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THE CONCENTRATION OF INCOME AT THE TOP IN BRAZIL, 2006-2014[1]

Pedro Herculano Guimarães Ferreira de Souza
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1 INTRODUCTION

Extreme inequality in Brazil is self-evident. The historian José Murilo de Carvalho emblematically chose to end his book on the history of citizenship in Brazil with the severe diagnosis that "inequality is the slavery of today, the new cancer that hinders the constitution of a democratic society" (Carvalho 2001, 229). Normative prescriptions aside, not even historical opponents of redistributive policies, such as Mário Henrique Simonsen, failed to recognise—even if reluctantly—income inequality as "undesirably high", and as a source of "pained conscience" (Simonsen 1972, 57; 59).

It is not a coincidence that empirical research on this theme in Brazil has had a rich tradition, since at least the famous 1970s controversy regarding the increase in inequality during the first years of the military dictatorship (Tolipan and Tinelly 1975). More recently, due to the greater availability of information, it has become possible to enrich this literature with data from personal income taxes (*Imposto de renda de Pessoas Físicas*—IRPF) which grant a new perspective of the top of the income distribution (Afonso 2014; Castro 2014; Gobetti and Orair 2016; Medeiros, Galvão, and Nazareno 2015; Medeiros, Souza, and Castro 2015a; 2015b; Morgan 2015; Souza 2014; 2016; Souza and Medeiros 2015).

The purpose of this paper is to summarise and update the analyses by Medeiros, Souza and Castro (2015a; 2015b) and Souza and Medeiros (2015) of the concentration of income at the top and of the distribution of income in general. To that end, we assess the level and trajectory of top income shares—from the 0.1 per cent to the 10 per cent at the top—between 2006 and 2014, and contrast the results against those from the National Household Sample Survey (*Pesquisa Nacional por Amostra de Domicílios*—PNAD) and from the international literature. We then construct income distributions that merge data from the PNAD and the IRPF and compare the level and evolution of the 'adjusted' Gini indexes with the original ones, as well as changes in the respective Lorenz curves.

All of our main findings point in the same direction: notwithstanding the changes that did in fact take place in the middle strata of the distribution of income among adults, the analysis of tax data reveals that the PNAD underestimates the level of inequality and overestimates its

1. This paper was originally published in Portuguese (Souza and Medeiros 2017).

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reduction, at least between 2006 and 2014. The general context was one of stability rather than of redistribution. Top income shares barely budged, while the 'adjusted' income distributions exhibited only modest changes.

Section 2 briefly discusses the advantages of tax data in relation to household sample surveys in capturing information about the richest people; section 3 presents the general outline of the necessary methodological procedures to produce the estimates; section 4 analyses the temporal evolution of the share of income received by the rich; section 5 compares the Gini indexes and Lorenz curves found in the PNAD with the 'adjusted' distributions, which combine PNAD data with IRPF data for the rich; and section 6 summarises our main findings and ponders future perspectives.

2 THE USE OF TAX DATA IN THE STUDY OF INEQUALITY

The IRPF is more than a tool to raise revenue and promote redistribution. It is also a valuable source of information, with great potential to contribute towards greater transparency and a deeper knowledge of society.

Personal income tax data are crucial for the study of income inequality in particular, as they capture the income of the rich better than any other source. In fact, pioneering empirical studies from the end of the 19th century to the Second World War, from Pareto to Kuznets, used the IRPF and similar taxes as their building blocks. More recently, led by Thomas Piketty and associates, social scientists from diverse backgrounds have reclaimed the use of tax data and the focus on the concentration of income at the top of the distribution (see Souza 2016).

There are many reasons for this. After all, household sample surveys—despite their many qualities—have well-known limitations for the purposes of studying inequality. The rich generally have higher unit and item non-response rates; underreporting of top incomes, as well as of business and investment incomes, is frequent; and data processing constraints and concerns about the anonymity of respondents often lead statistical agencies to top-code the income variables (Atkinson, Piketty, and Saez 2011; Canberra Group 2011; Gottschalk and Smeeding 2000; Kennickel 2009; Weinberg et al. 1999). Therefore, most researchers recognise that household sample surveys probably underestimate income concentration at the top (Atkinson, Piketty, and Saez 2011; Hoffmann 1988; Lluch 1982; Medeiros, Souza, and Castro 2015a; 2015b).

Data from the IRPF minimise these and other problems. On the other hand, its main disadvantages—limited coverage, lack of microdata etc.—are relatively less significant, especially for the study of the rich.

3 FROM IRPF TABULATIONS TO MEASURES OF INEQUALITY

Historically, revenue-collecting agencies have always published tabulations extracted from the personal annual income tax declarations (*Declaração Annual de Imposto de Renda de Pessoas Físicas*—DIRPF), grouped by income brackets. More recently, many countries—such as Colombia, Denmark, the USA, the UK and Sweden—have taken a further step and granted researchers access—in varying degrees—to microdata.

Brazil has had income tax tabulations by income brackets since the 1920s. They were almost always released intermittently and spread across various publications (Souza 2016, ch. 4).

After a long break, the Brazilian Federal Revenue Service (*Secretaria da Receita Federal*) reinstated this practice over recent years, publishing annual standardised tabulations from 2007 onwards (Brazil 2016). These tabulations are the basic source material of this article, complemented by data from Castro (2014) for 2006.

The procedures used to transform this information into measures of inequality were practically the same as those used by Medeiros, Souza and Castro (2015a; 2015b) and by Souza and Medeiros (2015), who, in turn, adapted the most common practices in the literature (Atkinson 2007; Piketty 2001; Piketty and Saez 2003; Vélez 2012). Therefore, this section only presents a general outline and discusses minor differences in relation to those works.

Our definition of income comprises all sources declared by individuals to the Federal Revenue. In other words, it is the sum of taxable, tax-exempt and tax-withheld incomes, including work remuneration; pensions and other social security and welfare benefits; rents; profits and dividends; earnings from financial investments; capital gains; and other sources. Incomes are assessed net of corporate income taxes and employers' payroll contributions, but before employees' payroll contributions and personal income taxes, except for some capital incomes taxed exclusively at the source. These incomes represent around 10 per cent of total income.

In Brazil, couples can opt to file their taxes jointly or separately. In this paper, in line with previous works, we consider that tax units correspond to individuals, given that separate declarations are more advantageous for couples with higher incomes. In 2014 almost 42 per cent of the declarations were filed by women (married or not), a value 5 percentage points higher than the one observed in 1998. This figure of 42 per cent is even higher than the participation of women (married or not) among the richest 20 per cent of the population according to individual adult income data from the 2014 PNAD (36 per cent).

Between 2006 and 2014, only around 20 per cent of adults filed annual personal income tax declarations. Therefore, some intermediary steps are necessary to transform the published tabulations in the estimates to the share of income received by strata such as the richest 1 per cent or 10 per cent.

First, we must define a control for the total population. In this paper, we have kept as base denominator the resident population aged 18 or older, according to the 2013 review of official projections by the Brazilian Institute of Geography and Statistics (*Instituto Brasileiro de Geografia e Estatística*—IBGE). This denominator ranges from 125.7 million in 2006 to 144.5 million in 2014. Next, given that tabulations never correspond exactly to the desired strata, some interpolation technique is necessary to obtain the total incomes of these fractiles. We have opted for the Pareto interpolation, following previous studies.

Finally, to convert the absolute income of the rich into top income shares, it is necessary to choose a control or denominator for total income. In this paper, we have applied the formula that Medeiros, Souza and Castro (2015b) term "household monetary income". However, we now use the exact values extracted from the National Accounts, and not the average of roughly two thirds of gross domestic product (GDP). Likewise, we use the most recent macroeconomic data (IBGE 2016). Consequently, our control for income is higher than the one from Medeiros, Souza and Castro (ibid.), and the difference increases with time: in 2006, our denominator is only 1 per cent higher; in 2009, 8 per cent; and in 2012, the last year of the previous work, it reaches 17 per cent.

To estimate the Gini coefficient 'adjusted' by the tax data, it is necessary to merge the latter—which covers only a fraction of the population—with survey data. There are a variety

of methods to accomplish this, whether by combining data (e.g. Medeiros, Souza, and Castro 2015a) or by combining estimates (e.g. Alvaredo 2011; Souza 2016). In this paper, we have adopted the first option, basically replicating the methodology in Medeiros, Souza and Castro (2015a) to build new income distributions by using absolute values from PNAD data for the 'non-rich' and absolute values from the DIRPF for the 'rich'.

Our estimates for top income shares and adjusted Ginis are quite robust to alternative specifications. For the sake of brevity, this article omits the sensitivity analysis, but readers can consult the preceding literature (Medeiros, Souza, and Castro 2015a; 2015b; Souza 2014; Souza and Medeiros 2015).

Finally, it is worth highlighting a particularly important point regarding the comparison of DIRPF data with PNAD data. In this article, we refer generically to 'underestimation' or 'under-declaration' of income in the PNAD, but it is important to clarify that, aside from sampling and non-response issues, this phenomenon can have at least two different causes: the concept of income in the survey and the underreporting itself. In the first case, discrepancies occur because the PNAD deliberately does not collect information about the same sources of income and with the same reference period as required by the DIRPF, such as, for example, the receipt of inheritances and capital gains. In the second case, the information is collected, but for some reason individuals report lower values when interviewed in the PNAD compared to what they report in the DIRPF.

At the moment, there is no way to isolate each cause. We acknowledge, however, that methodological issues must be analysed separately from shortcomings in data collection. Thus, this article does not intend to comprehensively evaluate the quality of income data in the PNAD, or to contrast it against other household surveys in Brazil or worldwide. In this sense, a promising path ahead is to compare the PNAD only with the distribution of gross taxable income in the DIRPF, as these are similar concepts.

4 STABILITY OF INCOME CONCENTRATION AT THE TOP

In accordance with earlier works (Medeiros, Souza, and Castro 2015b; Souza 2014; 2016), there have been no significant changes in income concentration at the top since 2006. Figure 1 shows the shares of total income accruing to the top 0.1, 1, 5, and 10 per cent. The use of revised GDP figures does away with the small increase shown by earlier estimates, but does not alter their main conclusions.

The richest one-thousandth—a group comprising around 140,000 people in 2014—received, on average, over 10 per cent of total income, while the richest 1 per cent received 23 per cent. The 5 per cent at the top received 41 per cent on average, and the top decile received slightly over half of total income.

In short, almost nothing has changed regarding the concentration of income at the top during this period. This conclusion is robust to different control choices for population and income, as demonstrated by Medeiros, Souza and Castro (2015b). The series by Souza (2016) also corroborates these results, indicating that the shares received by the rich have been reasonably stable since the late 1990s and are now at a level close to their historical averages.

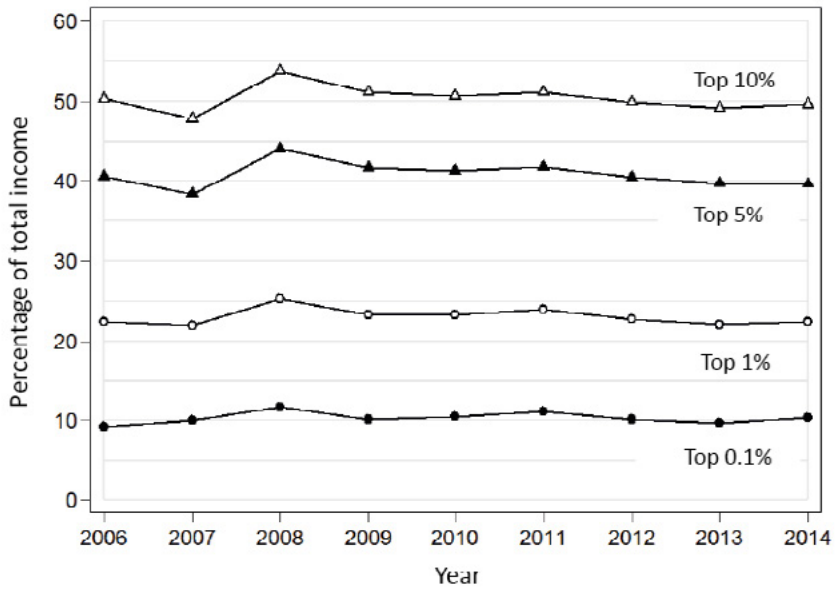
Capital gains are probably the reason tax estimates differ from the declining trend shown by household surveys, as suggested by Medeiros and Castro (2016). Generally speaking, even in the tax data there is some decline in inequality when the definition of income is harmonised with surveys.

The stability of income concentration at the top is worrisome because the levels are too high for international standards. Figure 2 presents the percentages received by the richest 1 per cent and 10 per cent of the population in Brazil and in 28 countries with recent estimates available from tax data. All the usual caveats to international comparisons apply, since tax legislation varies significantly between countries, especially when it comes to the definition of income and tax units. In fact, data for most countries do not include capital gains (except for Brazil, Canada and the USA), which leads to an underestimation of the income of the rich.

Despite these concerns, the comparison highlights the extreme level of inequality in Brazil. The proportion of the total income received by the richest 1 per cent of the adult population lies between 5 per cent and 15 per cent in 24 of the 29 countries, a heterogeneous group spanning from the Netherlands to Uruguay. Only five countries—South Africa, Argentina, Brazil, Colombia and the USA—are above this level. As noted, more than 20 per cent of total income accrues to the top 1 per cent in Brazil, about twice as much as the overall average (12 per cent). .

The conclusions are identical when considering the richest decile. Now, South Africa leads by a large margin, and Brazil and the USA are almost tied in second place. Elsewhere there is only a larger variance, as well as an absence of data for some countries. On average, the top 10 per cent receive 35 per cent of the total income in all countries.

FIGURE 1
Top income shares in Brazil, 2006–2014

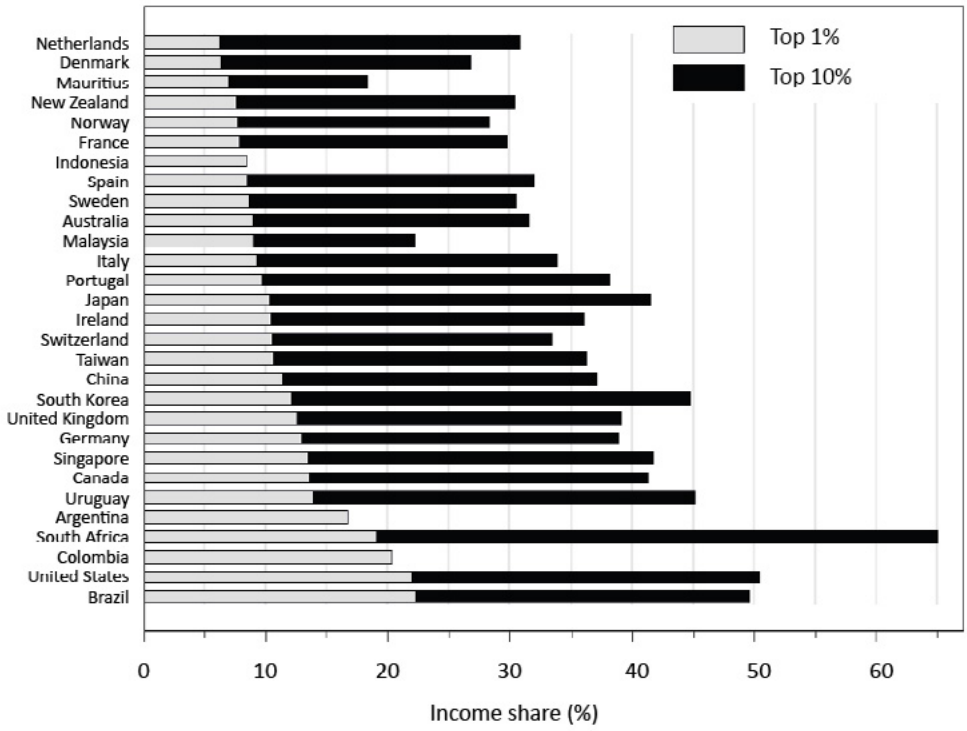


Source: Authors' elaboration using data from Castro (2014); IRPF *Grandes Números* 2007–2014 (Brazil 2016); IBGE, projection of the Brazilian population by sex and age: 2000–2016 (2013 revision); System of National Accounts (IBGE 2016).

Tax data, therefore, not only confirm severe inequality in Brazil and Latin America but also reassert its specific character: the concentration of income among the rich, especially the 1 per cent at the top. Brazil will only reach moderate levels of inequality, such as in Europe, if this concentration at the top drops dramatically. This, in turn, will probably demand policies that promote both fast income growth for the poor and direct redistribution from the top. Unfortunately, we are still far from this reality: there are countless examples of state actions

that reinforce the concentration at the top, such as wage premiums and generous retirement pensions for civil servants, the low share of direct taxation in the gross tax burden, and privileged access to subsidised public credit (Hoffmann 2002a; Medeiros and Souza 2015a; Mendes 2015; Soares et al. 2010; Souza 2016, ch. 6; Souza and Medeiros 2013). Even worse, historical experience dictates that pursuing growth at any cost and expecting it to solve all of our distributive problems has not worked in the past and will hardly work in the future (Souza 2016).

FIGURE 2
Top 1 per cent and top 10 per cent income shares in Brazil and in countries with recent tax estimates, circa 2014



Source: For Brazil, authors' elaboration using data from Castro (2014); IRPF *Grandes Números* 2007–2014 (Brazil 2016); projection of the Brazilian population by sex and age: 2000–2060 (2013 revision); System of National Accounts (IBGE 2016). For other countries, World Wealth and Income Database <http://wid.world/>. Accessed 20 February 2017.

Note: The most recent estimates were used, ranging from 2004 for Argentina and Indonesia to 2015 for China and the USA. For Argentina, Colombia and Indonesia, there are only estimates for the richest 1 per cent of the population.

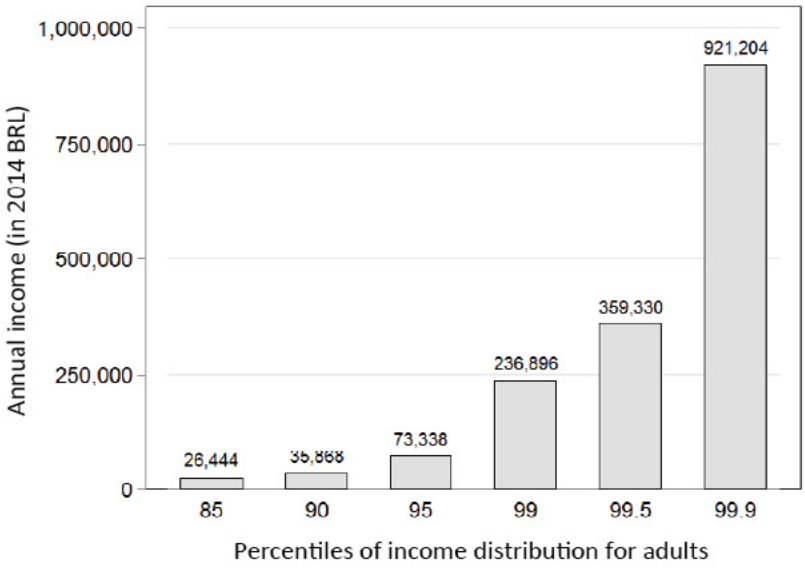
To round out this section and to better outline the profile of the rich, Figure 3 presents annual incomes for various percentiles of the income distribution among adults in 2014. In that year, to be among the richest 15 per cent of the population—in other words, above the 85th percentile—it was necessary to have a gross individual income of slightly under BRL26,500 per year, around BRL2,200 per month. This value is lower than the average income among all adults (BRL29,119 per year), obtained by dividing the control of total income by the adult population. This can be explained by the high degree of concentration at the top and the high number of adults without income.

The minimum income belonging to the top 10 per cent was 36 per cent higher, reaching BRL36,000 per year. From there, values rise dramatically. The 95th percentile registered incomes of over BRL73,000; the 99th percentile, which marks the top one-hundredth, reached

over BRL236,000; and the richest 0.5 per cent earned at least BRL360,000. Finally, the richest one-thousandth comprised individuals with an annual income of at least BRL921,000.

In relative terms, these numbers mean that it was necessary to earn at least 8.1 times the country's average income to be in the top 1 per cent. This value rises to 31.6 times for the top one-thousandth. In Germany, a country with moderate inequality according to Figure 3, these numbers were 4.7 and 17.1, respectively, in 1998, including capital gains (Dell 2007, tables 9G.2, 9H.2 and 9I.3). In other words, they were 40–45 per cent lower than in Brazil, even using comparable definitions.

FIGURE 3
Brazilian adult annual income by selected percentiles, in BRL, 2014



Source: For Brazil, authors' elaboration using data from Castro (2014); IRPF *Grandes Números* 2007–2014 (Brazil 2016); projection of the Brazilian population by sex and age: 2000–2060 (2013 revision); System of National Accounts (IBGE 2016).

Note: The average for all adults, obtained by dividing the control for total income by the control for total population, was BRL29,119, or BRL2,426 per month in 2014, which roughly corresponds to the 87th percentile, according to interpolations.

5 COMPARISON BETWEEN TAX DATA AND HOUSEHOLD SURVEYS

Since the early 1990s, Brazilian household surveys—especially the PNAD—have shown a decrease in inequality, first in the labour market and then, after 2001, in household per capita income (Barros et al. 2006; Hoffman 2002b; Soares 2006). The acceleration of this process, together with the economic recovery in that decade, fostered a series of optimistic interpretations and predictions regarding the country, at least until the outbreak of the economic and political crises of 2014–2017 (Alston et al. 2013; Neri 2007; 2008; Soares 2008).

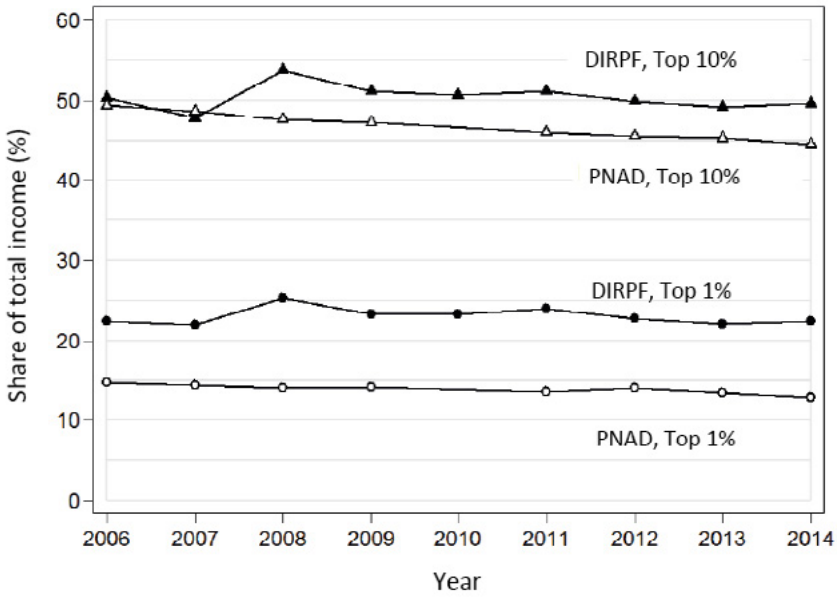
DIRPF data, however, cast doubt over the degree of redistribution observed in the PNAD, as the levels and trajectory of inequality are distinct. This is particularly noticeable when considering the rich. As explained previously, household surveys have many shortcomings when it comes to adequately capturing the highest incomes. Not even the PNAD, a widely known survey whose quality has been recognised, can escape these issues.

With the exception of the Consumer Expenditure Survey (*Pesquisa de Orçamentos Familiares*—POF), sample surveys are limited to capturing regular (monthly) incomes, which excludes predictable incomes, such as yearly bonuses, and irregular incomes, such as capital gains, eventual profits, donations, inheritances and sporadic transfers that, although increasing the net worth of households, are not classified as income. When taken into consideration, these incomes alter the level and trajectory of inequality in the country.

Figure 4 directly compares the percentages of total income received by the top 1 per cent and the top 10 per cent in tax data and PNADs between 2006 and 2014. The discrepancy is easily observed, and becomes especially apparent in the case of the richest 1 per cent, whose share of income is, on average, 9 percentage points higher in estimates based on the DIRPF. This difference is less pronounced when considering the top decile, which suggests that inequality among the rich is also quite understated in the PNAD.

The difference in trajectories is less visible. In tax data, the income share of the top 1 per cent is practically identical in 2006 and 2014 (22.4 per cent). In the PNAD, there is a moderate downward trend, with a reduction of 1.8 percentage points in the same period. The same happens for the top 10 per cent: according to DIRPF data, their income share decreases by a mere 0.7 percentage point when comparing 2006 to 2014; in the PNAD, the reduction is of almost 5 percentage points, which means that these series, which were initially very close, grow further apart over time.

FIGURE 4
Share of total income received by the top 1 per cent and the top 10 per cent of the population according to the DIRPF and the PNAD, Brazil, 2006–2014



Source: Authors' elaboration using data from Castro (2014); IRPF *Grandes Números* 2007–2014 (Brazil 2016); IBGE, projection of the Brazilian population by sex and age: 2000–2016 (2013 revision); System of National Accounts (IBGE 2016)

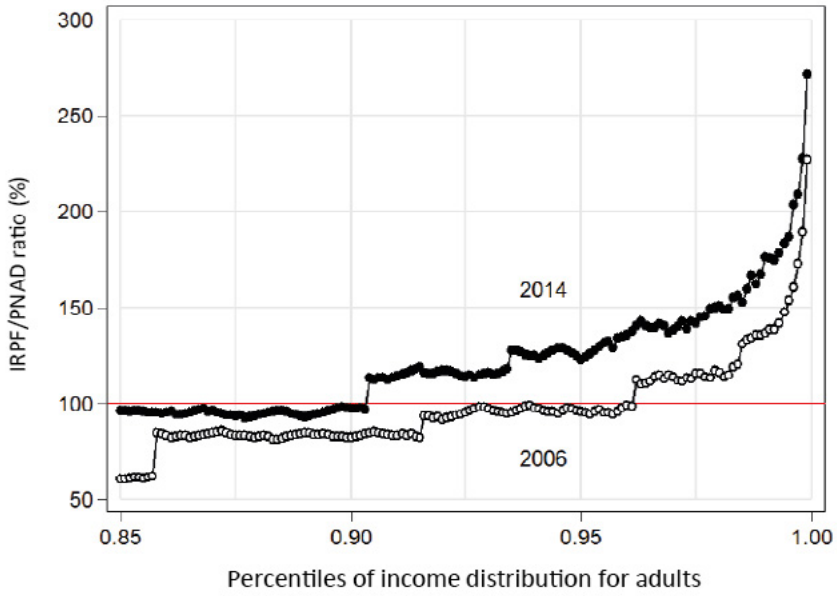
These differences in level and the divergence over time become clearer in Figure 5, which shows the ratio, for every percentile, between the value estimated in the DIRPF and the value observed in the PNAD, multiplied by 100. Therefore, ratios close to the horizontal line equal to 100 suggest that the estimates from both data sources are similar. Values above 100 indicate that results from the DIRPF are higher, and vice versa. For example, in 2006

the estimated value for the 95th percentile was around 5 per cent lower in the DIRPF than in the PNAD, but in 2014 it was 23 per cent higher.

This reveals three important aspects. First, there is an upward trend from 2006 to 2014—the most recent series always has higher ratios, which implies a higher detachment over time between the two sources of data. Evidently, nothing can be stated regarding the pre-2006 situation, and it is outside the scope of this paper to speculate about future trends.

Second, it is clear that ratios increase as we approach the top of the income distribution, including accelerated growth after the 95th percentile. This pattern empirically illustrates the limitations of household surveys in capturing the highest absolute incomes. There is an enormous discrepancy in the highest percentiles. For example, the value of the 99.9th percentile was 127 per cent and 171 per cent higher than the corresponding percentile in the 2006 and 2014 PNADs, respectively. A relevant question hitherto unexplored in international literature is whether this degree of understatement varies significantly among countries and over time. Therefore, it is not easy to evaluate whether the ratios reported in Figure 5 are small or large compared to other surveys worldwide.

FIGURE 5
Ratio between the income of each percentile in DIRPF and PNAD data (PNAD=100), Brazil, 2006–2014



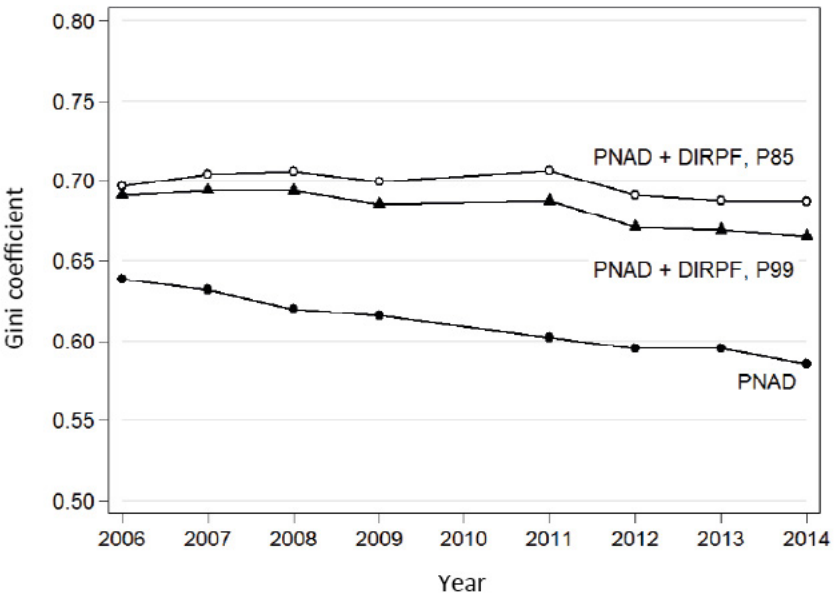
Source: Authors' elaboration using data from Castro (2014); IRPF *Grandes Números* 2007–2014 (Brazil 2016); IBGE, projection of the Brazilian population by sex and age: 2000–2016 (2013 revision); System of National Accounts (IBGE 2016); microdata from PNAD

Third, the figure also shows that it is not trivial to precisely determine the optimal merging point between the two distributions due to changes over time. In other words, the ideal merging threshold depends on income definitions and empirically observed distributions for each year. In 2006, understatement in the PNAD begins after the 95th percentile, but in 2014 the absolute values from the DIRPF already surpass those in the PNAD at around the 90th percentile. In any case, the preference by Medeiros, Souza and Castro (2015a) for the merging point at the 90th percentile is quite reasonable. It is vital to choose a point in the distribution previous to the upsurge of underestimation in

household surveys, which occurs, as said before, more strongly in the last hundredths.

In this light, Figure 6 presents the Gini coefficient of individual adult income originally observed in the PNADs, and the coefficients 'adjusted' by merging with the IRPF distribution at two distinct points—the 85th and 99th percentiles. In other words, the 'PNAD + DIRPF, p85' series contains information from the PNAD for the distribution of income among the poorest 85 per cent of the population and from the IRPF for the richest 15 per cent, while the 'PNAD + DIRPF, p99' series extracts data for the poorest 99 per cent from the PNAD, resorting to the DIRPF only for the gross incomes of the richest 1 per cent.

FIGURE 6
Gini coefficients observed in the PNAD and adjusted with results from the IRPF, Brazil, 2006 and 2014



Source: Authors' elaboration using data from Castro (2014); IRPF *Grandes Números* 2007–2014 (Brazil 2016); IBGE, projection of the Brazilian population by sex and age: 2000–2016 (2013 revision); System of National Accounts (IBGE 2016); microdata from PNAD.

Note: The 'PNAD + DIRPF, P85' series corresponds to the adjustment of incomes starting from the 85th percentile; that is, the data for the poorest 85 per cent of the population come from PNAD, and those for the richest 15 per cent are extracted from IRPF tabulations. The 'PNAD + DIRPF, P99' series alters the absolute values from the 99th percentile, or for the richest 1 per cent of the population.

These merging thresholds illustrate the range of possible adjustments. Other points between these percentiles yield series with intermediary levels which lie between the two curves shown in the figure: the higher the merging points, the lower the adjusted Gini value. As previously stated, the best threshold point would possibly be between the 90th and 95th percentiles. The estimates produced in this manner, however, are much closer to the series merged at the 85th percentile than the one for the 99th percentile. Therefore, we consider the series for the 85th percentile as preferable to the one for the 99th percentile, although this does not necessarily mean that this is the optimal merging point.

Broadly, the adjusted Ginis reinforce the previous findings for the share of income received by the rich: relative to tax data, the PNADs largely underestimate the level of inequality and overestimate its decrease between 2006 and 2014.

The Gini coefficient observed in the PNAD decreases almost monotonically, from 0.639 to 0.585 in the period, an 8 per cent reduction. In the series merged at the 85th percentile, the values are 14 per cent higher on average, and change over time is minimal, almost entirely concentrated between 2011 and 2012. In this series, the Gini starts at 0.697 and ends at 0.687, a mere 1 per cent decrease. For the series merged at the 99th percentile, there is a 4 per cent decline between the initial value of 0.691 and the final value of 0.666, also concentrated between 2011 and 2012.

In sum, the series that combine data from the DIRPF and the PNAD reduce the decrease in the Gini coefficient by half or to very low levels, between 2006 and 2014. These results are substantively identical to those from Medeiros, Souza and Castro (2015a), who used similar methods but different tabulations, and Souza (2016, ch. 5), who used distinct methods, combining estimates and not distributions directly.

It must be said that this does not mean that nothing has changed in the Brazilian income distribution over recent decades. In effect, the results of Souza (2016, ch. 5) indicate that even adjusted Ginis fall sharply and in a prolonged way between the late 1980s and 2006, partly due to the entry of women into the labour market, although the precariousness of data for these years advises caution in their interpretation. Besides, employment income exhibits a decline even in tax data over the years (Medeiros and Castro 2016).

Similar results are found for many other measures of inequality, as can be seen in the comparison of Lorenz curves for distributions of interest. Lorenz curves show the relationship between the accumulated share of total income and the accumulated share of the population, sorted from the poorest to the richest. 'Lorenz dominance' needs to exist to affirm that a distribution (*A*) is unequivocally more equitable than another distribution (*B*)—that is, the two curves must never cross, and the share accumulated by the poorest *x* per cent in *A* must be higher at some point than the accumulated share at the same point in *B*.[3] Lorenz dominance implies that all reasonable measures—i.e. consistent with the properties of the Lorenz curves—lead to the same ranking of distributions in terms of greater or lesser inequality.

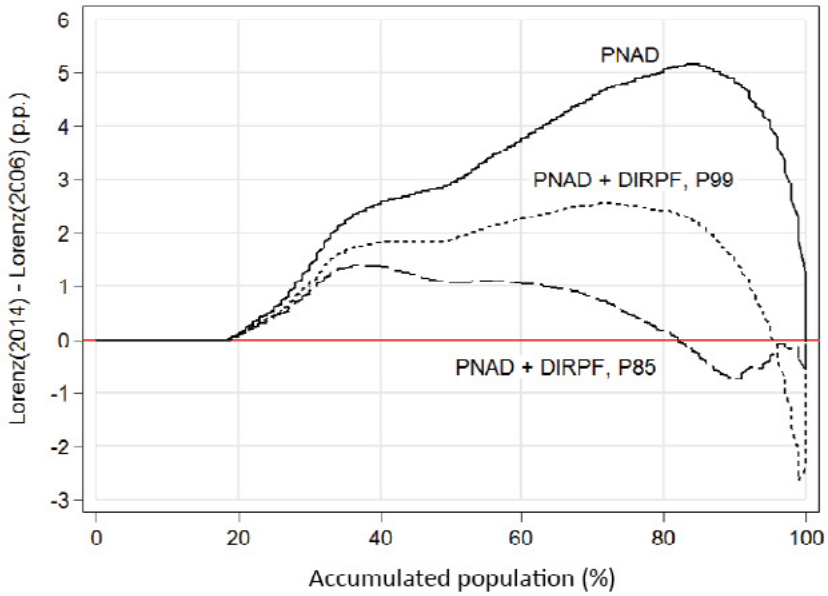
The best way to visually assess the existence or not of Lorenz dominance is by plotting the difference between two distributions. Figure 7 presents the differences between the 2014 and 2006 Lorenz curves for each of the three distributions, that is, each series in Figure 7 compares a distribution in 2014 with itself in 2006. We can only unambiguously conclude that inequality has decreased over time for all reasonable measures if there is Lorenz dominance in 2014 in relation to 2006—that is, if the values of the series in the chart are always non-negative. If a series has both positive and negative values, there is no Lorenz dominance; therefore, it is possible (at least in theory) to find logically reasonable measures of inequality that point to opposite conclusions.

Lorenz dominance is clear in the distributions originally observed in the PNAD: the difference between the 2014 and 2006 Lorenz curves is only nil in the hundredths of the distribution composed of individuals without income. Otherwise, the values are always

3. Formally, the Lorenz curve is given by $y = L(p)$, in which $p \in [0,1]$ is the accumulated share of the population, sorted from poorest to richest. For a continuous variable x, with a probability density function $f(x)$, accumulated density function $F(x)$ and quantile function $F^{-1}(p)$, we have $L(p) \equiv \frac{1}{\mu}\int_{t=0}^{p} F^{-1}(t)dt$, with $\mu \equiv \int_{x=-\infty}^{+\infty} xf(x)dx$. The Gini coefficient is calculated by $G \equiv 2\int_{p=0}^{1}(p - L(p))dp$. The Lorenz dominance of distribution A over distribution B occurs when $L_A(p) \geq L_B(p)$ for every $p \in [0,1]$, with $L_A(p) > L_B(p)$ for a given p.

positive, reaching a max of over 5 percentage points around the 85th percentile. This means that the poorest 85 per cent of the population increased their share of the total income by 5 percentage points between 2006 and 2014; consequently, the richest 15 per cent had a corresponding reduction. Therefore, any reasonable measure of inequality will regard the 2014 distribution as the most equitable, although obviously the extent of change varies across measures. For example, for the Gini coefficient (as previously stated) the reduction was of 8 per cent, while the reduction in the Theil index was of almost 17 per cent.

FIGURE 7
Differences between the 2014 and 2006 Lorenz curves in the PNAD and in distributions combined with the DIRPF, Brazil, 2006 and 2014



Source: Authors' elaboration using data from Castro (2014); IRPF *Grandes Números* 2007–2014 (Brazil 2016); IBGE, projection of the Brazilian population by sex and age: 2000–2016 (2013 revision); System of National Accounts (IBGE 2016); microdata from PNAD.

Note: The 'PNAD + DIRPF, P85' series corresponds to the adjustment of incomes starting from the 85th percentile; that is, the data for the poorest 85 per cent of the population come from PNAD, and those for the richest 15 per cent are extracted from IRPF tabulations. The 'PNAD + DIRPF, P99' series alters the absolute values from the 99th percentile, or for the richest 1 per cent of the population.

None of the distributions that combined data from the PNAD with data from the DIRPF exhibit Lorenz dominance. As expected, the lack of dominance is more obvious in the series merged at the 85th percentile, with negative values starting from the 80th percentile. In effect, not only is the Gini decrease very small, but it is also easy to find alternative measures that show some increase in inequality. For example, the Theil index for this distribution increases around 5 per cent (from 1.06 to 1.11). The series merged at the 99th percentile lies in between, with Lorenz dominance until the 95th percentile. Also in this case, the Theil index registers growth between 2006 and 2014.

Therefore, Figure 7 corroborates the assessment of the evolution of the Gini: the PNAD seems to indeed have overestimated the decline in inequality, which, in the best of circumstances, was minor and ambiguous—if the assumptions and procedures of this paper are accepted. In the worst-case scenario, expressed in our series that uses more data from the IRPF, one can point to stability in inequality, as did Medeiros, Souza and Castro (2015a).

The results, however, allow us to go further. It is evident that the relative stability of adjusted Ginis does not mean that income distribution has remained entirely stagnant. All signs point to the fact that the PNAD is very good at capturing income for most of the population, and, as can be seen, there was in fact redistribution in the intermediary deciles of the income distribution of adults. In general terms, even in the adjusted series the differences between Lorenz curves are positive at least between the 20th and 80th percentiles.

In this way, it is possible to at least partially reconcile the findings of recent Brazilian literature with the results based on the IRPF, as long as one keeps in mind that the changes at the top seem to have been much less significant than previously imagined—if they existed at all—and that it is unlikely that the Brazilian income distribution can improve very much without these changes actually taking place.

6 CONCLUSIONS

No tax is more important for scholars of inequality than the income tax (IRPF). On the one hand, it is one of the best tools available to national governments to exert some influence on inequality and promote redistribution. On the other hand, its very existence and normal functioning tend to produce information about the incomes of the rich that no other source can.

In this article, we have taken advantage of this second aspect to assess the evolution of the concentration of income at the top in Brazil between 2006 and 2014. After all, household surveys all over the world have well-known limitations in correctly capturing the incomes of the rich, and not even the PNAD—the main national survey—is able to avoid these issues. In a country such as Brazil, renowned for its concentration of income at the top of the distribution, this limitation is potentially even more serious.

Hence, we used publicly available income tax tabulations to assess income concentration at the top itself and to 'adjust' the PNAD data and analyse the distribution of income as a whole.

In the first case, we have concluded that top income shares have basically remained stable during the period. The richest one-thousandth of the adult population concentrates, on average, 10 per cent of the country's total income, the top 1 per cent has something between 22 per cent and 23 per cent, and the top decile has over 50 per cent. These values are very high by international standards: although methodological differences preclude an authoritative and definitive ranking of countries, available evidence clearly shows that Brazil is among the most unequal, far ahead of most other countries.

Tax data also indicate that the PNAD significantly underestimates the degree of concentration at the top, while overestimating the redistribution that has occurred over the last few years, at least under a broad definition of 'income inequality'. As with the shares of income received by the rich, the Gini coefficients 'adjusted' by the tax data present rates of decline that are much more modest than was originally observed in the PNAD. In fact, in our most reliable series, the variation of the adjusted Gini between 2006 and 2014 is of only 1 per cent, which constitutes an essentially stable picture.

Lorenz dominance of 2014 over 2006 as seen in the PNAD disappears in the distributions that also take into consideration data from the IRPF. Therefore, it is not possible to categorically state that there was a decrease (or increase) in inequality in these adjusted distributions.

Stability does not necessarily mean stagnation. In effect, there are no reasons to doubt the changes noted in the poorest and intermediary strata of income distribution. Nor does it mean that there was no reduction in the concentration of some types of income, such as employment income. It just so happens that, for a broad definition of income that includes types not captured by the PNAD, the degree of concentration at the top has a significant impact on the overall dynamics of inequality; therefore, we are just as unequal as before.

These results are robust and consistent with previous estimates. They highlight that an inexorable aspect of the high level of income inequality in Brazil is its concentration among the rich, especially the 1 per cent at the top of the distribution.

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