Informal sector has stronger differentials on individual earnings across education groups

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Abstract (maximum 160 words)

Brazil experienced variations in the composition of workers by age-education groups, as well as by formal and informal sectors between 1980 and 2010. We estimate if these area-level compositions reduced even further earnings of least-educated individuals. Our main hypothesis assesses that earnings are lower for those living in areas with higher proportions of workers with lower education and in the informal sector. Ordinary least squares regressions estimate variations on individual earnings of male workers living in urban areas using census data, including several individual- and area-level independent variables. Main results suggest that higher proportions of workers in the formal sector have positive associations with individual earnings. Higher group proportions generate stronger positive associations with individual earnings for workers with secondary and university education in the formal sector. Labor markets are not absorbing the least educated workers . Stronger differentials across earnings by education are observed among workers in the informal sector, which is evidence of greater economic inequality within this sector.

Keywords

Age-education composition; Informal sector; Earnings; Labor market; Brazil

Statements and Declarations

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Number of words from Introduction to References, not including the Appendix (maximum 10,000 words)

1. Introduction

The objective of this paper is to estimate associations of individual earnings of workers with compositions of the informal sector and with demographic and educational structures. We conduct this analysis for male workers living in Brazilian urban areas between 1980 and 2010. Previous studies estimated area-level models, which demonstrated that higher proportions of older and better educated workers have negative associations with earnings, but these effects have been decreasing over time (Amaral, 2012; Amaral et al., 2012; Amaral et al., 2013a; Amaral et al., 2013b; Amaral et al., 2015; Amaral et al., 2016). Workers with primary education have not experienced improvements on earnings even with their decreasing share in the population. Workers with secondary education already experience lower earnings than those with university education and, additionally, have earnings that are most affected by demographic and educational compositions. The Brazilian labor market seems to be assimilating and demanding workers with university education.

The main contribution of the current study is the estimation of individual-level models that evaluate associations of individual earnings of workers with area-level variables related to the composition of formal and informal sectors. The paper also contributes to the discussion of formal and informal labor markets in a developing economy, marked by large income inequality. Formal and informal sectors in Brazil are characterized by the working contract and labor law coverage. In the informal sector, labor legislation is non-existent. We are able to identify the sector of employment by the workers' response on whether or not a "employment card." There is an important discussion about the segmentation of the labor market in Brazil and we argue that our analysis shed some light on this discussion. We estimate the association of regional composition of the workforce by formal/informal sector, age, and education with individual earnings of workers. Our main hypothesis assesses that individual earnings of workers are lower for those living in areas with higher proportions of workers with lower education, as well as with higher proportions of workers in the informal sector.

Brazil is passing through a rapid process of demographic and educational changes with large regional and social inequalities (Barro and Lee, 2001; Lam and Marteleto, 2005; 2008; Marcílio, 2001; 2005; Potter et al., 2002; Potter et al., 2010; Riani, 2005; Gong and Van Soest, 2002;

Lustig et al., 2013; Rios-Neto and Guimarães, 2010). There have also been significant decreases in rates of jobs in the informal sector in the country (Barbosa Filho and Moura, 2015; Mello and Santos, 2009; Ramos, 2002; G. Ulyssea, 2005; G Ulyssea, 2018). Our analysis considers regional variations over time for demographic, educational, and formal/informal sector compositions. This paper is part of a broader discussion of regional differences in income and economic growth. We provide estimations that analyze simultaneously associations of three main area-level factors (compositions of educational groups , age structure , and distributions of formal/informal sectors) with individual male earnings.

The next section gives an overview of previous studies related to demographic and educational changes, as well as formal/informal sector characteristics in developing countries. The following section presents our data and different methodological strategies. We estimate a series of ordinary least squares regressions to understand variations in individual earnings, based on a series of individual- and area-level independent variables. This analysis is performed using Brazilian Demographic Censuses microdata from 1980 to 2010. We include further explanations about how we estimated models to evaluate how earnings at the individual level are associated with age, educational, and formal/informal sector compositions of the workforce. We then present results from our analysis, which indicate that demographic, educational, and formal/informal sector compositions are associated with individual earnings. We conclude with some final considerations that summarize our findings and contributions to this scientific field.

2. Background

The study of wage differentials in developing countries is an important subject to explore, since these countries are marked by larger economic differentials than developed countries. This section briefly summarizes studies dealing with the effects of geographical concentration of well-educated workers and cohort size on earnings. We further discuss factors that stimulate the emergence of informal sectors, emphasizing the particular case of Brazil. The analysis indicates the importance of investigating the association between the

process of increasing and variation in informality across regions and age groups in Brazil and labor market outcomes.

2.1 Variations in earnings due to demographic and educational compositions changes

There is a large literature indicating that the concentration of different types of individuals in some areas has strong relation to the labor market outcomes in those areas (Black, 1998; Rauch, 1993). For examples, the concentration of skilled people in some regions of the United States has a positive effect on productive gains, which further increases the concentration of qualified people in these areas (Berry and Glaeser, 2005). The concentration of more qualified workers results in higher wages of all workers in the areas (Moretti, 2004a; b; c; 2011). The larger proportion of people with higher educational attainment benefits the population, as the result of a spillover effect (Moretti, 2011; Hout, 2012). Thus, there is a positive effect of population concentration on individual incomes (Moretti, 2004a; b; c).

In Brazil, there are several studies about the labor market and its relation to income inequality and economic conditions. However, there are few comparative studies of dynamics that have recently been affecting local labor markets. Studies analyzed the concentration of human capital in Brazil (Queiroz and Golgher, 2008) while others emphasized positive effects of the concentration of skilled workers in the Brazilian labor market (Queiroz and Calazans, 2010). Additional research showed that variations in cohort size across municipalities in Brazil led to associations with workers' earnings (Amaral, 2012; Amaral et al., 2012; Amaral et al., 2013a; Amaral et al., 2013b; Amaral et al., 2015; Amaral et al., 2016). More specifically, higher proportions of the population in age-education groups are negatively associated with income of these groups. These effects are larger for groups with higher educational attainment, but with declining effects over time. Thus, the concentration of skilled workers in specific locations can generate benefits for some groups but it can produce negative results for other groups.

Educational expansion influences occupational structure and income distribution (Jaume, 2017). In Brazil (1995–2014), despite increased educational attainment, employment structure remained stable. Formal firms showed greater demand for university-educated workers, though the qualification mismatch persisted. Earnings rose for less educated workers and declined for highly educated ones, contributing to reductions in inequality and poverty. Policy simulations demonstrate that expanding secondary and higher education induces labor market shifts, with positive effects on wages and social indicators such as poverty and income inequality.

However, Brazilian labor market is also marked by high levels of informality (Gasparini and Tornarolli, 2009). In general, workers in the informal sector receive lower wages and less productive jobs. The concentration of informal, in combination with the distribution of workers by educational level, might have strong association to the labor market outcomes.

2.2. Informal sector in developing countries

Informal labor markets are prevalent in low- and middle-income countries, often representing between 25% and 80% of GDP, compared to 10–15% in high-income nations (Gasparini & Tornarolli, 2009; Binelli, 2016). These markets operate outside formal regulatory frameworks, typically without tax contributions or social protection compliance, resulting in low wage costs and minimal regulation (Meghir et al., 2015; Ulyssea, 2010). Though this environment can stimulate short-term economic growth, it compromises worker protection and contributes to broader inequality.

Informality is associated with weak institutions, high taxation, labor market rigidity, and corruption, often correlating with low aggregate welfare and elevated wage inequality (Binelli, 2016). In Mexico, over 60% of total wage inequality (1987–2002) originated within the informal sector. The 1995 financial crisis increased informality and inequality, serving as an instrumental variable for analyzing income variation.

Informal workers face greater employment instability and limited access to unemployment benefits (Bosch & Esteban-Pretel, 2015). Approximately 50% of unemployment inflows in Brazil and Mexico stem from informal jobs. Despite economic growth, few developing

countries offer adequate income support. When introduced, such systems have limited impact on reducing informality unless paired with reforms to lower formal employment costs.

In the case of Chile, Pardo & Ruiz-Tagle (2017) suggest that a universal unemployment insurance would slightly increase self-employment, particularly among inexperienced and less-educated workers, driven by risk aversion and sector-specific preferences. Labor regulations like minimum wage laws also influence informal markets. In Argentina and Brazil, increases in minimum wage raised informal workers' earnings without comparable gains for formal workers (Khamis, 2013). This suggests partial compliance with labor laws: many informal workers respect wage floors despite avoiding social security contributions (Bargain & Kwenda, 2014). Brazilian studies are divided; some identify labor market segmentation with wage disparities (Botelho & Ponczek, 2011), while others support a competitive view, where informal jobs may be preferable depending on individual preferences and constraints (Carneiro & Henley, 2001).

2.3. Informal sector in Brazil

In this context of high levels of workers in the informal sector in developing countries, it is important to analyze trends of jobs in the Brazilian labor market. The social protection system has undergone several changes and expanded its reach, especially after the 1988 Constitution. However, the country still experiences high rates of jobs in the informal sector, which presents a major challenge to the country's economy (Ulyssea, 2005; Ramos, 2002; Mello and Santos, 2009; Barbosa Filho and Moura, 2015; Botelho and Ponczek, 2011; Carneiro and Henley, 2001). High proportion of workers in the informal sector is a structural problem of the Brazilian labor market and not a cyclical aspect. Between 1990 and 2000, significant increases in the proportion of jobs in the informal sector were a result of the increased number of self-employed and those without a formal contract. Between 2000 and 2009, there was a steady decline of jobs in the informal sector, accompanied by significant economic growth. More specifically, there was a significant drop of workers in the informal sector after 2001, increasing from 54.3 percent in 1992 to 56.2 percent in 1999, and dropping to 48.7 percent in 2009 (Neto and Zylberstajn, 1999; Mourão et al., 2013).

This reduction of workers in the informal sector is related not only to changes in the composition of employed individuals, but mainly to improvements in educational distribution (Mello and Santos, 2009). Even with this recent decline, the high level of jobs in the informal sector (around 32.5 percent in 2012) is still a concern to the country's economy (Barbosa Filho and Moura, 2015). Some studies suggest that over 40 percent of the Brazilian workforce is employed in the informal sector in 2015 (Meghir et al., 2015)

Most of self-employed workers in Brazil have low education, evade tax, and are unlikely to employ other people or expand their businesses (Narita, 2013; Botelho and Ponczek, 2011; Bargain and Kwenda, 2014). According to data from 2002 to 2007, older people depended more on self-employment than younger people, because of lower levels of educational attainment (Narita, 2013). At the same time, earnings were proportional to the increase in age, indicating that older and more experienced workers achieved greater success compared to younger individuals. Simulations indicate that increasing workers in the informal sector have small effects on employment composition, reduce lowest wages (i.e. increase wage inequality), and improve welfare for those in the formal sector.

To understand effects of high percentage of workers in the informal sector in Brazil, different studies aim to investigate the issue in the country and regions. Meghir et al. (2015) proposed a job search model considering strategies by the government to enforce jobs and regulatory costs (e.g., taxes and minimum wages) in the formal sector, the results indicate that a firm can make similar profits in the formal and informal sectors. This suggests that the incidence of jobs in the informal sector is associated with institutional requirements for firms in the formal sector and with penalties for those in the informal sector. Informal firms do pay more than formal firms when controlling the level of productivity. However, informal firms are on average less productive than formal businesses, thus earnings in the formal sector are on average higher than those in the informal sector. A labor market with high levels of informal jobs reduces competition for workers and makes it harder for workers to get higher productivity jobs. Simulations indicate that policies aiming to reduce workers in the informal sector affect disproportionately larger informal firms, do not increase unemployment, improve

allocation of workers to better firms in the formal sector, increase wages, and increase overall access to welfare.

Rocha et al (2018) investigated whether lowering taxes reduces the informal sector, after the implementation of the Individual Micro-Entrepreneur Program by the federal government in 2009. This program aims to foster entrepreneurship, create new formal businesses, increase tax registration, intensify compliance of small informal firms, and increase contributions to the social security system. Findings indicated that reducing entry costs had no significant effects on the levels of workers in the informal sector. However, the reduction of tax obligation increased formalization. Results also suggested that the major inhibiting factor to formalization is the cost of staying formal, not registration costs. For these reasons, governments that seek to promote their formal economy should implement tax friendly laws on formal firms rather than only regulating the cost of entry. The SIMPLES program, implemented in 1996 to simplify taxation for micro and small enterprises, consolidated multiple federal taxes into a single monthly payment. Early studies (Fajnzylber et al., 2011; Monteiro & Assunção, 2012) reported positive effects on formalization, employment, and firm performance in eligible sectors. However, Piza (2018) found no significant impact, attributing earlier findings to measurement errors and unaccounted seasonal shocks. His analysis suggests SIMPLES had no short-term effect on formalization rates when using improved empirical methods.

An important question related to high levels of informal jobs in the Brazilian labor market is whether workers with similar levels of productivity higher wages in the formal sector have, compared to the informal sector (Barros and Ulyssea, 2010). Previous analysis have mixed results about whether workers in formal jobs receive higher wages than workers in informal jobs, controlling for their productivity. An important related question is whether wage variations alone of equally skilled workers could be utilized as an indication of a segmented labor market. Based on different models, this analysis suggests that it is difficult to determine the existence of segmentation in the labor market by only analyzing wage differentials (Barros and Ulyssea, 2010). To deal with these analytical challenges, the models we presented in this paper investigate individual earnings differentials by considering both individual and contextual associated factors.

In terms of the association between unemployment benefits and jobs in the informal sector, a study analyzed Brazilian household surveys between 1999 and 2009 (Mourão et al., 2013). Results suggest that after receiving unemployment benefits, the incidence of formal employment among workers decreases by 42 percent. The analysis of interactive terms indicates that increases in the real values of the benefits, held since 1999, have not significantly improve the occurrence of formal employment among workers.

Despite extensive literature regarding formal/informal sectors in Brazil, there is no consensus about the existence, direction, and magnitude of wage variations due to segmentation of the labor market in formal and informal activities. For instance, Almeida et al (2025) investigated urban wage premia in Brazil and identified that research that does not consider informal sector might be underestimating the magnitude of the urban premia. Engbom et al (2022) indicates that workers in the informal sector face large wage penalties and higher variability of wage levels. Finally, Gomes et al (2025) finds that informal wage penalties are greater for less educated workers and those in more vulnerable conditions.

3. Data and methods

We investigate associations of compositions in formal/informal sector and age-education structure with individual earnings of male workers between 15 and 64 years of age in Brazilian urban areas between 1980 and 2010. Based on the studies discussed in the previous section, we hypothesize that individual earnings of workers are lower for those living in areas with higher proportions of workers with lower education. Moreover, we expect that workers residing in areas with higher proportions of workers in the informal sector will experience even lower levels of individual earnings. In order to test these hypotheses, we analyze associations of the composition of the workforce of urban areas by formal/informal sector status, age, and education with individual earnings of workers. This analysis uses local-level data to construct age-education cells and follows their distributions over time. We use microdata from the Brazilian Demographic Censuses to estimate how composition of the formal/informal sector and age-education structure at the local level are correlated with individual earnings of male workers. We

analyze data from the 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses, which were obtained from the Brazilian Institute of Geography and Statistics (IBGE).

In terms of our methodological strategies, let the prospective worker have three choices: S, self-employment; I, informal employment; and F, formal employment. In Sectors S and I the person receives no social insurance benefits, in particular, no unemployment benefit coverage and no health insurance coverage. Assume that the worker chooses a sector by finding: $U^*=\text{argmax}[U(W^S), U(W^I), U(W^F)]$, where W indicates the wage in the sector. Let A be the worker's age, and assume that each W^S is a function of age. Assume too that workers' demand for social insurance peaks during their prime-age years because of family responsibilities, i.e., more dependents. Then W^F will be the utility-maximizing choice especially in prime-age years, because the benefits of having social insurance are greatest in the prime-age years. Moreover, that will be especially true for married men compared to unmarried men, with, if anything, the difference by marital status being reversed for women.

Beyond this, of course, the choice depends on relative wages in the three sectors. Those are endogenous with respect to choices in the entire labor market, as well as having issues of individual self-selection. As an instrument for opportunities in the sectors, we can write: $W^I=G_I(N^i)$, $G_I'<0$, and $W^F=G_F(N^i)$, $G_F'<0$, where N^i is the fraction of workers in the i'th person's labor market who are in his/her demographic (age-education) group. We have shown that this fraction affects wage rates (Amaral et al., 2013b), so we know that it is at least a candidate to be an instrument for wages in the context of sector choice. We can reasonably argue that the returns to self-employment do not depend on the demographic density of worker i's group in his/her labor market. Thus, we should expect that, where N^i is larger, the prosperity to choose self-employment will be greater, other things equal, since the individual's wage rate is depressed by this greater density. Regarding the functions G_I and G_F, the question is whether we can argue that $G_F'<G_I'<0$, i.e., that demographic density depresses relative wages more in the formal than in the informal sector.

At this point, we perform the analysis only for urban male workers. We categorized information on age into four groups: youths (15–24 years-of-age); young adults (25–34 years-of-age);

experienced adults (35–49 years-of-age); and older adults (50–64 years-of-age). The level of education was classified into four groups using information on completed years of schooling and considering the specificities of the school system in Brazil. We utilize a standardized variable, which allows for international comparisons and focus on complete educational levels. The four education groups are: (a) less than primary education; (b) complete primary education and incomplete secondary; (c) complete secondary education and incomplete university; and (d) complete university education.

We categorized workers by formal/informal sector status, informing whether they had a job in the formal sector or informal sector. We did not generate a self-employed category, because this would comprise a small number of workers and it would require specific methodological strategies to understand variations of earnings for this specific group, which go beyond the scope of this analysis. Workers in the formal sector are the following: workers employed with labor identification card; workers employed without labor identification card, but who contributed to the social security system; and workers in the public sector and government companies. All other individuals were classified as workers in the informal sector. Questions about formal/informal sector status in the labor market changed over time. In the 1980 and 1991 Censuses, these questions are related to the activity during the previous twelve months. In the 2000 and 2010 Censuses, these questions are related to the activity during the previous week.

We control our models for individual characteristics of workers in relation to race/color, marital status, religion, and region of residence. White workers have higher earnings than non-white workers. For marital status, married workers have higher earnings than non-married workers. The country has been experiencing an increase of Protestants over time with higher proportions of Protestants among individuals with lower income. For region of residence, those living in the Southeast (which includes the states of São Paulo and Rio de Janeiro) and in Center-West (which includes the national capital Brasília) have higher earnings than those living in the North, Northeast, and South.

As a strategy to generate area-level variables, we aggregated Census microdata by age-education group, time, and area. In relation to the geographical areas considered for this study, we are using

502 comparable areas through time, which have similar boundaries as the ones created by IBGE for the 1991 Demographic Census. These comparable areas though censuses were first proposed by Potter et al. (2002, 2010) and we updated this information with the 2010 Demographic Census. For this study, we are analyzing only residents in urban areas with the hypothesis that there is a unique pattern of employment in these areas. We are not seeking the comparison to rural areas at this moment.

Our main independent variable comes from a collapsed database with information on male working population distributed by age-education group, year, and area. Since we collapsed the data into 16 age-education groups, four censuses, and 502 comparable microregions, the maximum possible number of observations in this aggregated database is 32,128. This database used census weights to estimate proportional distributions of males by age-education group, time, and area. In order to measure the effect of area-level demographic and educational compositions on individual earnings, we merge this aggregated data back to the individual-level data.

The dependent variable is the natural logarithm of each individual male worker. In Brazil, information on earnings is based on primary occupation. In Equation (1), $log(Y_i)$ is the logarithm of individual earnings (i). A total of 16 indicators of age-education groups (G) are included in the model, which is estimated separately for each year (θ). The first age-education group is the reference category. This procedure originates a vector of 15 parameters (β_1) for each year. Our main hypothesis indicates that not only individual age and educational attainment have significant associations with earnings, but also demographic and educational compositions generate variation in cohort size and, thus, influence individual earnings. As a strategy to estimate associations of cohort size with earnings, the distribution of the male population in our 16 age-education groups (X) can be introduced as a set of variables from our aggregated database for each time (θ). This procedure originates a vector of 16 parameters (β_2) for each year. This exercise is similar to a study that estimated the effects of immigration on the U.S. labor market (Borjas, 2003). In our case, instead of including the immigration supply in the estimations, we include information on the male population distributed into age-education groups (g) by area (a) and time (θ), in order to verify its associations with individual earnings. These

aggregated level variables (X) allow us to test whether individual earnings of workers are lower for those living in areas with higher proportions of workers with lower educational attainment, for instance. At last, a binary variable for formal/informal sector status (formal vs. informal) is included, taking workers in the informal sector as the reference category, which generates an additional parameter (β_3) in the model. Other variables are included as controls (race/color, marital status, religion, and region of residence) in all models.

$$log(Y_i) = \beta_0 + \beta_1 G_i + \beta_2 X_{ga} + \beta_3 Formal/Informal\ Sector\ Status_i + \varepsilon_i. \quad (1)$$

Equation (2) includes a series of interaction parameters (I) combining the binary variable of formal/informal sector status with age-education groups (G), generating a vector of 15 parameters (β_4). This inclusion enables us to test whether age-education coefficients are different between workers in the formal and informal sectors.

$$log(Y_i) = \beta_0 + \beta_1 G_i + \beta_2 X_{ga} + \beta_3 Formal/Informal\ Sector\ Status_i + \beta_4 I_i + \varepsilon_i. \quad (2)$$

Equation (3) substitutes the binary variable about formal/informal sector status for a variable that indicates the proportion of workers in the formal sector (P) by area (a). This exercise allows us to understand whether the proportional size of workers in the formal sector within each microregion influences individual earnings.

$$log(Y_i) = \beta_0 + \beta_1 G_i + \beta_2 X_{ga} + \beta_3 P_a + \varepsilon_i. \quad (3)$$

We estimated two models, one including only workers in the formal sector (f) and the other only workers in the informal sector (if), represented by Equations (4) and (5). These models allow us to verify whether the magnitude and the direction of all individual- and area-level variables differ between the formal and informal sectors. These specifications are essential to test whether individual earnings of workers in the informal sector are lower for those living in areas with higher proportions of workers in the informal sector, compared to workers in the formal sector.

$$log(Y_i^{f}) = \beta_0^{f} + \beta_1^{f} G_i^{f} + \beta_2^{f} X_{ga}^{f} + \varepsilon_i^{f} \quad (4)$$

$$log(Y_i^{if}) = \beta_0^{if} + \beta_1^{if} G_i^{if} + \beta_2^{if} X_{ga}^{if} + \varepsilon_i^{if} \quad (5)$$

Finally, we estimated models with pooled data by combining all years and including interactions of years with our main independent variables. Throughout our results section we mention that the estimated coefficients vary with statistical significance over time. These assessments are based on these models with pooled data. We also estimated models for each Brazilian region (North, Northeast, South, Southeast, and Center-West) and they provided similar results as the ones presented throughout this paper. We did not include these results in the paper because of space limitations.

4. Results

We now present the results originated from our analysis. The estimation of an income equation is central to assess the association of individual earnings with an aging population, educational improvements, and decreases of workers in the informal sector. This study seeks to establish whether age, educational, and formal/informal sector compositions influenced earnings of male workers in Brazil. We focus the analysis on the sample of urban male workers between 15 and 64 years of age from 1980 to 2010, based on Brazilian Demographic Censuses (Table 1). Percentage of workers employed in the informal sector increased from 22.7 percent in 1980 to 40.9 percent in 2000, and dropped to 33.5 percent in 2010. Percentage of white urban male workers has been declining over time (from 61.6 percent in 1980 to 51 percent in 2010), which indicates an increase in diversity by race/color in the country. Percentage of married workers also declined in the period, which might result in lower earnings for this population, since married individuals have higher earnings than other marital status groups. The percentage of protestants increased significantly from 5.9 percent in 1980 to 20.3 percent in 2010. On average, protestants have lower earnings than the rest of the population.

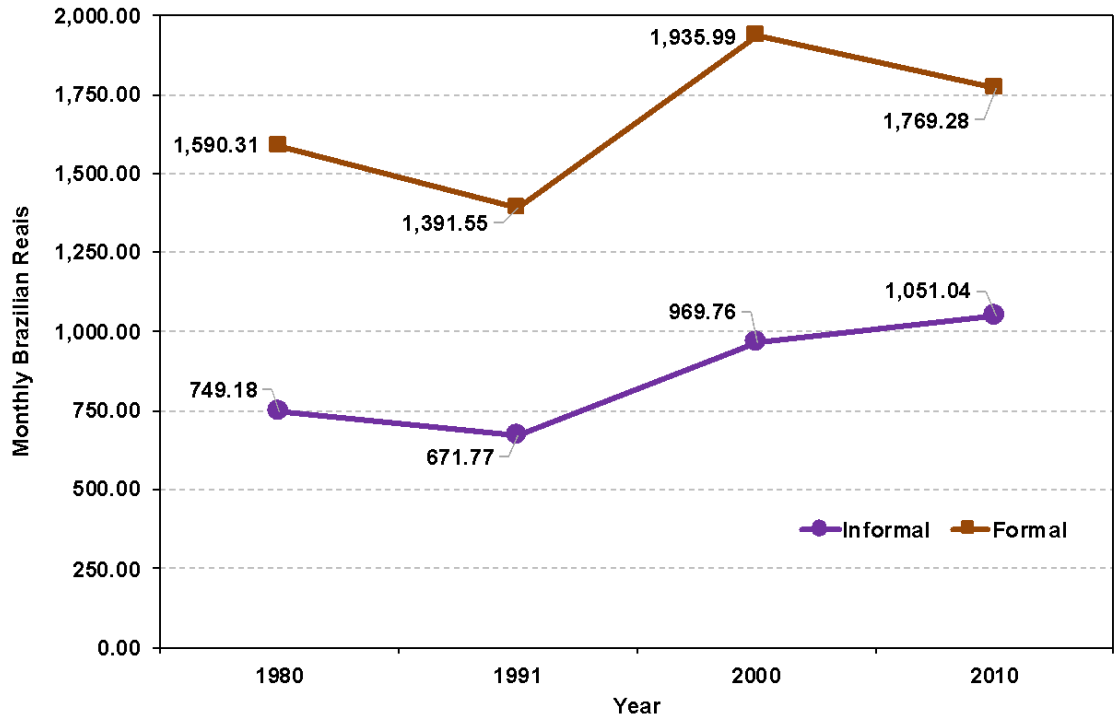
Table 1. Sample of urban male workers, Brazil, 1980–2010

Year	Informal sector (%)	White (%)	Married (%)	Protestant (%)	Sample size
1980	22.7	61.6	56.3	5.9	4,309,110
1991	30.8	56.2	66.8	7.9	2,775,824
2000	40.9	57.8	48.7	13.5	3,305,805
2010	33.5	51.0	43.2	20.3	3,708,484

Source: 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses (Brazilian Institute of Geography and Statistics – IBGE).

Figure 1 illustrates monthly real earnings of urban male workers for the formal and informal sectors over time. Income was adjusted by the national consumer price index (INPC) to correct for currency changes and inflation. Income is reported in 2010 values. INPC was developed by IBGE. Both the correction for currency changes and the deflation are done for convenience only. Taking logarithms of wages using nominal or real wages generates the same estimates of the crucial parameters in our regression models. In the 1970s, Brazil experienced increases in socioeconomic inequality in conjunction with economic growth, which is reflected on earnings measured by the 1980 Census. In the 1980s, the country experienced economic stagnation, which reflected in decreases of overall earnings, as measured by the 1991 Census. The Brazilian economy experienced stabilization on inflation in the 1990s, which contributed to an overall increase in earnings by the 2000 Census. Finally, in the 2000s, the country passed through improvement in overall educational attainment and economic stabilization, which contributed to improvements on the earnings of workers in the informal sector by 2010.

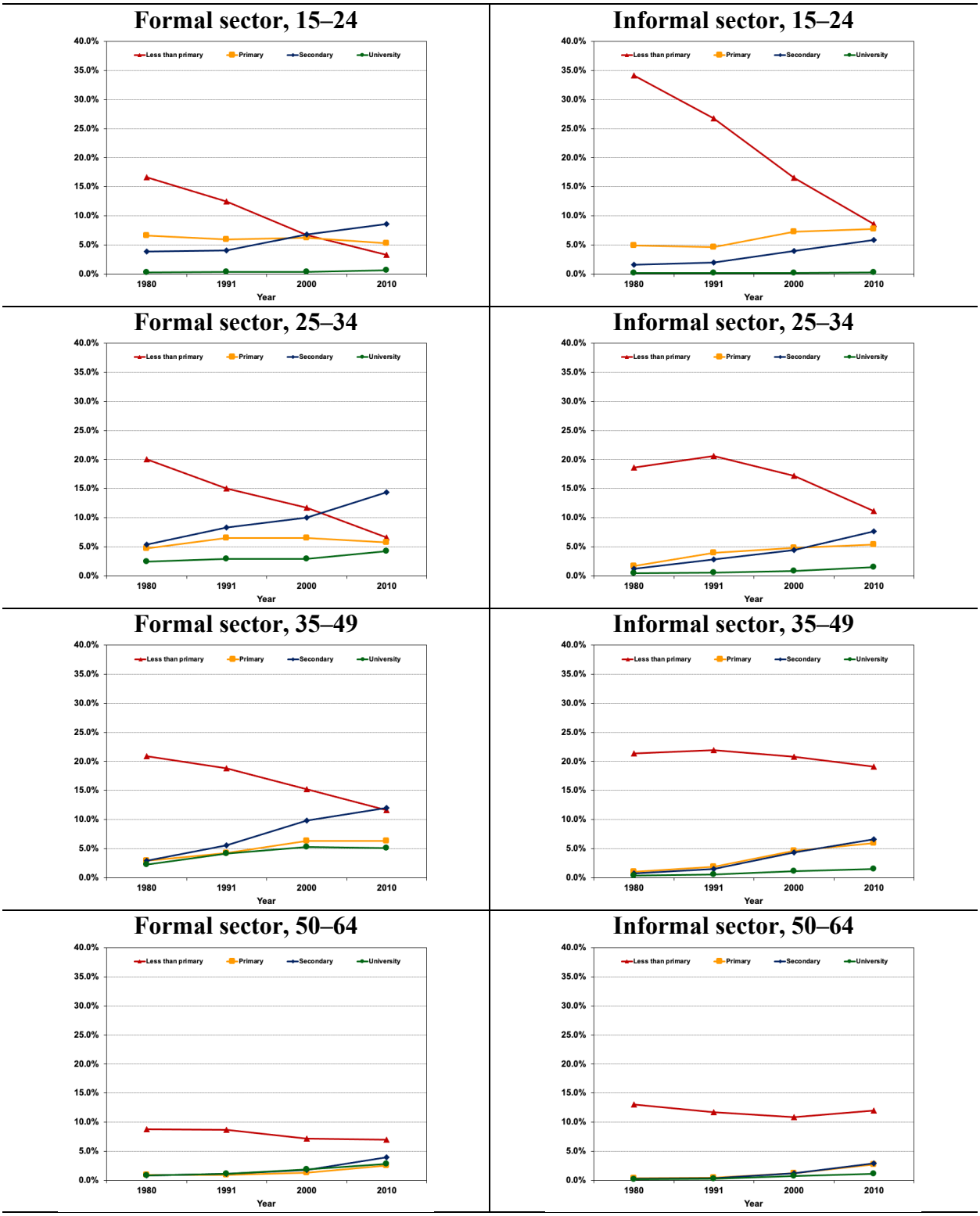
Figure 1. Monthly real earnings of urban male workers by formal/informal sector, Brazil, 1980–2010



Note: Income adjusted by the national consumer price index (INPC) to correct for currency changes and inflation. Income is reported in 2010 values. INPC was developed by the Brazilian Institute of Geography and Statistics (IBGE) (http://drcalc.net/easycalc/correcao.asp).
Source: 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses (Brazilian Institute of Geography and Statistics – IBGE).

Figure 2 provides an illustration of changes in the distribution of the male working population by formal/informal sector, age-education groups, and year. In general, the proportion of these men with less than primary completed decreased between 1980 and 2010. For example, the proportion of males between 15–24 years of age with less than primary completed and formal jobs fell considerably from 16.6 percent in 1980 to 3.3 percent in 2010 (Figure 2 and Table A1 in Appendix A). This trend is also observed for the other age groups with less than primary completed. In addition, the proportion of those with secondary and university completed increased during the period in all age groups. This is an expected outcome, since Brazil experienced an expansion of its educational system in the 1990s.

Figure 2. Urban male workers by formal/informal sector and age-education groups, Brazil, 1980–2010



Source: 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses (Brazilian Institute of Geography and Statistics – IBGE).

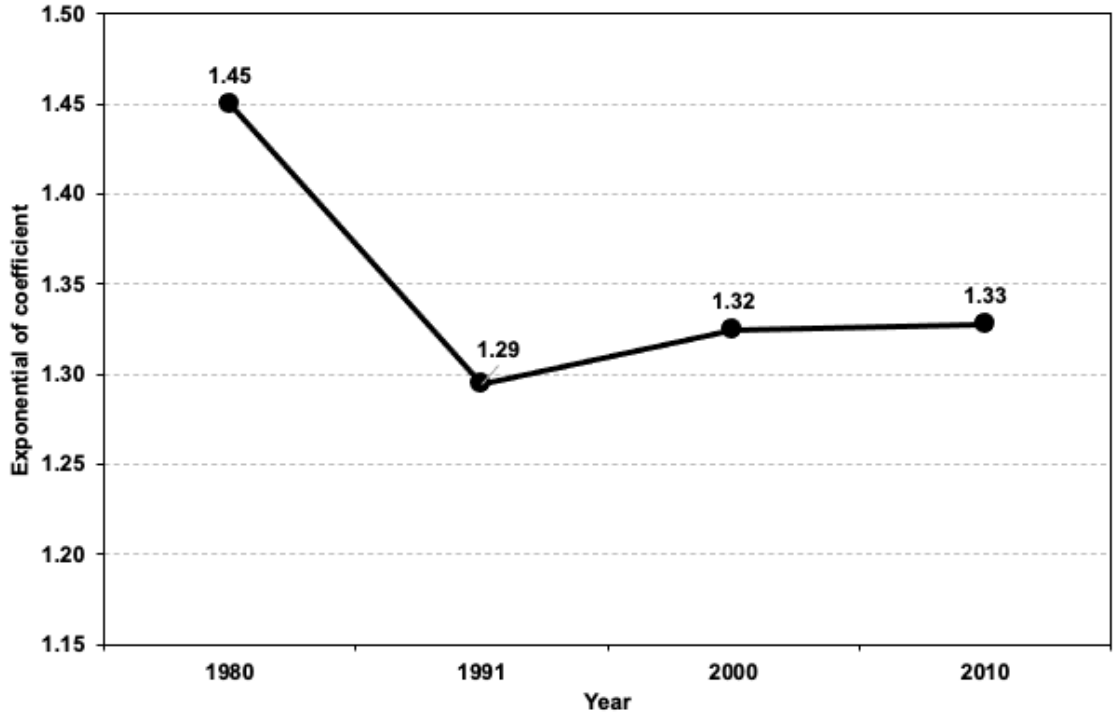
The percentage of non-white males in the formal sector increased from 34.4 percent in 1980 to 46.1 percent in 2010, while percentage of white males decreased from 65.7 percent in 1980 to 53.9 percent in 2010 (Table A1 in Appendix A). This result could be driven by an increase on the overall percentage of the non-white population in the country. However, the 3.8 percentage point increase of this group in the informal sector was much less pronounced (from 52.2 percent in 1980 to 56.0 percent in 2010) than the 11.7 percentage point increase in the formal sector (from 34.4 to 46.1 percent in the period). Due to decreases in marriage rates in the country, percentages of non-married workers increased in the formal and informal sectors over time. The percentage of protestants increased between 1980 and 2000, going from 5.2 percent in the informal sector and 6.0 percent in the formal sector to 19.5 and 20.5 percent, respectively. The majority of the male population in urban areas continues to be concentrated in the Southeast. However, the share of these males in the informal sector decreased from 44.3 percent in 1980 to 39.6 percent in 2010. The same happened in the formal sector, which indicates a slight decentralization of the population from the Southeast to other regions. Finally, Brazil has high levels of jobs in the informal sector, but they have been decreasing in recent years. The percentage of men in urban areas working in the informal sector increased from 22.7 percent in 1980 to 40.9 percent in 2000, but decreased to 33.8 percent in 2010.

According to Table A2 in Appendix A, differentials in average earnings between formal and informal sectors have been decreasing over time. Overall earnings in the informal sector were only 47 percent of earnings in the formal sector in 1980 (749.18/1,590.31), increased to 48 percent in 1991, 50 percent in 2000, and 59 percent in 2010. These results also indicate higher earnings for older, better educated, white, married, and non-protestant men, as well as those living in the Southeast and Center-West regions.

Exponential of coefficients of being on the formal sector, compared to being on the informal sector, from Equation (1) for each year are presented in graphical format in Figure 3 (complete estimates are available in Table A3 in Appendix A). This model indicates a positive association between individual earnings and formal sector across all years. Exponential of coefficients oscillated through time, but they have been increasing since 1991 until 2010, which highlights higher earnings for male workers in the formal sector. More specifically, workers in the formal

sector had earnings 1.45 times higher than workers in the informal sector in 1980, controlling for the other independent variables. This advantage declined to 1.29 in 1991 and reached 1.33 in 2010. As detailed in Table A3, coefficients for age-education indicators suggest that earnings are higher for those people with more schooling within each age category. We also verify that within each education group, earnings are higher for older men. These estimates are consistent with what we know about the association of age and education with earnings (Mincer, 1974; Hamermesh, 1993).

Figure 3. Effects on earnings of urban male workers from Equation (1) of being on the formal sector, compared to being on the informal sector, Brazil, 1980–2010



Source: 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses (Brazilian Institute of Geography and Statistics – IBGE).

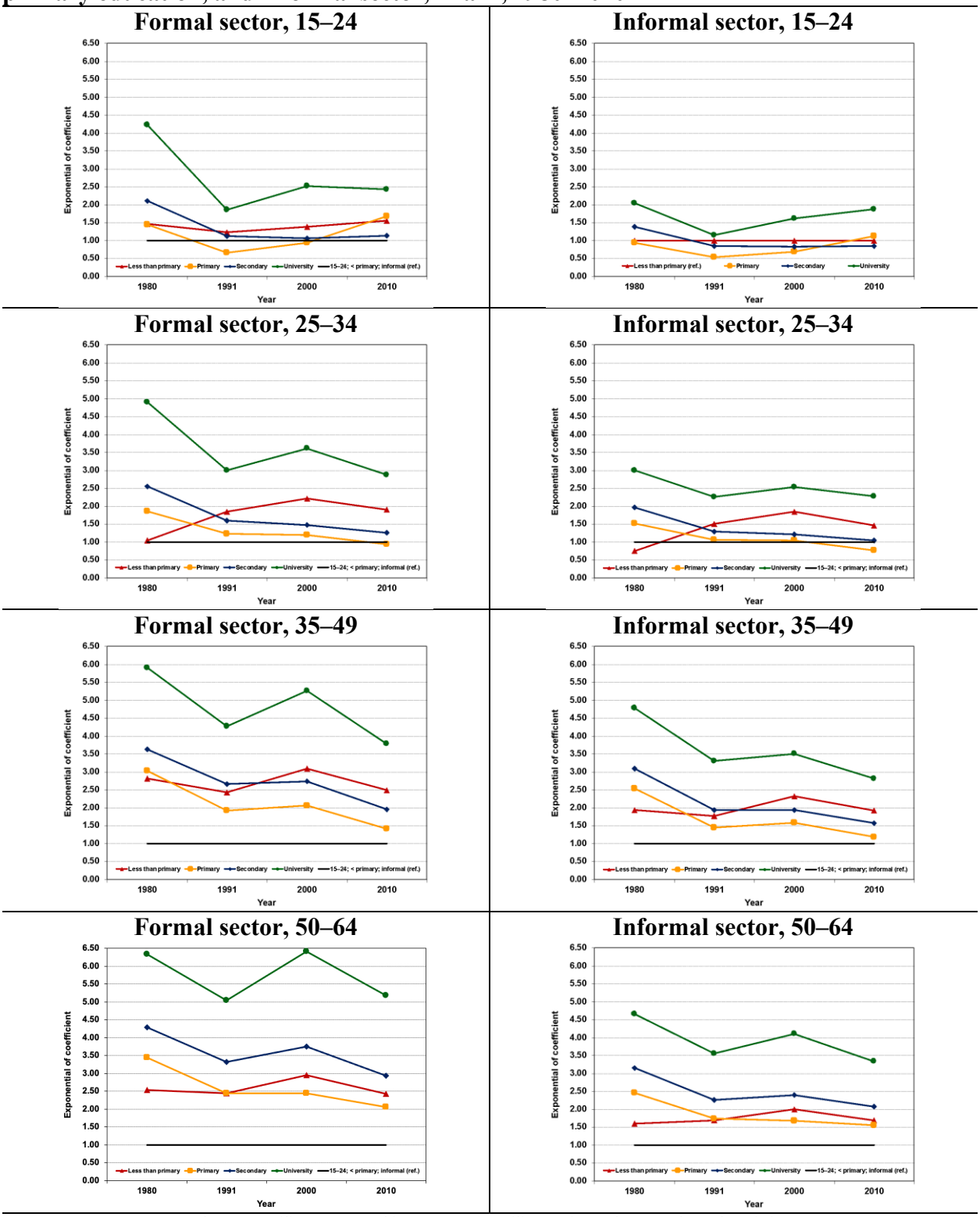
In relation to the distribution of males in age-education groups from Equation (1) in Table A3, higher proportions tend to have stronger negative effects on individual earnings for those with lower education (less than primary completed and primary completed). On other words, higher proportions of male workers on age-education groups generate lower earnings exactly for those with already lower earnings. More specifically, among 15–24-year-old males, higher proportions of males with less than primary education completed generate stronger negative effects on earnings (except in 1980). For men with 25–34 and 35–49 years, group proportions tend to have

positive associations with earnings over time for those with at least primary education completed. For 50–64-year-old men, positive associations are observed for those with at least secondary education completed. These estimates suggest that the Brazilian labor market does not require as many low educated men in recent years, as it did in previous decades. Local labor markets seem to be absorbing higher proportions of men in groups with secondary and university completed in recent years, without negative associations with their earnings.

The positive coefficients for age-education group proportions are stronger for workers with university education, compared to those with secondary education. These findings suggest that the Brazilian labor market is better at absorbing workers with higher levels of education (university completed) than with mid-level education (secondary completed). Finally, Table A3 also indicates higher earnings for white, married, non-protestant male workers, and those living in the Southeast and Center-West regions, when controlling for all other independent variables.

Equation (2) included interactions of age-education indicators with the formal sector. For each year, we add coefficients of binary variables for formal sector (informal sector as reference), age-education group (15–24 years and less than primary education as reference), and interaction of formal sector with age-education group (15-24 years, less than primary completed, and formal sector as reference). Figure 4 illustrates the exponential of these combinations of coefficients for being on each age-education group and formal/informal sector, compared to being on the 15–24 age group, less than primary education, and informal sector. Complete estimates from Equation (2) are available in Table A4 in Appendix A.

Figure 4. Effects on earnings of urban male workers from Equation (2) of being on each age-education-economic-sector group, compared of being on the 15–24 age group, less than primary education, and informal sector, Brazil, 1980–2010



Source: 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses (Brazilian Institute of Geography and Statistics – IBGE).

The comparison of graphs in Figure 4 for each age-education group indicate that workers in the formal sector have stronger positive associations with earnings. In 2010, taking those with 35–49 years and university education as an example, individual workers in the formal sector had earnings 3.78 times higher, while those in the informal sector had earnings 2.81 times higher, compared to the reference category (15–24 years, less than primary education, informal sector).

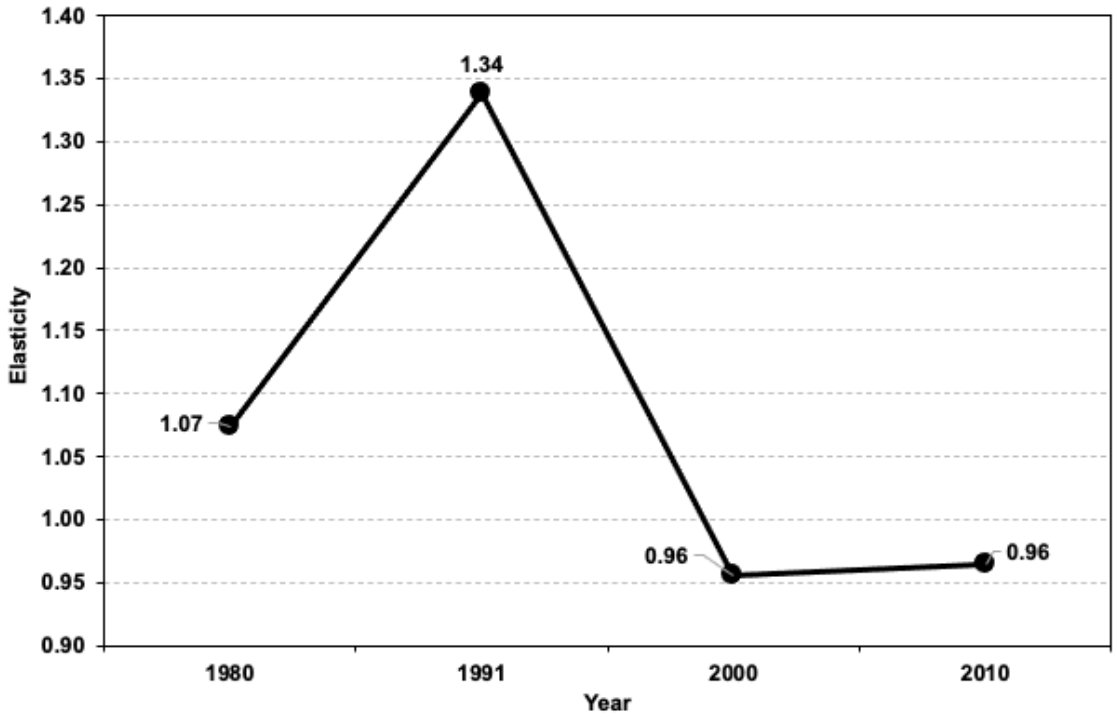
Furthermore, Figure 4 indicates that older workers and those with higher education usually have higher earnings than others. For almost all age-education-economic-sector groups, time trends of exponential of coefficients follow the same ones as observed in Figure 3. An important distinction is that, for workers with at least 25 years of age, coefficients lose magnitude in 2010, compared to 2000.

Only for workers in the informal sector with 15–24 years (primary and secondary education) or with 25–34 years (less than primary and primary education), there are exponential of coefficients smaller than one unit (Figure 4). In other words, these groups have smaller earnings than the reference category for specific years.

Equation (3) included the proportion of male workers in the formal sector as a control variable, instead of the binary variable for formal/informal sector (complete estimates in Table A5 in Appendix A). Figure 5 presents elasticities that were calculated as the product of coefficients of proportion in the formal sector (Tables A5 in Appendix A) and the national proportion of male workers in the formal sector (Table A1 in Appendix A) over time.[1]

Figure 5. Effects on earnings of urban male workers from Equation (3) of proportion in the formal sector (P_a), Brazil, 1980–2010

[1] In order to better understand the estimates, we calculate elasticities to demonstrate the impact of proportions in the formal sector on earnings over time. Elasticity describes the relationship between two variables, and is defined as the ratio of the percentage change in a dependent variable to a percentage change in an independent variable. Since we aim to understand the change in earnings (dependent variable) to a percentage change in the independent variables, we multiply the product of coefficients of proportion in the formal sector (Tables A5 in Appendix A) and the national proportion of male workers in the formal sector (Table A1 in Appendix A) by 0.01. We also calculate the exponential of this product, since we utilized logarithm of earnings in our models. Finally, we subtract one unit and multiply by 100 to estimate the result in percentage terms for each year. This procedure can be summarized as follows for each year: Exponential of ((coefficients of proportions in the formal sector in Table A5 * national proportions in Table A1 * 0.01) – 1) * 100.

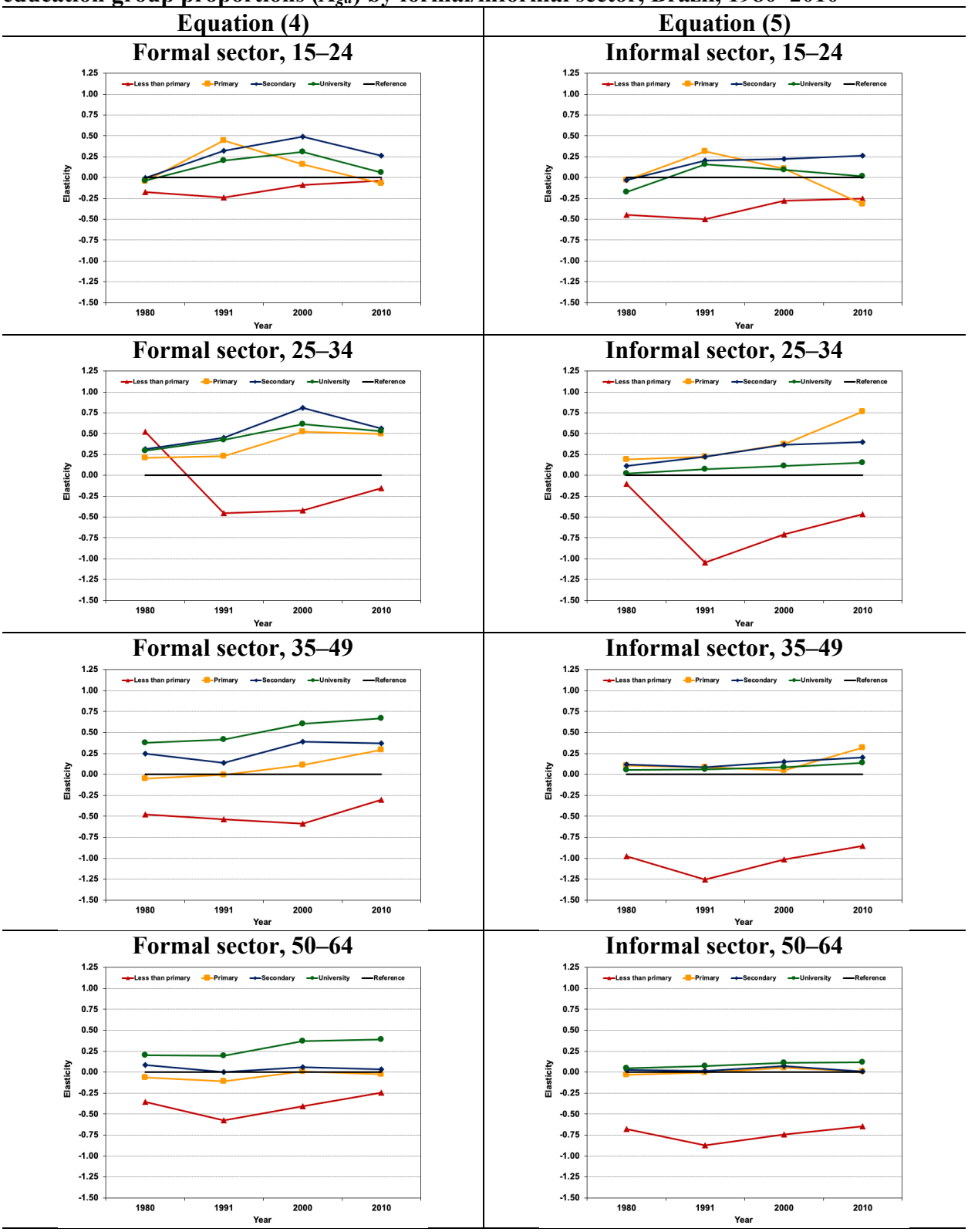


Source: 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses (Brazilian Institute of Geography and Statistics – IBGE).

For one percentage increase on male workers in the formal sector, individual earnings increased by 1.07 percent in 1980, controlling for the other independent variables (Figure 5). This positive association increased to 1.34 percent in 1991. In 2000 and 2010, this association decreased to 0.96 percent. However, these results indicate that associations remained positive even with the increase of urban male workers in the formal sector from 59.1 percent in 2000 to 66.5 percent in 2010 (Table A1 in Appendix A). This is a sign that the Brazilian labor market is absorbing the increasing share of workers in the formal sector.

Finally, we estimated models from Equations (4) and (5) that included proportions of male workers in age-education groups for those in the formal sector (Table A6 in Appendix A) and informal sector (Table A7 in Appendix A). Similar to Figure 5, Figure 6 presents elasticities that were calculated as the product of coefficients of age-education proportions for each formal/informal sector (Tables A6 and A7 in Appendix A) and the distribution of male workers by age-education groups in each formal/informal sector (Table A1 in Appendix A) over time.

Figure 6. Effects on earnings of urban male workers from Equations (4) and (5) of age-education group proportions (X_{ga}) by formal/informal sector, Brazil, 1980–2010



Source: 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses (Brazilian Institute of Geography and Statistics – IBGE).

According to Figure 2, proportions of workers in the formal sector have been increasing over time, especially for those in with secondary and university education. Due to these national increases, we could expect more competition in the labor market among these workers, which could translate in lower individual earnings. However, as illustrated on Figure 6, one percentage increase on male workers with 35–49 years and secondary education in the formal sector is associated with an increase of 0.37 percent on individual earnings in 2010. This positive association reaches 0.67 percent for those with university degree in the same age group in 2010. These results indicate that the Brazilian labor market has been absorbing the increasing proportions of workers in the formal sector without negative effects on earnings. These associations had smaller magnitudes among workers with 35–49 years in the informal sector: 0.20 percent (secondary education) and 0.14 percent (university education).

Furthermore, results in Figure 6 indicate that an increase in the proportion of male workers in the groups with less than primary education are negatively associated with individual earnings. These results are estimated in a time period of declining proportions of workers with less than primary education (Figure 2). These workers already have lower earnings than other individuals and they are not benefiting from being a smaller group of workers in recent years. These least educated workers experience stronger negative effects on their individual earnings from group proportions, especially among those in the informal sector. More specifically, when we compare elasticities for the least educated workers by formal/informal sector for similar age groups and year, negative associations are stronger for workers in the informal sector. This finding is an indication that the labor markets are not absorbing least educated workers even as they become as smaller group of workers.

Negative associations in the lowest education group lost magnitude in more recent years, even for workers in the informal sector (Figure 6). This might be an indication that declining proportions of workers with less than primary education in more recent years (Figure 1) generate less competition in the labor market among these workers. In any case, these elasticities remain negative in 2010 for all age-education groups in the formal and informal sectors.

Among workers in the informal sector, we observe stronger differentials among elasticities across education groups within each age group (Figure 6). This might be an indication of higher economic inequality within the informal sector by educational attainment, compared to workers in the formal sector.

5. Final considerations

Our study estimates variations in individual male earnings living in Brazilian urban locations, based on a series of individual-level and area-level characteristics. In terms of contextual information, we advance beyond the preceding literature by considering not only the influence of demographic and educational compositions (proportion of males in age-education groups), but also compositions of the formal/informal sector (formal and informal jobs). In relation to individual-level variables, older and better educated workers have higher earnings. White, married, non-protestant men have higher earnings than other groups, as well as those living in the Center-West and Southeast regions. Moreover, workers in the formal sector tend to have higher earnings than those in the informal sector.

Considering area-level variables, estimations suggest that compositions of the workforce are associated with levels of earnings. Higher proportions of workers in age-education groups tend to have stronger negative associations with individual earnings among those with lower education (less than primary completed and primary completed). Thus, higher proportions of male workers generate even lower earnings for the least-educated individuals who already have lower earnings. These results for proportions of low-educated workers are consistent with previous studies, which indicate that age-education groups are not perfect substitutes, generating negative associations of cohort size with income of individual workers.

Positive associations of group proportions with individual earnings are stronger for workers with university education, compared to those with secondary education. We also know that there are higher proportions of male workers with secondary education than with university education. These results are an indicative that labor markets are requiring workers with higher qualifications (university) than with mid-level qualifications (secondary). These models capture two sets of disadvantages for workers with secondary education: (1) They already have lower levels of

earnings than those with university education. This finding is indicated by age-education indicators (individual-level variables). (2) Workers with secondary education compete with a bigger cohort in the labor markets, which does not benefit their earnings at the same level as observed for workers with university education. This statement is suggested by the effects of proportions in age-education groups (area-level variables). There has been an increase in the demand for high-educated workers in Brazil during recent decades, which decreases the negative effects of the supply of workers with secondary or university education over time.

For results concerning formal/informal sector, workers in the formal sector have higher earnings than those in the informal sector. Interaction of age-education indicators with formal/informal sector indicate that individual workers in the formal sector have higher earnings across all age-education groups. These considerably higher earnings are especially observed among individual workers with university education in the formal sector.

We also estimated that recent increases in the proportion of workers in the labor market did not generate negative associations with individual earnings. This result is an indication that the labor market is absorbing the increasing share of workers in the formal sector.

Models estimated separately by formal/informal sector indicate that higher group proportions generate stronger positive associations with individual earnings for workers with secondary and university education in the formal sector. These effects are not so strong among workers in the informal sector. Higher proportions of workers with less than primary education have negative associations with individual earnings, especially for those in the informal sector. The proportion of these least educated workers have been decreasing over time, but they are not benefiting from the lower competition in the labor markets. This is an indication that the Brazilian labor markets are not absorbing the work of least educated workers. Furthermore, results suggest stronger differentials on individual earnings across education groups for workers in the informal sector. This finding suggests higher levels of economic inequality by education attainment in the informal sector, compared to workers in the formal sector.

Overall, our results suggest that the Brazilian labor market is relatively integrated, instead of presenting two segmented sectors. However, as observed by other studies, workers in the formal and informal sectors have specific characteristics in terms of age and education. There is a higher concentration of younger and less educated workers in the informal sector, compared to the formal sector.

References

Almeida, E., Araújo, V., & Gonçalves, S. (2025). The urban wage premium in a labor market with informality. The Annals of Regional Science, 74(2), 43.

Amaral, E. F. L. (2012). The decomposition of economic outcomes as a result of changes in Brazil's male age-education structure. *Population Research and Policy Review*, 31(6), 883-905.

Amaral, E. F. L., Almeida, M. E., Rios-Neto, E. L. G., & Potter, J. E. (2013a). Effects of the age-education structure of female workers on male earnings in Brazil. *Poverty & Public Policy*, 5(4), 336-353.

Amaral, E. F. L., Potter, J. E., Hamermesh, D. S., & Rios-Neto, E. L. G. (2013b). Age, education and earnings in the course of Brazilian development: does composition matter? *Demographic Research*, 28(20), 581-612.

Amaral, E. F. L., Queiroz, B. L., & Calazans, J. A. (2015). Demographic changes, educational improvements, and earnings in Brazil and Mexico. *IZA Journal of Labor & Development*, 4(23), 1-21.

Amaral, E. F. L., Rios-Neto, E. L. G., & Potter, J. E. (2012). Long term influences of age-education transition on the Brazilian labour market. *Bulletin of Latin American Research*, 31(3), 302-319.

Amaral, E. F. L., Rios-Neto, E. L. G., & Potter, J. E. (2016). The influence of internal migration on male earnings in Brazil, 1970-2000. *Migration and Development*, 5(1), 55-78. doi:http://dx.doi.org/10.1080/21632324.2015.1038010.

Barbosa Filho, F. d. H., & Moura, R. L. d. (2015). Evolução recente da informalidade do emprego no Brasil: Uma análise segundo as características da oferta de trabalho e o setor. *Pesquisa e Planejamento Econômico*, 45(1), 101-123.

Bargain, O., & Kwenda, P. (2014). The informal sector wage gap: New evidence using quantile estimations on panel data. *Economic Development and Cultural Change*, 63(117-153).

Barro, R. J., & Lee, J. W. (2001). International data on educational attainment: Updates and implications. *Oxford Economic Papers*, 53(3), 541-563.

Barros, R. P. d., & Ulyssea, G. (2010). On the empirical content of the formal-informal labor market segmentation hypothesis. *Brazilian Review of Econometrics*, 30(2), 289-310.

Berry, C., & Glaeser, E. (2005). The divergence of human capital levels across cities. *Papers in Regional Science*, 84(3), 407-444.

Binelli, C. (2016). Wage inequality and informality: Evidence from Mexico. *IZA Journal of Labor & Development*, 5(5), 1-18.

Black, D. (1998). Local human capital externalities: educational segregation and inequality. *Manuscript, London School of Economics*.

Borjas, G. J. (2003). The labor demand curve is downward sloping: Reexamining the impact of immigration on the labor market. *Quarterly Journal of Economics*, 118(4), 1335-1374.

Bosch, M., & Esteban-Pretel, J. (2015). The labor market effects of introducing unemployment benefits in an economy with high informality. *European Economic Review*, 75, 1-17.

Botelho, F., & Ponczek, V. (2011). Segmentation in the Brazilian labor market. *Economic Development and Cultural Change*, 59(437-463).

Carneiro, F., & Henley, A. (2001). Modelling formal vs. informal employment and earnings: Micro-econometric evidence for Brazil. *University of Wales at Aberystwyth, Management & Business Working Paper*, 2001-15.

Charlot, O., Malherbet, F., & Terra, C. (2015). Informality in developing economies: Regulation and fiscal policies. *Journal of Economic Dynamics and Control*, 51, 1-27.

Engbom, N., Gonzaga, G., Moser, C., & Olivieri, R. (2022). Earnings inequality and dynamics in the presence of informality: The case of Brazil. Quantitative Economics, 13(4), 1405-1446.

Fajnzylber, P., Maloney, W. F., & Montes-Rojas, G. V. (2011). Does formality improve micro-firm performance? Evidence from the Brazilian SIMPLES program. *Journal of Development Economics*, 94, 262-276.

Gasparini, L., & Tornarolli, L. (2009). Labor informality in Latin America and the Caribbean: Patterns and trends from household survey microdata. *Revista Desarrollo y Sociedad*, 63, 13-80.

Gomes, Magno, et al. (2025). The cost of informality in Brazilian wages–an updated discussion. Applied Economics, 1-15.

Gong, X., & Van Soest, A. (2002). Wage differentials and mobility in the urban labour market: A panel data analysis for Mexico. *Labour Economics*, 9(4), 513-529.

Hamermesh, D. (1993). Labor Demand. Princeton: Princeton University Press.

Hout, M. (2012). Social and economic returns to college education in the United States. *Annual Review of Sociology*, 38, 379-400.

Jaume, D. (2017) 'The labor market effects of an educational expansion. A theoretical model with applications to Brazil' D. o. E. Cornell University. Available at: https://ideas.repec.org/jmp/2017/pja468.pdf.

Khamis, M. (2013). Does the minimum wage have a higher impact on the informal than on the formal labour market? Evidence from quasi-experiments. *Applied Economics*, 45(4), 477-495.

Lam, D., & Marteleto, L. (2005). Small families and large cohorts: The impact of the demographic transition on schooling in Brazil. In C. B. Lloyd, J. R. Behrman, N. P. Stromquist, & B. Cohen (Eds.), *The Changing Transitions to Adulthood in Developing Countries: Selected Studies* (pp. 56-83). Washington, DC: The National Academies Press.

Lam, D., & Marteleto, L. (2008). Stages of the demographic transition from a child's perspective: Family size, cohort size, and children's resources. *Population and Development Review*, 34(2), 225-252.

Lustig, N., Lopez-Calva, L., & Ortiz-Juarez, E. (2013). Declining inequality in Latin America in the 2000s: The cases of Argentina, Brazil, and Mexico. *World Development*, 44, 129-141.

Marcílio, M. L. (2001). Why are Brazil's public schools so weak? Backwardness in education. *Braudel Papers*, 30, 3-11.

Marcílio, M. L. (2005). História da Escola em São Paulo e no Brasil. São Paulo: Imprensa Oficial do Estado.

Meghir, C., Narita, R., & Robin, J.-M. (2015). Wages and informality in developing countries. *American Economic Review*, 105(4), 1509-1546.

Mello, R. F., & Santos, D. D. (2009). Aceleração educacional e a queda recente da informalidade. *Boletim Mercado de Trabalho, IPEA*, 39, 27-34.

Mincer, J. (1974). Schooling, Experience, and Earnings. New York: National Bureau of Economic Research (NBER).

Monteiro, J. C. M., & Assunção, J. J. (2012). Coming out of the shadows? Estimating the impact of bureaucracy simplification and tax cut on formality in Brazilian microenterprises. *Journal of Development Economics*, 99, 105-115.

Moretti, E. (2004a). Estimating the social return to higher education: Evidence from longitudinal and repeated cross-sectional data. *Journal of Econometrics*, 121, 175-212.

Moretti, E. (2004b). Human capital externalities in cities. In J. V. Henderson, & J.-F. Thisse (Eds.), *Handbook of Urban and Regional Economics* (pp. 2063-3073). Amsterdam: North-Holland.

Moretti, E. (2004c). Workers' education, spillovers, and productivity: Evidence from plant-level production functions. *The American Economic Review*, 94(3), 656-690.

Moretti, E. (2011). Local labor markets. In O. Ashenfelter, & D. Card (Eds.), *Handbook of Labor Economics* (pp. 1237-1313). Amsterdam: North-Holland.

Mourão, A. N. M., Almeida, M. E., & Amaral, E. F. L. (2013). Seguro-desemprego e formalidade no mercado de trabalho brasileiro. *Revista Brasileira de Estudos de População*, 30(1), 251-270.

Narita, R. (2013). Self employment in developing countries: A search-equilibrium approach. *Working Paper Series, Department of Economics, FEA-USP*, 2013-21.

Neto, G., & Zylberstajn, H. (1999). O seguro-desemprego e o perfil dos segurados no Brasil: 1986–1998. (Paper presented at the Encontro Nacional de Economia, Belém)

Pardo, C., & Ruiz-Tagle, J. (2017). The dynamic role of specific experience in the selection of self-employment versus wage-employment. *Oxford Economic Papers*, 69(1), 189-212.

Paula, Á. d., & Scheinkman, J. A. (2007). The informal sector. *NBER Working Paper Series*, 13486.

Paz, L. S. (2014). The impacts of trade liberalization on informal labor markets: A theoretical and empirical evaluation of the Brazilian case. *Journal of International Economics*, 92, 330-348.

Piza, C. (2018). Out of the Shadows? Revisiting the impact of the Brazilian SIMPLES program on firms' formalization rates. *Journal of Development Economics*, 134, 125-132.

Potter, J. E., Schmertmann, C. P., Assunção, R. M., & Cavenaghi, S. M. (2010). Mapping the timing, pace, and scale of the fertility transition in Brazil. *Population and Development Review*, 36(2), 283-307.

Potter, J. E., Schmertmann, C. P., & Cavenaghi, S. M. (2002). Fertility and development: evidence from Brazil. *Demography*, 39(4), 739-761.

Queiroz, B. L., & Calazans, J. A. (2010). Os efeitos da concentração de capital humano no retorno privado e social da educaçao no Brasil. (Paper presented at the XVII Encontro Nacional de Estudos Populacionais, Caxambu, Brazil)

Queiroz, B. L., & Golgher, A. B. (2008). Human capital differentials across municipalities and states in Brazil. *Population Review*, 47(2), 25-49.

Ramos, L. (2002). A evolução da informalidade no Brasil metropolitano: 1991–2001. *IPEA Working Paper*, 914.

Rauch, J. E. (1993). Productivity gains from geographic concentration of human capital: Evidence from cities. *Journal of Urban Economics*, 34, 380-400.

Riani, J. L. R. (2005) Determinantes do resultado educacional no Brasil: Família, perfil escolar dos municípios e dividendo demográfico numa abordagem hierárquica e espacial. Universidade Federal de Minas Gerais (UFMG)

Rios-Neto, E. L. G., & Guimarães, R. R. M. (2010). The demography of education in Brazil: Inequality of educational opportunities based on grade progression probability (1986–2008). *Vienna Yearbook of Population Research*, 8(1), 283-312.

Rocha, R., Ulyssea, G., & Rachter, L. (2018). Do lower taxes reduce informality? Evidence from Brazil. *Journal of Development Economics*, 134, 28-49.

Ulyssea, G. (2005). Informalidade no mercado de trabalho brasileiro: Uma resenha da literatura. *IPEA Working Paper*, 1070.

Ulyssea, G. (2010). Regulation of entry, labor market institutions and the informal sector. *Journal of Development Economics*, 91(87-99).

Ulyssea, G. (2018). Firms, informality, and development: Theory and evidence from Brazil. *American Economic Review*, 108, 2015-2047.

Appendix A

Table A1. Urban male workers distributed into categories of independent variables and formal/informal sector (informal or formal), as percentage shares, Brazil, 1980–2010

Independent variables	1980		1991		2000		2010	
	Informal sector	Formal sector	Informal sector	Formal sector	Informal sector	Formal sector	Informal sector	Formal sector
Age-education indicators								
15-24 years; Less than primary completed	34.13	16.62	26.74	12.49	16.56	6.73	8.62	3.29
15-24 years; Primary completed	4.93	6.64	4.62	5.90	7.30	6.20	7.72	5.26
15-24 years; Secondary completed	1.62	3.84	1.92	4.07	3.93	6.76	5.84	8.62
15-24 years; University completed	0.15	0.24	0.15	0.35	0.20	0.38	0.28	0.62
25-34 years; Less than primary completed	18.61	20.01	20.63	14.99	17.21	11.73	11.12	6.64
25-34 years; Primary completed	1.63	4.66	3.90	6.50	4.83	6.54	5.38	5.77
25-34 years; Secondary completed	1.24	5.37	2.81	8.26	4.45	10.00	7.63	14.37
25-34 years; University completed	0.46	2.47	0.53	2.94	0.78	2.88	1.51	4.22
35-49 years; Less than primary completed	21.33	20.92	21.97	18.79	20.84	15.26	19.08	11.57
35-49 years; Primary completed	0.98	2.87	1.91	4.25	4.59	6.32	5.98	6.33
35-49 years; Secondary completed	0.74	2.89	1.46	5.54	4.30	9.78	6.56	12.03
35-49 years; University completed	0.36	2.20	0.52	4.12	1.06	5.24	1.50	5.07
50-64 years; Less than primary completed	13.00	8.75	11.72	8.67	10.86	7.16	12.01	6.94
50-64 years; Primary completed	0.37	0.90	0.47	0.94	1.20	1.34	2.67	2.48
50-64 years; Secondary completed	0.25	0.83	0.39	1.09	1.18	1.80	2.95	3.99
50-64 years; University completed	0.19	0.79	0.27	1.10	0.71	1.88	1.13	2.80
Race/color								
Non-white	52.19	34.35	55.56	38.92	49.37	37.56	55.83	45.97
White	47.81	65.65	44.44	61.08	50.63	62.44	44.17	54.03
Married								
Non-married	57.51	39.59	40.08	30.34	58.97	46.28	64.30	53.48
Married	42.49	60.41	59.92	69.66	41.03	53.72	35.70	46.52
Religion								
Non-protestant	94.77	93.97	92.63	91.89	86.48	86.46	80.32	79.49
Protestant	5.23	6.03	7.37	8.11	13.52	13.54	19.68	20.51
Region								
North	5.30	2.50	7.84	3.24	8.22	4.34	9.65	5.31
Northeast	29.38	13.87	31.09	14.88	27.30	15.42	27.75	15.95
South	11.36	17.09	12.59	17.32	13.26	18.11	12.89	17.73
Southeast	44.27	61.20	38.02	58.51	42.01	54.91	40.41	52.80
Center-West	9.69	5.33	10.45	6.04	9.21	7.22	9.29	8.21
Total	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**	**100.00**
Formal/informal sector								
Population percentage	22.65	77.35	30.79	69.21	40.91	59.09	33.45	66.55
Sample size	975,900	3,333,210	854,733	1,921,091	1,352,379	1,953,426	1,240,454	2,468,030
Total sample size	**4,309,110**		**2,775,824**		**3,305,805**		**3,708,484**	

Source: 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses (Brazilian Institute of Geography and Statistics – IBGE).

Table A2. Average real income of urban male workers by categories of independent variables and formal/informal sector (informal or formal), Brazil, 1980–2010

Independent variables	1980		1991		2000		2010	
	Informal sector	Formal sector	Informal sector	Formal sector	Informal sector	Formal sector	Informal Sector	Formal sector
Age-education indicators								
15-24 years; Less than primary completed	416.80	639.49	355.16	493.23	420.72	579.71	467.15	694.84
15-24 years; Primary completed	573.38	813.47	565.46	671.01	527.71	679.18	528.55	725.51
15-24 years; Secondary completed	955.42	1,307.42	798.16	999.18	842.36	1,024.30	748.15	939.00
15-24 years; University completed	1,523.25	2,636.32	1,222.29	1,757.34	1,545.82	2,325.39	1,569.66	1,829.81
25-34 years; Less than primary completed	717.37	1,048.75	570.31	755.21	705.90	857.04	681.08	878.81
25-34 years; Primary completed	1,346.28	1,636.21	975.39	1,117.13	1,108.13	1,225.89	912.40	1,044.38
25-34 years; Secondary completed	1,960.23	2,425.66	1,430.37	1,705.39	1,563.82	1,855.62	1,234.28	1,411.19
25-34 years; University completed	3,229.54	4,771.23	2,660.41	3,316.43	2,936.76	4,169.23	2,846.49	3,315.17
35-49 years; Less than primary completed	815.55	1,319.97	664.84	1,018.63	840.87	1,176.60	819.64	1,066.03
35-49 years; Primary completed	2,132.00	2,525.90	1,258.76	1,660.46	1,367.20	1,809.59	1,198.81	1,411.59
35-49 years; Secondary completed	3,233.28	3,792.14	1,975.94	2,535.42	2,148.13	3,032.83	1,720.32	2,096.14
35-49 years; University completed	5,631.51	6,693.26	4,300.66	5,066.40	4,461.99	6,478.57	4,217.73	5,161.21
50-64 years; Less than primary completed	745.45	1,326.77	612.53	1,003.57	843.11	1,373.27	839.15	1,205.08
50-64 years; Primary completed	2,332.67	2,930.67	1,573.44	2,096.54	1,593.31	2,484.86	1,325.19	1,736.50
50-64 years; Secondary completed	3,972.71	4,328.56	2,527.99	3,271.40	2,473.39	4,017.80	1,987.10	2,759.65
50-64 years; University completed	6,017.05	7,061.40	4,919.62	6,003.43	5,679.71	8,311.60	4,796.99	6,675.99
Race/color								
Non-white	574.27	1,014.89	519.55	896.46	700.38	1,192.20	798.49	1,260.80
White	940.12	1,891.40	862.05	1,707.01	1,232.43	2,383.37	1,352.00	2,196.53
Married								
Non-married	545.43	1,036.82	465.30	887.06	735.76	1,340.03	847.97	1,349.11
Married	1,024.99	1,953.09	809.90	1,611.23	1,306.00	2,449.32	1,390.94	2,242.22
Religion								
Non-protestant	745.50	1,596.51	669.12	1,406.29	967.72	1,988.86	1,044.25	1,841.85
Protestant	815.91	1,493.61	705.09	1,224.54	982.83	1,598.30	1,033.95	1,467.11
Region								
North	899.15	1,428.38	760.42	1,343.60	873.32	1,651.34	924.92	1,603.83

Northeast	511.63	1,268.53	450.02	1,015.66	642.31	1,436.47	702.38	1,402.27
South	832.87	1,452.88	721.12	1,283.73	1,052.49	1,889.65	1,182.19	1,776.59
Southeast	842.61	1,700.88	791.73	1,511.10	1,150.33	2,095.81	1,224.66	1,858.04
Center-West	862.49	1,674.90	769.01	1,494.39	1,083.97	2,074.89	1,271.70	2,004.30
Total	**749.18**	**1,590.31**	**671.77**	**1,391.55**	**969.76**	**1,935.99**	**1,042.24**	**1,765.12**

Note: Income adjusted by the national consumer price index (INPC) to correct for currency changes and inflation. Income is reported in 2010 values. INPC was developed by the Brazilian Institute of Geography and Statistics (IBGE) (http://drcalc.net/easycalc/correcao.asp).
Source: 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses (Brazilian Institute of Geography and Statistics – IBGE).

Table A3. Coefficients and standard errors estimated with ordinary least squares regression from Equation (1) for the logarithm of individual earnings as the dependent variable, urban male workers, Brazil, 1980–2010

Independent variables	1980	1991	2000	2010
Formal/informal sector				
Informal sector	ref.	ref.	ref.	ref.
Formal sector	0.371***	0.258***	0.281***	0.283***
	(0.001)	(0.001)	(0.001)	(0.001)
Age-education indicators				
15-24 years; Less than primary completed	ref.	ref.	ref.	ref.
15-24 years; Primary completed	-0.039***	-0.572***	-0.394***	0.114***
	(0.007)	(0.013)	(0.011)	(0.015)
15-24 years; Secondary completed	0.358***	-0.085***	-0.241***	-0.293***
	(0.008)	(0.012)	(0.008)	(0.009)
15-24 years; University completed	1.036***	0.378***	0.570***	0.483***
	(0.027)	(0.033)	(0.025)	(0.020)
25-34 years; Less than primary completed	-0.336***	0.405***	0.485***	0.235***
	(0.007)	(0.009)	(0.006)	(0.006)
25-34 years; Primary completed	0.273***	0.075***	-0.025**	-0.417***
	(0.008)	(0.012)	(0.011)	(0.015)
25-34 years; Secondary completed	0.564***	0.283***	0.112***	-0.142***
	(0.008)	(0.010)	(0.008)	(0.008)
25-34 years; University completed	1.202***	0.905***	0.959***	0.653***
	(0.009)	(0.013)	(0.010)	(0.009)
35-49 years; Less than primary completed	0.661***	0.714***	0.820***	0.500***
	(0.007)	(0.009)	(0.007)	(0.007)
35-49 years; Primary completed	0.751***	0.453***	0.424***	0.012
	(0.009)	(0.012)	(0.010)	(0.011)
35-49 years; Secondary completed	0.918***	0.781***	0.676***	0.280***
	(0.010)	(0.011)	(0.009)	(0.008)
35-49 years; University completed	1.400***	1.262***	1.331***	0.917***
	(0.009)	(0.011)	(0.009)	(0.009)
50-64 years; Less than primary completed	0.571***	0.698***	0.738***	0.446***
	(0.007)	(0.011)	(0.009)	(0.008)
50-64 years; Primary completed	0.861***	0.683***	0.534***	0.309***
	(0.013)	(0.018)	(0.015)	(0.012)
50-64 years; Secondary completed	1.080***	0.992***	0.960***	0.645***
	(0.015)	(0.018)	(0.014)	(0.010)
50-64 years; University completed	1.469***	1.418***	1.518***	1.209***
	(0.014)	(0.018)	(0.013)	(0.012)

(continue)

Independent variables	1980	1991	2000	2010
Proportions in age-education groups				
15-24 years; Less than primary completed	-1.143***	-1.588***	-1.737***	-3.337***
	(0.015)	(0.021)	(0.020)	(0.047)
15-24 years; Primary completed	-0.592***	6.669***	2.163***	-3.733***
	(0.071)	(0.160)	(0.106)	(0.153)
15-24 years; Secondary completed	-0.423***	8.369***	6.498***	3.520***
	(0.156)	(0.267)	(0.112)	(0.098)
15-24 years; University completed	-35.999***	71.660***	71.411***	6.067*
	(8.128)	(7.974)	(6.089)	(3.472)
25-34 years; Less than primary completed	2.101***	-3.507***	-3.639***	-3.593***
	(0.032)	(0.050)	(0.040)	(0.044)
25-34 years; Primary completed	4.493***	3.229***	6.655***	9.864***
	(0.197)	(0.203)	(0.201)	(0.284)
25-34 years; Secondary completed	5.748***	5.645***	7.814***	4.135***
	(0.166)	(0.148)	(0.111)	(0.064)
25-34 years; University completed	11.514***	14.690***	19.936***	11.365***
	(0.360)	(0.477)	(0.459)	(0.285)
35-49 years; Less than primary completed	-2.951***	-4.047***	-4.424***	-3.663***
	(0.032)	(0.044)	(0.035)	(0.034)
35-49 years; Primary completed	-0.683**	0.868***	1.241***	4.148***
	(0.295)	(0.326)	(0.178)	(0.186)
35-49 years; Secondary completed	9.508***	2.997***	3.908***	2.910***
	(0.353)	(0.237)	(0.119)	(0.080)
35-49 years; University completed	16.960***	10.220***	10.901***	11.971***
	(0.371)	(0.282)	(0.229)	(0.245)
50-64 years; Less than primary completed	-4.984***	-7.294***	-6.570***	-4.459***
	(0.056)	(0.079)	(0.070)	(0.059)
50-64 years; Primary completed	-7.437***	-9.369***	2.754***	-0.211
	(0.876)	(1.249)	(0.845)	(0.383)
50-64 years; Secondary completed	10.734***	1.145	4.239***	0.793***
	(1.275)	(1.121)	(0.632)	(0.236)
50-64 years; University completed	26.037***	18.686***	18.659***	12.714***
	(1.363)	(1.252)	(0.687)	(0.462)

(continue)

Independent variables	1980	1991	2000	2010
Race/color				
Non-white	ref.	ref.	ref.	ref.
White	0.190***	0.238***	0.204***	0.159***
	(0.001)	(0.001)	(0.001)	(0.001)
Marital status				
Non-married	ref.	ref.	ref.	ref.
Married	0.291***	0.326***	0.257***	0.200***
	(0.001)	(0.001)	(0.001)	(0.001)
Religion				
Non-protestant	ref.	ref.	ref.	ref.
Protestant	-0.031***	-0.021***	-0.035***	-0.046***
	(0.001)	(0.002)	(0.001)	(0.001)
Region				
North	-0.025***	0.006**	-0.104***	-0.067***
	(0.002)	(0.003)	(0.002)	(0.002)
Northeast	-0.309***	-0.406***	-0.347***	-0.271***
	(0.001)	(0.002)	(0.001)	(0.001)
South	-0.163***	-0.168***	-0.101***	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Southeast	ref.	ref.	ref.	ref.
Center-West	-0.070***	-0.024***	0.011***	0.098***
	(0.001)	(0.002)	(0.002)	(0.002)
Constant	8.491***	10.720***	5.455***	6.351***
	(0.003)	(0.005)	(0.003)	(0.005)
R^2	0.478	0.433	0.470	0.423
Sample size	4,309,104	2,775,824	3,305,805	3,708,484

Note: Robust standard errors are reported in parentheses. * Significant at p<0.1, ** Significant at p<0.05, *** Significant at p<0.01.
Source: 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses (Brazilian Institute of Geography and Statistics – IBGE).

Table A4. Coefficients and standard errors estimated with ordinary least squares regression from Equation (2) for the logarithm of individual earnings as the dependent variable, urban male workers, Brazil, 1980–2010

Independent variables	1980	1991	2000	2010
Formal/informal sector				
Informal sector	ref.	ref.	ref.	ref.
Formal sector	0.377***	0.207***	0.321***	0.441***
	(0.001)	(0.002)	(0.002)	(0.003)
Age-education indicators				
15-24 years; Less than primary completed	ref.	ref.	ref.	ref.
15-24 years; Primary completed	-0.074***	-0.619***	-0.375***	0.112***
	(0.008)	(0.013)	(0.012)	(0.016)
15-24 years; Secondary completed	0.318***	-0.165***	-0.198***	-0.170***
	(0.010)	(0.014)	(0.009)	(0.010)
15-24 years; University completed	0.716***	0.134***	0.478***	0.626***
	(0.036)	(0.042)	(0.029)	(0.025)
25-34 years; Less than primary completed	-0.281***	0.411***	0.607***	0.375***
	(0.007)	(0.010)	(0.007)	(0.007)
25-34 years; Primary completed	0.422***	0.060***	0.044***	-0.261***
	(0.010)	(0.013)	(0.011)	(0.015)
25-34 years; Secondary completed	0.679***	0.250***	0.188***	0.039***
	(0.011)	(0.012)	(0.009)	(0.009)
25-34 years; University completed	1.096***	0.812***	0.928***	0.819***
	(0.016)	(0.020)	(0.013)	(0.012)
35-49 years; Less than primary completed	0.658***	0.566***	0.842***	0.648***
	(0.008)	(0.010)	(0.007)	(0.008)
35-49 years; Primary completed	0.931***	0.363***	0.457***	0.162***
	(0.012)	(0.014)	(0.010)	(0.012)
35-49 years; Secondary completed	1.127***	0.661***	0.661***	0.447***
	(0.014)	(0.014)	(0.009)	(0.009)
35-49 years; University completed	1.563***	1.193***	1.252***	1.032***
	(0.016)	(0.020)	(0.012)	(0.013)
50-64 years; Less than primary completed	0.469***	0.523***	0.688***	0.521***
	(0.009)	(0.012)	(0.009)	(0.009)
50-64 years; Primary completed	0.898***	0.547***	0.510***	0.433***
	(0.020)	(0.024)	(0.016)	(0.013)
50-64 years; Secondary completed	1.148***	0.817***	0.874***	0.730***
	(0.025)	(0.026)	(0.016)	(0.012)
50-64 years; University completed	1.538***	1.267***	1.412***	1.206***
	(0.026)	(0.030)	(0.017)	(0.016)

(continue)

Independent variables	1980	1991	2000	2010
Interactions of age-education indicators and formal/informal sector				
15-24 years; Less than primary completed x Formal sector	ref.	ref.	ref.	ref.
15-24 years; Primary completed x Formal sector	0.062***	-0.020***	-0.011***	-0.040***
	(0.004)	(0.005)	(0.004)	(0.004)
15-24 years; Secondary completed x Formal sector	0.051***	0.068***	-0.072***	-0.148***
	(0.007)	(0.008)	(0.004)	(0.004)
15-24 years; University completed x Formal sector	0.350***	0.280***	0.124***	-0.178***
	(0.025)	(0.033)	(0.020)	(0.019)
25-34 years; Less than primary completed x Formal sector	-0.049***	-0.004	-0.135***	-0.172***
	(0.002)	(0.003)	(0.003)	(0.004)
25-34 years; Primary completed x Formal sector	-0.183***	-0.065***	-0.188***	-0.252***
	(0.006)	(0.006)	(0.004)	(0.005)
25-34 years; Secondary completed x Formal sector	-0.122***	0.006	-0.121***	-0.247***
	(0.008)	(0.007)	(0.005)	(0.004)
25-34 years; University completed x Formal sector	0.116***	0.078***	0.033***	-0.205***
	(0.013)	(0.017)	(0.010)	(0.009)
35-49 years; Less than primary completed x Formal sector	0.001	0.116***	-0.034***	-0.179***
	(0.002)	(0.003)	(0.003)	(0.004)
35-49 years; Primary completed x Formal sector	-0.199***	0.081***	-0.060***	-0.264***
	(0.009)	(0.009)	(0.005)	(0.005)
35-49 years; Secondary completed x Formal sector	-0.215***	0.112***	0.023***	-0.221***
	(0.010)	(0.010)	(0.005)	(0.005)
35-49 years; University completed x Formal sector	-0.164***	0.051***	0.086***	-0.144***
	(0.013)	(0.018)	(0.009)	(0.010)
50-64 years; Less than primary completed x Formal sector	0.081***	0.160***	0.073***	-0.076***
	(0.003)	(0.004)	(0.004)	(0.004)
50-64 years; Primary completed x Formal sector	-0.039**	0.138***	0.059***	-0.153***
	(0.017)	(0.020)	(0.010)	(0.007)
50-64 years; Secondary completed x Formal sector	-0.070***	0.177***	0.127***	-0.097***
	(0.021)	(0.022)	(0.010)	(0.007)
50-64 years; University completed x Formal sector	-0.070***	0.144***	0.125***	-0.002
	(0.023)	(0.027)	(0.012)	(0.012)

(continue)

Independent variables	1980	1991	2000	2010
Proportions in age-education groups				
15-24 years; Less than primary completed	-1.119***	-1.776***	-1.669***	-2.761***
	(0.015)	(0.022)	(0.020)	(0.049)
15-24 years; Primary completed	-0.719***	7.144***	2.076***	-3.127***
	(0.071)	(0.163)	(0.106)	(0.152)
15-24 years; Secondary completed	-0.451***	8.347***	6.623***	3.490***
	(0.156)	(0.269)	(0.113)	(0.099)
15-24 years; University completed	-27.537***	67.314***	70.429***	6.441*
	(8.125)	(7.956)	(6.079)	(3.491)
25-34 years; Less than primary completed	2.036***	-3.765***	-4.000***	-3.655***
	(0.032)	(0.050)	(0.040)	(0.045)
25-34 years; Primary completed	5.050***	4.036***	7.840***	10.629***
	(0.197)	(0.206)	(0.203)	(0.286)
25-34 years; Secondary completed	5.804***	5.735***	8.030***	4.317***
	(0.166)	(0.149)	(0.112)	(0.065)
25-34 years; University completed	11.506***	14.727***	19.749***	11.429***
	(0.360)	(0.477)	(0.460)	(0.285)
35-49 years; Less than primary completed	-2.918***	-3.850***	-4.416***	-3.726***
	(0.033)	(0.045)	(0.035)	(0.034)
35-49 years; Primary completed	-0.502*	0.784**	1.384***	5.115***
	(0.294)	(0.329)	(0.180)	(0.189)
35-49 years; Secondary completed	9.252***	2.905***	3.795***	3.040***
	(0.353)	(0.238)	(0.119)	(0.080)
35-49 years; University completed	16.797***	10.267***	10.753***	11.967***
	(0.371)	(0.283)	(0.229)	(0.245)
50-64 years; Less than primary completed	-4.555***	-6.982***	-6.389***	-4.404***
	(0.058)	(0.080)	(0.070)	(0.059)
50-64 years; Primary completed	-7.350***	-9.715***	2.053**	-0.247
	(0.876)	(1.251)	(0.848)	(0.387)
50-64 years; Secondary completed	10.827***	1.030	4.060***	0.688***
	(1.274)	(1.121)	(0.631)	(0.236)
50-64 years; University completed	26.025***	18.642***	18.657***	12.621***
	(1.363)	(1.252)	(0.685)	(0.461)

(continue)

Independent variables	1980	1991	2000	2010
Race/color				
Non-white	ref.	ref.	ref.	ref.
White	0.190***	0.237***	0.203***	0.159***
	(0.001)	(0.001)	(0.001)	(0.001)
Marital status				
Non-married	ref.	ref.	ref.	ref.
Married	0.292***	0.326***	0.257***	0.201***
	(0.001)	(0.001)	(0.001)	(0.001)
Religion				
Non-protestant	ref.	ref.	ref.	ref.
Protestant	-0.031***	-0.021***	-0.034***	-0.047***
	(0.001)	(0.002)	(0.001)	(0.001)
Region				
North	-0.027***	0.010***	-0.105***	-0.068***
	(0.002)	(0.003)	(0.002)	(0.002)
Northeast	-0.309***	-0.401***	-0.346***	-0.270***
	(0.001)	(0.002)	(0.001)	(0.001)
South	-0.163***	-0.168***	-0.101***	0.001
	(0.001)	(0.001)	(0.001)	(0.001)
Southeast	ref.	ref.	ref.	ref.
Center-West	-0.070***	-0.022***	0.012***	0.097***
	(0.001)	(0.002)	(0.002)	(0.002)
Constant	8.482***	10.786***	5.428***	6.224***
	(0.004)	(0.005)	(0.004)	(0.006)
R^2	0.479	0.434	0.471	0.424
Sample size	4,309,104	2,775,824	3,305,805	3,708,484

Note: Robust standard errors are reported in parentheses. * Significant at p<0.1, ** Significant at p<0.05, *** Significant at p<0.01.
Source: 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses (Brazilian Institute of Geography and Statistics – IBGE).

Table A5. Coefficients and standard errors estimated with ordinary least squares regression from Equation (3) for the logarithm of individual earnings as the dependent variable, urban male workers, Brazil, 1980–2010

Independent variables	1980	1991	2000	2010
Formal/informal sector				
Proportion of male workers in the formal sector	1.381***	1.921***	1.610***	1.442***
	(0.004)	(0.006)	(0.008)	(0.006)
Age-education indicators				
15-24 years; Less than primary completed	ref.	ref.	ref.	ref.
15-24 years; Primary completed	0.483***	0.286***	0.045***	0.107***
	(0.008)	(0.013)	(0.012)	(0.016)
15-24 years; Secondary completed	0.887***	0.667***	0.189***	0.252***
	(0.008)	(0.012)	(0.009)	(0.010)
15-24 years; University completed	1.464***	0.912***	0.862***	0.778***
	(0.028)	(0.034)	(0.026)	(0.020)
25-34 years; Less than primary completed	-0.079***	0.259***	0.402***	0.231***
	(0.007)	(0.009)	(0.006)	(0.006)
25-34 years; Primary completed	0.880***	0.869***	0.443***	0.071***
	(0.009)	(0.012)	(0.011)	(0.015)
25-34 years; Secondary completed	1.202***	1.106***	0.579***	0.413***
	(0.008)	(0.011)	(0.008)	(0.008)
25-34 years; University completed	1.736***	1.529***	1.290***	0.982***
	(0.009)	(0.013)	(0.010)	(0.010)
35-49 years; Less than primary completed	0.374***	0.453***	0.687***	0.395***
	(0.007)	(0.009)	(0.007)	(0.007)
35-49 years; Primary completed	1.183***	1.099***	0.793***	0.438***
	(0.009)	(0.013)	(0.010)	(0.012)
35-49 years; Secondary completed	1.434***	1.479***	1.107***	0.718***
	(0.010)	(0.011)	(0.009)	(0.009)
35-49 years; University completed	1.854***	1.866***	1.676***	1.236***
	(0.009)	(0.011)	(0.009)	(0.010)
50-64 years; Less than primary completed	0.462***	0.595***	0.659***	0.382***
	(0.008)	(0.011)	(0.009)	(0.008)
50-64 years; Primary completed	1.188***	1.157***	0.798***	0.541***
	(0.013)	(0.018)	(0.016)	(0.012)
50-64 years; Secondary completed	1.449***	1.490***	1.263***	0.906***
	(0.015)	(0.018)	(0.014)	(0.010)
50-64 years; University completed	1.822***	1.900***	1.806***	1.468***
	(0.014)	(0.018)	(0.013)	(0.012)

(continue)

Independent variables	1980	1991	2000	2010
Proportions in age-education groups				
15-24 years; Less than primary completed	-0.014	0.218***	-0.773***	-1.771***
	(0.016)	(0.022)	(0.021)	(0.050)
15-24 years; Primary completed	-3.226***	0.210	-0.443***	-1.942***
	(0.073)	(0.161)	(0.109)	(0.158)
15-24 years; Secondary completed	-5.117***	-0.024	3.112***	-0.610***
	(0.159)	(0.269)	(0.115)	(0.103)
15-24 years; University completed	-82.941***	32.559***	47.786***	-10.955***
	(8.471)	(8.085)	(6.234)	(3.487)
25-34 years; Less than primary completed	2.323***	0.070	-1.611***	-1.562***
	(0.032)	(0.050)	(0.041)	(0.046)
25-34 years; Primary completed	-3.597***	-4.502***	1.125***	3.806***
	(0.198)	(0.205)	(0.203)	(0.286)
25-34 years; Secondary completed	-1.731***	-1.165***	3.985***	0.768***
	(0.167)	(0.149)	(0.113)	(0.067)
25-34 years; University completed	0.750**	5.057***	14.396***	7.188***
	(0.368)	(0.481)	(0.468)	(0.288)
35-49 years; Less than primary completed	0.101***	-0.367***	-2.541***	-1.736***
	(0.034)	(0.045)	(0.037)	(0.035)
35-49 years; Primary completed	-6.104***	-6.586***	-2.417***	-0.524***
	(0.292)	(0.324)	(0.181)	(0.189)
35-49 years; Secondary completed	0.590*	-4.061***	0.503***	0.087
	(0.351)	(0.236)	(0.121)	(0.082)
35-49 years; University completed	8.797***	3.875***	7.332***	8.610***
	(0.374)	(0.284)	(0.233)	(0.247)
50-64 years; Less than primary completed	-1.654***	-2.866***	-4.261***	-2.466***
	(0.059)	(0.081)	(0.072)	(0.061)
50-64 years; Primary completed	-10.896***	-16.308***	-2.753***	-2.848***
	(0.882)	(1.249)	(0.859)	(0.389)
50-64 years; Secondary completed	2.460*	-6.512***	-1.453**	-1.393***
	(1.275)	(1.117)	(0.641)	(0.239)
50-64 years; University completed	18.403***	11.084***	13.741***	9.941***
	(1.358)	(1.247)	(0.697)	(0.468)

(continue)

Independent variables	1980	1991	2000	2010
Race/color				
Non-white	ref.	ref.	ref.	ref.
White	0.187***	0.214***	0.190***	0.147***
	(0.001)	(0.001)	(0.001)	(0.001)
Marital status				
Non-married	ref.	ref.	ref.	ref.
Married	0.334***	0.344***	0.280***	0.221***
	(0.001)	(0.001)	(0.001)	(0.001)
Religion				
Non-protestant	ref.	ref.	ref.	ref.
Protestant	-0.035***	-0.022***	-0.041***	-0.051***
	(0.001)	(0.002)	(0.001)	(0.001)
Region				
North	0.166***	0.382***	0.093***	0.122***
	(0.002)	(0.003)	(0.002)	(0.002)
Northeast	-0.118***	-0.079***	-0.154***	-0.088***
	(0.001)	(0.002)	(0.002)	(0.002)
South	-0.182***	-0.171***	-0.152***	-0.056***
	(0.001)	(0.001)	(0.001)	(0.001)
Southeast	ref.	ref.	ref.	ref.
Center-West	0.041***	0.195***	0.065***	0.125***
	(0.002)	(0.002)	(0.002)	(0.002)
Constant	7.550***	9.328***	4.704***	5.591***
	(0.005)	(0.007)	(0.006)	(0.006)
R^2	0.470	0.443	0.460	0.412
Sample size	4,309,104	2,775,824	3,305,805	3,708,484

Note: Robust standard errors are reported in parentheses. * Significant at p<0.1, ** Significant at p<0.05, *** Significant at p<0.01.
Source: 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses (Brazilian Institute of Geography and Statistics – IBGE).

Table A6. Coefficients and standard errors estimated with ordinary least squares regression from Equation (4) for the logarithm of individual earnings as the dependent variable, urban male workers in the formal sector, Brazil, 1980–2010

Independent variables	1980	1991	2000	2010
Age-education indicators				
15-24 years; Less than primary completed	ref.	ref.	ref.	ref.
15-24 years; Primary completed	-0.004	-0.701***	-0.375***	0.046***
	(0.008)	(0.016)	(0.014)	(0.015)
15-24 years; Secondary completed	0.367***	-0.110***	-0.253***	-0.137***
	(0.009)	(0.014)	(0.010)	(0.010)
15-24 years; University completed	1.043***	0.409***	0.621***	0.575***
	(0.028)	(0.036)	(0.028)	(0.021)
25-34 years; Less than primary completed	-0.413***	0.275***	0.485***	0.240***
	(0.007)	(0.011)	(0.007)	(0.006)
25-34 years; Primary completed	0.278***	-0.006	-0.090***	-0.261***
	(0.009)	(0.014)	(0.013)	(0.016)
25-34 years; Secondary completed	0.570***	0.245***	0.128***	-0.017**
	(0.009)	(0.012)	(0.009)	(0.009)
25-34 years; University completed	1.215***	0.865***	0.992***	0.730***
	(0.009)	(0.014)	(0.011)	(0.010)
35-49 years; Less than primary completed	0.560***	0.481***	0.781***	0.468***
	(0.008)	(0.012)	(0.009)	(0.007)
35-49 years; Primary completed	0.782***	0.448***	0.446***	0.072***
	(0.009)	(0.015)	(0.012)	(0.013)
35-49 years; Secondary completed	0.942***	0.762***	0.738***	0.372***
	(0.010)	(0.013)	(0.010)	(0.009)
35-49 years; University completed	1.406***	1.221***	1.377***	0.998***
	(0.009)	(0.012)	(0.009)	(0.010)
50-64 years; Less than primary completed	0.512***	0.621***	0.749***	0.501***
	(0.009)	(0.014)	(0.012)	(0.010)
50-64 years; Primary completed	0.872***	0.683***	0.660***	0.455***
	(0.013)	(0.020)	(0.020)	(0.015)
50-64 years; Secondary completed	1.095***	0.975***	1.080***	0.772***
	(0.015)	(0.020)	(0.017)	(0.012)
50-64 years; University completed	1.481***	1.393***	1.583***	1.324***
	(0.015)	(0.020)	(0.014)	(0.012)

(continue)

Independent variables	1980	1991	2000	2010
Proportions in age-education groups				
15-24 years; Less than primary completed	-1.042***	-1.933***	-1.301***	-1.087***
	(0.018)	(0.032)	(0.027)	(0.054)
15-24 years; Primary completed	-0.631***	7.518***	2.541***	-1.305***
	(0.074)	(0.194)	(0.131)	(0.151)
15-24 years; Secondary completed	-0.121	7.804***	7.230***	3.050***
	(0.162)	(0.297)	(0.127)	(0.103)
15-24 years; University completed	-16.674**	58.555***	80.043***	10.181***
	(8.379)	(8.526)	(6.779)	(3.731)
25-34 years; Less than primary completed	2.616***	-3.048***	-3.617***	-2.341***
	(0.034)	(0.063)	(0.050)	(0.050)
25-34 years; Primary completed	4.443***	3.506***	8.004***	8.542***
	(0.207)	(0.235)	(0.242)	(0.304)
25-34 years; Secondary completed	5.846***	5.420***	8.026***	3.876***
	(0.170)	(0.160)	(0.124)	(0.069)
25-34 years; University completed	11.937***	14.320***	21.245***	12.526***
	(0.365)	(0.491)	(0.487)	(0.301)
35-49 years; Less than primary completed	-2.294***	-2.864***	-3.850***	-2.623***
	(0.039)	(0.055)	(0.046)	(0.040)
35-49 years; Primary completed	-1.859***	-0.133	1.720***	4.669***
	(0.309)	(0.360)	(0.217)	(0.217)
35-49 years; Secondary completed	8.611***	2.533***	3.953***	3.060***
	(0.367)	(0.251)	(0.135)	(0.088)
35-49 years; University completed	17.136***	10.043***	11.506***	13.166***
	(0.382)	(0.288)	(0.241)	(0.251)
50-64 years; Less than primary completed	-4.084***	-6.666***	-5.670***	-3.518***
	(0.074)	(0.103)	(0.097)	(0.072)
50-64 years; Primary completed	-7.279***	-11.766***	0.512	-1.036**
	(0.919)	(1.365)	(1.058)	(0.472)
50-64 years; Secondary completed	10.324***	0.263	3.304***	0.926***
	(1.303)	(1.182)	(0.745)	(0.267)
50-64 years; University completed	25.776***	17.609***	19.756***	13.878***
	(1.389)	(1.296)	(0.744)	(0.492)

(continue)

Independent variables	1980	1991	2000	2010
Race/color				
Non-white	ref.	ref.	ref.	ref.
White	0.207***	0.255***	0.209***	0.163***
	(0.001)	(0.001)	(0.001)	(0.001)
Marital status				
Non-married	ref.	ref.	ref.	ref.
Married	0.289***	0.315***	0.242***	0.191***
	(0.001)	(0.002)	(0.001)	(0.001)
Religion				
Non-protestant	ref.	ref.	ref.	ref.
Protestant	-0.038***	-0.034***	-0.054***	-0.065***
	(0.001)	(0.002)	(0.001)	(0.001)
Region				
North	-0.129***	-0.044***	-0.097***	-0.040***
	(0.003)	(0.004)	(0.003)	(0.002)
Northeast	-0.288***	-0.408***	-0.301***	-0.197***
	(0.001)	(0.002)	(0.002)	(0.001)
South	-0.175***	-0.173***	-0.090***	0.001
	(0.001)	(0.002)	(0.001)	(0.001)
Southeast	ref.	ref.	ref.	ref.
Center-West	-0.113***	-0.061***	0.002	0.074***
	(0.002)	(0.003)	(0.002)	(0.002)
Constant	8.838***	11.026***	5.686***	6.513***
	(0.004)	(0.006)	(0.004)	(0.005)
R^2	0.441	0.407	0.465	0.408
Sample size	3,333,208	1,921,091	1,953,426	2,468,030

Note: Robust standard errors are reported in parentheses. * Significant at p<0.1, ** Significant at p<0.05, *** Significant at p<0.01.
Source: 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses (Brazilian Institute of Geography and Statistics – IBGE).

Table A7. Coefficients and standard errors estimated with ordinary least squares regression from Equation (5) for the logarithm of individual earnings as the dependent variable, urban male workers in the informal sector, Brazil, 1980–2010

Independent variables	1980	1991	2000	2010
Age-education indicators				
15-24 years; Less than primary completed	ref.	ref.	ref.	ref.
15-24 years; Primary completed	-0.127***	-0.601***	-0.323***	0.178***
	(0.017)	(0.022)	(0.017)	(0.026)
15-24 years; Secondary completed	0.359***	-0.259***	-0.146***	-0.282***
	(0.025)	(0.026)	(0.015)	(0.020)
15-24 years; University completed	0.987***	0.003	0.557***	0.592***
	(0.095)	(0.083)	(0.054)	(0.049)
25-34 years; Less than primary completed	0.117***	0.592***	0.617***	0.406***
	(0.015)	(0.015)	(0.009)	(0.010)
25-34 years; Primary completed	0.131***	-0.043*	0.036**	-0.468***
	(0.023)	(0.022)	(0.018)	(0.030)
25-34 years; Secondary completed	0.500***	0.101***	0.170***	-0.089***
	(0.031)	(0.025)	(0.016)	(0.017)
25-34 years; University completed	1.218***	0.817***	1.007***	0.808***
	(0.043)	(0.046)	(0.026)	(0.025)
35-49 years; Less than primary completed	0.946***	0.888***	0.909***	0.727***
	(0.014)	(0.016)	(0.010)	(0.011)
35-49 years; Primary completed	0.602***	0.228***	0.453***	0.109***
	(0.026)	(0.027)	(0.016)	(0.020)
35-49 years; Secondary completed	0.923***	0.529***	0.666***	0.404***
	(0.035)	(0.031)	(0.017)	(0.017)
35-49 years; University completed	1.557***	1.148***	1.314***	1.066***
	(0.036)	(0.045)	(0.024)	(0.029)
50-64 years; Less than primary completed	0.500***	0.552***	0.727***	0.586***
	(0.014)	(0.018)	(0.012)	(0.014)
50-64 years; Primary completed	0.877***	0.433***	0.448***	0.370***
	(0.038)	(0.041)	(0.024)	(0.020)
50-64 years; Secondary completed	1.106***	0.769***	0.816***	0.701***
	(0.059)	(0.051)	(0.025)	(0.020)
50-64 years; University completed	1.510***	1.160***	1.434***	1.198***
	(0.063)	(0.064)	(0.031)	(0.030)

(continue)

Independent variables	1980	1991	2000	2010
Proportions in age-education groups				
15-24 years; Less than primary completed	-1.317***	-1.863***	-1.664***	-2.909***
	(0.025)	(0.031)	(0.026)	(0.069)
15-24 years; Primary completed	-0.601***	6.740***	1.487***	-4.096***
	(0.179)	(0.293)	(0.164)	(0.252)
15-24 years; Secondary completed	-2.065***	10.638***	5.693***	4.535***
	(0.512)	(0.626)	(0.222)	(0.226)
15-24 years; University completed	-115.179***	104.151***	47.942***	5.659
	(27.449)	(21.340)	(13.222)	(9.362)
25-34 years; Less than primary completed	-0.536***	-5.110***	-4.133***	-4.185***
	(0.080)	(0.084)	(0.060)	(0.074)
25-34 years; Primary completed	11.868***	5.657***	7.721***	14.155***
	(0.596)	(0.419)	(0.347)	(0.585)
25-34 years; Secondary completed	9.032***	8.035***	8.150***	5.255***
	(0.677)	(0.397)	(0.241)	(0.158)
25-34 years; University completed	4.389**	14.389***	14.784***	10.213***
	(1.871)	(1.951)	(1.315)	(0.846)
35-49 years; Less than primary completed	-4.614***	-5.745***	-4.896***	-4.488***
	(0.060)	(0.075)	(0.054)	(0.056)
35-49 years; Primary completed	11.026***	4.343***	1.079***	5.309***
	(0.926)	(0.809)	(0.314)	(0.349)
35-49 years; Secondary completed	15.643***	5.767***	3.447***	3.042***
	(1.244)	(0.742)	(0.249)	(0.182)
35-49 years; University completed	15.313***	11.513***	8.120***	9.257***
	(1.541)	(1.431)	(0.713)	(0.881)
50-64 years; Less than primary completed	-5.220***	-7.498***	-6.888***	-5.379***
	(0.094)	(0.126)	(0.099)	(0.097)
50-64 years; Primary completed	-8.963***	-1.216	4.611***	0.210
	(2.810)	(3.107)	(1.410)	(0.665)
50-64 years; Secondary completed	11.831**	3.736	5.959***	0.191
	(5.262)	(3.400)	(1.179)	(0.490)
50-64 years; University completed	26.353***	27.094***	16.060***	10.474***
	(6.200)	(4.703)	(1.699)	(1.279)

(continue)

Independent variables	1980	1991	2000	2010
Race/color				
Non-white	ref.	ref.	ref.	ref.
White	0.134***	0.192***	0.195***	0.153***
	(0.002)	(0.002)	(0.002)	(0.002)
Marital status				
Non-married	ref.	ref.	ref.	ref.
Married	0.302***	0.350***	0.282***	0.228***
	(0.002)	(0.002)	(0.002)	(0.002)
Religion				
Non-protestant	ref.	ref.	ref.	ref.
Protestant	-0.007**	0.014***	-0.006***	-0.010***
	(0.003)	(0.004)	(0.002)	(0.002)
Region				
North	0.153***	0.081***	-0.126***	-0.133***
	(0.004)	(0.004)	(0.003)	(0.003)
Northeast	-0.327***	-0.369***	-0.398***	-0.390***
	(0.002)	(0.003)	(0.002)	(0.002)
South	-0.113***	-0.155***	-0.126***	-0.000
	(0.003)	(0.003)	(0.002)	(0.002)
Southeast	ref.	ref.	ref.	ref.
Center-West	0.029***	0.052***	0.013***	0.121***
	(0.003)	(0.003)	(0.003)	(0.003)
Constant	8.536***	10.793***	5.448***	6.280***
	(0.006)	(0.007)	(0.005)	(0.007)
R^2	0.303	0.286	0.327	0.307
Sample size	975,896	854,733	1,352,379	1,240,454

Note: Robust standard errors are reported in parentheses. * Significant at p<0.1, ** Significant at p<0.05, *** Significant at p<0.01.
Source: 1980, 1991, 2000, and 2010 Brazilian Demographic Censuses (Brazilian Institute of Geography and Statistics – IBGE).