



Macroeconomic Performance and Inequality: Brazil 1983-1994

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Abstract

We examine how poor macroeconomic performance, mainly in the role of high rates of inflation, affected earnings inequality in the 1980s and early 1990s in Brazil. The results—based initially on aggregate time-series, and then on the relatively novel sub-national panel time-series data and analysis—show that the extreme inflation, combined with an imperfect process of financial adaptation and an incomplete indexation coverage, had a regressive and significant impact on inequality. The implication of the results is that sound macroeconomic policies, which keep inflation low and stable in the long-run, should be a necessary first step of any policy package implemented to alleviate inequality in Brazil.

Keywords: Inequality, inflation, indexation, financial adaptation, Brazil.
JEL Classification: D31, E31, O11, O54.

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1 Introduction and Motivation

We examine the impact that poor macroeconomic performance, mainly in the role of high rates of inflation, had on earnings inequality in the 1980s and early 1990s in Brazil. The subject is important because, firstly, it is vital to investigate the distinguishing features of poor macroeconomic performance and high inequality, which are relevant not only for Brazil, but also for other developing countries that presented similar poor macroeconomic conditions during roughly the same period of time¹. Secondly, not only is an episode of generalised higher inflation currently taking place, but also some emerging developing countries—e.g. Zimbabwe—still present poor macroeconomic performance with all its consequences on economic welfare. Thirdly, the link between macroeconomic performance and inequality in Brazil has been markedly different from the one seen in developed countries.

The evidence shows that chronic, extreme inflation had a regressive impact on inequality. The high-inflationary environment in Brazil had a significant and positive effect on the Coefficient of Variation and Gini coefficient. The main *policy* implication arising from the evidence is that a better institutional framework is a *necessary* condition for a reduction in the excessive inequality seen in Brazil so that better macroeconomic performance is achieved.

For the analysis, we use a data set that combines a fairly long-time series T with a shorter panel N variation, which presents novel and interesting features in terms of estimation. Firstly, time-series data might well be non-stationary, and therefore the issue of testing for unit roots in panels is theoretically relevant for specification and estimation purposes. Secondly, there is the question of having heterogeneous dynamic panels. The treatment of heterogeneity is one of the central questions in panel time-series $T > N$ analysis, for in its presence the estimates might be biased. Thirdly, there is the possible occurrence of between-region dependence in the data. This is an important matter that, if not taken into account, can lead to few gains being made from the use of panel estimators instead of different time-series for each region.

This paper distinguishes itself from the previous studies for two important reasons. Firstly, it fills a gap in this literature on Brazil by concentrating its attention on the high-inflation period and hence avoiding the contamination from a different economic regime. This can be mirrored not only to other developing countries that presented similar poor macroeconomic conditions at the time, but also to emerging developing countries that still do not present credible anti-inflationary institutions².

Secondly, it makes use of both the time-series and panel variations present in the data. More fundamentally, it takes advantage of the relatively novel

¹For instance, Bolivia, Colombia, Mexico, Peru and Tanzania, see Bulíř (2001).

²For instance, the Reserve Bank of Zimbabwe has been recently plagued by political interference, which has resulted in high rates of inflation and adverse consequences on economic welfare, see Muñoz (2007). Moreover, Acemoglu, D., S. Johnson, et al. (2008) highlight the importance of the political determinants of inflation, i.e. they argue that although Zimbabwe implemented central bank independence in 1995, the constraints on the executive have been severely reduced and inflation has, in fact, exploded recently.

panel time-series analysis that deals with interesting empirical issues—which is a significant step forward when compared to previous studies, in terms of estimation—and therefore it is believed that better and more insightful estimates are reported³. Moreover, panel time-series does not suffer from the usual criticism applied to cross-sectional analysis, i.e. that periods of high inflation are usually followed by short periods of low inflation, which would cancel each other out, see Bruno and Easterly (1998).

The remainder of the paper is structured as follows: Section 2 reviews the previous empirical and theoretical literature on the subject, and Section 3 deals with the data set used. Firstly it explains how the variables are obtained and provides some descriptive statistics of the data, and secondly it shows some *stylised* facts in the data. In Section 4, we discuss the empirical strategy and also present and discuss the results. Finally, Section 5 concludes. It summarises the evidence, highlights the differences between developed and developing countries on the subject, suggests extensions and raises policy implications that arise from the empirical results.

2 Related Literature

The first wave of studies on, e.g. the US, covers the post-war period until the early 1970s. Schultz (1969), Metcalf (1969), Thurow (1970), Beach (1977) and Blinder and Esaki (1978), employing a range of methods based mainly on aggregate time-series data, report that inflation had small and not always statistically significant progressive effects on inequality⁴. However, Metcalf (1969) and Thurow (1970) also suggest that those groups more reliant on imperfectly-indexed public transfers—families with a female head and poor blacks—are more prone to lose with higher inflation.

A second wave of studies that incorporates data from the 1980s includes Blank and Blinder (1986), and Cutler and Katz (1991). Their results confirm the previous studies, but with smaller and less precise inflation effects on inequality. More recently, and with data from the 1990s, Romer and Romer (1999) report that inflation remains progressive on inequality in the US⁵.

Thus, it is fair to say that in *developed* countries, inflation is believed to be *progressive* through the debtor and creditor channel, i.e. in such economies the holders of nominal debt would, in fact, benefit from *moderate* rates of inflation. For instance, Romer and Romer (1999) use US data from 1995 to investigate the balance sheet of the poor, and they confirm the fact that the poor are nominal debtors with real state and installment debt being the two most important types

³For instance, Barros et al. (2000) use pooled data and analysis. However, they do not deal with non-stationarity, nor with a possible heterogeneity bias present in their dynamic models, nor with the possibility of cross-region dependence in panels.

⁴Schultz (1969) also makes use of Dutch data covering roughly the same period and he reports the same sort of qualitative results as for the US.

⁵Complementary to the above, Nolan (1987) uses UK data covering the 1960s and 1970s. He reports that over time, the shares of the top two quintiles decrease relative to the shares of the first and third quintiles of the income distribution when inflation rises.

of debt held by poor households. Therefore, the poor for being the nominal debt holders become the main beneficiaries of moderate inflation that keeps their non-indexed contractual debts relatively fixed in the short run.

On the other hand, Brazil has been known for its high inequality, e.g. Gini coefficients of .623 and .601 in 1976 and 1995 respectively, and is also known for its chronic, high rates of inflation, especially in the 1980s and early 1990s. The subject of inequality and inflation has been often anecdotally debated, however, given the lack of a consistent and reliable stream of data until the late 1970s, the literature on Brazil is, not surprisingly, sparse and relatively recent.

Kane and Morisset (1993) report that the shares of the four lowest quintiles of the income distribution were regressively affected by inflation in the 1980s in Brazil. Cardoso et al. (1995) also investigate the impact of inflation on inequality in the 1980s. Employing time-series data from metropolitan regions, they find that inflation has significant effects on increasing inequality in each region separately. Barros et al. (2000) pool time-series data with regional information from 1982 to 1998 and consider the presence of fixed effects across regions. Their findings confirm the ones contained in the previous studies, with or without regional fixed effects. Also using data from the 1980s, Ferreira and Litchfield (2001) estimate an aggregate time-series. They too report regressive effects of inflation on inequality. Therefore, these studies on Brazil indicate that, in contrast to what is seen in developed countries, inflation has regressive effects on inequality, with inflation being regressive for its high rates that, among other distortions caused, offset the debtor and creditor channel. More specifically:

- firstly, in an economy in which the Fisher relationship holds, and that presents and requires either cash-in-advance constraints or different shopping-time allocations for the consumption of a certain bundle of goods—e.g. Lucas and Stokey (1987), Sturzenegger (1992), Erosa and Ventura (2002), and Cysne et al. (2005)—the presence of inflation acts as a tax on consumption of goods requiring cash, therefore leading people to substitute consumption of cash for goods requiring credit, or financial and indexed assets. All the same, with this process of financial adaptation, the velocity of money increases, and the richer groups are able to hold assets that are not *so* affected by the inflation tax. On the other hand, the poorer are financial-assets constrained, and therefore end up holding the highly-taxed cash. In general, the richer groups would get their wages in period t , consume a bundle of goods in period t , however with, e.g. post-dated cheques and credit cards—instruments not available to the poorer—they would only pay for those goods in period $t + 1$. In a country with rampant rates of inflation, this monthly difference in prices paid between t and $t + 1$ would be considerable⁶.

⁶For instance, Beck, T., A. Demirguc-Kunt, et al. (2007) document that the ratio of private credit over GDP in the US and Brazil during the period 1960 to 1999 was .944 and .272 respectively, which illustrates how restrictive the financial sector is in Brazil when compared to the US. Furthermore, Singh (2006) argue that, in contrast to other Latin American countries, the usual method of financial adaptation, i.e. dollarisation, did not take place in Brazil during the hyperinflation period.

- secondly, imperfect wage indexation occurred due to lower bargaining power by the poorer, since in the Brazilian formal labour market, indexation during the high-inflation period was a function of wage levels, with higher wages being overindexed and the lower ones severely underindexed. In addition, although the government at the time imposed minimum levels of indexation to secure the purchasing power of the poor, firms were free to reward higher productivity workers—or those at the top of the earnings distribution—with higher levels of wage indexation (Dornbusch and Simonsen, 1983)⁷.
- thirdly, Alesina and Drazen (1991), Kane and Morisset (1993), Crowe (2006) and Albanesi (2007) highlight the political-economy channel of high rates of inflation and inequality, i.e. that macroeconomic stabilisation takes longer to be implemented in polarised societies, such as Brazil. Coincidentally, stabilisation occurred in 1994, only after full democratisation—or a reduction in political polarisation—took place in 1989, and inequality has been decreasing since 1995⁸.

3 The Data

3.1 Data Description

The data set comes from the Brazilian Institute of Geography and Statistics (IBGE), which is the Brazilian Census Bureau, and also from the Institute of Applied Economic Research (IPEA) files. The IPEA is an agency of the Brazilian government that, among other things, compiles primary data and provides secondary data coming from the IBGE itself and also other national sources.

The data on earnings come from the Monthly Employment Survey (PME) files produced by the IBGE—which is a monthly rotative survey that follows International Labour Organisation (ILO) recommendations for international comparability—and covers six major regions over time and approximately 38,500 households. The six regions are, from north to south: Pernambuco (PE), Bahia (BA), Minas Gerais (MG), Rio de Janeiro (RJ), São Paulo (SP) and Rio Grande do Sul (RS). The concept of before-tax earnings adopted by the PME includes wages, monetary bonuses and fringe benefits earned by those at work, profits made by those who are self employed and employers, and the monetary value of goods for those earning in-kind. Hence, although this concept of earnings does not include incomes from property and transfers, it is nevertheless broader and

⁷See also Agénor and Montiel (1999) for more on wage-contract indexation in Brazil and other developing countries during their high-inflation periods. Moreover, Cardoso (1992) documents the imperfect wage-indexation mechanism in Latin America between 1977 and 1989 and its regressive consequences on poverty.

⁸In addition, Acemoglu, D., S. Johnson, et al. (2003) argue that distortionary macroeconomic policies, in the role of high inflation in this case, are more likely to be a symptom of weak institutions used by the ‘elite’ to expropriate the resources of another group in society.

less restrictive than what is usually understood by more conservative definitions of earnings. Moreover, given the nature of the economic environment at the time, some would argue that monthly data give less inaccurate information on earnings, see Atkinson and Bourguignon (2000).

In a country which presented high rates of inflation for such a long period of time the way the data are deflated is important. The earnings data are deflated by the IBGE's National Index of Consumer Prices (INPC). One important prior adjustment is the use of a converter to express all data in Real (R\$) mainly because Brazil had many monetary reforms attempting to tackle high inflation, especially between 1986 and 1994. Some adjustments in the INPC itself are also implemented. These include a correction of 22.25 percent for the inflation incurred in June 1994, a month before the full implementation of the R\$. The reason is that the INPC calculated inflation using the price variations of a virtual, but not fully implemented R\$, which was lower than the price variation incurred by the still widely used Cruzeiro (CR\$).

Another important adjustment is the need to centre the INPC as if it was measuring inflation starting on the first day of each month, which is the date that most people receive their pay cheques. Hence, taking into consideration that the information on earnings reported in the questionnaires of the PME is related to the first day of a particular reference month t , earnings are in fact corrected by the deflator of month $t + 1$ to allow the inflation incurred in period t to be accounted for. All in all, these corrections are particularly important because otherwise, in a country with such high rates of inflation, the information on earnings would be severely distorted by inflation and the computed estimates would not be as reliable⁹.

Given that, we use the information of individual earnings from people between fifteen and sixty-five years of age to obtain the Coefficient of Variation (CV), the Gini coefficient ($GINI$) and the respective shares of each quintile of the earnings distribution (Q_i). These measures of inequality are used for their attractive properties. The Coefficient of Variation and the Gini coefficient are Lorenz-consistent, i.e. they satisfy all the four principles that a complete measure of inequality must follow so that comparisons can be made— anonymity, population, relative income and Dalton principles. The earnings shares are a more crude measure, nevertheless they are sufficient to measure inequality according to the relative income principle¹⁰.

Regarding the information on the rates of inflation ($INFL$), we use the variation in the IBGE's regional Consumer Price Indices (IPCs). A second concept of inflation used is the past or anticipated inflation ($PASTINFL$), which consists of a four-month average of the rates of inflation measured by the regional IPCs.

The unemployment rates ($UNEMP$) used as a control variable also come from the PME files. Unemployment is calculated by the IBGE following the

⁹See Corseuil and Foguel (2002) for more details on how best to deflate earnings and income data from Brazil.

¹⁰For more on inequality measures and their properties, see Sen and Foster (1997).

method of the number of people unemployed and who are currently looking for employment over the labour force, who are at least fifteen years old.

The regional minimum-wage Kaitz index (*MINWAGE*) is the national minimum wage divided by the average earnings of each region covered by the PME. The minimum wage data are from the IPEA files and deflated by the INPC.

Table 1 provides the descriptive statistics using the aggregate time-series variation in the data, and also the correlations between the inequality measures and the rates of inflation in Brazil. It is worth mentioning the high means of the Coefficient of Variation and Gini coefficient, 1.642 and .548 respectively—with both measures reaching their maximum values in August 1990 and January 1989 respectively. Also worth mentioning are the inflation rates, which average 18.46 percent *per month*, during the period in the first panel of the Table.

No less important is the fact that the richest 20 percent (*Q5*) of those in the sample appropriate, on average, an astounding 43 percent of the total earnings—reaching its maximum in November 1989, and the poorest forty percent (*Q12*) appropriate a mere 18 percent of the total earnings—reaching its minimum in December 1989¹¹. Considering that the rates of inflation reached the maximum of 82 percent per month in March 1990, it can be initially said that inequality deteriorated considerably during the first burst of hyperinflation.

Additionally, in the second panel of the Table we can see the positive correlations between the Coefficient of Variation and the Gini coefficient with inflation. Also important to mention are the negative correlations between the shares of the first four quintiles (*Q12* and *Q34*) of the earnings distribution with inflation and, in contrast, the positive correlation between the shares of the fifth quintile of the distribution with the very same rates of inflation. Most correlations are statistically significant at either the 5 or 10 percent level.

¹¹To further illustrate the distribution of earnings by quintiles, the poorest 80 percent appropriate a meagre 60 percent of the total earnings in the sample.

Table 1: Descriptive Statistics and the Correlation Matrix, Brazil, 1983-1994.

Variables	Observations	Mean	Std. Dev.	Min	Max	
CV	144	1.642	.211	1.277	2.984	
GINI	144	.548	.016	.510	.609	
Q12	144	.181	.010	.157	.211	
Q34	144	.392	.011	.325	.409	
Q5	144	.428	.019	.396	.521	
INFL	144	18.466	14.065	.430	82.180	
UNEMP	144	5.220	1.420	2.540	9.770	
MINWAGE	144	206.700	42.820	115.030	321.500	
Correlations	CV	GINI	Q12	Q34	Q5	INFL
CV	1					
GINI	.657**	1				
Q12	-.157*	-.698**	1			
Q34	-.298**	-.341**	.235**	1		
Q5	.289**	.618**	-.754**	-.080**	1	
INFL	.270**	.276**	-.091	-.304**	.271**	1

Source: PME, IPC, IBGE, IPEA and author's own calculations. ** significant at the 5 percent level. * significant at the 10 percent level.

3.2 Behaviour of the Variables

The behaviour of the rates of inflation in Brazil was notoriously erratic in the 1980s and first half of the 1990s. The rates of inflation cover a range that goes from a rate of virtually zero per cent, .43 percent in April 1986, up to around 80 percent, to 82.18 percent in March 1990 *per month*. For example, the accumulated inflation rate during the period between January 1983 and December 1994 is a staggering 2,659 percent, with an average of 18.46 percent per month. To illustrate it further, the annual rate of inflation in 1989 alone was 1,863 percent.

Figure 1 illustrates, using the aggregate time-series variation in the data, some important events that took place during the period. It shows the period of relatively low inflation after the implementation of the Cruzado Plan in February 1986¹²—nine months before regional elections took place—and the hyperinflationary period that happened during the period of 1989 to 1990 when inflation reached its peak of around 80 percent per month, and then the sudden, but not durable, drop due to the Collor Plan¹³. Another particular feature is the rising inflation, especially from 1991 onwards, which culminated with the

¹²See Agénor and Montiel (1999) for more on this plan.

¹³The stabilisation plan implemented by the then newly elected President Fernando Collor, and which literally confiscated most financial assets held by the public. See Kiguel and Liviatan (1992) for more on this plan.

implementation of the Real Plan in 1994¹⁴. The duration of the price stabilisation after those stabilisation plans is also significant. The drop due to the Real Plan has been not only much deeper, but also more durable than any other before, and the behaviour of inflation has actually been relatively low and stable in Brazil since then.

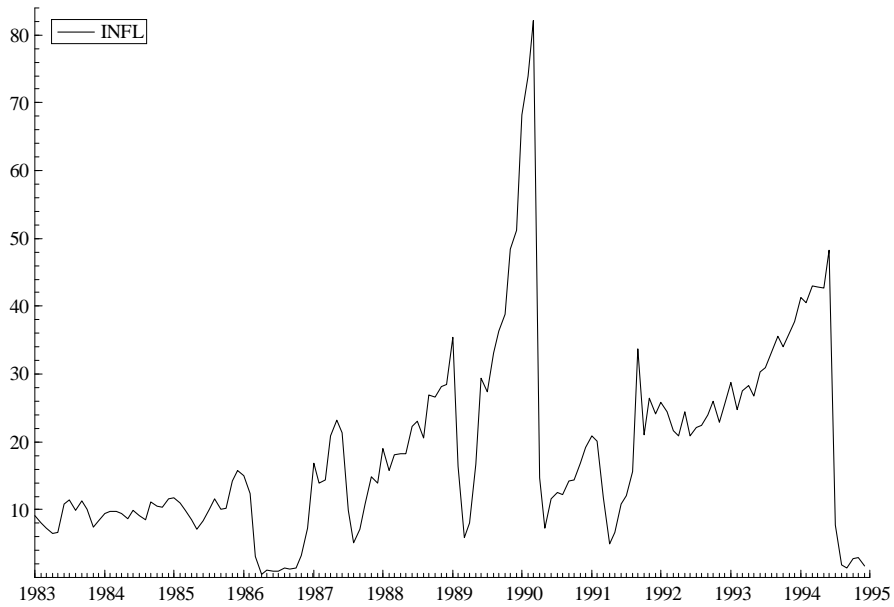


Figure 1: Monthly Inflation Rates in Brazil, 1983-1994. Source: IPC, IBGE. *INFL* is the inflation rates.

¹⁴The Real Plan was gradually implemented during the first half of 1994 and the Real (R\$) itself implemented in July 1994. See Agénor and Montiel (1999).

Regarding the behaviour of the Coefficient of Variation and Gini coefficient of the earnings distribution combined with inflation, the main feature in the data is that both inequality measures markedly increased during the hyperinflationary bursts. For instance, both measures of inequality presented increases of 43.71 and 9.19 percent between January 1988 and August 1990, as well as June 1988 and January 1989. The effects are symmetric though, i.e. when the hyperinflationary periods come to an end, inequality also returns to its previous figures. Figure 2 illustrates the above.

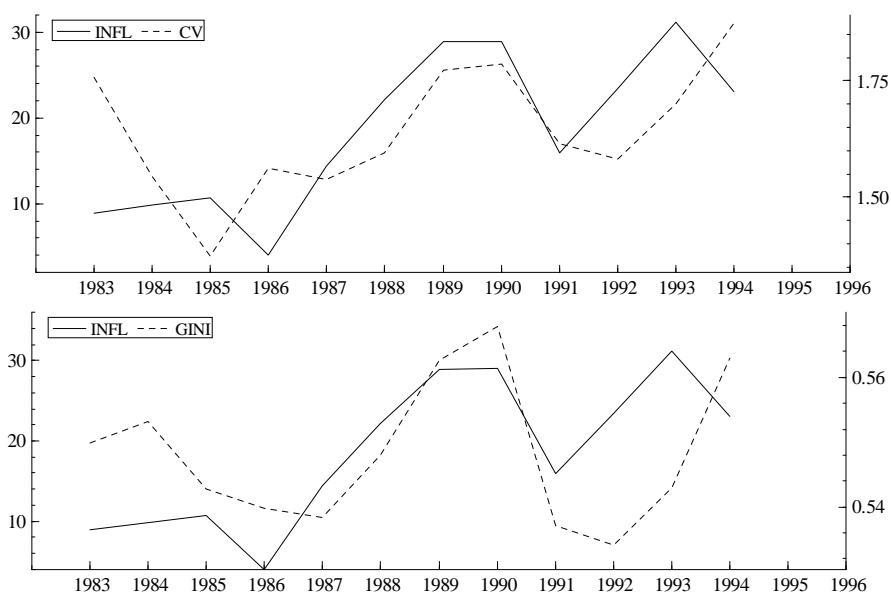


Figure 2: Annual Averages of Monthly Inflation and Inequality in Brazil, 1983-1994. Source: PME, IPC, IBGE and author's own calculations. The measures of inequality are the Coefficient of Variation (*CV*) and the Gini coefficient (*GINI*), and *INFL* is the inflation rates.

Moreover, when we plot the shares of the earnings of the low-middle ($Q23$) and top fifth ($Q5$) quintiles against inflation, the data show that during the hyperinflationary peak of 1989 to 1990 the shares of the earnings of the poor and middle classes fell markedly. For example, the decrease between July 1988 and November 1989 was 24.28 percent. However, after this hyperinflationary peak, there was a considerable recovery of earnings, to their previous figures at least, in the earnings shares of the second and third quintiles. With respect to the earnings of the top fifth quintile, its share increased significantly during the hyperinflation of 1989 to 1990 and then dropped when inflation fell. In this case, the increase between April 1988 and November 1989 was 26.61 percent. Figure 3 illustrates the above.

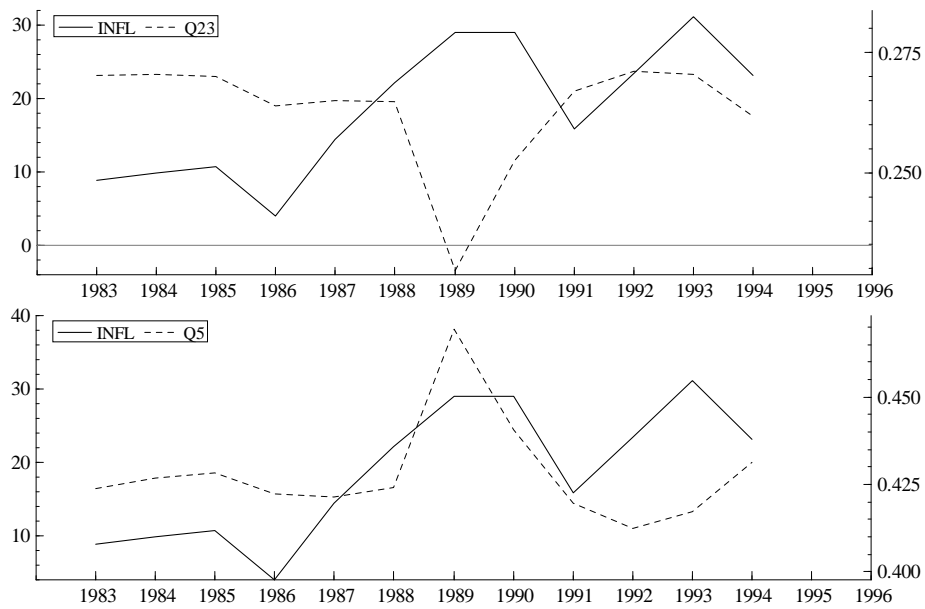


Figure 3: Annual Averages of Monthly Inflation and Inequality in Brazil, 1983-1994. Source: PME, IPC, IBGE and author's own calculations. The measures of inequality are the shares of the second and third quintiles ($Q23$) and the fifth quintile ($Q5$) of the earnings distribution, and $INFL$ is the inflation rates.

In addition, we plot the OLS regression lines between the measures of inequality and inflation. The Coefficient of Variation, the Gini and the shares of earnings of the fifth quintile of the distribution, as expected by now, display positive relationships with inflation. On the other hand, the shares of the second and third quintiles present a negative relationship with inflation. Figure 4 illustrates the results.

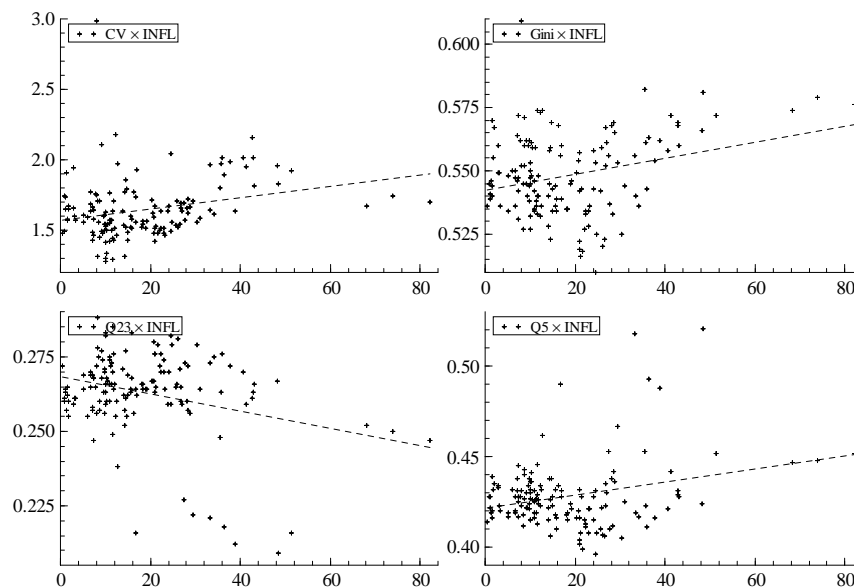


Figure 4: OLS Regression Lines, Inequality and Inflation, Brazil 1983-1994. Source: PME, IPC, IBGE and author's own calculations. The estimated equation is $INEQUALITY_t = \alpha + INFL_t + u_t$. The measures of inequality are the Coefficient of Variation (CV), the Gini coefficient ($GINI$), the shares of the second and third quintiles ($Q23$) and the fifth quintile ($Q5$) of the earnings distribution, and $INFL$ is the inflation rates. All estimates are statistically significant at the 1% level.

Therefore, the data suggests that high inflation was positively correlated with the earnings distribution during the period. Moreover, the inequality measures clearly presented the ability to decrease to their previous figures when inflation fell, i.e. inequality and inflation have literally moved together through time, which suggests that low and stable rates of inflation at least do not have a regressive effect on inequality¹⁵.

4 Empirical Strategy and Results

In this Section, we use the sub-national $T > N$ data to estimate the impact of poor macroeconomic performance on inequality, and also discuss some important issues present in panel time-series analysis. We then report and discuss the results.

Firstly, the centred twelve-point moving averages are used to deal with any possible seasonality and to smooth the irregular component in the series. These transformed data have information from January 1983 to December 1994 ($T = 132$) covering six major regions of Brazil ($N = 6$). Secondly, for non-stationarity in the regional time-series, we use the Im, Pesaran and Shin [IPS (2003)] test—which for sufficiently large T converge in probability to a standard normal distribution—and allows for heterogeneous parameters and serial correlation. Moreover, as N gets large with respect to T , the IPS test might present size distortions, however, this is not the case in the data set used¹⁶.

Thirdly, the issue of heterogeneity bias in dynamic $T > N$ panels—caused for under wrongly assumed homogeneity of the slopes the composite disturbance term is serially correlated and the explanatory variables x_s are not independent of the lagged variable y_{t-1} —is dealt with Swamy’s (1970) Random Coefficients (RC-GLS) estimator. This estimator gives consistent estimates of the expected values. The RC-GLS estimator assumes the existence of heterogeneous intercepts and slopes and it consists of a weighted average of $\hat{\alpha}_i$ and $\hat{\beta}_i$, and the weight is a modified variance-covariance matrix of the heterogeneous α_i and β_i . Moreover, the benchmark one-way Fixed Effects (FE) estimator also provides consistent estimates in dynamic models when $T \rightarrow \infty$, but only when the slopes are homogeneous¹⁷.

¹⁵Bulíř (2001) suggests that there is a ‘free lunch’, i.e. that there are no disinflation costs on inequality, but only benefits. Furthermore, Easterly and Fischer (2001) document that the poor from thirty-eight countries in 1995 considered inflation as a more pressing macroeconomic problem than their richer counterparts.

¹⁶An alternative to IPS (2003) is the test by Levin, Lin and Chu (2002). However, this test assumes parameter *homogeneity*, and therefore does not consider a possible heterogeneity bias present in the data.

¹⁷When heterogeneous slopes are present, the Mean Group (MG) estimator, proposed by Pesaran and Smith (1995) is also an alternative, however it is sensitive to outliers, a problem not faced by the RC-GLS estimator. A second alternative would be the Instrumental Variable estimator, however an instrument uncorrelated with the residuals will be uncorrelated with the explanatory variable, and hence not a valid instrument. Finally, GMM-type estimators are not an alternative under $T > N$ for the overfitting problem. See Pesaran and Smith (1995) or Bond (2002).

Fourthly, since the data present $T > N$ variation, between-region dependence is believed to be through the disturbances, i.e. $E(u_{it}u_{jt}) \neq 0$. This is accounted for with Zellner's (1962) Seemingly Unrelated Regressions (SUR-FGLS) estimator¹⁸. This estimator presents greater efficiency, the greater the correlation among the disturbances and it estimates different regional time-series, which are then weighted by the covariance matrix of the disturbances¹⁹.

Given the above, the IPS test for unit roots is based on an Augmented Dickey-Fuller (ADF) regression for each region of each variable, which are then averaged. The moments of the mean E and variance var of the average \bar{t} to be plugged into the IPS test are taken from IPS (2003) and in this case are -1.504 and .683 respectively. Equations 1 and 2 illustrate the regional ADF equations of a particular variable y and the IPS test respectively,

$$\Delta y_{it} = \alpha_i + \beta_i y_{it-1} + \sum_{j=1}^k \gamma_{ij} \Delta y_{i,t-j} + u_{it}, \quad (1)$$

$$IPS = \frac{\sqrt{N}(\bar{t} - E(\bar{t}))}{\sqrt{var(\bar{t})}}, \quad (2)$$

in which α_i is the heterogeneous intercept, u_{it} , is the residual and N accounts for the number of regions. The IPS statistics suggest that we can reject the null hypothesis of unit roots and accept in favour of the alternative that at least *one* region of each variable is stationary at the 5 percent level. Table 2 reports the results.

¹⁸An alternative to SUR-FGLS is the Common Effects Estimator proposed by Pesaran (2006). However, N is assumed to be large and in our data set $N=6$. Furthermore, Kapoor, M., H. H. Kelejian, et al. (2007) propose a FGLS estimator that also works best under the $N \rightarrow \infty$ assumption.

¹⁹For a more thorough discussion about panel time-series analysis in general, see Smith and Fuertes (2008).

Table 2: Panel Unit-Root Tests

Variables	IPS Statistics
CV	-2.02
GINI	-4.46
Q12	-3.27
Q34	-3.51
Q5	-2.95
INFL	-3.98
UNEMP	-5.78
MINWAGE	-2.81

The moments of the mean E and variance var of the average \bar{t} are respectively: -1.504 and .683. Source: Im, Pesaran and Shin (2003) and author's own calculations.

Given that no cointegration analysis might be pursued nor other data transformations needed, we proceed to the issue of heterogeneity bias in dynamic models and also to static models.

We first estimate dynamic equations using the benchmark FE estimator, which assumes heterogeneous intercepts and homogeneous slopes. Equation 3 illustrates the main estimated dynamic equation.

$$CV_{it} = \alpha_i + \beta CV_{it-1} + \gamma INFL_{it-1} + \delta UNEMP_{it-1} + \epsilon MINWAGE_{it} + u_{it}, \quad (3)$$

in which the explained CV_{it} is the Coefficient of Variation of the earnings distribution. The explanatory variables include lagged inflation ($INFL_{it-1}$), the lagged unemployment rates ($UNEMP_{it-1}$), the minimum-wage index ($MINWAGE_{it}$), and the lagged values of the Coefficient of Variation (CV_{it-1}). Furthermore, the lagged past inflation ($PASTINFL_{t-1}$), which consists of a four-month average of the rates of inflation, is estimated against the next period CV_{it+1} , and finally u_{it} is the residual.

The results in Table 3 show that in most equations and estimators, the dynamic estimates of inflation and past inflation are positive and statistically significant. For instance, using the dynamic RC-GLS estimates from the first specification, a point increase in inflation increases inequality by .626 points per year. Furthermore, the estimates of lagged past inflation at the bottom of the Table suggest that inequality is regressively affected not only by unanticipated, but also anticipated high rates of inflation.

Regarding the estimates of the lagged measure of inequality, they are positive and significant, confirming the fact that inequality is persistent²⁰. The static estimates of the unemployment rates are positive, somehow confirming the theoretical prediction that the poor are the ones to be displaced first when

²⁰Corroborating the fact that according to the IPS test all variables are stationary, it is important to mention that under $T > N$, a spurious regression is less of a problem anyway. Phillips and Moon (1999), argue that since these pooled estimators are averaging over the regions, the noise is attenuated and the estimates are consistent. Moreover, Smith and Fuentes (2008) suggest that this result holds even under between-region dependence.

a recession occurs. However, the dynamic estimates of unemployment are negative, although the RC-GLS estimates are not statistically significant.

The estimates of the minimum-wage index are all negative and significant, which suggests that this policy does not increase inequality via loss of employment of those located at the bottom of the earnings distribution²¹. The Likelihood Ratio (LR) tests for homogeneity of intercepts and slopes indicate that we can accept the alternative hypothesis that the parameters are in fact *heterogeneous*, which makes the RC-GLS estimator the most appropriate for these dynamic models.

In static specifications, we first estimate equations using the benchmark Pooled Ordinary Least Squares (POLS) estimator—which assumes homogeneous intercepts and slopes—and then move to the FE estimator²². In all specifications and estimators, the rates of inflation remain regressive and statistically significant. For instance, using the FE estimates of the more general second specification, for every point increase in inflation, inequality would increase by .604 points per year.

The unemployment rates estimates are significant and, as expected in the short run, regressive. The minimum wage is progressive and significant in the FE estimator, which confirms that this particular policy does not increase inequality. The LR tests reject the null hypothesis of homogeneous intercepts, suggesting the presence of regional fixed effects. Table 3 reports the results.

²¹Incidentally, Lemos (2004) argues in a study on the effects of the Brazilian minimum wage on employment that the minimum did not significantly create job losses between 1982 and 2000.

²²Zellner (1969) states that for static models all panel estimators give unbiased estimates of the expected values.

Table 3: Estimates of Macroeconomic Performance on Inequality, 1983-1994.

CV	Dynamic Models		Static Models	
	FE	RC	POLS	FE
INFL			.0998 (16.64)	.0924 (21.24)
INFL (1)	.0554 (12.37)	.0522 (2.37)		
UNEMP	.0826 (2.93)	.0218 (.20)	.3204 (8.28)	.0561 (1.67)
MINWAGE	-.0274 (-15.86)	-.0270 (-6.78)		
Constant		17.263 (30.77)	.1259 (49.73)	
LR test	771.98	2320.78		525.30
F test	274.34	NA	153.06	189.75
R ²	.73	.72	.27	.62
CV (1)	.8872 (80.21)	.8393 (29.00)		
INFL			.1027 (15.32)	.0504 (11.33)
INFL (1)	.0085 (5.34)	.0093 (1.53)		
UNEMP			.3079 (7.57)	.0945 (3.29)
UNEMP(1)	-.0170 (-1.82)	-.0303 (-1.47)		
MINWAGE	-.0040 (-6.28)	-.0059 (-2.28)	.0022 (.98)	-.0291 (-17.11)
Constant		2.9981 (5.09)	.1239 (38.53)	
LR test	84.89	231.48		776.08
F test	2954.02	NA	102.36	264.5
R ²	.97	.94	.28	.72
CV (1)	.9129 (67.47)	.8969 (49.33)		
PASTINFL (1)	.0096 (4.64)	.0121 (2.79)		
Constant		.1444 (5.45)		
LR test	26.78	56.33		
F test	2301.51	NA		
R ²	.95	.95		

T-ratios in parentheses, number of observations: $NT=792$. The basic estimated equation is $CV_{it} = \alpha_i + \beta INFL_{it} + \gamma UNEMP_{it} + \delta MINWAGE_{it} + u_{it}$, where CV is the Coefficient of Variation of the earnings distribution, $INFL$ the inflation rates, $UNEMP$ the unemployment rates and $MINWAGE$ the minimum-wage index. Source: author's own calculations.

Additionally, we look at the issue of between-region dependence, which is dealt with by the two-step SUR-FGLS estimator. This estimator is believed to deliver more insightful estimates since it disaggregates the analysis further²³. Equation 4 illustrates the general dynamic equation estimated for each region.

$$CV_t = \alpha_t + \beta CV_{t-1} + \gamma INFL_{t-1} + \delta UNEMP_{t-1} + \epsilon MINWAGE_t + u_t, \quad (4)$$

in which CV_t is the Coefficient of Variation of the earnings distribution, $INFL_{t-1}$ accounts for lagged inflation, $UNEMP_{t-1}$ for the lagged unemployment rates,

²³Furthermore, Phillips and Sul (2003) argue that when between-region dependence is present there is very little gain in using pooled analysis.

$MINWAGE_t$ for the minimum-wage index, CV_{t-1} for the lagged values of the Coefficient of Variation and u_t for the residual.

The dynamic and static effects of inflation are positive and significant in most regions. An interesting feature seen in those effects is that the poorer regions of the Northeast, i.e. Pernambuco (PE) and Bahia (BA), and to a lesser extent Rio de Janeiro (RJ), present the largest estimates of all, which indicates that the poorer the region, the more regressive inflation is. For instance, the SUR-FGLS estimates from the first specification indicate that a point increase in inflation increases inequality by .150 points per year in Pernambuco, which is the poorest region in the sample²⁴.

Unemployment presents regressive effects in those poor regions of the Northeast, i.e. Pernambuco and Bahia, and also Rio de Janeiro. In the more affluent regions of the South the effect of this variable is not clear cut, which possibly indicates the existence of more organised dual labour markets attenuating the regressiveness of short-run unemployment.

Regarding the minimum-wage index, the results show that the minimum wage does not have any regressive effect on inequality. The Lagrange Multiplier (LM) tests reject the null hypothesis that the variance-covariance matrices are diagonal, which suggests that these regions are, in fact, related to each other through the disturbances²⁵. Table 4 reports the results.

²⁴Related to that, Guitián (1998), and Romer and Romer (1999) show in cross-sections of countries that inflation presents regressive effects on inequality, the poorer the countries. Moreover, Bulir (2001) reports that in countries that present hyperinflationary periods, inflation presents stronger regressive effects on inequality.

²⁵The IPS test reported in Table 2 above assumes the existence of between-region *independence*. An alternative that considers the existence of between-region dependence is proposed by Pesaran (2007), the cross-section IPS (CIPS) test. However, CIPS assumes that $N > 10$ and we have $N = 6$ in our data set. It is therefore thought that the IPS test in this case is slightly biased but still informative and the best alternative available. See Baltagi, Bresson, et al. (2007) for more on panel unit-root tests and between-region dependence.

Table 4: SUR-FGLS Estimates of Macroeconomic Performance on Inequality, 1983-1994.

CV	SUR-FGLS		
	PE	BA	MG
INFL(1)	.1250 (15.29)	.0781 (8.77)	.0350 (3.27)
UNEMP(1)	.3606 (10.20)	.4411 (7.58)	-.2137 (-4.01)
MINWAGE	-.0151 (-6.58)	-.0371 (-11.71)	-.0174 (-4.45)
LM test	455.42		
CV (1)	.8774 (32.98)	.8461 (31.87)	.9180 (50.02)
INFL (1)	.0237 (5.57)	.0239 (6.57)	.0079 (3.10)
UNEMP (1)	.0005 (0.35)	.0031 (1.22)	-.0041 (-2.71)
MINWAGE	-.0001 (-1.07)	-.0004 (-3.04)	-.0001 (-1.96)
LM Test	57.98		
INFL	.1144 (13.71)	.0680 (7.31)	.0265 (2.45)
UNEMP	.0382 (10.61)	.0452 (7.49)	-.0222 (-4.21)
MINWAGE	-.0018 (-7.81)	-.0039 (-11.94)	-.0019 (-4.88)
LM test	513.88		
	RJ	SP	RS
INFL(1)	.0886 (11.76)	.0023 (0.30)	-.0168 (-1.38)
UNEMP(1)	.1295 (2.58)	-.1716 (-3.94)	-.1436 (-1.82)
MINWAGE	-.0202 (-7.01)	-.0379 (-9.94)	-.0297 (-5.96)
LM test	455.42		
CV (1)	.9062 (32.50)	.9247 (43.96)	.9225 (35.07)
INFL (1)	.0105 (2.93)	-.0053 (-2.57)	-.0029 (-0.74)
UNEMP (1)	-.0031 (-1.58)	-.0017 (-1.28)	-.0055 (-2.05)
MINWAGE	-.0001 (-1.08)	-.0008 (-6.87)	-.0002 (-1.18)
LM Test	57.98		
INFL	.0867 (11.67)	.0037 (.49)	-.0097 (-.79)
UNEMP	.01711 (3.40)	-.01711 (-3.91)	-.0092 (-1.13)
MINWAGE	-.0021 (-7.77)	-.0037 (-10.17)	-.0027 (-5.59)
LM test	513.88		

T-ratios in parentheses, number of observations: $NT=792$. The basic estimated equation is: $CV_t = \alpha_t + \beta INFL_t + \gamma UNEMP_t + \delta MINWAGE_t + u_t$, where CV is the Coefficient of Variation of the earnings distribution, $INFL$ the inflation rates, $UNEMP$ the unemployment rates and $MINWAGE$ the minimum-wage index. Source: author's own calculations.

The economic intuition behind the above evidence is: firstly, chronic high rates of inflation are detrimental to those who are not at the very top of the distribution²⁶; secondly, although the regional inflation rates follow a similar

²⁶When we estimate inflation and past inflation against the earnings shares of the quintiles, the results suggest that the only group that manages to increase its share is the richest 20 percent in the distribution. Also, when the Gini coefficient is the measure of inequality used, the same sort of qualitative results arise. Furthermore, when we estimate equations with the

national trend, they affect different regions differentially. In general, the poorer the region, the more regressive inflation tends to be, which highlights the fact that poor regions are more vulnerable to extreme inflation due to the absence of the right mechanisms, indexation coverage and a more flexible financial adaptation process.

Thirdly, in terms of unemployment effects, the static pooled evidence somehow confirms the standard prediction that those at the bottom of the distribution present lower turnover costs, and the more disaggregated SUR-FGLS evidence highlights that the poorer the region, the more regressive unemployment is.

Fourthly, regarding the minimum-wage index, the estimates suggest that this policy does not have a regressive impact on inequality via loss of employment. It is worth mentioning though, that the minimum wage had been kept reasonably low in Brazil until the stabilisation in 1995. Moreover, the minimum wage suffered severe restrictions from the government in terms of indexation, i.e. it would only be readjusted if inflation had reached a particular threshold, which suggests that the minimum was below the average wage in the economy at the time.

All in all, the evidence—based on panel time-series data and analysis—confirms the initial inspection of the data based on the aggregate time-series variation about the regressiveness of high inflation on inequality.

5 Concluding Remarks

We investigated the impact that poor macroeconomic performance had on earnings inequality in Brazil in the 1980s and first half of the 1990s. The evidence, based firstly on aggregate time-series and then on the relatively novel sub-national panel time-series $T > N$ data and analysis, suggests that extreme rates of unanticipated and anticipated inflation had significant effects in increasing inequality during the period. The evidence shows that the poorer groups did not have access to indexed financial assets to protect themselves against accelerating inflation, and nor fully monthly-indexed wages. Moreover, the panel time-series analysis permits us to disentangle the effects of inflation on regions with different levels of development, and the regions suffering most with high inflation are the poorest ones in the Northeast of the country.

The other two explanatory variables regressed against inequality alongside inflation, i.e. the unemployment rates and the minimum-wage index, presented mixed and non-regressive effects on inequality. Initially, the results confirm the fact that the poor present lower turnover costs in the short run, and hence lose their formal jobs and earnings first when a recession occurs, and that a minimum-wage policy does not increase inequality via loss of employment when the minimum is low enough. Still, with regards to unemployment, it can be said that the poorer the region, the more regressive unemployment tends to be,

inflation tax as the explained variable, the estimates are also similar to the ones reported. The results are available on request.

which suggests the importance of organised dual labour markets in buffering the regressive effects of unemployment in better-off areas, and somehow the dynamic pooled estimates confirm that.

With the above in mind, the relevance of conducting a historical study on the consequences of high inflation and hyperinflation on inequality is that not only are we experiencing an episode of generalised higher inflation, but also an episode of hyperinflation in Zimbabwe with all its consequences on economic welfare. In addition, this paper somehow relates to the new research on the political determinants of inflation, i.e. that in more polarised societies such as Brazil in the 1980s and first half of the 1990s, stabilisation is delayed, and inflation tends to be higher and more distortionary.

Moreover, the quality of the results is, to a certain extent, boosted not only by the inclusion of the minimum-wage index in the equations, but also by the novel analytical approach used. The evidence—particularly the one based on sub-national panel time-series $T > N$ data and analysis—deals with issues such as non-stationarity in panels, heterogeneity bias in dynamic panels and between-region dependence. None of these issues has been considered before in any other study of the impact of macroeconomic performance on inequality. Therefore, it is believed that, given the usual caveat that panel time-series is a rapidly developing area, the type of analysis carried out here can be regarded as a significant step forward in terms of achieving better and more insightful estimates.

Regarding future work, the use of Brazilian data from 1995 onwards to check whether the low rates of inflation generated by the Real Plan have actually had a progressive impact on inequality, as in developed countries, would naturally complement this study. Another extension is an investigation of the importance of financial development on inequality in Brazil, i.e. whether access to finance would really present the poor and the middle classes not only with credit that could be used to invest in all sorts of short- and long-run productive activities, but also with some sort of protection—via financial adaptation—of their earnings against high inflation. Furthermore, a study on the importance of economic and political polarisation in keeping inflation high is also worth pursuing.

To conclude, firstly we understand that in a country that presents high inequality like Brazil, the unstable macroeconomic performance of the 1980s and 1990s, although important, is not the whole story behind inequality. Secondly, however, when we take into consideration the high rates of inflation per month seen at the time and the size of the estimates presented in Section 3, the impact of bad macroeconomic performance on inequality is considerable. Therefore, the moral to be drawn from the evidence presented is that a stable macroeconomic environment—which is only to be achieved by the implementation of sound monetary and fiscal policies, i.e. a much better institutional framework—is

certainly a *necessary* condition to achieve lower inequality in Brazil²⁷ ²⁸.

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²⁷Singh (2006), Singh and Cerisola (2006), and Santiso (2006) highlight the role of macroeconomic stability in a range of positive economic outcomes in Latin America in general and in Brazil more recently. Furthermore, Carvalho and Chamon (2006) argue that real income growth in Brazil after the reforms of the 1990s has been, for methodological reasons, severely underestimated, which further highlights the importance of macroeconomic stability for improved welfare.

²⁸Although the Brazilian Central Bank has implemented, e.g. inflation targeting in the late 1990s, Carstens and Jácome (2005) argue that Brazil still possesses a central bank that are the *least* independent in the whole of Latin America.

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