

UCD CENTRE FOR ECONOMIC RESEARCH

WORKING PAPER SERIES

2012

**Growth and Income Redistribution Components of Changes in
Poverty: A Decomposition Analysis for Ireland, 1987-2005**

Wasiu Adekunle Are, University College Dublin

WP12/31

December 2012

**UCD SCHOOL OF ECONOMICS
UNIVERSITY COLLEGE DUBLIN
BELFIELD DUBLIN 4**

Growth and Income Redistribution Components of Changes in Poverty: A Decomposition Analysis for Ireland, 1987-2005

Wasiu Adekunle Are*
School of Economics
University College Dublin

June 2012

Abstract

This study analysed the contribution of economic growth and redistribution components to aggregate poverty changes in Ireland from 1987-2005, using the Shapley value decomposition approach. The analysis used the household disposable income data from the Household Budget Survey to calculate poverty indices. The result of the Shapley value decomposition of poverty changes into growth and redistribution components revealed that the growth component dominates the redistribution component in bringing about the decline in poverty. This suggests that the drastic fall in absolute poverty over the survey period could be attributed to the increase in the household mean income rather than the redistributive policies of government transfer and income tax systems. We also investigated the extent to which economic growth experienced over the survey period has been pro-poor, by using the Growth Incidence Curve proposed by Ravallion and Chen (2003). It was found that economic growth was slightly pro-poor between 1987 and 1994 and generally anti-poor between 1994 and 1999.

Key Words : economic growth, inequality, poverty decomposition, shapley value.

JEL Classification : D31, D63, I32, P36

*I gratefully acknowledge financial support from the UCD Ad Astra research scholarship. Correspondence to: Wasiu Are, UCD School of Economics, Newman Building, Dublin 4, Ireland. Email: wasiu.are@ucd.ie

1 Introduction

The unprecedented economic growth rate experienced by Ireland in the second half of the 1990s has had a tremendous impact on Irish living standard. During this period, the growth in real GDP exceeded both the European Union and OECD average. Real GDP growth per capita increased by 7 to 8 percent per annum between 1994 and 2000. A key feature of this growth was the rate of growth of employment and fall in the unemployment rate (Walsh, 2004). Unemployment fell from a high of 16 percent in 1994 down to less than 5 percent in 2000. At the same time, the number of employed increased dramatically. The employment rate increased by over 9 and 14 percentage point for men and women respectively, (CSO, 2005). Similarly, the annual inflation rate during this period was well below 3 percent. In general, the Irish living standard improved considerably over the period.

However, against this background of impressive economic growth lies the risk of both consistent and relative income poverty^{1,2}. Official estimates shows that 22.7 percent and 9.4 percent of the Irish population live in relative and consistent poverty in 2003 respectively (CSO, 2005). Table 1 presents the risk of poverty based on 60 percent of equivalised median income poverty line in the EU member states for 2005. The table shows that the risk of poverty in Ireland is 4 percent above the EU average. It is also observed from the table above that the poverty rate in Ireland is 1 percent higher than in the UK, 7 percent higher than in France, Luxembourg and Hungary and 11 percent higher than in Sweden, which happens to have the lowest EU poverty rates. Only Lithuania and Poland have higher poverty rate than that of Ireland.

In 1997, the Irish government adopted a National Anti Poverty Strategy (NAPS) and sets a ten year target to reduce consistent poverty in Ireland to 2% by 2007. In the first years, the poverty reduction target in the NAPS was virtually achieved with a reduction in the numbers of households experiencing consistent poverty (Layte *et al*, 2000). While relative poverty has been increasing, there has been dramatic decline in the level of consistent poverty since 1994³. The fall in consistent poverty is a welcome development given the fact that the economic growth initiated in the 90's has been sustained. Since changes in poverty can be the result of either changes in mean income or changes in inequality, this therefore raises some key questions; to what extent does Irish economic growth reduce poverty? That is, how did the resultant benefits from aggregate economic growth was distributed across Irish households? To what extent does income redistribution affect poverty changes? These and other similar questions will be addressed in this paper. Therefore, the main objective of this paper is to analyse the dynamics of poverty in Ireland, by examining the contribution of economic growth and redistribution components to aggregate poverty changes.

The basic motivation behind this study is from policy perspective. To understand the impact of growth and inequality, it becomes increasingly important to quantify the contribution of each component to poverty change. This may help to formulate the necessary developmental policy that may eradicate poverty in the society. Apart from policy concern, this study is also set for purely descriptive purposes. It may be useful to examine the impact of economic growth and inequality on poverty changes within

¹Consistent poverty measures the proportion of people or individual with an income below 60% of median income and at the same time experiencing deprivation of basic necessities such as good clothes and decent meals.

²Relative poverty is also referred as 'at risk of poverty'. This refers to people with income below a certain income threshold, usually set at 60% of median income.

³Relative poverty levels increased from 15.6 percent in 1994 to 22.7 percent in 2003 while consistent poverty levels reduced from 14.5 percent in 1994 to 9.4 percent in 2003 (CSO, 2005).

certain socio-demographic groups. For instance, how do changes in growth and inequality help to explain evolution of poverty among different age categories of household head?

A series of studies have been carried out on poverty and its underlying causes in Ireland based on different methodologies, mainly by calculating poverty and inequality indices such as poverty incidence, poverty gap, stochastic dominance analysis and Gini coefficient (Callan and Nolan, 1991; Callan et al, 1996; Madden and Smith, 2000; O’Neill and Sweetman, 2002; Nolan et al, 2003). This study however, adds to these methodologies by applying a new decomposition framework to explore poverty changes in Ireland and to attribute these changes to contribution by economic growth and redistribution. This procedure is based on the Shapley value decomposition approach, which is a concept in cooperative game theory.

Shapley value decomposition approach is based on the idea of average growth and inequality effects, the sum of which is equal to total change in poverty. It yields an exact decomposition of poverty into growth and redistribution components. This technique is in contrast to the regression based decomposition to measure the impact of changes in mean income and income inequality on poverty (Huppi and Ravallion, 1991; Adams, 2004)⁴. Though the regression method was attractive, the procedure was not very accurate as it often leaves a large residual in the poverty measure. Shapley value approach on the other hand is a simple descriptive tool that allows for exact decomposition of poverty changes into its components. Another advantage of this approach is that the decomposition can be easily implemented by using fewer data.

A general limitation of Shapley decomposition approach however, is that it relies on summary measures of poverty and inequality rather than full distribution of income or consumption expenditures (Bourguignon et al, 2001). Another limitation is that it does not account for possible endogeneity between growth and inequality.

The rest of this paper is organised into five sections. Section two discusses the concepts of poverty and presents the review of relevant literatures on economic growth, poverty and income distribution as well as on pro-poor growth measures. Section three describes the data and the methodology behind the Shapely decomposition procedure as well as pro-poor growth measure. Section four reports the results and findings of the study while section five presents the summary of major findings and conclusion.

2 Concepts of Poverty and Literature Review

2.1 Concepts of Poverty

The definition of poverty vary widely and is rather complex because it is a multi-dimensional concept involving not just deprivation in term of income alone but also deprivation in terms of capability and vulnerability to risks. The Irish government’s National Anti-Poverty Strategy (NAPS) adopted a more general definition of poverty as “People are living in poverty if their income and resources (material, cultural and social) are so inadequate as to preclude them from having a standard of living that is regarded as acceptable by Irish society generally. As a result of inadequate income and resources people may be excluded and marginalized from participating in activities that are considered the norm for other people in society”. This particular measure of poverty as defined by NAPS refers to people that are below

⁴They analyzed changes in poverty with a measure of GDP growth rate and income inequality as explanatory variables.

certain income level and at the same time experiencing basic deprivation as measured by non-monetary indicators such as education, health care, social class as well as cultural orientation.

On the other hand, the United Nations defines poverty as “a condition characterized by chronic deprivation of the resources, choices and opportunities which are basic to human development in order to enjoy an adequate standard of living as well as cultural, political and social rights” (United Nations, 2001). This complements Sen’s (1999) definition of poverty in terms of “capability deprivation”, in the sense that poverty is the lack of certain basic capabilities such as avoiding illiteracy, infant mortality and hunger as well as lack of adequate income.

The concept of poverty also encompasses both relative and absolute poverty, hence the distinction between absolute and relative poverty can be very important. Absolute poverty is related to the ability of an individual or a household to afford a fixed set of basic needs of income, food, shelter or clothing. Relative poverty on the other hand refers to income or consumption level of an individual or a household relative to a measure of central tendency for the society. In essence, relative poverty is closely linked to income or consumption inequality. Both absolute and relative poverty are appropriate for identifying the level of poverty in the society.

Poverty can be measured by income of the household and or aggregate consumption on a per capita basis. However, the use of micro-dimension of income and consumption to measure poverty has been found unsatisfactory as being too narrow. As a result, the World Development Report of 2000/2001 suggested that health, education, life expectancy and vulnerability to risk be included alongside economic indicators in the identifications of poverty. Given this definition, poverty can then be measured in terms of non-monetary dimensions such as education, access to clean water and health care as well as in terms of monetary dimensions such as income, consumption and wages. However, while multidimensional measures of poverty are preferable, the use of single dimension is still relevant (e.g Madden, 2010). In defining poverty, this paper makes use of three relative poverty line thresholds of 40 percent, 50 percent and 60 percent of median equivalised income. For absolute poverty, the poverty measure was based on 60 percent of 1987 median equivalised income.

2.2 Literature Review

This section reviews a number of studies which examine the relationship between poverty, growth and inequality. Recently, there has been an increasingly strong interest in the relationship between poverty, growth and inequality. The interests on this relationship by many authors were influenced by the existence of the Kutznet hypothesis (1956), which claims that growth and inequality are related in an inverted U-shape curve.

Though the relationship between poverty, growth and inequality is well documented in the literature, to the best of author’s knowledge there has been no previous study in Ireland that fully examine this interrelationship by poverty decomposition. The most recent study which is relevant to this paper is that of Clancy and Madden (2005). Clancy and Madden (2005) analysed the relationship between growth and inequality between 1987 and 2005, and also investigated the extent to which economic growth was pro-poor within the same period.

Nevertheless, various international studies have analysed the decomposition of poverty changes into growth and inequality components using different decomposition procedures. However, it should be

noted that poverty decomposition into growth and redistribution components is meaningless when a purely relative poverty measure is used, since the purely relative measures can only change following a change in distribution. Hence, the following poverty decomposition procedures were carried out with respect to fixed absolute poverty line.

Datt and Ravallion (1992) proposed a method that decomposed poverty change into growth, redistribution and a residual component. This proposed decomposition procedure was not an exact decomposition in the sense that there was a residual component that captures the interaction between growth and redistribution components.

Kakwani (1997) applied the axiomatic approach to decompose poverty change into growth and inequality effects. This approach provided for an exact decomposition in which the sum of average growth and inequality effects is equal to the total change in poverty. The axiomatic approach by Kakwani (1997) was further confirmed by Shorrocks (1999) method which applied the Shapley (1953) rule to a range of poverty decompositions. Both Kakwani (1997) and Shorrocks (1999) methods provided a solution to the limitation posed by the residual component in the Datt and Ravallion (1992) method.

Various recent studies have thereby provided empirical evidence of poverty decomposition into growth and inequality effects, based on the decomposition frameworks as suggested by Datt Ravallion (1992), Kakwani (1997) and Shorrocks (1999). Notable among them are Shorrocks and Kolenikov (2005) who applied a decomposition technique to explain the variations in poverty across the regions of Russia, in terms of difference in three sources of poverty variations: income per capita, inequality and price levels. Others include Baye (2006) who studied the decomposition of poverty changes in Cameroon in the period 1984-1996, Vermes (2006) for Kazakhstan, and Zhang and Wan (2006) who investigated the trends and causes of poverty in China in the 1990s, by attributing the changes in poverty trends to income growth and shifts in relative income distribution.

Various studies on decomposition of poverty changes into growth and inequality components have stimulated the need to measure the extent to which economic growth has been pro-poor. As a result, several methodologies have been proposed to identify pro-poor growth measure in many countries. Notable among them are Growth Incidence Curve (GIC) proposed by Ravallion and Chen (2003) for China, which was based on the change in the Watts index of poverty per unit time divided by the headcount index. This curve measures the rate of growth in mean income of each quantile of income distribution over a period. Others include Poverty Equivalent Growth Rate (PEGR) by Kakwani, Khandker and Son (2003) for Korea and Thailand, Poverty Growth Curve (PGC) proposed by Son (2004) for Thailand and Equally Distributed Equivalent Growth Rate (EDEGR) by Essama-Nssah (2005) for Indonesia in the 1990s.

For Ireland, Clancy and Madden (2005) applied the Growth Incidence Curve (GIC) proposed by Ravallion and Chen (2003) to investigate the extent to which growth was pro-poor between 1987 and 1999. They found that on the average growth was neither pro-poor nor anti-poor over the period.

In summary, the literature on poverty, economic growth and inequality points to the fact that both economic growth and inequality components are significant factors influencing poverty changes. For instance, Kakwani (1997) observed that the growth effect contributed more than the redistribution effect while analyzing poverty change in Thailand while Vermes (2006) revealed that inequality rather than economic growth accounted for the bulk of poverty change in Kazakhstan. Other highlights of the review show that growth effect is more pronounced than redistribution effect in reducing poverty in the majority

of the studies and that both economic growth and redistribution components are essential in reducing poverty in developing and transition economy (Baye, 2006; Vermes, 2004).

3 Research Methodology and Analytical Procedures

3.1 Model Specification

3.1.1 Poverty Measures

Poverty is to be measured by using the FGT index, which captures the number of the poor, the depth and severity of poverty.

The Foster-Greer-Thorbecke (FGT) index is defined as;

$$P_{\alpha} = \frac{1}{n} \sum_{i=1}^q \left(\frac{z - y_i}{z} \right)^{\alpha}$$

where n = total number of individuals, z = poverty line, y_i = mean income of the i^{th} household, q = the total number of people with income below the poverty line and α = poverty aversion parameter. The larger value of the parameter indicates that a greater weight is attached to the poverty gap of the poorest unit.

Therefore the poverty measures, (P_{α}) to be used are estimates of the distance between per capita income and the poverty line.

For this class of poverty measure (P_{α}), if $\alpha = 0$, the FGT index becomes the headcount index (HI), when $\alpha = 1$, the FGT index is called the poverty gap index (PGI) and if $\alpha = 2$, the index is reduced to the squared poverty gap index (SPGI), (Foster et al, 1984).

a. Headcount Index - HI ($\alpha = 0$)

The headcount index gives an estimate of the proportion of the population whose per capita income is less than a given poverty line z and this is a measure of poverty incidence.

The headcount index can be derived as;

$$P_0 = \frac{1}{n} \sum_{i=1}^q 1 = \frac{q}{n}$$

The headcount index is the simplest measure of poverty. It is very simple to analyse and easy to understand. The main setback of headcount index is that it gives no indication of the intensity and severity of poverty, even though poor households may be close to the poverty line or far below it. In addition, the headcount index is not sensitive to the distribution of income amongst the poor.

b. Poverty Gap Index – PGI ($\alpha = 1$)

The poverty gap index measures the average income shortfall from the poverty line, and this measures the depth of poverty.

The poverty gap index can be denoted as:

$$P_1 = \frac{1}{n} \sum_{i=1}^q \left(\frac{z - y_i}{z} \right)$$

The poverty gap index tends to measure the magnitude of poverty by considering the number of poor households below the poverty line and also determines their level of poverty. However, the poverty gap index is insensitive to transfers between two households on the same side of poverty line. It ignores the differences in the severity of the poverty among the poor households.

c. Squared Poverty Gap Index – SPGI ($\alpha = 2$)

The squared poverty gap index is the sum of the proportional poverty gaps weighted by themselves. This indicator is a measure of severity of poverty.

The squared poverty gap index can be expressed as;

$$P_2 = \frac{1}{n} \sum_{i=1}^q \left(\frac{z - y_i}{z} \right)^2$$

This measure implies that a transfer of income or any other measure of living standard from a household close to the poverty line to a household far below the line has the effect of reducing measured poverty.

3.1.2 Poverty Line

The procedure to derive poverty line for this study is based on both the relative and absolute poverty line approach. The relative poverty line is defined on the basis of three poverty threshold set at 40 percent, 50 percent and 60 percent of median household income, and this is used to examine the trends in poverty incidence over time. For the poverty decomposition analysis, a fixed absolute poverty line is considered, and this is based on the 60 percent of 1987 median equivalised income.

3.1.3 Lorenz curve

The Lorenz curve shows the degree of inequality that exists in the distributions of income and is often used to examine the extent that income or wealth is distributed unequally in a particular society. The Lorenz curve is a graphical representation of the cumulative proportion of individuals in the population ranked by income to the corresponding cumulative proportion of income. The horizontal or the x-axis records the cumulative proportion of population ranked by level of income. The vertical or the y-axis records the cumulative proportion of income for a given proportion of population (See Fig 1).

If all individuals had the same income, then the Lorenz curve is a straight line and is equal to the line of perfect equality whereas if there is unequal distribution of income, the Lorenz curve falls below the line of perfect equality. The more downward the Lorenz curve is the more unequal is the distribution of income.

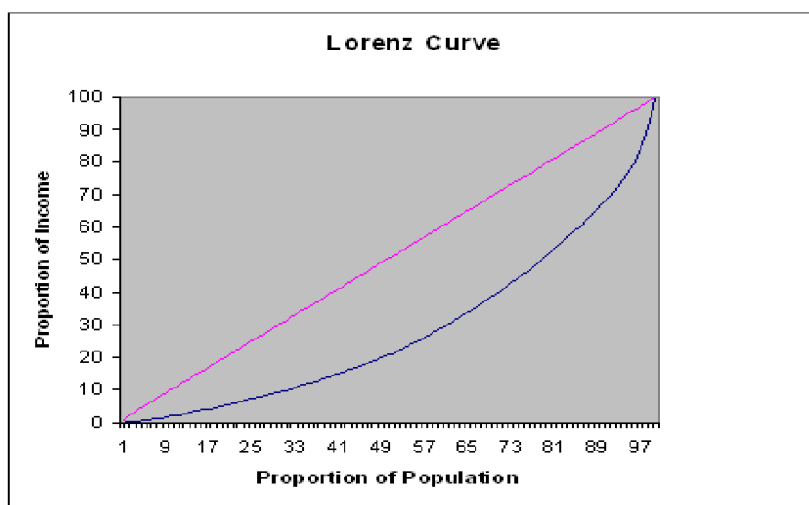


Figure 1: Lorenz Curve

3.1.4 Gini coefficient

The Gini coefficient is used in this study because parts of the objectives of the study requires calculating the Gini coefficient, and besides it is the most commonly referred to measure of inequality. The Gini coefficient is the ratio of the area between the Lorenz curve and the line of perfect equality to the total triangular area under the line of perfect equality. It ranges from a minimum value of zero when the Lorenz curve coincides with the line of perfect equality to a maximum value of one. If the area between the line of perfect equality and Lorenz curve is A , and the area under the Lorenz curve is B , then the Gini coefficient can be expressed as; Gini coefficient = $\frac{A}{A+B}$.⁵

If $A = 0$, the Gini coefficient becomes 0 which means perfect equality, whereas if $B = 0$, the Gini coefficient becomes 1 and this represents complete inequality. Since $A + B$ are a triangular area, then $A + B = 0.5$ and the Gini coefficient, $G = \frac{A}{0.5} = 2A = 1 - 2B$

If the Lorenz curve is represented by the function $Y=L(X)$, the value of B can be found with integration as; $G = 1 - 2 \int_0^1 L(x)dX$

Hence, the higher the value of Gini coefficient, the greater is the level of inequality.

3.2 Methods of Data Analysis

3.2.1 Shapley Value Decomposition Framework

The poverty decomposition analysis to be used in this paper will be based on the Shapley value decomposition framework proposed by Shorrocks (1999). Prior to this framework, there are several approaches that

⁵The formula for the Gini coefficient differs from that of chapter 2. The approach here allows us to express the relationship between the Gini coefficient and the Lorenz curve. However, it should be noted that the Gini coefficient provides less information than the full Lorenz curve.

offer a means of decomposing changes in poverty into growth and redistribution components. Datt and Ravallion (1992) decompose a change in poverty measure between two periods into growth, redistribution and a residual term. The residual exists whenever the poverty measure is not additively decomposable between mean income and distribution⁶. Datt and Ravallion (1992) actually found that the residual can be quite large and this poses a serious limitation to this decomposition approach. To overcome this limitation, Kakwani (1997) derived an axiomatic approach in which the residual term is removed by a simple averaging procedure. Shorrocks (1999) produces essentially the same result as Kakwani (1997) but applies Shapley value cooperative game theory to decompose poverty measures into growth and redistribution components. The Shapley value based decomposition is a generalised framework of the axiomatic approach.

Given a fixed poverty line z , let ΔP denote a change in poverty index P between the initial period 0 and final period 1. Then a change in poverty between period 0 and period 1 can be written as;

$$\Delta P = P_1(\mu_1, L_1) - P_0(\mu_0, L_0) \quad (1)$$

where $\mu(\cdot)$ is the mean income and $L(\cdot)$ is the Lorenz curve.

By definition, the growth component is the change in poverty due to a change in the mean income while holding its distribution (characterized by Lorenz curve) constant. The distribution component is the change in poverty due to a change in the distribution of income while holding its mean constant.

Then, the change in poverty, ΔP to be decomposed into a growth component G and a redistribution component R can thus be expressed by;

$$G = P(\mu_1, L_0) - P(\mu_0, L_0) \quad (2)$$

and

$$R = P(\mu_1, L_1) - P(\mu_1, L_0) \quad (3)$$

However, the problem with the above equations is that the choice of which configuration to use as base period is arbitrary. G indicates the marginal effect of the change in mean income with the distribution held constant at the initial configuration while R computes the marginal impact of redistribution holding mean income constant at the final configuration. One can equally carry out a decomposition with the base period interchanged and there is no logical reason for preferring one configuration over another.

Following Shorrocks (1999) and Kolenikov and Shorrocks (2005), the growth component and the redistribution component of change in poverty ΔP between period 0 and 1 is obtained by taking the average of the two components. Thus, the growth component is denoted by;

$$G = \frac{1}{2}[P(\mu_1, L_0) - P(\mu_0, L_0)] + \frac{1}{2}[P(\mu_1, L_1) - P(\mu_0, L_1)] \quad (4)$$

and the redistribution component by;

$$R = \frac{1}{2}[P(\mu_0, L_1) - P(\mu_0, L_0)] + \frac{1}{2}[P(\mu_1, L_1) - P(\mu_1, L_0)] \quad (5)$$

⁶The residual is due to the fact that the decomposition is sensitive to the choice of reference period. Given that the initial and final year are the two possible choices of reference period, then the residual will vanish if either mean income or distribution remains unchanged over the two periods.

3.2.2 Pro-Poor Growth Measures

The concept of pro-poor growth measure emanates from the fact that the gains from economic growth may or may not be evenly distributed among different household groups, most especially for those at the lower end of income distributions. Therefore, it is essential to examine how the gains from economic growth varied across different household groups. In general, pro-poor growth is the growth in income that is favourable to the poor more than the non-poor. In this study, the Growth Incidence Curve (GIC) is used to examine the extent by which economic growth has been pro-poor. The GIC is the curve which shows the growth rate in mean income for each quantile ranked by income. A curve which compares the growth rate in mean income for each quantile between two survey periods is also referred as Pen's parade. Basically, the GIC is derived on the basis of the growth or distance between two Pen's parades drawn over two time periods. This Growth Incidence Curve approach was based on the model proposed by Ravallion and Chen (2003).

a. The Growth Incidence Curve (GIC)

Let $F_t(y)$ be the cumulative distribution function (CDF) of income (expenditure), giving the proportion of the population with income less than y at date t . Inverting the CDF at the p th quantile gives the income of that quantile:

$$y_t(p) = F_t^{-1}(p) = L'_t(p)\mu_t \quad (y'_t(p) > 0)$$

where $L_t(p)$ is the Lorenz curve with slope $L'_t(p)$ and μ_t is the mean.

Comparing two dates t and $t - 1$, the growth rate in income of the p th quantile is given by;

$$g_t(p) = \left[\frac{y_t(p)}{y_{t-1}(p)} \right] - 1$$

By letting p vary from zero to one, $g_t(p)$ traces out what was termed the "growth incidence curve" by Ravallion and Chen (2003).

Given the expression $y_t(p)$ above, then;

$$g_t(p) = \frac{L'_t(p)}{L'_{t-1}(p)}(\gamma_t + 1) - 1$$

where $\gamma_t = \left(\frac{\mu_t}{\mu_{t-1}} \right) - 1$ is the growth rate in μ_t , the mean income.

b. Pro-Poor Growth Measure

The pro-poor growth measure is obtained from Watts's index (see Watts, 1968; Zheng, 1993) of poverty measure. Given a poverty line z , and the headcount index, $H_t = F_t(z)$. The Watts index can be expressed in terms of quantile function as follows:

$$W_t = \int_0^{H_t} \log \left[\frac{z}{y_t(p)} \right] dp$$

Thus by differentiating with respect to time,

$$-\frac{dW_t}{dt} = \int_0^{H_t} \frac{d \log y_t(p)}{dt} dp = \int_0^{H_t} g_t(p) dp$$

On dividing through by H_t , the headcount index, gives the measure of the rate of pro-poor growth which is the mean growth rate of the poor;

$$\frac{\int_0^{H_t} g_t(p) dp}{H_t}$$

3.3 Data Sources and Description

The main source of data for the analysis of this study is the Irish Household Budget Survey (HBS). HBS is a survey of a representative random sample of Irish households carried out by the Central statistics Office (CSO). The survey has been carried out periodically in 1973, 1980, 1987, 1994/95, 1999/2000 and 2004/2005, and contains detailed information on all sources of household income, expenditure pattern, socio-demographic characteristics and household composition. For this research study, data will be taken from the HBS survey of 1987/88, 1994/95, 1999/2000 and 2004/2005. These contain information on 7705, 7877, 7644 and 6884 households respectively. The income data in the HBS consists of gross income, direct income and disposable income. Gross income includes wages and salaries, income from self employment, retirement pensions, property income and state transfer payment. Disposable income is defined as gross income minus taxes and social security payment. For the analysis, weekly household disposable income is the preferred measure to calculate poverty indices. The weekly household disposable income is top coded, therefore the income data were trimmed by removing the top and bottom three percent of the distribution. This also eliminates the problem of measurement errors which are known to be prevalent at the top and bottom of income distribution. Since household tends to vary depending on size and composition, the poverty indicator to be used is the income per adult equivalent. This will be based on the OECD equivalence scale which assigns a value of 1.0 to the first adult, 0.7 for every additional adult and 0.5 for every child in the household. A child is defined as persons under the age of 14. This implies that actual household income is deflated to produce equivalised income. Household disposable income data was also adjusted into 2000 euro value using the CPI and the exchange rate. In addition the data was reweighted by the number of person in the household.

Table 2 presents the summary statistics of income and poverty lines for the period of survey. The mean and median of equivalised household income increased over the period. The mean equivalised income increased by 140 percent between 1987 and 2005, while the median equivalised income also increased by 151.7 percent over the same period. The relative poverty line expressed as 60 percent of median income was 68.17 euro and 171.59 euro in 1987 and 2005 respectively. These values represent the income per adult equivalent and indicate the minimum weekly disposable income for an adult to be above poverty level.

The trends, distribution and extent of relative poverty level are as shown in Table 3. The table presents the estimates of income poverty for FGT class of poverty measures and for three relative poverty line thresholds of 40 percent, 50 percent and 60 percent of median income. All the FGT poverty measures indicate an increase in poverty between 1987 and 2005. The headcount index increased from 7.0 percent in 1987 to 8.9 percent in 2005 with poverty line being 50 percent of median income and from 15.5 percent to 18.4 percent over the same period with poverty line being 60 percent of median income. The increase in headcount index implies that there were more people living below poverty line in 2005 than in 1987. The depth of poverty which is determined by the poverty gap index was 2.6 percent in 1987 and this later rose to 3.6 percent in 2005 with poverty line being 60 percent of median income. Similarly, the severity of poverty measured by the squared poverty gap index rose by 0.004 points over the same period. Furthermore, the aggregate poverty gap index grew by 38.5 percent more than the headcount index of 18.7 percent and the 57.1 proportionate increases in the squared poverty gap index indicates that poverty amongst the very poor increased by more than the rest of the poor.

Additional information about the trends in poverty level is provided by the line diagram shown in figure 2. The figure reveals that there has been a significant increase in the number of poor people between 1987 and 2005. On the basis of headcount index, it is observed that poverty rate fell considerably in 1994 and later rose in 1999 and has continued to fall since then. Other measures of poverty, the poverty gap index and the squared poverty gap index equally shows the same trends which correspond to increase in poverty rate. As a result of this dramatic increase in poverty rate, the number of people living below the 60 percent of median income poverty line has also increased. Table 4 presents the number of population below poverty line in Ireland. The table shows that the number of poor people was approximately 550,000 in 1987, and this has increased to about 760,000 in 2005.

Table 5 shows the FGT poverty measures based on the absolute poverty line of 60 percent of 1987 median equivalised income. The extent of poverty measured by the Headcount index was 15.6 percent in 1987, the poverty gap index which measures the depth of poverty was 2.6 percent while the severity of poverty measured by the squared poverty gap index was 0.007. The headcount index has drastically fallen over the period of twenty year from 15.6 percent in 1987 to 0.2 percent in 2005. Similarly, both the poverty gap and severity of poverty indexes have also declined over the survey period.

The increasing trend in relative poverty indicates that income inequality may have increased over the period. Hence, in order to ascertain this assumption, it becomes necessary to examine the pattern of income changes across the household income groups. Table 6 presents the changes in equivalised disposable income by each household decile group in 1987 to 2005. The equivalised income share of the bottom 10 percent of the population was 3.75 percent of the total income in 2005 while the top 10 percent of the population received income share of 21.43 percent of the total income in the same period. The table also reveals that the equivalised share of the bottom 10 percent fell from 3.96 percent in 1987 to 3.75 percent in 2005. Similarly, the income share of the top 10 percent of the population also fell from 22.25 percent to 21.43 percent over the period of survey. However, there was a substantial increase in the income share of the middle income group over the 20 years of survey.

Generally, the bottom ten percent experience income loss as does the top ten percent but the middle income groups do better. So overall inequality is unlikely to change but a measure which is sensitive to changes in the lower part of the income distribution will show a change.

The Lorenz curves of the change in the income distributions in 1987-2005 are as shown in figure 3.

The Lorenz curves for 1987, 1994, 1999 and 2005 income distribution appear to cross each other at various parts of the distribution. When two Lorenz curves cross each other, for instance 1987 and 1994 distributions, it is impossible to say which one is more equal. Since the difference in the Lorenz curves are difficult to distinguish visually, a clearer picture of the dominance of each of the Lorenz curves is thereby presented in the form of transformed Lorenz curves. Transformed Lorenz curve is obtained by plotting the difference between the line of perfect equality and the Lorenz curve (see Deaton, 1997). The transformed Lorenz curves for the pairwise comparison of 1987 and 1994, 1994 and 1999, 1999 and 2005 as well as 1987 and 2005 income distributions are presented in figures 4 - 7.

From figure 4, the Lorenz curves show that 1994 income distribution lies above that of 1987 up to the 30th percentile while 1987 income distribution lies above that of 1994 between the 30th and 85th percentile after which 1994 income distribution lies above. From figure 5, the Lorenz curves of 1994 and 1999 show that 1994 income distribution lies above that of 1999 distribution up to the 40th percentile, after which the Lorenz curve of 1999 lies above. On the other hand, figure 6 shows that there was clear dominance of Lorenz curves between 1999 and 2005 income distribution. The Lorenz curve of 2005 distribution lies everywhere above that of 1999 distribution. Finally, figure 7 shows that the Lorenz curve of 1987 income distribution lies above that of 2005 distribution up to the 40th percentile, after which that of 2005 distribution lies above it. This suggests that the overall decline in income inequality over the entire survey period occurred at the upper end of income distribution (see Table 7).

The Lorenz curve only provides a partial ranking of income distribution. This is because when two Lorenz curves intersect each other, it is impossible without recourse to an index to rank one distribution as being unequal over the other. As a result of this ambiguity, a number of alternative measures of income inequality were examined. Table 7 presents the various inequality indices in each of four survey years. The table presents six alternative measures of income inequality; these are the coefficient of variation, the standard deviation of the logarithm of income, the Gini coefficient, 90-50 ratios, 50-10 ratios and the Atkinson index with various values of inequality aversion parameter of $\alpha = 1, 2$ and 5 . Each of these inequality indices is more sensitive to changes in different parts of the income distribution. From the table, it is observed that the income inequality as measured by coefficient of variation fell between 1987 and 1994 and continued to fall from 1999 to 2005. Similarly, the 90-50 ratios fell between 1987 and 1994 and continued to fall from 1994 till 2005. However, for the standard deviation of logs, the Gini coefficient and the 50-10 ratios, income inequality fell between 1987 and 1994 and later rose between 1994 and 1999 and then fell in 2005. For the Atkinson index of $\alpha = 1$ which is more sensitive to changes in income inequality at the upper end of income distribution, income inequality fell between 1987 and 1994, rose in 1999 and then fell from 1999 to 2005. Similarly, for the Atkinson index of $\alpha = 5$ which is more sensitive to changes in income at the lower end of income distribution, it is observed that income inequality fell between 1987 and 1994, rose in 1999 and then fell again in 2005. For the 1987-2005 periods, the Atkinson index suggests a decrease in income inequality at the upper end of income distribution and an increase in income inequality at the lower end of the distribution. The pattern of income inequality as presented above shows that the change in inequality over the period was ambiguous. This is the corollary of not finding Lorenz dominance. Furthermore, the change in inequality indices are very small. This suggests that there is no significant change in inequality over the survey period.

The trend in income distribution is further analysed by examining the combined effects of changing inequality and mean income and their implications on social welfare changes. Figure 8 presents the Generalized Lorenz curves for the four survey periods. The generalized Lorenz curve is analogous to the

ordinary Lorenz curve but it is obtained by scaling up the Lorenz by mean income (Shorrocks, 1999), and can be used to compare social welfare changes. The Generalized Lorenz curve of 2005 lies everywhere above that of 1999 curve, which also lies above that of 1994. The 1994 curve also lies above that of 1987 curve. Each of the curves lies distinctly above one another without crossing each other except at the starting point. Therefore, it can be concluded social welfare has increased from 1987 to 2005 for all social welfare functions obeying certain properties.

This analysis presents the general trends about relative and absolute poverty and income distribution in Ireland over a period of 1987 to 2005. This research study hereby shows that while absolute poverty incidence has declined, income inequality has only changed very little over the survey periods. The results thereby demonstrated that the unprecedented economic growth experienced by Ireland during the survey period had actually reduced absolute poverty level. However, the actual interrelationship between economic growth, absolute poverty level and changes in inequality can fully be addressed by decomposing the changes in poverty into a growth and redistribution effect.

4 Results

4.1 Poverty Decomposition: Growth and Inequality

In the previous analysis on poverty and inequality we showed that absolute poverty incidence has declined and that there is no significant change in income inequality over the same periods. In general, economic growth and redistribution components do effect a change in poverty measures. However, it is not yet clear by how much the fall in absolute poverty is due to changes in mean income and inequality. Therefore, for purpose of policy formulation, it becomes necessary to identify the relative contribution of economic growth and redistribution components to poverty changes. Table 8 presents the poverty decomposition results for Ireland over the period of twenty years. The table presents the result of Shapley value decomposition of poverty changes into growth and redistribution components for Ireland over the period of twenty years. It is observed that the decline in all the three poverty measures of headcount index, poverty gap index and the squared poverty gap index was accounted for by the change in economic growth rather than by the change in redistribution. The economic growth component dominates the redistribution component in all sub-periods and over the entire period in bringing about the fall in poverty.

Between 1987 and 1994, both the economic growth and redistribution components contributed to reduction in poverty. The economic growth accounted for 9.75 percentage point decrease in poverty headcount index while redistribution components only accounted for 0.04 percentage point fall in poverty headcount index. Similarly, the economic growth accounted for 1.86 percentage point decline in poverty gap index and 0.47 point fall in squared poverty gap index while redistribution accounted for a marginal 0.04 percentage point and 0.006 point decrease in poverty gap index and square poverty gap index respectively. The same trend was observed between 1999 and 2005 in which both the economic growth and redistribution components also contributed to decline in poverty, though the overall fall in poverty was more pronounced in 1987-1994 sub-periods than in 1999-2005 sub-periods. However, between 1994 and 1999 only the economic growth contributed to the decrease in poverty while the redistribution component contributed to the increase in poverty. The economic growth accounted for 5.9 percentage point decrease

in poverty headcount index while redistribution accounted for 1.7 percentage point increase in poverty headcount index. Similarly, the economic growth accounted for 0.9 percentage points and 0.2 percentage points decline in poverty gap index and squared poverty gap index respectively while redistribution accounted for 0.4 percentage point and 0.1 percentage point increase in poverty gap index and square poverty gap index respectively.

Over the entire period, the poverty headcount index fell by 15.3 percent while both the poverty gap index and the squared poverty gap index fell by 2.6 percent and 0.7 percent respectively. This tremendous decline in absolute poverty was attributed to the unprecedented increase in economic growth experienced by Ireland over the period of survey. The redistribution effect had a negative impact on poverty reduction reflecting increased income inequality at the lower end of income distribution over the survey period (Table 7 and figure 7).

Table 9 shows the actual percentage contribution of growth and inequality. It is observed that between 1987 and 1994, economic growth accounts for 99.59 percent of the reduction in headcount index, while the change in inequality contributes 0.41 percent to the decrease in poverty headcount index. Similar trend is observed between 1999 and 2005 sub-periods. Between 1994 and 1999, economic growth accounts for 140.48 percent of the reduction in poverty headcount index, while the change in inequality accounts for 40.48 percent increase in poverty headcount ratio. Over the entire survey period from 1987 to 2005, economic growth reduced poverty headcount index by 100.65 percent while changes in inequality contributed 0.65 percent to the increase in poverty headcount index.

While the drastic fall in absolute poverty over the survey period was attributed to economic growth component, in certain sub-periods the contribution of income redistribution to poverty changes was also important. For instance, between 1994 and 1999, the redistribution component contributed to the increase in poverty and as a result the contribution of economic growth was much less. If redistribution did not change, poverty reduction by economic growth would have been 5.9 percent points but the actual reduction was 4.2 percent points for the headcount index. Thus, the change in redistribution has contributed to the increase in poverty by 1.7 percent points. On the other hand, between 1999 and 2005 poverty reduction would have been 1.1 percent points but the actual reduction as measured by the headcount index was 1.3 percent points. This is due to the fact that redistribution has contributed to a reduction in poverty by 0.2 percent point. These findings confirm the important role of redistribution in poverty changes over the periods.

Furthermore, it can be observed that the absolute value of redistribution component relative to the total change increases moving from P_0 (headcount index) to P_2 (severity of poverty). This is most remarkable for 1994-1999 and 1987-2005 periods. For 1994-1999 sub-periods, the redistribution component contributed to the change in P_0 by only 40.5 percent while change in redistribution explained 80.0 percent of the total change in P_1 and 100.0 percent of the change in P_2 respectively. Similar trend is observed in 1987-2005 period. The increasing value of redistribution component moving from P_0 to P_2 shows that the poorest may have become relatively worse-off over these periods in spite of high economic growth. This is an important finding which shows that economic growth alone does not benefit the ultra-poor in the society. This is a further indication that redistribution component had played a substantial role in poverty changes especially for the poorest.

In addition, our results also show that summary measures of inequality such as Gini coefficient can be a poor guide as to how changes in distribution have impacted on poverty. For instance, between 1994 and

1999 survey period, there was very little change in income distribution as measured by summary indices like the Gini coefficient. However, redistribution components over that sub-period did have a sizeable impact on poverty headcount index⁷. This indicates that even though the overall inequality has not really changed much, income distribution and hence poverty may have changed for certain subgroups (i.e. people just below the poverty line). Redistribution component thereby seems to give more information than the conventional inequality indices such as Gini coefficient in terms of poverty and inequality interactions in Ireland.

Table 10 shows the estimate of the decomposition of changes in poverty by the age of the household head. Age is an important socio-economic characteristic in the sense that it captures the effect of old age and retirement on poverty changes. Similar to the observed trend in the full sample, the overall decline in all three measures of poverty; the headcount index, poverty gap index and the squared poverty gap index was as a result of the change in mean income rather than inequality. However, this is not true in all cases as inequality was also important in reducing poverty.

For the under24 age category for instance, the economic growth component dominates the redistribution component in bringing about the decline in poverty. However, the redistribution component contributes significantly to the decline in poverty in 1987-1994 and 1999-2005 survey periods. With regards to over65 age category, both the economic growth and redistribution components contributed to fall in poverty in 1987-1994 periods while redistribution led to increase in poverty between 1994 and 1999 as well as 1999 and 2005. Previous study has shown that between 1994 and 2000 retirement pensions were confined only to the upper part of the income distribution while households in the lower end received relatively little income from retirement pensions, and this consequently led to increased inequality (Cussen, 2005)

4.2 Pro-Poor Growth Rates

The pattern of distribution of pro-poor growth rates for each period is as shown in the Growth Incidence Curve (GIC) in figures 9-12⁸. The Growth Incidence Curve for each sub-period was positive. This indicates that there has been growth in income at every part of the income distribution over the entire survey period. This also implies that absolute poverty has declined over the whole period of survey.

For the 1987-1994 sub-periods, the GIC slopes upward and downward at various part of the distribution. For the top ten deciles, the curve slopes upward indicating that the bottom half of income distribution experienced lower income growth. By comparing the growth rates in mean income between the lower and upper deciles shows that the mean income growth for the upper deciles was greater than that of lower deciles, though the difference was not so much pronounced.

For the 1994-1999 sub-periods, the GIC slopes upward indicating that the income of the upper deciles grew faster than the income of the lower deciles. The annual growth in mean income of the extreme lower deciles dropped considerably, suggesting that the households at the lower end fared less well than the rest of the population. On the other hand, for the 1999-2005 sub-periods, the GIC had a negative slope indicating that the income of the lower deciles grew faster than the income of the upper deciles. The curve also shows that the income of the households at the extreme lower end of the distribution increased

⁷The change in Gini index between 1994 and 1999 was 0.2 percent point while the change in redistribution component for the headcount index was 1.7 percent points over the same period.

⁸Note that the scale on the vertical axes are different for figures 3.9 to 3.12

considerably than the rest of the population. This implies that most of the increase in mean income over this period could be attributed to the poorest households. The GIC for the entire survey period slopes upward suggesting that the income of the upper deciles grew faster than that of lower deciles.

Table 11 presents the pro-poor growth rates of equivalised income for the 1987-2005 periods. It is observed that for the 1987-1994 sub-periods the pro-poor growth rate of the lowest (poorest) deciles was slightly higher than the annual growth rate in mean income. For the 1994-1999 periods, the pro-poor growth rate of the lowest deciles of 25.26 percent was lower than the ordinary growth rate of 36.35 percent. On the other hand, the pro-poor growth rate for the 1999-2005 sub-periods for the lowest deciles was higher than the ordinary growth rate of 42.05 percent.

The results suggest that between 1987 and 1994 the growth was slightly anti-poor. The rate of pro-poor growth for the poorest deciles was not so high compared to the ordinary growth rate of mean income. For the 1994-1999 sub-periods, growth was generally anti-poor. The pro-poor growth rate at the upper deciles was higher than for the lower deciles. Though absolute poverty declined in this sub-period, there was an increase in inequality at the lower deciles. For the 1999-2005 sub-periods, the pro-poor growth rate of poorest deciles was very high and therefore growth was pro-poor. For the entire survey period of 1987-2005, growth was anti-poor.

5 Summary and Conclusion

5.1 Summary of Major Findings

In this paper we examined the contribution of economic growth and redistribution components to aggregate poverty changes using the Shapley value decomposition approach. The study revealed that the absolute poverty has declined over the entire survey period. For instance, the headcount poverty index fell drastically from 15.6 percent in 1987 to 0.2 percent in 2005.

The pattern of income changes across the household income groups showed that the equivalised income share of the bottom 10 percent of the population fell from 3.96 percent in 1987 to 3.75 percent in 2005. Similarly, the equivalised income share of the top 10 percent also fell from 22.25 percent in 1987 to 21.43 percent in 2005. The change in inequality indices as measured by the coefficient of variation, the standard deviation of the logarithm of income, the Gini coefficient and the Atkinson index showed that inequality has not really changed much between 1987 and 2005.

The result of the Shapley value decomposition of poverty changes into growth and redistribution components revealed that the growth component dominates the redistribution components in bringing about the decline in poverty. This suggests that the drastic fall in absolute poverty over the survey period could be attributed to the increase in the household mean income rather than the redistributive policies of government transfer and income taxes systems or other factors of distribution.

We also investigated the extent to which economic growth experienced over the survey period has been pro-poor, by using the Growth Incidence Curve proposed by Ravallion and Chen (2003). We found that economic growth was slightly anti-poor between 1987 and 1994, generally anti-poor between 1994 and 1999 and generally pro-poor between 1999 and 2005.

5.2 Conclusion

In this paper we reveal that absolute poverty level has declined over the period and that economic growth component overwhelmingly dominates the redistribution component in bringing about this decline in poverty level. In addition, the result of the pro-poor growth measure shows that economic growth was both pro-poor and anti-poor over the period. For the purpose of policy formulation, these results emphasize the importance of sustained economic growth to reduce the incidence of poverty. However, despite the overwhelming dominance of economic growth component, it was observed that inequality as well as poverty reducing in certain periods. This finding thereby highlights the fact that the economic growth alone should not be the only priority of reducing poverty. It is essential that an effective income distribution policy which targets mainly the poor in the society is equally undertaken.

From a policy formulation perspective, this methodology is very useful as it provides policy maker detailed information about the relative contribution of economic growth and inequality to poverty changes. However, one important limitation of this decomposition analysis is that there are complex interactions between growth and inequality that are not captured by this technique which might result in small changes in inequality that are uncorrelated with growth. Furthermore, when analysing poverty changes with respect to growth and redistribution effect, it might be misleading to assume that it is easier to reduce income inequality by certain percentage as it is to achieve economic growth. In actual sense, it is easier to achieve economic growth than to change the Gini coefficient (Deininger and Squire, 1998).

The possibilities for future research are many for this methodology. One of such is the poverty decomposition analysis when the poverty line changes. In this case, the mean income, inequality and poverty line are treated as three separate factors in determining poverty changes. The procedure considers the marginal effect on poverty of varying one factor between initial and final period, and then compute the average of the marginal effect over all possible ways in which each of the three factors are interchanged in sequence from the base period. This is a case of three-way Shapely decomposition of poverty change into nominal income, inequality and poverty line effects (Shorrocks and Kolenikov, 2005)⁹.

⁹See Appendix for details.

References

- [1] Adams, Jr. R. (2004): "Economic Growth, Inequality and Poverty: Estimating the Growth Elasticity of Poverty", *World Development*, 32(12), 1989-2014.
- [2] Barrett, A., Fitzgerald, M and B. Nolan (2000): "Earning Inequality, Returns to Education and Immigration into Ireland", *Labour Economics*, 9, 665-680.
- [3] Baye, F.M. (2006): "Growth, Redistribution and Poverty Changes in Cameroon: A Shapley Decomposition Analysis," *Journal of African Economies*, 15(4), 543-570.
- [4] Bresson, F. (2008): "The Estimation of the Growth and Redistribution Components of Changes in Poverty: A Reassessment", *Economics Bulletin*, 9(14), 1-7.
- [5] Bourguignon, F., F. H. G Ferreira, et al. (2001): *The Microeconomics of Income Distribution Dynamics: A Comparative Analysis of Selected Developing Countries*. Washington DC, IADB- World Bank
- [6] Callan, T., and B. Nolan. (1991): "Concepts of Poverty and the Poverty Line", *Journal of Economic Surveys*, 5, 243-261.
- [7] Callan, T., Keeney, M., Nolan, B. and B. Maitre (2004): *"Why is Relative Income Poverty so high in Ireland"?* Dublin: Economic and Social Research Institute.
- [8] Central Statistics Office (2005): *Statistical Yearbook of Ireland 2005*. Dublin: Central Statistics Office.
- [9] Clancy, C and D. Madden (2005): "Growth and Inequality in Ireland: 1987-1999", University College Dublin Department of Economics Working Paper, WP05/16.
- [10] Commissions of the European Communities (2004): Joint Report on Social Inclusion. Brussels: Commission of the European Communities.
- [11] Datt, G., and M. Ravallion (1992): "Growth and Redistribution Components of Changes in Poverty Measures: A Decomposition with Applications to Brazil and India in the 1980s," *Journal of Development Economics*, 38, 275-295.
- [12] Deaton, A., (1997): *The Analysis of Household Surveys: A Microeconometric Approach to Development Policy*. John Hopkins University Press. Baltimore.
- [13] Deininger, K. and L. Squire (1998): "New Ways of Looking at Old Issues: Inequality and Growth", *Journal of Development Economics* 57, 259-287
- [14] Essamah-Nsah, B. (2005): "A Unified Framework for Pro-Poor Growth Analysis", *Economic Letters*, 89, 216-221.
- [15] Foster, J., Greer, J. and E. Thorbecke (1984): "A Class of Decomposable Poverty Measures", *Econometrica*, 52, 761-765.
- [16] Huppi, M. and M. Ravallion (1991): "The Sectoral Structure of Poverty During An Adjustment Period: Evidence for Indonesia in the Mid-1980s." *World Development* 19(12), 1653-78

- [17] Kakwani, N. (1997): "On Measuring Growth and Inequality Components of Poverty with Application to Thailand," Discussion Paper, School of Economics, The University of New South Wales, Australia.
- [18] Kakwani, N., S. Khandker, and H. Son (2003): "Poverty Equivalent Growth Rate: with Applications to Korea and Thailand," Tech. rep., Economic Commission for Africa.
- [19] Kutznets, S. (1955): "Economic Growth and Income Inequality", *American Economic Review*, 45, 1-28.
- [20] Layte, R., Nolan, B. and C. T. Whelan (2000): "Targeting Poverty: Lessons from Monitoring Ireland's National Anti-Poverty Strategy", *Journal of Social Policy*, (29), 553-557.
- [21] Madden, D. (2010): "Health and Income Poverty in Ireland, 2003-2006", forthcoming in *Journal of Economic Inequality*.
- [22] Madden, D. and F. Smith. (2000): "Poverty in Ireland, 1987-1994: A Stochastic Dominance Approach", *Economic and Social Review*, 31, 187-214.
- [23] National Anti-Poverty Strategy (1997): "Sharing in Progress: National Anti-Poverty Strategy". Dublin: Stationery Office.
- [24] Nolan B., B. Gannon, R. Layte, D. Watson, C. Whelan and J. Williams (2003): "Monitoring Poverty Trends in Ireland: Results from the 2001 Living In Ireland Survey", Economic and Social Research Institute, Dublin, 51
- [25] Nolan, B. (2003): "Income Inequality During Ireland's Boom", *Studies*, 92.
- [26] O'Neill, D., and O. Sweetman (2002): "Poverty and Inequality in Ireland 1987-1994: A Comparison Using Measures of Income and Consumption", *Journal of Income Distribution*, 10, 23-39
- [27] Ravallion, M. and M. Huppi (1989): "Poverty and Undernutrition in Indonesia During the 1980s, Policy, Planning and Research". Working paper 286, World Bank, Washington DC
- [28] Ravallion, M., and S.Chen (2003): "Measuring Pro-Poor Growth", *Economics Letters*, 78, 93-99.
- [29] Sen, A.K., (1999): "Development as Freedom", New York, Anchor Books.
- [30] Shapley, L. (1953): "A Value for n-Person Games", in H.W Kuhn and A. W. Tucker (eds), *Contributions to the Theory of Games*, Vol.2, Princeton University Press.
- [31] Shorrocks, A. F., and S. Kolenikov (2005): "Poverty Trends in Russia during the Transition", mimeo, Wider and University of North Carolina.
- [32] Shorrocks, A. P. (1999): "Decomposition Procedure for Distributional Analysis: A Unified Framework Based on the Shapley Value", Mimeo: Department of Economics, University of Essex.
- [33] Son, H. H. (2003): "A New Poverty Decomposition," *Journal of Economic Inequality*, 1(2), 181-187.
- [34] Son, H. H. (2004): "A Note on Pro-Poor Growth", *Economic Letters*, 82, 307-314.
- [35] UNDP (2001): Human Development Report, New York, Oxford University Press.
- [36] Verme, P. (2006): "Pro-Poor Growth during Exceptional Growth. Evidence from a Transition Economy", *The European Journal of Comparative Economics*, 3(1), 3-14.

- [37] Walsh, B. (2004): "The Transformation of the Irish Labour Market 1980-2003", Centre for Economic Research, University College Dublin, WP04/12.
- [38] Wan, G. H., and Y. Zhang (2006): "The impacts of Growth and Inequality on Rural Poverty in China," *Journal of Comparative Economics*, 34, 694-712.
- [39] Watts, H. (1968): "An Economic Definition of Poverty" in Moynihan, D.P. (ed.), In *Understanding Poverty*. Basic Books. New York.
- [40] World Bank (2001): World Development Report 2000/01: Attacking Poverty. Oxford, Oxford University Press.
- [41] Zheng, B. (1993): "An Axiomatic Characterisation of the Watts Index", *Economics Letters*, 42, 81-86

Appendix

Three-Way Shapley Value Decomposition Frameworks

Given that the poverty line varies, let ΔP denote a change in poverty index P between the initial period 0 and final period 1. Then a change in poverty between period 0 and period 1 can be written as;

$$\Delta P = P(\mu_1, L_1, Z_1) - P(\mu_0, L_0, Z_0) \quad (6)$$

where $\mu(\cdot)$ is the mean income, $L(\cdot)$ is the Lorenz curve and $Z(\cdot)$ is the poverty line.

By definition, the growth effect is the change in poverty due to a change in the mean income while holding its distribution (characterized by Lorenz curve) and poverty line constant. The distribution effect is the change in poverty due to a change in the distribution of income while holding its mean income and poverty line constant while the poverty line effect is the change in poverty due to a change in poverty line while holding its mean income and distribution constant.

Then, the change in poverty, ΔP to be decomposed into a growth effect G , a redistribution component R and a poverty line effect Z can thus be expressed by;

$$G = P(\mu_1, L_0, Z_0) - P(\mu_0, L_0, Z_0) \quad (7)$$

$$R = P(\mu_1, L_1, Z_0) - P(\mu_1, L_0, Z_0) \quad (8)$$

and

$$Z = P(\mu_1, L_1, Z_1) - P(\mu_1, L_0, Z_0) \quad (9)$$

Following Kolenikov and Shorrocks (2005), the growth, inequality and the poverty line components of change in poverty ΔP between period 0 and 1 is obtained by taking the average of the three components.

Thus, the growth component is denoted by;

$$G = \frac{1}{2}[P(\mu_1, L_0, Z_0) - P(\mu_0, L_0, Z_0)] + \frac{1}{2}[P(\mu_1, L_1, Z_1) - P(\mu_0, L_1, Z_1)] \quad (10)$$

the redistribution component by;

$$R = \frac{1}{2}[P(\mu_0, L_1, Z_0) - P(\mu_0, L_0, Z_0)] + \frac{1}{2}[P(\mu_1, L_1, Z_1) - P(\mu_1, L_0, Z_1)] \quad (11)$$

and the poverty line component by;

$$Z = \frac{1}{2}[P(\mu_0, L_0, Z_1) - P(\mu_0, L_0, Z_0)] + \frac{1}{2}[P(\mu_1, L_1, Z_1) - P(\mu_1, L_1, Z_0)] \quad (12)$$

Table 1: The risk of poverty in the European Union

Country	Poverty Risk
Lithuania	21
Poland	21
Greece	20
Spain	20
IRELAND	20
Italy	19
Latvia	19
Portugal	19
Estonia	18
United Kingdom	19
Cyprus	16
Belgium	15
Malta	15
Germany	12
France	13
Luxembourg	13
Hungary	13
Denmark	12
Austria	12
Slovenia	12
Slovakia	13
Finland	12
Netherlands	11
Czech Republic	10
Sweden	9
EU-25 Average	16

Source: Eurostat (2007)

Table 2: Household income and poverty line: Summary Statistics

	1987	1994	1999	2005
Mean equivalised income	132.64	164.49	224.28	318.58
Median equivalised income	113.62	141.90	200.40	285.98
Poverty line	68.17	85.14	120.24	171.59
Number of households	7705	7877	7644	6844
Change in income and poverty line (%)				
	1987-94	1994-99	1999-05	1987-05
Mean equivalised income	24.01	36.35	42.05	140.18
Median equivalised income	24.89	41.23	42.70	151.70
Poverty line	24.89	41.23	42.71	151.71

Notes: Poverty line is 60% of median equivalised income.

Table 3: FGT Relative Poverty Measures: 1987–2005

Poverty index	1987			1994			1999			2005		
	40%	50%	60%	40%	50%	60%	40%	50%	60%	40%	50%	60%
HI	0.013	0.070	0.155	0.013	0.058	0.149	0.042	0.100	0.184	0.041	0.089	0.184
PGI	0.002	0.009	0.026	0.002	0.008	0.024	0.006	0.019	0.039	0.005	0.017	0.036
SPGI	0.0006	0.002	0.007	0.0006	0.002	0.006	0.002	0.006	0.013	0.001	0.005	0.011

Source: Author's Calculation

Table 4: Population below relative income poverty line in Ireland: 1987–2005

Year	Poverty level (%)	Estimated total population ('000)	Population in Poverty ('000)
1987	15.5	3546.5	549.7
1994	14.9	3585.9	534.3
1999	18.4	3741.6	688.5
2005	18.4	4133.8	760.6

Notes: Poverty level is the headcount index (HI).

Poverty line is 60% of median equivalised income.

Table 5: FGT Absolute Poverty Measures: 1987–2005

Poverty Index	1987	1994	1999	2005
HI	0.156	0.057	0.015	0.002
PGI	0.026	0.007	0.003	0.0003
SPGI	0.007	0.002	0.0008	0.00004

Source: Author's Calculation

Table 6: Decile shares in Household Equivalised disposable Income: 1987–2005

Share in Equivalised Disposable Income (%)				
Decile	1987	1994	1999	2005
Bottom	3.96	3.98	3.61	3.75
2	5.06	5.06	5.04	5.07
3	6.12	5.99	5.96	6.06
4	7.07	6.83	7.04	7.23
5	8.04	7.84	8.27	8.35
6	9.20	9.14	9.59	9.60
7	10.61	10.76	10.98	10.93
8	12.47	12.61	12.80	12.56
9	15.19	15.28	15.24	15.01
Top	22.25	22.52	21.47	21.43
Total	100.00	100.00	100.00	100.00
Gini	0.284	0.283	0.285	0.278

Source: Author's Calculation

Table 7: Inequality Indices for Equivalised Income

Inequality measures	1987	1994	1999	2005
Coefficient of variation	0.552	0.544	0.536	0.528
Standard deviation	0.501	0.500	0.519	0.506
Gini coefficient	0.284	0.283	0.285	0.278
P90-50	0.699	0.677	0.640	0.628
P50-10	0.627	0.624	0.695	0.660
Atkinson, $\alpha=1.0$	0.121	0.120	0.124	0.119
Atkinson, $\alpha=2.0$	0.221	0.220	0.235	0.225
Atkinson, $\alpha=5.0$	0.435	0.430	0.478	0.457
Change in inequality indices for equivalised income				
Inequality measures	1987-94	1994-99	1999-05	1987-05
Coefficient of variation	-0.008	-0.008	-0.008	-0.024
Standard deviation	-0.001	0.019	-0.013	0.005
Gini coefficient	-0.001	0.002	-0.007	-0.006
P90-50	-0.022	-0.037	-0.012	-0.071
P50-10	-0.003	0.071	-0.035	0.033
Atkinson, $\alpha=1.0$	-0.001	0.004	-0.005	-0.002
Atkinson, $\alpha=2.0$	-0.001	0.015	-0.010	0.004
Atkinson, $\alpha=5.0$	-0.005	0.048	-0.021	0.022
Change in inequality indices for equivalised income (%)				
Inequality measures	1987-94	1994-99	1999-05	1987-05
Coefficient of variation	-1.45	-1.47	-1.49	-4.55
Standard deviation	-0.19	3.80	-2.50	0.99
Gini coefficient	-0.35	0.71	-2.46	-2.16
P90-50	-3.15	-5.47	-1.88	-11.30
P50-10	-0.48	11.38	-5.04	5.00
Atkinson, $\alpha=1.0$	-0.83	3.33	-4.03	-1.68
Atkinson, $\alpha=2.0$	-0.45	6.82	-4.26	1.78
Atkinson, $\alpha=5.0$	-1.15	11.16	-4.39	4.81

Source: Author's calculation

Table 8: Shapley Decomposition of Poverty into Growth and Redistribution Components

Period	Poverty Change	Growth Component	Redistribution Component
Headcount Index			
1987-1994	-0.0979	-0.0975	-0.0004
1994-1999	-0.042	-0.059	0.017
1999-2005	-0.013	-0.011	-0.002
1987-2005	-0.153	-0.154	0.001
Poverty Gap Ratio			
1987-1994	-0.0190	-0.0186	-0.0004
1994-1999	-0.005	-0.009	0.004
1999-2005	-0.003	-0.002	-0.001
1987-2005	-0.026	-0.028	0.002
Squared Poverty Gap Ratio			
1987-1994	-0.00479	-0.00473	-0.00006
1994-1999	-0.001	-0.002	0.001
1999-2005	-0.0007	-0.0006	-0.0001
1987-2005	-0.007	-0.008	0.001

Source: Author's calculation

Table 9: Percentage Change in Shapley Decomposition of Poverty into Growth and Redistribution Components

Period	Poverty Change	Growth Component	Redistribution Component
Headcount Index			
1987-1994	100	99.59	0.41
1994-1999	100	140.48	-40.48
1999-2005	100	84.62	15.38
1987-2005	100	100.65	-0.65
Poverty Gap Ratio			
1987-1994	100	97.89	2.11
1994-1999	100	180.00	-80.00
1999-2005	100	66.67	33.33
1987-2005	100	107.69	-7.69
Squared Poverty Gap Ratio			
1987-1994	100	98.75	1.25
1994-1999	100	200.00	-100.00
1999-2005	100	85.71	14.29
1987-2005	100	114.29	14.29

Source: Author's calculation

Table 10: Shapley Decomposition of Poverty by Age of Household Head

Period	Headcount Index											
	Under24			Age25-44			Age45-64			Over65		
	Poverty Change	Growth	Inequality	Poverty Change	Growth	Inequality	Poverty Change	Growth	Inequality	Poverty Change	Growth	Inequality
1987-1994	-0.112	-0.058	-0.054	-0.156	-0.166	0.010	-0.022	-0.042	0.020	-0.033	-0.015	-0.018
1994-1999	-0.050	-0.085	0.035	-0.062	-0.075	0.013	-0.027	-0.075	0.014	-0.002	-0.005	0.004
1999-2005	-0.016	-0.014	-0.003	-0.015	-0.013	-0.002	-0.012	-0.011	-0.001	-0.005	-0.008	0.004
1987-2005	-0.178	-0.151	-0.027	-0.233	-0.210	-0.023	-0.062	-0.084	0.022	-0.039	-0.034	-0.005
							Poverty Gap Ratio					
1987-1994	-0.011	-0.010	-0.001	-0.034	-0.035	0.002	-0.002	-0.007	0.006	-0.004	-0.002	-0.001
1994-1999	-0.004	-0.017	0.013	-0.006	-0.011	0.005	-0.005	-0.007	0.002	-0.006	-0.009	0.003
1999-2005	-0.005	-0.002	-0.003	-0.003	-0.002	-0.0007	-0.0016	-0.0014	-0.0001	-0.0005	-0.0011	0.0006
1987-2005	-0.020	-0.026	0.006	-0.043	-0.044	0.0009	-0.0083	-0.014	0.0058	-0.00007	-0.00017	0.00010
							Squared Poverty Gap Ratio					
1987-1994	-0.006	-0.020	0.014	-0.009	-0.010	0.0004	0.0001	-0.002	0.0021	-0.00069	-0.0006	-0.00009
1994-1999	0.001	-0.005	0.006	-0.001	-0.003	0.002	-0.0013	-0.002	0.0007	-0.0003	0.0004	0.0001
1999-2005	-0.002	-0.0008	0.001	-0.0009	-0.0007	-0.0002	-0.00037	-0.0003	-0.00007	-0.00007	-0.00017	0.00010
1987-2005	-0.003	-0.007	0.004	-0.012	-0.013	0.002	-0.017	-0.037	0.020	-0.0010	-0.0015	0.0005

Source: Author's calculation

Table 11: **Pro-Poor Growth Rates**

Growth Rate in Mean Income				
	1987-1994	1994-1999	1999-2005	1987-2005
	24.01	36.35	42.05	140.18
Pro-Poor Growth Rates				
Deciles	1987-1994	1994-1999	1999-2005	1987-2005
1 (poorest)	24.10	25.26	47.60	127.43
2	25.14	28.72	45.27	134.04
3	24.37	30.65	45.00	135.30
4	23.77	32.21	45.23	137.88
5	23.89	33.80	44.87	140.19
6	24.20	34.91	44.43	141.93
7	24.48	35.37	44.01	142.72
8	24.57	35.73	43.43	142.62
9	24.43	35.94	43.04	142.03
10 (richest)	24.24	35.68	42.92	140.96

Source: Author's calculation

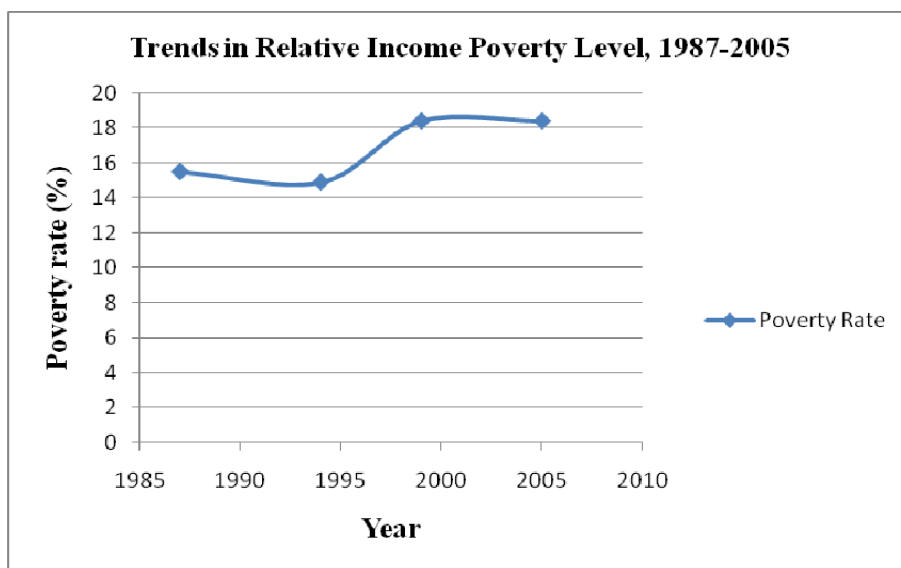


Figure 2: Trends in Relative Income Poverty Level: 1987-2005

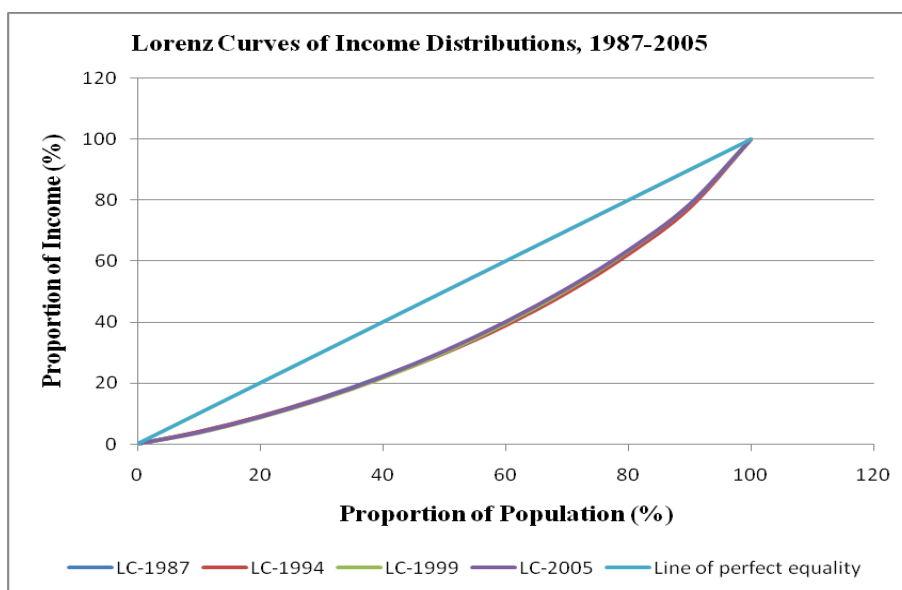


Figure 3: Lorenz Curve of Income Distributions: 1987-2005

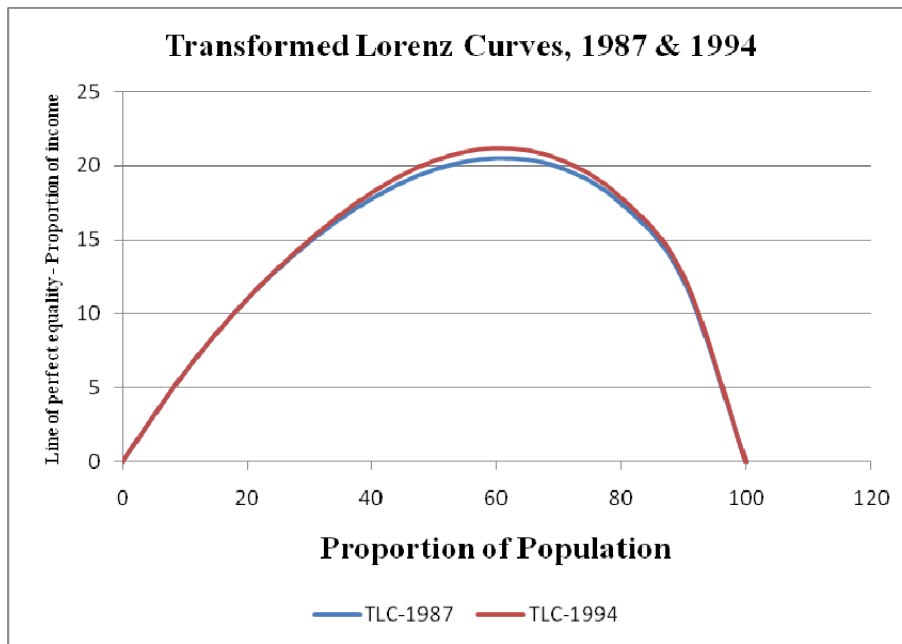


Figure 4: Transformed Lorenz Curves: 1987 & 1994

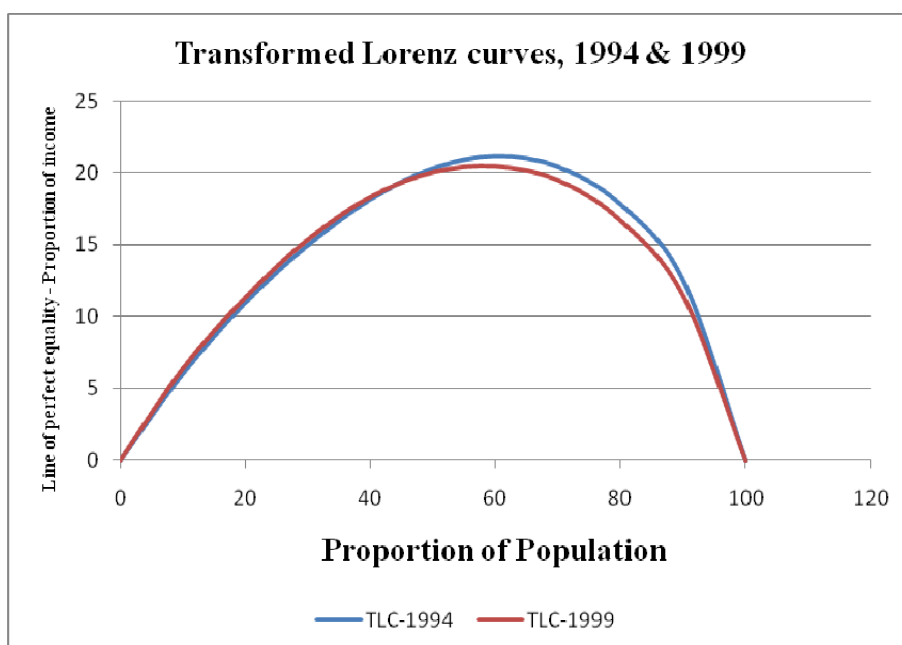


Figure 5: Transformed Lorenz Curves: 1994 & 1999

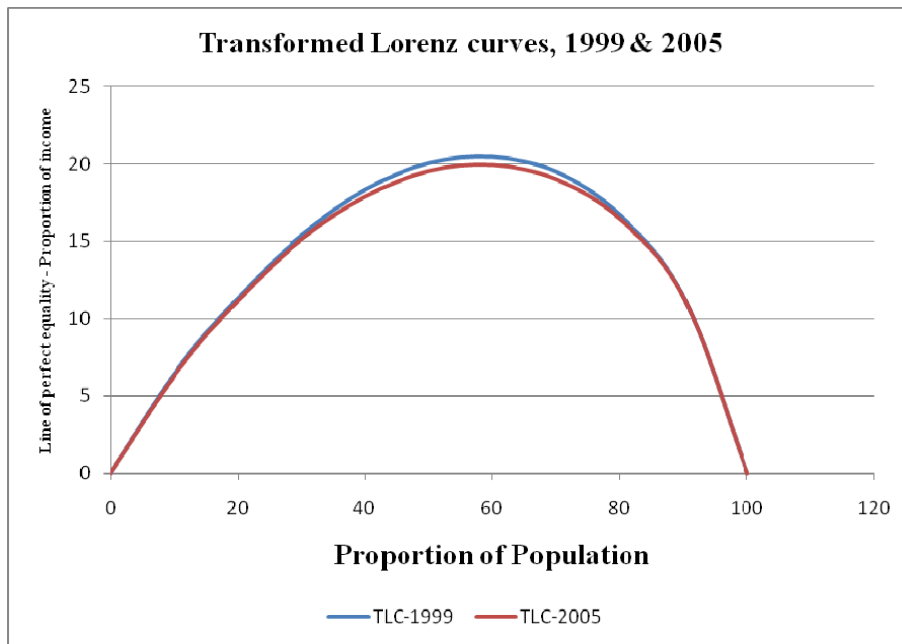


Figure 6: Transformed Lorenz Curves: 1999 & 2005

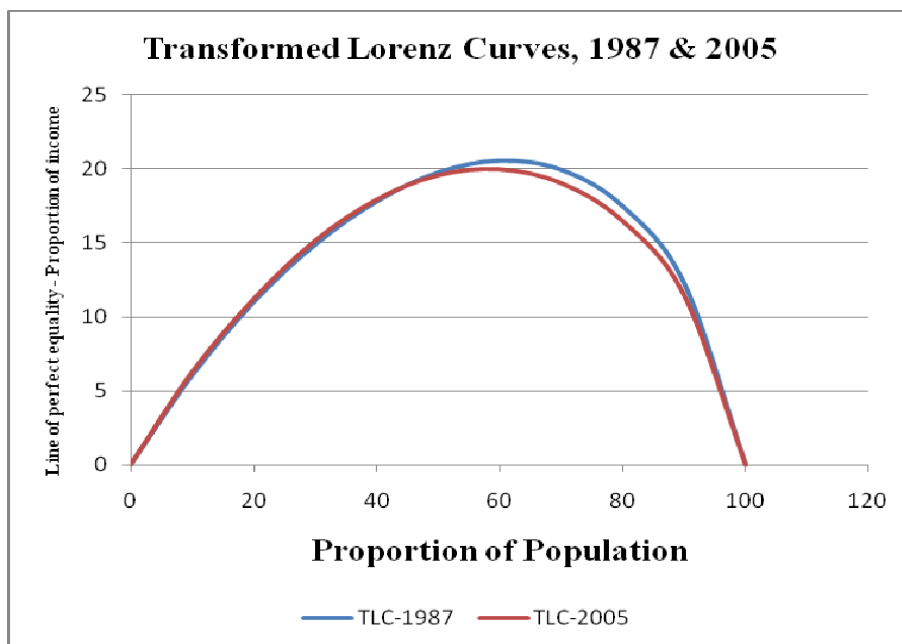


Figure 7: Transformed Lorenz Curves: 1987 & 2005

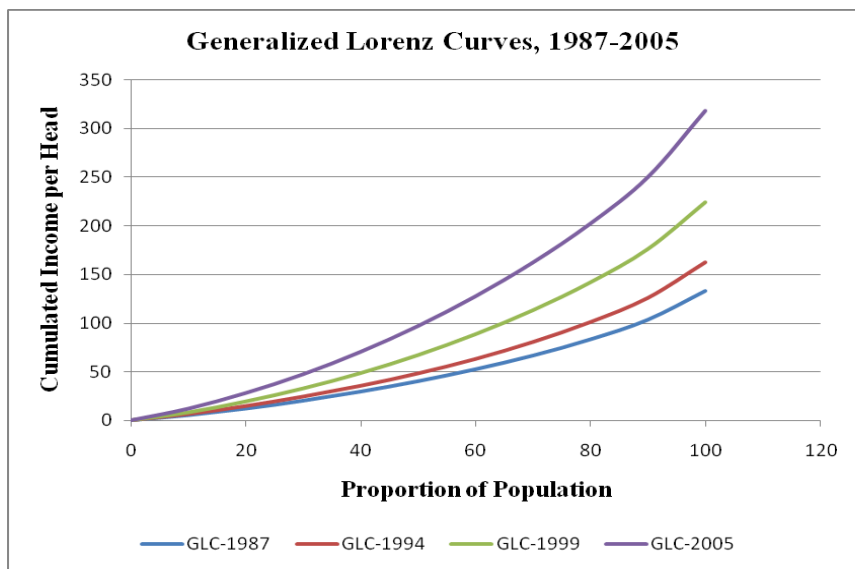


Figure 8: Generalized Lorenz Curves: 1987-2005

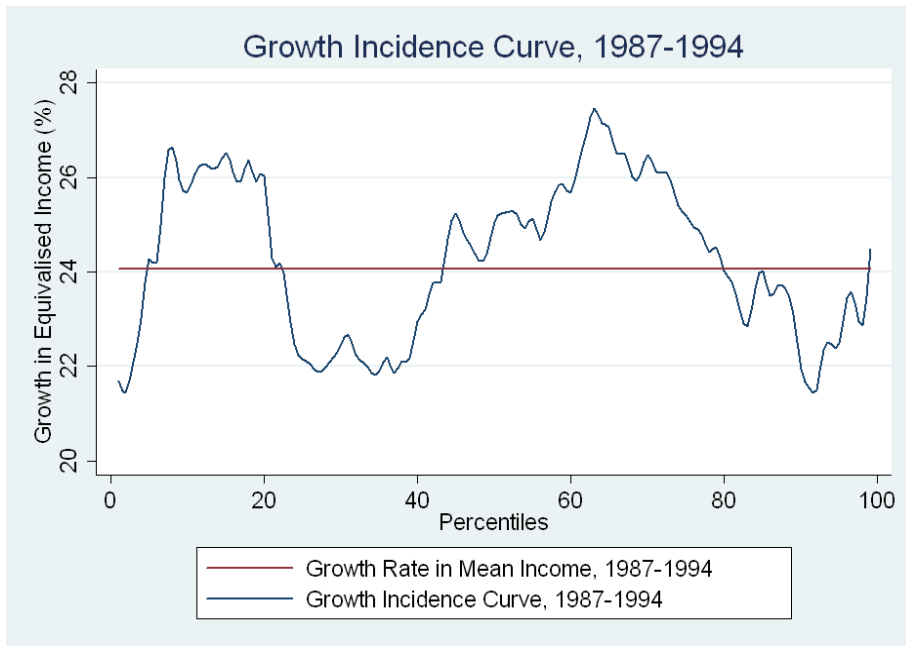


Figure 9: Growth Incidence Curve: 1987-1994

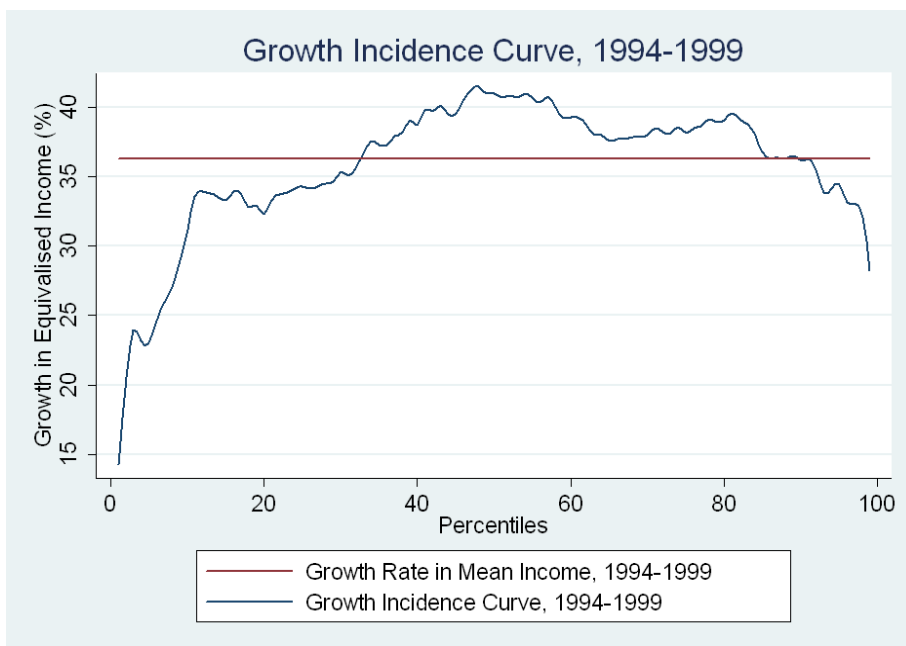


Figure 10: Growth Incidence Curve: 1994-1999

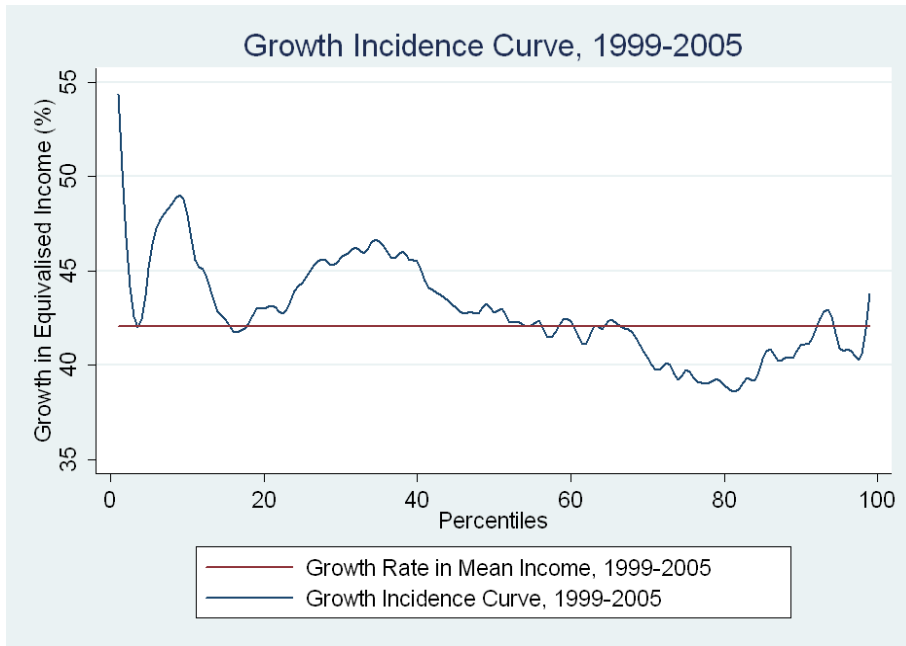


Figure 11: Growth Incidence Curve: 1999-2005

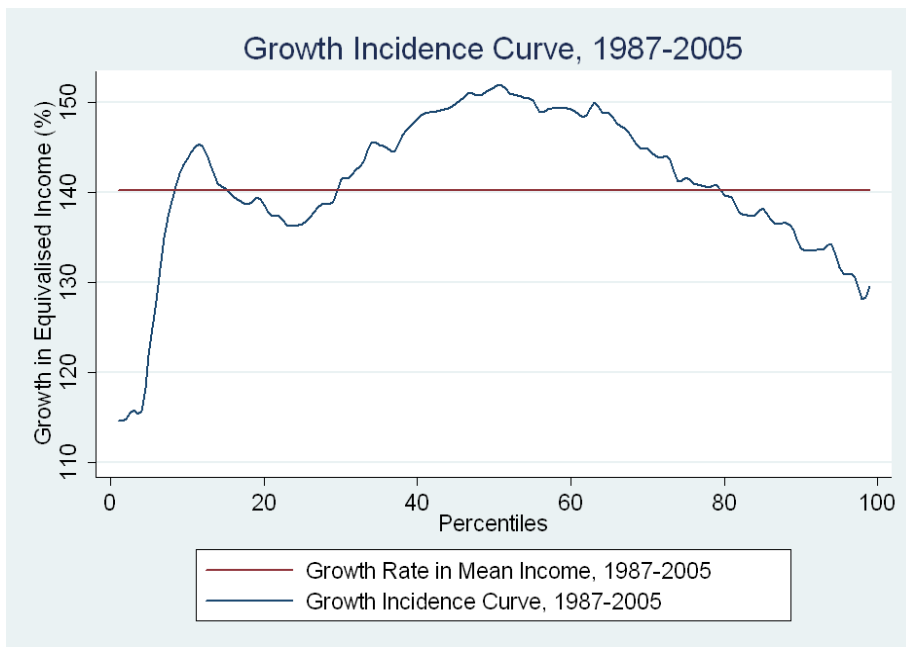


Figure 12: Growth Incidence Curve: 1987-2005

UCD CENTRE FOR ECONOMIC RESEARCH – RECENT WORKING PAPERS

- [WP12/07](#) Olivier Bargain, Eliane El Badaoui, Prudence Kwenda, Eric Strobl and Frank Walsh: 'The Formal Sector Wage Premium and Firm Size for Self-employed Workers' March 2012
- [WP12/08](#) Brendan Walsh: 'The Influence of Macroeconomic Conditions and Institutional Quality on National Levels of Life Satisfaction' March 2012
- [WP12/09](#) Ronald B Davies and Rodolphe Desbordes: 'Greenfield FDI and Skill Upgrading' March 2012
- [WP12/10](#) Morgan Kelly and Cormac Ó Gráda: 'Change Points and Temporal Dependence in Reconstructions of Annual Temperature: Did Europe Experience a Little Ice Age?' March 2012
- [WP12/11](#) Morgan Kelly and Cormac Ó Gráda: 'The Waning of the Little Ice Age' April 2012
- [WP12/12](#) Morgan Kelly and Cormac Ó Gráda: 'Agricultural Output, Calories and Living Standards in England before and during The Industrial Revolution' April 2012
- [WP12/13](#) Arnaud Chevalier and Orla Doyle: 'Schooling and Voter Turnout - Is there an American Exception?' April 2012
- [WP12/14](#) David Madden: 'The Relationship Between Low Birthweight and Socioeconomic Status in Ireland' April 2012
- [WP12/15](#) Robert W Fairlie, Kanika Kapur and Susan Gates: 'Job Lock: Evidence from a Regression Discontinuity Design' April 2012
- [WP12/16](#) John Regan: 'Ballot Order effects: An analysis of Irish General Elections' April 2012
- [WP12/17](#) Orla Doyle: 'Breaking the Cycle of Deprivation: An Experimental Evaluation of an Early Childhood Intervention' April 2012
- [WP12/18](#) Ivan Pastine, Tuvana Pastine and Paul Redmond: 'Incumbent-Quality Advantage and Counterfactual Electoral Stagnation in the U.S. Senate' May 2012
- [WP12/19](#) Adrian Corcoran and Robert Gillanders: 'Foreign Direct Investment and The Ease of Doing Business' July 2012
- [WP12/20](#) Wen Fan and Yuanyuan Ma: 'Estimating the External Returns to Education: Evidence from China' August 2012
- [WP12/21](#) David Madden: 'The Socioeconomic Determinants of Mental Stress in Ireland' August 2012
- [WP12/22](#) Sinéad Kelleher: 'Playing by the Rules? The Development of an Amended Index to Measure the Impact of Rules of Origin on Intra-PTA Trade Flows' September 2012
- [WP12/23](#) Christopher Jepsen, Kenneth Troske and Paul Coomes: 'The Labor-Market Returns to Community College Degrees, Diplomas, and Certificates' September 2012
- [WP12/24](#) Ronald B Davies: 'CCCTB 4 EU? SA vs. FA w/ FTA' October 2012
- [WP12/25](#) Ronald B Davies and Tine Jeppesen: 'Export mode, Trade Costs, and Productivity Sorting' October 2012
- [WP12/26](#) Vincent Hogan, Patrick Massey and Shane Massey: 'Competitive Balance and Match Attendance in European Rugby Union Leagues' October 2012
- [WP12/27](#) Mark E McGovern: 'Don't Stress: Early Life Conditions, Hypertension, and Selection into Associated Risk Factors' October 2012
- [WP12/28](#) Vincent Hogan, Patrick Massey and Shane Massey: 'Analysing Determinants of Match Attendance in the European Rugby Cup' October 2012
- [WP12/29](#) Karl Whelan: 'TARGET2 and Central Bank Balance Sheets' November 2012
- [WP12/30](#) Wasiu Adekunle Are: 'Poverty-Reducing Directions of Indirect Marginal Tax Reforms in Ireland' December 2012