Ann Reg Sci (2001) 35:133–152

The Annals of
Regional Science

Economic growth and regional income inequality in Brazil

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Received: April 1996/Accepted: February 2000

Abstract. This paper analyses the evolution of regional inequality in Brazil in the period 1939–1995. Based on a data set organized by the author, indicators of per capita income dispersion among states and regions are presented and their evolution over time is analyzed. The correlation between the regional initial level of per capita income and its growth is considered, testing for Beta convergence. The speed of convergence is calculated in two different forms, the neoclassical model and the coefficient of variation, the later allowing for the analysis of oscillations in inequality over time and its relationship to national economic growth rates. The Kuznetz hypothesis, relating regional income inequality and level of development, is tested. The results indicate the presence of signs of regional income convergence in Brazil, but with important oscillations in the evolution of inequality over time as well as across regions within the country. The association of regional inequality with national income growth produced interesting results, indicating a promising line for future research.

1. Introduction

The subject of regional inequality has gained importance lately with the development of the ''convergence controversy'', associated with the debate about the ideas of the New Theory of Growth or Endogenous Growth Theory. The starting point was the pioneering work by Romer (1986) and Lucas (1988), and more recently a very large number of studies by important economists have been developed and published in leading journals[1]. These studies are concerned with the issue of long-term growth in countries' per

Support from FINEP/PRONEX 41.96.0405.00, NEMESIS – Núcleo de Estudos e Modelos Espaciais Sistêmicos, is acknowledged.
An earlier version of this paper was presented at 42nd North American Meeting of the Regional Science Association International, Cincinnati, Ohio, November 9–12, 1995.

[1] Krugman (1991); Grossman and Helpman (1994); Solow (1994); Romer (1994); Barro (1994); Pack (1994); Barro and Sala-i-Martin (1995), and the special issue of Annals of Regional Science, 32 (1998) 1, to mention only a few.

Map 1. Regions and states in Brazil

capita income and with comparisons between countries' growth trajectories but are also interested in comparing the trajectories of regions within countries.

Brazil is an interesting case to examine, for it has impressive personal and regional disparities in income (see Map 1 for location of regions). As Table 1 below shows, the Northeast region hosts 28.5% of Brazil's population, with a per capita income level of USD 1,836 per year in 1996, while in the Southeast, with 42.7% of the population, per capita income is USD 5,433. The poorest state, Piauí, has a per capita income of USD 1,063 while São Paulo, the richest state, has USD 6,547, or 6.2 times the poorest state per capita income. This situation is the result of a process of economic development that favored the southern states of the country in this century[2]. Some authors have identified a tendency towards deconcentration of income in Brazil in recent years[3] but the results presented in this study do not strongly support this tendency. São Paulo state accounts for over 35% of national GDP since 1949, reaching a peak of 40.2% in 1975; from this year on, the state's share decreased to 35.3% in 1986, having remained around 36% since then, still an impressive proportion considering the state's 2.9% share of national territory.

The decrease in the state of São Paulo's share observed after 1975 is often taken as a sign of spatial deconcentration of income in Brazil. As a matter of fact, a deconcentration process in the neighborhood of this state has taken

[2] See Baer (1995), Chapt. 12 and Willumsen and Fonseca (1996), Chapt 11.
[3] Richardson (1980), Ferreira (1995). For a different view, see Azzoni (1993) and Diniz (1991).

place lately, with adjacent states profiting from São Paulo's agglomeration diseconomies (Townroe and Keen 1984). As an illustration, if the neighboring states of Paraná (South) and Minas Gerais (North) are added, the region's share goes up to over 50%, peaking at 55.3% in 1975, and declining after this year; the striking element in this case is that this region increases its share consistently after 1986. The Southeast region, on the other hand, including the states of São Paulo, Minas Gerais, Rio de Janeiro and Espírito Santo (mostly areas north of São Paulo state, not including Paraná state), shows a declining share in recent years, due mostly to the lasting decline in the economy of the state of Rio de Janeiro. Thus, it seems that spatial economic deconcentration in Brazil is taking place within a very limited portion of the country's territory. In that case, the huge North-Northeast/South-Southeast differences in per capita incomes would not be touched by this process.

Table 1. Population and income in Brazilian regions

Region	Share of national territory (%)	Share of national population (%)		Share of national income (%)		Per capita income (USD of 95/year)	
		1940	1996	1939	1996	1939	1996
North	45.3	3.5	7.2	2.7	5.0	446	2,592
Northeast	18.3	35.0	28.5	16.9	13.5	286	1,836
Piaui State	2.9	2.0	1.7	0.9	0.5	253	1,063
Southeast	10.9	44.5	42.7	63.0	58.1	839	5,443
São Paulo State	2.9	17.5	21.7	31.3	35.3	1,066	6,547
South	6.8	13.9	15.0	15.3	15.8	659	4,318
Center-West*	18.9	3.1	5.5	2.1	4.8	413	3,914
Brazil						593	3,938

* Income figures do not add up to 100% due to the exclusion of the Federal District (Brasília)

The objective of this paper is to analyze regional inequality in Brazil over time, trying to identify how much inequality there is, what are the trends and what is the correlation between the evolution of inequality and economic growth nationwide. It is a descriptive paper, that uses a new database assembled by the author from three different sources, covering different periods[4].

The paper is divided into five sections, aside from this introduction and the concluding section. In Sect. 2 the dispersion of per capita income among states is measured and its trend is analyzed; Sect. 3 deals with the relationship between the initial level of income in each state and its income growth over time, assessing the subjects of absolute and conditional convergence and computing the speed of convergence; Sect. 4 analyses the correlation between convergence or divergence in different sub-periods and the rhythm of economic growth in the country in those sub-periods; Sect. 5 addresses the Kuznetz "inverted U curve" hypothesis that inequality is higher in middle income regions and lower among poorer and richer regions.

[4] For methodological explanations, see Azzoni (1997). The database is available upon request from the author.

2. Dispersion of per capita income among regions: σ convergence[5]

In this section inequality indicators are calculated and their evolution over time is analyzed. The statistical basis consists of state by state data on gross domestic product for the years 1939, 1947–1968, 1970, 1975, 1980, 1985–1995, prepared by different sources and institutions and homogenized by this author. Population data refer to official census results and to interpolations for the years that do not coincide with the census[6]. To avoid the effect caused by the creation of new states during the period, the 1939 political-administrative division of Brazil was used, resulting in 20 states throughout the 1939–1995 period.

One way of looking at income inequality among regions is to observe the dispersion of per capita income around its average. This can be accomplished through the use of the coefficient of variation and Theil's inequality index, since they provide useful ways to stress important aspects in the analysis of regional income inequality. Theil's inequality index is given by

$$J = \sum_{i=1}^{n} \left(\frac{P_i}{P_{br}}\right) \ln \left[\frac{P_i}{P_{br}} \Big/ \frac{Y_i}{Y_{br}}\right] = \sum_{i=1}^{n} p_i \ln j_i \tag{1}$$

with P referring to population, Y to income, the subscripts i to state, br to Brazil and $n = 20$ to the number of states considered.

The results are presented in Table A-1 in the Appendix and Fig. 1. As can be seen, inequality obtains a high value nationwide throughout the period, rising until the mid-fifties and then decreasing until the mid-sixties. In the late sixties a sharp increase is observed until 1975, when there is a downturn until 1986. From then on the index is relatively stable: the level in 1995 is quite similar to that of 1985. Analysis of inequality within regions shows that it is highest in the Southeast region, followed by the Northeast region; the other regions present much lower levels of inequality. The Southeast region over-time behaves similar to the nation, except that it peaks later, in the mid-sixties. The Northeast region presents a stable level of inequality until 1970, to increase impressively until 1990 and then declining in the later years, a behavior that is similar to the North region. In the South, inequality grows until the mid-seventies, and then decreases sharply reaching in 1995, a level below that in 1939. The Center-West region inequality decreases until the late sixties, then increases in the seventies to stabilize around 0.4 in the 90s. Given this differentiated behavior, it is of value to investigate the role of inequality between regions and inequality within states of the same region in the makeup of total regional income inequality in Brazil. Inequality between regions is given by $J_{br} = \sum_{r=1}^{5} p_r \ln j_r$, where variable definitions are the same as before, with subscript r indicating the five sub-regions considered in this study (North, Northeast, Southeast, South and Center-West). Inequality within a specific

[5] This term is used by Barro and Sala-i-Martin (1995) for the variance of per capita income among regions.

[6] For details on income and population data, see Appendix 1.

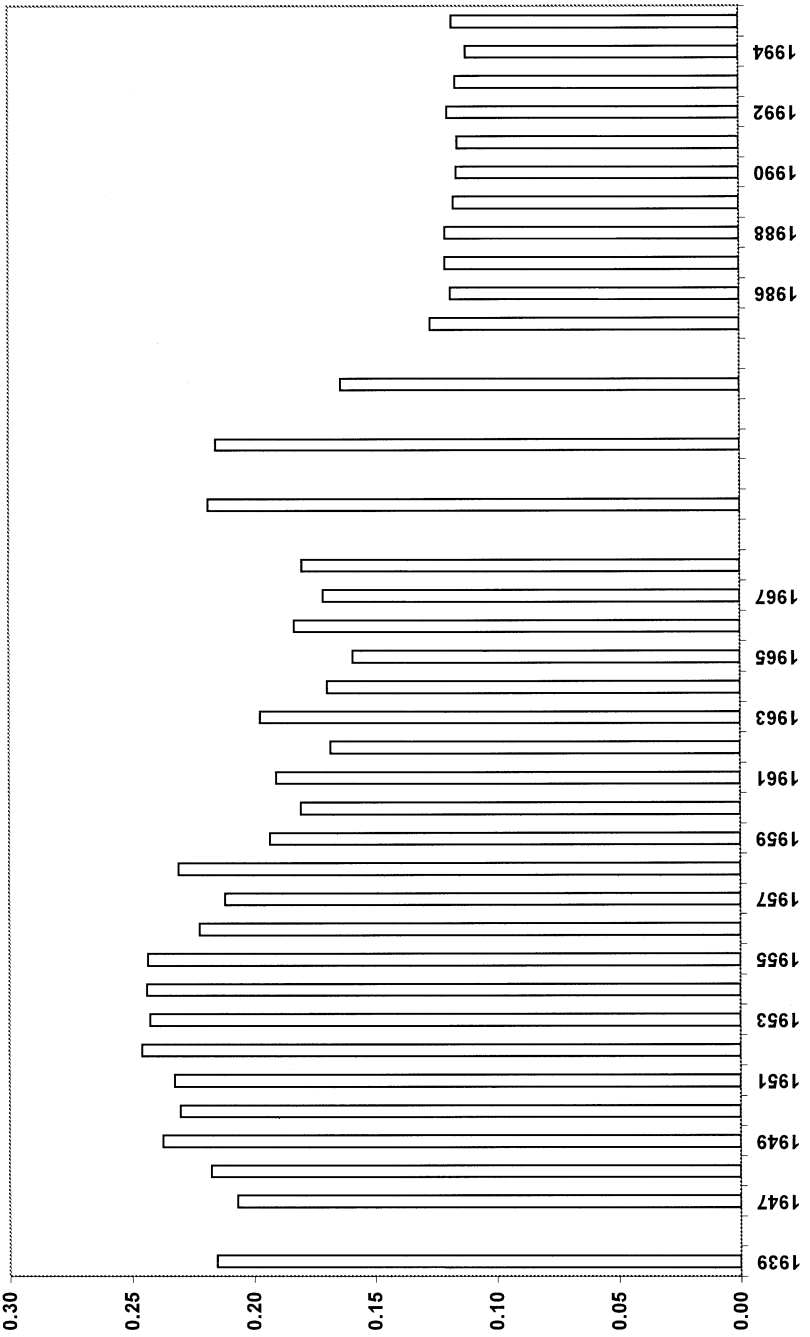

Fig. 1. Theil's inequality index for Brazil

region is given by $J_r = \sum p_{ir} \ln j_{ir}$, with summation over the number of states (i) compounding the region. It can be shown[7] that

$$J = J_{br} + \sum p_r J_r.$$

The results are shown in Table A-1 in the Appendix and Fig. 2. It can be seen that the relative importance of intraregional inequality decreases over time, starting with 38.9% of total inequality in 1939 and reaching 19.8% in 1995. It is interesting to note that the Southeast region accounted for 33.6% of total inequality in 1939 and for only 12.4% in 1995. On the other hand, the Northeast region almost doubled its share, from 3.5% in 1939 to 6.9% in 1995. Thus, it seems clear that the growing equality within the richer states in Brazil is decreasing overall regional income inequality nationwide, while the poorer regions face increasing intraregional inequality. It is also clear that differences between regions play an increasing role, as shown by the increasing importance of the interregional component.

3. Initial level and growth of per capita income

3.1. β convergence[8]

Another way of analyzing the question is by associating the region's initial level of per capita income with the increase in per capita income over time[9]. In terms of the neoclassical model, if all states are converging towards the same level of per capita income, a negative relationship should be observed between per capita income growth over time and the initial level of per capita income in the states. In that case, absolute convergence of per capita incomes occurs. If the regions differ in the parameters that determine their steady state situations (saving rates, degrees of capitalization etc.), each region should be converging towards its own steady state level of per capita income and not to a common level, as in the absolute convergence case. This situation is called conditional convergence[10].

In order to test for the hypotheses of absolute and conditional convergence of per capita incomes in Brazil in the period 1939–1995, regressions were estimated between the rate of growth of per capita income in states and the logarithm of their initial level of per capita income. This was done for the period 1948–1995 (average annual growth rate of per capita income between 1948 and 1995 against the logarithm of the 1948 level of per capita income). In order to avoid undesirable oscillations in yearly figures for state GDP, the average for the years 1948–1950 was used for the year 1948; and the GDP average for 1994–1996 was applied for 1995.

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[7] See Nissan and Carter (1993).

[8] Term used by Barro and Sala-i-Martin (1995).

[9] It is worth noting that the convergence of per capita incomes according to this indicator does not imply a decrease in their variance, as demonstrated by Barro and Sala-i-Martin (1995).

[10] See Barro and Sala-i-Martin (1995) for the development of the neoclassical model that underlines this hypothesis.

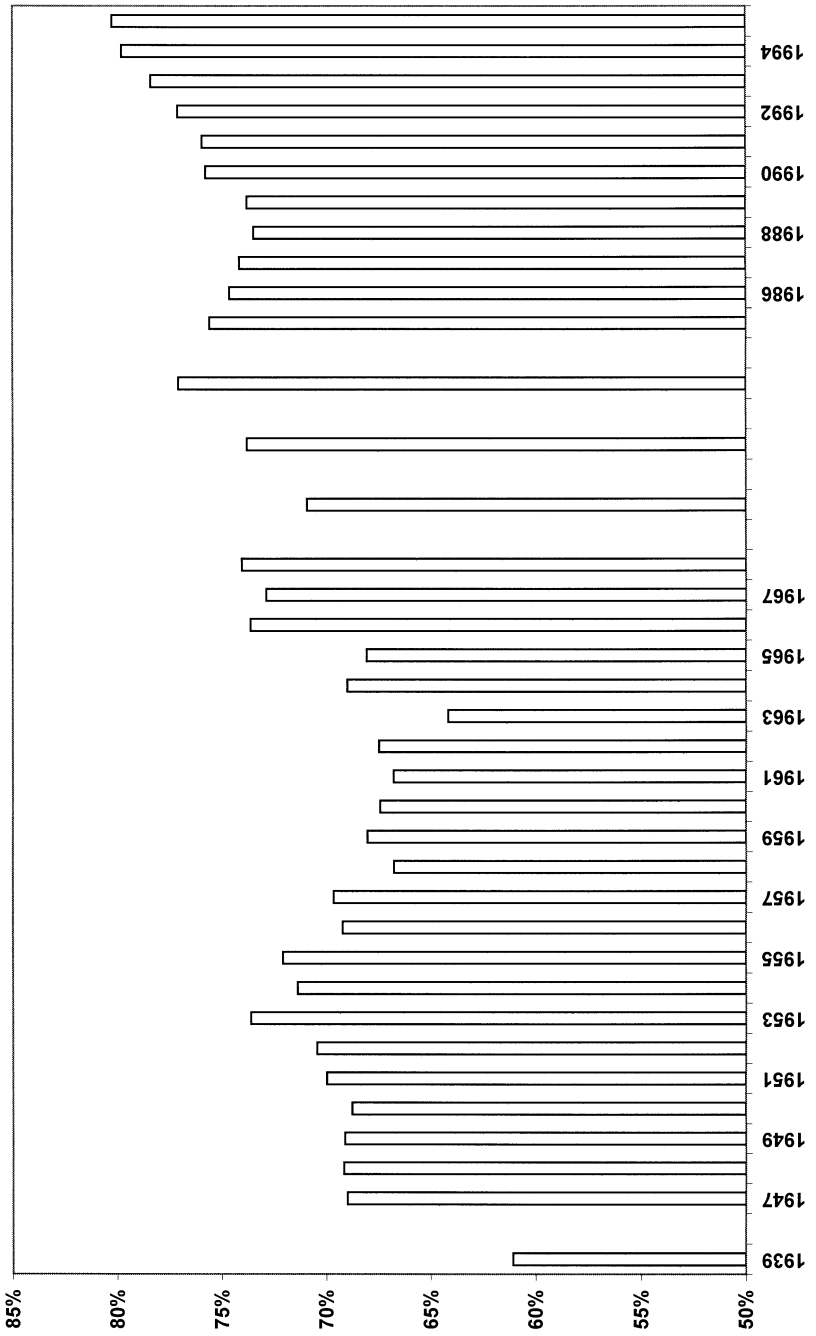

Fig. 2. Interregional share in regional inequality in Brazil

As derived by Barro and Sala-i-Martin (1995), the equation to be estimated is

$$(1/T) \cdot \log[y_{(T)}/y_{(0)}] = a + [(1 - e^{-vt})/T] \cdot \log y_{(0)} \quad (2)$$

with y standing for per capita income, T indicating the length of the period in years from $t = 0$ through T, a is a constant, and v indicates the speed of convergence. The result for the absolute convergence equation is[11]

Dependent variable	*Constant*	*Log of initial income*
Income growth	0.063	−0.0049
	0.0108	0.0017

$R2 = 0.31$; $F = 8.04$; $n = 20$; standard errors below coefficients

As the result indicates, there is evidence of absolute convergence among states in Brazil for the period 1948–1995. As shown below, however, there is significant differentiation among sub-periods within the 1939–1995 period. The same regression covering the period 1939–1970, for example, does not show any sign of convergence, indicating that the equalization of per capita incomes among states in Brazil is a process that took place mainly after 1970. The analysis of the σ-convergence indicators presented in the previous section points to the existence of a pronounced difference between the experiences of the South and Southeast, on the one hand, and the North and Northeast on the other. This indicates that the economies of the North and Northeast may present different steady states from those of the South and Southeast. Thus, when variables identifying their structures are included, it may be possible to observe signs of conditional convergence.

It is difficult to evaluate this hypothesis empirically in the absence of the necessary information, as is the case in Brazil. However, a rough test can be performed by introducing intercept dummy variables that distinguish between different regions of the country in the regressions. The existence of conditional convergence entails observing a negative value for the coefficient of initial per capita income, meaning that the higher the income at the start of the period, the lower the growth during the period, controlling for structural differences between regions. The result for the conditional convergence equation is

Dependent variable	*Constant*	*Log initial income*	*Northeast region dummy*
Income growth	0.0935	−0.0092	−0.0068
	0.0140	0.0021	0.00024

$R2 = 0.53$; $F = 9.64$; $n = 20$; standard errors below coefficients

Although the differentiation among regions was made in a very limited way, it seems clear that the hypothesis that different states are converging towards different levels of per capita income, as defined by the structural differences existing in the parameters that determine their steady state positions, cannot be rejected.

[11] A non linear method of estimation was used, leading to estimated values for v that are independent of the size of the time interval considered.

3.2. Speed of convergence

3.2.1. Neoclassical model

Considering the speed of convergence (v) computed from Eq. (2), the time t necessary for the initial level of per capita income to be half way to its steady state level is $e^{-vt} = 1/2$, or $t = \log(2)/v$. The steady state level is the same for all Brazilian states in the case of absolute convergence and specific to each region in the case of conditional convergence. In the first case, the computed speed of convergence is 0.68% per year and in the conditional case it is 1.29%; this leads to approximately 102 and 54 years to cut regional inequality by the half.

Thus, even considering the most optimistic case, total equalization of per capita income between Brazilian states would take many decades[12]. Similar studies for developed countries indicate faster convergence: American states (1880–1990): 1.74% per year (absolute) and 1.77% per year (conditional); Japanese prefectures (1930–1990): 2.79% absolute and 2.76% conditional; European regions (1950–1990): 1.90% absolute and 1.80% conditional (Barro and Sala-i-Martin, 1995, Chapt. 11). In the Brazilian case, although dealing with periods shorter and covering only more recent years, Ferreira and Diniz (1995), for the period 1970–1985, and Zini (1997), for the period 1970–1994, found higher values for v. The results indicate, thus, that regional income convergence in Brazil is occurring at a lower pace than in developed countries and that the speed is increasing in more recent years.

3.2.2. Coefficient of variation

As the previous analysis suggest, there may be significant differences among sub-periods in the process of regional income convergence in Brazil. Therefore, it is interesting to see how the speed of convergence oscillates over time. Let $CV = \sigma/y_{br}$ be the coefficient of variation of state per capita income levels, with σ standing for the standard deviation of state per capita incomes and y_{br} for the average (national) per capita income. Consider a situation in which per capita incomes for different states are converging towards the average y_{br}. It can be shown that $CV(t) = CV(0) \cdot \exp(-st)$, or $(\ln[V(t)/V(0)])/t = -s$, with s indicating the speed at which convergence is taking place within that period[13]. A negative sign for s indicates divergence of regional per capita incomes in the period; a positive sign indicates convergence.

Since the methodologies used in the calculation of the speed of convergence are different, one should not expect the values estimated by the two methods to be the same. In the first place, the coefficient of variation method deals with absolute convergence, since the assumption is that per capita incomes are converging towards a common level; secondly, the standard deviation does not take into account the absolute size of different states, since it compares per capita incomes regardless of the total income of states; finally,

[12] It should be noted that the relationship between the value of v and the number of years to eliminate income inequality is nonlinear.

[13] See Taylor and Williamson (1994), p. 4, for the demonstration.

Table 2. Speed of convergence by period

Period	Speed of convergence (%/year)	Period	Speed of convergence (%/year)
Longer Period 1939/95	0.24	Sub-period 1970/95	0.49
Sub-period 1939/70	0.04	1970/80	0.54
1939/50	−0.08	1970/75	0.15
1939/47	0.19	1975/80	0.94
1947/50	−0.79	1980/90	0.80
1950/60	0.54	1980/85	1.05
1950/55	−0.05	1985/90	0.56
1955/60	1.12	1990/95	−0.27
1960/70	−0.33	1939/55	−0.07
1960/65	0.43	1955/65	0.78
1965/70	−1.08	1965/75	−0.47
		1975/90	0.85
		1985/95	0.15

it considers only the two end points of the period, without considering oscillations within the period. Thus the information given by the coefficient of variation estimated speed of convergence should be used only as an indicator of the oscillations in the convergence process over time.

The variation in CV was calculated for different sub-periods and the results are shown in Table 2 and in Fig. 3. As can be seen, for the larger period (1939/95) a rate of convergence of 0.24% per year is observed; considering the two large sub-periods (1939/70 and 1970/95), the convergence rates are 0.04% per year in the first and 0.49% per year in the second. Thus, the final result of convergence for the whole period is mainly due to the process of convergence observed in later years. However, even within the first sub-period convergence was observed on occasion (1950–1960), while in the alter sub-period divergence appeared between 1990 and 1995.

4. Regional inequality and national income growth

The previous section showed that regional income inequality in Brazil varied over time, with alternating periods of increase and decrease. It has also been shown that the speed of convergence oscillates over time with alternating periods of convergence and periods of divergence. What reasons can be found for this phenomenon? The candidates for the explanation vary, with explicit regional policies taking first place; unintended spatial consequences of sectoral (non-spatial) policies could play a role too. It is not within the scope of this paper to offer explanations for this, but an alternative possible source will be explored, namely the speed of national income growth. One hypothesis is that in periods of fast demand growth, richer regions are better prepared to face growing demand than poorer regions, since they host the most dynamic sectors in the production structure of the country, their production mix is more diversified, etc. On the contrary, when the national economy slows down, the richer areas could be the first ones to the affected, with the poorer regions becoming involved later on.

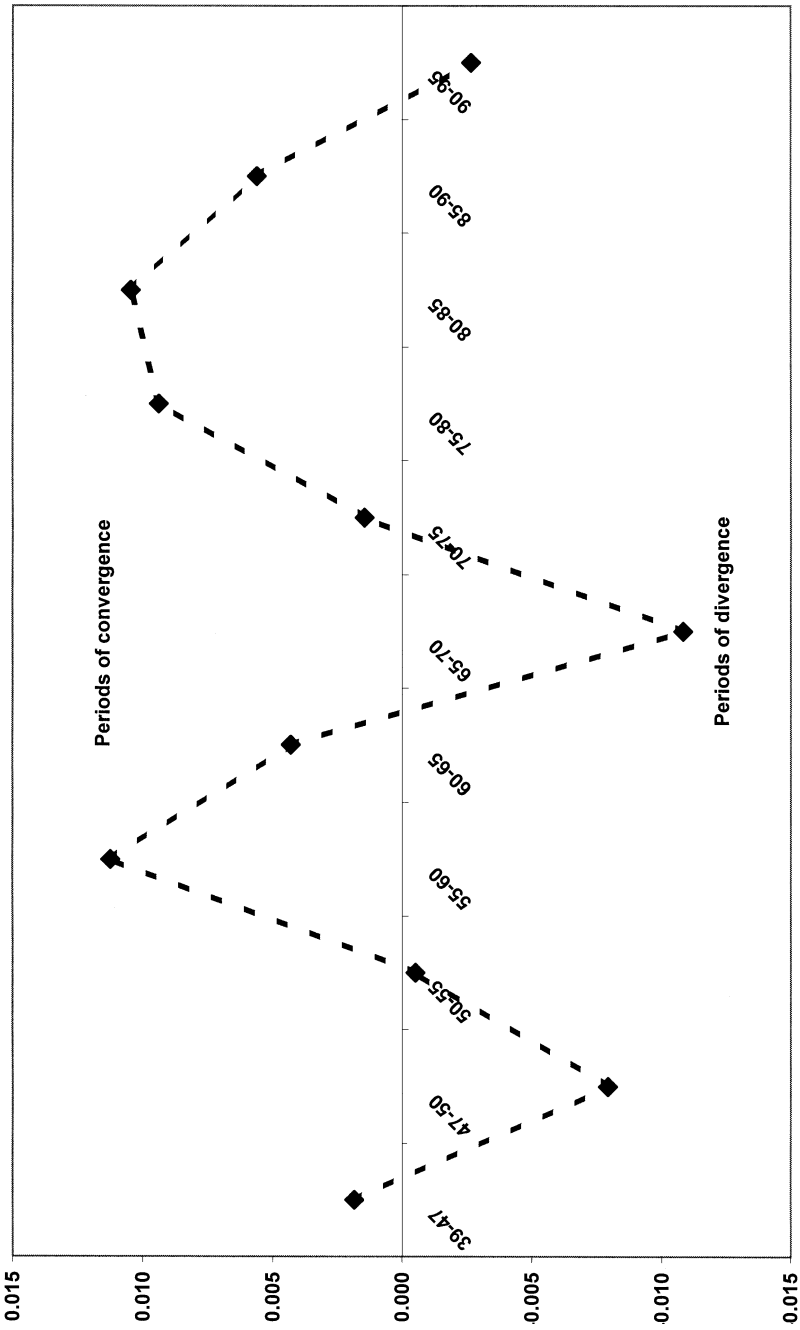

Fig. 3. Speed of convergence by period

In order to investigate this hypothesis, it is interesting to verify whether the sub-periods showing divergence were periods of fast economic growth and sub-periods of convergence were periods of stagnation or slow economic growth. As a first approach, the inequality index at the end of a period was regressed against national GDP growth in the period (data plotted in Fig. 4), leading to the following result:

$$\underset{}{\log J_t} = \underset{(4{,}82)}{0.1137} + \underset{(3.34)}{1.2529}\ \Delta\mathbf{GDP}_{t-1,t}$$

$R2 = 0.58$; $F = 11.19$; $n = 11$; Student t below the coefficients

in which J_t is the inequality index in year t and $\Delta\mathrm{GDP}_{t-1;t}$ is the annual average growth rate of national GDP between year $t-1$ (the beginning of the period) and year t. For the estimation, 11 periods of 5 years were used[14]. As the regression results indicate, the association between national income growth and regional inequality cannot be rejected.

The previous analysis considers the level of inequality at the end of the period in its relation to national GDP growth. Another way to look at the influence of national growth on inequality is to correlate the speed of convergence to the national rate of GDP growth in different sub-periods. This information is plotted in Fig. 5. A regression was estimated between the coefficient of variation speed of convergence displayed in Table 2 to the national rate of GDP growth for the same sub-periods. A visual inspection of Fig. 5 indicates two outlier periods: 1955–1960 and 1975–1980, highly associated with strong policy interventions aiming at reducing regional inequality in the country. Therefore, a dummy variable was applied for those cases, leading to the following result

$$\mathbf{s}_{t-1,t} = \underset{(2.74)}{0.009} - \underset{(-3.01)}{0.174}\ \Delta\mathbf{GDP}_{t-1,t} + \underset{(3.80)}{0.014}\ \mathbf{Dummy}$$

$R2 = 0.68$; $F = 8.58$; $n = 11$, Student t below the coefficients

These results indicate that fast growth periods are not only associated with increases in regional inequality but the speed at which inequality varies is also associated with national income variation: the higher the speed of national growth (decline), the higher the regional divergence (convergence).

This effect can be short lived, for in the longer run national economic growth could lead to decreasing regional inequality. In order to test for that, another regression was calculated, introducing the lagged national GDP variation. The result is

$$\mathbf{s}_{t-1,t} = \underset{(-4.44)}{-0.184}\ \Delta\mathbf{GDP}_{t-1,t} + \underset{(4.11)}{0.165}\ \Delta\mathbf{GDP}_{t-2,t-1} + \underset{(3.98)}{0.012}\ \mathbf{Dummy}$$

$R2 = 0.83$; $F = 16.72$; $n = 11$; Student t below the coefficients

[14] See Fig. 4 for period definitions.

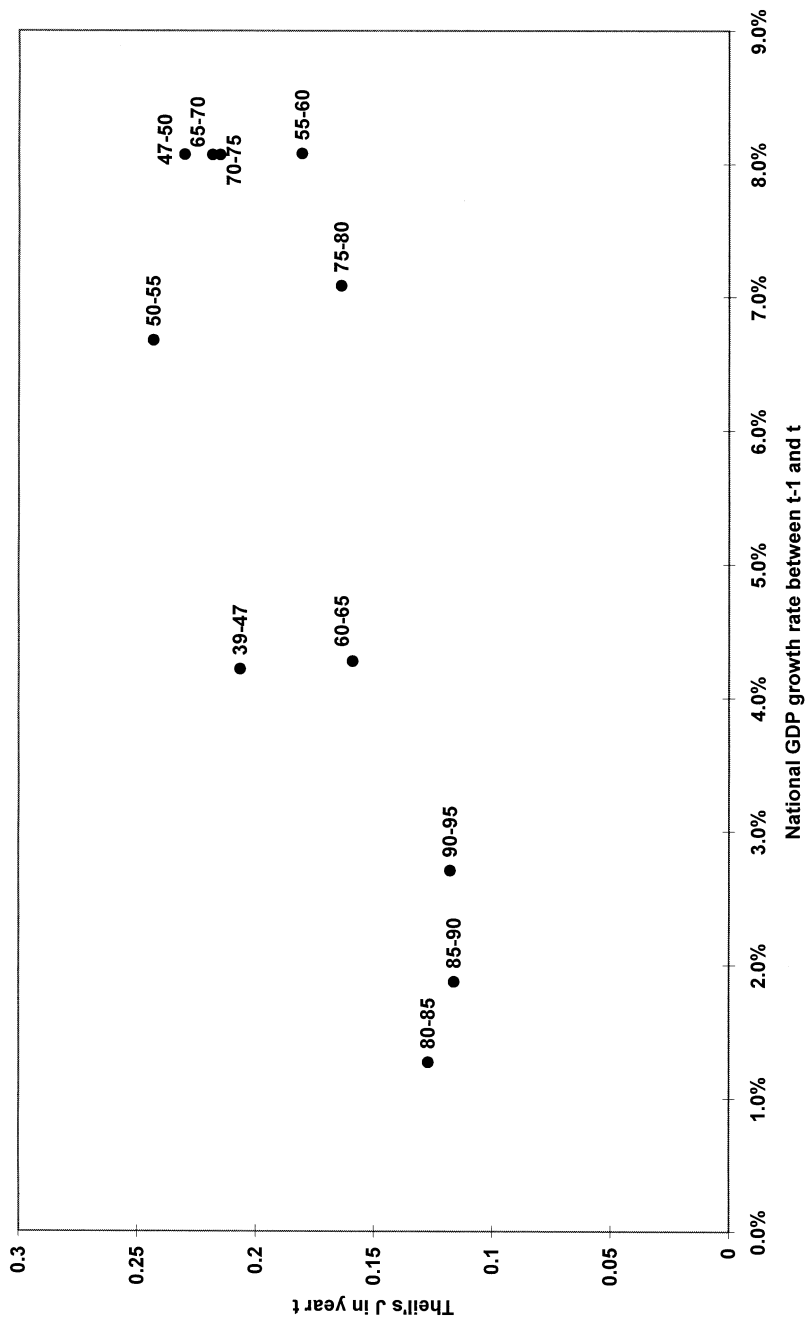

Fig. 4. Inequality and national GDP growth

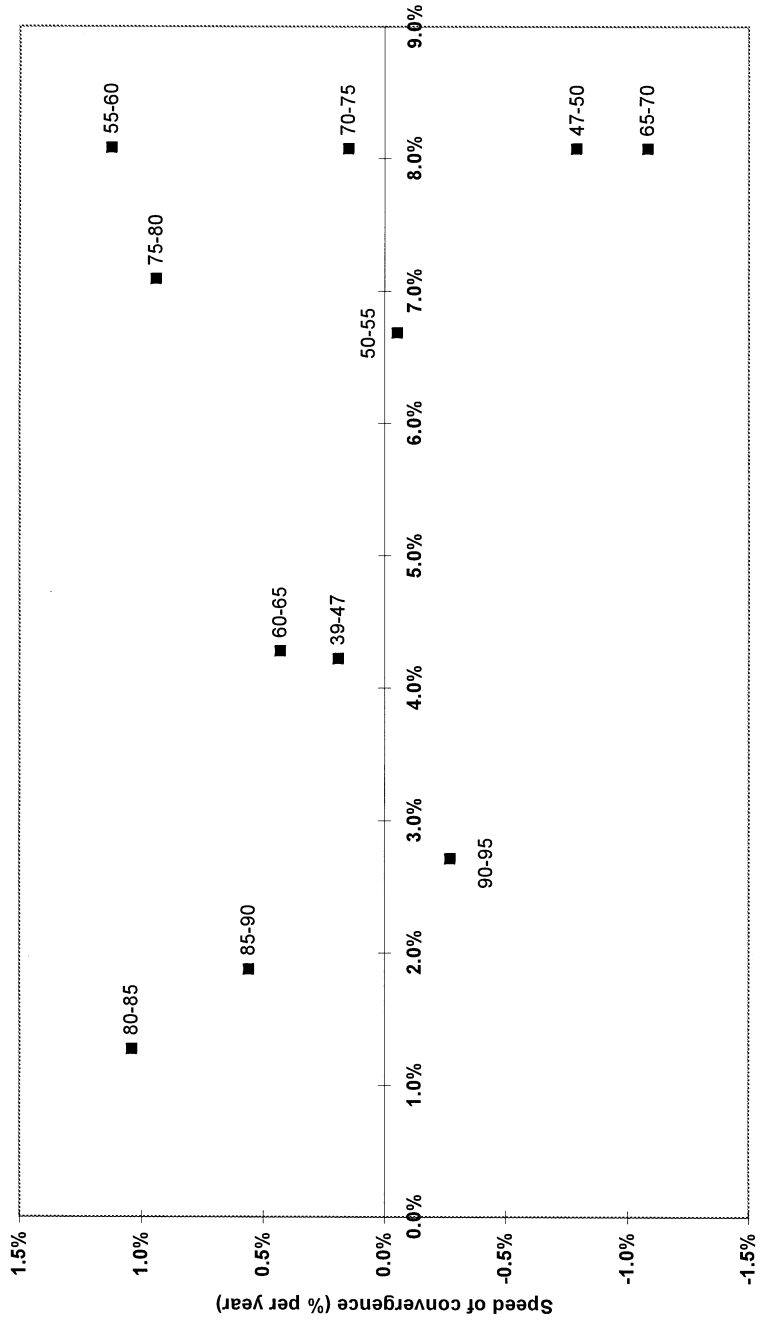

Fig. 5. Speed of convergence and national GDP growth

As the sign and significance of the coefficients indicate, the hypothesis that national income growth produces a decrease in the speed of convergence in the first moment and an increase in the following period cannot be rejected.

6. Inequality and level of development: The Kuznetz hypothesis

Examination of the information presented in this paper indicates that inequality is diminishing within the wealthier regions of the country and increasing within the poorer regions. This is compatible with the idea presented by Kuznetz, with his famous "inverted U curve" or, as labeled by Alonso, "bell-shaped curve", relating inequality and level of development. That being the case, the South and Southeast could have already reached the income level at which inequality among states would "naturally" tend to diminish, while the North and Northeast could still be on the ascending part of the curve.

In order to investigate this idea, the inequality level in the country was regressed against its level of per capita income. Per capita income levels were expressed both in absolute terms and as a percentage of the per capita income of the United States of America in the same year. This procedure takes into account the fact that income figures may mean different levels of development in different historical periods. Expressing income levels in terms of the US per capita income level (or any other relevant point of reference) at the same time, takes into account in a better fashion the idea proposed by Kuznetz, that is, considering the level of development of the country or region. To enhance the analysis, two sets of regions were defined: rich (South and Southeast) and poor (North, Northeast and Center-West); in each year, Theil's inequality index was calculated for states within each region, as well as the per capita income of states comprised in the region; periods of one and five years were considered.

Equation specifications leading to "inverted U" formats were tested for all cases. When national data is utilized, there is no evidence in favor of the acceptance of the Kuznetz hypothesis for Brazil. For absolute values of income, only one specification presented marginally significant results, with all other attempts failing to math standard statistical criteria. The same is true for income relative to US income. In this case, there is even a slight trend towards increasing inequality as Brazilian per capita income levels get closer to US levels, although failing to meet statistical standards.

For the division of the country into rich and poor regions, results are mixed: for absolute income values, there was no equation with significant results, suggesting that there is no evidence in favor of the Kuznetz hypothesis; on the other hand, for income relative to US levels, the Kuznetz hypothesis cannot be rejected, for there is at least one equation specification with significant results, as shown in Table 3. It is worth nothing, however, the second specification for each period in the table (with better statistical quality), leading to a growth of inequality for higher income levels (higher relations to US income levels), corresponding to a reversal in the downward trend postulated by the Kuznetz hypothesis.

It can also be seen in Fig. 6 that internal inequality in the rich regions diminishes throughout the period, except for 1965–1970, when both income and inequality rise ("P_t" refers to the poor region in time t; "R_t" refers to the rich region in time t). In the period 1980–1992, however, inequality stabilizes even though per capita income falls in the region. The poor region presents

Table 3. Tests of the Kuznetz hypothesis.
Equation: Theil inequality index = a + per capita income +

Period	Constant	(y_{br}/y_{usa})	$(y_{br}/y_{usa})^2$	$(y_{br}/y_{usa})^3$	$(y_{br}/y_{usa})^4$	$R2$	F	DW
1 year	−0.0258	1.5915	−5.5067			0.57	44.4	0.68
(74 obs.)	−2.65	9.24	−8.59					
	0.02350	−8.8784	127.88	−670.69	1155.65	0.81	66.1	1.44
	7.36	−7.21	8.30	−8.66	8.5			
5 years		1.0672	−3.3555			0.40	13.5	0.85
(22 obs.)		8.46	−5.62					
	0.2099	−8.1991	122.77	−657.85	1148.95	0.70	10.14	1.92
	2.67	−2.79	3.39	−3.69	3.80			

(second lines show the t statistic values)

less oscillation in both inequality and per capita income. A general increase up to 1980 and a decline since then can be observed, but for intermediate periods the situation is confusing: inequality growth with stable income (50–55, 60–65–70); increase in inequality with growing income (70–75–80) and decrease in inequality with declining income (80–92).

Thus, one can not accept the Kuznetz hypothesis for Brazil when inequality in the country as a whole, as expressed by Theil's coefficient, is regressed against per capita income levels in different years. However, when the country is split into rich and poor regions, there is no evidence for the rejection of the Kuznetz hypothesis in the relative income case. A careful analysis of the points plotted in figures 5 and 6 indicates that rich regions are always on the downward sloping part of the curve and the poor regions are always on the upward sloping part of the curve.

There are thus two different segments of the curve, each embracing different groups of states. This limits the conclusion that can be derived from this analysis, for there is no case of a region pertaining to different segments of the curve at distinct times. Thus, we could be facing two different economic processes that cause poor regions to keep increasing their internal inequality and rich regions to keep diminishing their inequality, instead of a common economic process that leads poor regions to reduce inequality when their per capita income levels increase further. Unfortunately, the exercise developed here is not able to provide answers to this fundamental question, but the results are interesting enough to be presented as a challenge for future development of the necessary explanation.

7. Conclusions

The evolution of regional inequality in Brazil in the period 1939–1995 is analyzed in this paper. Indicators of per capita income dispersion among states and regions were calculated for different years; the correlation between the initial level of per capita income and growth in this variable over time was considered, in order to test for Beta convergence; the speed of convergence was calculated in two different forms, according to the neoclassical model, and the coefficient of variation; the correlation between income growth and

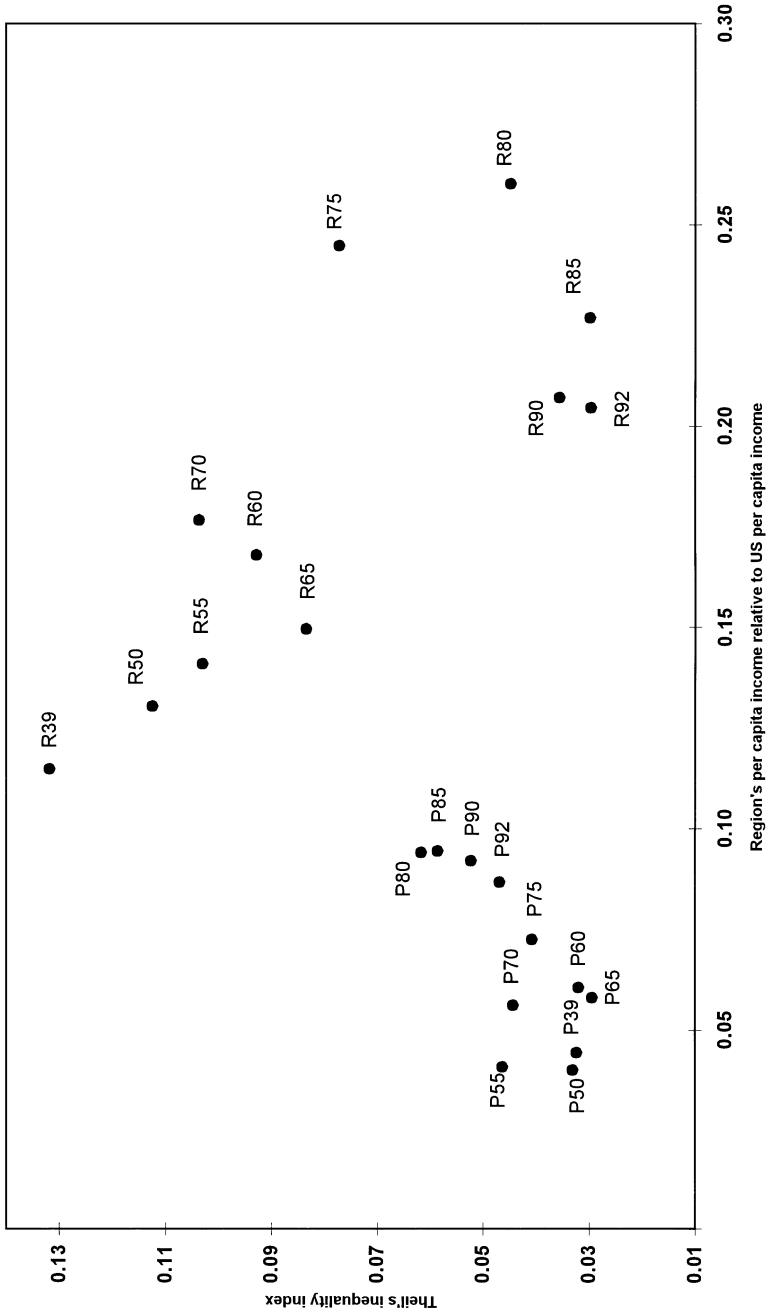

Fig. 6. Inequality and level of development

regional inequality was calculated; finally, the Kuznetz hypothesis, relating regional income inequality and level of development, was tested.

The results indicate the presence of signs of regional income convergence in Brazil, but with important oscillations in the evolution of inequality over time as well as across regions within the country. The association of regional inequality with national income growth produced interesting results, indicating a promising line for future research.

Appendix 1

Income data for Brazilian states, 1939–1995

There are different sources for data on state income in Brazil, that have been created with different methodologies. In this study data was homogenized according to the following procedures:

1. 1939 and 1947–68. Fundação Getúlio Vargas estimated state income without considering intermediate consumption in some important sectors. Therefore, the sum of sectoral figures for a specific state does not match the total figure estimated separately for the same state. The differences arising from the two distinct methods of estimation were proportionately allocated sector by sector, based on an assumption that they are proportional to the state's share of the national production in the specific sector. For example, intermediate consumption in agriculture for state *i* was assumed to be proportional to state *i*'s share in national agricultural production. In other words, it was admitted that the existing differences are proportional to the state's share in that specific sector. The adjustments were made on a sector-by-sector basis and added up at the end. Based on these numbers, the states' shares in national income were calculated and applied to official state GDP (factor cost), estimated separately by Fundação Getúlio Vargas, excluding financial intermediation services (Fibge 1990).

2. 1970, 1975, 1980 and 1985. Official GDP by state (factor cost), estimated by Fundação Instituto Brasileiro de Geografia e Estatística, without imputing the contribution of financial intermediation services (FGV 1971).

3. 1986–95. Estimates of GDP (factor cost) produced by Instituto de Pesquisa Econômica e Aplicada, Ministry of Planning, without imputing the contribution of financial intermediation services (Silva et al. 1995).

The series of state per capita income figures are available upon request from the author.

Table A-1. Interregional and intraregional inequalities in Brazil

	Total		% Inter	Intrarregional					
Year	*J*		Regional *J br*	All regions	North	North-east	South-east	South	Center West
1,939	0.2151	100%	61.08%	38.92%	0.06%	3.50%	33.64%	0.98%	0.73%
1,947	0.2066	100%	69.00%	31.00%	0.13%	4.81%	25.02%	0.29%	0.75%
1,948	0.2175	100%	69.17%	30.83%	0.05%	5.59%	23.78%	0.23%	1.18%
1,949	0.2372	100%	69.12%	30.88%	0.17%	5.72%	23.85%	0.35%	0.79%
1,950	0.2301	100%	68.77%	31.23%	0.06%	5.40%	25.10%	0.59%	0.09%

Table A-1. (cont.)

	Total		% Inter	Intrarregional					
Year	*J*		Regional *J br*	All regions	North	North-east	South-east	South	Center West
1,951	0.2324	100%	69.98%	30.02%	0.09%	6.72%	22.65%	0.54%	0.02%
1,952	0.2458	100%	70.46%	29.54%	0.07%	4.01%	24.18%	0.58%	0.70%
1,953	0.2424	100%	73.62%	26.38%	0.04%	4.72%	20.61%	0.54%	0.47%
1,954	0.2439	100%	71.37%	28.63%	0.02%	5.26%	21.58%	0.97%	0.80%
1,955	0.2433	100%	72.08%	27.92%	0.01%	4.76%	22.29%	0.48%	0.39%
1,956	0.2222	100%	69.21%	30.79%	0.03%	5.32%	23.50%	1.45%	0.49%
1,957	0.2116	100%	69.65%	30.35%	0.004%	5.97%	22.66%	1.18%	0.53%
1,958	0.2307	100%	66.77%	33.23%	0.0000%	8.95%	22.92%	0.60%	0.76%
1,959	0.1932	100%	68.02%	31.98%	0.02%	5.15%	26.04%	0.56%	0.21%
1,960	0.1805	100%	67.42%	32.58%	0.0001%	5.08%	26.43%	0.52%	0.55%
1,961	0.1905	100%	66.78%	33.22%	0.02%	4.56%	27.32%	0.68%	0.65%
1,962	0.1681	100%	67.47%	32.53%	0.01%	4.48%	26.33%	1.22%	0.49%
1,963	0.1971	100%	64.17%	35.83%	0.03%	6.12%	27.85%	1.75%	0.08%
1,964	0.1696	100%	68.98%	31.02%	0.01%	5.46%	23.28%	2.14%	0.13%
1,965	0.1590	100%	68.06%	31.94%	0.02%	5.54%	24.33%	1.89%	0.15%
1,966	0.1831	100%	73.63%	26.37%	0.06%	4.95%	19.77%	1.56%	0.03%
1,967	0.1711	100%	72.88%	27.12%	0.13%	4.83%	20.97%	1.19%	0.00%
1,968	0.1799	100%	74.04%	25.96%	0.09%	4.47%	19.84%	1.56%	0.00%
1,970	0.2184	100%	70.91%	29.09%	0.23%	5.48%	21.09%	2.09%	0.20%
1,975	0.2152	100%	73.79%	26.21%	0.44%	6.03%	18.14%	0.86%	0.74%
1,980	0.1639	100%	77.07%	22.93%	0.56%	8.26%	12.80%	0.85%	0.46%
1,985	0.1269	100%	75.58%	24.42%	1.14%	11.41%	11.18%	0.44%	0.24%
1,986	0.1185	100%	74.62%	25.38%	0.77%	11.49%	12.34%	0.38%	0.39%
1,987	0.1207	100%	74.15%	25.85%	0.68%	10.79%	13.82%	0.24%	0.32%
1,988	0.1206	100%	73.46%	26.54%	0.91%	10.72%	14.11%	0.31%	0.49%
1,989	0.1171	100%	73.78%	26.22%	0.61%	11.42%	13.08%	0.44%	0.67%
1,990	0.1160	100%	75.76%	24.24%	1.02%	8.26%	14.15%	0.41%	0.40%
1,991	0.1157	100%	75.94%	24.06%	0.55%	8.80%	14.09%	0.19%	0.44%
1,992	0.1197	100%	77.10%	22.90%	0.53%	9.44%	12.35%	0.09%	0.49%
1,993	0.1164	100%	78.38%	21.62%	0.50%	8.44%	12.21%	0.08%	0.39%
1,994	0.1121	100%	79.78%	20.22%	0.31%	7.71%	11.77%	0.08%	0.36%
1,995	0.1176	100%	80.24%	19.76%	0.35%	6.89%	12.26%	0.10%	0.16%

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