BLUE

TW
FS C
024

PATTERNS OF INCOME INEQUALITY IN ETHIOPIA

BY

Bereket Kebede
Department of Economics
Addis Ababa University
and
Abebe Shimeles
ACTIONAID-Ethiopia

CCRDA

Paper Presented at the Workshop on

"Poverty and Income Distribution
Issues in Ethiopia During Adjustment"

Organised By

ACTIONAID-ETHIOPIA
CARE-ETHIOPIA
OXFAM-UK
RADA BARNA
REDD BARNEN
SAVE THE CHILDREN FUND-UK

Sponsored By

UNDP
24 September 1997
International Livestock Center Conference Hall

Abstract:This paper attempts to measure the degree of income inequality in rural Ethiopia between 1980 and 1994 on the basis of available household budget studies by The Central Statistical Authority. A comparison is made with an alternative data sets produced by the Department of Economics in collaboration with the Centre for African Economic Studies, Oxford University. Further, the paper illustrates the effect of inflationary processes on the distribution of income using parameter estimates from an expenditure system on the basis of data for Addis Ababa.

1.Introduction

Interest in issues of income distribution in Ethiopia has not received so far the attention it truly deserved in the policy discussion and empirical investigation. One of the reasons is the lack of or paucity of data on income distribution at the national level. But, since the 1980s there have been a number of household budget surveys that can be used for the purpose of understanding and analysing income distribution issues.

It is well known that various theories of economic growth have tried to explain constraints to growth and development from the distributional perspective. Particularly, the now widely implemented economic policy through out the developing world, that is, Structural Adjustment Programmes, is built partly on the variety of growth model that hinges upon savings as one binding constraint to economic growth. On the other hand, savings are partly determined by the rate of marginal propensity to save of households belonging to different income groups. Thus, the underlying income distribution has enormous implications to saving formation and hence economic growth.

In addition, the seminal contribution by Kuznets (1962, 1955) on the implication of economic growth to income inequality spurred a prolific empirical work in the literature. In what was later to be called the Kuznets Process, it was asserted that at initial level of economic growth, the rate at which economic growth takes place severs the degree of income inequality and at a later stage of growth, income inequality declines. This proposition was alternatively dubbed the inverted-U curve hypothesis.

The empirical validity of the Kuznets Process has been a subject of intense debate in the literature. However, recently, the debate seems to have settled with the result that the Kunets Process cannot be as such considered as an empirical phenomenon and if fact such thing does not exist. However, the lack of sufficient evidence to support the relationships between growth and inequality cannot lead to the reverse conclusion, that income inequality improves with growth or emphasising on economic growth may not matter to income inequality.

In fact, countries at the lower stage of economic development may find it puzzling how to reconcile the objectives of economic growth and poverty alleviation in a situation of initial

CCRDA

high income inequality. It becomes a daunting exercise to subscribe to what the World Bank recently called "pro-poor" or a "win-win" path of growth.

This paper highlights the pattern of income inequality in Ethiopia on the basis of budget surveys conducted by the CSA for rural households and is organised as follows. Section II reviews in brief the policy and measurement issues concerning growth and inequality. Section III attempts to compare the degree of income inequality between two periods: 1980 and 1994 using published income distribution data sets by the CSA. An alternative estimate of income inequality is made using the integrated rural household survey by the Department of Economics in collaboration with Oxford University. Section IV of the paper investigates the relationships among income inequality, expenditure patterns and inflationary processes for available data sets. Section V is summary and conclusions.

II. Income Inequality: Policy and Measurement Issues

The concern over income inequality has been a subject of controversy over the last five decades in the development literature. The most relevant issues for countries such as Ethiopia are the question how existing level of income inequality can affect economic growth and how economic growth in turn affects the degree of income inequality. These issues have been treated quite exhaustively in the large body of the literature that started to appear since the 1950s. The accumulated empirical work and evidence did not however render clarity, rather increased the complexities involved in the subject.

We may summarize the controversies in the literature concerning growth and distribution into those which establish a vicious circle between inequality and economic growth and those who illustrate a virtuous circle on the basis of re-examination of the economic history of USA and Britain in the early 19th century (eg. Meier, 1995) and the performance of East Asian countries (World Bank, 1993).

The proponents of vicious circle between inequality and economic growth assert that there is an inherent trade-off between inequality and economic growth. Higher inequality can lead to higher economic growth through higher concentration of savings and thus formation of reproducible physical capital. On the other hand, higher economic growth leads initially to higher income inequality, following the Kuznets process. Thus, one can achieve faster and higher economic growth if prepared to face worsening of income inequality. A further extension of the debate is that of the role economic growth plays in reducing poverty and thus inequality (known as the "trickle-down" assertion) and the "immizerising of growth" which asserts that increased prosperity has been accompanied by increased polarization and marginalisation of the poor, that is the rich grow richer and the poor get poorer (see Fields, 1997 for a succinct account of the debate).

The weight of the evidence that is accumulating in recent periods indicate the lack of any concrete relationships between income inequality and economic growth. It is neither necessary to have higher inequality to spur faster economic growth nor higher inequality to follow spells of economic growth (references).

Work for the African region started to come out quite recently and most of them point out the positive effect of economic growth in reducing poverty and the inconclusive direction in

CSRDA

which it affects income inequality (say more).

The policy implications however of the issue of income inequality and economic growth cannot be paled by the lack of consensus on the exact nature of the causation. Depending on the specific factors working in each country the issues of income inequality and economic growth remain to be of primary concern of policy makers in delivering an efficient and equitable economic process.

The controversies in the link between growth and inequality lies less in the theoretical construct than in the empirical findings which are significantly affected on the method of estimation and the specific type of inequality measurement used.

Early works used to approximate the degree of income inequality on the basis of an index that measures relative dispersion of income distribution among the population in a given year or period. Largely the measures chosen were statistical frequency distributions free of value judgments, like income shares of x% of the poorest or richest population, etc.. But, the lack of intuitive interpretations in making welfare comparisons out of these inequality measures led to the search for complicated indices, like the variance of the logarithm of the income distribution, the Gini-index, Theil's class of enthropy measures, Atkinson's inequality index, etc.[1]

The inequality indices on the other hand have a value judgement inherent in their construction when they measure a given income distribution. For instance, indices like the Gini-coefficient consider every additional income earned by the poor and the rich equally, thus ranking income distributions say from the variance of the logarithm of income which offers different weights to people in different ladder of the income distribution. As a result, income inequality indices rank income distribution differently. The axiomatic development of income inequality measures (Sen 1973, Atkinson, 1970) subsequently offered insights into the desirable properties that need to be met by an inequality index.[2]

Among inequality measurement indices, the Gini coefficient remain to be one of the most popular and frequently applied measures of inequality in the literature. Its attraction lies in the fact that it can be read off the Lorenz curve a popular summary measure that can make a partial ordering of income distributions by setting a reference point of absolute equality.

Recent efforts to further characterise welfare levels through Lorenz curves succeeded in incorporating social-welfare functions into which one could conveniently pitch comparisons of wellbeing. The works of Shorrocks, Anthony F. (1980, 1983) [Ranking Income Distributions]. Economica, 50, 3-17] and Sapsonic (1983) made a significant contribution in developing the methodology of Lorenz Dominance to rank income distributions, which later became a powerful tool even to rank poverty levels when the measurement of poverty lines are fraught with measurement errors.

---

[1]See Chenery, et al (1976), Anand (1980), Kakwani (1980), Haggenars (1987) and Blackwood and Lynch (1994) for the details of the theoretical and empirical properties of the various inequality measures introduced in the literature.

[2]Properties like monotoncity, symmetry, anonymity, etc..

CCRDA

The statistical inferences from Lorenz curves for testing dominance have been developed in the works of Beach and Davidson (1983) and Beach and Kaliski (1986) so that one can use micro-data on income distribution without recourse to specifying income distribution function.

Section III:Empirical Results

This study derives the inequality measure of the Gini-coefficient by specifying an underlying distribution function since the data used is grouped data from the publication of the Central Statistical Authority (1988,1994) and expenditure decile computed from the integrated Rural Household Survey conducted by the Department of Economics and Centre for The Study of African Economies.

The fitted functions are the popular Beta function and the Generalized Quadratic Lorenz functions and the Beta Lorenz functions specified respectively as :

$$L(p) = p - \theta p^{\gamma}(1-p)^{\delta}$$

where, p and L(p) represent respectively the ordinate and absicca of the Lorenz function or the cumulative percentage of the population and the cumulative income share accruing to the corresponding population. The rest are constant parameters;

$$L(1-L) = a(p^2-L) + bL(p-1) + c(p-1)$$

$$L(p) = -[bp+e+(mp^2+np+e^2)^{1/2}]/2m$$

$$\text{where, } e = -(a+b+c+1)$$

$$m = b^2 - 4a$$

$$n = 2be - 4c$$

The estimation of the parametrized Lorenz functions of the Beta and the GQ have been greatly facilitated by a POVCAL computer programme[3] developed at the World Bank. Appendix 1 reports the full detail of the estimated parameters and the associated Gini-Coefficients. The exercise also offers the elasticity of poverty indices with respect to mean

[3]The Beta Lorenz function was first introduced by Kakwani (1980) and the Generalized Quadratic form is suggested by Villasenor and Arnoid (1989).The POVCAL computer programme is developed by Chen, Datt and Ravallion in the World Bank.

CCRDA

income and the Gini-coefficient for alternative poverty lines to highlight the degree of responsiveness of the slope of the Lorenz curve to growth in mean income and reduction in income inequality. The results of the regression indicated that both functional forms are valid though the GQ fits the data well for the 1994 budget survey and the Beta function for the 1980 survey.

According to the estimates of the Gini-coefficient in both functional specification and for both years indicate a relatively lower level of income inequality than what one might have expected in such a poor economy, around 20.7% in 1994 and 19.8% for 1980. The growth in real income of the rural households has not been computed but indications are that the level of real mean income increased between 1980 and 1994; with a worsening of income inequality as measured by the Gini-coefficient.

Of course, these results may have to be qualified for what they are not able to reveal because of the aggregation involved. Most serious is the fact that the estimation of the Lorenz parameters assumes equal distribution of income within each income class. Secondly, demographic factors such as household size have not been squarely addressed in constructing the income classes. Thirdly, there is the question of sampling error between the two surveys, even though the methodology employed is exactly the same. Given this limitations, it was felt instructive to compare with a rather more comprehensive data that has the opportunity of comparing the estimated Gini-coefficient with the "true" Gini computed from the individual household data.

On the other hand estimates of income inequality based on the integrated household survey conducted by the Department of Economics, jointly with the Center for African Economies, Oxford University, offered a complete different picture. The estimated Gini-coefficient for 1994 period for rural Ethiopia was 59%, which is close to various estimates available for countries in SSA. In addition, the relative poverty measure, where the poverty line was set at 2/3 of mean income was 50%. In addition, the elasticity of poverty with respect to mean income and level of income inequality indicated the rather competing objectives. If the rural sector experiences a 10% growth, poverty declines by about 6% due to existing inequality.

Thus, comparison of the two data sets revealed that the quality of data available is an essential component of any analysis concerned with poverty and inequality. With the same data sets it has been observed that between 1980-1994, income inequality increased with mean income in rural Ethiopia. This poses for further research as indicated in the review of the literature.

CCRDA

IV. Inflation and Income Inequality

The fact that households belonging to different income classes experience changes in their wellbeing of varying degrees following an inflationary process led to a large amount of empirical and theoretical works. Notably, the question that which groups of households suffer most because of an inflationary process, and following this how should government react to mute the dire consequences remain puzzling in the absence of some empirical evidence.

Early studies focused on the formulation of common statistical price indices to measure the rate of inflation without recourse to some theoretical framework. The concept of index numbers, as it has become to be known eventually, introduced the Pasche and Lasperyes price indices to measure the cost of living in general. On the theoretical side, the argument over forced saving through a deliberate inflationary policy was also gaining currency as a growth strategy to developing countries[4] What was indeed missing was a systematic measure of an inflationary process that has strong empirical appeal to various issues related to welfare. The notions of equivalent and compensated variations reduced from expenditure functions offered the neoclassical synthesis a strong empirical relevance in the analysis of cost of living and its impact on welfare of households. Extensive discussion of these concepts is found in Deaton and Muellbauer (1980), and Green (1976). Empirical application of this approach presupposes the estimation of separate demand systems for each household belonging to different income groups. Once this is done, the evaluation of the "true cost of living " follows as an extension of the duality theory characterizing neo-classical demand systems whereby a gain or loss in welfare may be compared for different categories of households.

Though consistent in terms of economic theory, estimation of demand systems requires a data set generated from expenditure survey with complete price series data, a kind that is severely lacking in Ethiopia. Demand systems with reasonably large amount of information on preference structures and price responses by individual consumers could not be estimated econometrically because of the severity in degrees of freedom allowed by the available data sets, In addition, the effect of households' composition and size on the estimates of the underlying demand systems shall have to be treated explicitly to take care of aggregation problem.

On the other hand, the Gini coefficient measure of income inequality brought out an important link with that of expenditure elasticities. As a result, Engel functions of various specification used to go around this apparently formidable barrier.

Kakwani(1980) proved the following important corollary regarding the relationship between the Gini index, G, of a random variable x, and the Gini index of the linear function $(a+bx)$, G^*, for $b>0$. It can be shown easily that this will result in:

---

[4]This is a view still widely held by proponents of the Structuralist approach to the macroeconomics of Least Developed Countries.

CCRDA

$$G = \frac{b\mu G^{*}}{a+b\mu} \quad \ldots\ldots\ldots (1)$$

where $E(x) = \mu$

Since Engel functions establish a functional relationship between income, and expenditure on the its commodity,it follows then that for demand system appropriately linear in income, (i.e., linear Engel curves), it is possible to establish a link between the Gini index for income, and Giniindex for expenditure. The Extended Linear Expenditure System (ELES) is one of the demand systems that can be easily expressed in terms of the Gini index and in the Ethiopian case its parameters have been estimated by Abebe (1993) for Addis Ababa and Rural households. The ELES was introduced by Lluch (1974), while its empirical importance to cases where one cross-section is available is developed by Howe (1975). Lluch, et al. (1977) applied extensively the ELES to households living in developing countries to examine expenditure patterns. The empirical attraction of ELES is the ease with which one can estimate all parameters from just one cross-section budget study if information on savings is available. In fact, the identification problem plagues the process of estimating demand systems in countries where budget studies corresponding to a few years are available. In this context, it is important to point the attempts of Howe (1975), Bettencourt (1977), Kakwani (1980), and Pollak and Wales (1978) who respectively used, savings, leisure, the Gini index, and two period prices to identify all the parameters of the popular Linear Expenditure Systems (LES). It would indeed be an interesting exercise to make a comparison of all these alternatives empirically to learn more about the relative importance of these factors in the structure of preferences.

The ELES belong to the family of the Linear Expenditure System originally suggested by Stone (1954), which is derived from the Stone-Gear, or Rubin-Klein type of utility function of the form:

$$U(x_1, \ldots, x_n) = \sum_{i=1}^{n} \beta_i \ln(x_i - \gamma i) : \sum_{i=1}^{n} \beta_i = 1 \quad \ldots\ldots\ldots (2)$$

U( ) is a utility function of an individual consumer defined over exhaustive set of x_i commodities. B_i stands for marginal budget shares, which is a constant, and γ_i is a term which represents the "subsistence" level of consumption"[5].

[5]see Abebe (1993) for the detailed properties of this utility function.

CCRDA

The indirect utility function corresponding to (2) is given by the Roy's identity which is:

$$v(P,y)=\sum_{i=1}^{n}\beta_i[\ln\beta_i(y-\sum_{k=1}^{n}p_k\gamma_k)]\,,\ldots\ldots\ldots\ldots(3)$$

P represents a vector of commodity prices $p_1,\ldots,p_n$ and y is income of the consumer. The change in utility following a new set of prices, with the level of income remaining unchanged is:

$$\Delta V=\ln(y^*-a^*)-\ln(y-a)-\sum_{i=1}^{n}\beta_i(\ln p_i^*-\ln p_i)\,,\ldots\ldots\ldots(4)$$

$$where,\ a^*=\sum_{i=1}^{n}p_i^*\gamma_i$$

we assume utility to remain invariant to the new set of prices, then we may solve for the total amount of expenditure needed to secure this. This will be:

$$y^*=a^*+(y-a)\prod_{i=1}^{n}(p_i^*/p_i)^{\beta_i}\,,\ldots\ldots\ldots\ldots(5)$$

The link established between the parameters of the ELES and the Gini-coefficient by Kakwani (1980) offers an opportunity to see whether or not over all income inequality increased or decreased following an inflationary process.

$$G_R=\frac{\prod_{i=1}^{n}(p_i^*/p_i)^{\beta_i}m^*G^*}{a^*+(m^*-a)\prod_{i=1}^{n}(p_i^*/p_i)^{\beta_i}}\,,\ldots\ldots(6)$$

CCRDA

This can be shown by noting the theorem that if G_R represents the Gini index of the real expenditure y.at the new prices, then,where m^* and G^* represent the mean and the Gini index of total expenditure, respectively, in the base year. A slight manipulation of equation (6) and using equation (5) we can show that :

$$\frac{G_r}{G} \geq 1 \text{ as } \frac{\sum_{i=1}^{n} p_i^* \gamma_i}{\sum_{i=1}^{n} p_i \gamma i} \leq \prod_{i=1}^{n} (p_i^*/p_i)^{b_i}$$

Therefore, real-expenditure Gini index deviates from the real-expenditure Gini index by the proportion of the deviation of super-numerary expenditure ratio to subsistence expenditure ratio. The interpretation is straight-forward. If price changes induce greater expenditure ratio in subsistence consumption rather than in non-subsistence one, then, income inequality widens due to an inflationary process; in the reverse case, income inequality improves.

The numerical results on the new index of income inequality, based on the Addis Ababa Household Budget Study[6] are presented in Table 1. The number of commodities covered are 7 whose parameters have been estimated by Abebe (1993) for the Linear Expenditure System specification.

CCRDA

[6]see Central Statistical Office (1984) for details on the nature of the data set and the methodology employed. Also see Abebe (1993), op cit, pp.17

Table 1. Index of Income Inequality, Addis Ababa, 1980-1990.

year	$\frac{\sum p_i^* \gamma_i}{\sum p_i \gamma_i}$	$\prod [(p^*_i / p_i)]^{\beta_i}$	Inequality Index
1980	1	1	1
1981	1.141	1.116	.9853
1982	1.21	1.173	.979
1983	1.184	1.158	.929
1984	1.288	1.22	.964
1985	1.507	1.36	.932
1986	1.389	1.186	.896
1987*	1.382	1.223	.919
1988	1.474	1.41	.970
1989	1.6	1.506	.96
1990*	1.628	1.515	.952

* Price index for the Third Quarter

CCRDA

The table indicates that index of inequality declined consistently through out the period for Addis Ababa implying worsening of income inequality as a result of changes in relative prices alone. The situation is marked in 1984, where the Gini index of real expenditure would be higher than the Gini index of actual money expenditure by about 1.12 per cent. Therefore inflation hit hard more those people found at the lower end of the income distribution as compared to those at the upper end. Inflation is considered income distribution neutral if the inequality index is uniformly equal to unity.

V. Summary and Conclusions

Issues of income inequality and economic growth are relevant policy issues in the context of the Economic Reform being pursued by the government. This paper attempted to look at the pattern of income inequality between two periods in rural Ethiopia. Results showed an overall lower level of inequality when published data sets of the CSA are used. Over this period, the Gini-coefficient increased for various functional forms of the Lorenz curve, with real mean income of rural households increasing. An alternative data sets revealed a significantly higher income inequality in rural Ethiopia and massive relative poverty. In addition, the prospect for poverty alleviation hinges on the initial condition of income inequality and economic growth.

Investigations of the effect of inflation on households in Addis Ababa showed that the poor had been significantly affected during 1980-1990 period even though a wide range of commodities were ostensibly under subsidy. The methodology can be used on current data to further examine how adjustment measures affected prices and thus wellbeing of the poor.

CCRDA

SELECTED REFERENCES

Abebe, S.,1993, Systems of Demand Equations:Theory and Applications, Ethiopian Journal of Economics, Vol.II, No.2, 1-54

Anand, S., 1983, Inequality and Poverty in Malysia, Oxford:Oxford University Press

Atkinson, A.B., On the Measurement of Income Inequality, Journal of Economic Theory 2:244-263.

Beach, C.M, and Davidson, R., 1983, Distribution-Free statistical inference with Lorenz curves and income shares, Review of Economic Studies, 50, 723-735.

Beach, C.M, and Kaliski, S.F, 1986, Lorenz Curve Inference with Sample Weights:an Application to the Distribution of Unemployment Experience, Applied Statisitcs, 35, No., 1, 38-45

Blackwood, D.L., and Lynch, R.G., 1994, The Measurement of Inequality and Poverty:A Policy Maker's Guide to the Literature, World Development, vol 22, No.4, 567-578.

Central Statistics Office, 1984, Report on The Household Energy Consumption Survey of Addis Ababa, 1979/80, Statistical Bulletin 40

Central Statistics Authority (1988), Rural Households Income, Consumption and Expenditure Survey, Statistical Bulletin 61.

Chenery, H., Ahluwalia, M., Bell, C., C., Duloy, J. and Jolly, R., 1974, Redistribution with Growth, Oxford:Oxford University Press.

Deaton, A.S., 1981, Optimal Taxes and The Structure of Preferences, Econometrica, Vol.49, 1245-1260

Fields, G., 1997, Poverty, Inequality and Economic Well-being:African Economic Growth In Comparative Perspective, Unpublished

Green H.A.J., 1976, Consumer Theory, Second Edition, New York, Macmillan Publishers

Howe, H., 1975, Development of The Extended Linear Expenditure System From Simple Saving Assumptions, European Economic Review,6, 305-359

Kakwani, N., 1980 Income Inequality, and Poverty: Methods of Estimation and Policy Applications, Oxford University Press

CCRDA

Kuznets, S, 1955, Economic Growth and Income Inequality, American Economic Review, 45:1-28.

Lluch, 1994, The extended Linear Expenditure System, European Economic Review, 4, 18, 21-23

Lluch, C., A.A. Powell, and R.A. williams, 1977, Patterns In Household Demand and Saving, Oxford University Press.

Meier, G.M., 1995, Leading Issues in Development, Oxfrod University Press.

National Bank of Ethiopia (1989/90), Quarterly Bulletin, Vol.5, No.3, Phied Quarter.

Pollak, R.A., and Wales,T.J., (1978), Estimation of Complete Demand Systems From Household Budget Data: The Linear Expenditure System and Quadratic Expenditure Systems, American Revies,68, 348-359.

Shorrocks, A.F, 1983, Ranking Income Distributions, Economica, 50, 3-17

Sen, A. K., 1973, On Economic Inequality, Oxford University Press

Stone,R., (1954), The Linear Expenditure System and Demand Analysis: An Application to The Pattern Of British Demand, The Economic Journal, 64, 511-527.

World Bank, 1993, The East-Asian Miracle

CCRDA

APPENDIX

Summary Results of The Estimation of Parametrized Lorenz Functions

THE DATA SET IS csa2 (1994 Rural Budget Studies)

600.000000	1.320000	452.640000
999.000000	2.850000	464.050000
1399.000000	5.770000	545.770000
1999.000000	10.860000	568.890000
2599.000000	12.910000	649.590000
3399.000000	14.960000	739.770000
4199.000000	12.950000	923.710000
5399.000000	12.010000	932.860000
6599.000000	8.040000	1021.300000
8999.000000	8.270000	1208.520000
12599.000000	5.440000	1303.770000
16199.000000	2.490000	1523.840000
19999.000000	1.000000	2051.630000
23999.000000	1.130000	3962.350000

DATA FOR SUB-GROUP 1

Estimated mean from the data)= Birr 894.878000

p	L
1.320000E-02	6.676719E-03
4.170000E-02	2.145574E-02
9.940000E-02	5.664594E-02
2.080000E-01	1.256849E-01
3.371000E-01	2.193983E-01
4.867000E-01	3.430684E-01
6.162000E-01	4.767407E-01
7.363000E-01	6.019382E-01
8.167000E-01	6.936965E-01
8.994000E-01	8.053817E-01
9.538000E-01	8.846384E-01
9.787000E-01	9.270393E-01
9.887000E-01	9.499657E-01
1.000000	9.999999E-01

*********GENERAL QUADRATIC LORENZ CURVE********

THE ESTIMATED REGRESSION IS:

PARAMETER ESTIMATE	STANDARD ERROR	T RATIO:
.916709	.022676	40.426810
-1.771122	.041331	-42.851670

CCRDA

.095295 .036476 2.612580

INPUT POVERTY LINE Z WHICH IS WITHIN THE RANGE:

(360., 1961.)

THE IMPLIED PARAMETERS OF THE GENERAL QUADRATIC LORENZ CURVE ARE:

A	B	C
9.167086E-01	-1.771122	9.529536E-02

INPUT DATA ON MEAN (MU) AND POVERTY LINE (Z):
MU= 894.88 Z= 700.00

THE ESTIMATED GINI INDEX(%) IS:
20.764230

THE ESTIMATED POVERTY MEASURES (%) ARE:

HEADCOUNT INDEX	POVERTY GAP INDEX	FGT2 INDEX
H	PG	FGT2
29.3866	5.5583	1.5795

WHICH HAVE THE FOLLOWING ELASTICITIES WITH RESPECT TO

	MEAN CONSUMPTION	GINI INDEX
H	-3.61227	1.00565
PG	-4.28701	2.47189
FGT2	-5.03780	3.95930

THE OVERALL SUM OF SQUARED ERROR OF FITTED LORENZ CURVE IS:
SSE--Q= 1.842822E-04
THE SUM OF SQUARED ERROR OF FITTED LORENZ CURVE UP TO THE HEADCOUNT
INDEX OF POVERTY IS:
SSEZ--Q= 6.032024E-05

********** BETA LORENZ CURVE **********

THE ESTIMATED REGRESSION IS:

PARAMETER ESTIMATE	STANDARD ERROR	T RATIO:
-.993903	.043668	(-22.760700
.917034	.017849	51.376180
.515888	.016215	31.815080

CCRDA

THE IMPLIED PARAMETERS OF BETA LORENZ CURVE ARE:

THETA	GAMMA	DELTA
3.701292E-01	9.170340E-01	5.158877E-01

Z SHOULD BE WITHIN (360.000000, 1965.000000)

THE ESTIMATED GINI INDEX(%) IS:
20.568880

THE ESTIMATED POVERTY MEASURES (%) ARE:

HEADCOUNT INDEX	POVERTY GAP INDEX	FGT2 INDEX
H	PG	FGT2
33.1709	4.7367	.9974

WHICH HAVE THE FOLLOWING ELASTICITIES WITH RESPECT TO

	MEAN CONSUMPTION	GINI INDEX
H	-3.90977	1.08847
PG	-6.00296	2.94960
FGT2	-7.49777	4.64415

THE OVERALL SUM OF SQUARED ERROR OF FITTED LORENZ CURVE IS:
SSE--B= 3.290474E-04
THE SUM OF SQUARED ERROR OF FITTED LORENZ CURVE UP TO THE HEADCOUNT
INDEX OF POVERTY IS:
SSEZ--B= 7.412000E-05

BOTH SPECIFICATIONS ARE VALID LORENZ CURVES.
GQ FITS THE DATA BETTER.

INPUT POVERTY LINE Z WHICH IS WITHIN THE RANGE:

(362., 1972.)

THE IMPLIED PARAMETERS OF THE GENERAL QUADRATIC LORENZ CURVE ARE:

A	B	C
9.167086E-01	-1.771122	9.529536E-02

INPUT DATA ON MEAN (MU) AND POVERTY LINE (Z):
MU= 900.00 Z= 1970.00

CCRDA

*******GENERAL QUADRTIC LORENZ CURVE ******

THE ESTIMATED GINI INDEX(%) IS:
20.764230

THE ESTIMATED POVERTY MEASURES (%) ARE:

HEADCOUNT INDEX	POVERTY GAP INDEX	FGT2 INDEX
H	PG	FGT2
97.9796	55.3193	33.1778

WHICH HAVE THE FOLLOWING ELASTICITIES WITH RESPECT TO

	MEAN CONSUMPTION	GINI INDEX
H	-.06628	-.03600
PG	-.77116	.03800
FGT2	-1.33472	.18876

THE OVERALL SUM OF SQUARED ERROR OF FITTED LORENZ CURVE IS:
SSE--Q= 1.842822E-04
THE SUM OF SQUARED ERROR OF FITTED LORENZ CURVE UP TO THE HEADCOUNT
INDEX OF POVERTY IS:
SSEZ--Q= 1.842822E-04

********** BETA LORENZ CURVE **********

THE IMPLIED PARAMETERS OF BETA LORENZ CURVE ARE:

THETA	GAMMA	DELTA
3.701292E-01	9.170340E-01	5.158877E-01

Z SHOULD BE WITHIN (362.000000, 1976.000000)

THE ESTIMATED GINI INDEX(%) IS:
20.568880

THE ESTIMATED POVERTY MEASURES (%) ARE:

HEADCOUNT INDEX	POVERTY GAP INDEX	FGT2 INDEX
H	PG	FGT2
97.9643	55.4345	33.2645

WHICH HAVE THE FOLLOWING ELASTICITIES WITH RESPECT TO

	MEAN CONSUMPTION	GINI INDEX
H	-.07055	-.03832

CGRDA

PG	-.76721	.04015
FGT2	-1.33295	.18972

THE OVERALL SUM OF SQUARED ERROR OF FITTED LORENZ CURVE IS:
SSE--B= 3.290474E-04
THE SUM OF SQUARED ERROR OF FITTED LORENZ CURVE UP TO THE HEADCOUNT
INDEX OF POVERTY IS:
SSEZ--B= 3.290474E-04

BOTH SPECIFICATIONS ARE VALID LORENZ CURVES.
GQ FITS THE DATA BETTER.

THE DATA SET IS ant (1980 Rural Budget Studies)

2.600000E-01	76.130000
5.500000E-01	98.030000
1.270000	116.920000
1.640000	146.050000
2.730000	177.050000
3.820000	195.270000
4.150000	183.720000
4.760000	209.840000
9.900000	238.550000
9.530000	254.240000
7.890000	280.330000
7.970000	297.430000
6.950000	352.970000
11.660000	362.920000
7.430000	399.680000
9.660000	448.590000
4.250000	545.640000
2.450000	545.780000
1.040000	492.200000
5.900000E-01	594.500000
4.400000E-01	621.120000
1.040000	585.920000

DATA FOR SUB-GROUP 1

MU(estimated from your data) = 322.148000

p	L
2.600520E-03	6.145547E-04
8.101621E-03	2.288545E-03
2.080416E-02	6.898789E-03
3.720744E-02	1.433543E-02
6.451291E-02	2.934230E-02
1.027206E-01	5.250185E-02

CCRDA

1.442289E-01	7.617391E-02
1.918384E-01	1.071857E-01
2.908582E-01	1.805097E-01
3.861772E-01	2.557357E-01
4.650930E-01	3.244074E-01
5.448090E-01	3.980069E-01
6.143229E-01	4.741716E-01
7.309462E-01	6.055551E-01
8.052611E-01	6.977555E-01
9.018804E-01	8.322975E-01
9.443889E-01	9.042965E-01
9.688938E-01	9.458125E-01
9.792959E-01	9.617055E-01
9.851971E-01	9.725957E-01
9.895980E-01	9.810808E-01
1.000000	1.000000

*********GENERAL QUADRATIC LORENZ CURVE********

THE ESTIMATED REGRESSION IS:

PARAMETER ESTIMATE	STANDARD ERROR	T RATIO:
1.106145	.022752	48.617440
-1.765154	.031553	-55.942990
.236807	.045600	5.193164

INPUT POVERTY LINE Z WHICH IS WITHIN THE RANGE:

(136., 589.)

THE IMPLIED PARAMETERS OF THE GENERAL QUADRATIC LORENZ CURVE ARE:

A	B	C
1.106145	-1.765154	2.368070E-01

INPUT DATA ON MEAN (MU) AND POVERTY LINE (Z):
MU= 322.15 Z= 137.00

THE ESTIMATED GINI INDEX(%) IS:
19.874830

THE ESTIMATED POVERTY MEASURES (%) ARE:

HEADCOUNT INDEX	POVERTY GAP INDEX	FGT2 INDEX
H	PG	FGT2
.8255	.0149	.0004

CCRDA

WHICH HAVE THE FOLLOWING ELASTICITIES WITH RESPECT TO

	MEAN CONSUMPTION	GINI INDEX
H	-28.11725	37.99894
PG	-54.50319	76.00954
FGT2	-80.95161	114.10460

THE OVERALL SUM OF SQUARED ERROR OF FITTED LORENZ CURVE IS:
SSE--Q= 8.394022E-05
THE SUM OF SQUARED ERROR OF FITTED LORENZ CURVE UP TO THE HEADCOUNT
INDEX OF POVERTY IS:
SSEZ--Q= 5.513609E-06

********** BETA LORENZ CURVE **********

THE ESTIMATED REGRESSION IS:

PARAMETER ESTIMATE	STANDARD ERROR	T RATIO:
-.697610	.032152	-21.696950
.930803	.010690	87.069650
.865222	.011939	72.469160

THE IMPLIED PARAMETERS OF BETA LORENZ CURVE ARE:

THETA	GAMMA	DELTA
4.977735E-01	9.308026E-01	8.652222E-01

Z SHOULD BE WITHIN (85.000000, 543.000000)

THE ESTIMATED GINI INDEX(%) IS:
19.697720

THE ESTIMATED POVERTY MEASURES (%) ARE:

HEADCOUNT INDEX	POVERTY GAP INDEX	FGT2 INDEX
H	PG	FGT2
2.3683	.3173	.0812

WHICH HAVE THE FOLLOWING ELASTICITIES WITH RESPECT TO

	MEAN CONSUMPTION	GINI INDEX
H	-6.50144	8.78634
PG	-6.46479	11.08826
FGT2	-5.81368	12.55976

THE OVERALL SUM OF SQUARED ERROR OF FITTED LORENZ CURVE IS:
SSE--B= 3.297495E-04

CCRDA

THE SUM OF SQUARED ERROR OF FITTED LORENZ CURVE UP TO THE HEADCOUNT
INDEX OF POVERTY IS:
SSEZ--B= 5.585048E-07
BOTH SPECIFICATIONS ARE VALID LORENZ CURVES.
BETA FITS THE DATA BETTER.

THE DATA SET IS 1994 Integrated Household Survey

10.000000	62.130000
10.000000	120.210000
10.000000	168.450000
10.000000	226.120000
10.000000	190.450000
10.000000	382.400000
10.000000	508.760000
10.000000	696.700000
10.000000	1067.600000
10.000000	2989.600000

DATA FOR SUB-GROUP 1

MU(estimated from your data)= 641.242000

p	L
1.000000E-01	9.689010E-03
2.000000E-01	2.843544E-02
3.000000E-01	5.470477E-02
4.000000E-01	8.996759E-02
5.000000E-01	1.196678E-01
6.000000E-01	1.793020E-01
7.000000E-01	2.586418E-01
8.000001E-01	3.672903E-01
9.000001E-01	5.337797E-01
1.000000	1.000000

*********GENERAL QUADRATIC LORENZ CURVE********

THE ESTIMATED REGRESSION IS:

PARAMETER ESTIMATE	STANDARD ERROR	T RATIO:
.772492	.062712	12.318190
1.346223	.927003	1.452231
.271121	.152812	1.774207

)

INPUT POVERTY LINE Z WHICH IS WITHIN THE RANGE:

(55., 3587.)

CCRDA

THE IMPLIED PARAMETERS OF THE GENERAL QUADRATIC LORENZ CURVE ARE:

A	B	C
7.724922E-01	1.346223	2.711205E-01

INPUT DATA ON MEAN (MU) AND POVERTY LINE (Z):
MU= 641.24 Z= 321.00

THE ESTIMATED GINI INDEX(%) IS:
59.303110

THE ESTIMATED POVERTY MEASURES (%) ARE:

HEADCOUNT INDEX	POVERTY GAP INDEX	FGT2 INDEX
H	PG	FGT2
50.5446	24.6512	14.8780

WHICH HAVE THE FOLLOWING ELASTICITIES WITH RESPECT TO

	MEAN CONSUMPTION	GINI INDEX
H	-.71498	.71329
PG	-1.05039	3.04555
FGT2	-1.31378	5.30595

THE OVERALL SUM OF SQUARED ERROR OF FITTED LORENZ CURVE IS:
SSE--Q= 1.803273E-04
THE SUM OF SQUARED ERROR OF FITTED LORENZ CURVE UP TO THE HEADCOUNT
INDEX OF POVERTY IS:
SSEZ--Q= 1.228474E-04

********** BETA LORENZ CURVE **********

THE ESTIMATED REGRESSION IS:

PARAMETER ESTIMATE	STANDARD ERROR	T RATIO:
-.005597	.033041	-.169386
1.032317	.019110	54.018710
.379796	.019110	19.873830

THE IMPLIED PARAMETERS OF BETA LORENZ CURVE ARE:

THETA	GAMMA	DELTA
9.944189E-01	1.032317	3.797959E-01

Z SHOULD BE WITHIN (119.000000, 3172.000000)

CCRDA

THE ESTIMATED GINI INDEX(%) IS:
59.336160

THE ESTIMATED POVERTY MEASURES (%) ARE:

HEADCOUNT INDEX	POVERTY GAP INDEX	FGT2 INDEX
H	PG	FGT2
49.1945	24.7720	15.2804

WHICH HAVE THE FOLLOWING ELASTICITIES WITH RESPECT TO

	MEAN CONSUMPTION	GINI INDEX
H	-.70360	.70193
PG	-.98589	2.98120
FGT2	-1.24234	5.23468

THE OVERALL SUM OF SQUARED ERROR OF FITTED LORENZ CURVE IS:
SSE--B= 2.663888E-04
THE SUM OF SQUARED ERROR OF FITTED LORENZ CURVE UP TO THE HEADCOUNT
INDEX OF POVERTY IS:
SSEZ--B= 1.431952E-04

GQ SPECIFICATION IS A VALID LORENZ CURVE. BUT BETA IS NOT.
GQ FITS THE DATA BETTER.

CCRDA