

## Linkages between Pro-Poor Growth, Social Programmes and Labour Market: The Recent Brazilian Experience<sup>\*</sup>

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**Abstract:** From a methodological point of view, this paper makes two contributions to the literature. One contribution is the proposal of a new measure of pro-poor growth. This new measure provides the linkage between growth rates in mean income and in income inequality. In this context, growth is defined as pro-poor (or anti-poor) if there is a gain (or loss) in the growth rate due to a decrease (or increase) in inequality. The other contribution is a decomposition methodology that explores linkages between three dimensions: growth patterns, labour market performances, and social policies. Through the decomposition analysis, growth in per capita income is explained in terms of four labour market components: the employment rate, hours of work, the labour force participation rate, and productivity. We also assess the contribution of different non-labour income sources to growth patterns. The proposed methodologies are then applied to the Brazilian National Household Survey (PNAD) covering the period 1995-2004. The paper analyzes the evolution of Brazilian social indicators based on per capita income exploring links with adverse labour market performance and social policy change, with particular emphasis on the expansion of targeted cash transfers and devising more pro-poor social security benefits.

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**JEL Classification:** D31; I32; N36; O15; J21; I38

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## I. Introduction

The Brazilian experience has been quite peculiar in the sense that structural reforms, and in particular trade liberalization, started comparatively late, only a few years ago.

Whereas other countries in Latin America started opening their economies in the early or mid-1980s, the same process started in Brazil only in the early 1990s. The same happened with inflation control: while Mexico started its stabilization process in the mid-80s and Argentina in the early 1990s, Brazil achieved successful price stabilization only after 1994.

Brazil is the country in the world that presented the highest inflation in the period 1960-1995. From at least the beginning of the 1980s, curbing inflation became the focus of public policy in Brazil. Successive macroeconomic packages and three major stabilization efforts have been attempted since then: the *Cruzado* Plan in 1986, the *Collor* Plan in 1990 and the *Real* Plan in 1994. Only the *Real* Plan was successful in bringing down and controlling inflation. The *Real* plan belongs to the ‘exchange-rate based stabilization’ type of plans that led to consumption booms instead of recessions but the need to support an overvalued exchange rate for stabilization purposes increased the fragility of the Brazilian economy to the waves of external shocks that hit it such as Mexican (1995), Asian (1997) and Russian (1998) crises.

The 1999 Brazilian devaluation crisis triggered important changes in the macroeconomic and social policies that can be still observed today, such as: i) the adoption of floating exchange rates; ii) the adoption of inflation targets; iii) the implementation of the Fiscal Responsibility Law binding all government levels and state enterprises alike<sup>1</sup> but with an increase in the size of the tax burden of about 10 percentage points of GDP from 1995 onwards, reaching around 38 percent in the end of 2005. One also has to bear in mind that there was very high real interest rates and an expansion of public expenditure that

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<sup>1</sup> The *Lei de Responsabilidade Fiscal* represents a milestone in the new public finance regime at the different levels of the state. It constitutes a key element in accomplishing enduring fiscal adjustment by restricting public expenditure to the budget approved for the year in question.

contributed to the rise in the Brazilian public debt that reached more than 50 percent of GDP and to the slow growth trend assumed.

On the social front, minimum wages rose 75 percent in real terms from the beginning of 1995 to 2004 – and 100 percent until 2006. The minimum wage is also the numéraire of several cash transfers policies indexing benefits and eligibility criteria, in particular social security benefits. In 1995, social security expenditure already accounted for 50 percent of Brazilian social expenditure and 11 percent of GDP. In 1998, there was a change in social security income policies with progressive benefits adjustments but it was not particularly noticed because it did not require any reform or constitutional change. From 2000 onwards, with the creation of the Poverty Eradication Fund, there was gradual adoption of programmes emanating from central government to municipalities which had lower Human Development Index levels. The expansion of targeted and conditional cash transfers such as the *Bolsa-Escola*, and now the *Bolsa Família*, aimed to combine compensatory and structural components. The availability and expansion of safety nets from 2001 onwards generated a pro-poor impact in many instances. The social effects of the new generation of income policies were not fully assessed because changes in social security benefit passed largely unnoticed and the diffusion of targeted cash transfers was gradual and relatively recent.

During the last 25 years, changes in social indicators based on per capita income such as inequality, poverty and social welfare have reflected the marked volatility of the Brazilian macroeconomic environment: until 1994 the source of instability was the rise and failure of successive stabilization attempts, while from 1995 onwards the main source of instability was the arrival (and the departure) of external crisis, but at the same time increasingly expanding and targeted cash transfers cushioned the social consequences of the high instability and low growth trends observed.

As is generally claimed, there is a strong association between growth and poverty reduction in Brazil. Whether growth translates into significant poverty reduction depends upon numerous factors such as inflation, external shocks, unemployment, minimum

wages, social programmes etc. One of the most important factors influenced by all others is the degree of inequality in the country. Studies have found that poverty is more responsive to growth when the distribution of income and assets is more equal. In this context, a more equal society will grow faster. Brazil has been notoriously known as one of the countries with the highest income inequality in the world (DFID 2003, Li et al 1998, Psacharopoulos 1991). After its steep rise in the 1960s, Brazilian income inequality has been high and stable between 1970 and 2000 (Langoni 1973, Bacha and Taylor 1978, Hoffman 1989, Bonelli et al. 1989, Barros et al. 1992, Ramos 1993, Barros et al. 2000). In recent years, however, inequality has been on the decline. High inequality in the country would have prevented the economy from growing faster. It is imperative to emphasize that a combination of economic growth and income distribution would lead to a more rapid and effective solution to poverty reduction.

This paper proposes and applies to Brazil a growth and a pro-poor growth account methodology that explains how intense and regressive were the changes observed in labour market factors such as participation rates, employment, underemployment, productivity and returns to education. We measure how each of these factors affects the growth patterns which are characterized by the growth in the level and in the distribution of per capita income. The methodology also assesses the growth patterns of different income sources found in the Brazilian National Household Survey (PNAD), with particular emphasis on social security benefits and conditional cash transfers. We calculate the ratio between the additional fiscal cost and the benefit in terms of pro-poor growth of expanding the main public cash transfer programmes in the period studied at. The final objective is to reveal the contribution of each labour and non-labour component discussed above to total per capita growth and to pro-poor growth.

We focus our empirical analysis on the period of relative price stability but frequent external crisis from 1995 to 2004, whose results – we believe - are more structural, less explored in the literature and more reliable. The deflation process of nominal incomes during a sharp inflationary transition such as those frequently observed before 1995 is rather complex and uncertain, the choice of specific price indexes and associated weights

and lags involves arbitrary decisions that affect the average level of real incomes. Since incomes are nominally adjusted, received and spent at different moments, inflation also affects inequality measures in spurious ways. In other words, it is not only causality that explains the coincidence between the peaks of inflation and inequality that happened in Brazil in 1989 and 1994 but measurement error as well (see section V).

The period starting in 1995 misses out the labour market boom and poverty reduction that were both observed after the *Real* plan stabilization (Neri 1996, Rocha 2003, Barros et al. 2000). On the other hand, it captures the income inequality reduction of the 2001-2004 period which brought Brazilian inequality to its lowest levels in the last 25 years (Neri 2005, Ferreira et al. 2006, Soares 2006). After the peak of the so-called unemployment crisis of the second half of the nineties, there was some recovery of the labour market, specifically in terms of formal employment. The role played by different labour market variables on changes observed in the level and distribution of per capita income will be studied later in this paper. Another key factor to be studied is the adoption and expansion of a new regime of income policies - without dismantling the old regime - based on the expansion of new targeted cash transfer programmes financed by the central government.

This paper is organized in the following manner. Section II is devoted to the derivation of pro-poor growth rate that adjusts for inequality. Section III outlines empirical aspects of calculating the pro-poor growth rate using household surveys. Section IV develops a decomposition methodology to link pro-poor growth with labour market characteristics. While section V describes trends in growth, inequality and poverty, section VI discusses economic, institutional and social fluctuations in Brazil. Sections VII and VIII present the empirical results for pro-poor growth rates and the decomposition method, respectively. Based on a Shapely decomposition, section IX looks at the contribution of main components to growth patterns. Similarly, section X investigates the contributions of different non-labour income sources to growth. While section XI discusses demographic trends in Brazilian society, section XII concludes the study.

## II. Pro-poor growth rate

Suppose  $x$  is the real income of an individual, which is a random variable with density function  $f(x)$ , then the real mean income of the population is defined as<sup>2</sup>

$$\mu = \int_0^{\infty} xf(x)dx \quad (1)$$

A county's performance in average standard of living can be measured by the growth rate  $\gamma$  given by

$$\gamma = \Delta \ln(\mu) \quad (2)$$

Economic growth has an impact on each individual in a different manner. Following Kakwani and Pernia (2000), growth can be defined as pro-poor (or anti-poor) if the benefits of growth go to the poor proportionally more (or less) than to the non-poor. Thus, a pro-poor growth decreases inequality whereas an anti-poor growth increases inequality. The pattern of growth can be described by two factors: (i) the growth rate in mean income defined by  $\gamma$  and (ii) how inequality changes over time. To formulate poverty reduction policies, it is important to look at the distributive pattern of economic growth and not just at the growth rate in mean income.

To understand the pattern of economic growth, we have to link economic growth with changes in income distribution. To achieve this objective, we need to specify a social welfare function, which gives a greater weight to utility enjoyed by the poor compared to utility enjoyed by the non-poor. Suppose  $u(x)$  is the utility function, which is increasing in  $x$  and concave, then we can define a general class of social welfare function as

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<sup>2</sup> The real income is the nominal income adjusted for prices. The prices can vary across regions and over time. The determination of real income will depend on both regional price indices and consumer prices indices, which vary over time.

$$W = \int_0^{\infty} u(x)w(x)f(x)dx \quad (3)$$

where  $w(x)$  is the weight given to the utility of the individual with income  $x$ . The main problem with this social welfare function is that it is not invariant to the positive linear transformation of the utility function. Following Atkinson's (1970) idea of equally distributed equivalent level of income, we can get a money-metric social welfare function denoted by  $x^*$  from (3) as

$$W = u(x^*) = \int_0^{\infty} u(x)w(x)f(x)dx \quad (4)$$

where  $x^*$  is the equally distributed equivalent level of income which, if given to every individual in the society results in the same social welfare level as the actual distribution of income.

To make pro-poor growth operational, we need to specify  $u(x)$  and  $w(x)$ . The most popular form of the utility function is the logarithmic utility function which, given by  $u(x) = \log(x)$ , is increasing and concave in  $x$ . In this study we adopt the logarithmic utility function not only because of its popularity but also because of its attractive features such as decomposability of growth rate in terms of some labour market characteristics. We will discuss this decomposition methodology in the next section.

The weighting function  $w(x)$  should capture the relative deprivation that is suffered by the poor relative to the non-poor in society; the greater the deprivation suffered by an individual with income  $x$ , the greater should be  $w(x)$ . Thus,  $w(x)$  should be a decreasing function of  $x$ . Further, total weight given to all individuals should add up to unity, which implies

$$\int_0^{\infty} w(x)f(x)dx = 1 \quad (5)$$

A simple way to capture relative deprivation is to assume that an individual's deprivation depends on the number of persons who are better off than him/her in society. Such a weighting scheme is given by

$$w(x) = 2[1 - F(x)] \quad (6)$$

where  $F(x)$  is the distribution function. This function implies that the relative deprivation suffered by an individual with income  $x$  is proportional to the proportion of individuals who are richer than this individual. It can be verified that  $w(x)$  in (6) is a decreasing function of  $x$  and satisfies equation (5).<sup>3</sup>

Substituting  $u(x) = \log(x)$  and  $w(x)$  from (6) in (4) gives the social welfare function:

$$\log(x^*) = 2 \int_0^{\infty} [1 - F(x)] \log(x) f(x) dx \quad (7)$$

which provides the basis for empirical analysis presented in this paper. It will be useful to write (7) as

$$\log(x^*) = \log(\mu) - \log(I) \quad (8)$$

where

$$\log(I) = 2 \int_0^{\infty} [1 - F(x)] [\log(\mu) - \log(x)] f(x) dx \quad (9)$$

where  $I$  is a new measure of inequality. Taking first difference in (8) gives

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<sup>3</sup> Note that this weighting scheme is also implicit in the Gini index, which is the most popular measure of inequality.

$$\gamma^* = \gamma - g \tag{10}$$

where  $\gamma^* = \Delta \log(x^*)$  is the growth rate of money-metric social welfare  $x^*$ ,  $\gamma = \Delta \log(\mu)$  is the growth rate of mean income  $\mu$  and  $g = \Delta \log(I)$  is the growth rate of inequality as measured by  $I$ . This equation describes a growth pattern which provides the linkage between growth rates in the mean income and income inequality.

$\gamma^*$  is the proposed measure of pro-poor growth rate. If  $g$  is positive, then growth is accompanied by an increase in inequality. In this case, we have  $\gamma^* < \gamma$  and thus, there is a loss of growth rate due to the increase in inequality. If  $g$  is negative, this implies that growth is accompanied by a decrease in inequality. In this case,  $\gamma^* > \gamma$ , which suggests that there is a gain in growth rate due to the decrease in inequality. Growth is defined as pro-poor (or anti-poor) if there is a gain (or loss) in growth rate.

### III. Calculating pro-poor growth rate from household surveys

This study utilizes the Pesquisa Nacional por Amostra de Domicílios (PNAD, the Brazilian Annual National Household Survey) from 1995 to 2004. Each household survey contains a variable called the weighting coefficient (WTA), which is the number of population households represented by each sample household. The sum of the WTAs for all sample households provides the total number of households in the country. A population weight variable (POP) can be constructed by multiplying the weighting coefficient (WTA) by the household size. The sum total of the (POP) variable for all sample households provides an estimate of the total population in the country. The total population estimate for Brazil was calculated as equal to 148.11 million for 1995, which increased to 173.71 million in 2004.

Using the (POP) variable, one can easily calculate the relative frequency that is associated with every sample household. Suppose  $f_{jt}$  is the relative frequency associated

with the  $j$ th household at year  $t$ . If  $x_{jt}$  is the per capita real income of the  $j$ th household at year  $t$ , then the mean income of all individuals in the country at year  $t$  can be estimated as

$$\mu_t = \sum_{j=1}^n f_{jt} x_{jt} \quad (11)$$

which was estimated for every year between 1995 and 2004. We then estimate the growth rate of the mean income at year  $t$  as

$$\gamma_t = \Delta \log(\mu_t) \quad (12)$$

To compute the social welfare function defined in (7), we need an estimate of the probability distribution function  $F(x)$ . An unbiased estimate of  $F(x)$  for the  $j$ th household at year  $t$  is given by<sup>4</sup>

$$p_{jt} = \sum_{i=1}^j f_{it} - f_{jt} / 2 \quad (13)$$

when households are arranged in ascending order of their per capita real income  $x_{it}$ .

Substituting (13) into (7) gives a consistent estimate of money-metric social welfare  $x_t^*$  as given by

$$\log(x_t^*) = 2 \sum_{j=1}^n f_{jt} (1 - p_{jt}) \log(x_{jt}) \quad (14)$$

which gives an estimate of pro-poor growth rate at year  $t$  as

$$\gamma_t^* = \Delta \log(x_t^*) \quad (15)$$

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<sup>4</sup> This equation makes a continuity correction, which is estimated by obtaining an unbiased estimate of  $F(x)$ .

Growth will be pro-poor (anti-poor) at year  $t$  if  $\gamma_t^*$  is greater (less) than  $\gamma_t$ .

#### IV. Linking pro-poor growth with labour market characteristics

The PNAD provides labour market characteristics of individuals. From the individual information, we can calculate the following variables at household level.

- Per capita real labour income ( $y_l$ )
- Per capita non-labour income ( $y_{nl}$ )
- Per capita employed persons in the household ( $e$ )
- Per capita labour force participation rate ( $\ell$ )
- Per capita hours of work in the labour market ( $h$ )
- Per capita years of schooling in the household ( $s$ )

Using these variables we calculate the following variables of interest:<sup>5</sup>

- Employment rate:  $e_r = e / \ell$
- Hours worked per employed person:  $h_e = h / e$
- Productivity:  $\xi = y_l / h$

Using these variables in the places of per capita real income in (11), (12), (14) and (15), we can calculate growth rates in mean values and pro-poor growth rates for each of the above variables. These growth rates will allow us to judge whether individuals' labour market characteristics are pro-poor or anti-poor. For instance, we can answer questions such as: does the employment generated by the growth process favour the poor more than the non-poor? is the growth process increasing or decreasing the level of underemployment (in terms of work hours) between the poor and the non-poor? is

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<sup>5</sup> Productivity of a household is defined as labour earnings of the household's per hour of work.

growth increasing or decreasing the productivity differences between the poor and the non-poor?, and are the differences in labour force participation rates between the poor and the non-poor increasing or decreasing over time?

We may provide the linkage between growth rate of per capita labour income and growth rates of the labour market characteristics. This linkage is provided through the following definition:

$$\ln(y_t) = \ln(e_r) + \ln(h_e) + \ln(\ell) + \ln(\xi) \quad (16)$$

Using this definition it is easy to show that growth rate in per capita labour income is related to labour market characteristics in an additive fashion. Thus

$$\gamma(y_t) = \gamma(e_r) + \gamma(h_e) + \gamma(\ell) + \gamma(\xi) \quad (17)$$

This equation shows that growth in per capita labour income can be explained by four factors relating to labour market. Each of these factors can be either positive or negative. The first factor is the employment rate. If this factor is positive, this suggests that the employment rate has improved in the economy, contributing positively to economic growth. A similar interpretation can be given to the other factors. The last factor is the contribution of change in productivity to growth rate of per capita labour income.

Again using the identity in (16) in (14), it is easy to show that the pro-poor growth rate of per capita labour income is also related with pro-poor growth rates of labour market characteristics in an additive fashion as shown in<sup>6</sup>

$$\gamma^*(y_t) = \gamma^*(e_r) + \gamma^*(h_e) + \gamma^*(\ell) + \gamma^*(\xi) \quad (18)$$

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<sup>6</sup> Note that the pro-poorness of labour income is measured with respect to the total per capita income.

which explains the pro-poor growth rate in per capita labour income in terms of the pro-poor growth rates of four labour market characteristics. Subtracting (17) from (18) gives the decomposition of the growth rate of inequality in total income in terms of four factors as

$$g^*(y_l) = g^*(e_r) + g^*(h_e) + g^*(\ell) + g^*(\xi) \quad (19)$$

The growth rate of labour income is pro-poor (or anti-poor) if  $g^*(y_l)$  is greater (or less) than 0. This equation provides the contributions of various labour market characteristics to a gain (or loss) of growth rate due to changes in the pattern of per capita labour income.<sup>7</sup> If, for instance,  $g^*(e_r)$  is positive (or negative), it means that employment generated in the economy contributes to a decrease (or increase) in inequality in per capita income. A similar interpretation applies to the other factors.

Schooling is a major factor that has an impact on productivity. It is generally true that the higher the level of schooling an individual possesses, the greater is his/her productivity (or labour earnings per hour). Thus, an increase in amount of schooling should lead to an increase in productivity. But the relationship between schooling and productivity is not that simple. The changes in amount of schooling are also accompanied by the changes in returns from schooling. The returns from schooling also vary from one household to another depending on hosts of factors such as age, location, occupation and so on. Also growth rates of returns are also not uniform across households.

Productivity of the  $j$ th household denoted by  $\xi^j$  can be written as

$$\xi^j = y_l^j / h^j \quad (20)$$

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<sup>7</sup> A gain in growth rate implies a decrease in inequality and a loss in growth rate indicates an increase in inequality.

where  $y_i^j$  is the per capita labour income of the  $j$ th household and  $h^j$  is the per capita hours of work in the labour market provided by the  $j$ th household. Suppose  $\bar{r}$  is the average hourly return from per year of schooling of all working population and  $\bar{r}^j$  is the average return (per hour) from per year of schooling of the  $j$ th household. Then the productivity of the  $j$ th household can be written as

$$\xi^j = s^j \bar{r} (\bar{r}^j / \bar{r}) \quad (21)$$

where

$$\bar{r}^j = \xi^j / s^j \quad (22)$$

Taking logarithm in both sides of equation (21), we obtain

$$\log(\xi^j) = \log(s^j) + \log(\bar{r}) + \log(\bar{r}^j / \bar{r}) \quad (23)$$

which on utilizing the averages of the variables and taking first differences gives

$$\gamma(\xi) = \gamma(s) + \gamma(\bar{r}) \quad (24)$$

which shows that growth rate in the mean productivity can be decomposed into two components. The first component is the growth rate of mean years of schooling, and the second component is the growth rate of average returns from per year of schooling.<sup>8</sup>

Applying the identity (23) in (14), it can be easily shown that the pro-poor growth rate of productivity is related to three factors in an additive fashion as

$$\gamma^*(\xi) = \gamma^*(s) + \gamma^*(\bar{r}) + \gamma^*(\bar{r}^j / \bar{r}) \quad (25)$$

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<sup>8</sup> Changes in relative rates of returns from schooling do not affect the growth rate of productivity but will have an impact on the pro-poor growth rate of productivity through changes in the distribution.

Subtracting (24) from (25) gives the decomposition of the growth rate of inequality in productivity in terms of three factors:

$$g^*(\xi) = g^*(s) + g^*(\bar{r}) + g^*(\bar{r}^j / \bar{r}) \quad (26)$$

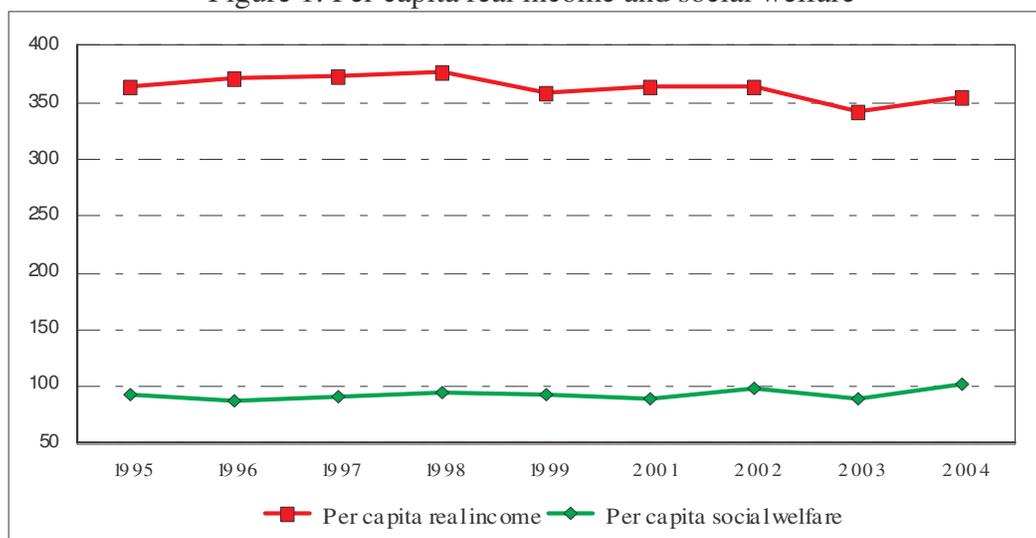
The first term in (26) relates to how growth in years of schooling is distributed among the poor and the non-poor. The schooling will be pro-poor (or anti-poor) if  $g^*(s)$  is greater (or less) than zero. The second term in (26) will be always zero, because  $\bar{r}$  is the same for all households. The third term measures the impact of redistribution of the rates of returns among households. If  $g^*(\bar{r}^j / \bar{r})$  is greater (or less) than 0, changes in the rates of returns from schooling favour poor (or non-poor) households more than non-poor (or poor) households. This decomposition is useful in understanding the impact of schooling on growth and inequality.

## V. Trends in Growth, Inequality and Poverty

For this study, we have chosen per capita real income as a welfare indicator. Per capita real income is defined as per capita nominal income adjusted for prices, which vary across regions and over time. This is achieved by dividing the per capita nominal income by the per capita poverty line expressed as a percentage. The poverty line used in this paper takes into account regional costs of living (Ferreira et al. 2003, Neri 2001).

Figure 1 presents the estimates of per capita real income and money-metric social welfare for the period, 1995-2004. The per capita social welfare indicator shows the per capita income that takes inequality into account. When accounting for inequality, the per capita income shows a marked reduction. The sharp disparity between per capita real mean income and per capita social welfare reflects a high level of inequality in Brazil over the period. However, the good news is that the disparity between the two indicators has narrowed in the recent years. This indicates a fall in inequality in Brazil over the past years.

Figure 1: Per capita real income and social welfare



Source: authors' calculation based on PNAD

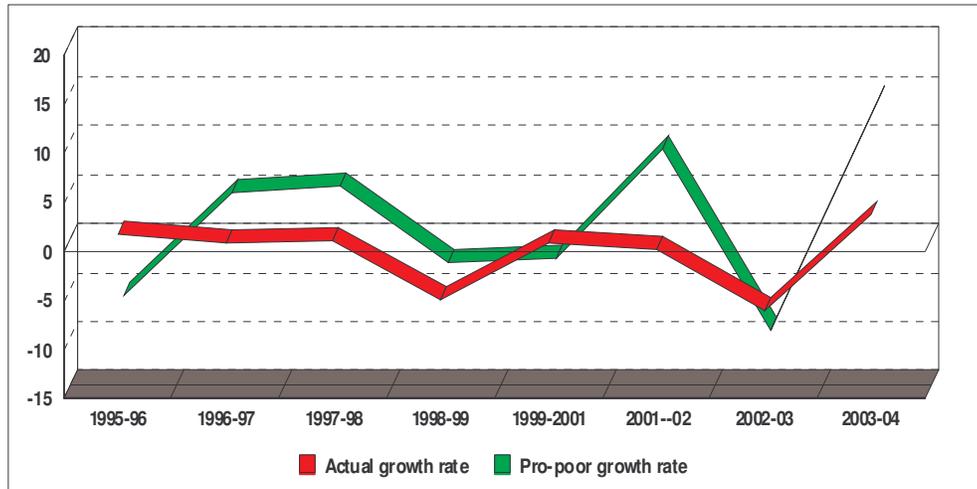
Table 1 presents growth rates of per capita real income and per capita social welfare. The results reveal that the trend in per capita real income has been declining at an annual rate of 0.63 percent over 1995-2004. Hence, the actual growth rate of per capita real income has been almost stagnant. This unimpressive performance in per capita real income worsened even further in the second period 2001-2004, when per capita real income fell at an annual rate of 1.35 percent.

Table 1: Growth rates of per capita real income and social welfare

Period	Actual growth rate	Pro-poor growth rate	Gain(+)/loss(-) of growth
1995-96	1.59	-5.95	-7.54
1996-97	0.65	4.42	3.77
1997-98	0.97	5.07	4.10
1998-99	-5.15	-2.53	2.63
1999-2001	0.76	-2.17	-2.94
2001-2002	0.11	8.98	8.87
2002-2003	-6.12	-9.64	-3.52
2003-2004	3.56	14.11	10.55
<b>1995-2004</b>	<b>-0.63</b>	<b>0.73</b>	<b>1.36</b>
<b>1995-2001</b>	<b>-0.30</b>	<b>0.10</b>	<b>0.40</b>
<b>2001-2004</b>	<b>-1.35</b>	<b>3.07</b>	<b>4.42</b>

Source: authors' calculation based on PNAD

Figure 2: Growth rates of per capita real income and social welfare



This pessimistic picture, however, tends to disappear if growth is evaluated in terms of social welfare adjusted for inequality, which is called the pro-poor growth rate in the table. This is a more relevant concept for evaluating a country's performance in relation to its standard of living. In the first period (1995-2001), the trend in the pro-poor growth rate, although positive, was only 0.10 percent, which cannot be regarded as a good performance but the trend in the growth rate in the second period (2001-2004) increased to 3.07 percent, which is an exceptionally good performance.

The last column of Table 1 is obtained by subtracting the actual growth rate from the pro-poor growth rate. Gains in growth rates imply a decline in inequality, while losses in growth rates imply an increase in inequality. Substantial gains in growth rates are quite noticeable in the second period, 2001-2004. There have been gains in growth rates equivalent to 4.42 percent per annum because of falling inequality in the 2000s. By contrast, the gains had been merely 0.40 percent per year in the first period, 1995-2001. Thus, in the second period, the poor were able to benefit proportionally much more from growth than in the first period. This growth pattern has led to an unprecedented reduction in inequality in Brazil.

Having examined the trends in growth and inequality, we now go on to analyze the trends in poverty over 1995-2004. Poverty estimates for the headcount ratio, the poverty

gap ratio and the severity of poverty are presented in Table 2. The results show a significant increase in the proportion of the population crossing the poverty line between 1995 and 1998.

Table 2: Poverty estimates

Period	Headcount ratio	Poverty gap ratio	Severity of poverty
1995	29.37	12.80	7.69
1996	29.23	13.31	8.26
1997	29.24	13.00	7.98
1998	27.83	12.28	7.40
1999	28.81	12.58	7.53
2001	28.28	12.75	7.84
2002	27.39	11.78	6.95
2003	28.19	12.32	7.51
2004	26.04	10.87	6.36
<i>Annual growth rates</i>			
1995-2001	-0.68	-0.54	-0.50
2001-2004	-2.20	-4.32	-5.52
1995-2004	-1.00	-1.46	-1.76

Source: authors' calculation based on PNAD

The Asian crisis had a negative impact on poverty through the pressure on the currency and higher interest rates. For Brazil, the percentage of the poor increased from 27.83 percent in 1998 to 28.81 percent in 1999. Since 1999, poverty had been on decline. Note that the real minimum wage had increased to its highest point during the period 2000-2001, 9.1 percent. It appears that raising the minimum wage is an important measure that reduces poverty in Brazil as a whole. It should be highlighted, however, that the positive impact of a higher minimum wage rate can be reduced with a rising unemployment rate, due to higher costs. In Brazil, the annual growth rate of the minimum wage has been increasing over time and the unemployment rate has been on the rise as well. The unemployment rate has recently reached almost 10 percent in 2001 (WDI 2004). This indicates that the positive impact of the increasing minimum wage on poverty reduction could have been mitigated by the rising unemployment rate in the 1990s.

All in all, the Brazilian experience exhibits an interesting pattern between growth in per capita real income and poverty: while per capita real income has declined over the

period, poverty has also fallen. This is an interesting case that does not support a *priori* the notion that a positive (or negative) growth leads to a decrease (or increase) in poverty. More importantly, the negative growth during the period, 1995-2004, was pro-poor in the sense that the poor made positive gains in their incomes despite the fact that average incomes declined. Thus, there was a sharp decline in inequality over the period which offset the adverse effect of the negative growth on poverty.

## **VI. Economic, Institutional and Social Fluctuations**

We decided to restrict the analysis to the 1995-2004 period in order to avoid the imprecision associated with the deflation process during the sharp inflationary transitions often observed before this period. The problem is not only that the choice of a specific price index involves arbitrary decisions that affect the average level of real incomes. Fluctuations in inflation also introduce problems in the measurement of inequality firstly, because nominal incomes are received at different time periods. Secondly, since real incomes are not all spent at payments dates, it involves the incidence of inflation tax paid on cash holdings specifically by the poor who do not have access to indexed financial accounts, yet this effect is not captured in standard household surveys. Finally, and most importantly, when nominal income adjustments are not synchronized, inequality of monthly earnings (an indicator traditionally used in Brazil) is biased upward in an inflationary spiral.<sup>9</sup> For all these reasons, we decided to start the empirical analysis after 1994 but it is worth describing the socio-economic context at the time.

After the launch of the *Real Plan*, inflation dropped instantaneously from about 45 percent per month to less than 1 percent per month. The *Real Plan* differed from previous plans in at least two major ways. First, it encompassed a very successful ‘de-indexation’ process, which was based on the establishment of a transitory unit of account fully indexed to inflation. Second, it unfolded in a considerably more open economic

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<sup>9</sup> Cardoso et al. (1995), Neri (1995) and Ferreira et al. (2006) discuss the impacts of inflation on inequality in Brazil. Neri and Camargo (2001) showed using panel data that the post-stabilization fall in inequality measures on a monthly basis is up to 4 times higher than on a four-month mean earnings basis and the difference is exactly due to the reduction on the temporal variation of each individual incomes. Inflation stabilization brought more stability than equity.

environment with a somewhat overvalued currency. The *Real* Plan belongs to the ‘exchange-rate based stabilization’ type of plans that led to consumption booms, instead of recessions. The exchange rate plays the role of an anchor on the prices of tradable goods. Hence, there was a change in relative prices against tradable sectors and in favour of non-tradable sectors – which benefited low-income workers, notably in personal and social services<sup>10</sup> but the need to support an overvalued exchange rate for stabilization purpose made the Brazilian economy more fragile to the waves of external shocks that hit the Brazilian economy such as the Mexican (1995), Asian (1997), Russian (1998) and Brazilian (1999) crises.

Between 1996 and 1999, household per capita income from labour decreased at an average of 4.5 percent *per annum* in metropolitan areas, while remaining stable in the rest of the country. Unemployment rates (specifically metropolitan long-run unemployment) rose more than two percentage points in December 1997 after the sharp interest rate hike, which would be reinstated after each crisis in order to avoid capital outflows. Unemployment rates remained at an average annual rate of 8 percent until the very end of 2000 – the infamous ‘Unemployment Crisis’ (Neri 2000, Ramos and Brito 2003). Although there was a decrease in average total incomes, national poverty fell; the labour market performed negatively between 1996 and 1999; while the social safety nets softened the crises’ effects (and that of the 1998 drought in the Northeast) on the poorest.

The 1999 Devaluation crisis triggered important changes in the macroeconomic and social regimes that can be still observed today, such as: i) the adoption of floating exchange rates; ii) the adoption of inflation targets; iii) the implementation of the Fiscal Responsibility Law (Lei de Responsabilidade Fiscal (LRF)) binding all government levels and state enterprises alike; iv) on the social front, we observe a change in social security income policies with progressive benefits adjustments since 1998; and v)

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<sup>10</sup> Neri et al. (1996) and Rocha (2003) present a detailed description of the impact of the *Real* plan on poverty and inequality.

expansion of targeted and conditional cash transfers such as the *Bolsa-Escola* among other programmes.

In 2000, the labour market experienced a brief recovery. In this period, contrary to the *Real* plan's initial boom, the exchange rate devaluation favoured export sectors and formal employment rates started to increase. In April 2001, a new crisis suddenly broke out, liquidating GDP growth, reportedly up to 4 percent. This crisis was a result of three new adverse shocks: the electrical energy rationing, the Argentinean economic collapse, and the American recession. In 2002, it was possible to observe a decrease in poverty rates despite the macroeconomic instability, triggered perhaps by fears of macroeconomic policy changes.

The new administration gave a 'confidence shock' to the market at the beginning of 2003, mainly keeping the three main features of the macroeconomic regime, whilst fighting inflation and exchange rate depreciation, resorting once again to very high real interest rates. The launching of the *Fome Zero* (Zero Hunger) programme at the beginning of the new administration meant an initial rupture with the cash transfer policies that were gradually being implemented. The net result of what may be perceived as a lack of adjustment in social policy, combined with the social costs of the macroeconomic adjustment, resulted in stagflation in 2003 and an increase in poverty.

In October 2003, the government adopted a new programme called the *Bolsa-Família* (Family Grant) following the same lines as the previous administration programmes, expanding the number of beneficiaries and the average size of the benefit with several upgrades, namely: it provides higher benefits to the poorest; it also attempts to integrate different programmes, unify the beneficiary registration system, if and it provides greater transparency and accountability to society. In 2004, the Brazilian economy presented brighter prospects, with GDP growing at 4.5 percent and poverty falling. It is important to notice that despite the instability in GDP growth in the 2001-2004 period, inequality fell during this whole period and in particular in 2003-04.

## VII. Patterns of Pro-Poor Growth

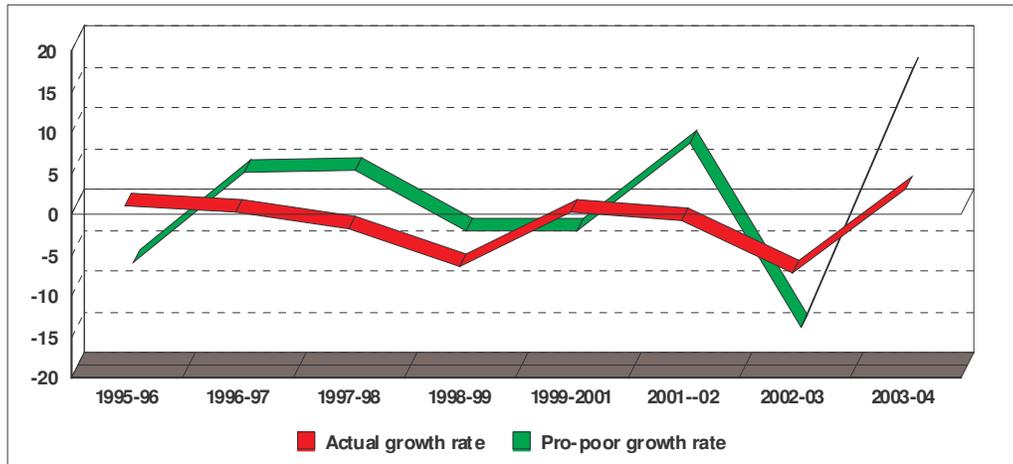
In this section, our concern is with explaining the pro-poor growth in terms of factors relating mainly to the labour market. Per capita total income can be derived from both labour and non-labour income sources. To begin with, Table 3 shows growth rates of per capita labour income during 1995-2004. Consistent with the growth rate in per capita total income, earnings from the labour market have not performed well over the period. Per capita real labour income declined at an annual rate of 1.49 percent between 1995 and 2004. The second period was even worse, when the growth rate in labour income became -2.05 percent per annum. However, the per capita growth rate in social welfare became positive, with an annual rate of 0.97 percent in the second period. Thus, there was gain of 3.02 percent in growth rate, which is attributed to a decline in inequality. This indicates that in the 2000s, the labour market conditions became better for the poor relative to the non-poor. Figure 4 shows that labour income had benefited the poor proportionally more than the non-poor in the latest period, 2003-04, in particular. It will be interesting to find out what factors of the labour market – such as employment and productivity among others – play a major role in explaining this pro-poor growth pattern in this period. This task is taken up in section VIII.

Table 3: Growth rates of per capita labour income

Period	Actual growth rate	Pro-poor growth rate	Gain(+)/loss(-) of growth
1995-96	1.16	-7.21	-8.37
1996-97	0.33	3.71	3.38
1997-98	-1.66	3.97	5.63
1998-99	-6.23	-3.38	2.84
1999-2001	0.39	-3.54	-3.93
2001-2002	-0.58	7.24	7.82
2002-2003	-7.15	-15.20	-8.05
2003-2004	3.28	16.24	12.97
<b>1995-2004</b>	<b>-1.49</b>	<b>-0.73</b>	<b>0.76</b>
<b>1995-2001</b>	<b>-1.30</b>	<b>-0.97</b>	<b>0.32</b>
<b>2001-2004</b>	<b>-2.05</b>	<b>0.97</b>	<b>3.02</b>

Source: authors' calculation based on PNAD

Figure 4: Actual and pro-poor growth rates of per capita labour income



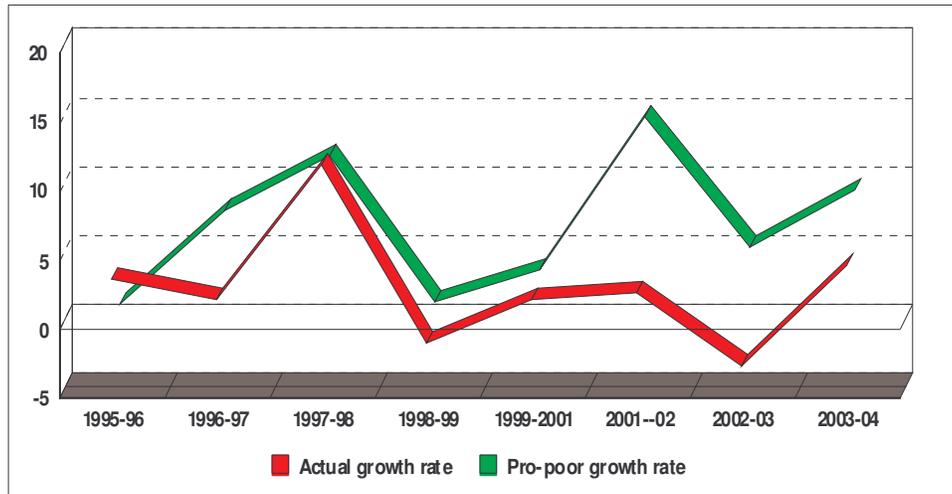
Next we look at the aggregate picture of non-labour income in Brazil over the period, 1995-2004. The results emerging from non-labour income are in contrast with those from labour income, which we have just discussed. The story of non-labour income can be told with the help of Table 4. According to the table, per capita non-labour income has been growing at an annual rate of 2.64 percent between 1995 and 2004. Non-labour income had grown much faster in the first period, 1995-2001, compared to the second period when its growth rate has slowed down to 1.02 percent per annum.

Table 4: Growth rates of per capita non-labour income

Period	Actual growth rate	Pro-poor growth rate	Gain(+)/loss(-) of growth
1995-96	3.56	0.95	-2.61
1996-97	2.10	7.63	5.53
1997-98	11.77	11.66	-0.11
1998-99	-1.13	1.01	2.14
1999-2001	2.09	3.42	1.33
2001-2002	2.51	14.53	12.02
2002-2003	-2.69	5.06	7.76
2003-2004	4.48	9.18	4.71
<b>1995-2004</b>	<b>2.64</b>	<b>6.30</b>	<b>3.66</b>
<b>1995-2001</b>	<b>3.69</b>	<b>5.20</b>	<b>1.51</b>
<b>2001-2004</b>	<b>1.02</b>	<b>9.14</b>	<b>8.12</b>

Source: authors' calculation based on PNAD

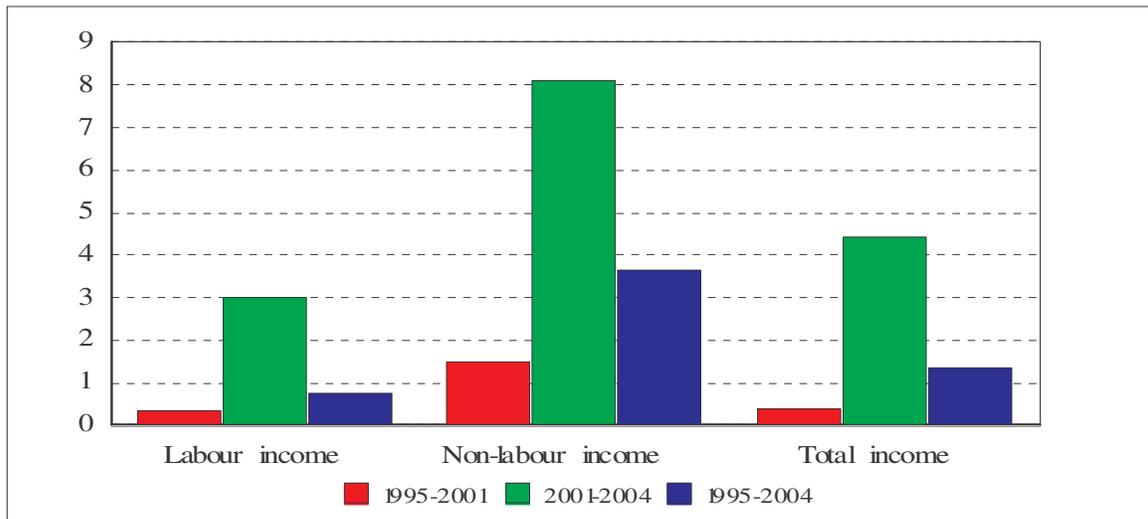
Figure 5: Actual and pro-poor growth rates of per capita non-labour income



In view of the pro-poor growth, the non-labour income has performed even better than the actual growth. Interestingly, when the non-labour income is adjusted for inequality, the growth rate becomes much higher for the second period than for the first period. This is suggested by the fact that the annual pro-poor growth rates are 5.20 and 9.14 percent for 1995-2001 and 2001-2004, respectively. Hence, the growth in non-labour income has been much more pro-poor in the period of 2001-2004. More importantly, the high pro-poorness of non-labour income is the factor that underpins the fall in inequality during the second period. It can be seen clearly from Figure 5 that the gap between the pro-poor growth rate and the actual growth rate has opened up in the second period compared to the first period. In sections IX and X, we examine what income components in particular have played a significant role in explaining the high pro-poorness of the total non-labour income over the period.

In summary, growth in total income has been much more pro-poor in the second period than in the first period. This is due mainly to the non-labour income that has benefited the poor proportionally more than the non-poor. Compared to the non-labour income, the pro-poorness of the labour income has been rather small over the period. Figure 6 sums up these findings.

Figure 6: Gains and losses of growth rates



## VIII. Linkages between labour market and pro-poor growth<sup>11</sup>

In this section, we look into the role that labour market characteristics play in determining pro-poor growth in Brazil. With reference to the decomposition methodology we proposed in the earlier section, our focus will be on factors including the labour force participation rate, the employment rate, hours of work per employed person, and productivity. These factors will be discussed in turn before we present the results of the decomposition methodology.

### VIII.1 Labour force participation

The labour force participation rate is defined as the proportion of population who are either employed or unemployed. The labour force participation rate is then adjusted by the size of household to obtain per capita labour force participation rate. Thus, the per capita labour force participation rate will differ across households. Results shown in Table 5 suggest that the actual growth in per capita labour force participation rate has been quite slow over the decade, growing at an annual rate of just 0.73 percent. The

<sup>11</sup> Barros and Camargo (1992) and Barros et al. (2004) develop an alternative decomposition methodology also applying to Brazilian data. Amadeo et al. (1993) and Amadeo and Camargo (1997) discuss the characteristics of Brazilian labour markets.

situation has been much better in the second period, 2001-2004, compared to the earlier period.

Not only did the second period perform relatively better in terms of the actual growth rate, but it also did much better than the first period in terms of the growth rate of the per capita labour force participation rate for the poor. Nevertheless, while the labour force participation rate overall has been anti-poor it has shown a slight improvement in the 2000s. When the economy is not dynamic enough to absorb the labour forces in the market, people such as unskilled labour are likely to be discouraged from participating in the labour market. Yet when there is a sign of economic recovery, the labour force participation rate also tends to rise. This might explain the trend in the labour force participation rate among the poor in Brazil.

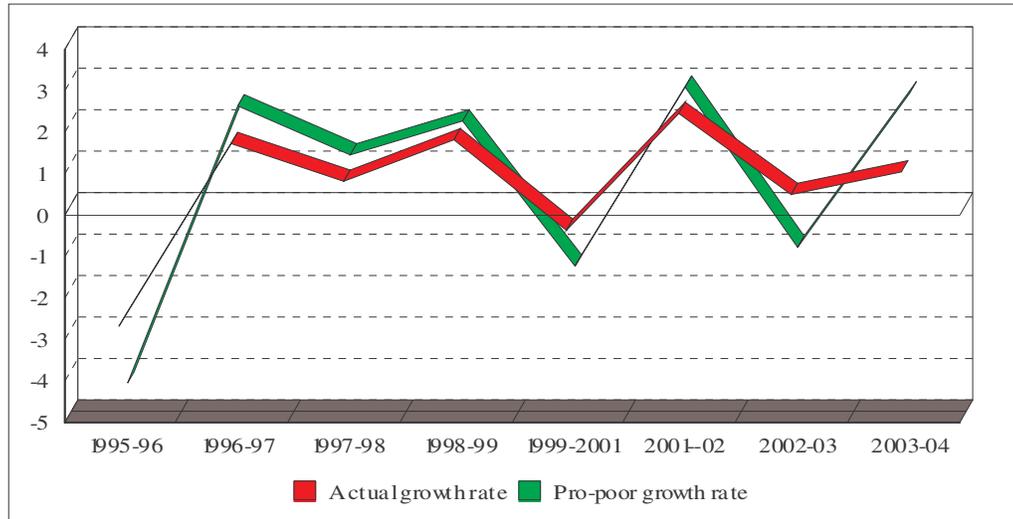
In addition, Figure 7 makes an interesting point. What emerges from the figure is that the pro-poor growth rate for labour force participation is more volatile than the actual or market growth rate for the same variable. This suggests that labour force participation among the poor is affected more by the business cycle of the economy. When the economy is in recession, the labour force participation rate for the poor tends to fall sharply more than the national average. When the economy is in recovery, the labour force participation for the poor tends to rise much faster than the national average.

Table 5: Growth rates of per capita labour force participation rate

Period	Actual growth rate	Pro-poor growth rate	Gain(+)/loss(-) of growth
1995-96	-2.66	-4.28	-1.62
1996-97	1.75	2.39	0.63
1997-98	0.86	1.22	0.35
1998-99	1.83	2.03	0.20
1999-2001	-0.33	-1.50	-1.17
2001-2002	2.48	2.82	0.34
2002-2003	0.53	-1.02	-1.55
2003-2004	1.06	2.69	1.63
<b>1995-2004</b>	<b>0.73</b>	<b>0.41</b>	<b>-0.32</b>
<b>1995-2001</b>	<b>0.48</b>	<b>0.19</b>	<b>-0.29</b>
<b>2001-2004</b>	<b>1.27</b>	<b>1.24</b>	<b>-0.03</b>

Source: authors' calculation based on PNAD

Figure 7: Actual and pro-poor growth rates of per capita labour force participation rate



## VIII.2 Employment

The employment rate is defined as the ratio of per capita employment to per capita labour force participation rate.<sup>12</sup> As indicated by Table 6, overall employment growth has been negative over 1995-2004. The job growth rate of -0.66 percent per annum in the first period has become positive in the second period, at 0.07 percent per annum. This suggests that overall job growth in the labour market has been rather sluggish for the period, 1995-2004. As far as employment growth for the poor is concerned, it has been pessimistic in the entire period, anti-poor in general. However, employment among the poor has become pro-poor in the second period. As shown in Figure 8, employment growth was strongly in favour of the poor in 2001-02 and also in 2003-04 but highly against the poor in 2002-03.

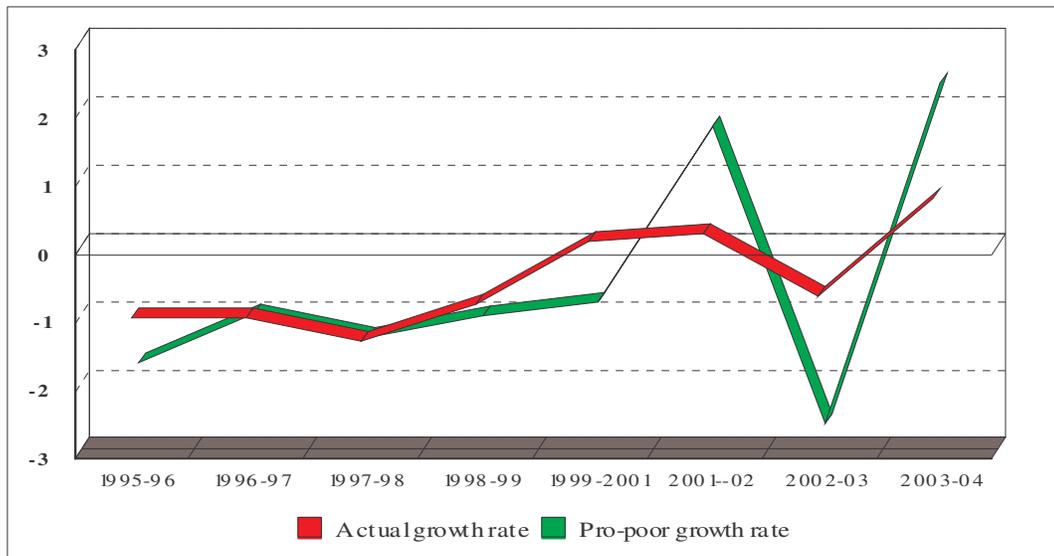
<sup>12</sup> Note that this is the usual definition of the employment rate: the percentage of labour force that is employed.

Table 6: Growth rates of per capita employment rate

Period	Actual growth rate	Pro-poor growth rate	Gain(+)/loss(-) of growth
1995-96	-0.95	-1.76	-0.80
1996-97	-0.93	-1.02	-0.09
1997-98	-1.29	-1.38	-0.09
1998-99	-0.74	-1.05	-0.31
1999-2001	0.17	-0.86	-1.03
2001-2002	0.28	1.74	1.46
2002-2003	-0.64	-2.63	-2.00
2003-2004	0.79	2.35	1.56
<b>1995-2004</b>	<b>-0.34</b>	<b>-0.68</b>	<b>-0.34</b>
<b>1995-2001</b>	<b>-0.66</b>	<b>-1.14</b>	<b>-0.48</b>
<b>2001-2004</b>	<b>0.07</b>	<b>0.17</b>	<b>0.11</b>

Source: authors' calculation based on PNAD

Figure 8: Actual and pro-poor growth rates of per capita employment rate



### VIII.3 Hours of work per employed person

The hours of work per employed person refers to the ratio of hours worked per person to per capita employed persons in the household. Table 7 presents both actual and pro-poor growth rates of hours of work per employed person. The results reveal that while the number of weekly hours per employed person has reduced over time, it has been anti-

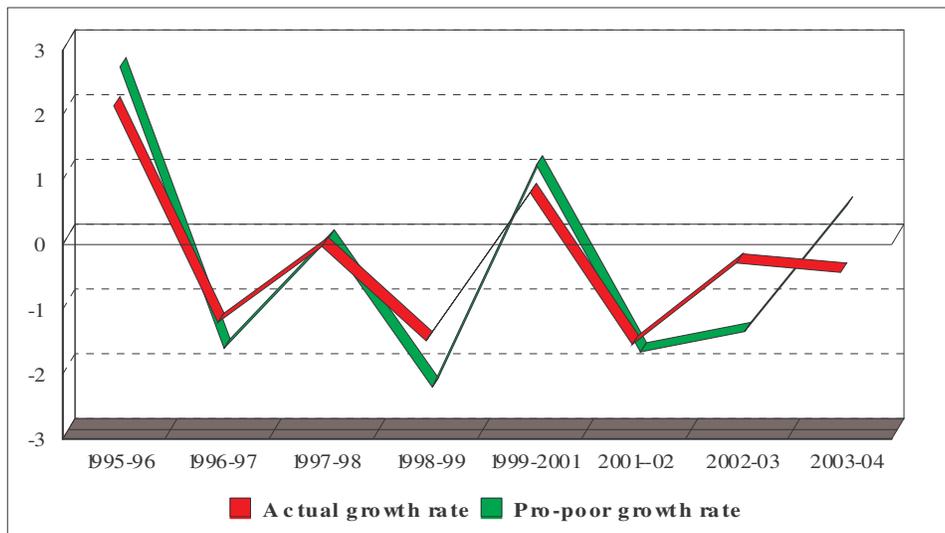
poor in general. These findings suggest that there has been a problem with underemployment in the economy during the period 1995-2004. This underemployment problem has become more serious in the second period (2001-2004) relative to the first period (1995-2001). This has also happened to the poor. On the whole, while both employment and labour force participation rates for the poor have improved in the period 2001-2004, the number of their working hours have declined in the same period.

Table 7: Growth rates of hours of work per employed person

Period	Actual growth rate	Pro-poor growth rate	Gain(+)/loss(-) of growth
1995-96	2.12	2.59	0.47
1996-97	-1.21	-1.75	-0.54
1997-98	-0.05	-0.07	-0.02
1998-99	-1.51	-2.35	-0.84
1999-2001	0.78	1.08	0.29
2001-2002	-1.56	-1.82	-0.26
2002-2003	-0.30	-1.50	-1.19
2003-2004	-0.43	0.44	0.87
<b>1995-2004</b>	<b>-0.25</b>	<b>-0.41</b>	<b>-0.17</b>
<b>1995-2001</b>	<b>-0.07</b>	<b>-0.21</b>	<b>-0.14</b>
<b>2001-2004</b>	<b>-0.72</b>	<b>-1.01</b>	<b>-0.29</b>

Source: authors' calculation based on PNAD

Figure 9: Actual and pro-poor growth rates of hours of work per employed person



## VIII.4 Productivity

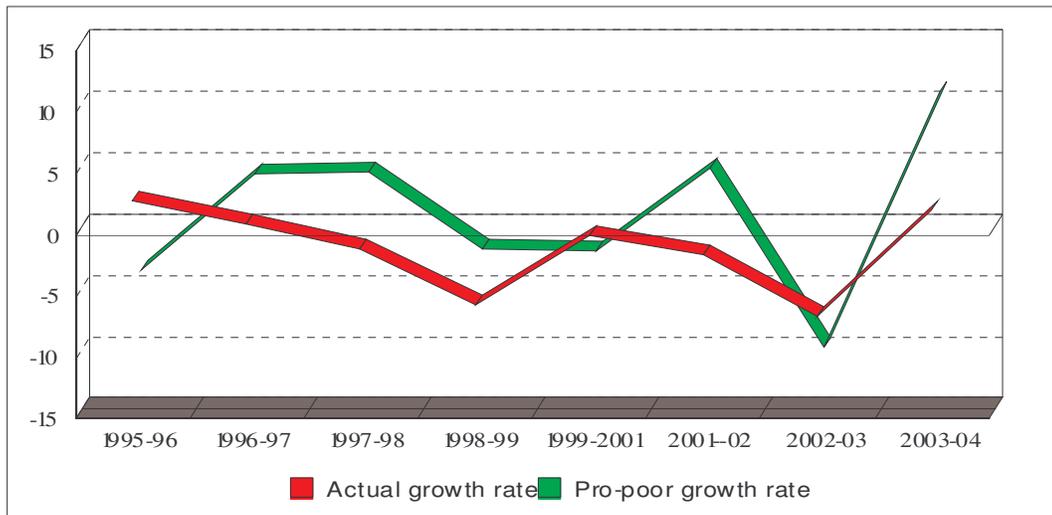
In this study, per capita productivity is defined as per capita labour income per hour worked. According to Table 8, per capita productivity has been declining over time. Productivity deteriorated sharply in the second period in particular. However, per capita productivity has been pro-poor, improving from 0.18 percent per annum in the first period to 0.56 percent per annum in the second period. The pro-poorness of productivity has made a positive contribution to a reduction in inequality over the period, in particular the second period, 2001-04. As Figure 10 illustrates, per capita productivity was highly pro-poor in 2003-04.

Table 8: Growth rates of per capita productivity

Period	Actual growth rate	Pro-poor growth rate	Gain(+)/loss(-) of growth
1995-96	2.65	-3.77	-6.41
1996-97	0.71	4.09	3.38
1997-98	-1.18	4.20	5.39
1998-99	-5.80	-2.01	3.79
1999-2001	-0.23	-2.26	-2.02
2001-2002	-1.78	4.50	6.28
2002-2003	-6.74	-10.04	-3.31
2003-2004	1.86	10.76	8.90
<b>1995-2004</b>	<b>-1.63</b>	<b>-0.05</b>	<b>1.58</b>
<b>1995-2001</b>	<b>-1.05</b>	<b>0.18</b>	<b>1.23</b>
<b>2001-2004</b>	<b>-2.67</b>	<b>0.56</b>	<b>3.23</b>

Source: authors' calculation based on PNAD

Figure 10: Actual and pro-poor growth rates of per capita productivity



People acquire human capital through schooling. It is generally believed that an increase in human capital improves people’s earning potential. As can be seen from Table 9, that per capita schooling of working members within household had increased at an annual rate of 2.34 percent in the first period, 1995-2001. In the subsequent period (2001-2004), the growth rate in the years of schooling has been 4.04 percent per annum. Thus, in the 2000s there has been a dramatic improvement in education among working population in Brazil. More importantly, the growth rate of social welfare calculated from the years of schooling has been 6.47 percent per annum during the same period. This suggests that the expansion of education has been pro-poor. In other words, inequality in schooling has been on the decline. This pro-poor expansion of education is generally expected to result in a higher productivity in the economy, particularly among the poor.

There exists no monotonic relationship between productivity and level of schooling. If an expansion of schooling is accompanied by a reduction in returns from education, then productivity in the economy may even fall. This is exactly happening in Brazil. It is evident from Figure 11 that average returns from per year of schooling have been falling monotonically since 1996. The fall in educational returns has offset the increase in the average years of schooling. The fall in returns from schooling can be explained in terms of sluggish demand in the labour market.

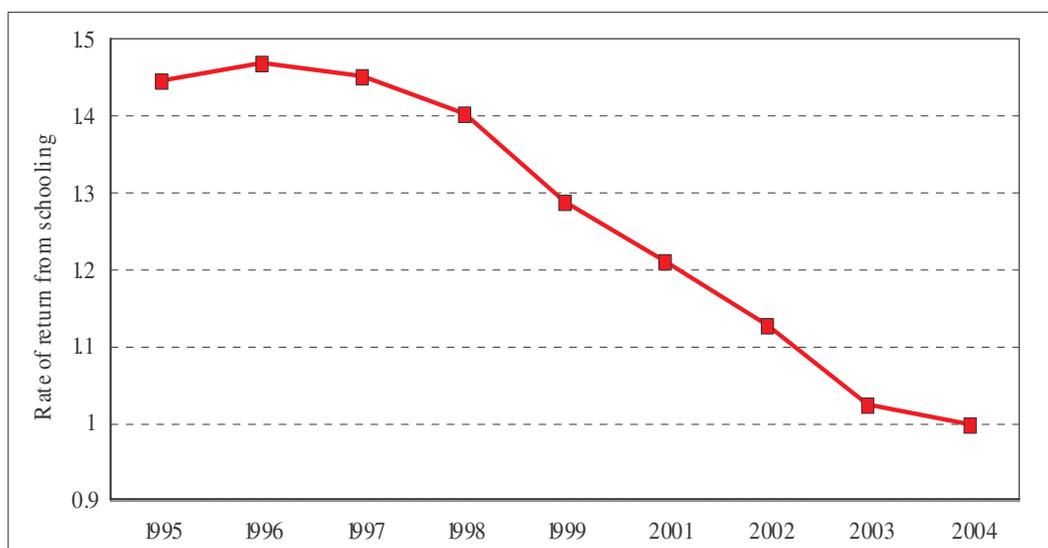
Another factor that can impact productivity is changes in relative returns from education. All households do not enjoy the same rates of returns for the same level of schooling. Changes in relative returns over time have also effects on both growth rate in the mean income and income inequality. The impact of changes in relative returns on growth and inequality is measured in the next section.

Table 9: Growth rates of per capita years of schooling, working members

Period	Actual growth rate	Pro-poor growth rate	Gain(+)/loss(-) of growth
1995-96	1.09	-1.30	-2.38
1996-97	2.03	2.52	0.49
1997-98	2.26	4.49	2.24
1998-99	2.53	4.68	2.15
1999-2001	2.96	2.03	-0.93
2001-2002	5.25	8.75	3.50
2002-2003	2.81	3.96	1.16
2003-2004	4.49	7.54	3.05
<b>1995-2004</b>	<b>2.99</b>	<b>3.95</b>	<b>0.97</b>
<b>1995-2001</b>	<b>2.34</b>	<b>2.80</b>	<b>0.46</b>
<b>2001-2004</b>	<b>4.04</b>	<b>6.47</b>	<b>2.43</b>

Source: authors' calculation based on PNAD

Figure 11: Average Rate of Returns from per year of schooling, working members



## VIII.6 Decomposition analysis

So far, we have examined four factors in turn that have impacts on the pro-poor growth rate of per capita labour income. These factors are now put together by means of the new decomposition methodology we are proposing in this study. The decomposition results are presented in Tables 11-13.

Table 11: Explaining growth rates of per capita real income

Explanatory factors	1995-2004	1995-2001	2001-2004	2003-04
<b>Labour force participation rate</b>	0.73	0.48	1.27	1.06
<b>Employment rate</b>	-0.34	-0.66	0.07	0.79
<b>Hours of work per person employed</b>	-0.25	-0.07	-0.72	-0.43
<b>Productivity</b>	-1.63	-1.05	-2.67	1.86
- Years of schooling	2.99	2.34	4.04	4.49
- Average rate of returns per year of schooling	-4.62	-3.38	-6.71	-2.63
- Relative rate of returns per year of schooling	-0.00	0.00	0.00	-0.00
Total labour income	-1.49	-1.30	-2.05	3.28

Source: authors' calculation based on PNAD

The per capita labour income declined at an annual rate of 1.49 percent in the entire period from 1995 to 2004. The factors contributing to this decline are employment rate, hours of work and productivity. The employment rate and hours of work contributed to a decline in growth rate by 0.34 and 0.25 percent, respectively. The decline in productivity was the major factor that contributed to a decline of growth rate by 1.63 percent. Despite the weak labour market, the labour force participation rate increased at an annual rate of 0.73 percent, which made a positive contribution to growth by the same magnitude.

It is also evident that the work force in Brazil is getting more educated. The years of schooling of the labour force increased at an annual rate of 2.99 percent during the 1995-04 period, which contributed to an increase in productivity by the same rate (2.99 percent). The expansion of education has been accompanied by a decline in the average rates of return from schooling at an annual rate of 4.62 percent. This suggests that the demand in the labour market has been sluggish and that growth in wage rates has not kept up with the supply of workers with more years of schooling.

A similar story emerges when we look at the sub periods: 1995-01 and 2001-04. However, the story changes when we look at the changes occurred during 2003-04, when the per capita labour income increased by 3.28 percent. Again, productivity was the major factor contributing to the growth, but in this case it contributed a positive rate of 1.86 percent. The labour force participation rate increased by 1.06 percent, while the employment rate increased by 0.79 percent. This implies that per capita employment rate (i.e. the sum of the labour force participation rate and the employment rate) increased by 1.85 percent. From these observations, we can conclude that the labour market turned around very strongly in the 2003-04 period. The rate of return from schooling declined at much slower rate of only 2.63 percent despite the fact that years of schooling of the work force increased at a faster rate of 4.49 percent.

Table 12: Explaining pro-poor growth rate of money-metric social welfare

Explanatory factors	1995-2004	1995-2001	2001-2004	2003-04
<b>Labour force participation rate</b>	0.41	0.19	1.24	2.69
<b>Employment rate</b>	-0.68	-1.14	0.17	2.35
<b>Hours of work per person employed</b>	-0.41	-0.21	-1.01	0.44
<b>Productivity</b>	-0.05	0.18	0.56	10.76
- Years of schooling	3.95	2.80	6.47	7.54
- Average rate of returns per year of schooling	-4.62	-3.38	-6.71	-2.63
- Relative rate of returns per year of schooling	0.61	0.77	0.81	5.85
Total labour income	-0.73	-0.97	0.97	16.24

Source: authors' calculation based on PNAD

Table 12 presents the growth rates of money metric social welfare. The growth rate of per capita social welfare is -0.97 percent in the first period (1995-01) but increases to 0.97 in the second period (2001-02). The factors that are contributing positively to growth in the second period are labour force participation rate, employment rate and productivity. The productivity growth rate of 0.56 percent is further decomposed into three factors: (i) years of schooling, which contributes to an increase in the growth rate of productivity by 6.47 percentage points; (ii) average rate of return which contributes to a decline in productivity by 6.71 percentage points; and (iii) relative rate of return, which contributes to an increase in the growth rate of productivity by 0.81 percentage points.

Different households enjoy different rates of return from per year of schooling. These differences may be caused by a host of variables including age and gender of earners in household, number of earners in household, sectors of employment by workers in household, educational levels of working members and so on. Thus, relative rates of returns will also change due to a multitude of factors. The changes in relative rates of return will not affect the growth rate of the mean labour income but they will affect the social welfare, which is sensitive to changes in relative distribution. Our empirical results show that the changes in relative rates of return have contributed to the increase in the growth rate of social welfare by 0.81 percentage points. This is a small contribution compared to the decline in welfare that is caused by the average rate of return from schooling.

Table 13 presents gains (and losses) of growth rates due to pro-poor (and anti-poor) growth. The labour income has become highly pro-poor in the 2001-04 period contributing to gains in the growth rate of 3.02 percent. In 2003-04, the gain in growth rate increased to 12.97 percent, which indicates a large reduction in inequality. Thus, the Brazilian labour market has become highly pro-poor in 2003-04. Productivity is the most important factor contributing to gains in the growth rate of 8.9 percent. Schooling contributes to gains in the growth rate of about 3 percent. The relative rates of returns from schooling have become highly favourable to the poor contributing to gains in the growth rate of 5.8 percent.

Table 13: Explaining gains and losses in growth rates

Explanatory factors	1995-2004	1995-2001	2001-2004	2003-04
<b>Labour force participation rate</b>	-0.32	-0.29	-0.03	1.63
<b>Employment rate</b>	-0.34	-0.48	0.11	1.56
<b>Hours of work per person employed</b>	-0.17	-0.14	-0.29	0.87
<b>Productivity</b>	1.58	1.23	3.23	8.90
- Years of schooling	0.97	0.46	2.43	3.05
- Average rate of returns per year of schooling	0.00	0.00	0.00	0.00
- Relative rate of returns per year of schooling	0.61	0.77	0.81	5.85
Labour income	0.76	0.32	3.02	12.97

Source: authors' calculation based on PNAD

Apart from productivity, the other labour market characteristics such as the labour force participation rate, the employment rate and work hours per employed person have also contributed to a large reduction in inequality during 2001-04.

## **IX. Contribution of Income Sources to Growth**

The separation of per capita total income into labour and non-labour components allows us to capture the main sources of the total growth patterns assumed. As we have previously seen for the 1995-2004 period, total income average growth was -0.63 percent while labour income grew at an average rate of -1.49 percent; and, non-labour income grew at an average rate of 2.64 per annum. However, in order to see the contribution of different income sources to total income - as we have done for the labour market components - it is not sufficient to gauge the growth rates of different component ratios, but also to take into account the relative weights of each income source in total income. This point also applies to pro-poor growth and to the inequality aspects of social welfare. The interaction between the high non-linearity of these last two concepts and the additive nature of income sources create some difficulties. As a result, a Shapely decomposition was used to obtain each income source contribution to pro-poor growth, which is explained in the Appendix. In general, the contribution of a given source to the total growth of a particular social welfare concept is positively related to its initial weight and to its relative rate of growth in the same period. In Table 14, we present the rates of growth and the contributions to the rates of growth of total income, together with its labour and non-labour components.

In 1995, labour income amounted to 82.1 percent of total income, while the remaining 17.9 percent referred to non-labour. However, the main sources of growth, and in particular pro-poor growth sources, relied on the latter. As shown in Table 14, the fall of total income of -0.63 percent per year in the overall 1995-2004 period can be decomposed into the adverse labour income contribution of -1.17 percent per year and the contribution of non-labour income of 0.54 percent per year.

Table 14: Growth rates and contributions to growth by income components

Period	Growth rates			Contributions to growth rates		
	Labour income	Non-labour income	Total income	Labour income	Non-labour income	Total income
<b>Actual growth</b>						
1995-2004	-1.49	2.64	-0.63	-1.17	0.54	-0.63
1995-2001	-1.30	3.69	-0.30	-1.02	0.72	-0.30
2001-2004	-2.05	1.02	-1.35	-1.59	0.24	-1.35
<b>Pro-poor growth</b>						
1995-2004	-0.73	6.30	0.73	-0.60	1.33	0.73
1995-2001	-0.97	5.20	0.10	-0.74	0.84	0.10
2001-2004	0.97	9.14	3.07	0.61	2.46	3.07
<b>Inequality</b>						
1995-2004	0.76	3.66	1.36	0.57	0.79	1.36
1995-2001	0.32	1.51	0.40	0.28	0.12	0.40
2001-2004	3.02	8.12	4.42	2.20	2.22	4.42

Source: authors' calculation based on PNAD

In turn, differences in pro-poor average annual growth rates are somewhat smaller as can be seen from Table 14: total social welfare increased 0.73 percent; labour income declined by 0.73 percent and non-labour income increased by 6.30 percent. The weight of labour income in social welfare in the initial period 1995 was 83.9 percent, which is even higher than in the case of average total incomes. Its contribution to total social welfare growth in the whole period was -0.60 percent per annum, i.e. about half of its contribution to average income growth. Conversely, non-labour income's share of the social welfare growth was 1.33 percent per year, making it an important factor in determining the positive social welfare trend assumed in the 1995-2004 period.

Focusing on individual periods, the contribution of labour income to average annual growth changed from -1.02 percent in 1995-2001 to -1.59 percent in 2001-04. The track record of labour income's contribution to pro-poor growth is better than its contribution to growth per se: -0.74 percent in 1995-2001 and 0.61 percent in 2001-04. Likewise, non-labour's income share of pro-poor growth also surpasses its effects on average

income growth in both periods. Note that from 1995 to 2001, non-labour's income impact on pro-poor growth rose from 0.84 percent per year to 2.46 percent per year in the 2001-2004 period.

Both labour and non-labour incomes have contributed to a decline in total inequality. During the 1995-2001 period, it was the labour income that had a higher contribution to the inequality reduction: 0.28 and 0.12 percent due to the labour and non-labour income, respectively. In total, the reduction in inequality amounts to a gain in growth rate by only 0.40 percent. In the second period (2001-04), the gain in growth rate due to a fall in inequality was 4.42 percent, which is substantially greater than the corresponding figure for the first period (1995-2001). Of the gain of 4.42 percent, 2.20 percent was contributed by the labour income and 2.22 percent by the non-labour income. Thus, the contribution of non-labour income to the inequality reduction was slightly higher than that of labour income despite the fact that the share of labour in total income was much higher than that of non-labour income. This suggests that the non-labour income has been more pro-poor than the labour income in the second period.

## **X. Decomposing the Contribution of Non-Labour Incomes**

This section aims to assess the contribution of different types of non-labour income sources to the total growth of different welfare concepts, through a decomposition scheme of these income sources impacts.

Special attention is paid to incomes mostly directly affected by social policies, such as social security benefits and other non-labour income sources that include cash transfers from social programmes and capital income - which turns out to be underestimated in PNAD data. The remaining sources of non-labour income such as rents and private transfers (remittances, donations, child maintenance support, etc) are part of what is called non-social income.

Table 15: Growth rates by non-labour components

Period	Labour income	Non-labour income			Total income
		Social security	Other non-labour	Non-social income	
<b>Actual growth</b>					
1995-2004	-1.49	3.25	5.77	-2.43	-0.63
1995-2001	-1.30	4.69	0.73	-1.23	-0.30
2001-2004	-2.05	0.86	13.26	-3.69	-1.35
<b>Pro-poor growth</b>					
1995-2004	-0.73	3.12	29.94	1.43	0.73
1995-2001	-0.97	2.56	25.50	4.41	0.10
2001-2004	0.97	3.90	35.21	-1.97	3.07
<b>Inequality</b>					
1995-2004	0.76	-0.13	24.17	3.86	1.36
1995-2001	0.32	-2.13	24.77	5.64	0.40
2001-2004	3.02	3.04	21.94	1.72	4.42

Source: authors' calculation based on PNAD

Table 15 presents trends in growth rates by non-labour income components. The results reveal that while social security has contributed to a rise in inequality during the 1995-2004 period, the others – including other non-labour income and non-social income – have been attributed to a fall in inequality during the same period. Interestingly, in the 2001-04 period all three non-labour income components made a positive contribution to the reduction in inequality.

Table 16 explains the net contributions of each non-labour income component to growth patterns and inequality reduction. The results are obtained from the Shapely decomposition method (see Appendix). According to the table, other non-labour income has been the dominant net contributor to a reduction in inequality over the decade 1995-2004. Its net contribution is particularly high in the latter period 2001-04. While non-social income appears to play a smaller role in reducing inequality, the net impact of social security has been quite important. During the first period (1995-2001), the net effect of social security resulted in an increase in inequality. Its net contribution on inequality was greater than the net contributions by the other two components. Nevertheless, the sum of net contributions by the other two sources had offset the net

contribution by social security. As a result, inequality of the non-labour income in the first period showed a slight fall by 0.12 percent.

Table 16: Explaining contributions of growth rates by non-labour income components  
(based on Shapely decomposition)

Period	Labour income	Non-labour income			Total income
		Social security	Other non-labour	Non-social income	
<b>Actual growth</b>					
1995-2004	-1.17	0.54	0.06	-0.07	-0.63
1995-2001	-1.02	0.75	0.01	-0.04	-0.30
2001-2004	-1.59	0.17	0.16	-0.10	-1.35
<b>Pro-poor growth</b>					
1995-2004	-0.60	0.40	0.88	0.04	0.73
1995-2001	-0.74	0.34	0.38	0.12	0.10
2001-2004	0.61	0.48	2.00	-0.03	3.07
<b>Inequality</b>					
1995-2004	0.57	-0.14	0.82	0.11	1.36
1995-2001	0.28	-0.41	0.37	0.16	0.40
2001-2004	2.20	0.31	1.84	0.07	4.42

Source: authors' calculation based on PNAD

## X.1 Non-Social Income

Non-social income fell at an average rate of -2.43 percent per year in the 1995-2004 period, but it had a sharper decrease in the second period (-3.69 percent) than the rate of -1.23 percent per year observed in the first period (Table 15). In spite of the negative growth, non-social income has contributed to a fall in inequality over the decade. Its effect on the inequality reduction had been much greater in the first period compared to the second period; 5.64 percent (in 1995-2001) against 1.72 percent (in 2001-04).

Nevertheless, the net contribution of non-social income to overall growth performance was rather small given its growth rates. As shown in Table 16, the net effect of non-social income on inequality reduction was just 0.11 percent between 1995-2004; its magnitude fell to 0.07 percent in the 2001-04 period from 0.16 percent in the 1995-2001 period.

## X.2 Social Security Benefits

Social security is the main component of social income in Brazil, and second only to labour earnings among all income sources collected by PNAD. In 2004, it amounted 19.55 percent of all income sources and 92.5 percent of social income. Social security benefits information includes a contributory Pay as You Go system and non contributory benefits, both subject to discretionary income policies from the government. The average growth rate of per capita social security benefits was 3.25 percent per year from 1995 to 2004 (Table 15). The average growth rate of social security in the first period was much higher than in the second period, 4.69 percent against 0.86 percent. However, rapid growth in social security has resulted in an increase in inequality in Brazil over the 1995-2004 period. Its adverse impact amounted to an increase of inequality by 2.13 percent in the first period. Yet the impact of social security income on inequality was reversed when its growth slowed down: it led to a reduction in inequality by 3.04 percent in the second period. A similar story emerges from the results reported in Table 16.

Given the dominance of the public transfer aspect in this income aggregate, it is useful to observe the ratio of pro-poor growth to total growth contribution. This can be interpreted as an elasticity that shows how many public resources (measured by their share of total income) are translated into social welfare, a type of cost-benefit analysis. The corresponding elasticity of pro-poor growth with respect to total growth (i.e. its fiscal cost) both explained by social security rose from 0.45 in the 1995-2001 period to 2.82 in 2001-2004, demonstrating a marked improvement in the ability of social security benefits targeting the poorest segments of Brazilian society.<sup>13</sup> After 1998 the government adopted the new policy of setting higher adjustment rates to lower social security

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<sup>13</sup> One possibility is to divide the information on social security benefits in two regimes: one with benefits equal to one minimum wage, the constitutional floor, and the rest. Neri (1998, 2001) followed this approach and showed that around 60% of social security benefits amounted to one minimum wage while 80% of social security income accrued to benefits above this level. Each additional real spent adjusting the social security benefits floor resulted in 4.5 times more poverty reduction than a uniform adjustment to all benefits.

benefits. In the entire 1995-2004 period, this elasticity amounts to be 0.74. This elasticity allows comparing to what extent different types of public transfers reach the poor.

### **X.3 Other Non-labour Income**

Other non-labour income sources include very different types of incomes, ranging from cash transfer programmes such as the *Bolsa-Família* to capital income such as flows derived from interest rates paid on government debt. The pro-poor aspects of these items are expected to be very different, despite the fact that both are not only subject to public policy choices but are mostly mediated by the state<sup>14</sup>, as well. Interest income is largely underestimated by PNAD data, hence this income concept is largely explained by public cash transfer programmes such as *Bolsa-Família*.

According to Table 15, the other sources of non-labour income aggregate have grown at an annual rate of 5.77 percent in the whole period from 1995 to 2004, presenting very diverse patterns across sub-periods. They increased on average 0.73 percent in the first period 1995-2001, but this growth has accelerated considerably in the 2001-2004 period to 13.26 percent, reflecting the expansion of the conditional cash transfer programmes.

Table 15 also assesses the impact of other non-labour income source on inequality reduction. This income source has attributed to a reduction in inequality by 24.17 percent per year in the 1995-2004 period. This favourable effect on inequality can be explained by the fact that cash is aimed at the poorest sectors of the population. The effect on inequality reduction of this income component has reduced to some extent, falling from 24.77 percent in the 1995-2001 period to 21.95 percent in the 2001-2004 period. This suggests that the impact of cash transfers has become slightly less pro-poor in the second period.

As we have seen, to measure the contribution of the expansion of cash transfer programmes from 2001 onwards, it is not sufficient to gauge its relatively high growth

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<sup>14</sup> The public debt is the main source of interest gains earned by Brazilian households.

rates. Instead, its relative weight among different non-labour income sources must also be considered. In Table 16, the net contribution of other non-labour income to total growth per year during the 1995-2004, 1995-2001 and 2001-2004 periods was 0.06, 0.01 and 0.16, respectively. This means that the role of cash transfers to explain income growth is quite small. But by the same token, the impacts of other income sources on the fiscal budget deficit were also relatively mild.

According to Table 16, the net contribution of other non-labour income source to inequality reduction outweighs the contributions made by the other two income components. In the overall 1995-2004 period, it was responsible for 0.82 percent of the fall in inequality. Similarly, its net contribution was 0.37 percent of the fall in inequality in the 1995-2001 period and then increased to 1.84 percent of the inequality fall. This indicates that other non-labour income sources constitute a key determinant of the reduction in inequality in Brazil over the period.

The elasticity of the contribution to pro-poor growth of a particular income transfer with respect its contribution to total growth is useful to guide policies aimed at the poorest groups in the Brazilian society. The corresponding other non-labour income sources elasticity was 14.66 during the 1995-2004 period which is much higher than the one found for social security benefits. Each percentage point in the share of government transfers in this item bought 19.8 times more pro poor growth in other non-labour income than in social security benefits, this result is consistent with the evaluation of conditional cash transfers done in Brazil and elsewhere (Lindert et al. 2005, Barros 2005, Hoffman 2005, Soares 2006, Bourguignon et al. 2003, Skoufias et al. 2001, Coady et al. 2004, Suplicy 2002).<sup>15</sup>

In sum, other non-labour income sources have played a dominant role in pro-poor growth pattern assumed while having a minor contribution to total growth and to the Brazilian

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<sup>15</sup> The cash transfer elasticity of pro poor growth decreased from 38 in the 1995-2001 period to 12.5 percent in 2001-2004, showing a loss in the pro-poorness of cash transfers but in the last period it is still 4.43 higher than the value the elasticity found for social security benefits.

fiscal accounts. It seems that a small increase in government cash transfers programmes had a high impact on poor people's living conditions.

## **XI. Demographic Trends**

The main transfers in terms of social income such as social security and cash transfers are aimed at specific age groups. Social security benefits attempt in principle to smooth living conditions specifically in the old age, while the new generation of cash transfer programmes in Brazil is mostly focused on children and teenagers. Labour income is also predominantly earned by non-elderly adults. There are however exceptions for cash transfers programmes included in the other source of non-labour income that attempt to provide income to other age groups such as the continuous assistance benefit (BPC) for the old and the disabled or unemployment insurance that benefits mostly adults. Non-social income accrues to individuals in very diverse age groups. To make things more complex, these programs are mixed in different income concepts. One way to check the levels and trends of how total incomes affect different age groups in different ranks of the society is to compare per capita growth rates of these groups in the population with their respective pro-poor growth rates.

We have divided the population in three age groups and calculated the levels and trends of the following variables:

- Per capita children and young teenagers in household, aged between 0 and 15 years.
- Per capita adults in household, aged 16-64 years.
- Per capita elderly in household, aged from 65 years and over.

Table 17: Demographic trends (%)

Period	Unadjusted			Inequality adjusted		
	Per capita child	Per capita adults	Per capita elderly	Per capita child	Per capita adults	Per capita elderly
1995	0.347	0.596	0.057	0.393	0.541	0.036
1996	0.337	0.605	0.058	0.382	0.551	0.040
1997	0.333	0.608	0.059	0.378	0.554	0.039
1998	0.325	0.615	0.060	0.372	0.560	0.037
1999	0.318	0.620	0.062	0.365	0.567	0.036
2001	0.309	0.630	0.062	0.356	0.576	0.033
2002	0.301	0.635	0.064	0.348	0.582	0.035
2003	0.294	0.640	0.066	0.341	0.588	0.042
2004	0.290	0.643	0.067	0.338	0.591	0.034
<b>Trend 1995-2004</b>	<b>-1.96</b>	<b>0.83</b>	<b>1.66</b>	<b>-1.64</b>	<b>0.96</b>	<b>-0.67</b>
<b>Trend 1995-2001</b>	<b>-1.94</b>	<b>0.90</b>	<b>1.37</b>	<b>-1.60</b>	<b>1.00</b>	<b>-2.03</b>
<b>Trend 2001-2004</b>	<b>-2.05</b>	<b>0.70</b>	<b>2.59</b>	<b>-1.81</b>	<b>0.90</b>	<b>2.31</b>

Source: authors' calculation based on PNAD

Table 17 shows that in 1995, children and young teenagers group represented 34.7 percent in average household and the corresponding figure goes up to 39.3 percent when we use the inequality-adjusted weighting scheme. This implies that it is more likely to find a child in the lowest per capita income ranks of Brazilian society than elsewhere. Furthermore, the average annual growth rate of the population below 16 years of age in the 1995-2004 period has been -1.96 percent while its inequality-adjusted growth rate has been -1.64 percent. This implies a declining trend in the number of children in average household, but with a much slower decline among poor households. On the other hand, the number of adults in household shows an increasing trend. These findings suggest that cash transfer programmes relating to children can be further expanded because of the increase in the number of working population in Brazil.

The situation is opposite in all aspects for the old-age group. The share in the total population is higher than that using inequality-adjusted weights and this gap has increased over the decade. Inequality-adjusted per capita elderly was represented 3.6 percent in average household in 1995. In the 1995-2004 period, an annual growth rate of

per capita elderly has been 1.66 percent against its inequality-adjusted growth rate of -0.67 percent. Overall, elderly population in Brazil is on the increase. This trend in turn puts pressure on the cash transfer programmes targeted at the elderly. The good news, however, is that the increase in elderly population among the poor appears to be slower than elderly among the non-poor. Hence, sustainability of cash transfer programmes for elderly in the long-term calls for a targeting strategy in such a way that poor elderly receive greater benefits from the programmes compared to non-poor.

## **XII. Conclusions**

From the methodological point of view, the authors feel that this paper makes two important contributions to the literature. One contribution is its proposal for a new measure of pro-poor growth. This new measure provides the linkage between growth rates in the mean income and income inequality. In this sense, growth is defined as pro-poor (or anti-poor) if there is a gain (or loss) in growth rate due to the decrease (or increase) in inequality. The other contribution is to develop a decomposition methodology exploring linkages between three dimensions; growth patterns, labour market performances, and social policies. Through this decomposition, the growth in per capita income is explained in terms of four components: the employment rate, hours of work in the labour market, the labour force participation rate, and productivity. We also assess the contribution of different non-labour income sources to growth patterns, with particular emphasis on the expansion of targeted cash transfers and devising more pro-poor social security benefits. These components are all translated into per capita growth in mean incomes and inequality adjusted incomes. The paper provides a growth and a pro-poor growth account exercise.

For empirical analysis, the study has used the Brazilian National Household Survey (PNAD) from 1995 to 2004. The paper has analyzed the evolution of Brazilian social indicators based on per capita income exploring links with adverse labour market performance and social policy changes, in particular the expansion of targeted cash transfers and devising more pro-poor social security benefits. The description of these

social indicators depends on two main dimensions: i) who was affected by shocks perceived in the labour market and changes observed in social policies? In particular, to what extent did these innovations affect more the poorest segments of the Brazilian society?; and ii) to what extent did the crisis affect labour income vs. other income sources such as official cash transfers, social security benefits or private incomes?

The general answer to these questions is that labour earnings of the upper segments of Brazilian society were the epicentre of the economic crisis. Although per capita income fell during the 1995-2004 period, it cannot be referred to as a 'poverty crisis'. While labour markets were quite adversely affected, incomes derived from social security, and other government transfers played a crucial role cushioning the consequences of macro shocks observed, specifically among the poorest segments of Brazilian society.

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**Appendix:  
Shapely Decomposition to Explain Contributions of  
Income Components to Pro-Poor Growth**

Suppose there are four income components, which include:

- $X_{1t}$ : Per capita labour income at year t
- $X_{2t}$ : Per capita social security income at year t
- $X_{3t}$ : Per capita cash transfers at year t
- $X_{4t}$ : Per capita non-social income at year t

Total per capita income at year t is thus the sum of individual four income components. Thus we can write

$$X_t = X_{1t} + X_{2t} + X_{3t} + X_{4t}$$

Suppose  $\log(x^*(X_t))$  is the logarithm of social welfare at year t calculated on the basis of total per capita income  $X_t$ , which can be calculated from equation (14). Then the growth rate of social welfare at year t is given by

$$\gamma_t^* = \log(x^*(X_t)) - \log(x^*(X_{t-1})) \quad (\text{A.1})$$

The Shapely decomposition can be used to calculate the contribution of each income component to the growth rate of social welfare of the total per capita income  $X_t$  as

$$\gamma_t^* = \gamma_t^*(C_1) + \gamma_t^*(C_2) + \gamma_t^*(C_3) + \gamma_t^*(C_4) \quad (\text{A.2})$$

where,  $\gamma_t^*(C_i)$ , where  $i$  varies from 1 to 4, is the contribution of the  $i$ th income component to growth rate of total welfare. Thus (A.1) is the proposed decomposition method which can be used to analyze the net contribution of each income component to growth rate of welfare. This equation can also be utilized to analyze contributions of each income component to growth in total inequality. Using the Shapely decomposition, we can write the net contribution of each income component to growth rate of total welfare as follows:

$$\begin{aligned} \gamma_t^*(C_1) = & \frac{6}{24} \left[ \log x^*(X_{1t} + X_{2t} + X_{3t} + X_{4t}) - \log x^*(X_{1t-1} + X_{2t} + X_{3t} + X_{4t}) \right] \\ & + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t-1} + X_{3t} + X_{4t}) - \log x^*(X_{1t-1} + X_{2t-1} + X_{3t} + X_{4t}) \right] \end{aligned}$$

$$\begin{aligned}
& + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t} + X_{3t-1} + X_{4t}) - \log x^*(X_{1t-1} + X_{2t} + X_{3t-1} + X_{4t}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t} + X_{3t} + X_{4t-1}) - \log x^*(X_{1t-1} + X_{2t} + X_{3t} + X_{4t-1}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t-1} + X_{3t-1} + X_{4t}) - \log x^*(X_{1t-1} + X_{2t-1} + X_{3t-1} + X_{4t}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t-1} + X_{3t} + X_{4t-1}) - \log x^*(X_{1t-1} + X_{2t-1} + X_{3t} + X_{4t-1}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t} + X_{3t-1} + X_{4t-1}) - \log x^*(X_{1t-1} + X_{2t} + X_{3t-1} + X_{4t-1}) \right] \\
& + \frac{6}{24} \left[ \log x^*(X_{1t} + X_{2t-1} + X_{3t-1} + X_{4t-1}) - \log x^*(X_{1t-1} + X_{2t-1} + X_{3t-1} + X_{4t-1}) \right]
\end{aligned}$$

$$\begin{aligned}
\gamma_t^*(C_2) &= \frac{6}{24} \left[ \log x^*(X_{1t} + X_{2t} + X_{3t} + X_{4t}) - \log x^*(X_{1t} + X_{2t-1} + X_{3t} + X_{4t}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t-1} + X_{2t} + X_{3t} + X_{4t}) - \log x^*(X_{1t-1} + X_{2t-1} + X_{3t} + X_{4t}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t} + X_{3t-1} + X_{4t}) - \log x^*(X_{1t} + X_{2t-1} + X_{3t-1} + X_{4t}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t} + X_{3t} + X_{4t-1}) - \log x^*(X_{1t} + X_{2t-1} + X_{3t} + X_{4t-1}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t} + X_{3t-1} + X_{4t-1}) - \log x^*(X_{1t} + X_{2t-1} + X_{3t-1} + X_{4t-1}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t-1} + X_{2t} + X_{3t} + X_{4t-1}) - \log x^*(X_{1t-1} + X_{2t-1} + X_{3t} + X_{4t-1}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t-1} + X_{2t-1} + X_{3t} + X_{4t}) - \log x^*(X_{1t-1} + X_{2t-1} + X_{3t-1} + X_{4t}) \right] \\
& + \frac{6}{24} \left[ \log x^*(X_{1t-1} + X_{2t} + X_{3t-1} + X_{4t-1}) - \log x^*(X_{1t-1} + X_{2t-1} + X_{3t-1} + X_{4t-1}) \right]
\end{aligned}$$

$$\begin{aligned}
\gamma_t^*(C_3) &= \frac{6}{24} \left[ \log x^*(X_{1t} + X_{2t} + X_{3t} + X_{4t}) - \log x^*(X_{1t} + X_{2t} + X_{3t-1} + X_{4t}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t-1} + X_{2t} + X_{3t} + X_{4t}) - \log x^*(X_{1t-1} + X_{2t} + X_{3t-1} + X_{4t}) \right]
\end{aligned}$$

$$\begin{aligned}
& + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t-1} + X_{3t} + X_{4t}) - \log x^*(X_{1t} + X_{2t-1} + X_{3t-1} + X_{4t}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t} + X_{3t} + X_{4t-1}) - \log x^*(X_{1t} + X_{2t} + X_{3t-1} + X_{4t-1}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t-1} + X_{2t-1} + X_{3t} + X_{4t}) - \log x^*(X_{1t-1} + X_{2t-1} + X_{3t-1} + X_{4t}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t-1} + X_{2t} + X_{3t} + X_{4t-1}) - \log x^*(X_{1t-1} + X_{2t} + X_{3t-1} + X_{4t-1}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t-1} + X_{3t} + X_{4t-1}) - \log x^*(X_{1t} + X_{2t-1} + X_{3t-1} + X_{4t-1}) \right] \\
& + \frac{6}{24} \left[ \log x^*(X_{1t-1} + X_{2t-1} + X_{3t} + X_{4t-1}) - \log x^*(X_{1t-1} + X_{2t-1} + X_{3t-1} + X_{4t-1}) \right]
\end{aligned}$$

$$\begin{aligned}
\gamma_t^*(C_4) &= \frac{6}{24} \left[ \log x^*(X_{1t} + X_{2t} + X_{3t} + X_{4t}) - \log x^*(X_{1t} + X_{2t} + X_{3t} + X_{4t-1}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t-1} + X_{2t} + X_{3t} + X_{4t}) - \log x^*(X_{1t-1} + X_{2t} + X_{3t} + X_{4t-1}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t-1} + X_{3t} + X_{4t}) - \log x^*(X_{1t} + X_{2t-1} + X_{3t} + X_{4t-1}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t} + X_{3t-1} + X_{4t}) - \log x^*(X_{1t} + X_{2t} + X_{3t-1} + X_{4t-1}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t-1} + X_{2t-1} + X_{3t} + X_{4t}) - \log x^*(X_{1t-1} + X_{2t-1} + X_{3t} + X_{4t-1}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t-1} + X_{2t} + X_{3t-1} + X_{4t}) - \log x^*(X_{1t-1} + X_{2t} + X_{3t-1} + X_{4t-1}) \right] \\
& + \frac{2}{24} \left[ \log x^*(X_{1t} + X_{2t-1} + X_{3t-1} + X_{4t}) - \log x^*(X_{1t} + X_{2t-1} + X_{3t-1} + X_{4t-1}) \right] \\
& + \frac{6}{24} \left[ \log x^*(X_{1t-1} + X_{2t-1} + X_{3t-1} + X_{4t}) - \log x^*(X_{1t-1} + X_{2t-1} + X_{3t-1} + X_{4t-1}) \right]
\end{aligned}$$

Similarly, we can calculate the contribution of each income component to growth rate of total per capita income:

$$\gamma_t = \gamma_t(C_1) + \gamma_t(C_2) + \gamma_t(C_3) + \gamma_t(C_4) \tag{A.3}$$

Subtracting (A.3) from (A.2) gives the contribution of each income component to inequality of total per capita income.

$$g_t^* = g_t^*(C_1) + g_t^*(C_2) + g_t^*(C_3) + g_t^*(C_4) \quad (\text{A.4})$$