	0.366	0.505
	(0.046)	[0.000]	[0.000]	[0.000]
1989		2.0318	0.148	0.286
		(0.030)	[0.000]	[0.000]
1992			2.171	0.139
			(0.027)	[0.000]
1994				2.032
				(0.027)
Total adults in the Household				
1984	2.562	0.104	-0.054	-0.060
	(0.026)	[0.000]	[0.048]	[0.029]
1989		2.665	0.049	0.043
		(0.018)	[0.032]	[0.045]
1992			2.616	-0.006
			(0.020)	[0.411]
1994				2.622
				(0.018)

Sample means along the diagonals. Difference in means off the diagonals. [P-values] below mean differences, (Standard errors) below means. See Table 3.1

TABLE 3.3
Summary Statistics

Household Demographics Mean Statistics				
	Wave 1984	**1989**	**1992**	**1994**
Total Adult Males in the Household				
1984	1.218	-0.042	-0.031	-0.023
	(0.017)	[0.021]	[0.069]	[0.130]
1989		1.260	0.011	0.019
		(0.012)	[0.264]	[0.122]
1992			1.249	0.008
			(0.013)	[0.313]
1994				1.241
				(0.011)
Total Adult Females in the Household				
1984	1.344	-0.061	-0.023	-0.037
	(0.017)	[0.001]	[0.133]	[0.035]
1989		1.405	0.039	0.024
		(0.011)	[0.008]	[0.064]
1992			1.367	-0.014
			(0.012)	[0.194]
1994				1.381
				(0.012)

Notes: Sample means along the diagonals. Difference in means off the diagonals. [P-values] below mean differences, (standard errors) below means. See Table 3.1

TABLE 3.4
Summary Statistics

Household Head Mean Statistics				
	Wave 1984	**1989**	**1992**	**1994**
Educational Level				
No Education				
1984	0.212	0.012	0.038	0.020
	(0.009)	[0.142]	[0.000]	[0.031]
1989		0.200	0.026	0.008
		(0.006)	[0.001]	[0.175]
1992			0.174	-0.018
			(0.006)	[0.011]
1994				0.193
				(0.006)
1 to 6 Years				
1984	0.592	0.065	0.056	0.078
	(0.011)	[0.000]	[0.000]	[0.000]
1989		0.527	-0.009	0.013
		(0.008)	[0.198]	[0.103]
1992			0.536	0.023
			(0.008)	[0.017]
1994				0.514
				(0.007)
7 to 12 Years				
1984	0.196	-0.077	-0.094	-0.098
	(0.009)	[0.000]	[0.000]	[0.000]
1989		0.273	-0.017	-0.021
		(0.007)	[0.044]	[0.014]
1992			0.289	-0.004
			(0.007)	[0.329]
1994				0.294
				(0.007)
Head's Age				
1984	44.436	-0.187	0.604	-0.259
	(0.345)	[0.322]	[0.071]	[0.264]
1989		44.623	0.791	-0.072
		(0.212)	[0.005]	[0.407]
1992			43.831	-0.864
			(0.225)	[0.003]
1994				44.695
				(0.221)

Notes: Sample means along the diagonals. Difference in means off the diagonals. [P-values] below mean differences, (standard errors) below means. See Table 3.1

TABLE 3.5
Stochastic Dominance Hypothesis Testing

Total Household Expenditure *Per Capita*
Whole Sample

Decile	Dcf Difference ($^V{}_T$ vector) (1)	t-value (2)	Deficit Curve Difference. ($^V{}_F$ vector) (3)	t-value (4)	3rd Order Stoch. Dominance Diff. ($^V{}_C$ vector) (5)	t-value (6)
1984 vs 1989						
I	0.038	(7.201)	2.047	(7.201)	111.640	(7.201)
II	0.060	(8.597)	4.452	(8.200)	272.357	(7.625)
III	0.061	(7.664)	7.422	(8.871)	564.549	(8.228)
IV	0.058	(6.829)	10.619	(8.955)	1,048.813	(8.700)
V	0.057	(6.581)	14.367	(8.844)	1,861.355	(8.967)
VI	0.040	(4.658)	18.325	(8.440)	3,198.693	(8.999)
VII	0.036	(4.466)	22.505	(7.838)	5,468.885	(8.779)
VIII	0.018	(2.586)	27.334	(7.051)	9,967.303	(8.270)
IX	0.011	(2.170)	32.864	(5.942)	21,340.700	(7.340)
X	0.000	----	52.028	(3.936)	165,243.644	(4.949)
PAT's χ^2	90.059	[0.000]				
1984 vs. 1992						
I	0.087	(16.392)	4.725	(16.392)	257.723	(16.392)
II	0.133	(18.864)	10.154	(18.441)	625.697	(17.272)
III	0.153	(18.970)	17.192	(20.259)	1,298.615	(18.662)
IV	0.151	(17.447)	25.342	(21.073)	2,440.321	(19.960)
V	0.164	(18.661)	35.582	(21.598)	4,421.597	(21.003)
VI	0.135	(15.688)	47.842	(21.726)	7,834.237	(21.733)
VII	0.120	(14.856)	62.035	(21.302)	13,943.481	(22.070)
VIII	0.086	(12.216)	80.625	(20.507)	26,819.870	(21.942)
IX	0.053	(10.031)	106.900	(19.060)	62,249.830	(21.110)
X	0.000	---	196.744	(14.675)	576,966.305	(17.037)
PAT's χ^2	527.874	[0.000]				
1984 vs. 1994						
I	0.091	(17.677)	4.950	(17.677)	270.006	(17.677)
II	0.133	(19.460)	10.488	(19.607)	651.820	(18.521)
III	0.142	(18.102)	17.258	(20.935)	1,334.611	(19.742)
IV	0.142	(16.926)	24.877	(21.293)	2,465.616	(20.758)
V	0.142	(16.567)	34.100	(21.306)	4,383.563	(21.433)
VI	0.119	(14.148)	44.750	(20.918)	7,609.081	(21.727)
VII	0.098	(12.561)	56.820	(20.084)	13,256.423	(21.599)
VIII	0.074	(10.751)	72.351	(18.942)	24,915.232	(20.982)
IX	0.045	(8.860)	94.845	(17.406)	56,504.265	(19.724)
X	0.000	---	171.937	(13.201)	508,736.043	(15.463)
PAT's χ^2	496.305	[0.000]				
Wave	1984	1989	1992	1994		
Households	4,766	11,398	10,379	12,672		

Notes: t-values correspond to the ten decile differences that under the null are each distributed as a student distribution function with infinite degrees of freedom. The 10th decile under fist-order dominance is degenerate because of the way the singular covariance matrix is transformed in this particular case. Otherwise, with 10 multiple comparisons and infinite degrees of freedom the 5% critical value of this distribution under the null, corresponds to Bonferroni's critical value of 2.7729. PAT represents the *Pearson Analogue Goodness of Fit* statistic that, under the null of both cumulative distributions are equal to zero (and alternative $H_1 \neq 0$), are distributed as a χ^2 with 9 degrees of freedom. [P-value] in parentheses.

TABLE 3.6
Stochastic Dominance Hypothesis Testing

Total Household Expenditure *Per Capita* **Whole Sample**						
Decile	Def' Difference (^V_F vector) (1)	t-value (2)	Deficit Curve Difference. (^V_P vector) (3)	t-value (4)	3rd Order Stoch. Dominance Diff. (^V_C vector) (5)	t-value (6)
1989 vs 1992						
I	0.049	(12.061)	2.678	(12.061)	146.082	(12.061)
II	0.073	(13.483)	5.702	(13.443)	353.340	(12.661)
III	0.092	(14.815)	9.769	(14.945)	734.066	(13.694)
IV	0.092	(13.907)	14.723	(15.893)	1,391.507	(14.774)
V	0.107	(15.801)	21.215	(16.717)	2,560.242	(15.787)
VI	0.096	(14.403)	29.517	(17.401)	4,635.544	(16.693)
VII	0.084	(13.568)	39.530	(17.621)	8,474.596	(17.413)
VIII	0.068	(12.549)	53.291	(17.596)	16,852.567	(17.898)
IX	0.042	(10.244)	74.036	(17.136)	40,909.130	(18.009)
X	0.000	- - - -	144.716	(14.013)	411,722.661	(15.782)
PAT's χ^2	354.599	[0.000]				
1989 vs. 1994						
I	0.053	(13.743)	2.903	(13.743)	158.366	(13.743)
II	0.073	(14.227)	6.036	(14.958)	379.464	(14.291)
III	0.081	(13.684)	9.836	(15.815)	770.062	(15.098)
IV	0.084	(13.247)	14.258	(16.176)	1,416.803	(15.810)
V	0.085	(13.106)	19.733	(16.342)	2,522.208	(16.346)
VI	0.079	(12.487)	26.424	(16.372)	4,410.389	(16.692)
VII	0.063	(10.641)	34.315	(16.077)	7,787.538	(16.817)
VIII	0.056	(10.771)	45.017	(15.622)	14,947.930	(16.685)
IX	0.034	(8.824)	61.982	(15.077)	35,163.365	(16.270)
X	0.000	- - -	119.909	(12.203)	343,492.399	(13.838)
PAT's χ^2	316.641	[0.000]				
1992 vs. 1994						
I	0.004	(1.039)	0.225	(1.039)	12.283	(1.039)
II	0.000	(0.054)	0.334	(0.808)	26.123	(0.959)
III	-0.011	(-1.840)	0.067	(0.105)	35.996	(0.688)
IV	-0.009	(-1.335)	-0.465	(-0.515)	25.295	(0.275)
V	-0.023	(-3.414)	-1.482	(-1.197)	-38.034	(-0.240)
VI	-0.017	(-2.585)	-3.092	(-1.868)	-225.155	(-0.831)
VII	-0.021	(-3.529)	-5.215	(-2.383)	-687.058	(-1.447)
VIII	-0.012	(-2.358)	-8.275	(-2.800)	-1,904.638	(-2.073)
IX	-0.008	(-1.894)	-12.055	(-2.859)	-5,745.564	(-2.592)
X	0.000	- - -	-24.806	(-2.462)	-68,230.262	(-2.680)
PAT's χ^2	33.088	[0.000]				
Wave	1984	1989	1992	1994		
Households	4,766	11,398	10,379	12,672		

Notes: See Table 3.5

TABLE 3.7
Stochastic Dominance Hypothesis Testing

Total Household Expenditure *Per Capita* Households: **Head with Zero Years of Education**						
Decile	Dcf' Difference ($^V{}_F$ vector) (1)	t-value (2)	Deficit Curve Difference. ($^V{}_F$ vector) (3)	t-value (4)	3rd Order Stoch. Dominance Diff. ($^V{}_C$ vector) (5)	t-value (6)
1984 vs 1989						
I	0.051	(4.157)	1.947	(4.157)	74.852	(4.157)
II	0.050	(3.077)	3.395	(4.149)	151.793	(4.176)
III	0.082	(4.406)	5.324	(4.364)	279.299	(4.281)
IV	0.086	(4.329)	7.896	(4.701)	475.024	(4.471)
V	0.069	(3.394)	10.401	(4.779)	777.931	(4.663)
VI	0.078	(3.919)	13.658	(4.785)	1,311.590	(4.812)
VII	0.051	(2.747)	17.336	(4.715)	2,195.163	(4.886)
VIII	0.016	(0.968)	20.353	(4.215)	3,897.160	(4.783)
IX	0.005	(0.372)	21.953	(3.436)	7,239.593	(4.356)
X	0.000	----	24.048	(2.204)	28,532.469	(3.050)
PAT's χ^2	37.015	[0.000]				
1984 vs. 1992						
I	0.072	(5.896)	2.786	(5.896)	107.111	(5.896)
II	0.109	(6.659)	5.400	(6.540)	225.013	(6.134)
III	0.152	(8.090)	9.216	(7.485)	438.734	(6.665)
IV	0.165	(8.209)	13.927	(8.291)	783.192	(7.305)
V	0.187	(9.108)	19.764	(9.000)	1,343.097	(7.978)
VI	0.153	(7.645)	29.304	(9.481)	2,387.132	(8.680)
VII	0.136	(7.239)	35.550	(9.582)	4,178.996	(9.219)
VIII	0.081	(4.938)	45.339	(9.305)	7,831.860	(9.525)
IX	0.035	(2.821)	54.469	(8.450)	15,717.350	(9.372)
X	0.000	---	70.511	(6.406)	73,567.855	(7.793)
PAT's χ^2	100.289	[0.000]				
1984 vs. 1994						
I	0.112	(9.455)	4.300	(9.455)	165.344	(9.455)
II	0.149	(9.439)	8.055	(10.134)	343.289	(9.723)
III	0.157	(8.712)	12.533	(10.575)	644.329	(10.168)
IV	0.190	(9.840)	17.704	(10.949)	1,094.375	(10.604)
V	0.172	(8.747)	23.728	(11.225)	1,782.924	(11.002)
VI	0.152	(7.858)	30.919	(11.154)	2,995.071	(11.314)
VII	0.121	(6.677)	38.685	(10.832)	4,979.345	(11.411)
VIII	0.072	(4.581)	47.395	(10.105)	8,866.569	(11.203)
IX	0.018	(1.488)	54.493	(8.782)	16,916.302	(10.479)
X	0.000	---	62.638	(5.912)	71,133.688	(7.828)
PAT's χ^2	143.850	[0.000]				
Wave	1984	1989	1992	1994		
Households	874	1,986	1,875	2,438		

Notes: See Table 3.5

TABLE 3.8
Stochastic Dominance Hypothesis Testing

Total Household Expenditure *Per Capita*
Households: **Head with Zero Years of Education**

Decile	Dcf Difference ($^V{}_P$ vector) (1)	t-value (2)	Deficit Curve Difference. ($^V{}_F$ vector) (3)	t-value (4)	3rd Order Stoch. Dominance Diff. ($^V{}_C$ vector) (5)	t-value (6)
1989 vs 1992						
I	0.022	(2.259)	0.839	(2.259)	32.260	(2.259)
II	0.059	(4.591)	2.005	(3.088)	73.219	(2.539)
III	0.070	(4.736)	3.891	(4.020)	159.435	(3.081)
IV	0.079	(4.984)	6.102	(4.620)	308.167	(3.656)
V	0.118	(7.306)	9.363	(5.423)	565.166	(4.270)
VI	0.075	(4.785)	13.646	(6.027)	1,075.542	(4.975)
VII	0.085	(5.744)	18.214	(6.244)	1,983.833	(5.566)
VIII	0.065	(5.061)	24.986	(6.523)	3,934.700	(6.087)
IX	0.030	(3.119)	32.517	(6.416)	8,477.756	(6.430)
X	0.000	----	46.462	(5.369)	45,035.385	(6.068)
PAT's χ^2	76.804	[0.000]				
1989 vs. 1994						
I	0.061	(6.749)	2.353	(6.749)	90.492	(6.749)
II	0.099	(8.179)	4.659	(7.646)	191.496	(7.074)
III	0.075	(5.446)	7.208	(7.933)	365.030	(7.513)
IV	0.104	(7.020)	9.879	(7.968)	619.351	(7.827)
V	0.104	(6.850)	13.327	(8.223)	1,004.994	(8.089)
VI	0.074	(4.986)	17.261	(8.122)	1,683.482	(8.295)
VII	0.070	(5.020)	21.349	(7.796)	2,784.182	(8.322)
VIII	0.057	(4.675)	27.041	(7.520)	4,969.409	(8.189)
IX	0.013	(1.441)	32.540	(6.840)	9,676.709	(7.818)
X	0.000	---	38.590	(4.750)	42,601.219	(6.115)
PAT's χ^2	105.705	[0.000]				
1992 vs. 1994						
I	0.039	(4.274)	1.514	(4.274)	58.233	(4.274)
II	0.040	(3.236)	2.654	(4.286)	118.277	(4.300)
III	0.006	(0.395)	3.317	(3.592)	205.595	(4.164)
IV	0.025	(1.684)	3.777	(2.998)	311.183	(3.870)
V	-0.014	(-0.918)	3.964	(2.407)	439.828	(3.484)
VI	-0.002	(-0.109)	3.615	(1.674)	607.940	(2.948)
VII	-0.015	(-1.082)	3.134	(1.126)	800.349	(2.354)
VIII	-0.009	(-0.705)	2.055	(0.563)	1,034.709	(1.678)
IX	-0.017	(-1.851)	0.023	(0.005)	1,198.952	(0.953)
X	0.000	---	-7.872	(-0.954)	-2,434.166	(-0.344)
PAT's χ^2	57.355	[0.000]				
Wave	1984	1989	1992	1994		
Households	874	1,986	1,875	2,438		

Notes: See Table 3.5

TABLE 3.9
Stochastic Dominance Hypothesis Testing

Total Household Expenditure *Per Capita*
Households: **Head with 1 to 6 Years of Education**

Decile	Dcf Difference ($^{V}{}_{F}$ vector) (1)	t-value (2)	Deficit Curve Difference. ($^{V}{}_{F}$ vector) (3)	t-value (4)	3rd Order Stoch. Dominance Diff. ($^{V}{}_{C}$ vector) (5)	t-value (6)
1984 vs 1989						
I	0.022	(3.084)	1.127	(3.084)	58.443	(3.084)
II	0.025	(2.610)	2.096	(3.172)	125.896	(3.132)
III	0.043	(4.021)	3.437	(3.522)	235.314	(3.287)
IV	0.035	(3.079)	5.097	(3.802)	415.243	(3.511)
V	0.030	(2.515)	6.636	(3.762)	692.895	(3.685)
VI	0.030	(2.566)	8.367	(3.668)	1,132.547	(3.769)
VII	0.011	(1.066)	9.936	(3.406)	1,832.322	(3.746)
VIII	0.015	(1.588)	11.449	(3.049)	3,057.927	(3.584)
IX	0.000	(0.061)	13.112	(2.631)	5,717.693	(3.254)
X	0.000	----	13.399	(1.525)	23,421.636	(2.214)
PAT's χ^2	26.762	[0.002]				
1984 vs. 1992						
I	0.070	(9.791)	3.620	(9.791)	187.658	(9.791)
II	0.103	(10.854)	7.241	(10.835)	414.951	(10.206)
III	0.114	(10.459)	11.534	(11.685)	786.244	(10.858)
IV	0.115	(9.900)	16.366	(12.069)	1,374.458	(11.490)
V	0.111	(9.380)	21.732	(12.182)	2,276.033	(11.967)
VI	0.120	(10.286)	28.509	(12.354)	3,748.314	(12.334)
VII	0.085	(7.773)	36.325	(12.312)	6,227.058	(12.585)
VIII	0.073	(7.678)	45.360	(11.944)	10,908.524	(12.641)
IX	0.020	(2.804)	55.430	(10.996)	21,823.055	(12.280)
X	0.000	---	68.780	(7.740)	104,768.184	(9.790)
PAT's χ^2	190.572	[0.000]				
1984 vs. 1994						
I	0.075	(10.833)	3.899	(10.833)	202.167	(10.833)
II	0.103	(11.084)	7.621	(11.713)	443.282	(11.197)
III	0.112	(10.548)	11.863	(12.342)	828.601	(11.752)
IV	0.110	(9.670)	16.533	(12.521)	1,427.254	(12.253)
V	0.101	(8.739)	21.521	(12.389)	2,327.758	(12.569)
VI	0.086	(7.602)	57.010	(12.021)	3,749.909	(12.673)
VII	0.062	(5.866)	32.684	(11.377)	6,032.140	(12.521)
VIII	0.052	(5.605)	39.223	(10.607)	10,153.188	(12.083)
IX	0.019	(2.710)	46.879	(9.551)	19,477.174	(11.256)
X	0.000	---	59.444	(6.870)	90,478.103	(8.682)
PAT's χ^2	166.596	[0.000]				
Wave	1984	1989	1992	1994		
Households	2,658	5,682	5,299	6,273		

Notes: See Table 3.5

TABLE 3.10
Stochastic Dominance Hypothesis Testing

Total Household Expenditure *Per Capita*
Households: **Head with 1 to 6 Years of Education**

Decile	Dcf' Difference ($^{V}_{F}$ vector) (1)	t-value (2)	Deficit Curve Difference. ($^{V}_{F}$ vector) (3)	t-value (4)	3rd Order Stoch. Dominance Diff. ($^{V}_{C}$ vector) (5)	t-value (6)
1989 vs 1992						
I	0.048	(8.391)	2.492	(8.391)	129.215	(8.391)
II	0.079	(10.298)	5.145	(9.582)	289.055	(8.848)
III	0.071	(8.069)	8.097	(10.209)	550.930	(9.469)
IV	0.080	(8.533)	11.269	(10.343)	959.215	(9.980)
V	0.082	(8.579)	15.097	(10.532)	1,583.138	(10.360)
VI	0.090	(9.644)	20.141	(10.863)	2,615.767	(10.713)
VII	0.073	(8.362)	26.389	(11.132)	4,394.736	(11.055)
VIII	0.058	(7.601)	33.911	(11.113)	7,850.597	(11.323)
IX	0.020	(3.414)	42.317	(10.449)	16,105.362	(11.280)
X	0.000	----	55.381	(7.756)	81,346.548	(9.460)
PAT's χ^2	160.519	[0.000]				
1989 vs. 1994						
I	0.053	(9.732)	2.772	(9.732)	143.724	(9.732)
II	0.078	(10.659)	5.525	(10.731)	317.386	(10.131)
III	0.069	(8.170)	8.426	(11.078)	593.287	(10.633)
IV	0.074	(8.269)	11.436	(10.944)	1,012.011	(10.980)
V	0.072	(7.816)	14.885	(10.829)	1,634.863	(11.156)
VI	0.057	(6.314)	18.643	(10.485)	2,617.362	(11.178)
VII	0.051	(6.044)	22.748	(10.007)	4,199.818	(11.016)
VIII	0.037	(5.045)	27.773	(9.491)	7,095.261	(10.671)
IX	0.018	(3.346)	33.767	(8.694)	13,759.481	(10.049)
X	0.000	---	46.045	(6.724)	67,056.467	(8.132)
PAT's χ^2	140.852	[0.000]				
1992 vs. 1994						
I	0.005	(0.964)	0.280	(0.964)	14.508	(0.964)
II	-0.001	(-0.078)	0.381	(0.726)	28.331	(0.888)
III	-0.002	(-0.240)	0.329	(0.424)	42.358	(0.745)
IV	-0.006	(-0.617)	0.167	(0.156)	52.796	(0.562)
V	-0.010	(-1.109)	-0.212	(-0.151)	51.725	(0.346)
VI	-0.034	(-3.674)	-1.499	(-0.827)	1.595	(0.007)
VII	-0.022	(-2.626)	-3.641	(-1.572)	-194.917	(-0.502)
VIII	-0.021	(-2.828)	-6.137	()-2.059	-755.336	(-1.115)
IX	-0.001	(-0.210)	-8.550	(-2.161)	-2345.881	(-1.682)
X	0.000	---	-9.336	(-1.338)	-14,290.080	(-1.701)
PAT's χ^2	33.496	[0.000]				
Wave	1984	1989	1992	1994		
Households	2,658	5,682	5,299	6,273		

Notes: See Table 3.5

TABLE 3.11
Stochastic Dominance Hypothesis Testing

Total Household Expenditure *Per Capita*
Households: **Head with 7-12 Years of Education**

Decile	Dcf' Difference ($^V{}_F$ vector)	t-value	Deficit Curve Difference. ($^V{}_F$ vector)	t-value	3rd Order Stoch. Dominance Diff. ($^V{}_C$ vector)	t-value
	(1)	(2)	(3)	(4)	(5)	(6)
1989 vs 1992						
I	0.079	(9.585)	8.670	(9.585)	954.050	(9.585)
II	0.092	(8.404)	15.855	(9.942)	1,985.215	(9.753)
III	0.112	(8.918)	23.665	(10.286)	3,497.635	(10.042)
IV	0.127	(9.443)	33.916	(10.726)	5,970.019	(10.433)
V	0.151	(11.032)	49.385	(11.401)	10,606.936	(10.965)
VI	0.155	(11.541)	70.724	(12.203)	18,980.943	(11.600)
VII	0.133	(10.613)	99.554	(12.782)	36,016.252	(12.300)
VIII	0.107	(9.728)	139.396	(12.985)	75,704.362	(12.910)
IX	0.051	(6.192)	188.159	(12.532)	177,101.765	(13.114)
X	0.000	- - - -	310.078	(9.755)	1,370,452.544	(11.313)
PAT's χ^2	192.890	[0.000]				
1989 vs. 1994						
I	0.059	(7.513)	6.499	(7.513)	715.191	(7.513)
II	0.071	(6.750)	11.958	(7.840)	1,491.212	(7.660)
III	0.098	(8.165)	18.418	(8.370)	2,653.648	(7.967)
IV	0.088	(6.818)	26.386	(8.726)	4,577.411	(8.364)
V	0.087	(6.642)	36.103	(8.715)	8,055.859	(8.708)
VI	0.095	(7.428)	48.820	(8.808)	13,976.700	(8.931)
VII	0.079	(6.571)	66.254	(8.894)	25,489.214	(9.102)
VIII	0.076	(7.256)	91.992	(8.960)	51,772.939	(9.231)
IX	0.054	(6.855)	132.218	(9.208)	121,178.881	()9.382
X	0.000	- - -	261.301	(8.595)	1,063,715.827	(9.181)
PAT's χ^2	119.781	[0.000]				
1992 vs. 1994						
I	-0.020	(-2.429)	-2.171	(-2.429)	-238.858	(-2.429)
II	-0.021	(-1.972)	-3.898	(-2.474)	-494.003	(-2.457)
III	-0.014	(-1.122)	-5.248	(-2.309)	-843.987	(-2.453)
IV	-0.039	(-2.958)	-7.530	(-2.410)	-1,392.608	(-2.463)
V	-0.064	(-4.737)	-13.282	(-3.104)	-2,551.077	(-2.669)
VI	-0.060	(-4.491)	-21.904	(-3.826)	-5,004.243	(-3.096)
VII	-0.054	(-4.381)	-33.300	(-4.328)	-10,527.038	(-3.639)
VIII	-0.031	(-2.823)	-47.404	(-4.470)	-23,931.424	(-4.131)
IX	0.003	(0.368)	-55.941	(-3.771)	-55,922.884	(-4.192)
X	0.000	- - -	-48.776	(-1.553)	-306,736.717	(-2.563)
PAT's χ^2	47.153	[0.000]				
Wave	1984	1989	1992	1994		
Households	874	2,838	2,510	2,991		

Notes: See Table 3.5

APPENDIX

Fig. 3.0a: Welfare Distribution

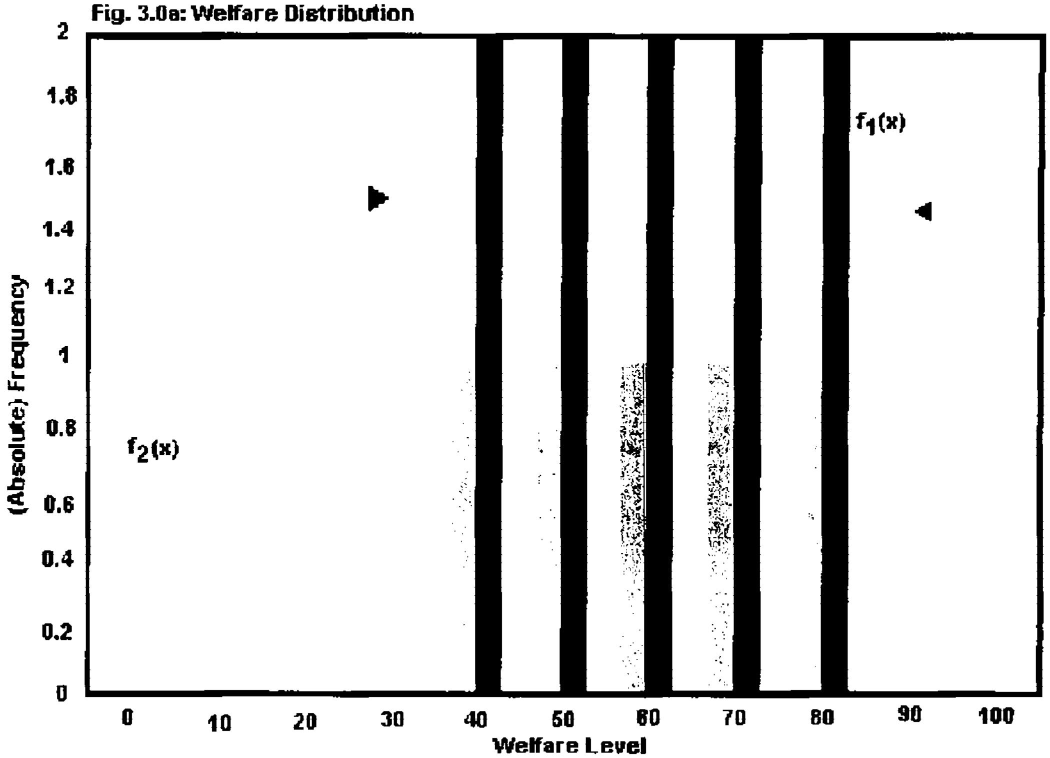
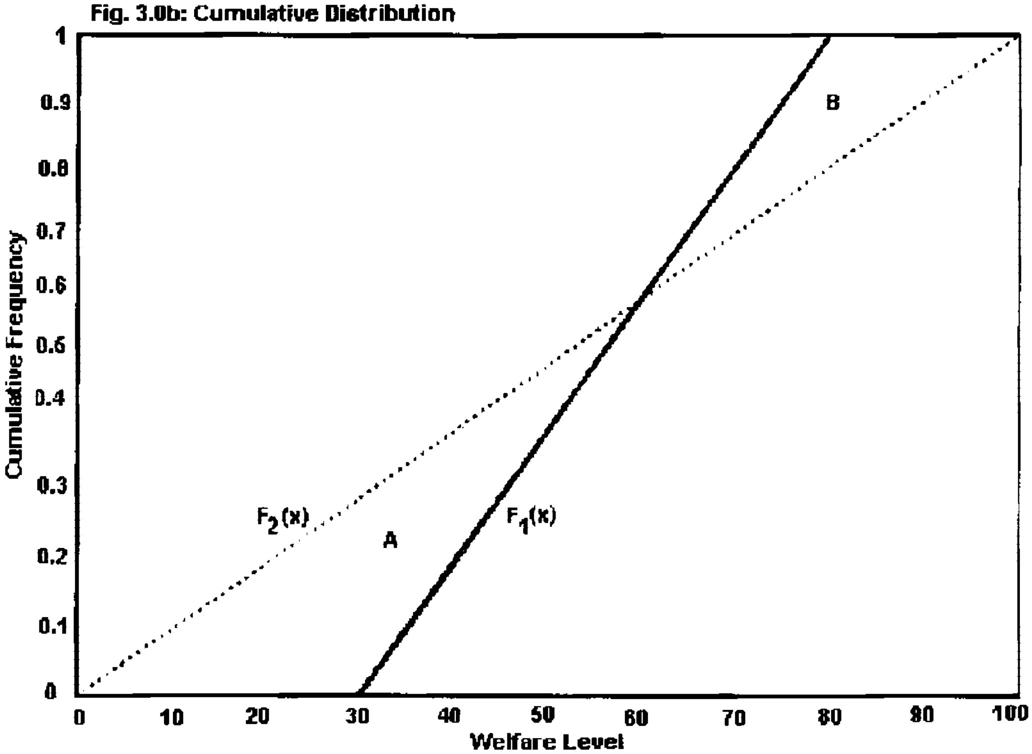


Fig. 3.0b: Cumulative Distribution



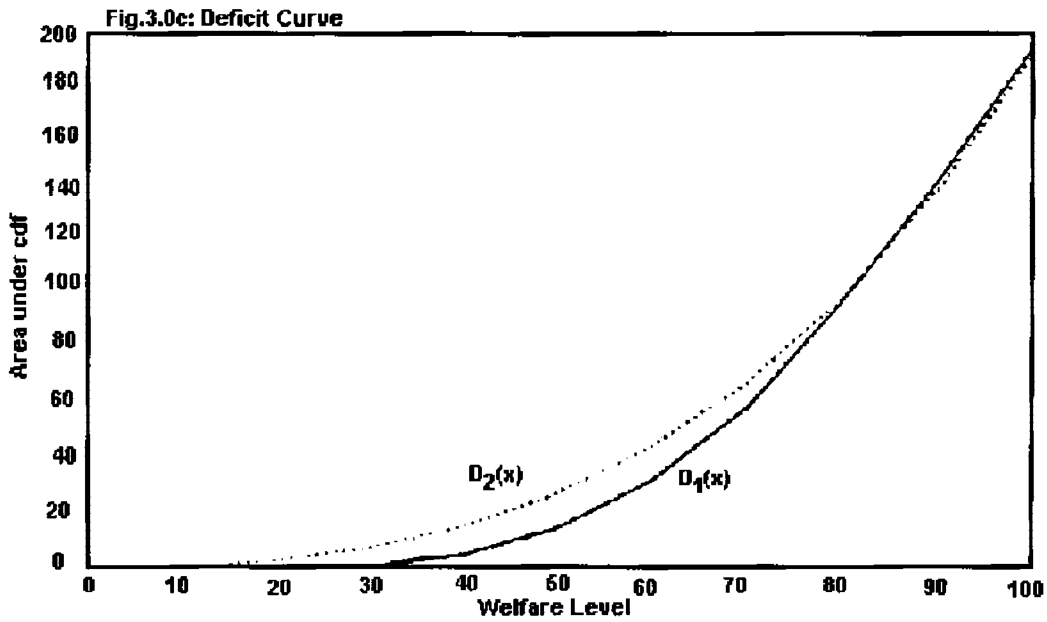


Fig.3.0c: Deficit Curve
200
180
160
140
120
100
80
60
40
20
0
Area under cdf
D2(x)
D1(x)
0
10
20
30
40
50
60
70
80
90
100
Welfare Level

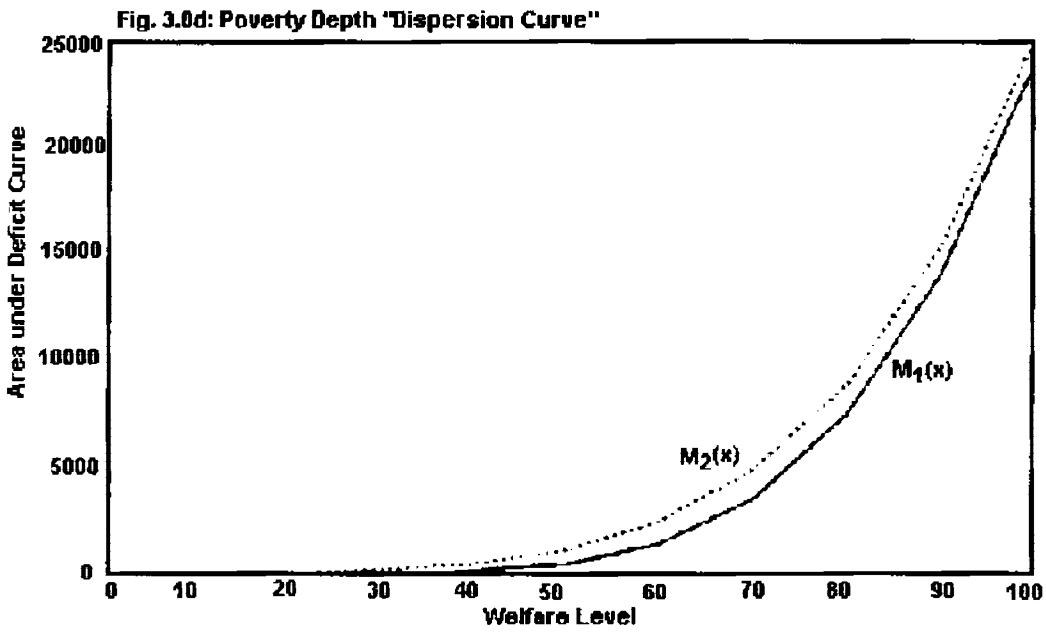


Fig. 3.0d: Poverty Depth "Dispersion Curve"
25000
20000
15000
10000
5000
0
Area under Deficit Curve
M2(x)
M1(x)
0
10
20
30
40
50
60
70
80
90
100
Welfare Level

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