# CHANGES IN WELFARE AND POVERTY: AN APPLICATION OF STOCHASTIC DOMINANCE CRITERIA*

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***Abstract***

*The study analyses changes in urban and rural poverty levels in Ethiopia between 1994 and 1997 using stochastic dominance criteria. The results show that there are only small differences in urban and rural poverty levels. Rural poverty was significantly reduced between 1994 and 1997, while urban poverty remained largely unchanged. Both urban and rural areas saw an increase in average incomes combined with an increase in inequality. The welfare evaluation of these changes depends on one's valuation of efficiency or mean income change relative to equity change. We use a welfare criterion proposed by Tam and Zhang, by which rural welfare can be seen to have increased even for relatively egalitarian preferences, while urban welfare did not increase even in the case of little concern for equity.*

## 1. INTRODUCTION

This paper analyses changes in the levels of rural and urban poverty in Ethiopia between 1994 and 1997. Particularly, we attempt to address the problem of applying an appropriate poverty line in the analysis of poverty using stochastic dominance criteria. This is particularly important in the Ethiopian setting, where errors in the measurement of a poverty line is confounded by the prevalence of multiple prices in regional markets, different units of measurement of quantities consumed, varying consumption patterns of households across regions and other differences in characteristics that affect welfare comparisons. The paper examines the implications of changes in mean per-capita expenditure and income distribution on overall welfare and poverty for urban as well as rural areas of Ethiopia and is organised as follows. Section 2 discusses the stochastic dominance literature as applied to welfare and poverty comparisons, while section 3 reports our empirical results. Section 4 provides a summary and conclusions.

## 2. STOCHASTIC DOMINANCE, WELFARE AND POVERTY: A REVIEW

Looking at the body of literature on the measurement of poverty that has emerged since the pioneering work of Sen (1973), it is not difficult to see its strong influence on

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the measurement of inequality. It also owes a great deal to the classical work of Atkinson (1970), who developed analytical constructs that link statistical measures of income inequality and their welfare interpretations (see Haggenars 1987). Atkinson integrated the notion of social welfare functions in the comparison of different situations with statistical summary measures of income distribution, so that popular measures such as the Lorenz curve and the Gini-coefficient came to reflect an underlying social welfare function that meets certain regularity conditions. Thus, Atkinson, invoking the stochastic dominance concept popular in the finance literature, showed that if two income distributions have the same mean and if one of the distributions Lorenz dominates the other, social welfare (which is quasi-concave in income) in one distribution is higher than in the other. Sen (1973) demonstrated that if two distributions have unequal means, then Lorenz dominance does not offer any clear-cut welfare inferences. However, Rothschild and Stiglitz (1973) argued that comparison of welfare in a situation of unequal means could be made on the basis of the income received by the $k^{th}$ poorest people. Saposnik (1981) proved that rank dominance of absolute incomes of Lorenz curves is sufficient and necessary to generate welfare dominance, irrespective of the level of mean income. This is what is known as first degree stochastic dominance. Rank dominance utilises efficiency criteria alone, since dominance follows if the income of individuals in each decile is higher than that in the distribution being compared, regardless of the level of inequality within each distribution.

The application of rank dominance to income distribution was facilitated by the development and simplifications of distribution-free test procedures in Beach and Davidson (1983), Beach and Richmond (1985) and Beach et al. (1994). Following this, Bishop et al. (1991) and others have applied rank dominance to the comparison of welfare on the basis of the ordinates of Lorenz curves. The application to poverty was self-evident. Atkinson (1987) and Foster and Shorrocks (1988) proved that for all additive poverty indices, that is for those based on a utilitarian social welfare function, the dominance of a distribution within a given range of poverty lines is equivalent to the poverty ordering implied by the poverty indices.

The task of poverty measurement involves two distinct but interrelated aspects: the identification of the poor, and the measurement of how much poverty there is. The first aspect is mainly concerned with the setting of a poverty line, which divides the population into poor and non-poor. The conceptual and empirical basis of setting poverty lines has for long been relegated to the background in the literature of poverty measurement (see Ravallion 1998 for a recent discussion of this issue). Emphasis has been given to the construction of aggregate poverty indices that meet certain ethically consistent criteria. However, in empirical applications and in policy analyses, the estimation of the poverty line became a subject of great concern. Most measures are quite sensitive to the level of the poverty line and thus, worries about the lack of accuracy of the measurement of the poverty line has meant that the poverty indices have lacked the robustness needed for reliable poverty comparisons. They have therefore become less useful for policy makers.

Most studies approach the estimation of the poverty line without much concern as to how it can distort poverty profiles and analysis, but the sensitivity of the poverty line to slight changes in household composition, tastes, price differences and other factors that affect household welfare, is a constant challenge. One of the problems often mentioned (Atkinson 1987; Fields and Bourginignon 1997) is the issue of instant gradation in welfare when a person crosses the poverty line by a fraction of a dollar. While the distinction between poor and non-poor is one of the fundamental issues of concern in poverty analysis, the welfare effect of a marginal increase in income at the poverty line is enormous.[2] The application of dominance testing offers an opportunity to provide poverty orderings by taking a wider range of poverty lines into account. If for the specified range, one distribution rank dominates another distribution, then poverty, whichever way measured, is higher in the rank dominated distribution.

More formally, the stochastic dominance test criterion may be described as follows: Suppose F (y) is a distribution function or cumulative density function of income f (y) (so that F (y)= $\int$(fy) dy) where y is a vector of household income arranged in ascending order such that $y_1<y_2<,..,<y_n$. The inverse distribution function or quintile function, y(p):inf{ F(y) $\geq$p}, p$\in$[0,1], yields individuals' incomes in increasing order. If $W_p$ denotes the class of anonymous, increasing welfare functions, then, following Saposnik (1981), for two distributions, X and Y, we have the following theorem:

*X>R Y (X rank dominates Y) iff w(X) > w(Y) " w$\in$Wp.*

Thus, distribution X dominates distribution Y iff x(p)$\geq$Y(p) $\forall$ p$\in$[0,1]. If $\forall$ p$\in$ [0,1] X(p)=Y(P), then X and Y have the same income distribution and standard of living. If X(p)>Y(p) for some p, and X(p)<Y(p) for some other p, the distributions cannot be ordered using the rank dominance criterion.

Atkinson (1987) and Foster and Shorrocks (1988) show, as a corollary to the above dominance theorem, that rank dominance for all z, the poverty line, implies that the head-count ratio, defined as the proportion of the population in poverty is higher in one distribution than another in the range specified for the poverty line. They also show that rank dominance implies higher order dominance which extends also to dominance for additive poverty indices, such as the $P_\alpha$ class defined as $P_\alpha$=$\int${z-f(y)/z}$^\alpha$ dy, where z represents the poverty line, f(y) is the density function of the income distribution, and $\alpha$ is distribution parameter.[3] In the current poverty literature, this class of poverty indices is known as the Foster-Greer-Thorbecke indices.

Rank dominance is a sufficient condition for higher order dominance, but is neither necessary nor works backwards. Generally, rank dominance, that is a simple dominance comparison of two Lorenz curves, has an intuitive appeal if the mean incomes in the two distributions are the same. If that is not the case, dominance testing fails to account for the effect of a higher level of income, which by itself is a

welfare-improving phenomenon, given that distributions are held unchanged. Thus, Dasgupta, Sen and Starrett (1973) proposed the Generalised Lorenz dominance criterion, which was further explored by Shorrocks (1983) and Kakwani (1984) to get around with the problem of focusing only on efficiency considerations. Thus, rank dominance, a situation where the cumulative incomes of one Lorenz curve lies above another for all ordinates of the Lorenz curve, is equivalent to first-degree stochastic dominance as in the finance literature, where expected returns on different investment opportunities are ranked.

The extension to a situation of unequal mean incomes also imposed stricter regularity conditions on the underlying social welfare function, which have to be scur-concave and additive over individual incomes. Generalised Lorenz dominance (called the second degree dominance, see for instance, Bishop et al., 1991, 1993) is simply scaling up the ordinates of the ordinary Lorenz curve by mean income to account for differences in the level of mean income. It is to be recalled that the slope of the Lorenz curve does not change if all of its ordinates are multiplied by a scalar. Generalised Lorenz dominance in terms of poverty measurement is equivalent to comparing the poverty gap measure (or the depth of poverty) between two distributions regardless of the poverty line. By this recursive process, third degree stochastic dominance is equivalent to dominance of poverty severity between two distributions. Thus, if we have first degree dominance for the relevant range of the poverty line, then, it means that the head-count ratio is also significantly different between the two distributions. Second degree dominance implies that the depth of poverty in one distribution is higher than the other regardless of where the poverty line is fixed, and so on.

The statistics necessary to conduct dominance testing is quite straightforward following the work of Beach and Davidson (1983). Consider a situation where the individual incomes y, are arranged in ascending order and divided into p quintile groups, which in the case of deciles is $p_1$=0.1, $p_2$=0.2, ... , $p_{10}$=1. Given the assumption that the mean and variance of the distribution exist and are finite, an income quintile, $\xi_p$, corresponding to abscissa p ($0 \leq p \leq 1$) on a Lorenz curve is defined implicitly by $F(\xi_p)$, where F is monotonic. Thus, corresponding to a set of k-1 abscissa, $0<p_1<p_2<...,<p_{k-1}$, we have a set of k-1 population income quintiles, $\xi_{p1}<\xi_{p2}<,....<\xi_{pk-1}$, and a set of k cumulative means, $\gamma_i \equiv E(Y \mid Y \leq \xi_{pi})$, for incomes less than or equal to $\xi_{pi}$. We can also define the conditional means, $\mu_i=E(y \mid \xi_{pi-1} < Y < \xi_{pi})$. The test procedure for dominance is based on these estimators. Until the paper by Beach and Davidson (1983), inference based on the ordinates of the Lorenz curve had to rely on parameterised Lorenz functions, but this is not adequate to undertake the joint test (mean income and Lorenz ordinates) of dominance. It has been proved in Beach and Davidson (1983) that the above ordinates of the Lorenz curve are asymptotically normal with mean zero and has a variance-covariance matrix $\Omega=(w_{ij})$, where

$$w_{ij}=p_i [\lambda_i^2 + (1-p j)(\xi_{pi}-Y_i)(\xi_{pj}-Y_j) + (\xi_{pi}-Yi)(Y_j-Y_i)$$

is the asymptotic variance of the k cumulative means. Beach et al. (1994) showed that a statistical test based on the conditional means of the Lorenz ordinates can be constructed to test the hypothesis of dominance between two Lorenz curves (say distributions 1 and 2) using the statistical test for mean difference. The test statistics for large samples can be written as:

$$T_i = (\mu_{i1}-\mu_{i2})/\{\sqrt{(\text{var}(\mu_{i1})/N1+\text{var}(\mu_{i2})/N2}\},$$

where $T_i$ can be looked upon as a t-ratio. The null-hypothesis is to accept that the relevant quintiles have conditional means, which are equal. If this is accepted for the entire range of the distribution, then, the two distributions are said to have equal welfare ranking, whatever the level of the poverty line is. If there is a crossing, then a further criterion has to be imposed. Bishop et al. (1991) have stated that if two distributions cross, and the crossing is statisitcally significant, then ranking the two distributions will not be possible according to a social welfare functions. Dominance exists if for all other quintiles the distributions exhibit equal mean and have at least one dominance in either direction, and if it is statistically significant. If there are two ordinates with different signs, which are statistically significant, then dominance testing cannot rank the distributions according to a criterion underlying quasi-concave social welfare functions.

Empirical poverty studies (e.g., Bishop et al., 1991) generally find that distributions with higher mean income dominates because of the emphasis given to efficiency considerations. This prompted Tam and Zhang (1996) to suggest a Lorenz dominance criterion of $\beta$-order that can take equity considerations into account, even when mean income of two distributions are significantly different from each other. Normally, a Generalised Lorenz curve is defined as $G(P)=\mu L(P)$, where, $L(p)$ is the ordinary Lorenz curve. Notice that $L(p)=\int pd(p)/\mu$. Thus, the ordinates of the Generalised curve are given by the vector $Y:(p_1Y_1, p_2Y_2, \ldots, p_kY_k)$. Tam and Zhang suggested that instead of multiplying the ordinates of the Lorenz curve by the mean of the total distribution, m, we can use $\mu^{\beta}$, where $0\leq\beta\leq1$, so that preference can be given to equity even in a situation of unequal means. It is noticed that a scaling up of the Lorenz curve by a constant does not change the relative inequality in a distribution. If $\beta=1$, then, the $\beta$-order Lorenz curve reduces to the Generalised Lorenz curve. If $\beta<1$, then, preference for equity is considered along with efficiency (that is higher income is always better for given levels of inequality). This measure thus allows a choice of the amount of mean income increase that is needed to compensate for an increase in inequality to keep welfare constant.

The Generalized Lorenz Dominance criterion proposes that welfare in Y is higher than in X if and only if

$$GL(Y,p)=\mu_y L(Y,p)\geq GL(X,p)=\mu_x L(X,p) \qquad [1]$$

where $\mu_y$ and $\mu_x$ respectively stand for per capita income in income distribution Y and X. Tam and Zhang (1996) argue that the trade-off between economic growth (efficiency) and inequality (equity) is not well captured by the Generalized Lorenz dominance criterion. They show that the Generalized dominance criterion implies that there has been a welfare improvement if the incomes of all people, except for the richest person, remain unchanged, and mean income increases as a result of an increase in the income of the richest person. In this case, it is obvious that *income shares* of all people, except for the richest one, decline. They propose what is known as the β-dominance criterion, where the Generalized Lorenz dominance is shown to be a special case.

The β-criterion is based on (1), which after some rearrangement can be rewritten as:

$$\frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x_i} \geq 1 \qquad [2]$$

Following (2), Tam and Zhang proposed a β-criterion as follows:

$$\frac{\sum_{i=1}^{n} y_i}{\sum_{i=1}^{n} x_i} \geq \tau^{1-\beta}, 0 \prec \beta \prec 1 \qquad [3]$$

where $\tau=\mu_y/\mu_x$, and β indicates the degree of preference for efficiency. The higher β is, the higher is one's preference for efficiency and vice versa. If β=1, the β-dominance criterion reduces to the Generalized Lorenz dominance criterion. The Tam and Zhang criterion is a Rawlsian type of criterion, whereby welfare can only increase if the poor share in the growth. Welfare will here increase only if there is an increase in the income of the poorest group or person.

## 3. RESULTS OF STOCHASTIC DOMINANCE TESTS

The data for this study is taken from two independent panel surveys–one urban and the other rural–conducted by the Department of Economics of the Addis Ababa University, the former in collaboration with the Centre for the Study of African

Economies of Oxford University and the International Food Policy Research Institute and the latter with the Department of Economics, Goteborg University.

Table 1 reports the conditional means by decile and overall means between 1994-1997 for rural and urban households. Over time, there has been an increase in real per capita expenditure in urban as well as rural areas, which is statistically significant. Because of our concern about the temporary jump in rural incomes in 1995, we restrict our inter-temporal comparisons to 1997 versus 1994. The average rate of growth in per capita expenditures in real terms in rural areas was 9.2%, while it was 8.8% between 1994 and 1997 in urban areas.[4] All values are in constant 1994 prices. That is, per capita consumption expenditure for urban areas was adjusted for regional and temporal price changes based on the price data from the Central Statistical Authority (CSA). For rural areas, we used price data colleted parallel with the household surveys.

The difference in per capita expenditure between rural and urban households is small for 1994 and 1997 (while in 1995 rural households reported real per capita consumption expenditures significantly higher than urban households). In terms of welfare and poverty, the rank dominance criterion we employed led to the result that urban poverty was generally not significantly different from rural poverty for a fairly high poverty line.

The Generalized Lorenz dominance criterion, a test sometimes referred as second-order dominance, for rural and urban households is reported in Table 2. Our results suggest that differences in mean income did differentiate in urban from rural areas in 1994 for any income level up to the fifth decile. That is, we could rank urban areas as having higher welfare than rural areas by the Generalised Lorenz dominance criterion up to that level of the poverty line. However, the situation in 1997 is consistent with the one for rank dominance. There was no significant welfare difference between rural and urban households according to our estimates.

The comparison of welfare and poverty changes over time in rural and urban areas is subject to a methodological problem as far as the test statistics are concerned. As indicated above, the statistical test used to compare income distributions is built on the assumption that the samples are drawn independently. In our case, with data from a panel, each round does not stand on its own. Households interviewed in each round are generally the same, leading to the problem of dependent sample distributions.[5] Still, to get a feel for what did happen over time, we use the 1994 and 1997 distribution data to compare changes in poverty and welfare for both urban and rural households (see Table 3). In rural areas, there is strong evidence that poverty declined between 1994 and 1997 for a poverty line up to the mean expenditure of the bottom fifth decile. In urban areas, the 1994 distribution dominated the 1997 one for the bottom decile, while changes remained insignificant all the way up to the income of the top decile. During this period, rural poverty thus declined, while that of urban poverty remained largely unchanged. This finding is corroborated by the direct

computation of the poverty indices.

Table 1: Rank Dominance Criterion: Rural vs. Urban Per capita Expenditure: Birr per month per person

| | 1994 | | | | 1995 | | | | 1997 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pi | Conditional Mean Rural | Cond. Mean Urban | Difference in Cond. Mean | T Ratio* | Cond. Mean Rural | Cond. Mean Urban | Mean Difference | T Ratio* | Cond. Mean Rural | Cond. Mean Urban | Mean Diff. | T Ratio* |
| 0.1 | 18.9 | 18.28 | -0.6 | 0.61 | 16.04 | 19.76 | 3.72 | -3.33 | 22.28 | 20.54 | -1.74 | 2.30 |
| 0.2 | 30.0 | 32.92 | 2.9 | -1.62 | 29.92 | 34.82 | 4.9 | -2.35 | 36.26 | 35.95 | -0.31 | 0.13 |
| 0.3 | 40.6 | 44.74 | 4.2 | -1.82 | 42.94 | 46.75 | 3.81 | -1.49 | 48.7 | 48.45 | -0.25 | 0.09 |
| 0.4 | 52.1 | 55.99 | 3.9 | -1.27 | 56.19 | 58.43 | 2.24 | -0.64 | 60.29 | 62.45 | 2.16 | -0.63 |
| 0.5 | 65.2 | 67.37 | 2.2 | -0.55 | 74.56 | 71.14 | -3.42 | 0.67 | 72.53 | 75.97 | 3.44 | -0.76 |
| 0.6 | 80.0 | 80.15 | 0.2 | -0.03 | 96.21 | 85.64 | -10.57 | 1.53 | 88.6 | 94.8 | 6.2 | -0.92 |
| 0.7 | 97.4 | 99.05 | 1.6 | -0.21 | 125.27 | 106.99 | -18.28 | 1.80 | 112.01 | 121.29 | 9.28 | -0.95 |
| 0.8 | 116.8 | 127.14 | 10.3 | -0.97 | 167.71 | 137.13 | -30.58 | 1.99 | 144.58 | 151.68 | 7.1 | -0.52 |
| 0.9 | 147.1 | 170.38 | 23.3 | -1.43 | 244.03 | 183.55 | -60.48 | 2.37 | 197.8 | 204.19 | 6.39 | -0.29 |
| 1 | 249.5 | 341.96 | 92.4 | -3.19 | 654.99 | 350.09 | -304.9 | 9.84 | 365.44 | 450.46 | 85.02 | -3.23 |
| **Overall Mean** | **90.0** | **103.8** | **13.8** | **-2.01** | **150.6** | **109.44** | **41.28** | **11.5** | **114.8** | **126.59** | **11.9** | **-2.3** |

Source: Calculations based on household panel data
*T≥ 2.8 is significant at 5% level of significance.

Table 2: Generalised Lorenz Dominance Criterion Between Urban and Rural Households

| | Generalized Lorenz Ordinates | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | 1994 | | | 1995 | | | 1997 | | |
| Pi | Rural | Urban | T-ratios | Rural | Urban | T-ratios | Rural | Urban | T-ratios |
| 0.1 | 1.9 | 1.8 | 6.06 | 1.6 | 2.0 | -3.3 | 2.2 | 2.1 | 1.50 |
| 0.2 | 4.9 | 5.1 | -4.92 | 4.6 | 5.5 | -3.3 | 5.9 | 5.6 | 0.80 |
| 0.3 | 8.9 | 9.6 | -5.61 | 8.9 | 10.1 | -3.0 | 10.7 | 10.5 | 0.54 |
| 0.4 | 14.2 | 15.2 | -4.64 | 14.5 | 16.0 | -2.4 | 16.8 | 16.7 | 0.02 |
| 0.5 | 20.7 | 21.9 | -3.38 | 22.0 | 23.1 | -1.3 | 24.0 | 24.3 | -0.40 |
| 0.6 | 28.7 | 29.9 | -2.16 | 31.6 | 31.7 | -0.1 | 32.9 | 33.8 | -0.83 |
| 0.7 | 38.4 | 39.9 | -1.63 | 44.1 | 42.4 | 1.1 | 44.1 | 45.9 | -1.22 |
| 0.8 | 50.1 | 52.6 | -1.94 | 60.9 | 56.1 | 2.2 | 58.5 | 61.1 | -1.31 |
| 0.9 | 64.8 | 69.6 | -2.63 | 85.3 | 74.4 | 3.6 | 78.3 | 81.5 | -1.21 |
| 1.0 | 89.8 | 103.8 | -4.61 | 150.8 | 109.4 | 5.9 | 114.8 | 126.6 | -2.23 |

Source: Computed from Panel data.

The investigation of welfare and poverty for urban households was extended by classifying the urban sites into three major urban groups: the capital city, Addis Ababa, the Northern urban group (Mekele, Dessie and Bahir Dar) and the Southern urban group (Jimma, Aswassa and Dire Dawa). Such a classification is of interest, since it can capture some of the regional characteristics of the sites. Addis Ababa is the largest city in Ethiopia with an approximate population of 3-4 million people. The other towns are smaller, but are situated in locations with different types of rural economic activities. The Northern urban groups are predominantly in the area of the cereal producing farming systems, while the Southern cities are located in cash-crop producing areas.

Table 3 : Urban and Rural Real Expenditure Decile Means, Mean Differentials 1994-1997

| Decile | Conditional Mean 94 ($\mu_{94}$) Urban | Cond Mean 97 ($\mu_{97}$) Urban | $\mu_{97}-\mu_{94}$ (Urban) | T-Ratio | Cond. Mean 94 ($\mu_{94}$) (Rural) | Cond. Mean 97 ($\mu_{97}$) (Rural) | $\mu_{97}-\mu_{94}$ (Rural) | T-Ratio |
|---|---|---|---|---|---|---|---|---|
| 1 | 20.76 | 21.05 | 0.71 | 0.36 | 18.9 | 22.28 | 3.9 | 3.35 |
| 2 | 37.4 | 37.33 | -0.07 | -0.031 | 30.0 | 36.26 | 6.26 | 3.54 |
| 3 | 4 | 50.42 | -0.42 | -0.146 | 40.6 | 48.7 | 8.1 | 3.39 |
| 4 | 63.49 | 64.85 | 1.36 | 0.373 | 52.1 | 60.29 | 8.19 | 2.50 |
| 5 | 76.55 | 79.23 | 2.68 | 0.553 | 65.2 | 72.53 | 7.33 | 1.70 |
| 6 | 91.06 | 98.33 | 7.27 | 1.046 | 80.0 | 88.6 | 8.6 | 1.41 |
| 7 | 112.57 | 125.62 | 13.05 | 1.102 | 97.4 | 112.01 | 14.61 | 1.71 |
| 8 | 144.27 | 157.18 | 12.91 | 0.84 | 116.8 | 144.58 | 27.78 | 2.31 |
| 9 | 192.89 | 209.91 | 17.02 | 0.771 | 147.1 | 197.8 | 50.7 | 2.68 |
| 10 | 378.6 | 442.12 | 63.52 | | 249.5 | 365.44 | 115.94 | |
| Overall Mean | 116.75 | 128.52 | 11.77 | 2.33 | 90.0 | 114.8 | 24.8 | |

Source: Computed from panel data.

Between 1994-1997, the trends for these regional groupings were consistent with what was observed for the whole group (See AT1-AT6). Welfare and poverty remained largely unchanged. The changes in mean income were not significant for the Northern and Southern urban groups, but for Addis Ababa the situation is slightly different. There we saw a significant increase of mean per capita income by about 10% between 1994 and 1997. Still, by the rank dominance criterion, overall welfare remained largely unchanged for Addis Ababa, despite the increase in mean income. A Generalised Lorenz dominance test was undertaken to explore the implications of higher mean income for overall welfare. It was found that welfare by this criterion increased between 1994 and 1997. It is important to note that the Lorenz domination test procedure is biased towards efficiency as shown by Tam and Zhang (1996), This means that even if the increase in income is captured by the people in the highest deciles, overall welfare is said to have increased, although income of the people in the lowest deciles remained unchanged. For the Northern and Southern regions there were no significant improvement in mean income and no rank dominance is observed.

Our comparisons across regions gave some interesting results. Addis Ababa was rank dominated both by Southern and Northern regions in 1994. (In 1995 Southern urban regions dominated the Northern and Addis Ababa regions). The implication in terms of poverty is that in 1994, Addis Ababa had a larger fraction of the population in poverty than any of these two urban regions for any poverty line. In 1995, the Southern region experienced low poverty as defined by the head count ratio compared to other regions. This probably had to do with the major coffee boom the country experienced at about the time of the 1995 survey. In 1997, all urban regions had similar level of welfare and poverty.

So far, our efforts to compare welfare and poverty changes have been based on rank and generalised Lorenz dominance criteria. We now attempt to provide more insight based on the β-dominance criterion introduced by Tam and Zhang (1996). From Equation [3], let β* be related to the quintile that registered the highest improvement between two periods (computed from columns 5 and 6 in Table 4) Then we equate that ratio with the mean ratio for two periods and get β*.[6] We apply the β-dominance criterion to compare welfare changes for Ethiopia between rural and urban areas for the period 1994-1997.

By construction, $0 \leq \beta \leq 1$. If the estimated value $\beta^* < 0$, it means that whatever the amount of growth experienced between the two periods, welfare cannot improve because of the increase in inequality. That is, the concern about the worsening in inequality is so strong that no amount of economic growth can justify an increase in it. On the other hand, if $\beta^* > 1$, welfare improves because of growth regardless of the level of inequality. That is, there is no trade-off between growth and inequality. For $0 < \beta^* < 1$, there is a trade-off between growth and inequality depending on one's valuation of efficiency versus equity.

**Table 4: Lorenz Ordinates and Ratios for Ethiopia: 1994-1997**

| Population Share | $\rho_{94rural}$ (1) | $\rho_{94urban}$ (2) | $\rho_{97rural}$ (3) | $\rho_{97urban}$ (4) | $\rho_{94rural}/\rho_{97rural}$ (5) | $\rho_{94urban}/\rho_{97urban}$ (6) |
|---|---|---|---|---|---|---|
| 10 | 0.021 | 0.017 | 0.019 | 0.015 | 1.103619 | 1.169262 |
| 20 | 0.055 | 0.049 | 0.050 | 0.042 | 1.082922 | 1.169013 |
| 30 | 0.100 | 0.091 | 0.093 | 0.079 | 1.079998 | 1.155559 |
| 40 | 0.158 | 0.145 | 0.145 | 0.127 | 1.092652 | 1.135777 |
| 50 | 0.230 | 0.210 | 0.208 | 0.188 | 1.108507 | 1.115497 |
| 60 | 0.319 | 0.287 | 0.285 | 0.262 | 1.116912 | 1.095585 |
| 70 | 0.426 | 0.383 | 0.384 | 0.354 | 1.108524 | 1.081079 |
| 80 | 0.556 | 0.506 | 0.512 | 0.469 | 1.084732 | 1.078211 |
| 90 | 0.720 | 0.669 | 0.684 | 0.631 | 1.052491 | 1.060792 |
| Gini Coefficient | 39 | 43 | 44 | 48 | | |

**Source:** Own calculations based on household panel data, Department of Economics, AAU.

We calculated the largest value of β* for rural and urban households for Ethiopia to measure the welfare implications of the growth in per capita income. We found a maximum β* value of about 0.44 for rural households and 1.03 for urban households. The extent to which welfare improved is subject to ones perceptions of equity. A person with a greater weight for equity (here a b less than 0.44) would argue that welfare did not increase in rural Ethiopia, while one with a greater emphasis on economic growth (with a b larger than 0.44) would argue that welfare improved. For urban areas, even for an individual who is all for growth, by our criterion welfare has deteriorated since the value of β* is greater than one. The results of the welfare evaluation thus depend quite a lot on the value judgment attached to inequality and economic growth. The approach used here allows a choice of the amount of increase

in mean income that is needed to compensate for increased inequality. This is reflected in the b parameter. These results demonstrate the inherent trade-off existing in a growing economy, especially one that takes the first step to the long journey of development from a condition of very low income and high level of income inequality.

## 4. CONCLUSIONS

Over the short time period considered in this paper, the evidence suggests that there were considerable improvements in the state of welfare in rural areas, while urban areas generally recorded only small improvements. Our regional profile of urban poverty showed that in 1994, Addis Ababa had a higher incidence of poverty than other urban areas. This changed to equal poverty incidence in 1997. Similarly, in 1995, the Southern urban areas generally had a higher overall welfare and lower poverty than any other urban areas probably due to the significant increase in incomes caused by the coffee boom.

To draw attention to the threat of rising income inequality in a growing economy, we used various Lorenz dominance criteria to compare welfare between 1994 and 1997 for rural and urban areas. Our result show that welfare changes in rural areas are positive according to standard criteria, while even changes in the rural areas might be considered to be negative within the Tam and Zhang framework if the evaluator has a very high valuation of equity. For urban areas welfare computed in this (radical) way actually worsened due to increase in inequality in spite of some increase in real per capita income.

Our comparisons of welfare and poverty show no clear difference between rural and urban areas. This is a surprising result, given the presumption that poverty is higher in rural areas than in urban areas in Africa. We would need further evidence to back up this unusual result, but it may well reflect the fact that urban areas of Ethiopia have seen a lot of immigration from the rural areas, at the same time as relatively little in terms of advanced economic activity is available. Most of economic activities that one sees in urban Ethiopia are very basic. The problem of poverty in Ethiopia is thus not confined to the rural areas, but is to be found in all regions. This needs to be taken into account by policy makers.

## NOTES

[1] Bishop et al. (1993) applied stochastic dominance testing to poverty comparisons for selected countries.

[2] Sen (1980) noted that the behavior of poverty indices around the poverty line does not adhere to the notion of declining marginal utility of income, which is an important assumption in social welfare analysis. As argued by critiques of Sen's index (notably Thon 1979, 1981), the jump exhibited in Sen's index around the poverty line is one of its major drawbacks. Recently, Shorrocks (1995) dealt with the discontinuity issue, but Sen argued that poverty

indices around the poverty line should be highly elastic with per capita income because it is always very important to have one less poor person in a community.

[3] See Foster et al. , 1984 for the derivation of this poverty index.

[4] The increase in per capita real expenditure among the panel households between 1994-1995 in rural areas was a dramatic 65%. This declined by 24% in 1997, leading to an average increase of about 14% in the three years. If we skip 1995, the average growth rate in real per capita expenditure among rural households in the panel would come to 9.2%. The growth rate in per capita consumption growth rate for urban areas that we reported here was computed by taking into account the actual time difference in survey periods between 1994 and 1997, which was about 2 and half years.

[5] Davidson and Duclos (2000) constructed a non-parametric test statistics when the sample distributions are dependent.

$$\left[\frac{L(y_i,p)}{L(x_i,p)}\right]=\left[\frac{\mu_y}{\mu_x}\right]^{1-\beta^*} \Rightarrow$$

$$\ln\frac{\left[\frac{L(y_i,p)}{L(x_i,p)}\right]}{\left[\frac{\mu_y}{\mu_x}\right]}=1-\beta^*$$

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# APPENDIX TABLES

AT1 : Urban Real Expenditure Decile Means and Mean Differentials - Addis Ababa 1994-1997

| Decile | Conditional mean 94 ($\mu_{94}$) | Cond. mean 95 ($\mu_{95}$) | Cond. mean 97 ($\mu_{97}$) | $\mu_{95}-\mu_{94}$ | t-ratio | $\mu_{97}-\mu_{95}$ | t-ratio | $\mu_{97}-\mu_{94}$ | t-ratio |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 18.95 | 21.33 | 21.05 | 2.38 | 1.508 | -0.28 | -0.161 | 2.1 | 1.277 |
| 2 | 32.78 | 35.92 | 36.55 | 3.14 | 1.206 | 0.63 | 0.23 | 3.77 | 1.421 |
| 3 | 43.57 | 47.66 | 48.28 | 4.09 | 1.29 | 0.62 | 0.178 | 4.71 | 1.392 |
| 4 | 54.86 | 58.99 | 62.38 | 4.13 | 0.926 | 3.39 | 0.729 | 7.52 | 1.392 |
| 5 | 67.17 | 69.45 | 75.69 | 2.28 | 0.424 | 6.24 | 1.044 | 8.52 | 1.555 |
| 6 | 78.56 | 83.6 | 93.33 | 5.04 | 0.711 | 9.73 | 1.131 | 14.77 | 1.436 |
| 7 | 95.73 | 103.27 | 119.33 | 7.54 | 0.701 | 16.06 | 1.303 | 23.6 | 1.796 |
| 8 | 127.18 | 133.15 | 150.7 | 5.97 | 0.343 | 17.55 | 0.933 | 23.52 | 1.939 |
| 9 | 176.92 | 186.62 | 206.5 | 9.7 | 0.342 | 19.88 | 0.648 | 29.58 | 1.285 |
| 10 | 366.63 | 354.94 | 464.27 | -11.69 | | 109.33 | | 97.64 | |
| **Overall Mean** | **106.35** | **109.49** | **127.81** | **3.14** | **0.563** | **18.32** | **2.781** | **21.46** | **3.176** |

AT2 : Urban Real Expenditure Decile means and Mean Differentials - Northern Towns 1994-1997

| Decile | Conditional Mean 94 ($\mu_{94}$) | Cond. Mean 95 ($\mu_{95}$) | Cond. Mean 97 ($\mu_{97}$) | $\mu_{95}-\mu_{94}$ | t-ratio | $\mu_{97}-\mu_{95}$ | t-ratio | $\mu_{97}-\mu_{94}$ | t-ratio |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 24.7 | 17.42 | 22.07 | -7.28 | -1.875 | 4.65 | 1.446 | -2.63 | -0.694 |
| 2 | 47.2 | 36.83 | 39.68 | -10.37 | -1.684 | 2.85 | 0.483 | -7.53 | -1.264 |
| 3 | 61.44 | 53.78 | 55.42 | -7.66 | -0.956 | 1.64 | 0.208 | -6.02 | -0.779 |
| 4 | 78.89 | 69.72 | 69.75 | -9.17 | -1.193 | 0.03 | 0.003 | -9.14 | -1.248 |
| 5 | 91.36 | 84.77 | 88.43 | -6.59 | -0.473 | 3.66 | 0.286 | -2.93 | -0.198 |
| 6 | 108.18 | 102.06 | 110.23 | -6.12 | -0.414 | 8.17 | 0.477 | 2.05 | 0.127 |
| 7 | 132.63 | 125.69 | 138.34 | -6.94 | -0.308 | 12.65 | 0.524 | 5.71 | 0.236 |
| 8 | 165.14 | 153.64 | 175.96 | -11.5 | -0.367 | 22.32 | 0.638 | 10.82 | 0.323 |
| 9 | 210.55 | 194.71 | 224.55 | -15.84 | -0.347 | 29.84 | 0.569 | 14 | 0.27 |
| 10 | 430.31 | 341.14 | 443.45 | -89.17 | | 102.31 | | 13.14 | |
| **Overall Mean** | **134.87** | **117.85** | **136.6** | **-17.02** | **1.655** | **18.75** | **1.844** | **1.73** | **0.168** |

AT3 : Urban real Expenditure Decile means and Mean Differentials - Southern Towns 1994-1997

| Decile | Conditional Mean 94 ($\mu_{94}$) | Cond. Mean 95 ($\mu_{95}$) | Cond. Mean 97 ($\mu_{97}$) | $\mu_{95}-\mu_{94}$ | t-ratio | $\mu_{97}-\mu_{95}$ | t-ratio | $\mu_{97}-\mu_{94}$ | t-ratio |
|---|---|---|---|---|---|---|---|---|---|
| 1 | 27.84 | 27.03 | 21.16 | -0.81 | -0.204 | -5.87 | -1.993 | -6.68 | -1.741 |
| 2 | 49.9 | 47.29 | 37.84 | -2.61 | -0.408 | -9.45 | -1.518 | -12.06 | -2.015 |
| 3 | 65.11 | 62.82 | 52.8 | -2.29 | -0.305 | -10.02 | -1.396 | -12.31 | -1.659 |
| 4 | 79.8 | 78.83 | 67.05 | -0.97 | -0.093 | -11.78 | -1.154 | -12.75 | -1.347 |
| 5 | 95.9 | 95.74 | 83.4 | -0.16 | -0.013 | -12.34 | -0.996 | -12.5 | -1.028 |
| 6 | 113.54 | 116.08 | 101.2 | 2.54 | 0.147 | -14.88 | -0.793 | -12.34 | -0.697 |
| 7 | 133.58 | 143.1 | 133.59 | 9.52 | 0.413 | -9.51 | -0.379 | 0.01 | -0.001 |
| 8 | 162.99 | 173.59 | 157.61 | 10.6 | 0.332 | -15.98 | -0.489 | -5.38 | -0.178 |
| 9 | 206.91 | 231.11 | 202.95 | 24.2 | 0.429 | -28.16 | -0.523 | -3.96 | -0.075 |
| 10 | 365.65 | 416.61 | 373.98 | 50.96 | | -42.63 | | 8.33 | |
| **Overall Mean** | **129.42** | **140.05** | **122.89** | **10.63** | **1.072** | **-17.16** | **-1.719** | **-6.53** | **-0.679** |

AT4: Real Expenditure Decile Mean Differentials - Addis Ababa and Northern Towns 1994-1997

| Decile | 1994 | | 1995 | | 1997 | |
|---|---|---|---|---|---|---|
| | $\mu_a - \mu_n$ | t-ratio | $\mu_a - \mu_n$ | t-ratio | $\mu_a - \mu_n$ | t-ratio |
| 1 | -5.75 | -1.641 | 3.91 | 1.395 | -1.02 | -0.359 |
| 2 | -14.42 | -2.84 | -0.91 | -0.18 | -3.13 | -0.617 |
| 3 | -17.87 | -2.797 | -6.12 | -0.919 | -7.14 | -1.055 |
| 4 | -24.03 | -4.601 | -10.73 | -1.366 | -7.37 | -0.913 |
| 5 | -24.19 | -1.905 | -15.32 | -1.571 | -12.74 | -1.265 |
| 6 | -29.62 | -2.589 | -18.46 | -1.394 | -16.9 | -1.218 |
| 7 | -36.9 | -1.958 | -22.42 | -1.191 | -19.01 | -0.966 |
| 8 | -37.96 | -1.397 | -20.49 | -0.768 | -25.26 | -0.927 |
| 9 | -33.63 | -0.846 | -8.09 | -0.198 | -18.05 | -0.426 |
| 10 | -63.68 | | 13.8 | | 20.82 | |
| Overall Mean | **-28.52** | **-3.34** | **-8.36** | **-1.364** | **-8.89** | **-1.131** |

AT5 : Real Expenditure Decile Mean Differentials - Addis Ababa and Southern Towns 1994-1997

| Decile | 1994 | | 1995 | | 1997 | |
|---|---|---|---|---|---|---|
| | $\mu_a - \mu_s$ | t-ratio | $\mu_a - \mu_s$ | t-ratio | $\mu_a - \mu_s$ | t-ratio |
| 1 | -8.89 | -2.567 | -5.7 | -2.28 | -0.11 | -0.046 |
| 2 | -17.12 | -3.635 | -11.37 | -2.248 | -1.29 | -0.278 |
| 3 | -21.54 | -3.662 | -15.16 | -2.691 | -4.52 | -0.784 |
| 4 | -24.94 | -3.265 | -19.84 | -2.349 | -4.67 | -0.619 |
| 5 | -28.73 | -3.067 | -26.29 | -2.713 | -7.71 | -0.773 |
| 6 | -34.98 | -2.84 | -32.48 | -2.315 | -7.87 | -0.509 |
| 7 | -37.85 | -2.24 | -39.83 | -2.092 | -14.26 | -0.681 |
| 8 | -35.81 | -1.496 | -40.44 | -1.475 | -6.91 | -0.262 |
| 9 | -29.99 | -0.681 | -44.49 | -0.983 | 3.55 | 0.082 |
| 10 | 0.98 | | -61.06 | | 88.29 | |
| Overall mean | **-23.07** | **-2.865** | **-30.56** | **-3.65** | **4.92** | **0.556** |

AT6: Real Expenditure Decile Mean Differentials
Addis Ababa and Northern and Southern Towns 1994-1997

| Decile | 1994 | | 1995 | | 1997 | |
|---|---|---|---|---|---|---|
| | $\mu_n - \mu_s$ | t-ratio | $\mu_n - \mu_s$ | t-ratio | $\mu_n - \mu_s$ | t-ratio |
| 1 | -3.14 | -0.668 | -9.61 | -2.856 | 0.91 | 0.284 |
| 2 | -2.7 | -0.419 | -10.46 | -1.56 | 1.84 | 0.296 |
| 3 | -3.67 | -0.452 | -9.04 | -1.118 | 2.62 | 0.327 |
| 4 | -0.91 | -0.114 | -9.11 | -0.85 | 2.7 | 0.278 |
| 5 | -4.54 | -0.306 | -10.97 | -0.868 | 5.03 | 0.404 |
| 6 | -5.36 | -0.347 | -14.02 | -0.789 | 9.03 | 0.497 |
| 7 | -0.95 | -0.041 | -17.41 | -0.712 | 4.75 | 0.190 |
| 8 | 2.15 | 0.067 | -19.95 | -0.59 | 18.35 | 0.572 |
| 9 | 3.64 | 0.07 | -36.4 | -0.676 | 21.6 | 0.431 |
| 10 | 68.36 | | -120.47 | | 69.47 | |
| Overall Mean | **5.45** | **0.553** | **-22.2** | **-2.5** | **13.71** | **1.419** |