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INTRODUCTION

Does inequality in the distribution of income increase or decrease in the course of a country's economic growth? What factors determine the secular level and trend of income inequalities? The debate on these issues was begun by Professor Simon Kuznets in 1955 in his classical article "Economic Growth and Income Inequality". This article representing the first major attempt to relate income inequality to economic growth has been the focus of almost all studies carried out in this field since its publication more than thirty years ago.

In this paper, Kuznets examined income distribution in a cross-section of countries at different levels of development. Comparing five countries - India, Sri Lanka, Puerto Rico, the United Kingdom and the United States - he arrived at the hypothesis that "in the early phases of industrializations in the underdeveloped countries, income inequality forces become strong enough first to stabilize and then reduce income inequalities". This hypothesis is now popularly known as an "inverted U-shaped pattern of income inequality", the inequality first increasing and then decreasing with development.

Kravis (1960) and Oshima (1962) continued the debate on the relationship between income inequality and economic growth initiated by Kuznets. Using income distribution data of the early fifties from ten countries, Kravis confirmed the Kuznets hypothesis of greater inequality in

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developing countries than in developed countries. Oshima, however, expressed reservation about the conclusions of Kravis, because, he concluded, it is difficult to generalize about intercountry patterns in view of the vast historic, physical, regional, political, racial and religious differences.

A number of important studies were subsequently made, among which are those of Adelman and Morris (1971), Paukert (1973), Ahluwalia (1974,1976) and Chenery and Syrquin (1975). Adelman and Morris compiled data on the size distribution of income for forty-four countries. Their work was criticized by Paukert for the poor quality used by them. Paukert presented income distribution data for fifty-six countries. These data supported the hypotheses proposed by Kuznets.

In 1974 and more elaborately in 1976, Ahluwalia re-examined the empirical basis of the inverted U-shaped pattern of the secular behaviour of income inequality. His investigation was based on distributions for sixty-two countries; the multiple regression technique was used to identify the relationship between income inequality and the level of development, units of observations being the countries. He observed a statistically significant relationship between income shares and the logarithms of per capita GNP for both the upper income groups (top 20 percent) and lower income groups (lowest 60 and 40 percent). In this relationship the logarithm of income entered in quadratic form, and as a result, generated an inverted U-shaped curve.

With emergence of these cross-country studies, Kuznets's hypothesis of inverted U-shaped curve has acquired the status of modern paradign (Saith 1983). Recently, these studies have been subjected to severe criticisms (Anand and Kanbur 1984). They have been criticized on the grounds that they are based on defective data and questionable methodology. However, the most severe of them relates to the applicability of cross-country results to particular country experiences (Bacha 1977).

In an attempt to explain his findings, Kuznets (1955) identified two factors that lead to increasing inequality during the first stage of economic development. The first factor relates to the concentration of savings in the upper income brackets. The second factor which he emphasized most and which has become important in the literature is the changing structure of the economy. This model assumes that the economy can be divided into two sectors with different sectoral income distributions and that development entails a continuous shift of population from the relatively backwards rural sector to the relatively modern urban sector. With the help of a numerical example based on this model Kuznets formulated several hypothesis including this famous hypothesis of inverted U-shaped pattern of income inequality. The present paper investigates rigorously and in more general terms these hypothesis and provides several numerical illustrations using Sri Lankan data.

The main objective of the present paper, however, is to explore how the behaviour of welfare, income inequality and poverty changes during the course of a country's economic development. The analysis presented in the paper is based on Kuznets's model of sectoral dualism which has been the focal point of many models of development (Lewis 1954, Fei and Ranis 1964 and Harris and Todaro 1970). The analytical approach adopted in the paper has been followed earlier by Robinson (1976), Fields (1979) and more recently by Anand and Kanbur (1984, 1985). The present paper, however, provides many new results and interpretations which have not been explored earlier.

2. A MODEL OF DUAL ECONOMY

In a simple model of dual economy, the income distribution of the total population is viewed as a combination of the income distributions of the rural and of the urban populations. It is assumed that the rural population belongs to the relatively backwards traditional sector whereas the urban population belongs to relatively advanced (industrial) modern sector. Total income X of the country-wide income distribution is equal to the sum of modern sector income X_1 and traditional sector income X_2, which gives

$$\mu = \mu_1\alpha + (1-\alpha)\mu_2 \tag{2.1}$$

where μ is the per capita income of the total population; μ_1 and μ_2 are the per capita incomes of the modern and traditional sectors, respectively, and α is the proportion of population in the modern sector. This equation shows that the per capita income in the economy is equal to the weighted sum of the per capita incomes in the two sectors.

Development entails a monotonic shift of population from the traditional sector to the modern sector. Differentiating (1) with respect to α gives

$$\frac{\partial\mu}{\partial\alpha} = \mu_1 - \mu_2 \tag{2.2}$$

which shows that if the per capita income in the modern sector (henceworth to be called sector I) is higher than that in the traditional sector (to be called sector II), which usually is the case, economic development leads to monotonic increase in the per capita income of the total population. This effect may be called the modern sector enlargement effect (Fields 1979).

It is obvious from (2.1) that the per capita income of the total population is also affected by changes in the sectoral per capita incomes. Differentiating (2.1) with respect to μ_1 and μ_2 gives

$$\frac{\partial\mu}{\partial\mu_1} = \alpha \tag{2.3}$$

and

$$\frac{\partial\mu}{\partial\mu_2} = (1-\alpha) \tag{2.4}$$

respectively; which shows that the total per capita increases monotonically with increases in the per capita incomes of either sectors. These may be called enrichments effects caused by the changes in the income levels within sectors (Fields 1979).

In order to analyze the effect of economic growth on welfare, it will be necessary to consider a welfare measure which is not only sensitive to the mean income but also to changes in the distribution of income. This can be accomplished only if we allow for different sectoral income distributions. Many of the development models of dual economy have assumed that all persons within sectors have exactly the same income (or wages), i.e., the inequality of income in the total population is only due to intra-sectoral income differences (Lewis 1954, Fei and Ranis 1964, Harris and Todaro 1970 and Fields 1979). The welfare analysis presented in the next section allows for different intra-sectoral income distributions, in the most general fashion.

3. WELFARE IN A DEVELOPING ECONOMY

This section explores how social welfare changes during the course of a country's economic development. Before we discuss this issue, it will be necessary to outline the concept of Lorenz curve which is widely used to represent and analyze the size distributions of income and wealth. It is defined as the relationship between the cumulative proportion of income units and cumulative proportion of income received when units are arranged in ascending order of their income.

The Lorenz curve is represented by a function $L(p)$, which is interpreted as the fraction of total income received by the lowest pth fraction of income units. It satisfies the following conditions (Kakwani 1980):

(a) if $p = 0$, $L(p) = 0$

(b) if $p = 1$, $L(p) = 1$

(c) $L'(p) = \frac{x}{\mu} > 0$ and $L''(p) = \frac{1}{\mu f(x)} > 0$ (3.1)

(d) $L(p) < p$

where income x of a unit is a random variable with probability density function $f(x)$ with mean μ and $L'(p)$ and $L''(p)$ are the first and second derivatives of $L(p)$ with respect to p, respectively.

The Lorenz curve has been used to compare inequality in income distributions: for if the Lorenz curve for one distribution X lies anywhere above that for another distribution Y, then the distribution X may be said to be more equal than the distribution Y. However, the ranking provided by the curve is only partial - when two Lorenz curves interest, neither distribution can be said to be more equal than the other.

The Lorenz curve makes distributional judgement independently of the size of income, which as Sen (1973) points out, "will make sense only if the relative ordering of welfare levels of distributions were strictly neutral to the operation of multiplving everybody's income by a given number". This is rather an extreme requirement because social welfare depends on both size and distribution of income.

Working independently on extensions of the Lorenz partial ordering Shorrocks (1983) and Kakwani (1984) arrived at a criterion which would rank any two distributions with different mean incomes. The new criterion given by $L(\mu, p)$ may be called the generalized Lorenz curve and is the product of the mean income μ and the Lorenz curve $L(p)$. This criterion of ranking has been justified from the welfare point of view in terms of several alternative classes of social welfare functions. Thus, it can be said that if the generalized Lorenz curve for distribution X lies everywhere above that for another distribution Y, then distribution X is welfare superior to distribution Y. This criterion may be used to judge between the distributions without knowing the form of the welfare function except that it is symmetric and quasi-concave in incomes.[1]

The question to which this section is addressed is: What are the conditions under which the modern sector enlargement and enrichment of individual sectors will lead to higher welfare for the entire population? Our main results are presented in the form of various propositions.

PROPOSITION 1. If the generalized Lorenz curve for the urban sector distribution lies everywhere above that for the rural sector distribution, the generalized Lorenz curve for the country-wide distribution will shift upwards at all points as migration takes place from the rural to urban sector.

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1. Kakwani (1984) has used this criterion for international comparison of welfare using data from 72 countries.

The implication of this proposition is that if urban sector distribution is welfare superior to the rural sector distribution, then the migration from rural sector to urban sector will increase the welfare of the country-wide distribution.[2]

This proposition is proved below under the assumption that the migration does not change the intra-sectoral distributions.

PROOF OF PROPOSITION 1

Suppose $F_1(x)$ and $F_2(x)$ are the probability distribution functions of the urban and rural sector income distributions, respectively, then the probability distribution function of the country-wide income distribution is given by

$$F(x) = \alpha F_1(x) + (1-\alpha)F_2(x). \tag{3.2}$$

where α is the proportion of population in the urban sector. Further, suppose that $L_1(p)$ and $L_2(p)$ are the Lorenz functions for the urban and rural sectors, respectively, the Lorenz function of the country-wide distribution is then given by

$$\mu L(p) = \alpha\mu_1 L_1[F_1(x)] + (1-\alpha)\mu_2 L_2[F_2(x)] \tag{3.3}$$

where $p = F(x)$ can be assumed to be fixed.

Differentiating (3.2) and (3.3) with respect to α gives

$$\alpha \frac{\partial F_1(x)}{\partial\alpha} + (1-\alpha)\frac{\partial F_2(x)}{\partial\alpha} = F_2(x) - F_1(x) \tag{3.4}$$

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2. Anand and Kanbur (1984) have proved this proposition using the first and second order dominance conditions given in Hadar and Russell (1969).

and

$$\frac{\partial \mu L(p)}{\partial \alpha} = \mu_1 L_1[F_1(x)] - \mu_2 L_2[F_2(x)] +$$

$$+ \alpha\mu_1 L_1'[F_1(x)]\frac{\partial F_1(x)}{\partial \alpha} + (1-\alpha)\mu_2 L_2'[F_2(x)]\frac{\partial F_2(x)}{\partial \alpha} \quad , \tag{3.5}$$

respectively, where use has been made of the assumption that p is fixed, i.e., $\frac{\partial p}{\partial \alpha} = 0$.

Equation (3.1) implies that

$$x = \mu L'(p) = \mu_1 L_1'[F_1(x)] = \mu_2 L_2'[F_2(x)] \tag{3.6}$$

which on using in (3.4) and (3.5) leads to

$$\frac{\partial \mu L(p)}{\partial \alpha} = \mu_1 L_1[F_1(x)] - \mu_2 L_2[F_2(x)] + x[F_2(x) - F_1(x)] \tag{3.7}$$

Applying the mean value theorem on the function $L_2[F_2(x)]$ and using (3.6), equation (3.7) simplifies to

$$\frac{\partial \mu L(p)}{\partial \alpha} = \mu_1 L_1[F_1(x)] - \mu_2 L_2[F_1(x)] + [F_2(x) - F_1(x)]\S \tag{3.8}$$

where

$$\begin{aligned} \S &> 0 \quad \text{if } F_2(x) - F_1(x) > 0 \\ \S &< 0 \quad \text{if } F_2(x) - F_1(x) < 0 \end{aligned} \tag{3.9}$$

implying that $[F_2(x) - F_1(x)]\S > 0$ always holds. It can be seen from (3.8) that if $\mu_1 L_1[F_1(x)] - \mu_2 L_2[F_1(x)] > 0$, i.e., if the generalized Lorenz curve for the urban sector distribution lies everywhere above that for the rural sector distribution, the entire generalized Lorenz curve for the country-wide distribution shifts upwards. This completes the proof of proposition 1.

Next we consider how the welfare in the country-wide distribution changes with respect to increase in sectoral mean incomes. Again assuming that $p = F(x)$ fixed, i.e., $\frac{\partial p}{\partial \mu_1} = 0$, then differentiating (3.2) and (3.3) with respect to μ_1 gives

$$\alpha \frac{\partial F_1(x)}{\mu_1} + (1-\alpha)\frac{\partial F_2(x)}{\mu_1} = 0 \tag{3.10}$$

and

$$\frac{\partial \mu L(p)}{\partial \mu_1} = \alpha L_1[F_1(x)] + \alpha\mu_1 L_1^{'}[F_1(x)] \frac{\partial F_1(x)}{\partial \mu_1} + (1-\alpha)\mu_2 L_2^{'}[F_2(x)] \frac{\partial F_2(x)}{\partial \mu_1} \tag{3.11}$$

respectively. Using (3.6) in (3.11), yields

$$\frac{\partial \mu L(p)}{\partial \mu_1} = \alpha L_1[F_1(x)] \tag{3.12}$$

and similarly

$$\frac{\partial \mu L(p)}{\partial \mu_2} = (1-\alpha)L_2[F_2(x)]$$

These equations immediately lead to the following proposition.

PROPOSITION 2. **The welfare of the country-wide population increases as the mean income of either of the two sectors increases. The magnitude of increase in welfare with respect to the increase in the ith sector mean income is directly proportional to the proportion of population in the ith sector, where i equals 1 or 2.**

Suppose the two sectores have the same level of equality in the Lorenz sense, i.e., $L_1(p) = L_2(p)$ for all p and $\mu_1 > \mu_2$, i.e., the urban sector has the higher mean income than the rural sector. Since

$$\mu_1 L_1^{'}[F_1(x)] = \mu_2 L_2^{'}[F_2(x)],$$

$\mu_1 > \mu_2$ must imply

$$L_1^{'}[F_1(x)] \leqslant L_2^{'}[F_2(x)]$$

and if the Lorenz curves in the two sectors are identical, then $F_1(x) \leqslant F_2(x)$ must hold which implies

$$L_1[F_1(x)] \leqslant L_1[F_2(x)].$$

It is reasonable to assume that $\alpha < (1-\alpha)$, i.e., the proportion of population in the urban sector is lower than that in the rural sector which is a characteristic of developing countries, then

$$\frac{\partial \mu L(p)}{\partial \mu_1} \leqslant \frac{\partial \mu L(p)}{\partial \mu_2}$$

for all p must hold. This leads to the following proposition.

PROPOSITION 3. If the rural and urban sectors have the same Lorenz curve, the increase in the mean income of the rural sector will lead to greater increase in the country-wide welfare than the increase in the mean income of the urban sector.

It is easy to demonstrate that

$$\mu_1 L_1[F_1(x)] = xF_1(x) - \Phi_1(x) \tag{3.13}$$

$$\mu_2 L_2[F_2(x)] = xF_2(x) - \Phi_2(x) \tag{3.14}$$

where

$$\Phi_1(x) = \int_0^x F_1(X)dX$$

$$\Phi_2(x) = \int_0^x F_2(X)dX$$

Substituting (3.13) and (3.14) into (3.7) yields

$$\frac{\partial \mu L(p)}{\partial \alpha} = \Phi_2(x) - \Phi_1(x) \text{ for all } x \tag{3.15}$$

which means that the larger the difference between the curves $\Phi_2(x)$ and $\Phi_1(x)$, the greater the shift in the country-wide generalized Lorenz curve will be as α increases. Differentiating (3.6) with respect to μ_1 gives

$$L_1''[F_1(x)]\frac{\partial F_1(x)}{\partial \mu_1} = -\frac{x}{\mu_1^2}$$

where x is assumed to be fixed. Using the Lorenz curve property (3.1) (c) gives

$$L_1''[F_1(x)] = \frac{1}{\mu_1 f_1(x)} \quad ,$$

where $f_1(x)$ being the density function of income distribution in sector I, equation (3.14) yields

$$\frac{\partial \Phi_1(x)}{\partial \mu_1} = \int_0^x \frac{\partial F_1(x)}{\partial \mu_1}\, dx = -\frac{1}{\mu_1}\int_0^x X f_1(X)dx = -L_1[F_1(x)] < 0.$$

Since x is fixed,

$$\frac{\partial \Phi_2(x)}{\partial \mu_1}$$

will obviously be equal to zero. Thus, the difference between curves $\Phi_2(x)$ and $\Phi_1(x)$ will widen for all x as μ_1 increases (μ_2 being fixed). This leads to the following proposition.

PROPOSITION 4. **If the generalized Lorenz curve for the urban sector is higher than that for the rural sector at all points, then the larger the per capita income differentials between the two sectors, the greater the increase in welfare will be, as the proportion of urban sector population increases.**

Following the similar argument, one can easily arrive at the following proposition

PROPOSITION 5. **If the generalized Lorenz curve for the urban sector is higher than that for the rural sector at all points, then the smaller the intra-sectoral inequality differentials between the two sectors, the greater the increase in welfare will be, as the proportion of urban sector population increases.**

4. INCOME INEQUALITY IN A DUAL ECONOMY

This section explores the behaviour of income inequality in a dual economy which is characterized by the shift of population from the rural sector to the urban sector.

Differentiating the lefthand side of (3.7) with respect to α and using (3.3) yields

$$\frac{\partial L(p)}{\partial \alpha} = \frac{\mu_1 \mu_2}{\mu^2} \left[L_1(F_1(x)) - L_2(F_2(x))\right] + \frac{x}{\mu}\left[F_2(x) - F_1(x)\right] \tag{4.1}$$

which on using the mean value theorem on the function $L_2[F_2(x)]$ becomes

$$\frac{\partial L(p)}{\partial \alpha} = \frac{\mu_1 \mu_2}{\mu_2}[L_1(F_1(x)) - L_2(F_1(x))] - [\frac{F_2(x) - F_1(x)}{\mu^2}][\mu_1(x-\S) - \mu x] \tag{4.2}$$

where $\S$ as defined in (3.9) is given by

$$x - \S = \mu_2 L_2'[F_1(x) + \theta(F_2(x) - F_1(x))] \tag{4.3}$$

$0 \leqslant \theta \leqslant 1$; if $F_2(x) - F_1(x) > 0$, then $\S > 0$, otherwise $\S$ is negative.

Assuming that the two sectors have the same Lorenz functions, then it was shown in Section 3 that $F_2(x) - F_1(x) > 0$ for all x. Then equation (4.3) implies

$$x - \S \geqslant \mu_2 L_1'[F_1(x)]$$

which on using (3.6) gives

$$(\mu_1 - \mu_2)x - \mu_1 \S \geqslant 0.$$

Under these assumptions (4.2) can be written as

$$\frac{\partial L(p)}{\partial \alpha} = -[\frac{F_2(x) - F_1(x)}{\mu^2}] \; [(\mu_1 - \mu_2)x - \mu_1 \S - \alpha x(\mu_1 - \mu_2)]$$

Substituting $\alpha = 0$ and 1, this equation gives

$$\frac{\partial L(p)}{\partial \alpha} < 0 \quad \text{for } \alpha = 0$$

$$\frac{\partial L(p)}{\partial \alpha} > 0 \quad \text{for } \alpha = 1$$

and

$$\frac{\partial L(p)}{\partial \alpha} = 0 \quad \text{for}$$

$$\alpha = \frac{(\mu_1 - \mu_2)x - \mu_1 \S}{(\mu_1 - \mu_2)x}$$

which lies between 0 and 1. It means that as α increases, L(p) decreases first, and then it increases, or in other words the relationship between L(p) (for any fixed p) and α has a U-shaped form. This leads to the following proposition.

PROPOSITION 6. If the rural and urban sectors have the same Lorenz curve, the relationship between inequality and development follows an inverted U-shaped pattern, with inequality first increasing and then decreasing.

It should be pointed out that Kuznets's hypothesis concerning the inverted U-shaped curve was based on a simple numerical illustration. Robertson(1976), however, provided a rigorous proof of the U-shaped hypothesis but his analysis was based on one specific index of inequality - the variance of the logarithm of income. Anand and Kanbur (1984) used the general framework as adopted here and proved that at the start of the development process, when $\alpha = 0$,

$$\frac{\alpha L(p)}{\partial \alpha} < 0.$$

But this is an extreme situation when the entire population lives in the rural sector or in other words the urban sector does not exist at all. The above proposition provides a condition under which the income share of the lowest 100 x p percent population (for all p) followsthe inverted U-shaped pattern of economic development.

The sufficient condition for the existence of inverted U-shaped curve is that $\frac{\partial L(p)}{\partial \alpha} > 0$ as α approaches 1. It can be seen that as α approaches 1, $F_1(x)$ approaches p and μ approaches μ_1. Substituting this in (4.2), it immediately follows that

$$\frac{\partial L(p)}{\partial \alpha} = \frac{\mu_2}{\mu_1^2}[L_1(p) - L_2(p)] + [F_2(x) - p]\,\mu_1 \S$$

in which the first term is negative and the second term positive. The net effect of the two will be positive only if the difference in income inequality between the two sectors is small. Thus, the existence of the inverted U-shaped curve depends on the difference in the within sectors inequalities - if with the economic development this difference enlarges, it may be possible to have a situation when the inequality in the country-wide distribution increases monotonically as α increases.

Assuming that the income inequality in the urban sector is higher than that in the rural sector and the two sectors have the same per capita income, obviously then, the generalized Lorenz curve for the rural sector distribution will be higher than that for the urban sector distribution at all points. Under these conditions, the difference $\Phi_2(x) - \Phi_1(x)$ will be negative for all x which from (3.15) implies that

$$\mu \frac{\partial L(p)}{\partial \alpha} < 0 \text{ for all } p.$$

This leads to the following proposition.

PROPOSITION 7. **If the income inequality in the urban sector is higher than that in the rural sector and the two sectors have the same per capita income, the inequality in the country-wide distribution increases monotonically as there is a shift in population from the rural sector to the urban sector.**

Next we consider how the inequality in the country-wide distribution changes with respect to increase in sectoral mean incomes. Differentiating the lefthand side of (3.12) with respect to μ_1 and utilizing (3.3), gives

$$\frac{\partial L(p)}{\partial \mu_1} = \frac{\alpha(1-\alpha)\mu_2}{\mu^2}[L_1(F_1(x)) - L_2(F_2(x))] \quad (4.4)$$

and similarly

$$\frac{\partial L(p)}{\partial \mu_2} = -\frac{\alpha(1-\alpha)\mu_1}{\mu^2}[L_1(F_1(x)) - L_2(F_2(x))] \quad (4.5)$$

Suppose the two sectors have the same Lorenz function, then $F_2(x) \geq F_1(x)$ for all x which from (4.4) and (4.5) implies that

$$\frac{\partial L(p)}{\partial \mu_1} < 0 \quad \text{and} \quad \frac{\partial L(p)}{\partial \mu_2} > 0$$

which leads to the following proposition.

PROPOSITION 8. If the two sectors have the same inequality but the per capita income of the urban sector is higher than that of the rural sector, the enrichment of the urban (rural) sector increases (decreases) the inequality in the country-wide income distribution.

One of the implications of this proposition is that if the two sectors have the different inequality in the Lorenz sense, it is not possible to infer unambiguously that the increasing per capita income differential in favour of the urban sector will necessarily lead to higher inequality in the country-wide income distribution.

Applying the mean value theorem on $L_2[F_2(x)]$, (4.4) can be written as

$$\frac{\partial L(p)}{\partial \mu_1} = \frac{\alpha(1-\alpha)\mu_2}{\mu^2}[L_1(F_1(x)) - L_2(F_1(x))] -$$

$$- \frac{\alpha(1-\alpha)}{\mu^2}[F_2(x) - F_1(x)](x-\S)$$

where $x-\S \geqslant 0$ (see equation 4.3). This derivative will be negative if $F_2(x) \geqslant F_1(x)$, *otherwise its sign is indeterminant. This result immediately leads* to the following proposition.

PROPOSITION 9. If the urban sector has higher inequality than the rural sector, but $F_2(x) \geqslant F_1(x)$, for all x, the enrichment of the urban (rural) sector increases (decreases) the inequality in the country-wide income distribution.

5. THE INEQUALITY-DEVELOPMENT RELATIONSHIP IN TERMS OF SINGLE INDICES OF POVERTY

Whereas the Lorenz curve provides only a partial ranking of distributions, measures of inequality have been devised to provide complete ranking. This section explores the inequality-development relationship in a dual economy in terms of several wellknown indices of income inequality.

5.1 Generalized Entropy Family

Theil (1967) proposed two inequality measures which are based on the notion of entropy in information theory. These measures have gained popularity because of their decomposability property - if a population is divided into a number of groups according to certain socio-economic characteristics of individuals, these measures can be decomposed into "between group" and "within group" income inequality. Shorrocks (1980) has derived the entire class of measures which are decomposable under relatively weak restrictions on the form of the index. This class of generalized entropy measures is given by

$$T_c = \frac{1}{c(c-1)} \int_0^\infty [(\frac{x}{\mu})^c - 1]\, f(x)dx \qquad c \neq 0,1$$

$$T_0 = \log\mu - \int_0^\infty \log x\, f(x)dx$$

$$T_1 = \frac{1}{\mu} \int_0^\infty x \log x\, f(x)dx - \log\mu$$

where $f(x)$ is the probability density function. T_0 and T_1 are the two inequality measures proposed by Theil. The square of the coefficient of variation is a member of this class when $c=2$. The parameter c can be interpreted as a measure of the degree of equality-aversion. As c decreases, the index becomes more sensitive to transfers at the lower end of the distribution and less weight is attached to transfers at the top.

The effects of modern sector enlargement on these measures are given by

$$\frac{\partial T_c}{\partial \alpha} = \frac{(1+\S)^c\,(1+\alpha\S - \alpha c\S)}{(1+\alpha\S)^{c+1}} [T_c^1 + \frac{1}{c(c-1)}] - \frac{(1+\alpha\S + c\S - \alpha c\S)}{(1+\alpha\S)^{c+1}} [T_c^2 + \frac{1}{c(c-1)}] \quad (5.1)$$

$$\frac{\partial T_0}{\partial \alpha} = (T_0^1 - T_0^2) + \frac{\S}{(1+\alpha\S)} - \log(1+\S) \quad (5.2)$$

$$\frac{\partial T_1}{\partial \alpha} = \frac{(1+\S)}{(1+\alpha\S)^2} [T_1^1 - T_1^2 + \log(1+\S)] - \frac{\S}{(1+\alpha\S)} \quad (5.3)$$

where $\mu_1 = \mu_2(1+\S)$, $\S \geqslant 0$ and T_c^1 and T_c^2 are inequality measures in the urban and rural distributions, respectively.

If we assume that the inequality in the urban sector distribution is higher than that for the rural sector distribution, it can be seen from (5.1) that

$$\frac{\partial T_c}{\partial \alpha} > 0 \quad \text{for } \alpha = 0$$

if $(1+\S)^c - (1+c\S) > 0$, which holds only if $c > 1$. As already pointed out, Anand and Kanbur (1984) have proved that at the start of development process when $\alpha = 0$, there is an unambiguous increase in inequality. This result may not be true in the case of generalized entropy family when $c < 1$ (except when $c = 0$ and $c = 1.0$).

Assuming that the two sectors have the same inequality, it can be shown that

$$\frac{\partial T_c}{\partial \alpha}\Big|_{\alpha=0} > 0 \quad \text{and} \quad \frac{\partial T_c}{\partial \alpha}\Big|_{\alpha=1} < 0 \quad \text{for } c > 1$$

$$\frac{\partial T_0}{\partial \alpha}\Big|_{\alpha=0} > 0 \quad \text{and} \quad \frac{\partial T_0}{\partial \alpha}\Big|_{\alpha=1} < 0$$

$$\frac{\partial T_1}{\partial \alpha}\Big|_{\alpha=0} > 0 \quad \text{and} \quad \frac{\partial T_1}{\partial \alpha}\Big|_{\alpha=1} < 0$$

which lead to the following proposition.

PROPOSITION 10. If the rural and urban sector distributions have the same inequality and the urban sector has higher per capita income than the rural sector, the inequality measured by the entire family of generalized entropy measures (for $c > 1$, $c = 0$ and 1.0) increases first and then decreases, as the population shifts from the rural to urban sectors.

Next, we consider the enrichment effects of modern and traditional sectors on income inequality which are measured by the following derivatives.

$$\frac{\partial T_c}{\partial \mu_1} = \frac{c\alpha(1-\alpha)}{\mu(1+\alpha\S)^c} \left[(1+\S)^{c-1}\left(T_c^1 + \frac{1}{c(c-1)}\right) - \left(T_c^2 + \frac{1}{c(c-1)}\right)\right]$$

$$\frac{\partial T_c}{\partial \mu_2} = -\frac{c\alpha(1-\alpha)(1+\S)}{\mu(1+\alpha\S)^c}\left[(1+\S)^{c-1}\left(T_c^1 + \frac{1}{c(c-1)}\right)-\left(T_c^2 + \frac{1}{c(c-1)}\right)\right]$$

$$\frac{\partial T_1}{\partial \mu_1} = \frac{\alpha(1-\alpha)}{\mu(1+\alpha\S)}\left[T_1^1 - T_1^2 + \log(1+\S)\right]$$

$$\frac{\partial T_1}{\partial \mu_2} = -\frac{\alpha(1-\alpha)(1+\S)}{\mu(1+\alpha\S)} \left[T_1^{\,1} - T_1^{\,2} + \log(1+\S)\right]$$

$$\frac{\partial T_0}{\partial \mu_1} = \frac{\alpha(1-\alpha)\S}{\mu(1+\S)}$$

$$\frac{\partial T_0}{\partial \mu_2} = -\frac{\alpha(1-\alpha)\S}{\mu}$$

The above equations immediately lead to the following proposition.

PROPOSITION 11. If the urban sector has higher inequality than the rural sector, the modern (traditional) sector enrichment leads to higher (lower) inequality (measured by the entire class of generalized entropy measures for $c > 1$, $c = 0$ and $c = 1.0$) in the country-wide distribution.

This proposition may not hold when $c < 1$ (except when $c = 0$).

5.2 Atkinson's measures

Atkinson (1970) proposed a family of inequality measures that are based on the concept of "the equally distributed equivalent level of income". These measures are derived from the social welfare function which is utilitarian and every individual has exactly the same utility function. Under the assumption that the individual utility function is homothetic, these measures are equal to

$$A(\varepsilon) = 1 - \frac{1}{\mu}\left[\int_0^\infty x^{1-\varepsilon} f(x)dx\right]^{\frac{1}{1-\varepsilon}}, \ \varepsilon \neq 1$$

$$= 1 - \frac{g}{\mu}, \ \varepsilon = 1$$

where g is the geometric mean of the distribution - and ε is a measure of the degree of inequality aversion - or the relative sensitivity to income transfers at different income levels. As ε rises, more and more weight is attached to transfers at the lower end of the distribution and less weight to transfers at the top. If $\varepsilon = 0$, it reflects an inequality-neutral attitude, in which the society does not care about the inequality at all.

The effects of modern sector enlargement on Atkinson's measures are given by

$$\frac{\partial A(\varepsilon)}{\partial \alpha} = \frac{\S[1-A(\varepsilon)]}{(1+\alpha\S)} - \frac{[1-A(\varepsilon)]^{\varepsilon}\ [(1+\S)^{1-\varepsilon}\ K_1 - K_2]}{(1-\varepsilon)(1+\alpha\S)^{1-\varepsilon}}$$

$$\frac{\partial A(1)}{\partial \alpha} = [1-A(1)]\ [\frac{\S}{1+\alpha\S} - \log(1+\S) - \log P_1 + \log P_2]$$

where

$$K_1 = (1-A^1(\varepsilon))^{1-\varepsilon}$$

$$K_2 = (1-A^2(\varepsilon))^{1-\varepsilon}$$

$A^1(\varepsilon)$ and $A^2(\varepsilon)$ being the inequality measures in the urban and rural sector distributions, respectively and

$$P_1 = G_1/\mu_1 \text{ and } P_2 = G_2/\mu_2,$$

G_1 and G_2 being the geometric means of the urban and rural sectors, respectively.

The following proposition follows from the above derivatives.

PROPOSITION 12. If the rural and urban sector distributions have the same inequality (measured by the entire class of Atkinson's measures) and urban sector has higher per capita than the rural sector, the inequality in the country-wide distribution follows an inverted U-shaped pattern as α increases during the course of a country's economic development.

The enrichment effects of modern and traditional sectors on inequality are given by the following derivatives.

$$\frac{\partial A(\varepsilon)}{\partial \mu_1} = \frac{\alpha(1-\alpha)\ [\ 1-A(\varepsilon)]^{\varepsilon}}{\mu(1+\alpha\S)^{1-\varepsilon}\ \ (1+\S)^{\varepsilon}}\ [(1+\S)^{\varepsilon}\ K_2 - K_1]\quad ,$$

$$\frac{\partial A(1)}{\partial \mu_1} = \frac{\alpha(1-\alpha)\ [1-A(1)]\ \S}{\mu(1+\S)} > 0$$

$$\frac{\partial A(\varepsilon)}{\alpha\mu_2} = -\frac{\alpha(1-\alpha)\ [1-A(\varepsilon)]^{\varepsilon}}{\mu(1+\alpha\S)^{1-\varepsilon}(1+\S)^{\varepsilon-1}}\ [(1+\S)^{\varepsilon}\ K_2 - K_1]$$

$$\frac{\partial A(1)}{\partial \mu_2} = -\frac{\alpha(1-\alpha)\ [1-A(1)]\S}{\mu} < 0$$

These equations immediately lead to the following proposition.

PROPOSITION 13. If the urban sector has higher inequality than the rural sector, the modern (traditional) sector enrichment leads to higher (lower) inequality (measured by the entire class of Atkinson's measures for $\varepsilon < 1$) in the country-wide distribution.

This proposition may not hold for $\varepsilon > 1$, an important implication of which is that the increase in per capita income differences between the two sectors may not necessarily lead to increase in inequality in the country-wide distribution. If, however, the two sectors have the same inequality, this result holds for all values of ε.

6.POVERTY IN A DUAL ECONOMY

Suppose z is the poverty line, the threshold income below which one is considered to be poor and which may reflect the socially accepted minimum standard of living. Further, assume that there is range (0 to z*) over which z may vary. The proportion of individuals below the poverty line, called the head-count ratio is the most widely used index of poverty. But this index does not reflect the intensity of poverty suffered by the poor. An alternative poverty measure proposed by Sen (1976) is the normalized deficit measure

$$D = \int_0^z \left(\frac{z-x}{z}\right) f(x)dx = F(z) \left(\frac{z-\mu^*}{z}\right) \qquad (6.1)$$

where $F(z)$ is the head-count ratio and μ^* is the mean income of the poor. This is a suitable measure of poverty if all the poor have exactly the same income.

Since all the poor do not have exactly the same income several poverty measures have been proposed in the literature which take into account the inequality of income among the poor. A class of additively separable and symmetric poverty measures is given by

$$G(P) = \int_0^z P(x,z) f(x)dx \qquad (6.2)$$

where $P(x,z)$ is a decreasing and differentiable function of x over $(0,z)$ and $P(x,z) = 0$ for $x \geqslant z$. Examples of members of this class are given in Table 1 (Atkinson 1985)

TABLE 1: **Class of Additively Separable Poverty measures**

Normalized deficit $\quad D = \int_0^z \left(\frac{z-x}{z}\right) f(x)dx$

Watt's (1968) measure $\quad W = \int_0^z \log_e(z/x) f(x)dx$

Foster, Green and Thorbecke (1984)

$$P_\alpha = \int_0^z \left(\frac{z-x}{z}\right)^\alpha f(x)dx, \ \alpha \geqslant 1$$

Clark, Hemming and Ulph (1981)

$$C_\alpha = \frac{1}{\alpha} \int_0^z \left[1 - \left(\frac{x}{z}\right)^\alpha\right] f(x)dx$$

The following lemma has been proved by Atkinson (1985):

LEMMA. The following statements are equivalent

(a) $\quad \phi_1(z) \leqslant \phi_2(z)$ for $0 \leqslant z \leqslant z^*$

(b) $\quad \int_0^z P(x,z) f_1(x)dx \leqslant \int_0^z P(x,z) f_2(x)dx$ for $0 < z \leqslant z^*$.

This lemma implies that if the generalized Lorenz curve for distribution I is everywhere above that for distribution II, the distribution I will have lower poverty than distribution II for all poverty lines. This lemma in conjunction with (3.15) and Proposition 1 leads to Proposition 14.

PROPOSITION 14. If the generalized Lorenz curve for the urban sector distribution is higher than that for the rural sector distribution at all points upto the income level z*, the country-wide poverty (measured by a class of additively separable poverty measures G(P)) decreases monotonically as the proportion of population in the urban sector increases.

The following propositions follow immediately from propositions 2, 4 and 5.

PROPOSITION 15. The poverty in the country-wide population decreases as the mean income of either of the two sectors increases. The magnitude of decrease in poverty with respect to increase in the mean income of the ith sector is directly proportional to the proportion of population in the ith sector.

PROPOSITION 16. If the generalized Lorenz curve for the urban sector lies everywhere above that for the rural sector upto the income level z*, the larger the per capita income differential between the two sectors, the greater the decrease in poverty will be due to migration of population from the rural to the urban sector.

PROPOSITION 17. If the generalized Lorenz curve for the urban sector is higher than that for the rural sector, the smaller the intra-sectoral inequality differentials between the two sectors, the greater the decrease in poverty will be, as the proportion of urban sector population increases

A class of non-additive separable measures proposed by Kakwani (1980) is given by

$$S(k) = \frac{(k+1)}{z} \int_0^z (z-x) \left[1 - \frac{F(x)}{F(z)} \right]^k f(x)dx \tag{6.3}$$

which leads to Sen's (1976) well-known poverty measure when k = 1.0.

The following propositions follow immediately from the first order dominance condition of Atkinson (1985).

PROPOSITION 18. If the head-account ratio in the urban sector distribution is higher (lower) than that in the rural sector distribution for all poverty lines in the range $0 < z < z^*$, the poverty measured by S(k) for all values of k in the country-wide distribution increases (decreases) as the proportion of population in the urban sector increases.

PROPOSITION 19. If the two sectors have the same inequality in the Lorenz sense but the per capita income of the urban sector is higher than that of the rural sector, the poverty measured by S(k) for all k in the country-wide distribution decreases as the population shifts from the rural to the urban sector.

7. EMPIRICAL APPLICATIONS TO SRI LANKA

This section presents the empirical applications of the methodology developed in the previous sections. The data used for this purpose are from the consumer finance surveys conducted by the Central Bank of Sri Lanka. These surveys are conducted on regular basis beginning from 1953. For our applications we have chosen 1978-79 and 1981-82 surveys covering 8,000 households in each survey. The survey data were collected both with respect to income receivers and spending units. The numerical results presented below are based on income receivers.

The Sri Lankan economy can be divided into three distinct sectors, viz, urban, rural and estate. Accordingly, the sample in these surveys was stratified on the basis of these three sectors. Since this paper is based on a simple model of dual economy, it was necessary to combine the rural and estate sectors into one sector which can be treated as traditional sector characterized by low incomes. The urban sector is treated as modern sector which has higher per capita income as well as higher inequality than the other two sectors.

The income concept used in the survey is fairly comprehensive - it includes both money income and income in kind. Cash receipts including food stamps were included in money income. Income in kind was taken as the imputed value of goods and services received as remuneration for employment, the imputed value of home production and transfer payments in kind. The imputed value of owner occupied dwelling was treated as income in kind.

Sri Lanka has been a unique example of a developing country whose performance in terms of basic needs has been extremely impressive compared to its income level. These impressive results were achieved as a result of the social welfare policies followed by the successive governments since World War II. Three major social policies followed were

(a) subsidised food

(b) free education system and

(c) a free health care service on a universal basis.

These policies involved massive expenditures which could only be maintained by curtailing investment in the physical capital formation. As a result, the growth slowed down and the country often ran into chronic balance of payment problems.

The new goverment elected in 1977 changed the earlier welfare oriented development strategy and introduced new economic policies which centered around more growth and investment. One of the major policy changes was the substitution of food subsidies by a means-tested food stamps programme. The enormous savings made as a result of these changes were directed to production and employment activities. Furthermore, the trade was liberated and exchanged control was virtually withdrawn. This drastic change of policies must have considerably affected the living standards of the population. It is therefore important to analyze the data of 1978-79 and 1981-82 surveys in order to determine whether these growth oriented policies led to increase or decrease in economic welfare in Sri Lanka.

In order to determine whether the welfare increases or decreases during the course of economic development we compared the generalized Lorenz curves for the urban and rural sectors which are displayed in Figures 1 and 2 for the years 1978-79 and 1981-82, respectively. It can be observed that the generalized Lorenz curve for the urban sector distribution lies everywhere above that for the rural sector distribution. Then according to proposition 1, if the intra-sectoral distributions remain the same, the migration from rural sector to urban sector will increase the welfare of the country-wide distribution. Similarly, applying proposition 14, it can be concluded that the country-wide poverty measured by a class of additively separable poverty measures G(P) for any poverty line will decrease monotonically as the proportion of population in the urban sector increases provided, of course, the intra-sectoral distributions do not change.

Figures 3 and 4 display the probability distribution functions for the urban and rural sectors for the years 1978-79 and 1981-82, respectively. It can be seen that the probability distribution function for the rural sector lies everywhere above that for the urban sector. It means that for any given poverty line z, the head-count ratio for the rural sector is always higher than that for the urban sector. Then applying proposition 18, it can be concluded that the country-wide poverty measured by the entire class of poverty measures S(k) for all k decreases monotonically as the proportion of population in the urban sector increases.

In order to determine how the welfare has changed during the period 1978-79 to 1981-82, it is necessary to convert the sectoral mean incomes given at current prices to constant prices. For this purpose we used the price index constructed by Edirisinghe (1985) which showed that prices increased by 92 % during the period of three years (from 1978-79 to 1981-82). The mean incomes in each sector at current and constant prices are given below.

Sectors	Mean Income at current prices		Mean Income at at constant prices	
	1978-79	1981-82	1978-79	1981-82
Urban	827.51	1625	827.51	846.19
Rural/ Estate	557.86	988	557.86	514.63
All Island	616.85	1111	616.85	578.58

These figures show that the real income in the urban sector has increased by 2.26 % in three years whereas in the rural/estate sector it has decreased by about 7.75 %. As a result, the real income in the entire population shows a decrease of about 6.20 %.

To compare the welfare levels over time, we plotted the generalized Lorenz curves for the years 1978-79 and 1981-82 (see figures 5, 6 and 7). It can be observed that the generalized Lorenz curve for the year 1978-79 lies everywhere above that for the year 1981-82 for whole island and the rural/estate sector (figures 5 and 7), which demonstrates that the welfare of the total population in Sri Lanka as well as that of the rural/estate population has decreased unambiguously.[3] In the case of urban sector population, however, it is not possible to say unambiguously whether the welfare has decreased or increased because the generalized Lorenz curves for the two years (1978-79 and 1981-82) cross three times (at points where p = .052, .097 and .988). In order to be able to make a definitive statement concerning the welfare change in the urban sector it will be necessary to compute single measures of welfare (see for instance Sen 1974 or Kakwani 1981).

Data on the distribution income were provided in the group form giving

(1) the number of income earners in each income range

(2) the total (for each range) of their incomes.

From these basic data we derived the data on p's and L(p)'s for each income range. The following equation of the Lorenz curve was estimated by the ordinary least-squares after applying the logarithmic transformation:

$$L(p) = p - ap^{\alpha} (1-p)^{\beta}$$

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3. When we say the welfare has decreased unambiguously, it means that this result is valid for a wide class of welfare functions(without specifying a welfare function).

where a, α and β are the parameters, and are assumed to be greater than zero. The sufficient conditions for L(p) to be convex to the p axis are $0 < \alpha \leqslant 1$ and $0 < \beta \leqslant 1$. This new functional form of the Lorenz curve was introduced by Kakwani (1981) in connection with the estimation of a class of welfare measures. This curve provided extremely good fit to the entire range of income distribution data on Sri Lanka and was used to estimate the various inequality measures.

A class of inequality measures which was estimated is the generalized Gini index proposed by Kakwani (1986):

$$G(k) = 1 - k(k+1) \int_0^1 L(p)(1-p)^{k-1}\, dp$$

which on substituting k = 1 leads to the well-known Gini index. The parameter k is the measure of inequality aversion. As k rises, more and more weight is attached to income transfers at the lower end of the distribution and less weight to transfer at the top.

The estimated values of various inequality measures are presented in Table 1. Kakwani's (1980) Lorenz measure given in the last row of the table is given by

$$L = \frac{\ell - \sqrt{2}}{2 - \sqrt{2}}$$

where ℓ is the lenght of the Lorenz curve. This measure is sensitive to income transfers at the lower end to income distribution. The conclusions emerging from this table are summarized below.

The urban sector distribution is more unequal than the rural/estate sector distribution in both years. This is evident from the estimates of all the inequality measures. However, the gap between intra-sectoral inequalities in the two sectors has widened considerably during the period 1978-79 to 1981-82. It means the inequality in the urban sector distribution has increased considerably more than that in the rural/estate sector. This is an important finding because it has implication for the inverted U-shaped curve which will be discussed at a later stage.

The magnitude of the gap between the intra-sectoral inequalities in the two sectors depends on the particular inequality measure. It is observed that the gap becomes narrower as the parameter of inequality aversion increases. For instance in the case of Atkinso's measures $A(\varepsilon)$, ε measures the degree of inequality aversion - the larger the value of ε, more and more weight is attached to the lower end of the distribution than at the middle and at the top. As ε increases, the inequality gap between the two sectors decreases from .017 to .012 in 1978-79 survey.

The income inequality has increased in both the sectors as well as in all island during the period 1978-79 and 1981-82. This conclusion follows from all inequality measures (except A(2.0) for rural/estate sector). The income share of the first four quintile has decreased and that of the fifth quintile increased during the three-year period.

Next we derived the behaviour of income inequality when the proportion of population in the urban sector (α) varies from 0 to 1 keeping intra-sectoral distributions unchanged. The results are presented in figures 8 to 33. These diograms show how the indicators of inequality change when the proportion of population in the modern sector increases. Figures 8 to 18 display the inequality-development relationship based on the income shares of each of the five quintiles for the years 1978-79 and 1981-82.

It can be seen that the income shares of the first two quintiles follow the U-shaped curve - the share decreases first and then it increases. This is observed in both 1978-79 and 1981-82 surveys. The share of the third quintile follows the U-shaped curve for the year 1978-79 but in 1981-82, it decreases monotonically. The share of the fourth quintile decreases monotonically in both years as α increases from 0 to 1. The income share of the 5th quintile, however, follows the inverted U-shaped curve - i.e., it increases first and then decreases during the year 1978-79 but in 1981-82, this share increases monotonically as α varies from 0 to 1. Although these observations provide insight into the changes in the country-wide income distribution at quintile points, they do no permit us to draw the definitive conclusions regarding the behaviour of inequality-development relationship. And, therefore, we turn to the remaining diograms (figures 19 to 33) which display the inequality-development relationships in terms of single measures of income inequality.

It can be observed that most of the inequality measures follow the inverted U-shaped pattern of development as hypothesized by Kuznets, i.e., with development, the inequality increases first and then decreases. However, the turning points depend on the inequality measure used. Table 2 provides the turning points for various measures of inequality. Several conclusions can be drawn from this table.

First, it is important to know where the turning point occurs - whether at the early stages of development or at the late stage. It is apparent that the inequality starts declining at a fairly late stage of development. The minimum value of α is .556 and the maximum 1.0 and in almost all developing countries the actual value of α is considerably less than .566. It means that it will be considerably long time before the inequality starts declining in the developing countries unless, of course, governments in these countries follow the development strategy which redistributes income in favour of low income earners.

Second, the different measures of inequality vary with respect to the degree of inequality aversion. For instance, the generalized Gini index G(k) becomes more and more sensitive to income transfers at the bottom end of the distribution as k increases. It is interesting to note that the turning point changes systematically with respect to the degree of inequality aversion - the greater the degree of inequality aversion, the smaller the turning point. This is an important finding - it implies that with economic development poverty starts declining earlier than the income inequality.

Third, in the case of some inequality measures, the turning point occurs when $\alpha = 1.0$ which means that the inequality may never decline with economic development implying that the Kuznets's inverted U-shaped curve does not always exist.

Fourth, comparing 1978-79 and 1981-82 years it can be seen that turning points have shifted forward for all inequality measures. Some of the measures which followed the inverted U-shaped curve in 1978-79 show the monotonic increase in income inequality. It means that intra-sectoral distributions have changed (during the three-year period) such a way that it will take much longer for income inequality in the country-wide distribution to decrease (if at all) during the normal course of economic development. It was observed earlier that the gap between the intra-sectoral inequalities has considerably widened which has the effect of shifting the turning forward. Thus, our emprical results are consistent with the theory discussed in Section 4.

Next we discuss the empirical results on poverty in Sri Lanka which are presented in Table 3. The poverty line was assumed to be Rs 200 per month at 1978-79 prices. Since the analysis presented here is of illustrative nature, it is unnecessary to discuss the controversy surrounding the specification of the poverty line.

It can be observed that the poverty has increased in the rural/estate sector and in the all Island during the period 1978-79 to 1981-82. This is indicated by all the poverty measures. Since the generalized Lorenz curve for 1978-79 lies everywhere above that for 1981-82 for the rural/estate sector and for the all Island, then from Lemma 1 it follows that the poverty measured by all decomposable poverty measures must increase for all poverty lines. Thus, our empirical results are consistent with the theoretically derived results.

Since the generalized Lorenz curves for the years 1978-79 and 1981-82 in the urban sector intersect, it is not possible to say, apriori, whether the poverty in the urban sector has increased or decreased over time. It is interesting to observe that the poverty measured by decomposable measures which also include Normalized deficit decreases during the period from 1978-79 to 1981-82 whereas, that measured by head-count ratio and Kakwani's class of measures (which also includes Sen's measure) increases during the same period. Thus, the choice of poverty measures (whether decomposable or non-decomposable) is important in determining the direction of change in poverty.

TABLE 1. INEQUALITY MEASURES: INCOME RECEIVERS
SRI LANKA 1978-79 AND 1981-82

Inequality Measures	1978-79			1981-82		
	Urban sector	Rural/Estate sector	Total	Urban sector	Rural/Estate sector	Total
Quintile Shares						
1	3.72	3.81	3.65	3.55	3.69	3.58
2	8.01	8.33	8.06	7.41	8.01	7.72
3	12.80	13.35	13.03	11.66	13.03	12.46
4	20.13	20.83	20.55	18.37	20.66	19.80
5	55.35	53.68	54.71	59.00	54.61	56.43
Generalized Gini						
G(1.0)	.510	.493	.505	.546	.503	.522
G(1.5)	.587	.572	.583	.617	.583	.598
G(2.0)	.637	.625	.636	.664	.635	.649
Atkinson's measure						
A(1.0)	.384	.367	.380	.426	.374	.397
A(1.5)	.499	.485	.501	.529	.494	.513
A(2.0)	.626	.622	.634	.650	.611	.635
Generalized Entropy						
T_0	.484	.457	.478	.555	.468	.505
T_1	.517	.473	.499	.620	.494	.545
T_2	1.484	1.179	1.32	2.496	1.268	1.666
Kakwani's Lorenz measure	.215	.201	.211	.247	.212	.225

TABLE 2. TURNING POINTS FOR INVERTED U-SHAPED CURVE:
SRI LANKA, INCOME RECEIVERS, 1978-79 to 1981-82

Inequality Measures	1978-79 %	1981-82 %
Income share of lowest		
20 % population	55.6	62.3
40 % "	59.1	71.2
60 % "	65.3	84.3
80 % "	74.1	100.0 (monot. incr.)
Generalized Gini		
G(1.0)	70.00	95.00
G(1.5)	65.31	86.09
G(2.0)	63.59	81.17
Atkinson's measure		
A(1.0)	66.6	88.8
A(1.5)	59.5	69.8
A(2.0)	59.8	69.6
Generalized Entropy		
T_0	67.2	88.8
T_1	76.3	100.0
T_2	100.0	100.0
Kakwani's Lorenz measure	68.1	100.0

TABLE 3. POVERTY MEASURES: INCOME RECEIVERS
SRI LANKA 1978-79 AND 1981-82

Poverty Measures	1978-79 Urban sector	1978-79 Rural/Estate sector	1978-79 Total	1981-82 Urban sector	1981-82 Rural/Estate sector	1981-82 Total
Head-count ratio	17.24	25.92	24.23	17.83	29.78	27.26
Normalized deficit	6.07	9.90	9.23	6.06	11.85	10.48
Kakwani's Measures k equals						
1.0	7.59	13.23	12.15	7.78	15.71	13.91
1.5	8.45	14.41	13.26	8.68	16.96	15.10
2.0	9.14	15.33	14.12	9.41	17.93	16.03
Decomposable poverty measures α equals						
1.5	4.23	7.08	6.59	4.19	8.53	7.47
2.0	3.11	5.32	4.94	3.07	6.42	5.60
2.5	2.39	4.15	3.85	2.35	5.00	4.34
3.0	1.90	3.33	3.08	1.86	3.99	3.46

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Figure 1. GENERALIZED LORENZ CURVES FOR URBAN AND RURAL SECTORS: INCOME RECIPIENT UNITS IN SRI LANKA 1978-1979

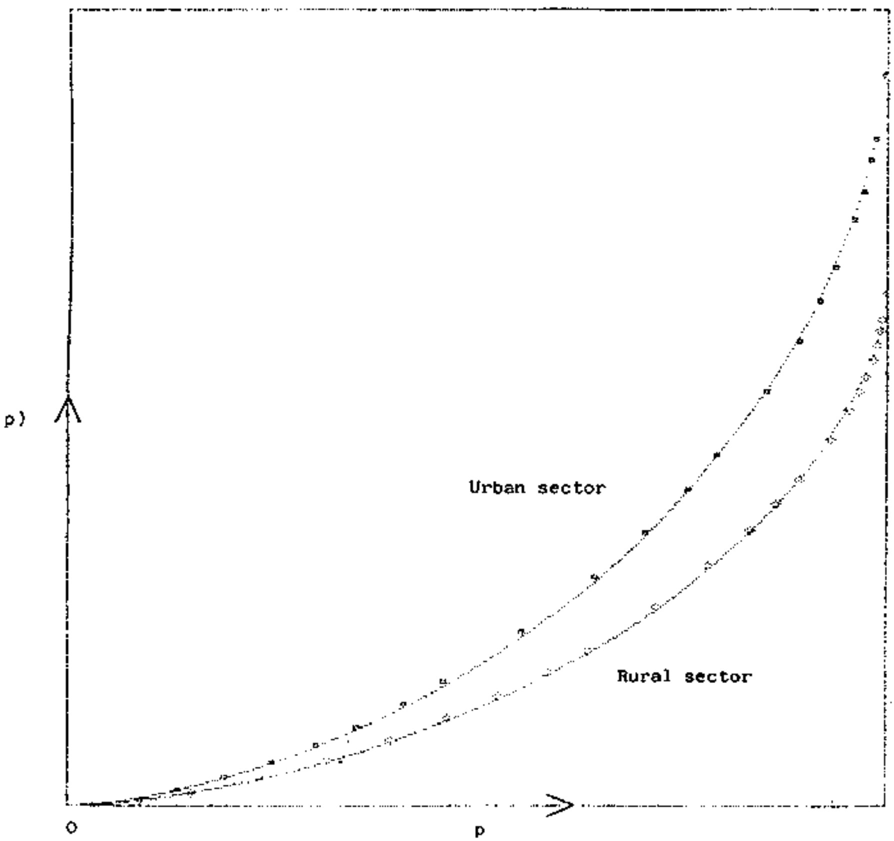

Figure 2. GENERALIZED LORENZ CURVES FOR URBAN AND RURAL SECTORS: INCOME RECIPIENT UNITS I SRI LANKA 1981-1982

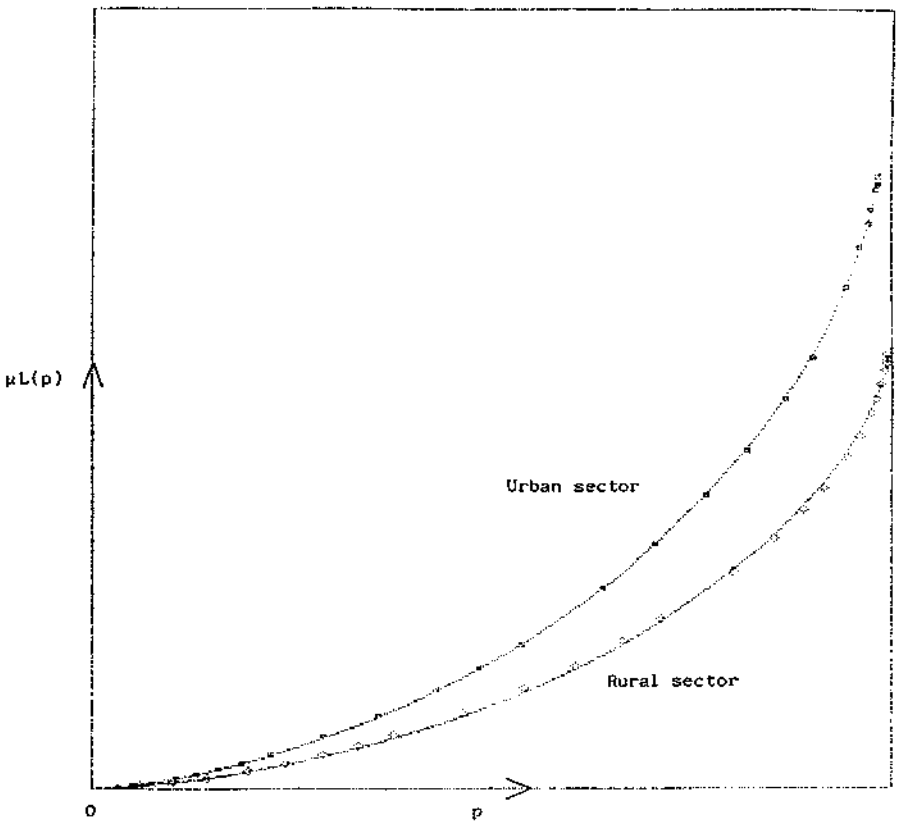

Figure 3. PROBABILITY DISTRIBUTION FUNCTION FOR URBAN AND RURAL SECTORS: INCOME RECIPIENT UNITS IN SRI LANKA 1978–1979

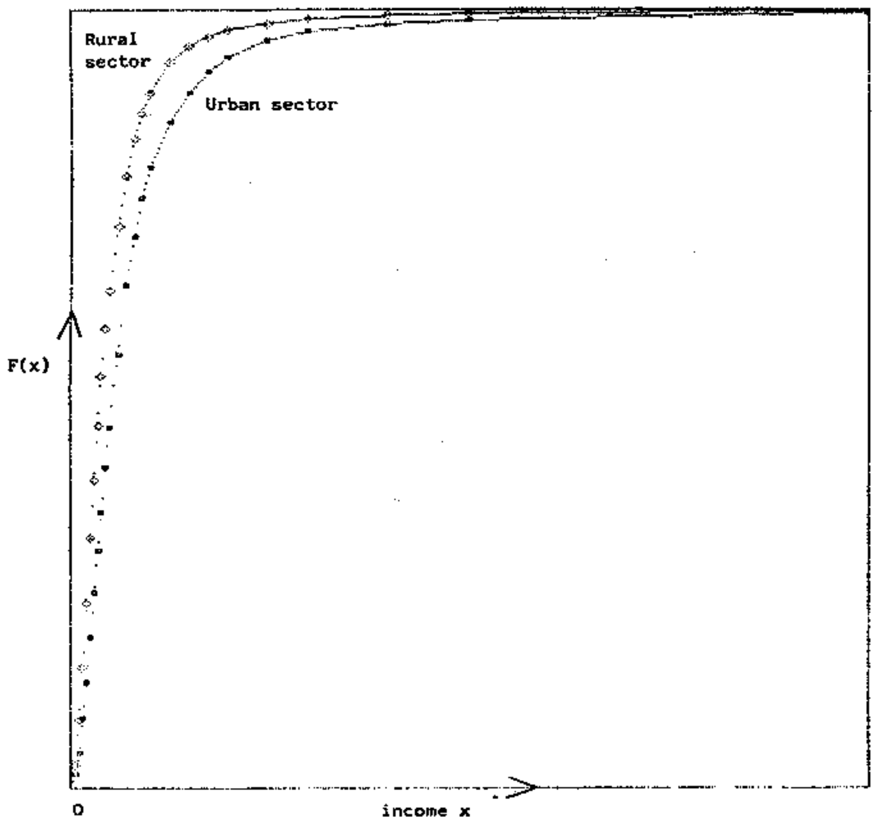

Figure 4. PROBABILITY DISTRIBUTION FUNCTION FOR URBAN AND RURAL SECTORS: INCOME RECIPIENT UNITS IN SRI LANKA 1981-1982

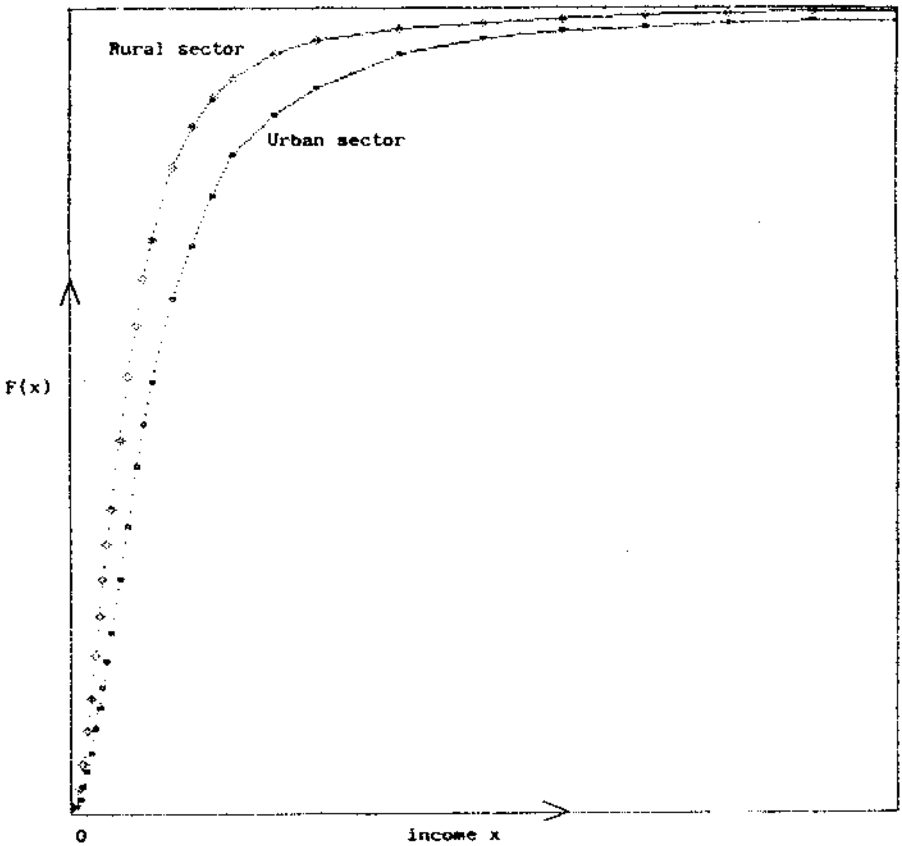

FIGURE 5. PLOT OF GENERALIZED LORENZ CURVES FOR TWO YEARS: 1978-79 AND 1981-82, SRI LANKA, ALL ISLAND

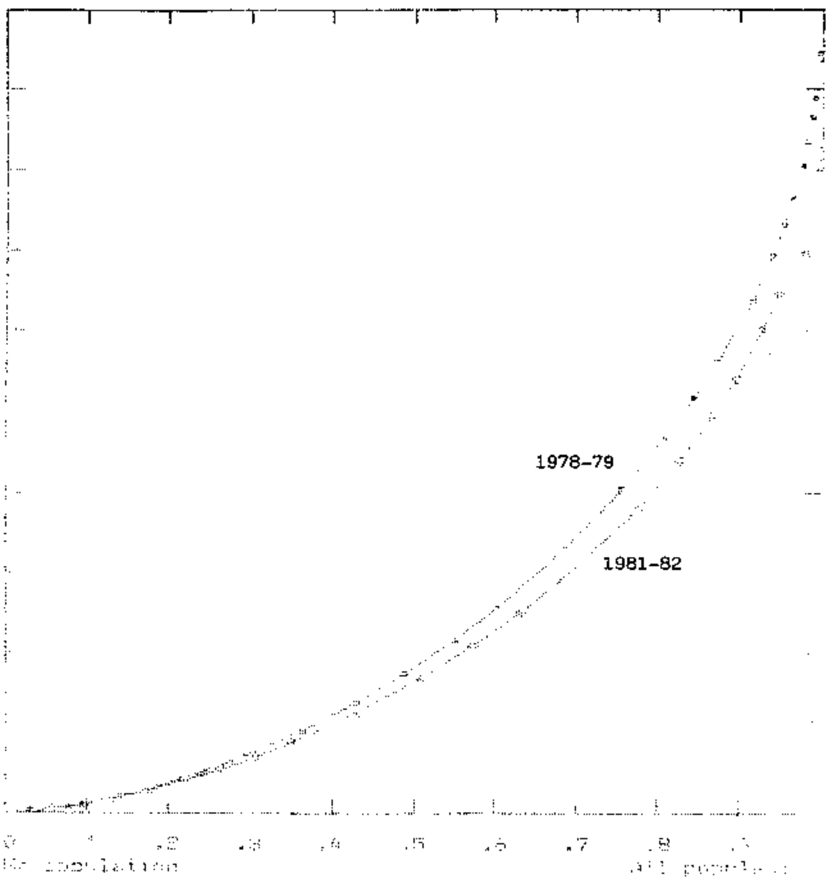

FIGURE 6. PLOT OF GENERALIZED LORENZ CURVE FOR TWO YEARS: 1978-79 AND 1981-82, SRI LANKA, URBAN SECTOR

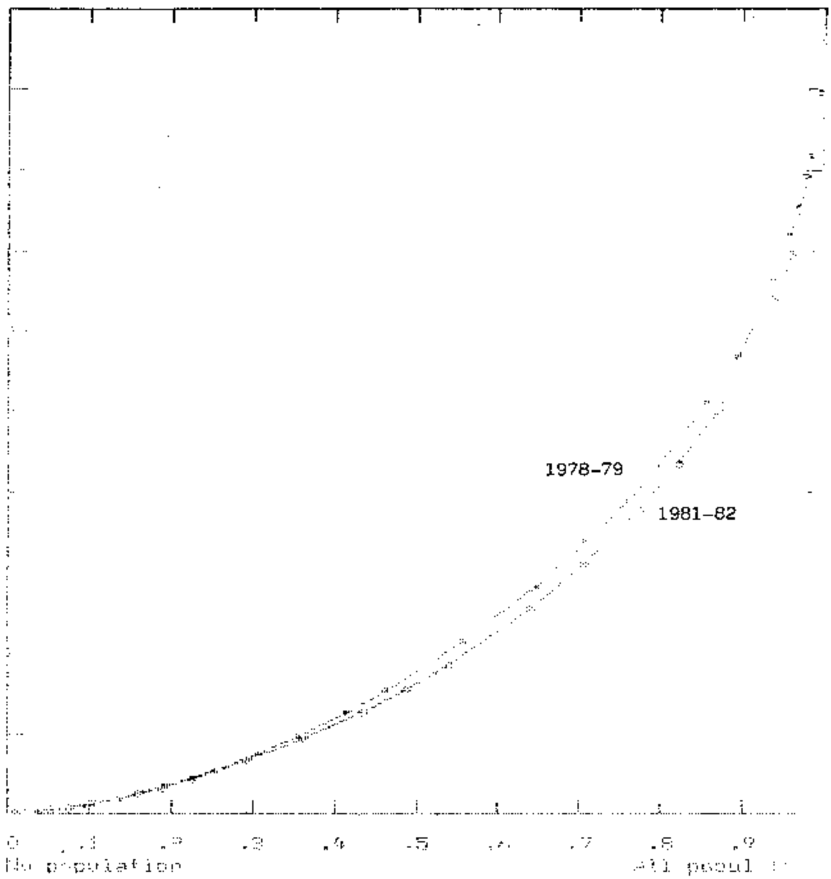

FIGURE 7. PLOT OF GENERALIZED LORENZ CURVES FOR TWO YEARS: 1978-79 AND 1981-82, SRI LANKA, RURAL/ESTATE SECTOR

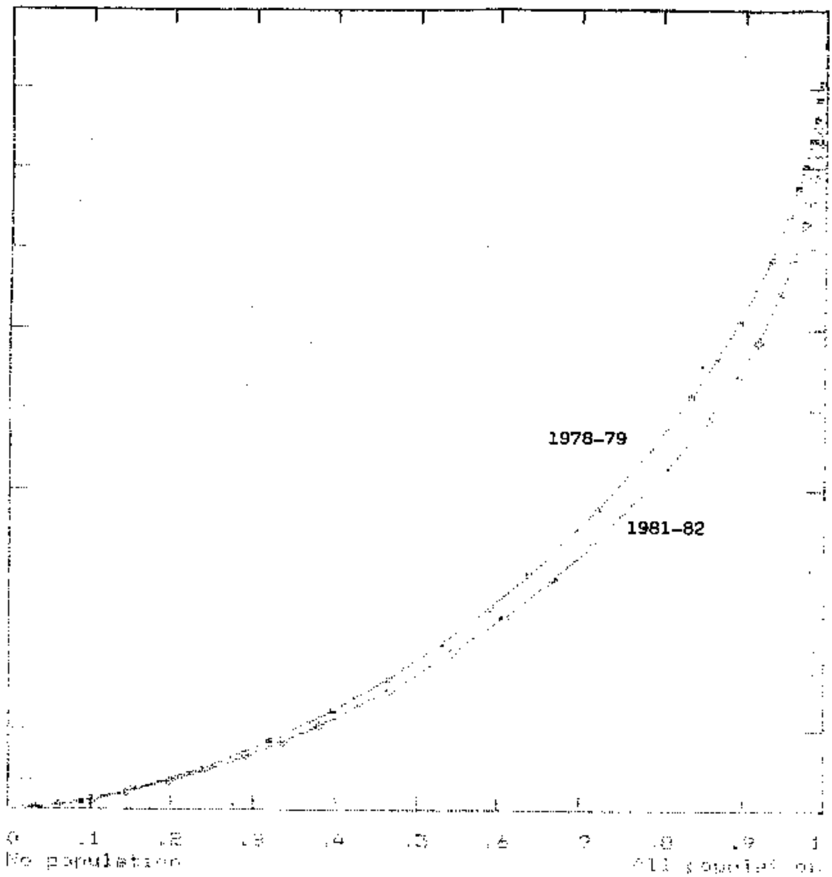

FIGURE 8. INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON THE INCOME-SHARE OF THE POOREST 20 % POPULATION: SRI LANKA, 1978-79

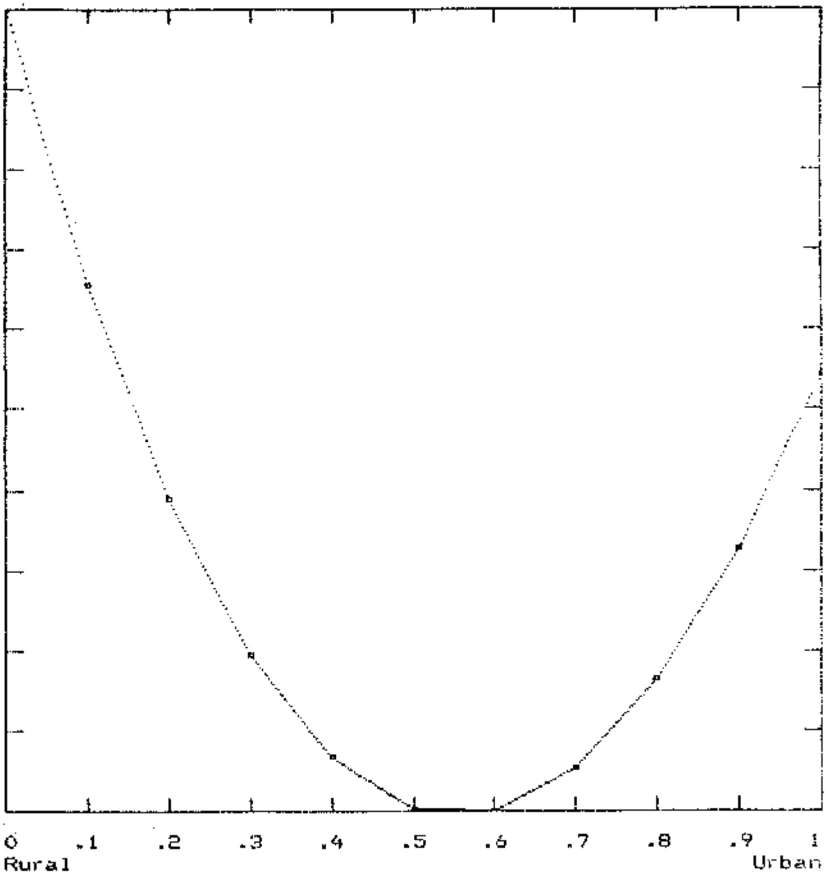

FIGURE 9. INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON THE INCOME-SHARE OF THE POOREST 20 % POPULATION: SRI LANKA, 1981-82

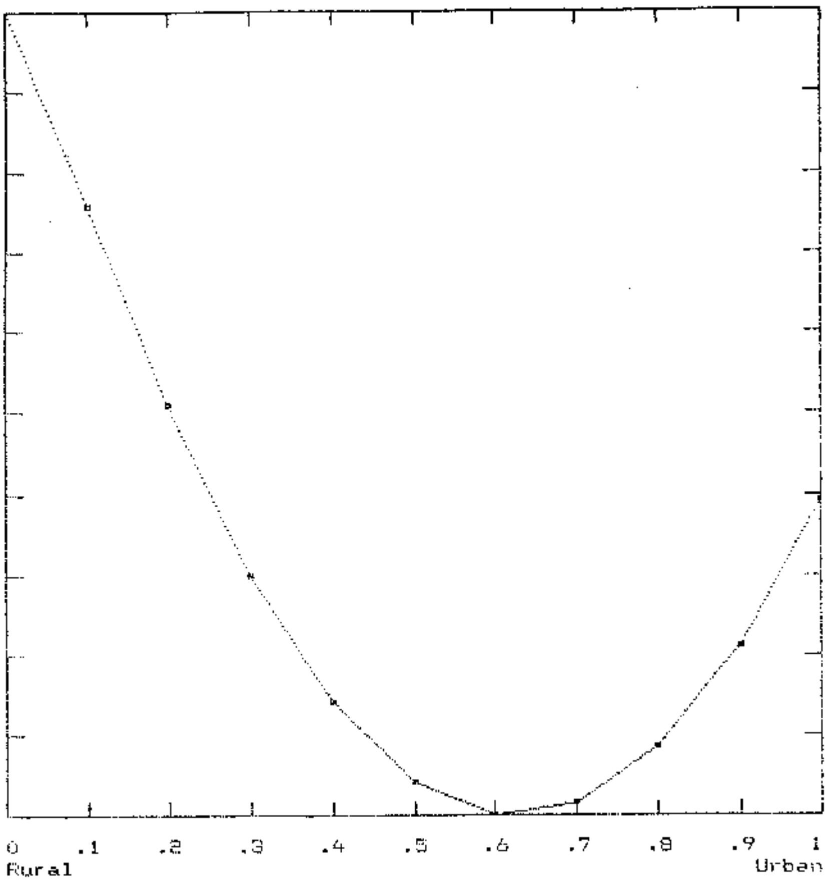

FIGURE 10 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON THE INCOME-SHARE OF THE 2nd QUINTILE: SRI LANKA, 1978-79

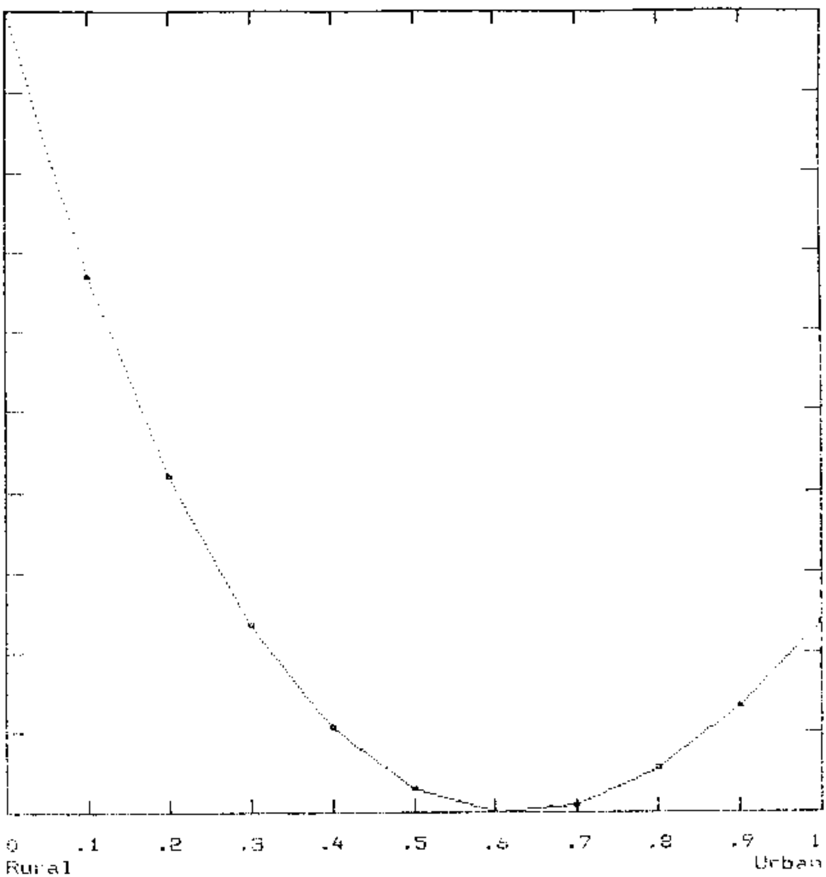

FIGURE 11 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON THE INCOME-SHARE OF THE 2nd QUINTILE: SRI LANKA, 1981-82

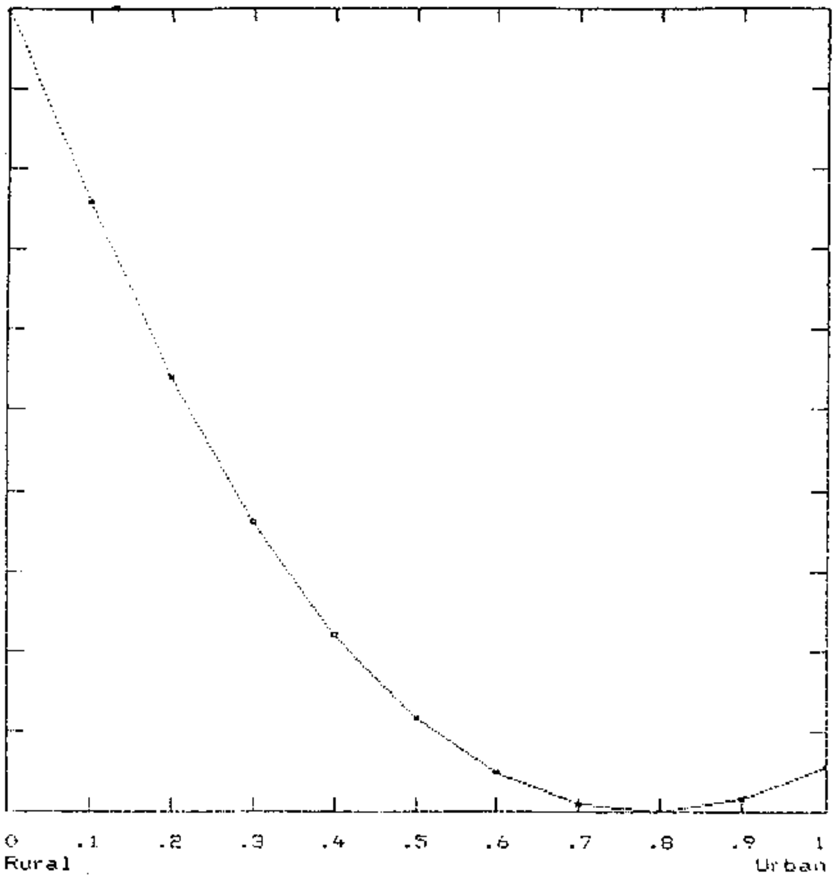

FIGURE 12 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON THE INCOME-SHARE OF THE 3rd QUINTILE: SRI LANKA, 1978-79

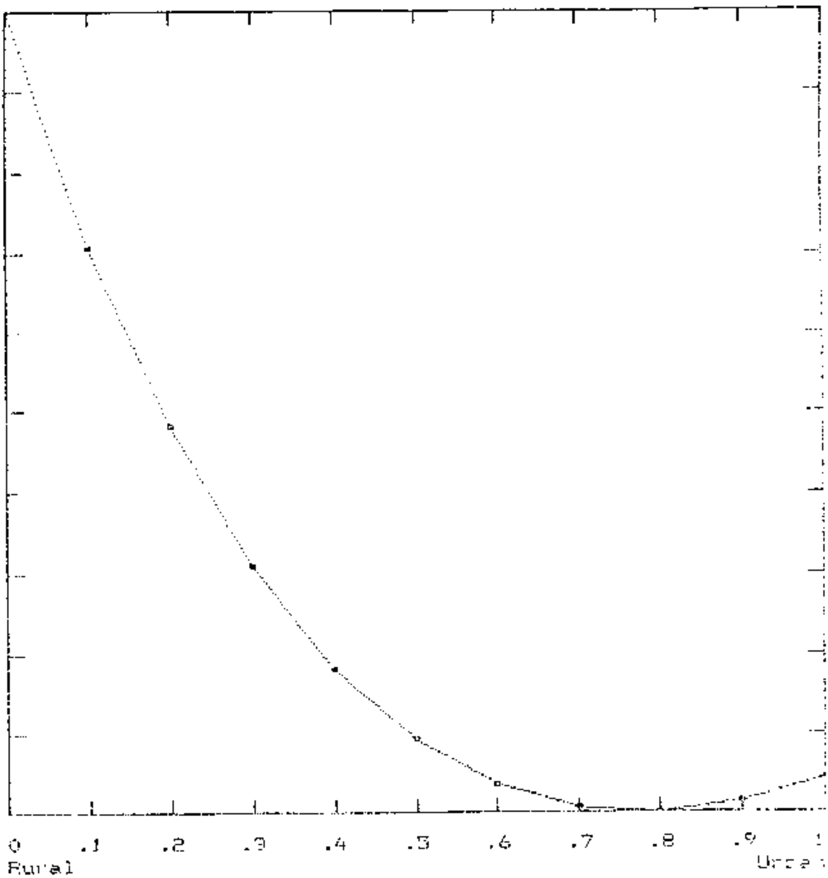

FIGURE 13 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON THE INCOME-SHARE OF THE 3rd QUINTILE: SRI LANKA, 1981-82

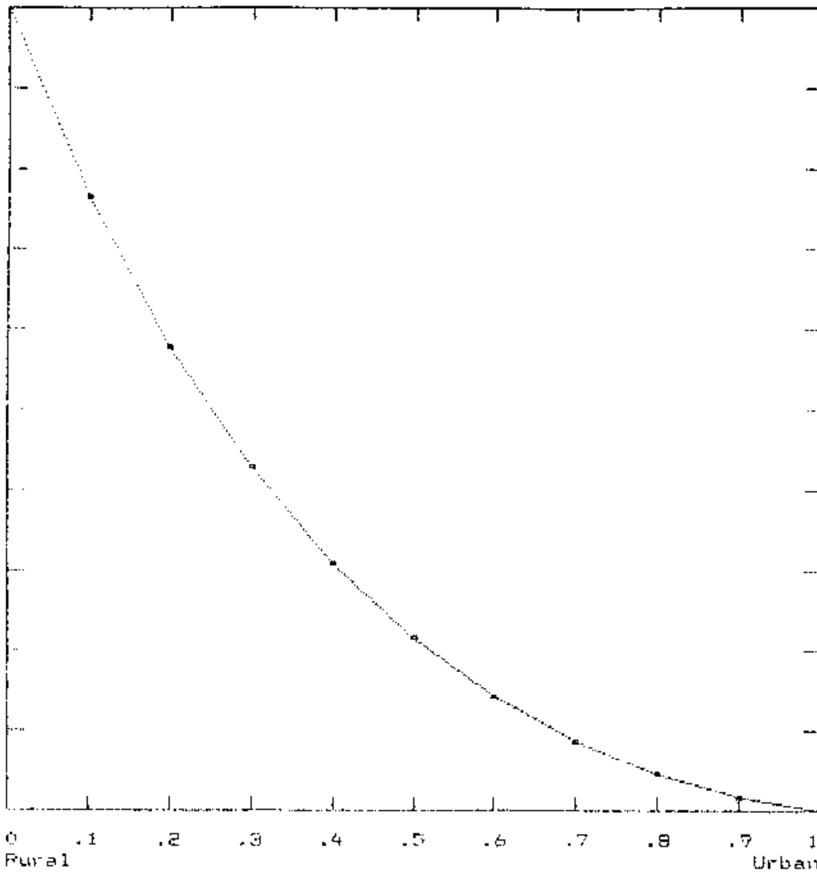

FIGURE 14 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON THE INCOME-SHARE OF THE 4th QUINTILE: SRI LANKA, 1978-79

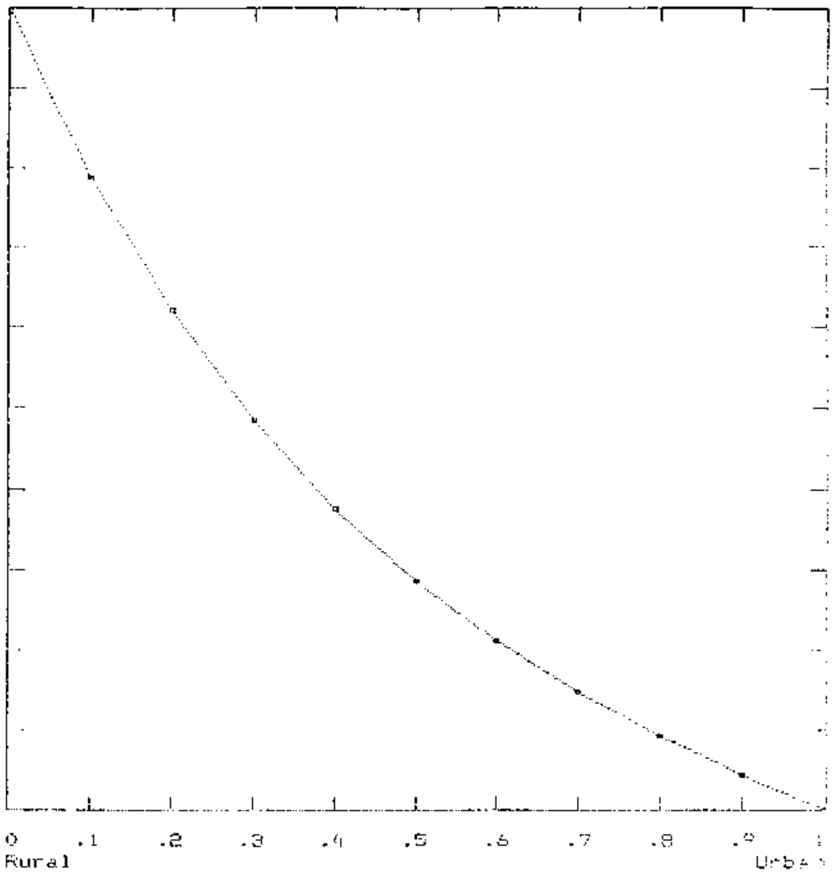

FIGURE 15 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON THE INCOME-SHARE OF THE 4th QUINTILE: SRI LANKA, 1981-82

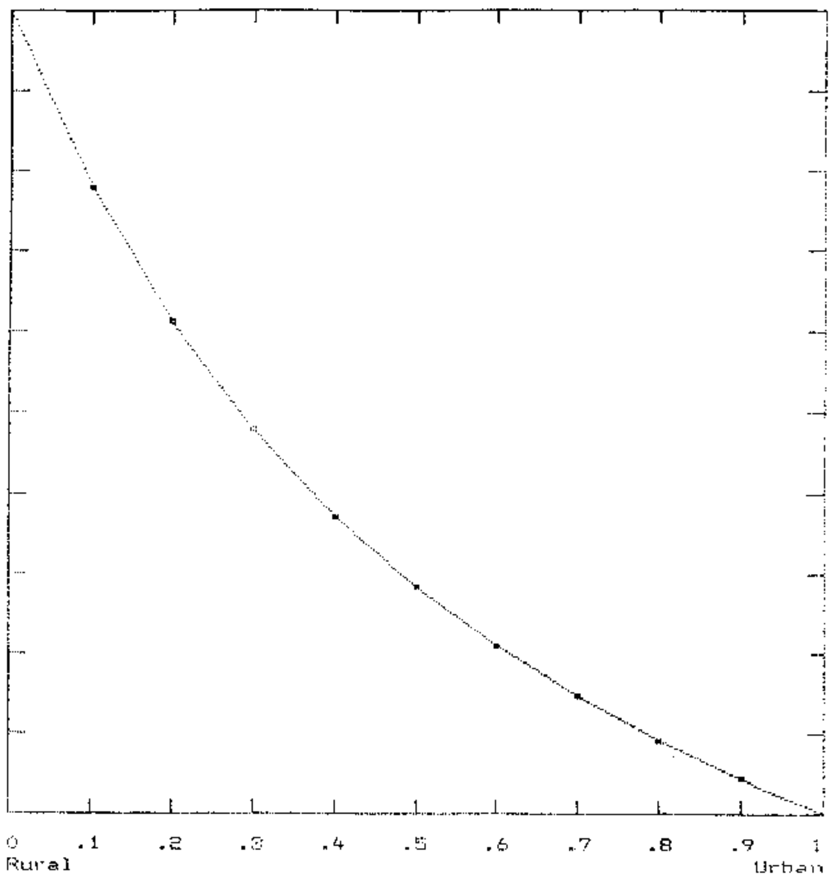

FIGURE 16 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON THE INCOME-SHARE OF THE 5th QUINTILE: SRI LANKA, 1978-79

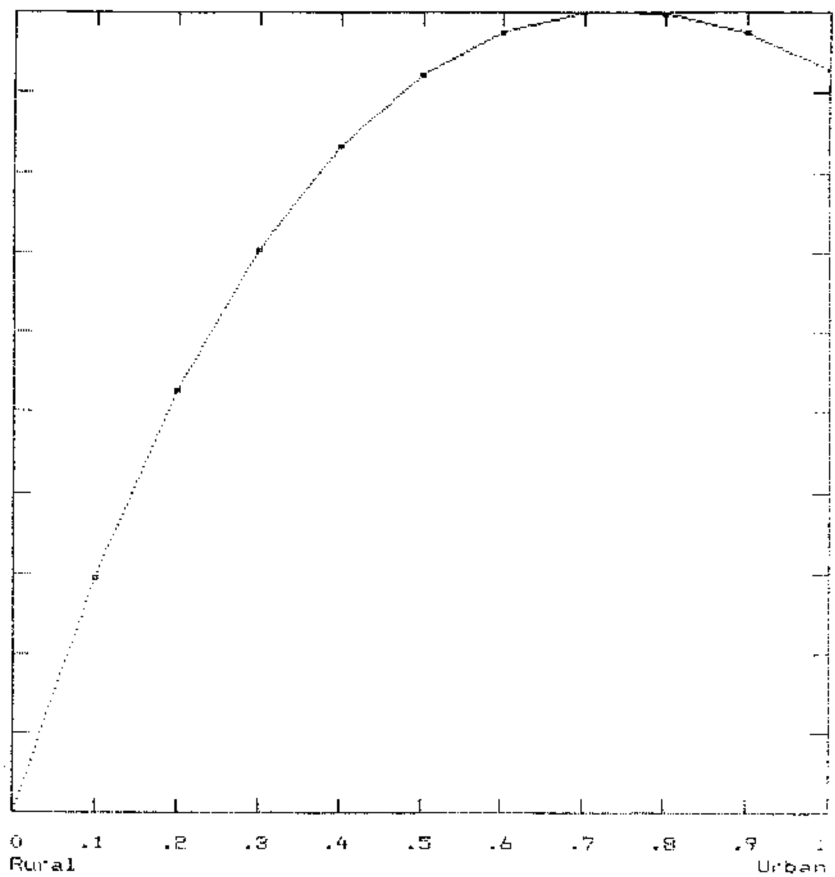

FIGURE 17 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON INCOME-SHARE OF THE 5th QUINTILE: SRI LANKA 1981-82

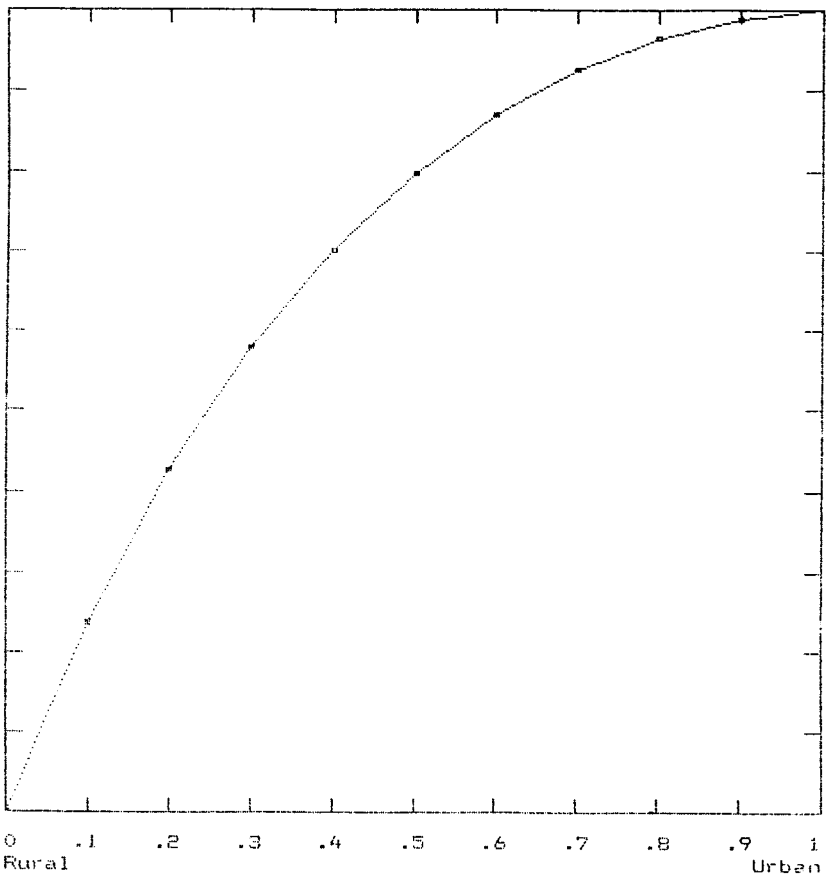

FIGURE 18 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON ATKINSON'S MEASURE FOR ϵ = 1.0, SRI LANKA, 1978-79

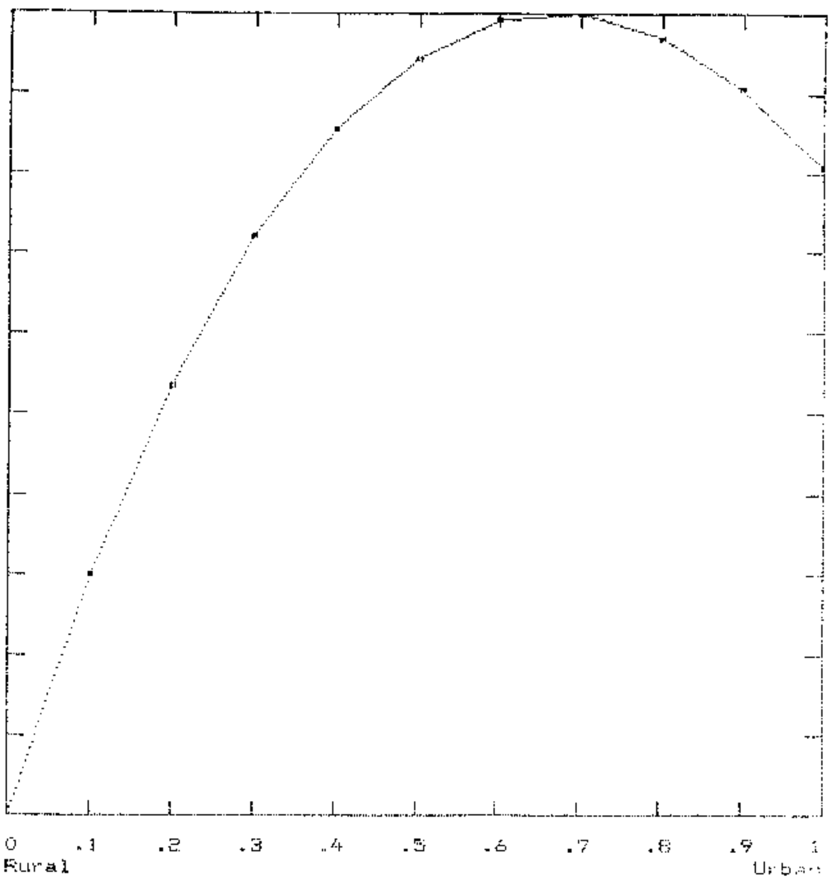

FIGURE 19 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON ATKINSON'S MEASURE FOR ϵ = 1.0, SRI LANKA, 1981-82

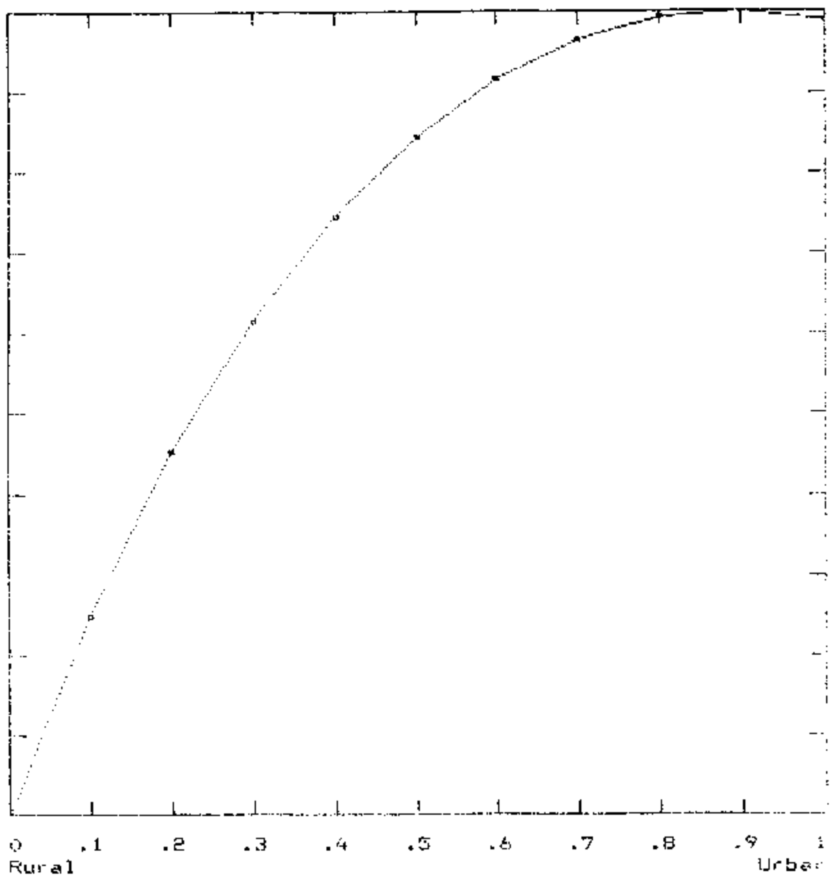

FIGURE 20 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON ATKINSON'S MEASURE FOR ϵ = 1.5, SRI LANKA, 1978-79

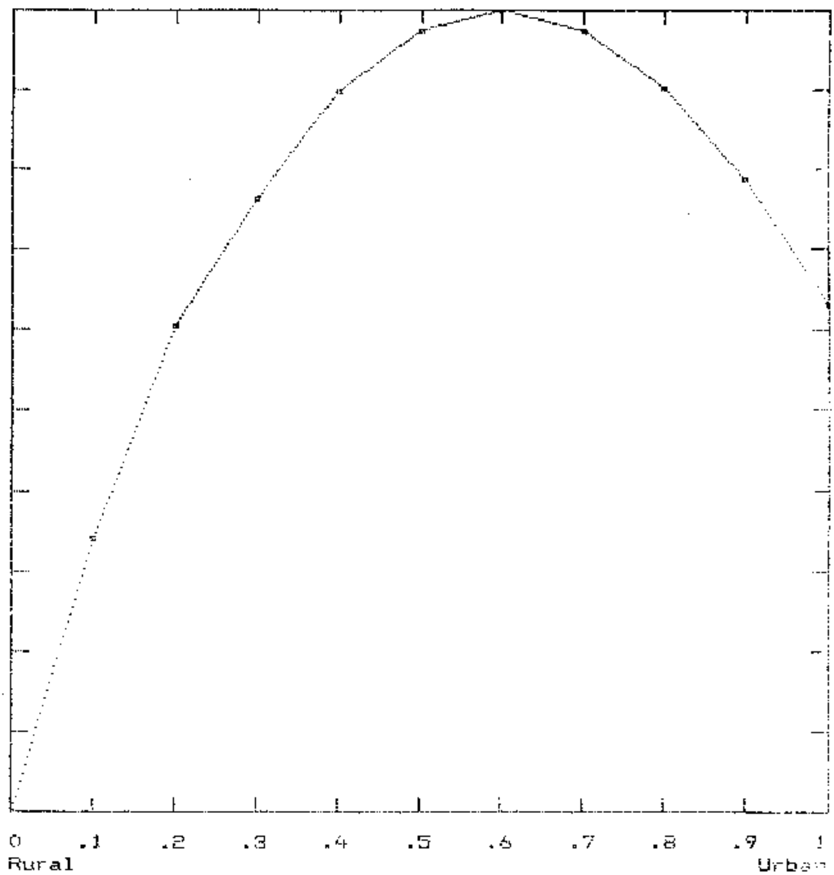

FIGURE 21 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON ATKINSON'S MEASURE FOR ε = 1.5, SRI LANKA, 1981-82

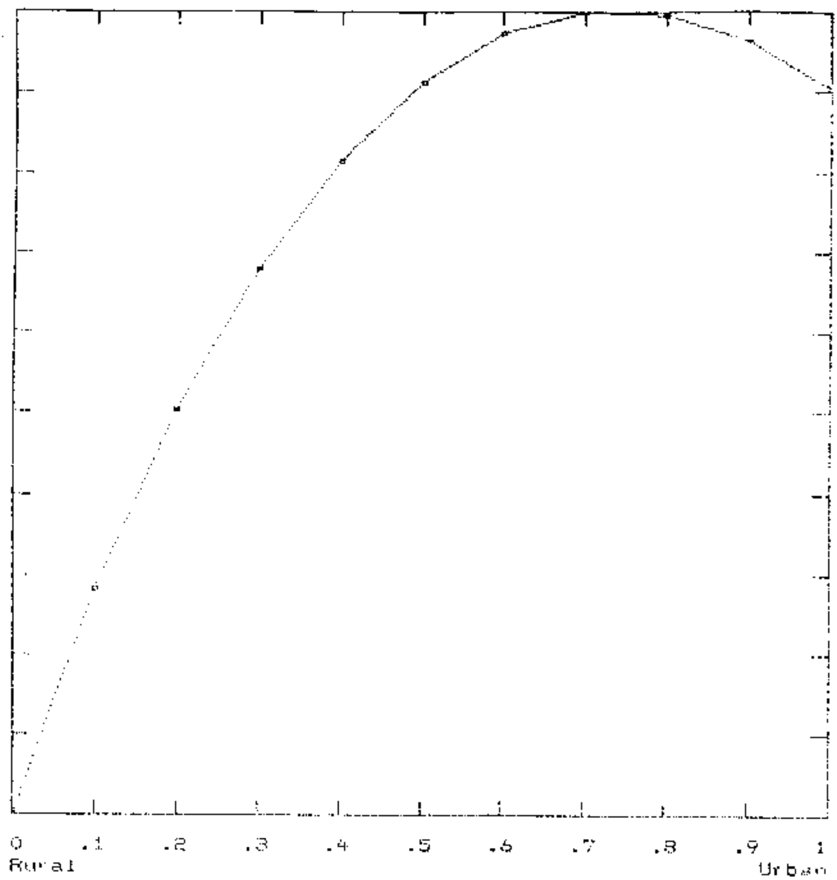

FIGURE 22 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON ATKINSON'S MEASURE FOR ϵ = 2.0, SRI LANKA, 1978-79

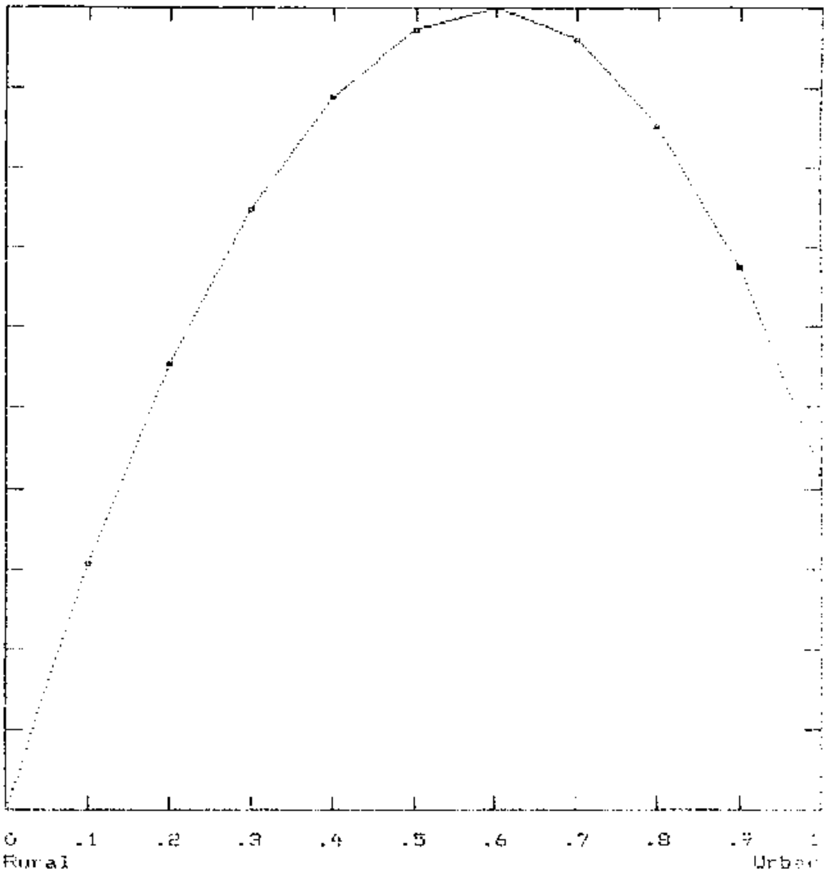

FIGURE 23 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON ATKINSON'S MEASURE FOR ε = 2.0, SRI LANKA, 1981-82

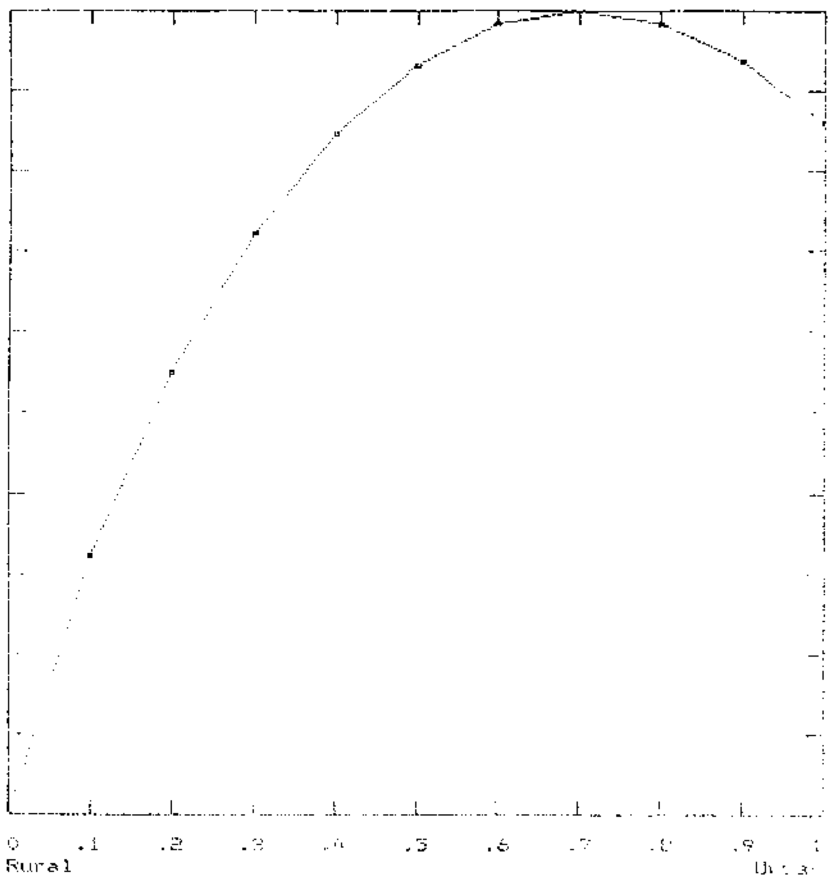

FIGURE 24 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON GINI INDEX: SRI LANKA, 1978-79

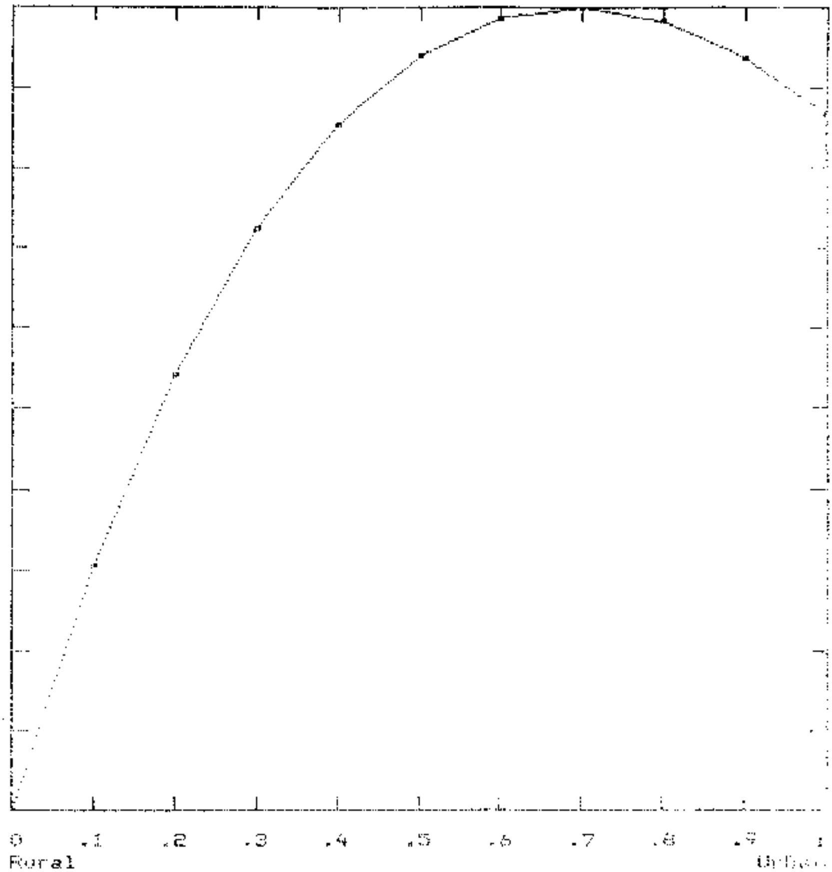

FIGURE 25 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON GINI INDEX: SRI LANKA, 1981-82

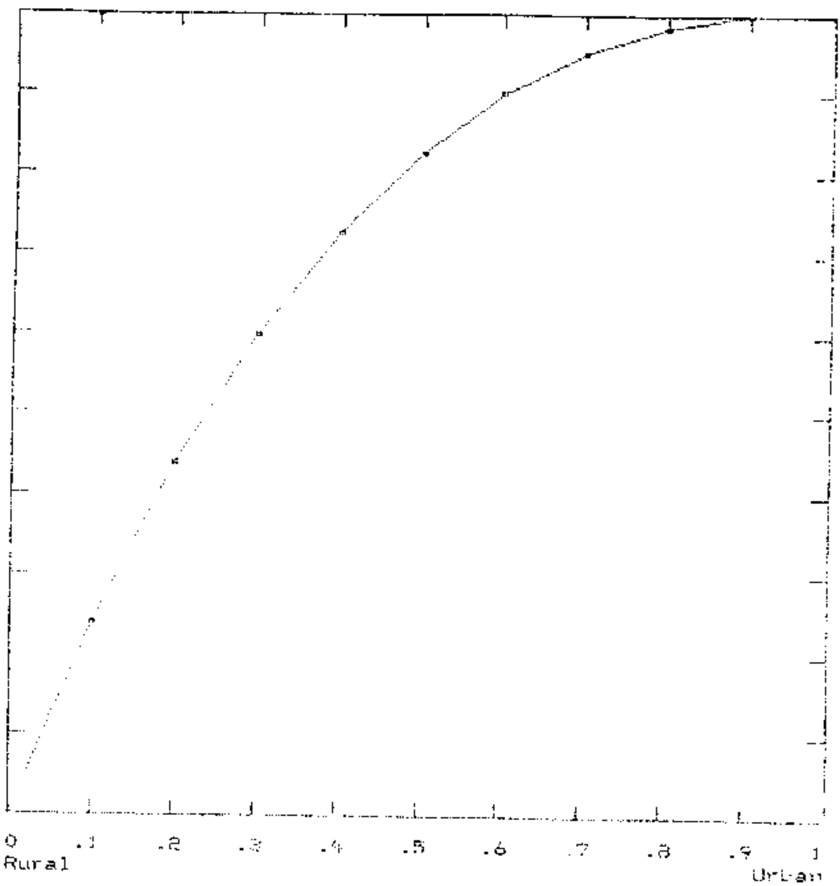

FIGURE 26 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON GENERALIZED GINI INDEX FOR k = 1.5, SRI LANKA, 1978-79

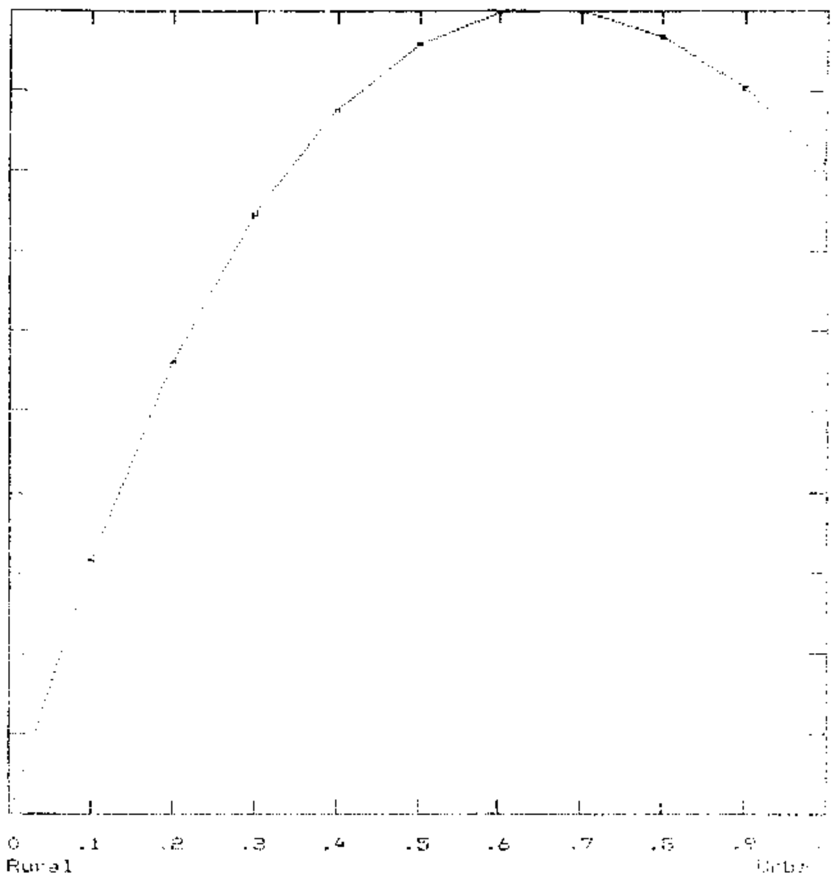

FIGURE 27 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON GENERALIZED GINI INDEX FOR k = 1.5, SRI LANKA 1981-82

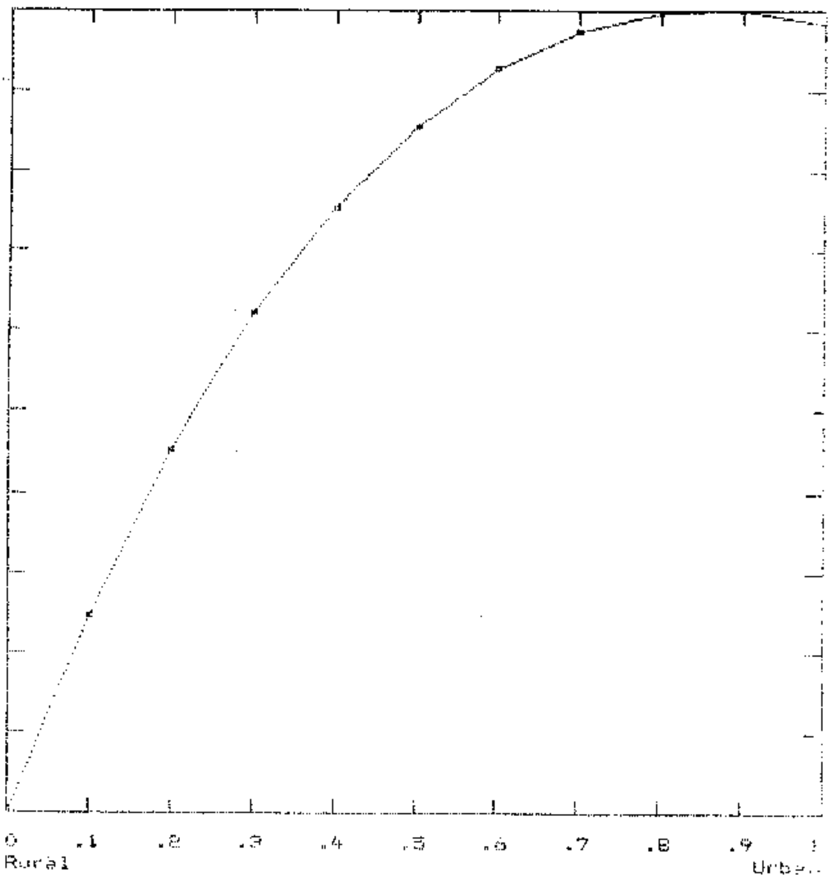

FIGURE 28 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON GENERALIZED GINI INDEX FOR k = 2, SRI LANKA, 1978-79

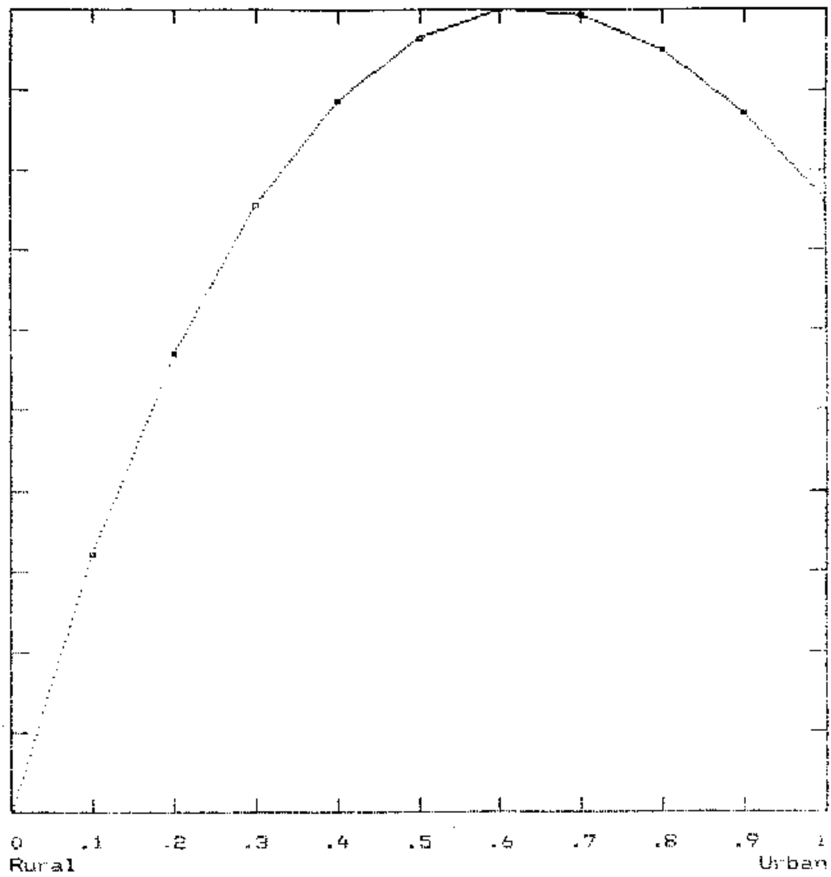

FIGURE 29 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON GENERALIZED GINI INDEX FOR k = 2, SRI LANKA, 1981-82

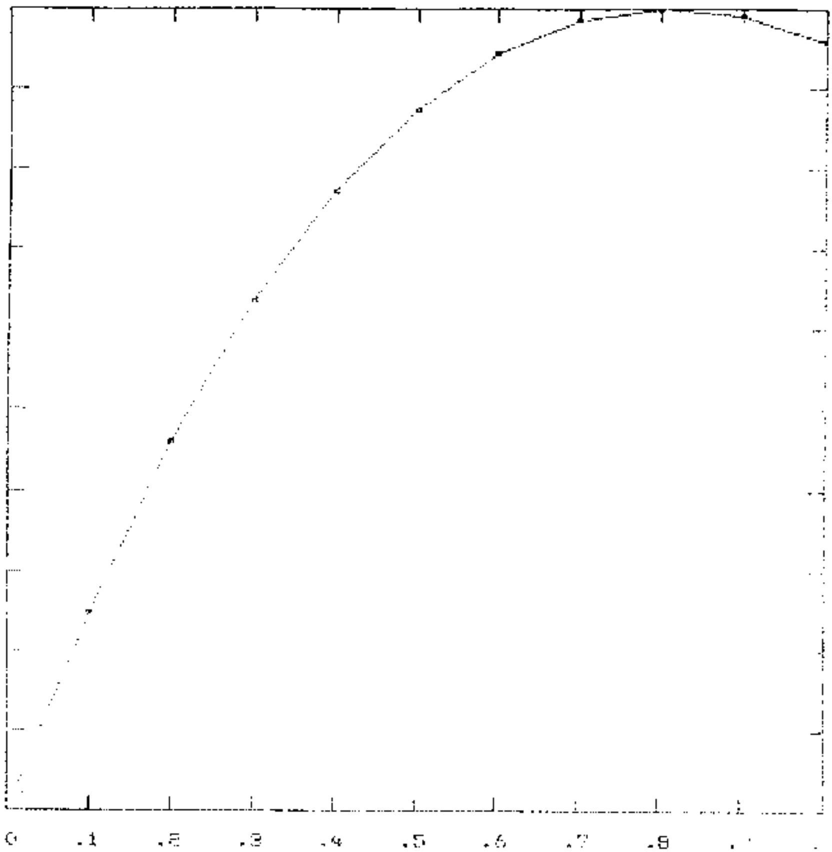

FIGURE 30 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON GENERALIZED ENTROPY MEASURE T_0: SRI LANKA, 1978-79

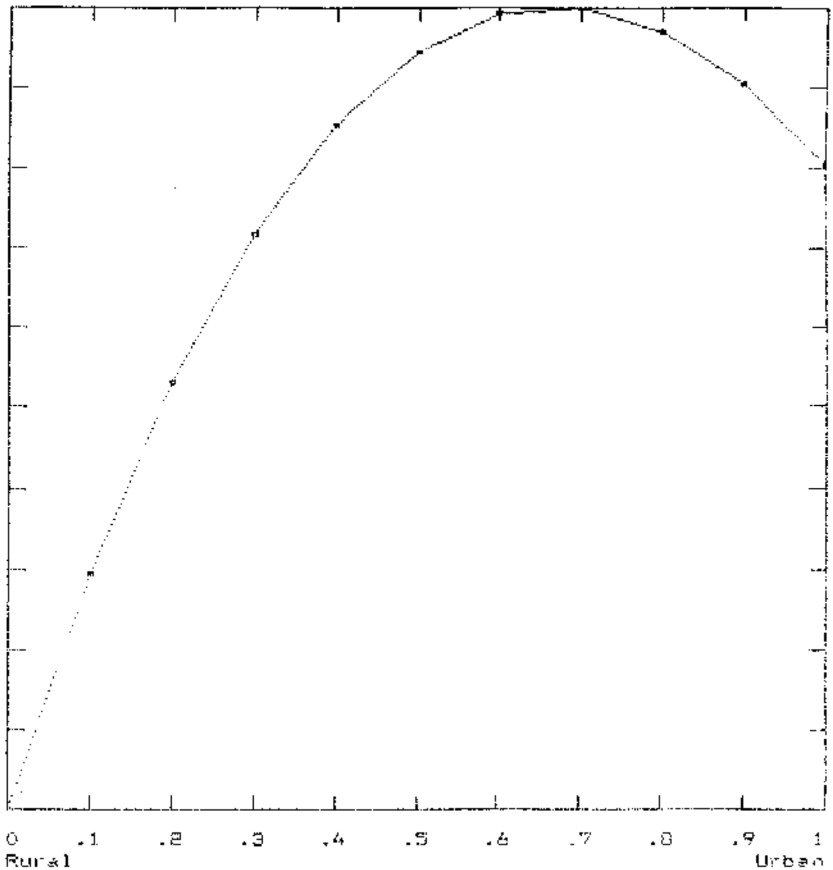

FIGURE 31 INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON GENERALIZED ENTROPY MEASURE T_0: SRI LANKA, 1981-82

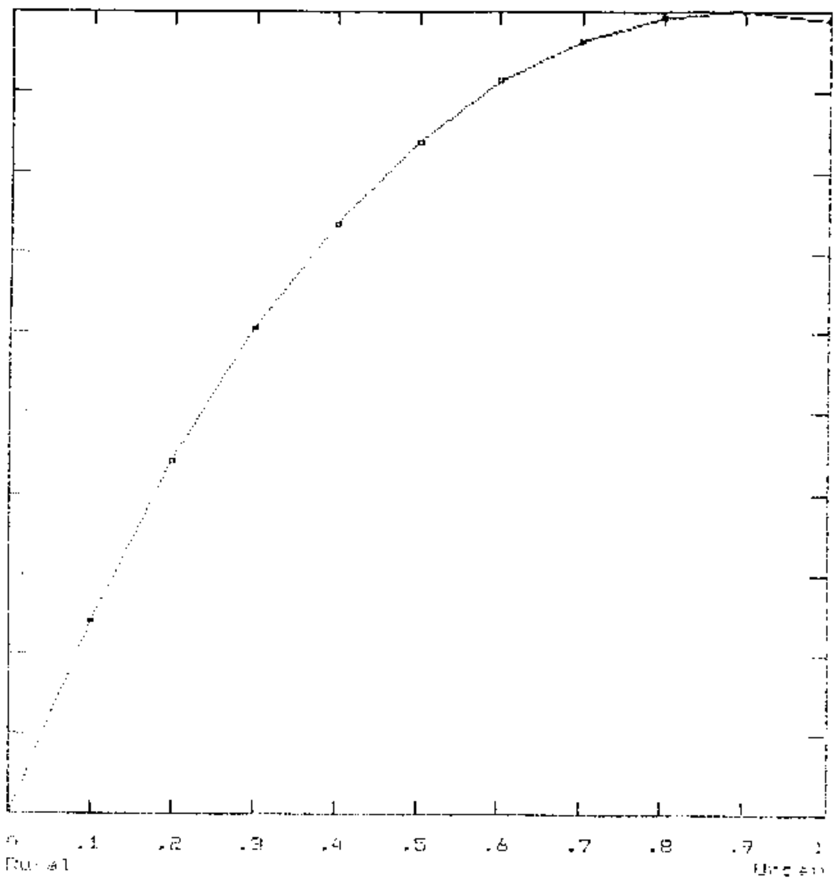

FIGURE 32. INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON GENERALIZED ENTROPY MEASURE, T_1: SRI LANKA, 1978-79

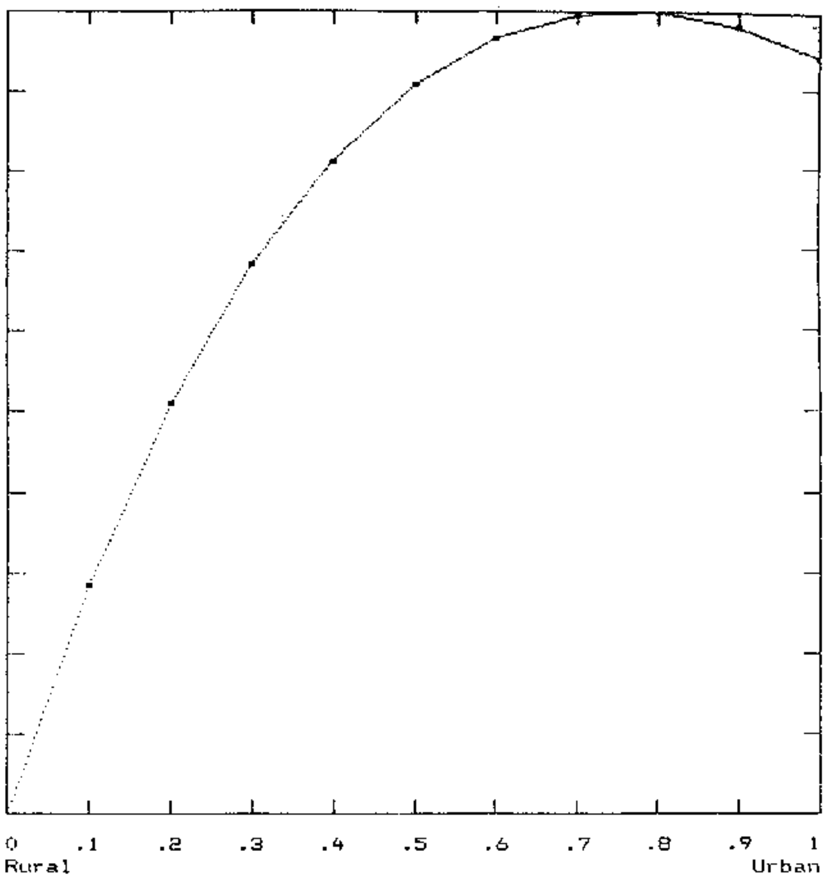

FIGURE 33. INEQUALITY-DEVELOPMENT RELATIONSHIP BASED ON GENERALIZED ENTROPY MEASURE, T_1: SRI LANKA, 1981-82