# Income Inequality and Educational Attainment Before and After the Neoliberal 1990s in Brazil

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## Abstract

This article aims to characterize the overlooked relationship between education outcomes and income inequality before and after the neoliberal 1990s in the fifth-largest nation in the world: Brazil. While increasing levels of educational attainment has been toted as the key equalizer to the pervasive income inequality seen over the past centuries, this article finds that after the neoliberal period in Brazil, educational attainment was associated with a diminished relationship with lower levels of income inequality by a reduction of more than seven fold. This article places special attention on the 1990s period as Brazilian privatization spilled over into schools on every level. By leveraging an Ordinary Least Squares model with state-level fixed effects and interaction terms, the author finds an important relationship previously uncharacterized.[1]

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# 1 Introduction

The global trend of neoliberalism in the late 1980s to 1990s was characterized by mass deregulation, privatization, and market liberalization.[12][2][?][3] Across the planet, this change in economic structure had important implications on the environment, social welfare programs, profit in the private sector, and democratic outcomes. Brazil was no different than the global community at the time, and under the presidencies of Fernando Collor de Mello (1990-1992) and Fernando Henrique Cardoso (1995-2002), Brazilian policy was in line with the themes of the neoliberal period. Brazil has always been a country characterized simultaneously by an abundance of natural resources and an unfortunate seemingly unmovable threshold for high income inequality and wealth disparity. In Brazil's major cities such as São Paulo, Rio de Janeiro, or Bahia, this wealth disparity is famously visible, with Brazilian *favelas* directly adjacent to some of the wealthiest gated communities in the country. *Favelas* are low-income neighborhoods who have receives their name from the Brazilian "favela" vine, which can climb up nearly any rock—signaling favelas' tendency to be informal housing units built on top of one another in a dangerous but artful fashion.

This article explores the relationship between educational attainment in the neoliberal period and income inequality in Brazil by state, as previous literature has notably not explored this relationship. Specifically, this article answers the following research question: How did the relationship between educational attainment and income inequality change in Brazilian states before and after the 1990s period of neoliberalism? This article focuses on educational attainment since it is one of the most pervasive social welfare indicators within countries and is simultaneously historically one of the strongest road maps to economic mobility. Thus, investigating the relationship between educational attainment and income inequality before and after this specific period will highlight whether the global trend of increased education was blunted by cuts to funding for public education. The article analyzes educational attainment at the primary school level, the secondary school level, and the university level.

To explore this relationship empirically, this article utilizes an Ordinary Least Squares (OLS) model with interaction terms and state-level fixed effects. The dependent variable is a self-constructed Gini coefficient for each state, and the independent variables of interest are interaction terms between Post-1990 observations and Average Educational Attainment Levels for a state. The Gini coefficient is a statistical measure of income inequality that ranges from 0 (indicating perfect equality) and 1 (indicating total inequality).[18][4] The model

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[2]Kotz, David M. (2015).
[3]
[4]Reis, Eustáquio (2014).

controls for urbanization rate, as it is postulated that more urbanized states will have higher average education attainment rates. The model also includes fixed effects on the state level to control for everything constant over time but variable between states. This article utilizes data from the Brazilian Census in the years 1970 to 2010.

The results of the empirical model suggest that while generally higher rates of average educational attainment at the university and primary school level were associated with lower income inequality, the effect was in fact blunted in the post-1990 period in comparison to the pre-1990 period. For example, a one percentage point increase in the population's share of university-educated individuals is associated with a .00694 decrease in the Gini Coefficient of a given state in a year after 1990, whereas in the pre-1990 period, a one percentage point increase in the population's share of university-educated individuals is associated with a .05120 decrease in the Gini Coefficient of a state. Secondary-level educational attainment's relationship with income inequality presented an inverted pattern: higher levels of secondary-level educational attainment for states were associated with higher levels of income inequality, a perplexing finding discussed in further detail in Section 7.

This article contributes to the literature on the impact of the economic structure of neoliberalism on income inequality, but fills the need for increased literature characterizing the relationship between neoliberal policies in Brazil, specifically those that increased the privatization of higher education, and regional income inequality. This article opens further avenues for future research because its results indicate a consequential change in the assumed relationship between educational attainment and income inequality in the economic theory of developing nations.

This article begins with a brief historical background on Brazil's political climate, economy, and education system in Section 2. Section 3 outlines the existing literature and the gaps that this article begins to fill. Section 4 discusses the data the article uses. Next, Section 6 presents results and interpretations. Section 7 concludes and discusses key takeaways.

## 2 Historical Background

Politically, Brazil has faced many regime changes over past centuries, from the Brazilian Republic (a liberal and oligarchical structure lasting from 1889 to 1930), to Vargas' 1930 Revolution (a corporatist dictatorship in 1930), to decades of import substitution industrialization (ISI), democratic presidencies from 1945 to 1964, a right-wing military dictatorship in 1964, before finally returning to democracy in 1980.[4][5] Since 1980, the country has faced volatile political and economic movements, rarely seeing periods of stability– including the

[5]Bucciferro, Justin R. (2020)

jailing of the Worker's Party leadership and members of many executives of Brazil's state-owned enterprise and engineering companies on counts of corruption in 2014.[15][6][14][7] Notably, one of the top officials who was jailed in the persecution of the Worker's Party in 2014 was recently reelected to the Brazilian presidency in 2019, a move that highlights the instability of democracy in Brazil. Consistent with economic theory, countries lacking political stability develop slower than their stable counterparts, and Brazil's economy has reflected this political instability in the form of volatility in various indicators. This article focuses specifically on the Brazilian economy from 1970 to 2010, so it will be useful to remember the major events within Brazil as the article progresses.

Economically, the period from 1950 to 1980 was seen as somewhat of a "golden age" of growth and public investment[19][8], followed by a "neoliberal age" characterized by a collapse in public investment and significantly slowed growth. In the 1980s, Brazil, along with many other Latin American countries, experienced "The Lost Decade", a period of economic crisis and stagflation. After an oil shock in 1979, Brazil faced a severe debt crisis and the government responded with extensive austerity measures, which culminated into one of the largest recessions in Brazilian history to date.[9][9][3][10] Then, in the 1990s, Brazil followed the Washington Consensus and the Paris Plan[15][11][][12][5][13] to a series of neoliberal reforms including budget deficit restructuring, privatization, liberalization of foreign direct investment, and tax reforms, along with many others.[6][14][8][15] The 1994 Plano Real, an extensive executive policy aimed at targeting the hyperinflation that the real (the Brazilian currency) was experiencing, introduced an era focused primarily on fiscal responsibility in economic policy within Brazil. Brazil saw moderate growth from 1994 to 2003, and then accelerated growth from 2003 to 2013.[15][16][22][17]

Inequality within Brazil at the state level also varied greatly throughout this time.[10][18] Brazil experiences a North-South divide economically that dates back to the colonial empire.[24][19] In colonial times, northern Brazil was the economic center and was therefore much richer

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[6]Medeiros, Carlos Aguiar De, and Nicholas Trebat(2021).

[7]Martuscelli, Danilo Enrico (2017).

[8]Serrano, Franklin and Summa, Ricardo (2019)

[9]De Oliveira, Fernando C. and Coelho, Suani T.(2017).

[10]Bogliaccini, Juan Ariel (2013).

[11]Medeiros, Carlos Aguiar De, and Nicholas Trebat (2021).

[12]Weiss, Martin A.

[13]Cheng, Gong and Diaz-Cassou, Javier and Erce, Aitor (2019).

[14]Chhibber, Ajay, and Victoria M Elliott.

[15]Aguiar de Medeiros, Carlos (2009).

[16]Medeiros, Carlos Aguiar De, and Trebat, Nicholas(2021).

[17]Tiryaki, Gisele Ferreira and Teixeira, Diego Nunes and Araújo, Vinícius Ferreira De(2019).

[18]Fox, Louise M. (2024).

[19]Pereira, Zamberlan and Augusto, Thales (2020).

and further developed than the south, while the south was underdeveloped and impoverished. Bucciferro and Ferreira de Souza (2020) present evidence that this trend inverted during Brazilian industrialization towards the south being richer than the north. Brazilian industrialization was the time that slavery was abolished and the dire need for labor led to the Brazilian government encouraging vast numbers of European immigrants to enter São Paulo, the largest city in southern Brazil at the time and currently the largest city in all of South America– likely due to the changes during this time period.[4][20] The shift to São Paulo being the industrial capital of Brazil had massive ramifications for the wealth distribution of Brazilians, and the north remains poor relative to the south.[2][21]

There were major changes to the Brazilian education system during the period of analysis. Brazilian education was established as a universal right that should be protected and promoted by the government in the 1988 constitution, a development that took place well into this period of study. This is likely why, as will be seen later in this article, every level of educational attainment grew over time. Primary school, secondary school, and public universities are free for Brazilian citizens, and after the 1988 constitution, primary school became compulsory for all Brazilians. There also exist many private schools at all levels.[21][22]

# 3 Literature Review

## 3.1 Neoliberalism and Income Inequality

Given this article's interest in income inequality on the state-level's relationship with neoliberalism, it is relevant to explore the existing literature on neoliberalism in other countries. As Quiggin (1999) argues in his article about neoliberalism's impact on inequality in Australia, neoliberalism exacerbates inequality through the mechanisms of less progressive tax structures and the reduction of social welfare systems that primarily benefit the poor. His article also argues that neoliberalism has reduced job security for workers as outsourcing increases.

Additionally, Quiggin analyzes how changes to labor markets under neoliberalism generally favored high-level, skilled employees over unskilled workers, raising managers' wages while reducing lower-tiered employees' wages, evidently resulting in heightened inequality. Neoliberal policies have also weakened unions and therefore the bargaining power of low-skilled workers in the labor market. Arguably, this can also be seem in the counter-movements previously discussed within Brazil's Worker's Party. Finally, Quiggin argues that

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[20]Bucciferro and Ferreira de Souza (2020).
[21]Baer, Werner (1986).
[22]Stanek, Cristina (2013).

income security over the long-term has been reduced for all workers and has thus worsened inequality for everyone within Australia.[17][23]

Jeffry G. Williamson (1965) is a seminal article that relates economic policy and development to income inequality even further. His article underlines the importance of understanding income inequality on a regional level rather than generalizing to a country level. His article also offers mechanisms for understanding income inequality changes over time, most importantly for the current article being governmental policies and capital migration.[23][24]

This article contributes to this literature by studying the relationship between educational attainment and income inequality in the pre- and post-neoliberal periods. Education was greatly impacted by neoliberalism, especially in a country like Brazil in which privatization of industries also extended to the privatization of schools.[13][25] The role of neoliberalism on education, and further on income inequality, is understudied, and this article aims to begin to characterize this hole in the literature.

## 3.2   Education and Inequality

Kátia Regina de Souza Lima[13][26] explores how neoliberalism affected higher education, ultimately concluding that austerity measures and privatization have eroded academic rights and public funding. She argues that these reforms, along with market-driven outcomes, have increased tuition costs and made education less accessible to marginalized groups. In total, de Souza Lima argues that in the neoliberal world order, education became a commodity, not an equalizing social lever.

Sokoloff and Engerman (2000) wrote arguably one of the most important pieces to the discussion of developing countries' income inequality, exploring deeply how colonial legacy still pervasively affects the outcomes of post-colonized states. In summary, on the topic of education's role in pervasive inequality, Sokoloff and Engermen conclude that post-colonial limitations on educational opportunities worsens income inequality.[20][27]

In a piece specifically exploring education's role in income inequality efforts, David Coady and Allan Dizioli explain that improving educational outcomes theoretically blunts increasing income inequality over the medium-term horizon as it can break the intergenerational transmission of poverty as well as blunt inequality of opportunity, both of which reduce future income inequality. The article explores a traditional human capital model to substantiate these claims with economic theory, and uses corrective econometrics (dynamic panel

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[23]Quiggin, John (1999).

[24]Williamson, Jeffry G. (1965)

[25]de Souza Lima, Kátia Regina (2019).

[26]Regina de Souza Lima, Kátia (2019).

[27]Sokoloff and Engerman (2000)

estimation techniques) to show an even stronger positive relationship between education inequality and income inequality.[7][28] This result further motivates this article because it demonstrates the relationship that exists between education inequality and income inequality, and thus strengthens the results found in this article suggesting that in Brazil 1990, Brazilian education's relationship with income inequality changed.

## 3.3 Brazilian Inequality

In María Gómez León's 2021 article, "The Kuznets Curve in Brazil, 1850-2010" Léon uses social tables and household surveys to verify Kuznets' (1955) article on Economic Growth and Income Inequality in Brazil. The Kuznets Curve theory postulates that income inequality in developing countries first increases as the country develops, then decreases, resulting in an inverted U-shaped curve. Léon's article finds that Brazil followed a long Kuznet Curve from 1850 to 2010, implying that Brazil in the period this article focuses on experienced lessening income inequality and thus further supports the aim of this article to characterize income inequality within Brazil.[11][29]

In his 2024 article on South American income inequality, Pablo Astorga compares major South American countries' patterns of income inequality from 1920-2011. Astorga also uses social tables to construct his Gini coefficient measure and finds that even countries with similar colonial histories have markedly different patterns of income inequality changes.[1][30]

# 4 Data

For this article, the full count censuses from 1970-2010 in Brazil sourced from Integrated Public Use Microdata Series (IPUMS) International are utilized. This amounts to 112,124,065 observations and 23 variables at the individual level that are transformed into state-level data for each census year (1970, 1980, 1991, 2000, and 2010). Individuals are only kept in the sample if they are between the ages of 16 and 64 (as this analysis aims to characterize the working-age population) and if they have reported their income in the census. For the educational attainment variable, unknown and not-in-universe observations were dropped. It is possible that observations who were not in universe or unknown were more likely to have been individuals without any formal schooling, but there is no reason to believe that this bias would be worse in some years than others, so the observations were voided to proceed with analysis. The final state-level data is thus 125 observations that are means for each of

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[28]Coady and Dizioli (2017).
[29]León, María Gómez (2021).
[30]Astorga, Pablo (2024).

the 25 states in their respective census year (1970, 1980, 1991, 2000, or 2010) of the following variables.

Using the individual total reported income variable ("inctot"), a Gini coefficient is constructed for each state in each census year using "ineqdeco," a Stata module that calculates inequality indices according to subgroups. This index is used as the key dependent variable of interest. Then, a dummy variable is created that equals one if the observation is after 1990 and zero if the observation is before 1990. An urban/rural rate is constructed for each state measuring the proportion of observations residing in urban versus rural areas. Educational attainment rate variables are calculated as the proportion of observations in each state that have finished less than primary school, primary school, secondary school, or university. These categories are mutually exclusive and sum to one, so they can be considered as one dummy variable in conjunction. Individuals who are currently in school at the time of the census but are younger than is required to have finished university schooling are counted as having not finished university, which may slightly bias my university completion rate downwards, but there is no reason to believe that this bias would be worse in some states than others.

Table 1: Summary Statistics

| State | Gini $\mu$ | Gini SD | U $\mu$ | U SD | S $\mu$ | S SD | P $\mu$ | P SD | <P $\mu$ | <P SD | Freq. |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Acre | 0.523 | 0.073 | 0.027 | 0.028 | 0.107 | 0.095 | 0.173 | 0.093 | 0.693 | 0.210 | 340,000 |
| Alagoas | 0.566 | 0.042 | 0.025 | 0.020 | 0.096 | 0.072 | 0.158 | 0.096 | 0.720 | 0.188 | 1,898,318 |
| Amapá | 0.521 | 0.062 | 0.032 | 0.033 | 0.158 | 0.124 | 0.252 | 0.086 | 0.557 | 0.226 | 236,867 |
| Amazonas | 0.544 | 0.053 | 0.026 | 0.024 | 0.142 | 0.108 | 0.217 | 0.091 | 0.616 | 0.216 | 1,444,057 |
| Bahia | 0.586 | 0.037 | 0.023 | 0.019 | 0.121 | 0.095 | 0.165 | 0.095 | 0.691 | 0.207 | 9,061,400 |
| Ceará | 0.599 | 0.031 | 0.026 | 0.021 | 0.117 | 0.095 | 0.174 | 0.100 | 0.683 | 0.215 | 4,922,353 |
| Distrito Federal | 0.591 | 0.044 | 0.103 | 0.063 | 0.221 | 0.102 | 0.271 | 0.054 | 0.405 | 0.202 | 901,370 |
| Espírito Santo | 0.560 | 0.028 | 0.041 | 0.036 | 0.154 | 0.100 | 0.215 | 0.094 | 0.590 | 0.225 | 2,009,935 |
| Goiás, Tocantins | 0.560 | 0.048 | 0.035 | 0.034 | 0.133 | 0.104 | 0.214 | 0.104 | 0.618 | 0.236 | 4,139,925 |
| Maranhão | 0.544 | 0.074 | 0.015 | 0.017 | 0.103 | 0.090 | 0.161 | 0.104 | 0.720 | 0.210 | 3,727,770 |
| Mato Grosso do Sul | 0.555 | 0.051 | 0.039 | 0.037 | 0.125 | 0.100 | 0.211 | 0.100 | 0.624 | 0.232 | 2,733,940 |
| Minas Gerais | 0.572 | 0.026 | 0.041 | 0.034 | 0.134 | 0.090 | 0.203 | 0.094 | 0.620 | 0.215 | 13,219,617 |
| Paraná | 0.552 | 0.046 | 0.048 | 0.043 | 0.143 | 0.101 | 0.204 | 0.098 | 0.605 | 0.238 | 7,259,539 |
| Paraíba | 0.584 | 0.029 | 0.033 | 0.025 | 0.105 | 0.083 | 0.157 | 0.088 | 0.704 | 0.196 | 2,822,200 |
| Pará | 0.550 | 0.055 | 0.022 | 0.017 | 0.112 | 0.083 | 0.208 | 0.096 | 0.658 | 0.192 | 3,362,349 |
| Pernambuco, Arquipelago | 0.594 | 0.025 | 0.035 | 0.023 | 0.127 | 0.088 | 0.187 | 0.091 | 0.651 | 0.201 | 5,523,707 |
| Piauí | 0.576 | 0.051 | 0.021 | 0.025 | 0.095 | 0.077 | 0.158 | 0.093 | 0.726 | 0.193 | 2,196,949 |
| Rio Grande de Norte | 0.578 | 0.027 | 0.032 | 0.026 | 0.127 | 0.102 | 0.183 | 0.098 | 0.659 | 0.223 | 2,061,069 |
| Rio Grande do Sul | 0.546 | 0.031 | 0.050 | 0.035 | 0.151 | 0.097 | 0.242 | 0.091 | 0.557 | 0.220 | 7,371,347 |
| Rio de Janeiro | 0.564 | 0.028 | 0.071 | 0.038 | 0.194 | 0.100 | 0.262 | 0.065 | 0.473 | 0.197 | 9,147,934 |
| Rondônia | 0.524 | 0.069 | 0.024 | 0.026 | 0.105 | 0.092 | 0.190 | 0.095 | 0.681 | 0.209 | 635,268 |
| Roraima | 0.515 | 0.058 | 0.030 | 0.031 | 0.140 | 0.123 | 0.232 | 0.090 | 0.597 | 0.224 | 157,507 |
| Santa Catarina | 0.508 | 0.044 | 0.045 | 0.043 | 0.144 | 0.107 | 0.221 | 0.092 | 0.589 | 0.234 | 3,814,477 |
| Sergipe | 0.575 | 0.040 | 0.028 | 0.027 | 0.114 | 0.088 | 0.182 | 0.092 | 0.676 | 0.204 | 1,213,317 |
| São Paulo | 0.545 | 0.019 | 0.066 | 0.046 | 0.176 | 0.103 | 0.238 | 0.080 | 0.520 | 0.221 | 21,922,850 |
| Brazilian Total | 0.557 | 0.049 | 0.038 | 0.035 | 0.134 | 0.092 | 0.203 | 0.090 | 0.625 | 0.207 | 112,124,065 |

These summary statistics are all (with the exception of the final column) proportions of the state's given measurement over the five total census years. Gini denotes the state's gini coefficient, "U" is the state's university completion proportion, "S" is the state's secondary school completion proportion, "P" is the state's primary school completion proportion, and "<P" is the state's less than primary school completion proportion. The final column is the raw count of observations for each state over all five included years.

In Table 4 columns 3 and 4, summary statistics for the share of the population in each state that finished university over the five census years are displayed. Clearly, university completion rates are more variable among states than income inequality measures are, with some states having less than one percent of their populations completing university in some years to some states having more than 10 percent of their populations completing university in some years. This variation is further shown in the average across Brazil (found by looking at the last row: "Brazilian Total" 3.8% across the five census years with a standard deviation of 3.5 % between states. This variation in university completion rates is shown in Figure 3 in green, where one can observe that from 1970 to 2010, university completion rates on the country level increased notably.

Columns 5 and 6 show summary statistics for the percentage of the population in each state that finished secondary school over the five census years. There is still significant variability regionally in Brazil in secondary school completion rates, with the range of completion rates being around 9% to 22%. While higher on average than the university completion rate for Brazil, 13.4% compared to 3.8%, the standard deviation in secondary school completion rates are still higher between states at the secondary level with a standard deviation of 9.2%. This is also illustrated in Figure 3 in yellow, where secondary school completion rates clearly increase significantly over the 50-year period.

In columns 7 and 8, similar statistics are shown for primary school completion rates. The range is still large: from around 15% to 26% across the five census years. The average for Brazil is 20.3% and the standard deviation between states is 9%. Represented in Figure 3 in red, primary school completion rates across Brazil clearly similarly increase significantly over the 50-year period.

Columns 9 and 10 show the remaining educational completion rate category: observations with less than primary school completed. Functionally, this category is treated as a "no formal education" variable, so it predictably shows much higher levels than our formal education variables: ranging from around 40% to 73%, averaging 62.5% for Brazil and obtaining a massive standard deviation of 20.7%. However, Figure 3 shows in blue that the proportion of Brazilians without formal education drastically reduced over the 50-year period analyzed.
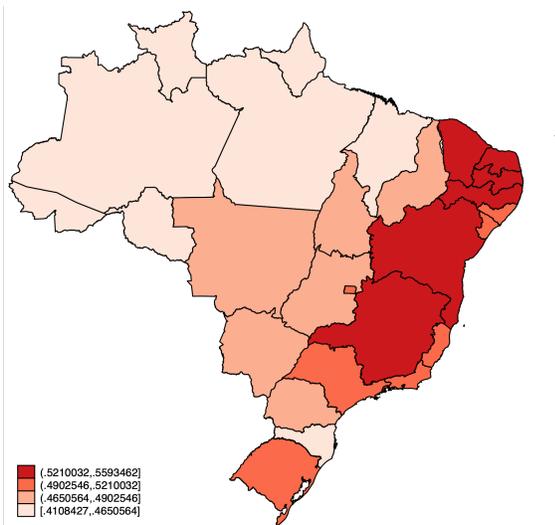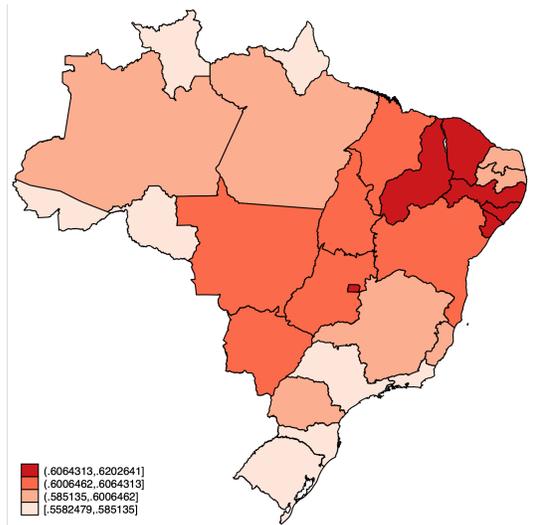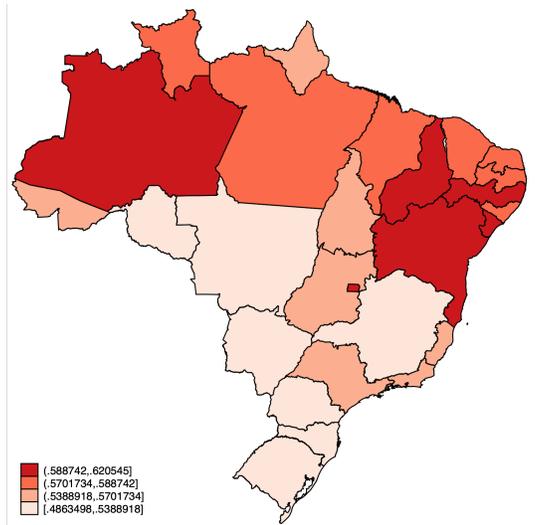
(a) 1970
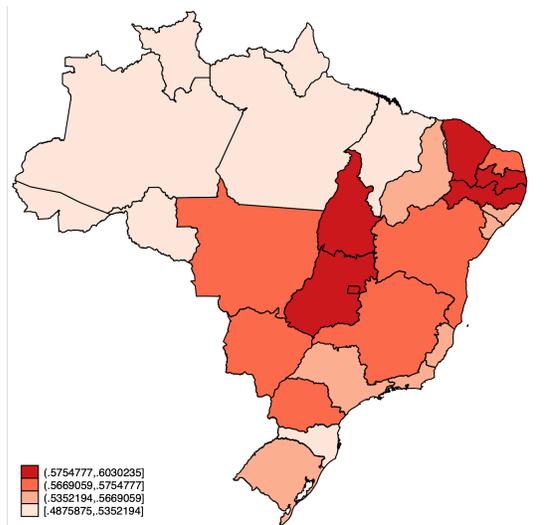
(b) 1980

(c) 1990

(d) 2000

(e) 2010

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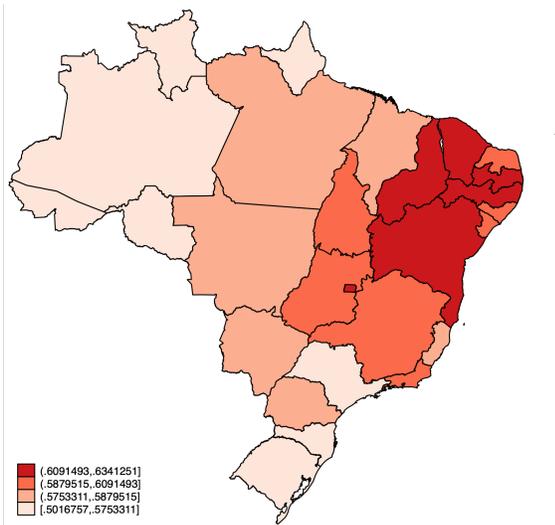
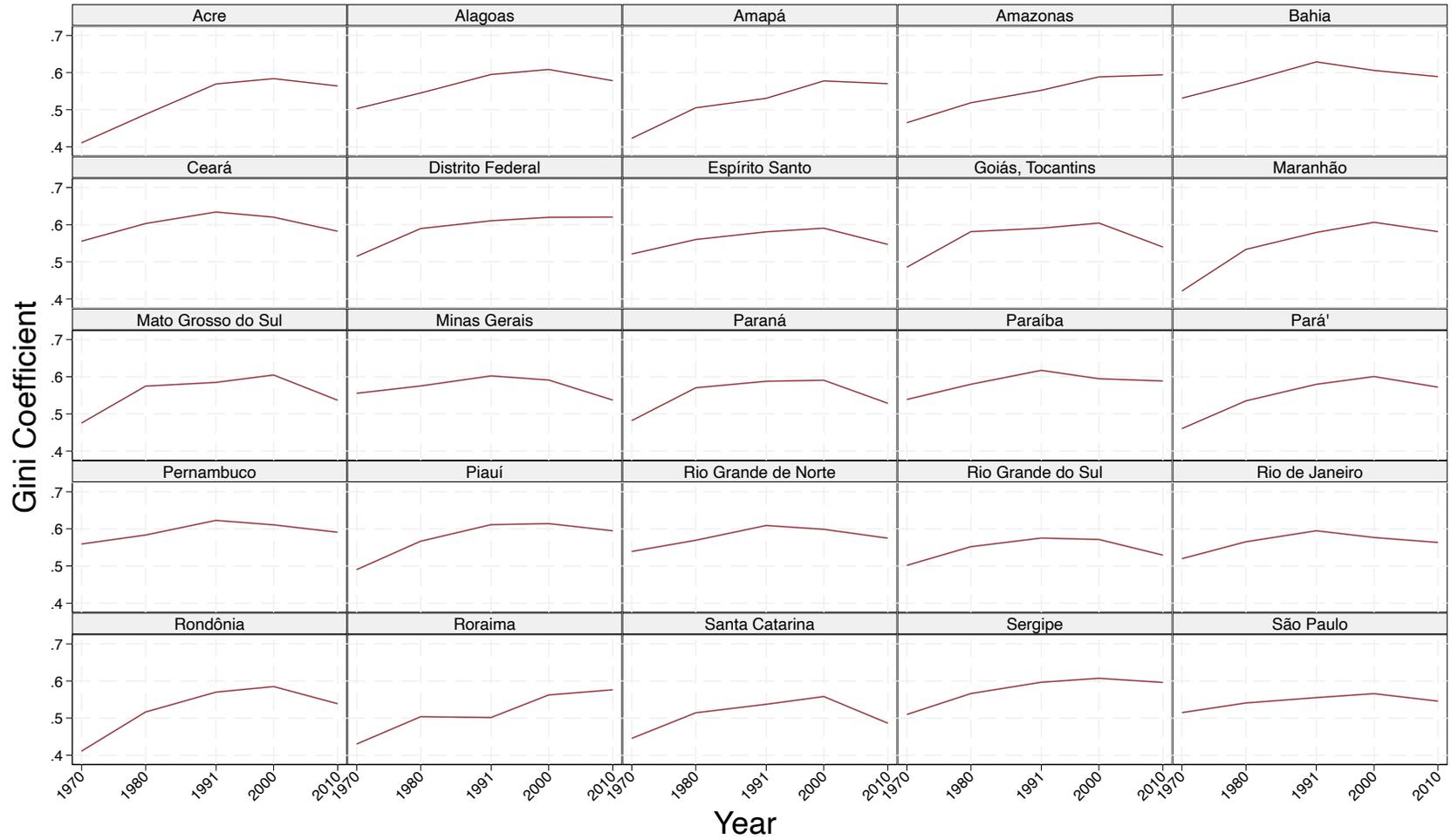Figure 1: Heat Maps of Gini Coefficients Over Time

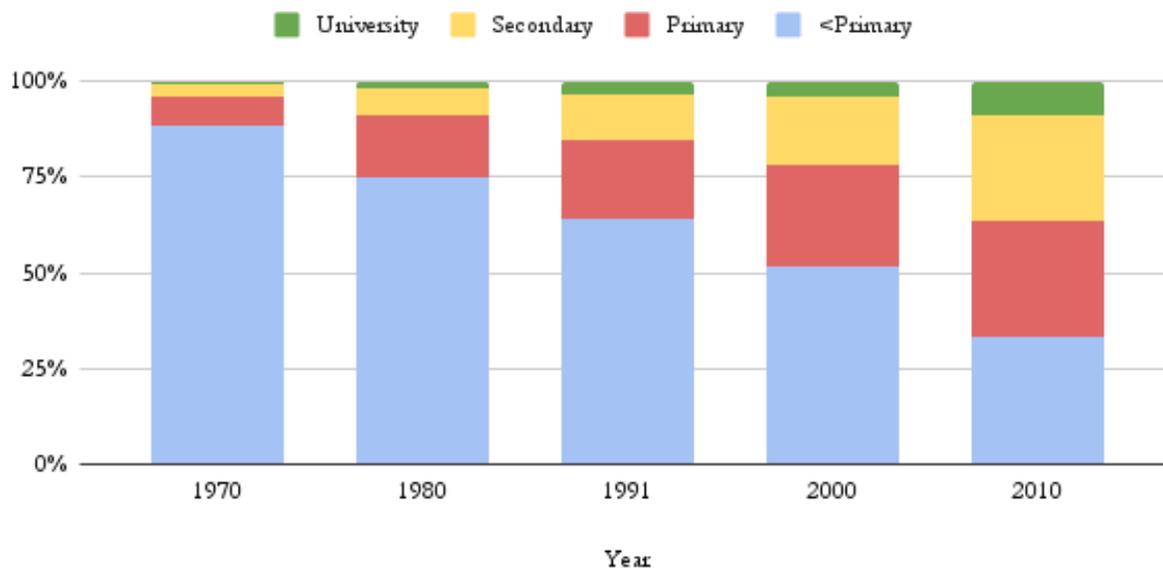Figure 2: Income Inequality by State from 1970-2010

Figure 3: Brazilian Education Levels Achieved by Year

As can be seen in Figure 1, Table 4 columns 1 and 2 and Figure 2, inequality, measured by the Gini Index variable, differs greatly between states and regions over time. Since much of Brazil's population is concentrated on the eastern coast, it follows that some of the worst inequality over time can also consistently be seen on the coast. One noteworthy change over time is the northwestern most state, Amazonas, whose inequality worsened considerably over the 50 years pictured in the heat maps. Generally, the inequality indexes across states averaged over time (seen in Table 4) ranged from 0.5-0.6, with an average of 0.557 and a standard deviation of 0.049, which is considered to be a very high inequality marker.

Overall, Figure 3 displays educational attainment on the country level by year to illustrate the changes in demographics across the time period this article examines. There is an evident increase in all levels of educational completion within Brazil. With this figure's trend, if one believed education to be an equalizing force for income inequality, one would expect income inequality to also reduce at a similar rate. However, in Figure 2 the overall trend is increasing, rather than decreasing, income inequality across states. For Brazil in total, the Gini coefficient in 1970 was 0.491, 0.553 in 1980, 0.585 in 1991, 0.594 in 2000, and 0.565 in 2010. This shows that income inequality increased in every census year except 2010, where it slightly decreased but was still at a level of extreme income inequality.

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Figure 4 displays the urban population's density across Brazil. There is great variation in the percentage of urban dwellers between Brazilian states.[16][31] As previously noted, much of the Brazilian population is concentrated on the eastern coast of Brazil, which is also clearly associated with higher inequality as Figure 1 indicates. Therefore, the inclusion of this percentage as a control variable helps refine results to be more targeted at the variable of interest: educational attainment.
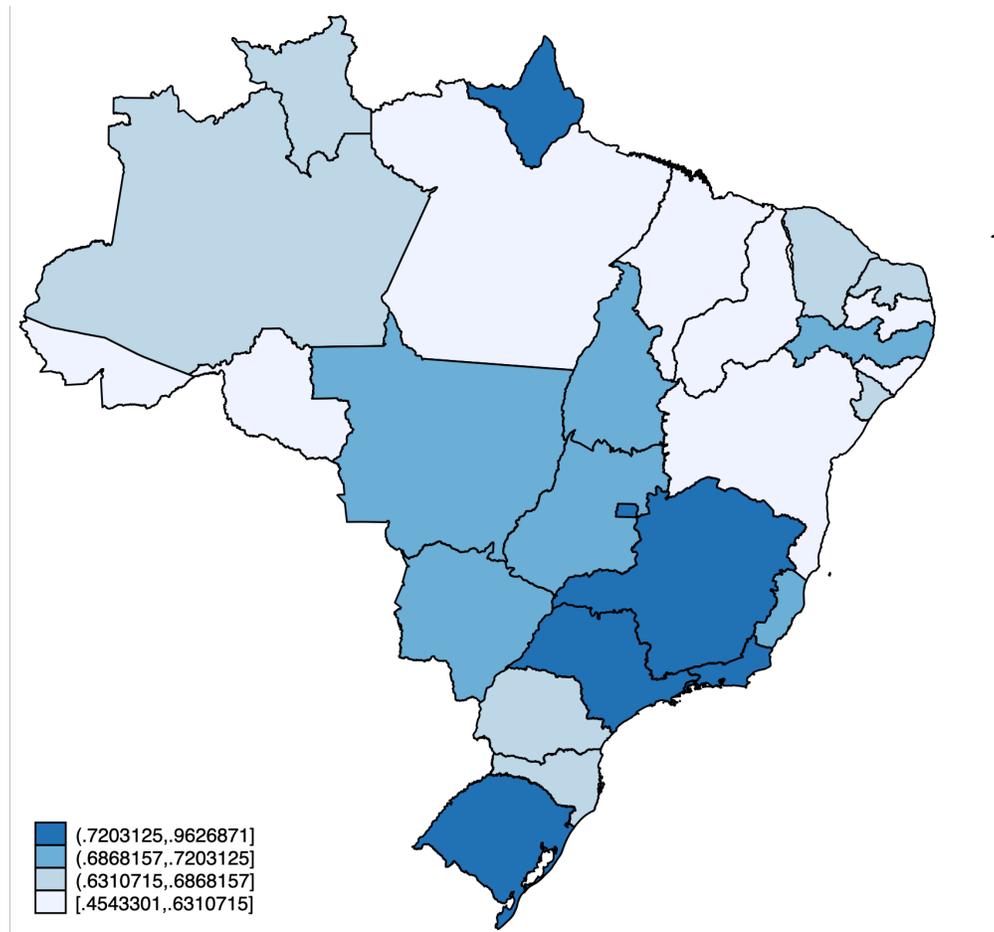


Figure 4: Urban-Rural Rate by State in Brazil

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[31]Neves, Mateus De Carvalho Reis and Freitas, Carlos Otávio and Silva, Felipe De Figueiredo and Costa, Davi Rogério De Moura and Braga, Marcelo José, (2020).

# 5  Empirical Model

To identify a relationship between the level of education completed within states pre- versus post-1990 with the level of income inequality within a state, this article runs an Ordinary Least Squares (OLS) regression with state-level fixed effects and interaction terms for each level of education. The model is written as follows:

$$\text{Gini}_{i,t} = \beta_0 + \beta_1 \text{Post-1990}_{i,t} + \beta_2 \textbf{Education Level}'_{i,t} +$$

$$\beta_3 \textbf{Education Level X Post-1990}'_{i,t} + \beta_4 \text{Urban-Rural Pct.}_{i,t} + \alpha_{i,t} + \epsilon_{i,t}$$

In the above equation, $\text{Gini}_{i,t}$ is the calculated Gini Coefficient for each state $i$ in each year $t$. $\text{Post-1990}_{i,t}$ is a dummy variable that equals one if the observation is taken after 1990 (in this case all observations from the 1991, 2000, and 2010 Brazilian censuses), and 0 is the observation is taken before 1990 (1970 and 1980 censuses). $\textbf{Education Level}'_{i,t}$ is a vector of dummy variables that each represent a portion of the population's level of finished education in state $i$ in year $t$. These dummy variables are Finished Less Than Primary School$_{i,t}$, Finished Primary School$_{i,t}$, Finished Secondary School$_{i,t}$, and Finished University$_{i,t}$. Since these variables are mutually exclusive and sum to one (as aforementioned in Section 4), one must be left out as our reference category; Finished Less Than Primary School$_{i,t}$ is thus not included in the model and should be considered as the reference category when interpreting results. Similarly, $\textbf{Education Level X Post-1990}'_{i,t}$ is a vector of interaction terms, one for each of the above levels of completed education in state $i$ in year $t$ interacted with the $\text{Post-1990}_{i,t}$ variable. $\text{Urban-Rural Pct.}_{i,t}$ is the percentage of the population that resides in a city and is added as a control variable. The $\alpha_{i,t}$ are state fixed effects which control for everything constant over time but varying between states. The $\epsilon_{i,t}$ is the error term.

OLS models must meet the Gauss-Markov Assumptions for Regression in order for $\beta_0$ and $\beta_1$ to be unbiased. The Gauss-Markov Assumptions for regression state that the expected value of the error term conditional on our dependent variables is zero (no endogeneity), the model must be linear in parameters (linearity), there must be random and representative sampling, and variables should not perfectly explain one another (no perfect collinearity). Further, if the variance of the error term should be the same for each observation (homoskedasticity) and the errors are uncorrelated with one another, OLS is the best linear unbiased estimator. It should be noted that one does not need to assume normality in OLS due to the Central Limit Theorem.

To begin addressing each of these assumptions, note that the first of the Gauss-Markov assumptions, that there is nothing in the error term that explains our results, is difficult to

definitively argue has been completely addressed. The most worrisome area in this model for the exogeneity condition is the correlation between the error term and the Post-1990$_{i,t}$ variable. It is quite possible that something else changed in 1990 that is unaccounted for in this model that is associated with a change to income inequality in Brazilian states. The most pervasive example is the population's trend of moving from rural to urban, which is why a control has been added to hedge the influence of the population's movement to cities on the Gini Coefficient of the state. In regards to the second assumption, it is clear that this model is linear in parameters from the equation above. The third condition, random and representative sampling is met by the Brazilian censuses methods. A valid concern with respect to Brazilian census methods could be the under representation of those residing in favelas since they are informal housing, but the Brazilian Institute of Geography and Statistics has published lengthy methodology surrounding their community outreach and partnership with social programs to represent favela-dwellers as accurately as possible in the samples. Finally, to meet the condition of no perfect collinearlity, variables cannot perfectly explain one another. Since this model includes dummy variables that (if all included) would perfectly explain one another, it is vital that one be left out. As aforementioned, Finished Less Than Primary School$_{i,t}$ is the model's reference category and there is thus no perfect collinearity in our model.

Next, to test that the errors are not homoskedastic, the residuals were plotted against the fitted values to ensure that there was no pattern and that the residuals and fitted values were randomly scattered. This plot is displayed in Appendix 8, Figure 5, and there is no clear pattern to the results, so one can conclude that the errors meet the condition of homoskedasticity. To conclude that errors are uncorrelated with one another, the issue of serial correlation (errors within states from one time period being correlated with errors from that state in a future time period) was considered. To address this issue, clustered standard errors were used as a form of robust standard errors.

# 6 Results

The results of the main regression with a state's Gini coefficient as the outcome variable of interest are displayed in column (1) of Table 1. It should be noted that in order to correctly interpret any of the coefficients on the interaction terms, one must also consider the respective coefficient on the variable with the mean of the states' population for that level of education. The results in column (1) show that the impact of moving from a group that finished less than primary school before 1990 to a group that finished primary school in the period after 1990 had no statistically significant effect on the income inequality of states. However, this

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is the only level of education for which the results shown are insignificant at the p<.01 level. For example, post 1990, the effect of a one percentage point increase in the share finishing university education on inequality is a .00694 decrease in a state's Gini coefficient. This is calculated by adding the coefficients on Finished University mean (-0.0512) and Post-1990 X Finished University (0.04426). Before 1990, a one percentage point increase in the share of a state's population finishing university-level education is a .0512 decrease in the Gini coefficient. This result is economically significant as well as statistically significant. To contextualize this change, consider the average Gini coefficient across all states from years pre 1990 (1980 and 1970): 0.522 (taken by averaging the Brazilian Gini coefficients stated in Section 4). To decrease this Gini coefficient by .00694 is a 1.3% decrease in the Gini coefficient of that state after 1990. Compared to decreasing the average Gini coefficient post 1990 for Brazil, 0.581 (taken by averaging the Brazilian Gini coefficients stated in Section4: 1991, 2000, and 2010) by .0512 (a 8.76% decrease), this differential is very large. The $R^2$ value for the main model is .829, suggesting that 82.9% of variability in the Gini Coefficient of a state is accounted for by the independent variables in the full model.

Also, post 1990, the effect of a one percentage point increase in the share finishing primary school on inequality is a 0.00168 decrease in a state's Gini coefficient. Before 1990, a one percentage point increase in the share of a state's population finishing primary school education is a 0.0033 decrease in the Gini Coefficient. This result is much less economically significant than the result of having finished university, and the coefficients are not statistically significant even to the 10% level, which is interesting considering the historical context, which will be explored more in Section 7.

However, post 1990, the effect of a one percentage point increase in the share of a state finishing secondary school on inequality is a 0.00241 *increase* in a state's Gini coefficient. Before 1990, a one percentage point increase in the share of a state's population finishing secondary-level education is a 0.03092 *increase* in the Gini Coefficient. This, counterintuitively, is interpreted as income inequality being worse in states with better secondary education rates. Unlike the result of university-level education, post 1990, the relationship between secondary school completion rates and income inequality improved.

Overall, post 1990, the impact of finishing education on income inequality is mixed. Finishing primary school post 1990 is associated with lower inequality, but this result is not statistically significant so it will not be discussed further in this section. Finishing secondary school post 1990 is associated with higher inequality. Finishing university post 1990 is associated with lower inequality. However, one can still glean impactful results from this mix. The greatest takeaway is that while the relationship between finishing university post 1990 is positive, but it is *less* positive compared to the pre-1990 period. A one percentage

point increase in the population's share of university-educated individuals is associated with a .00694 decrease in the Gini Coefficient of a given state in a year after 1990, whereas in the pre-1990 period, a 1 percentage point increase in the population's share of university-educated individuals is associated with a .05120 decrease in the Gini Coefficient of a state. As can be seen in the table, this result is statistically significant to the p<.01 level. This is a more than six-fold difference in the relationship between educational attainment and income inequality before 1990 compared to after 1990. This follows the hypothesis of this article; education, while being one of the best levers of socioeconomic mobility, saw a reduction in its ability to aid in the pervasive income inequality in Brazil after 1990. Furthermore, this pattern (the worsening of the relationship between income inequality and educational attainment) can also be seen at the secondary level, even though the initial relationship appears to be inverted. The effect of a one percentage point increase in the share of finishing secondary school on inequality is a 0.00241 *increase* in a state's Gini coefficient. Before 1990, a one percentage point increase in the share of a state's population finishing secondary-level education is a 0.03092 *increase* in the Gini Coefficient. The magnitude of the increase in income inequality associated with the post-1990 period is much larger than that of the pre-1990 period (12.8 times larger).

Table 2: Main Regression Results

| | (1) Full Model | (2) <Primary | (3) Primary | (4) Secondary | (5) University |
|---|---|---|---|---|---|
| <Primary Completed | | $-0.00266^{***}$ $(-3.08)$ | | | |
| Primary Completed | $-0.00330$ $(-1.20)$ | | $0.00388^{***}$ $(3.17)$ | | |
| Secondary Completed | $0.03092^{***}$ $(5.05)$ | | | $0.00870^{***}$ $(3.90)$ | |
| University Completed | $-0.05120^{***}$ $(-6.31)$ | | | | $0.00503$ $(0.87)$ |
| Post 1990 | $0.00135^{***}$ $(6.42)$ | $-0.00170^{***}$ $(-3.92)$ | $0.00129^{***}$ $(6.18)$ | $0.00114^{***}$ $(6.16)$ | $0.000578^{***}$ $(3.63)$ |
| Post 1990 X <Primary | | $0.00288^{***}$ $(4.84)$ | | | |
| Post 1990 X Primary | $0.00162$ $(0.63)$ | | $-0.00530^{***}$ $(-5.47)$ | | |
| Post 1990 X Secondary | $-0.02851^{***}$ $(-4.10)$ | | | $-0.00964^{***}$ $(-4.92)$ | |
| Post X University | $0.04426^{***}$ $(5.52)$ | | | | $-0.00928^{*}$ $(-1.79)$ |
| Urban-rural | $0.000165$ $(0.17)$ | $0.000652$ $(1.03)$ | $0.000651$ $(1.02)$ | $0.000298$ $(0.49)$ | $0.00149^{***}$ $(2.78)$ |
| Constant | $0.468^{***}$ $(12.81)$ | $0.670^{***}$ $(7.35)$ | $0.439^{***}$ $(16.77)$ | $0.462^{***}$ $(17.28)$ | $0.432^{***}$ $(16.94)$ |
| R-Squared | 0.829 | 0.767 | 0.759 | 0.773 | 0.738 |
| Observations | 125 | 125 | 125 | 125 | 125 |
| State Fixed Effects | $Yes$ | $Yes$ | $Yes$ | $Yes$ | $Yes$ |

$t$ statistics in parentheses; Clustered standard errors at state level; $^{*}$ $p < 0.1$, $^{**}$ $p < 0.05$, $^{***}$ $p < 0.01$.
Note that <Primary completed, Primary Completed, Secondary Completed, University Completed, and Urban-Rural are each proportions of their respective measurement at the state-level.

In Table 1 Columns 2-5, individual regressions are run on each level of education with their respective interaction terms with the Post-1990 variable. The only statistically significant result when the models are run individually is in Column (4), which has a similar direction and magnitude of an effect as in the model in column (1) for Finishing Secondary School's effect on income inequality.

# 7    Summary and Concluding Remarks

In summary, this article has explored the relationship between educational attainment at varying levels of educational attainment in the period before and after 1990 and income inequality for states in Brazil in an attempt to target an important marker of social mobility at a time when many social welfare programs faced limitations as a result of neoliberal policies.

The results of this article suggest that in the period after 1990, university-level educational attainment had less positive effects on wealth disparity compared to the period before 1990. This result is significant both statistically and economically. This also indicates that education became a worse method for reducing income inequality after 1990 in Brazil, an important conclusion to draw in the context of neoliberalism, a time when Brazil saw a trend of privatizing schools and less funding being put towards public schooling (as well as social welfare programs in general).[13]

These results raise an important question: why? Though it would be outside of the scope of this article to do anything more than speculate about potential mechanisms, further research could explore returns to private schooling in Brazil to attempt to show that private schooling was a mechanism that helped upward mobility in Brazil at the time (obviously staying mindful of the inherent contradiction implied by connecting private schooling to upward mobility for a *general* population). Other than private schooling and education in general, it is important to note that income inequality is an incredibly complex topic with many factors that affect it. Inequality could have been worsening for other reasons, and as previously mentioned in reference to Coady and Dizioli (2019), education is a long-term investment in inequality reduction efforts, and could be that returns are not able to be seen in the period selected for analysis.

Another central question raised by the results presented in this article is what drove the difference in the relationship between secondary school rates and university rates. Why are increased rates of completion of secondary school associated with worse income inequality? This question opens an avenue of research that could be illuminating in Brazil's fight against inequality. Given the literature explore earlier in this article, it seems rational to being to

target funding of public schools and enrollment in private school to begin to understand this mechanism.

Although these results are important to consider, there are limitations to this research that are worth discussing. Primarily, there could be many mechanisms at play that caused a worsening return to educational attainment on income inequality that are outside of the realm of neoliberalism during this period. In general, these results are merely evidence of correlation and not of a causal relationship, and appropriate interpretations should follow. Finally, the endogeneity concern remains for this article, and future research could consider more controls in empirical analysis.

These results have potential implications on policy making that aims to reduce income inequality. Noting that in the post-1990 period, Brazilian states observed blunted returns to education while the country experienced a macro-level trend of privatization, increased investment in schools could revitalize the ability of schooling to help reduce income inequality for developing countries. It is also relevant to note that urban-rural status had neither statistically nor economically significant results impacting the wealth disparity of a state. Therefore, policies should target both urban and rural areas to help reduce income inequality measures.[32]

Extending this framework of analysis to other structurally similar countries during the period of neoliberalism could provide fruitful insights and implications for future research. Exploring other areas of life that could have been impacted by neoliberal policies at this time could also be important areas for further research. For example, impacts on other social welfare indicators and the environment could help illuminate the impact of neoliberalism on society and inequality more generally.

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[32]Further analysis should explore whether the state fixed effects absorbed the impact of urban-rural status.

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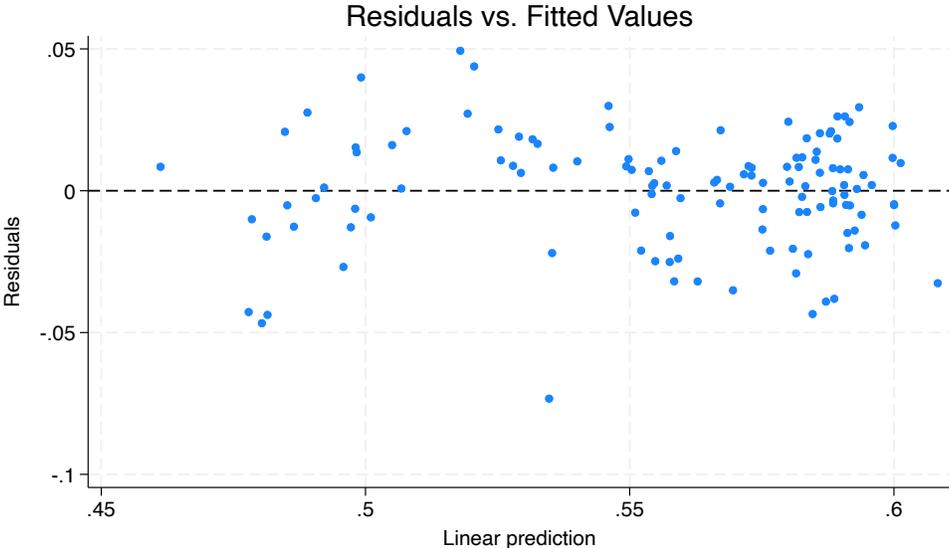
# 8 Appendix



Figure 5: Residuals vs. Fitted Values