Welfare Distribution in Rural and Urban Centres in Nigeria
A Stochastic Dominance Approach

Odozi J. C. ¹, T. T. Awoyemi¹; B. T. Omonona¹

¹Department of Agricultural Economics, University of Ibadan

Abstract

Policy makers are interested in knowing the welfare effect of the many development programmes implemented in rural centres in Nigeria. This study applied stochastic dominance approach to show whether the aggregate welfare in rural centres was better than in urban centres using the household survey data for Nigeria collected by the national Bureau of Statistics. The monetary approach of measuring welfare was adopted and consumption expenditure was chosen over household income following its practicability in a developing country context. Adjustments were also made so as to fit welfare distribution as much as possible. The main findings were that rural centres had better aggregate welfare only for the class of welfare function that is equity loving. For the class of welfare function that is equity and efficiency loving, aggregate welfare dominance of rural centres over urban centres was inconclusive. However, with further imposition of Pigou Dalton transfer condition using the generalized Lorenz curve, rural aggregate welfare showed dominance over urban aggregate welfare. This suggests that redistribution of incomes through rural development programmes may have much more effect on rural aggregate welfare.

Key words: Welfare, Stochastic Dominance, Income distribution, Efficiency

*Correspondence E-mail: chiwuzulum@yahoo.com; Telephone number: +234703538613

Introduction

Nigeria’s economy is broadly dichotomised into a large, rural, agriculture-based traditional centre (sector) that encompasses about two-third of the population living in squalor, and smaller, urban, capital-intensive centre. This pattern is visible in all the 36 states of the federation as well as the federal capital territory Abuja. Although the progression from an urban centre to rural centre traverses a continuum of settlement patterns, population and occupation, rural centres, as found in many African economies, is traditional, mostly of private agricultural activities that are characterised by small-scale, poor farmers and informal traders. The urban centres are characterised by capital intensive economic activities, few multinational firms, a multitude of small scale industries, and a myriad of government parastatals. The capital-intensive economic activities generate better returns; savings and higher income growth. Thus urban centres are highly favoured and promoted by government policies.
Be that as it may, policy bias in favour of urban centres has attracted much criticism both within and beyond Nigeria and in the last three decades, rural issues, problems, policies have been a persistent theme in the agenda of public policy initiatives. The whole idea is to achieve an appropriate broad based development pattern that is all inclusive and that strikes an acceptable balance between efficiency and equity objectives. In light of this, in the 1980s and through the 1990s, a number of rural development programmes were initiated to redistribute resources to rural centres in order to improve the aggregate welfare. Examples, include: The Directorate for Food, Road and Rural Infrastructure (DFFRI), Nigerian Agricultural Land Development Agency, (NALDA), Better Life Programme (BLP), Family Support Programme (FSP), Agricultural Development Programme (ADPs), Family Economic Advancement Programme (FEAP), Community Banks (CBs), People’s Bank of Nigeria (PBN), and National Economic Recovery Funds (NERFUND), which were instituted to bring about better welfare for rural dwellers (NISER, 2000). These efforts were also intensified at the start of another civilian administration in 1999 with the implementation of National Economic Empowerment Development Strategy (NEEDS) and Poverty Alleviation Programmes.

Knowledge of the effect of these programmes on the aggregate welfare of rural centres is important to government, policy advisers and the society who are generally concerned with welfare, poverty and inequality progress. Two general approaches in making statement regarding these concerns are the lifetime wealth approach of Atkinson (1983) hereafter referred to as ATK approach and the functioning and capabilities approach of Sen (1995) hereafter referred to as FCA approach. The ATK approach uses income and consumption as proxies for welfare while the FCA uses non monetary measures like health, education, infrastructure to make statement regarding the progress of welfare, poverty and inequality. The first approach is widely used by economist and does not have the problem of observation.

Secondly, many of FCA arguments are not directly observable and therefore knowing the appropriate aggregating function becomes difficult. Thus unidimensional comparison as against the multidimensional is the commonest approach in economics literature which this article adopts. However two basic empirical approaches to making unidimensional welfare, poverty and inequality comparisons are indices and stochastic dominance analysis. While much of the studies that had been done till date in Nigeria used income inequality and poverty indices such as the Gini coefficient and FGT to evaluate the progress of poverty and inequality, stochastic dominance analysis approach remains scanting in the existing welfare literature in Nigeria. Indices such as the Gini coefficient for example, though permit a complete ordering of distributions can give ambiguous results and are known to suffer from the lack of universal acceptance of the value judgments of the underlying welfare functions (Valenzuela and Lean, 2007). Contradicting conclusions can thus emerge and present problems for policy analysis and decision making.

Furthermore, inequality analysis is concerned with the dispersion of the income distribution while poverty considers only a censored portion of the income distribution; the population living below a certain minimum standard. Welfare analysis is broader and concerned with both the absolute income.
and the relative income of the distribution. (Litchfield, 1999). The application of stochastic dominance analysis has been growing and mostly used by authors in developed countries (Bishop, et al., 1992; Beach and Slotsve, 1994; Araar, 2007). Since the approach considers the dispersion (relative income) and the mean (absolute income) of the distribution simultaneously, it averts the arbitrary judgments about the success or failure of development programmes underlying studies that considered inequality and mean income separately. Also, a Parallel development in the use of this approach is the use of inferential statistics to test validity of results (Beach and Davidson, 1983; Bishop et al., 1992; Shimeles and Tadesse, 2005).

This paper examines both the absolute and relative mean income of rural and urban distributions in order to establish whether the aggregate welfare of rural centres was better in relation to urban centres in 2004. The paper proceeds as follows. The next section reviews the literature on stochastic dominance and its various approaches and application. The third section presents conceptual and analytical issues while the last section describes the results and discussion.

2. Literature review

Stochastic dominance analysis is a recent contribution in the field of income distribution analysis to analyse alternative distributions in terms of their means and dispersion using explicit normative consideration. (Bishop et al., 1992). It has received considerable attention in recent literature (See Barrett and Donald, 2003; Davidson and Duclos 2000). This form of analysis is useful for assessing progress towards eliminating poverty and for evaluating the effectiveness of various policy initiatives directed towards welfare improvement. The theoretical basis of the approach is the expected utility theory as revived by Von Neumann and Morgenstern (Bawa, 1982). The theory allows the expression of alternative distributions in the form of aggregate welfare function. The concept of aggregate welfare function makes it possible to rank or compare alternative distributions across time, and space. Precise specification of aggregate welfare function requires judgments about the relative utility of particular characteristics of income distributions such as mean income and the dispersion of income and the proportion of the population categorized as below a poverty line. Because such judgments will rarely be generally accepted, it has been useful to consider broad classes of aggregate welfare functions with a few restrictive assumptions that have more general acceptance.

When comparing two income distributions within this context, we say that one income distribution $X$ dominates another $Y$ if $X$ is preferred to $Y$ for all members of a particular class of aggregate welfare functions. Different classes of aggregate welfare functions with varying degrees of restrictive assumptions lead to consideration of alternative stochastic dominance relationships. Three types of stochastic dominance relationships common in the literature, are Lorenz dominance, generalized Lorenz dominance (second order stochastic dominance) and first order stochastic dominance. Bishop et al (1992) used the Lorenz curve, the generalized Lorenz curve and inferential statistics to assess if there was convergence over time of south and Non-south income distributions. Lorenz dominance is said to exist if the Lorenz curve for one distribution dominates that.
for another. Further, if the two income distributions have the same mean, then aggregate welfare\(^1\) in that distribution that Lorenz dominates is higher for the set of aggregate welfare function that is equity loving (Atkinson, 1970). However, Rothschild and Stiglitz (1973) suggested the introduction of efficiency preference to allow establishment of aggregate welfare\(^2\) dominance. Efficiency preference is a sufficient condition for aggregate welfare to be established and indicates that one distribution should have both a higher mean and higher Lorenz curve than another distribution. This means that the dominating distribution is that in which equity and efficiency preferences converge.

Shorrock (1983) pointed out that this sufficiency condition is unnecessarily strong and may preclude many important situations in which alternative distributions can be ranked. Thus he proposed the generalized Lorenz curve technique as an alternative which allows ranking of one distribution over another if that distribution has both a higher mean and higher Lorenz curve or a higher mean sufficient to compensate for a lower Lorenz curve. He further pointed out that it constitutes the first step in the evaluation of the distribution of welfare and can later on be supplemented by the choice of particular indices to resolve cases of inconclusiveness. The generalized Lorenz has been extensively used in practice for making welfare and inequality comparisons with a reasonable degree of success.

The generalized Lorenz curve is constructed by scaling the ordinary Lorenz curve by the mean of the distribution. Shorrocks (1983) compared the Lorenz curve and the generalized Lorenz curve in their conclusiveness in ranking alternative distributions using the distributional data for 20 countries. Using the sufficiency criteria or Lorenz curve ranking, there was intersection of Lorenz curves in at least 108 of the 190 pair wise comparisons. In 29 cases where Lorenz curves did not intersect, the country with the higher Lorenz curve had the lowest mean. Thus ranking countries only when one has both a higher Lorenz curve and a higher mean would produce conclusive results in just 28\% of the total possible pair wise ranking. For the generalized Lorenz curve ranking that is softening the sufficiency criteria, there was intersection in only 31 of the 190 possible pair wise comparisons and dominance was found to be conclusive in 84 percent of the cases. Tam and Zhang (1996), suggested that scaling up the Lorenz curve by a constant does not change the relative inequality in a distribution and as such rather than multiplying the ordinates of the Lorenz curve by the mean of the total distribution, they suggested the \(\beta\)-dominance criterion where \(\beta\) is one's preference for efficiency and ranges between 0 and 1. If \(\beta=1\), the \(\beta\)-dominance criterion reduces to the generalized Lorenz curve dominance.

Shimeles and Tadesse (2005) applied the Lorenz dominance, generalized Lorenz dominance and \(\beta\)-dominance criterion using panel data from 1994 to 1997 on household expenditure in Ethiopia. They found no clear difference of rural and urban welfare. Stochastic dominance approach is complemented by hypothesis testing for more robust ranking and has received considerable attention in literature(see

---

1 This dominance holds for social welfare function that is schur concave. This is also equivalent to equity preference assumption.

2 This dominance holds for social welfare functions that are non-decreasing and schur concave(Shorrock,1983)
for example, Barrett and Donald 2003, Davidson and Duclos, 2000; Beach and Davidson, 1983; Beach and Richmond, 1985; Araar, 2007). Beach and Davidson (1983) proposed the distribution-free statistical inference test. The advantage of this is that that they do not require knowledge of the underlying population distribution from which the sample income data was drawn. Bishop et al., (1992) documented the application of hypothesis testing using the union intersection test which is simple and easy to apply.

Araar (2007) advanced a theoretical framework to check the dominance of poverty and inequality using discrete data and also proposed stochastic dominance conditions that check for the statistical robustness of the inferred ranking. The methodology developed was applied to Burkina Faso’s household expenditure for the years 1994 and 1998. Chotikapanich and Griffiths (2006) used the Bayesian approach of testing dominance. This approach involves the comparison of two income distributions in terms of the posterior probabilities for each of three possible outcomes: (a) X dominates Y, (b) Y dominates X, and (c) neither X nor Y is dominant.

3. Methodology

3.1. Analytical framework

This section develops an analytical framework following shorrocks (1983), Beach and Davidson (1983) and Bishop et al., (1992) to examine the stochastic dominance relationship of the aggregate welfare between rural and urban centres. Assuming income or consumption expenditure X as a proxy for welfare and rural and urban income distributions are independent such that $X^{Rural}$ and $X^{Urban}$ represent rural and urban income X with corresponding cumulative distributions $F^{Rural}$ and $F^{Urban}$ that are continuous and differentiable to at least second order. Also the mean and variance of the random income variable X exist and is finite. All incomes are positive and households are identical in all aspect except their income. Rural and urban centres have population of households represented by N with incomes ordered from the smallest to the largest such that $x_1 < x_2 < \ldots < x_N$ and mean income denoted by $\mu$. From the forgone, empirical Lorenz curves $L^{Rural}$ and $L^{Urban}$ are generated and are characterised by a set of Lorenz ordinates $\{L_i; i = 1...k\}$ corresponding to the abscissae $\{P_i; i = 1...k\}$. Thus corresponding to a set of k abscissae $(P_1 < P_2 < \ldots < P_k)$, we have a set of k population income quantile functions $X(P_1) < X(P_2) < \ldots < X(P_k)$ and a set of k population Lorenz curve ordinates $L(P_1) < L(P_2) < \ldots < L(P_k)$. An income quantile function $X(p)$ corresponding to the abscissa $p$, while the Lorenz curve is the aggregate welfare level for the proportion of the population $P$ and it is implicitly defined as $F(X(p)) = p$ where $F$ is assumed to be monotonic.

The quantile function aggregates the $P^{th}$ quantile, having a population size, $(n_i)$, into a single number. This number is defined as the conditional mean income or group mean income. The conditional mean income is defined mathematically as $x_i = E(X|X < X(P_i))$, and estimated as $\hat{x}_i = \left(\frac{1}{n} \sum_{j=1}^{n} X_{(j)}\right)$ where $X_{(j)}$ is the sample order statistics and the sum is over the $n_i$ observations in the $i^{th}$ group. While the Lorenz curve ordinate is defined as $L(p_i) = p_i \frac{x_i}{\mu}$ the Lorenz ordinate is estimated as $\hat{L} = p_i \frac{\hat{x}_i}{\hat{\mu}}$. 

38
where $\bar{\mu} = (1/N)\sum_{i=1}^{N} x_i$ is the mean income of the sample size $N$. From the above, corresponding to a vector of $k$ abscissae $(P_i)$ we have a vector of $k$ population conditional mean income groups estimates $(\hat{x_i}, ..., \hat{x_k})_{rural}$ and a vector of $k$ Lorenz ordinates groups estimates $(\hat{L_i}, ..., \hat{L_k})_{rural}$.

In testing for dominance it is common practice to divide the process into two stages (Shorrock, 1983). In the first stage, if it is established that the two income distributions have the same mean, rural welfare dominates urban welfare $W_{rural} \geq W_{urban}$ for all set of welfare function that is equity loving {i.e Schur-concave $W()$} if and only if rural Lorenz curve is higher than urban Lorenz curve ($L_{rural} \geq L_{urban}$) for all $p$.

In the second stage we introduce the efficiency preference. Rural welfare dominates urban welfare $W_{rural} \geq W_{urban}$ for all set of welfare function that is equity and higher income loving (non-decreasing-Schur concave welfare functions). This means that the sufficient condition for welfare dominance to hold is that rural income distribution has both a higher mean and a higher Lorenz curve or vice versa. {i.e. $X_{rural}(p) \geq X_{urban}(p)$ for all $p \in [0,1]$ and $L_{rural} \geq L_{urban}$ for all $p$ or vice versa}. In a situation where these conditions become too strong to allow ranking, the generalized Lorenz curve is employed by scaling the Lorenz curve by the mean of the income distribution (Shorrock, 1983). Generalized Lorenz curve is defined as $GL(p) = \mu L(p)$ for all $p \in [0,1]$, and so rural welfare dominates urban welfare for all welfare function that belong to the set of non-decreasing schur-concave welfare function if

$$GL^{rural}(p) \geq GL^{urban}(p)$$

To complement the analysis inferential statistics is used to test if the corresponding conditional mean income for the rural area is significantly different from that of the urban area. We follow the union intersection test as used in Bishop et al., (1992). The test statistic is:

$$T_i = \frac{\hat{x_i}_{rural} - \hat{x_i}_{urban}}{\sigma_{rural} / N_{rural} + \sigma_{urban} / N_{urban}}$$

Where

$T_i =$Test statistic

$\hat{x_i} =$ conditional mean or average absolute income

$\sigma_u / N =$ Standard Deviation

The studentized maximum modulus variate with $k$ and infinite degrees of freedom is used to test for significance. For deciles, the $5\%$ critical value is 2.80, and the $1\%$ critical value is 3.29.

3.2. Data

Secondary data from 2004 Nigeria Living Standard Survey, collected by the National Bureau of Statistics, were used. Data obtained were on 19158 households. The reason for this choice is that it is the only comprehensive and professionally collected data made available for public use. The data can also be disaggregated by rural and urban sub-population groups. Stratified random sampling technique was employed for its collection and in each state of the federation, 120 census enumeration areas (EAs) were randomly selected. We used consumption expenditure as welfare indicator and it is the sum total of expenditure on household own produced food, purchased food, health, education, housing, non food expenses on frequently purchased items and none food expenses on less frequently
purchased items. Further adjustment was made on total household expenditure by adult equivalent scale and by consumer price index to reflect household size and composition and also regional price differences.

4. Results and discussion

Table 1 shows the conditional mean income for rural and urban centres and the test statistic. The conditional means are arranged from the first decile to the last decile where each decile represents 10 per cent of the population. Three points can be inferred from the table: first, excluding the test statistic, the conditional mean income across all deciles for rural centres is lower than the conditional mean incomes for urban centres; Second, for rural centres the conditional mean income per month for the last and first deciles, representing richest and poorest 10% of the population respectively are N10, 420 and N596 while for urban centres, the conditional mean income per month is N11, 332 and N627 respectively. This implies a wide gap in absolute mean income between the richest and the poorest 10%. However, to substantiate this fact, test statistics were employed to test for significant differences across deciles. The T-test is shown in column 3 of Table 1 which reveals no difference between rural and urban conditional mean incomes across all the deciles at 5% and 1% significant levels. Bishop et al., (1992) documented that if we fail to reject the null hypothesis at all deciles, then we fail to reject the overall null hypothesis and we rank the two distributions as equal. This implies that rural and urban income distributions have the same mean. This is clearly depicted in figure 1 showing the intersection of the two distributions.

### Table 1: Conditional mean income for rural and urban centres

<table>
<thead>
<tr>
<th>Deciles</th>
<th>Rural centre</th>
<th>Urban centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>596.95</td>
<td>627.60</td>
</tr>
<tr>
<td>2</td>
<td>1075.37</td>
<td>1090.62</td>
</tr>
<tr>
<td>3</td>
<td>1452.25</td>
<td>1470.88</td>
</tr>
<tr>
<td>4</td>
<td>1813.93</td>
<td>1820.39</td>
</tr>
<tr>
<td>5</td>
<td>2194.39</td>
<td>2199.45</td>
</tr>
<tr>
<td>6</td>
<td>2636.31</td>
<td>2651.69</td>
</tr>
<tr>
<td>7</td>
<td>3216.68</td>
<td>3238.30</td>
</tr>
<tr>
<td>8</td>
<td>4007.50</td>
<td>4021.43</td>
</tr>
<tr>
<td>9</td>
<td>5305.66</td>
<td>5313.80</td>
</tr>
<tr>
<td>10</td>
<td>10420.2</td>
<td>11332.72</td>
</tr>
<tr>
<td>Total</td>
<td>3063.554</td>
<td>4160.916</td>
</tr>
</tbody>
</table>

* T > 2.8 is significant at 5% level of significance, ** T > 3.29 is significant at 1% level of significance
Table 2: Lorenze ordinates for rural and urban centres

<table>
<thead>
<tr>
<th>Deciles</th>
<th>Rural centre</th>
<th>Urban centre</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2.05</td>
<td>1.43</td>
</tr>
<tr>
<td>2</td>
<td>3.57</td>
<td>2.58</td>
</tr>
<tr>
<td>3</td>
<td>4.74</td>
<td>3.53</td>
</tr>
<tr>
<td>4</td>
<td>5.92</td>
<td>4.356</td>
</tr>
<tr>
<td>5</td>
<td>7.18</td>
<td>5.27</td>
</tr>
<tr>
<td>6</td>
<td>8.60</td>
<td>6.37</td>
</tr>
<tr>
<td>7</td>
<td>10.50</td>
<td>7.78</td>
</tr>
<tr>
<td>8</td>
<td>13.08</td>
<td>9.66</td>
</tr>
<tr>
<td>9</td>
<td>17.32</td>
<td>12.77</td>
</tr>
<tr>
<td>10</td>
<td>34.01</td>
<td>27.23</td>
</tr>
</tbody>
</table>

higher than urban Lorenz curve implying a better income inequality than urban inequality. Therefore, rural aggregate welfare dominates urban welfare for all social welfare function that is equity loving or schur concave. However, for all welfare function that is equity and efficiency loving (non-decreasing schur concave), the dominance of rural aggregate welfare over urban is said to be inconclusive.

To conclusively rank the distributions, we employed the generalized Lorenz dominance. This simply means scaling up the Lorenz values with the mean of the distribution (Shorrocks, 1983). The new values are shown in Table 3. As the table shows, there are clear differences across deciles and they are all significant at 5% and 1% except for the first and second deciles. This suggests that the mean for rural income distribution is significantly higher than the mean for urban income distribution. Therefore rural aggregate welfare dominates urban welfare for all social welfare function that is non-decreasing schur concave. The implication for policy is that increased investment through programmes and projects aimed at increasing incomes of households in rural centres may have much more effect on aggregate welfare than similar investments in urban centres.

Figure 2: Rural and urban household consumption Lorenz values by deciles

Table 2 shows the Lorenz curve ordinates for both rural and urban centres and also the Lorenz curves as shown in figure 2. These ordinates also represent the relative income. As the figure shows, rural Lorenz curve is
Table 4: Conditional mean income per month in naira (₦)

<table>
<thead>
<tr>
<th>Deciles</th>
<th>Rural</th>
<th>Urban</th>
<th>t-statistic</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>678.70</td>
<td>473.44</td>
<td>1.01</td>
</tr>
<tr>
<td>2</td>
<td>1181.94</td>
<td>854.17</td>
<td>2.54</td>
</tr>
<tr>
<td>3</td>
<td>1569.30</td>
<td>1168.69</td>
<td>4.21*</td>
</tr>
<tr>
<td>4</td>
<td>1959.96</td>
<td>1442.16</td>
<td>7.55*</td>
</tr>
<tr>
<td>5</td>
<td>2377.12</td>
<td>1744.77</td>
<td>13.60*</td>
</tr>
<tr>
<td>6</td>
<td>2847.25</td>
<td>2108.95</td>
<td>28.49*</td>
</tr>
<tr>
<td>7</td>
<td>3476.29</td>
<td>2575.76</td>
<td>241.28*</td>
</tr>
<tr>
<td>8</td>
<td>4330.46</td>
<td>3198.18</td>
<td>54.54*</td>
</tr>
<tr>
<td>9</td>
<td>5734.22</td>
<td>4227.83</td>
<td>28.85*</td>
</tr>
<tr>
<td>10</td>
<td>11259.86</td>
<td>9015.17</td>
<td>14.34</td>
</tr>
</tbody>
</table>

*T = >2.8 is significant at 5%; **T = >3.29 is significant at 1%*

5. Conclusion

Rural issues, rural problems, and rural policies have been a persistent theme in the agenda of public policy initiatives over the past three decades. For example, the 1980s through the 1990s and the earliest part of the 2000s witnessed a number of rural development programmes in Nigeria. To relate the effect of these programmes on the level of aggregate welfare experienced by households in rural and urban centres, income distributional analysis is often employed. This study applied stochastic dominance analysis to rank rural and urban aggregate welfare at a point in time using the household survey data for Nigeria collected by the national Bureau of Statistics. The welfarist approach of measuring welfare was adopted and consumption expenditure was chosen over household income following its practicability in a developing country context. Adjustments were also made so as to fit welfare distribution as much as possible. The main findings are as follows: Although rural income distribution was better, there was no significant difference between rural mean income and urban mean income and as such rural aggregate welfare dominance over urban welfare was
inconclusive. However, imposing the condition of transfer using the generalized Lorenz curve, rural aggregate welfare showed dominance over urban welfare for all welfare functions that are equity loving and efficiency loving. This suggests that increases in the incomes of households through development programmes may have much more effect on rural aggregate welfare than for urban. The policy implication is that increases in the incomes of the very poor may have much more effect on aggregate welfare than similar increases for those already better off. For further research this study suggests over time comparison using a panel household data and a general equilibrium analysis to elucidate winners and losers across sub-population groups.

References


