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Pós Graduação

em Economia

da Fundação

Getúlio Vargas

Nº 634

ISSN 0104-8910

***Linkages between Growth, Poverty and the
Labour Market***

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Dezembro de 2006

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Linkages between Growth, Poverty and the Labour Market*

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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 growth patterns, and labour market performances. 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. The proposed methodology 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.

Keywords: Inequality; Poverty; Growth; Pro-Poor Growth; Labour Market;

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

Resumo: Uma contribuição deste artigo é a proposta de uma nova medida do crescimento pró-pobre, no sentido de aumentar a ponderação daqueles com menor renda. Esta nova medida permite uma ligação direta entre as taxas de crescimento na renda média e na desigualdade de renda em termos de mudanças de bem estar. A outra contribuição é uma metodologia de decomposição da contribuição de diferentes elementos do mercado de trabalho. Através desta decomposição, o crescimento da renda per capita é segmentado em quatro componentes: taxa de ocupação, taxa de participação, horas de trabalho e produtividade. Também avaliamos a contribuição de diferentes fontes de renda não-trabalho no padrão de crescimento assumido. As metodologias utilizadas são aplicadas a Pesquisa Nacional por Amostra de Domicílios (PNAD) analisando a evolução dos indicadores sociais brasileiros baseados na renda per capita de 1995 até 2004, explorando ligações com diferentes aspectos do fraco desempenho do mercado de trabalho observadas.

Palavras-Chaves: Desigualdade, Pobreza, Crescimento Pró-Pobre; Mercado de Trabalho

* This paper was presented in a keynote address at the 5th General Meeting of the Poverty and Economic Policy Research Network, which was held in June 18-22, 2006 in Addis Ababa, Ethiopia

Linkages between Growth, Poverty and the Labour Market

I. Introduction

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 growth patterns, and labour market performances. Through the decomposition analysis, growth in per capita income is explained in terms of various labour market components: the employment rate, hours of work, the labour force participation rate, productivity, quantity and returns to education. The paper applies to Brazil this growth and a pro-poor growth account methodology that explains how intense and regressive were the changes observed in labour market factors. 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 using the Brazilian National Household Survey (PNAD). 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.

The period starting in 1995 misses out the labour market boom and poverty reduction that were both observed after the *Real* plan stabilization (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 (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 scrutinized.

The 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. Section IX 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 as¹

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

¹ 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.

A county's performance in average standard of living can be measured by the growth rate γ 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 γ 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

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

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).²

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

$$\gamma^* = \gamma - g \quad (10)$$

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 μ 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.

² Note that this weighting scheme is also implicit in the Gini index, which is the most popular measure of inequality.

γ^* 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 h household at year t is given by³

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

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

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

Growth will be pro-poor (anti-poor) at year t if γ_t^* is greater (less) than γ_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)

³ This equation makes a continuity correction, which is estimated by obtaining an unbiased estimate of $F(x)$.

- Per capita non-labour income (y_{nl})
- Per capita employed persons in the household (e)
- Per capita labour force participation rate (ℓ)
- 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:⁴

- 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 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:

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

⁴ Productivity of a household is defined as labour earnings of the household's per hour of work.

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

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

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 in⁵

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

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

⁵ Note that the pro-poorness of labour income is measured with respect to the total per capita income.

income.⁶ 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 ξ^j can be written as

$$\xi^j = y_1^j / h^j \quad (20)$$

where y_1^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

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

⁶ A gain in growth rate implies a decrease in inequality and a loss in growth rate indicates an increase in inequality.

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.⁷

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

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

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

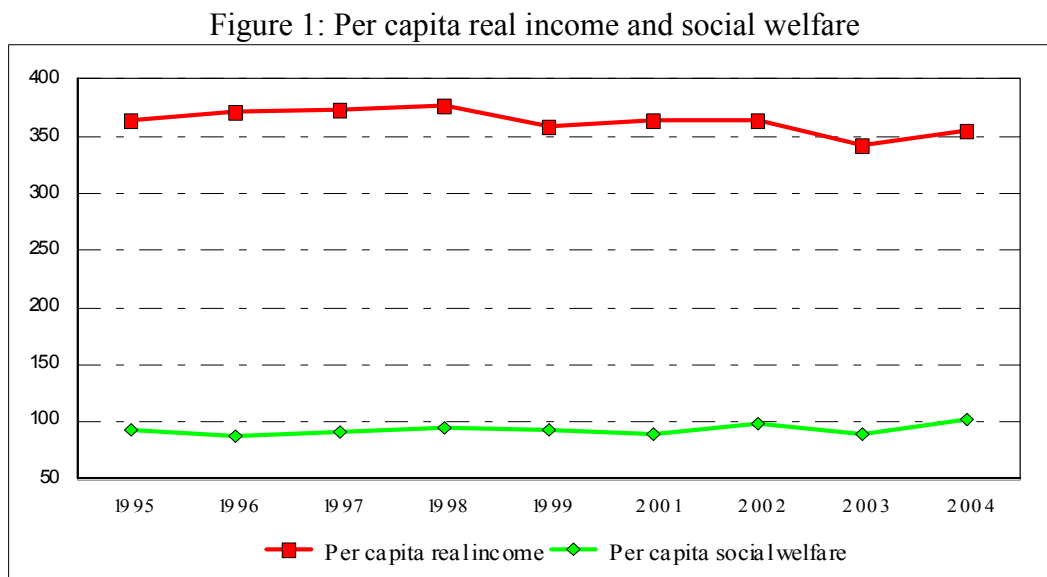
⁷ Changes in relative rates of returns from schooling do not affect the growth rate of productivity but will have an impact on the pro-poor growth rate of productivity through changes in the distribution.

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).

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.



Source: authors' calculation based on PNAD

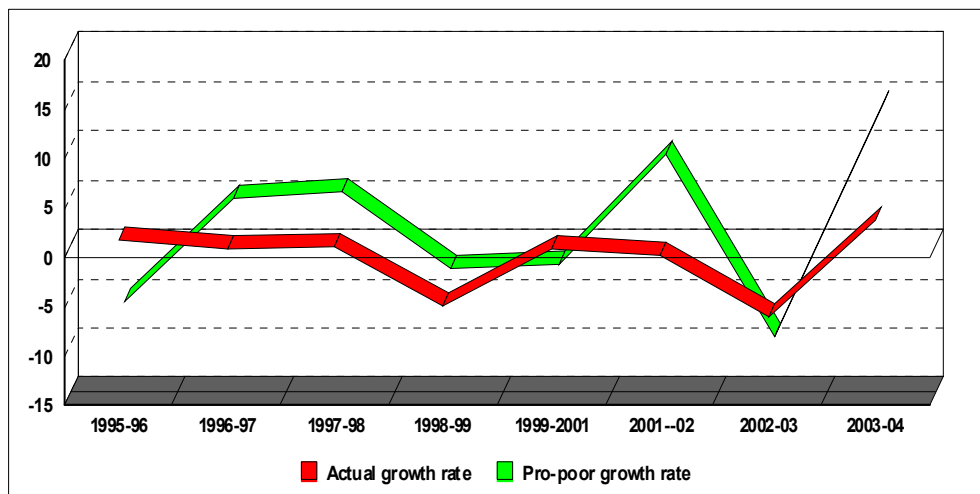
Table 1 presents growth rates of per capita real income and per capita social welfare. The results reveal that the trend in per capita real income has been declining at an annual rate of 0.63 percent over 1995-2004. Hence, the actual growth rate of per capita real income has been almost stagnant. This 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
1995-2004	-0.63	0.73	1.36
1995-2001	-0.30	0.10	0.40
2001-2004	-1.35	3.07	4.42

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.⁸ 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 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 services⁹ but the need to support an overvalued exchange rate for stabilization

⁸ Cardoso et al. (1995) and Ferreira et al. (2006) discuss the impacts of inflation on inequality in Brazil. Camargo and Neri (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.

⁹ Rocha (2003) present a detailed description of the impact of the *Real plan* on poverty and inequality.

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’ (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) 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-Familia* (Family Grant) following the same lines as the previous administration programmes. 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.

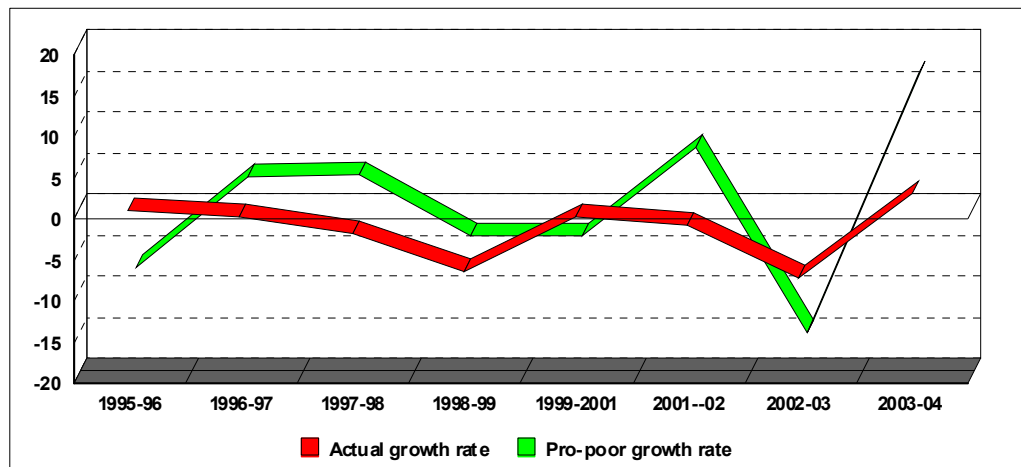
This indicates that in the 2000s, the labour market conditions became better for the poor relative to the non-poor. Figure 4 shows that labour income had benefited the poor proportionally more than the non-poor in the latest period, 2003-04, in particular. It will be interesting to find out what factors 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
1995-2004	-1.49	-0.73	0.76
1995-2001	-1.30	-0.97	0.32
2001-2004	-2.05	0.97	3.02

Source: authors' calculation based on PNAD

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



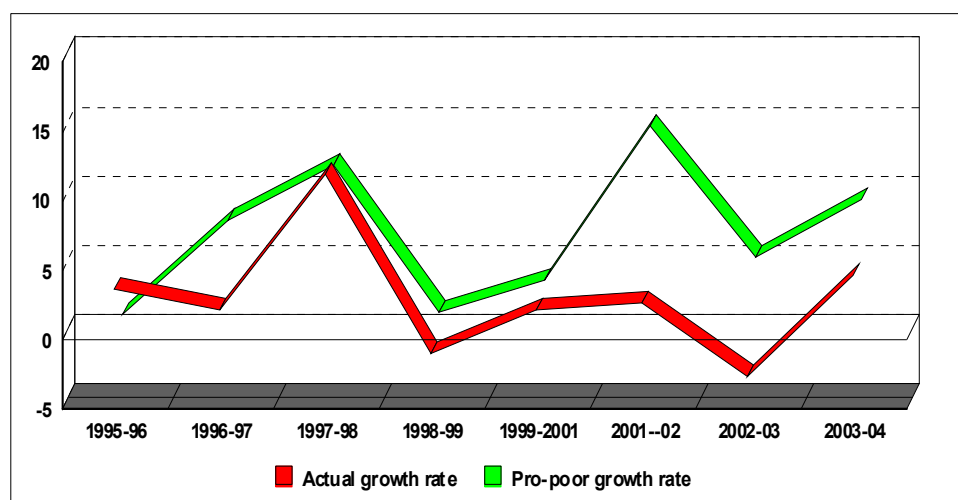
Next we look at the aggregate picture of non-labour income in Brazil over the period, 1995-2004. The results emerging from non-labour income are in contrast with those from labour income, which we have just discussed. The story of non-labour income can be told with the help of Table 4. According to the 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
1995-2004	2.64	6.30	3.66
1995-2001	3.69	5.20	1.51
2001-2004	1.02	9.14	8.12

Source: authors' calculation based on PNAD

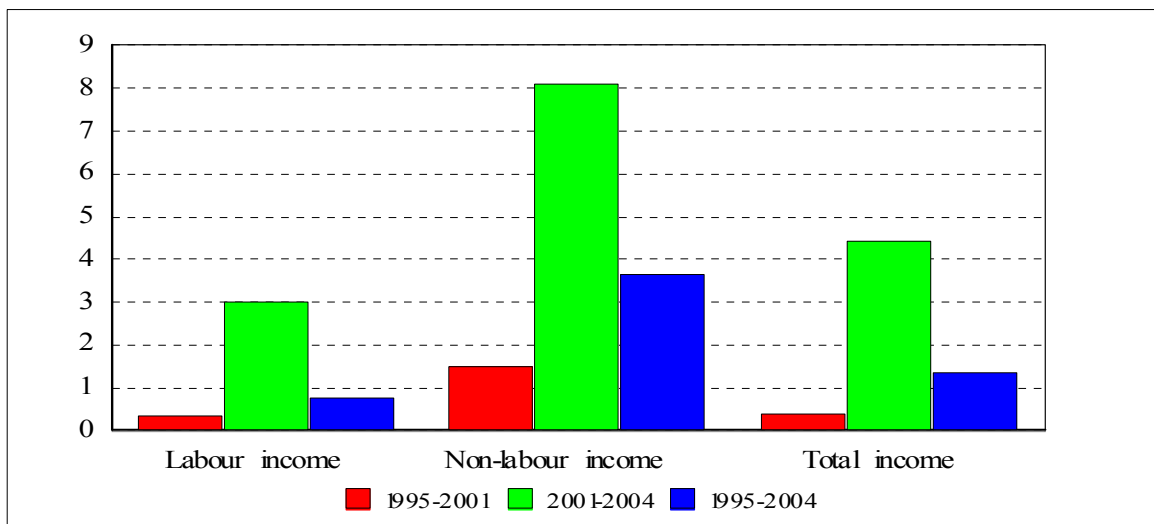
Figure 5: Actual and pro-poor growth rates of per capita non-labour income



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 growth¹⁰

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 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.

¹⁰ 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.

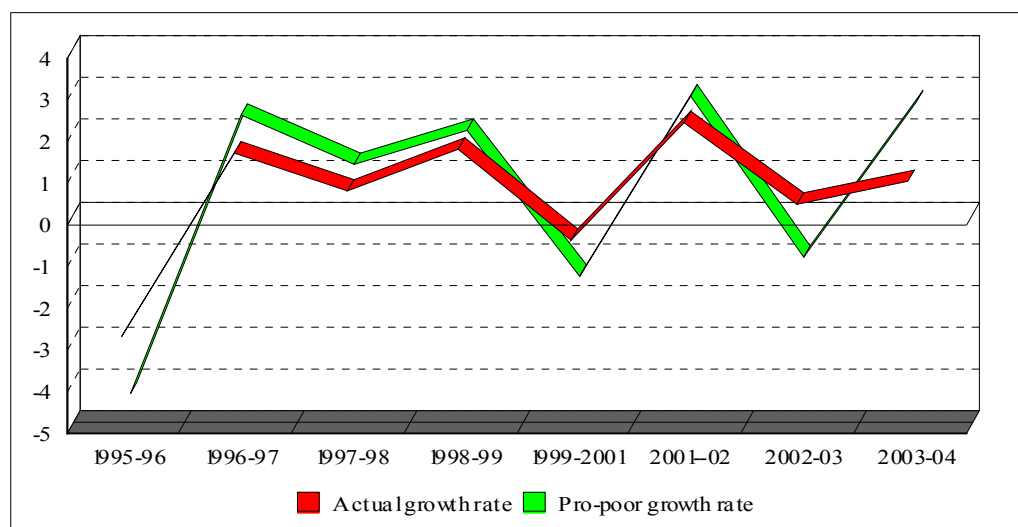
In addition, Figure 7 makes an interesting point. What emerges from the figure is that the pro-poor growth rate for labour force participation is more volatile than the actual or market growth rate for the same variable. This suggests that labour force participation among the poor is affected more by 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
1995-2004	0.73	0.41	-0.32
1995-2001	0.48	0.19	-0.29
2001-2004	1.27	1.24	-0.03

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.¹¹ 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.

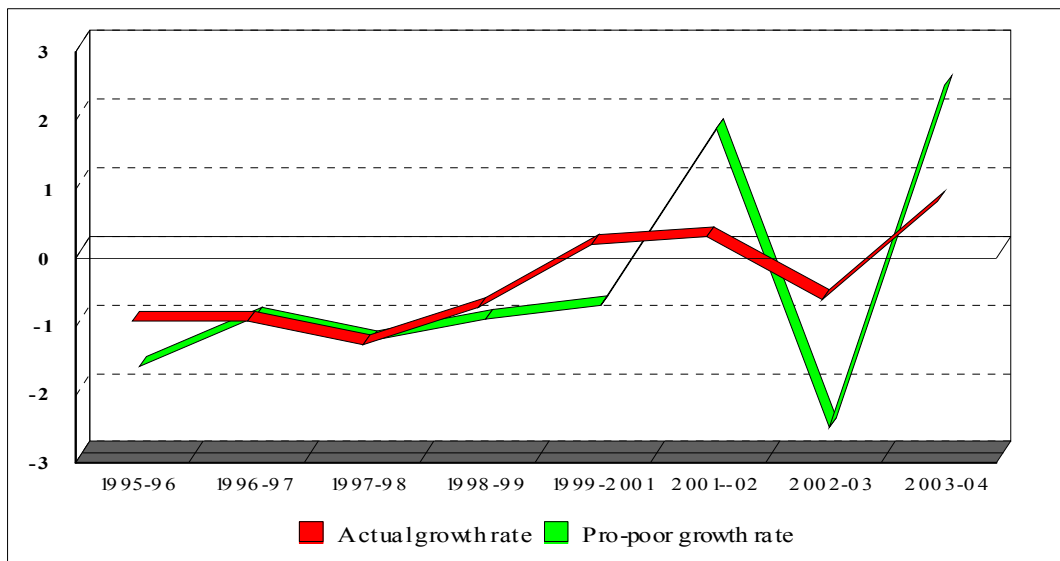
¹¹ Note that this is the usual definition of the employment rate: the percentage of labour force that is employed.

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
1995-2004	-0.34	-0.68	-0.34
1995-2001	-0.66	-1.14	-0.48
2001-2004	0.07	0.17	0.11

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-

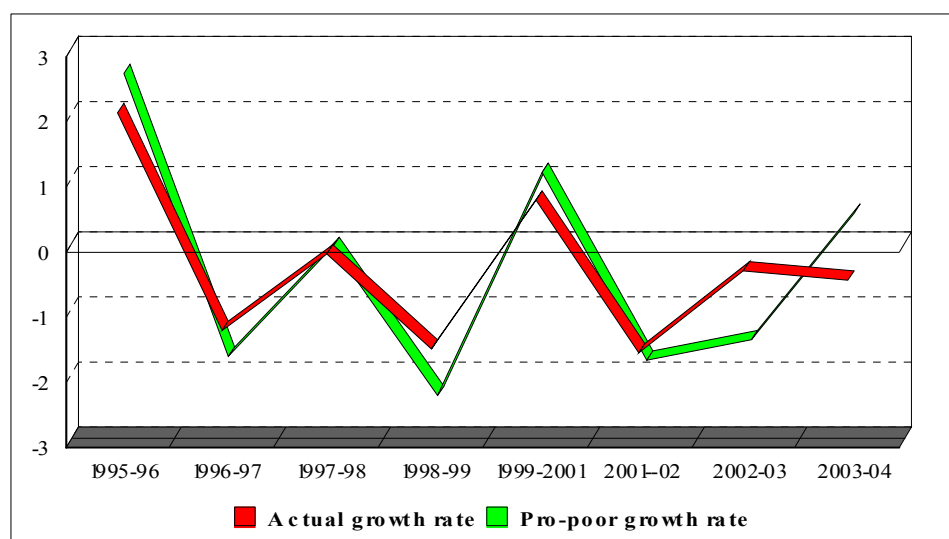
poor in general. These findings suggest that there has been a problem with underemployment in the economy during the period 1995-2004. This underemployment problem has become more serious in the second period (2001-2004) relative to the first period (1995-2001). This has also happened to the poor. On 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
1995-2004	-0.25	-0.41	-0.17
1995-2001	-0.07	-0.21	-0.14
2001-2004	-0.72	-1.01	-0.29

Source: authors' calculation based on PNAD

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



VIII.4 Productivity

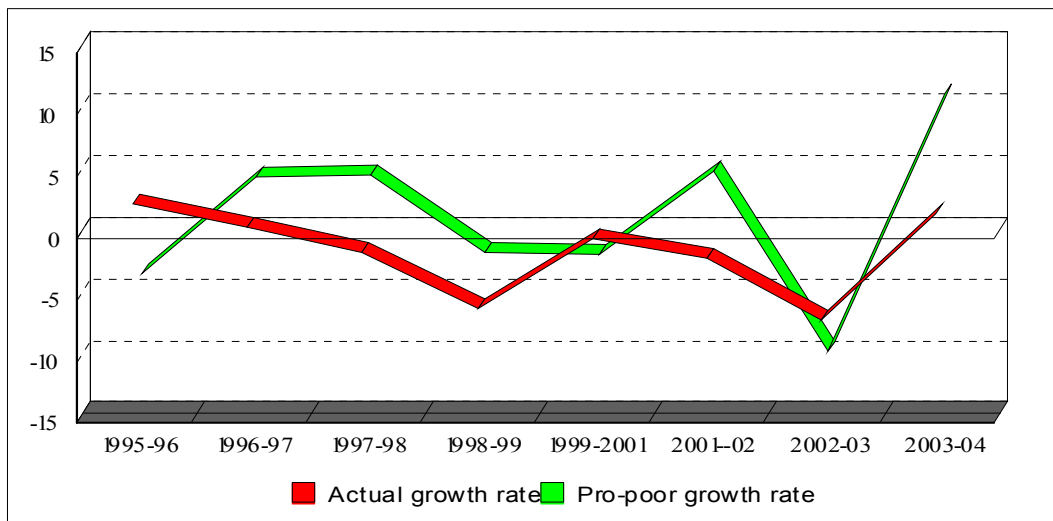
In this study, per capita productivity is defined as per capita labour income per hour worked. According to Table 8, per capita productivity has been declining over time. Productivity deteriorated sharply in the second period in particular. However, per capita productivity has been pro-poor, improving 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
1995-2004	-1.63	-0.05	1.58
1995-2001	-1.05	0.18	1.23
2001-2004	-2.67	0.56	3.23

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.

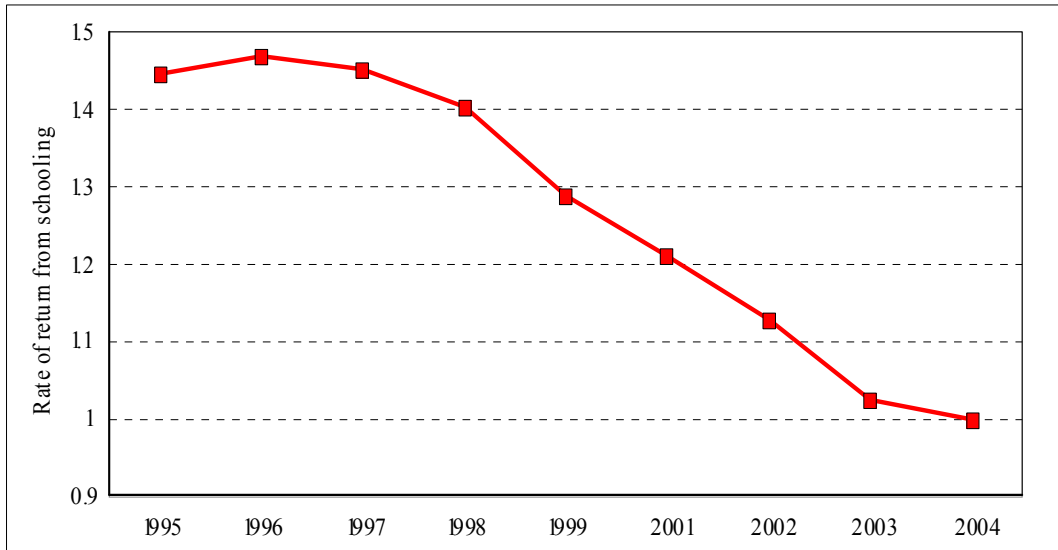
Another factor that can impact productivity is changes in relative returns from education. All households do not enjoy the same rates of returns for the same level of schooling. Changes in relative returns over time have also effects on both growth rate in the mean income and income inequality. The impact 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
1995-2004	2.99	3.95	0.97
1995-2001	2.34	2.80	0.46
2001-2004	4.04	6.47	2.43

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
Labour force participation rate	0.73	0.48	1.27	1.06
Employment rate	-0.34	-0.66	0.07	0.79
Hours of work per person employed	-0.25	-0.07	-0.72	-0.43
Productivity	-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
Labour force participation rate	0.41	0.19	1.24	2.69
Employment rate	-0.68	-1.14	0.17	2.35
Hours of work per person employed	-0.41	-0.21	-1.01	0.44
Productivity	-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 (2001-04). 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
Labour force participation rate	-0.32	-0.29	-0.03	1.63
Employment rate	-0.34	-0.48	0.11	1.56
Hours of work per person employed	-0.17	-0.14	-0.29	0.87
Productivity	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. 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 five components: the employment rate, hours of work in the labour market, the labour force participation rate, productivity, and non labour income. These components are all translated into per capita growth in mean incomes and inequality adjusted incomes. In this way 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. The paper shows that labour earnings 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'. 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 while the labour force participation rate made a positive contribution to growth.

The growth rate of per capita social welfare is -0.73 percent in the 1995-2004 period. 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.

While labour markets were quite adversely affected, specially in the upper segments of Brazilian society incomes derived from government transfers played a crucial role cushioning the consequences of macro shocks observed, specifically among the poorest segments of Brazilian society.

In the final year, we see light in the end of the tunnel, when pro-poor labor income rises by 16.24 percent. 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 10.74 percent. Schooling contributes to gains in the growth rate of about 7.54 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.

Appendix: Alternative Methodology to Decompose Productivity

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). The relationship between productivity and schooling is not exact. There can be many unexplained factors that have an impact on productivity. A household consists of working and non-working members. Schooling of non-working members may not be relevant to explaining labour productivity in the household. Hence we account for per capita years of schooling of only working members within household. Suppose s^* is the per capita years of schooling of the working members in household. Using this variable, we fit the following regression model that explains productivity:

$$\log(\xi) = \alpha + \beta_1 \log(s^*) + \beta_2 \log(s^*)^2 + \log(u) \quad (\text{A1})$$

where u is the error term which represents the aggregate impact of omitted variables from the model. Note that this regression equation can be estimated at household level using the weighted least squares method with weights being equal to population households represented by each sample household in the survey. Suppose $\hat{\alpha}$, $\hat{\beta}_1$ and $\hat{\beta}_2$ are the estimates of the model, which on substituting in (A1) gives

$$\log(\xi) = \log(\hat{\xi}_s) + \log(\hat{u}) \quad (\text{A2})$$

where

$$\log(\hat{\xi}_s) = \hat{\alpha} + \hat{\beta}_1 \log(s^*) + \hat{\beta}_2 \log(s^*)^2 \text{ and } \log(\hat{u}) = \log(\xi) - \log(\hat{\xi}_s).$$

Using (A2), we can write the growth rates and the pro-poor growth rates in productivity in an additive fashion as

$$\gamma(\xi) = \gamma(\hat{\xi}_s) + \gamma(\hat{u}) \quad (\text{A3})$$

and

$$\gamma^*(\xi) = \gamma^*(\hat{\xi}_s) + \gamma^*(\hat{u}) \quad (\text{A4})$$

which show that growth rates in productivity can be decomposed as the sum of two components: the first component is the impact of schooling and the second component is the aggregate effect of all the unexplained factors.

Subtracting (A3) from (A4) gives

$$g^*(\xi) = g^*(\hat{\xi}_s) + g^*(\hat{u}) \tag{A5}$$

This equation provides the contributions of schooling and other unexplained variables to the growth rate of inequality in productivity. If, for instance, $g^*(\hat{\xi}_s)$ is positive (or negative), this means that changes in schooling contribute to a decrease (or increase) in inequality in per capita income. Schooling can impact inequality in productivity through two factors. The first factor is the change in inequality of years of schooling and the second factor relates to returns from education. The first component in (A6) is the total effects of both factors.

There could be various factors that have impacts on productivity. These factors might include years of schooling, returns to schooling, gender, experience, and so forth. In this study, we particularly look into years of schooling and returns to schooling. According to our regression analysis, the years of schooling are able to explain per capita productivity by almost 93-95 percent: R-square of the regression model varies between 0.93 and 0.95. This suggests that the years of schooling could be a prime factor that explains per capita productivity.

Table A1 examines growth rates of years of schooling over the period with which we are concerned. Note that the number of years of schooling differ from one household to another as they are adjusted for household size. In the table per capita years of schooling are presented for both all members and only working members within household. From the results we find an overall increase in years of schooling but a higher increase for the poor. As a result, more years of schooling have contributed to a fall in inequality of years of schooling over the period, which is sharper in the second period, 2001-04. The pro-

poorness of schooling is far greater in the second period compared to the first period. In addition, the results highlight that the degree of pro-poorness of schooling of working members is higher than that of all members within household.

Table A1: Growth rates of per capita years of schooling

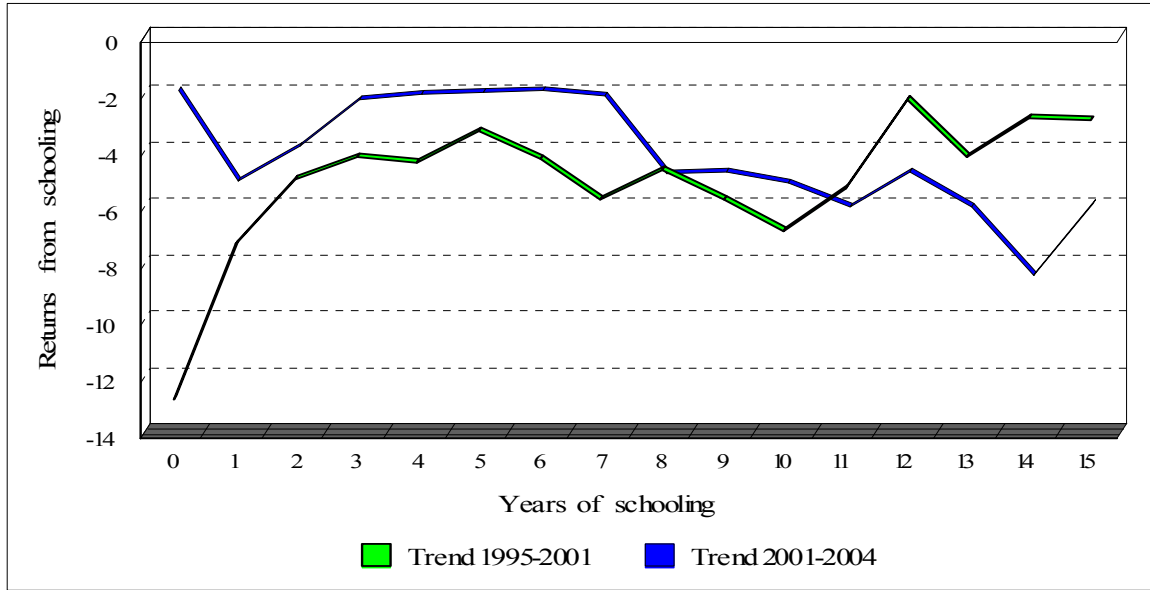
Period	All members			Working members		
	Actual growth rate	Pro-poor growth rate	Gain(+)/loss(-) of growth	Actual growth rate	Pro-poor growth rate	Gain(+)/loss(-) of growth
1995-96	5.28	7.97	2.68	1.09	-1.30	-2.38
1996-97	1.73	1.53	-0.20	2.03	2.52	0.49
1997-98	3.80	5.15	1.35	2.26	4.49	2.24
1998-99	2.93	5.57	2.63	2.53	4.68	2.15
1999-2001	2.55	3.67	1.12	2.96	2.03	-0.93
2001-2002	3.71	5.48	1.77	5.25	8.75	3.50
2002-2003	3.24	8.13	4.89	2.81	3.96	1.16
2003-2004	2.54	0.65	-1.89	4.49	7.54	3.05
1995-2004	3.05	4.66	1.61	2.99	3.95	0.97
1995-2001	3.05	4.46	1.41	2.34	2.80	0.46
2001-2004	3.17	5.09	1.92	4.04	6.47	2.43

Source: authors' calculation

The impact of schooling on changes in inequality can be explained by two factors. One is changes in inequality of years of schooling and the other is changes in returns from schooling. As we have observed earlier, schooling has become more equal across the population in Brazil. This in turn has contributed to a reduction in inequality: the higher level of education, the greater earnings per hour. However, rates of return from education also change over time. In this context, we look at the returns to each year of schooling in Brazil over 1995-2004. Figure A2 presents the trends in the returns from schooling over two periods, 1995-2001 and 2001-2004. The results show that educational returns have declined at all levels. It is evident that across educational levels, the curve of returns has an upward sloping in the first period but a downward sloping in the second period. This suggests that the gap in educational returns widened in the first period but narrowed in the second period. While the widening gap indicates an increasing inequality, the narrowing gap implies a fall in inequality. Therefore, a sharp decline in inequality over

the 2001-04 period is mainly due to the gap in educational returns that has narrowed over the period between higher and lower levels.

Figure A1: Returns from schooling



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