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Individual earnings differentials by education level in Brazil: the greater inequality of the informal sector

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Abstract

In Brazil, workforce composition by age-education groups and distribution between the formal and informal sectors changed from 1980 to 2010. We estimate whether these area-level compositions reduced earnings of the least-educated individuals further. Our main hypothesis is that earnings are lower for residents of areas with higher proportions of less-educated and informal sector workers. Ordinary least squares (OLS)

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regressions performed on census data are used to estimate variations in male urban workers' individual earnings, including several individual- and area-level independent variables. The main results suggest that an increase in the proportion of formal sector workers is positively associated with individual earnings. Higher group proportions have the strongest positive associations with individual earnings for formal sector workers with secondary and university education. Labour markets are not absorbing the least educated workers. The largest earnings differentials by education level are observed among informal sector workers, indicating greater economic inequality within this sector.

Keywords: informal sector, men, income, labour market, workforce, age, education, population composition, Brazil.

Resumen

El Brasil experimentó cambios en la composición de la fuerza laboral por grupos de edad y nivel educativo, y en la distribución entre los sectores formal e informal entre 1980 y 2010. Se estima aquí si estas composiciones a nivel de área redujeron aún más los ingresos de las personas con menor nivel educativo. La hipótesis principal es que los ingresos son más bajos para quienes viven en áreas donde hay mayor proporción de trabajadores con bajo nivel educativo y empleados en el sector informal. Se utilizaron regresiones de mínimos cuadrados ordinarios sobre datos censales para estimar las variaciones en los ingresos individuales de trabajadores hombres que viven en zonas urbanas, incluidas algunas variables independientes a nivel individual y de área. Los resultados principales sugieren que un aumento en la proporción de trabajadores del sector formal está asociado positivamente con los ingresos individuales. Las proporciones más altas de grupos tienen las asociaciones positivas más fuertes con los ingresos individuales para trabajadores del sector formal con educación secundaria y universitaria. Los mercados laborales no están absorbiendo a los trabajadores con menor nivel educativo. Las mayores diferencias de ingresos según el nivel educativo se observan entre los trabajadores del sector informal, lo que es evidencia de una mayor desigualdad económica dentro de este sector.

Palabras clave: sector informal, hombres, ingresos, mercado de trabajo, mano de obra, edad, educación, composición de la población, Brasil.

Introduction

This study estimates the associations between the individual earnings of workers and the composition of the informal sector and demographic and educational structures. The analysis is based on male workers living in urban areas in Brazil between 1980 and 2010. Previous studies were based on area-level models, which demonstrated negative associations between higher proportions of older and better-educated workers and earnings, but these effects have been decreasing over time (Amaral, 2012; Amaral et al., 2012; 2013a; 2013b; 2015; 2016). Workers with primary education or less have not seen their earnings improve, despite the fact that they account for an increasingly smaller share of the population. The earnings of workers with secondary education are already lower than those of workers with university education, and are most affected by demographic and educational compositions. The Brazilian labour market appears to be absorbing and demanding workers with university education.

The main contribution of the present study is the estimation of individual-level models that evaluate associations of the individual earnings of workers with area-level variables related to the composition of formal and informal sectors. It also furthers the discussion on formal and informal labour markets in developing economies marked by considerable income inequality. In Brazil, the formal and informal sectors are determined by the existence of work contracts and labour law coverage. The latter is non-existent in the informal sector, and we were able to determine whether persons worked in the formal or informal sector on the basis of their response to the question about whether or not they had a *carteira de trabalho* (employment card). Our analysis sheds light on the important discussion on labour market segmentation in Brazil. We estimate the association between the individual earnings of workers and the regional composition of the workforce based on age, education and sector (formal or informal). Our main hypothesis is that individual earnings are lower among workers living in areas with a higher proportion of less-educated workers, or with a higher proportion of informal sector workers.

Brazil is undergoing rapid demographic and educational change that reflects significant regional and social inequalities (Barro and Lee, 2001; Lam and Marteleto, 2005, 2008; Marcílio, 2001, 2005; Potter et al., 2002, 2010; Riani, 2005; Gong and Van Soest, 2002; Lustig et al., 2013; Rios-Neto and Guimarães, 2010). The proportion of informal jobs in the country has also decreased significantly from 2000 to 2010 (Barbosa Filho and Moura, 2015; Mello and Santos, 2009; Ramos, 2002; Ulyssea, 2005 and 2018). Our analysis considers regional variations over time for compositions based on demography, education and sector (formal or informal). This paper is part of a broader discussion on regional differences in income and economic growth. We provide estimations that simultaneously analyse associations between three main area-level factors (compositions of education groups, age structure and distribution between the formal and informal sectors) and individual earnings for men.

In the following section, we provide an overview of previous studies related to demographic and educational changes, as well as formal or informal sector characteristics in developing countries. Next, we present 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 demographic census microdata for Brazil for the period 1980–2010. We include further explanations about how we estimated models to evaluate how individual earnings are associated with workforce composition based on age, education and sector (formal or informal). We then present the results of our analysis, which confirm the association of these factors with individual earnings. We conclude with some final considerations that summarize our findings and contribution to this scientific field.

A. Background

The study of wage differentials in developing countries is important, since economic differentials in these countries are larger than those in developed countries. This section briefly summarizes studies on the effects of geographical concentration of well-educated workers and cohort size on earnings. We also discuss factors that encourage the emergence of informal sectors, emphasizing the specific case of Brazil. The analysis indicates the importance of investigating the association between increasing informality and variation in informality across regions and age groups in Brazil and labour market outcomes.

1. Variations in earnings owing to changes in demographic and educational compositions

There is an extensive literature indicating the close link between the concentration of different groups of individuals in some areas and the labour market outcomes in those areas, including works by Black (1998) and Rauch (1993). In addition, Berry and Glaeser (2005) show that the concentration of skilled people in some regions of the United States has a positive effect on productivity gains, which further increases the concentration of qualified people in those areas. The concentration of more qualified workers results in higher wages for all workers in those areas (Moretti, 2004a; 2004b; 2004c; 2011) and a larger proportion of people with higher educational attainment benefits the population because of a spillover effect (Moretti, 2011; Hout, 2012). Thus, the concentration of skilled workers has a positive effect on individual incomes (Moretti, 2004a; 2004b; 2004c).

Several studies have been conducted on Brazil's labour market and its relation to income inequality and economic conditions. However, there are few comparative studies of recent trends in local labour markets. In some studies, authors analysed the concentration of human capital in Brazil (Queiroz and Golgher, 2008) while in others, they emphasized positive effects of the concentration of skilled workers in the Brazilian labour market (Queiroz and Calazans, 2010). Additional research showed associations between variations in cohort size across municipalities in Brazil and workers' earnings (Amaral, 2012; Amaral et al., 2012; 2013a; 2013b; 2015; 2016). More specifically, it indicated that larger proportions

of the population in age-education groups are negatively associated with the income of these groups. These effects are stronger for groups with higher educational attainment, but decline over time. Thus, the concentration of skilled workers in specific locations may generate benefits for some groups but negative outcomes for others.

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

However, the Brazilian labour market is also marked by high levels of informality (Gasparini and Tornarolli, 2009). Workers in the informal sector generally receive lower wages and hold less productive jobs. The concentration of informal workers and the distribution of workers by education level is strongly associated with labour market outcomes.

2. The informal sector in developing countries

Informal labour markets are prevalent in low- and middle-income countries, often representing between 25% and 80% of GDP, compared with 10%–15% in high-income nations (Gasparini and 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, labour market rigidity and corruption, often correlating with low aggregate welfare and considerable wage inequality (Binelli, 2016). In Mexico, between 1987 and 2002, the informal sector accounted for over 60% of total wage inequality. Informality and inequality increased as a result of the 1995 financial crisis, which was an instrumental variable in the analysis of income variation.

Informal workers face greater employment instability and limited access to unemployment benefits (Bosch and Esteban-Pretel, 2015). Approximately 50% of unemployment inflows in Brazil and Mexico stem from informal jobs. In spite of 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 and Ruiz-Tagle (2017) suggest that universal unemployment insurance would slightly increase self-employment, particularly among inexperienced and less-educated workers, driven by risk aversion and sector-specific preferences. Labour

regulations such as minimum wage laws also influence informal markets. In Argentina and Brazil, increases in the minimum wage raised informal workers' earnings without generating comparable gains for formal workers (Khamis, 2013). This suggests partial compliance with labour laws: many informal employers respect minimum wage regulations despite avoiding social security contributions (Bargain and Kwenda, 2014). Studies focused on Brazil vary; some identify labour market segmentation with wage disparities (Botelho and Ponczek, 2011), while others support a competitive view, whereby informal jobs may be more desirable depending on individual preferences and constraints (Carneiro and Henley, 2001).

3. Informal sector in Brazil

In light of the large numbers of workers in the informal sector in developing countries, it is important to analyse job trends in the Brazilian labour market. The social protection system has undergone several changes and its coverage has expanded, especially since the adoption of the 1988 Constitution. However, informal sector job rates are still high, which presents a major challenge for Brazil's economy (Ulyssea, 2005; Ramos, 2002; Mello and Santos, 2009; Barbosa Filho and Moura, 2015; Botelho and Ponczek, 2011; Carneiro and Henley, 2001). The large proportion of workers in the informal sector is a structural, not cyclical, problem of the Brazilian labour market. Between 1990 and 2000, significant increases in the share of informal sector jobs resulted from the greater number of persons who were self-employed or without a formal contract. However, between 2000 and 2009, jobs in the informal sector declined steadily, as the country recorded strong economic growth. More specifically, the share of informal sector workers increased from 54.3% in 1992 to 56.2% in 1999, then fell to 48.7% in 2009 (Neto and Zylberstajn, 1999; Mourão et al., 2013). This decline stemmed partly from changes in the composition of employed persons, but was due mainly to improvements in educational distribution (Mello and Santos, 2009). Even with this recent decrease, the large proportion of jobs in the informal sector (around 32.5% in 2012) poses a risk to the country's economy (Barbosa Filho and Moura, 2015). Some studies suggest that over 40% of the Brazilian workforce was employed in the informal sector in 2015 (Meghir et al., 2015).

Studies indicate that most self-employed workers in Brazil have limited education, evade taxes and are unlikely to employ other people or expand their businesses (Narita, 2013; Botelho and Ponczek, 2011; Bargain and Kwenda, 2014). According to Narita (2013), on the basis of data from 2002 to 2007, older persons depended more on self-employment than younger people because of lower levels of educational attainment. At the same time, earnings were proportional to the increase in age, indicating that older and more experienced workers were more successful than younger workers. Simulations indicate that an increase in informal sector workers has limited effects on employment composition, reduces the lowest wages (i.e. increases wage inequality) and improves the well-being of formal sector workers.

To understand the effects of the high percentage of informal sector workers in Brazil, different studies have set out to investigate the issue in the country and its regions. Meghir et al. (2015) proposed a job search model that incorporated strategies by the government to enforce formal sector employment and regulatory costs (e.g. taxes and minimum wages). The results indicated that a firm could make similar profits in the formal and informal sectors. This suggests that the incidence of informal sector jobs is influenced by institutional requirements for firms in the formal sector and by penalties for those in the informal sector. Informal firms pay higher wages than formal firms when productivity is controlled for, but are less productive on average, so that average earnings are higher in the formal sector than in the informal sector. A labour market with high levels of informal employment reduces competition for workers and makes it harder for workers to get higher-productivity jobs. Simulations indicate that policies to reduce informal sector working disproportionately affect larger informal firms, do not increase unemployment, improve the allocation of workers to better firms in the formal sector, increase wages and enhance overall welfare.

Rocha et al. (2018) investigated whether lower taxes reduced informal sector working after the implementation of the Individual Micro-Entrepreneur (MEI) programme by the federal government in 2009. This programme aims to foster entrepreneurship, create new formal businesses, increase tax registration, improve compliance by small informal firms and increase contributions to the social security system. The findings indicated that reducing entry costs had no significant effect on the level of informal sector employment, but that reducing tax obligations increased formalization. The results also suggested that the main factor inhibiting formalization was the cost of staying formal rather than registration costs. For these reasons, governments seeking to promote the formal economy should implement formal-friendly tax laws rather than just regulating the cost of entry. The Integrated Tax and Contribution Payment System for Micro and Small Enterprises (SIMPLES) programme, implemented in 1996 to simplify taxation for smaller firms, consolidated multiple federal taxes into a single monthly payment. Early studies (Fajnzylber et al., 2011; Monteiro and Assunção, 2012) reported positive effects on formalization, employment and firm performance in eligible sectors. However, Piza (2018) found no significant impact, attributing the earlier findings to measurement errors and seasonal shocks that had not been accounted for: his analysis suggested that SIMPLES had no short-term effect on formalization rates when improved empirical methods were used.

An important question raised by Barros and Ulyssea (2010) in relation to the high level of informal working in the Brazilian labour market is whether workers with similar productivity receive higher wages in the formal sector than in the informal sector. Controlling for productivity, previous analyses had obtained mixed results. A related question is whether variations in the wages of equally skilled workers alone can be taken as an indication of a segmented labour market. On the basis of different models, their analysis suggests that it is difficult to determine the existence of labour market segmentation by analysing wage differentials only (Barros and Ulyssea, 2010). To deal with these analytical challenges, the models we present in this paper investigate individual earnings differentials by considering both individual and associated contextual factors.

Mourão et al. (2013) analysed Brazilian household surveys between 1999 and 2009 to ascertain the association between unemployment benefits and informal sector working. Their results suggest that the incidence of formal employment among workers who have received unemployment benefits decreases by 42%. Analysis of interactive terms indicates that increases in the real value of benefits since 1999 have not significantly improved the incidence of formal employment among workers.

Despite the extensive literature on the formal and informal sectors in Brazil, there is no consensus about the existence, direction or magnitude of wage variations due to segmentation of the labour market into formal and informal activities. For instance, Almeida et al. (2025) investigated urban wage premiums in Brazil and found that research which did not include the informal sector might be underestimating the magnitude of these. Engbom et al. (2022) indicated that workers in the informal sector had to contend with large wage penalties and more variable wage levels. Lastly, Gomes et al. (2025) found that informal wage penalties were greater for less educated and more vulnerable workers.

B. Data and methods

We investigate associations between the composition of employment by sector (formal or informal), age and education level with the individual earnings of male workers aged from 15 to 64 in Brazilian urban areas between 1980 and 2010. On the basis of the studies discussed in the previous section, we hypothesize that individual earnings are lower for workers living in areas where higher proportions of them are less educated. Moreover, we expect that workers residing in areas with higher proportions employed in the informal sector will experience even lower levels of individual earnings. To test these hypotheses, we analyse associations between the composition of the urban workforce by sector (formal or informal), age and education with workers' individual earnings. This analysis uses local-level data to construct age-education cells and follows their distributions over time. Microdata from the Brazilian Demographic Censuses are employed to estimate how composition by sector and age-education structure at the local level is correlated with the individual earnings of male workers. We analyse data from the 1980, 1991, 2000 and 2010 Brazilian Demographic Censuses, obtained from the Brazilian Institute of Geography and Statistics (IBGE).

As regards our methodological strategies, prospective workers are taken to have three choices: self-employment (S), informal employment (I) and formal employment (F). Those in sectors S and I receive no social insurance benefits, and in particular have no unemployment benefit coverage and no health insurance coverage. We assume that workers choose a sector by finding:

$$U^* = argmax[U(W^S), U(W^I), U(W^F)] \quad (1)$$

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. because they have more dependents. Then W^F will be the utility-maximizing choice, especially in the prime age years, because the benefits of having social insurance are greatest in those years. Moreover, this will be especially true for married men compared to unmarried men, with the difference by marital status being reversed, if anything, for women.

Apart from this, the choice will of course depend on relative wages in the three sectors. These are endogenous to choices in the entire labour market, as well as being affected by issues of individual self-selection. As an instrument for opportunities in the different sectors, we can write:

$$W^I = G_I(N^i), G_I' < 0 \tag{2}$$

and

$$W^F = G_F(N^i), G_F' < 0 \tag{3}$$

where N^i is the fraction of workers in the i-th person's labour market who are in his or 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 or her labour market. Thus, we should expect that the propensity to choose self-employment will be greater when N^i is larger, other things being 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 stage, we perform the analysis only for urban male workers. We categorize age information into four groups: youth (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). Levels of education are 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 completed educational levels. The four education groups are: (i) less than primary education; (ii) complete primary and incomplete secondary education; (iii) complete secondary and incomplete university education; and (iv) complete university education.

We categorize workers by formal or informal status, indicating whether they were employed in the formal sector or the informal sector. We did not generate a self-employed category, because it would comprise only a small number of workers and require special methodological strategies that are beyond the scope of this analysis to understand earnings variations in that specific group. Formal sector workers comprise: workers employed with a *carteira de trabalho*; workers employed without a *carteira de trabalho* but contributing to the social security system; and workers in the public sector and government enterprises. All other individuals were classified as informal sector workers. Questions about formal or

informal status in the labour market have changed over time. In the 1980 and 1991 censuses, the criterion used was the individual's activity during the previous 12 months, while in the 2000 and 2010 censuses, it was activity during the previous week.

Our models control for the individual characteristics of workers in respect of race or colour, marital status, religion and region of residence. White workers have higher earnings than non-white workers. Regarding marital status, married workers have higher earnings than unmarried workers. The number of Protestants in the country has increased over time, with higher proportions of Protestants among lower-income individuals. As for region of residence, those living in the South-East (which includes the States of São Paulo and Rio de Janeiro) and the Centre-West (which includes the national capital, Brasília) have higher earnings than those living in the North, North-East and South.

As a strategy to generate area-level variables, we aggregated census microdata by age-education group, time and area. As regards the geographical areas considered for this study, we used 502 areas that are comparable through time, having boundaries similar to the ones created by IBGE for the 1991 Demographic Census. These areas were first proposed by Potter et al. (2002, 2010) as being comparable from census to census, and we updated the information from the 2010 Demographic Census. For this study, we analyse only residents of urban areas on the hypothesis that there is a unique pattern of employment in these areas; we are not attempting comparison with rural areas for the time being.

Our main independent variable comes from a collapsed database with information on the 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. The database uses census weights to estimate proportional distributions of males by age-education group, time and area. To measure the effect of area-level demographic and educational compositions on individual earnings, we merged this aggregated data back into the individual-level data.

The dependent variable is the natural logarithm of each individual male worker's earnings. In Brazil, information on earnings is based on primary occupation. In equation (4), $\log(Y_i)$ 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 gives rise to a vector of 15 parameters (β_1) for each year. Our main hypothesis postulates that not only do individuals' age and educational attainment have significant associations with earnings, but demographic and educational compositions generate variations in cohort size and thus influence individual earnings. As a strategy to estimate associations between cohort size and 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 produces a vector of 16 parameters (β_2) for each year. The exercise is similar to a study that estimated the effects of immigration on the United States labour market (Borjas, 2003). In our case, instead of including immigration in the estimates, we include information on the male population distributed into age-education groups (G) by area (a)

and time (θ) to ascertain associations with individual earnings. These aggregated level variables (X) allow us to test whether individual earnings are lower for workers living in areas where higher proportions of them have lower educational attainment, for instance. Lastly, a binary variable for formal versus informal status 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 or colour, marital status, religion and region of residence) in all models.

$$log\,(Y_i) = \beta_0 + \beta_1 G_i + \beta_2 X_{ga} + \beta_3 Formal/Informal\ Sector\ Status_i + \epsilon_i \quad (4)$$

Equation (5) includes a series of interaction parameters (I) that combine the formal versus informal sector binary variable with age-education groups (G), generating a vector of 15 parameters (β_4). This enables us to test whether age-education coefficients differ between formal and informal sector workers.

$$log(Y_i) = \beta_0 + \beta_1 G_i + \beta_2 X_{ga} + \beta_3 Formal/Informal\ Sector\ Status_i + \beta_4 I_i + \epsilon_i \quad (5)$$

Equation (6) replaces the formal versus informal sector binary variable with a variable for the proportion of formal sector workers (P) by area (a). This exercise allows us to understand whether the proportion of formal sector workers within each microregion influences individual earnings.

$$log\,(Y_i) = \beta_0 + \beta_1 G_i + \beta_2 X_{ga} + \beta_3 P_a + \epsilon_i \quad (6)$$

We estimated two models, one including only formal workers (f) and the other only informal workers (if), represented by equations (7) and (8). These models allow us to ascertain whether the magnitude and direction of all individual- and area-level variables differ between the formal and informal sectors. These specifications are essential to test whether individual informal sector earnings are lower for workers living in areas with higher proportions of informal than formal workers.

$$log(Y_i^f) = \beta_0^f + \beta_1^f G_i^f + \beta_2^f X_{ga}^f + \epsilon_i^f \quad (7)$$

$$log\,(Y_i^{if}) = \beta_0^{if} + \beta_1^{if} G_i^{if} + \beta_2^{if} X_{ga}^{if} + \epsilon_i^{if} \quad (8)$$

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

C. Results

We shall now present the results of our analysis. Estimation of an income equation is essential to gauge the association between individual earnings and an ageing population, educational improvements and a decline in informal sector working. This study seeks to establish whether age, educational and formal versus informal sector compositions have influenced the earnings of male workers in Brazil. We focus the analysis on urban male workers between 15 and 64 years of age from 1980 to 2010, working from the Brazilian Demographic Censuses (table 1). The proportion of workers employed in the informal sector increased from 22.7% in 1980 to 40.9% in 2000 before dropping back to 33.5% in 2010. The share of white urban male workers declined over time (from 61.6% in 1980 to 51% in 2010), which indicates an increase in diversity by race or colour in the country. The proportion of married workers also declined in the period, which might be a cause of lower earnings for this population, since married individuals have higher earnings than other marital status groups. The proportion of Protestants increased significantly, from 5.9% in 1980 to 20.3% in 2010. On average, Protestants have lower earnings than the rest of the population.

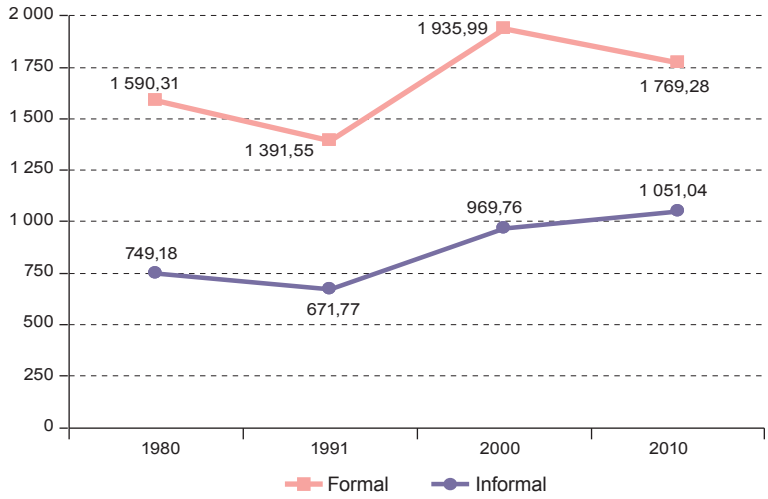
Table 1
Brazil: urban male workers, 1980–2010

Year	Informal sector *(Percentages)*	White *(Percentages)*	Married *(Percentages)*	Protestant *(Percentages)*	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: Brazilian Institute of Geography and Statistics (IBGE), Brazilian Demographic Censuses of 1980, 1991, 2000 and 2010.

Figure 1 illustrates the monthly real earnings of urban male workers in the formal and informal sectors over time. Incomes are reported in 2010 values, adjusted by the IBGE national consumer price index (INPC) to correct for currency movements and inflation. Both the correction for currency movements and deflation were carried out for convenience only. Taking logarithms of nominal or real wages generates the same estimates for the crucial parameters in our regression models. In the 1970s, Brazil experienced increases in socioeconomic inequality in conjunction with economic growth, reflected in earnings as measured by the 1980 census. In the 1980s, the country experienced economic stagnation, reflected by a decline in overall earnings as measured by the 1991 census. Inflation in the Brazilian economy stabilized in the 1990s, which contributed to an overall increase in earnings by the time of the 2000 census. In the 2000s, lastly, the country experienced economic stabilization and an improvement in overall educational attainment, which contributed to higher earnings for informal sector workers by 2010.

Figure 1
Brazil: monthly real earnings of urban male workers, by formal or informal sector, 1980–2010
(Constant reais at 2010 prices)



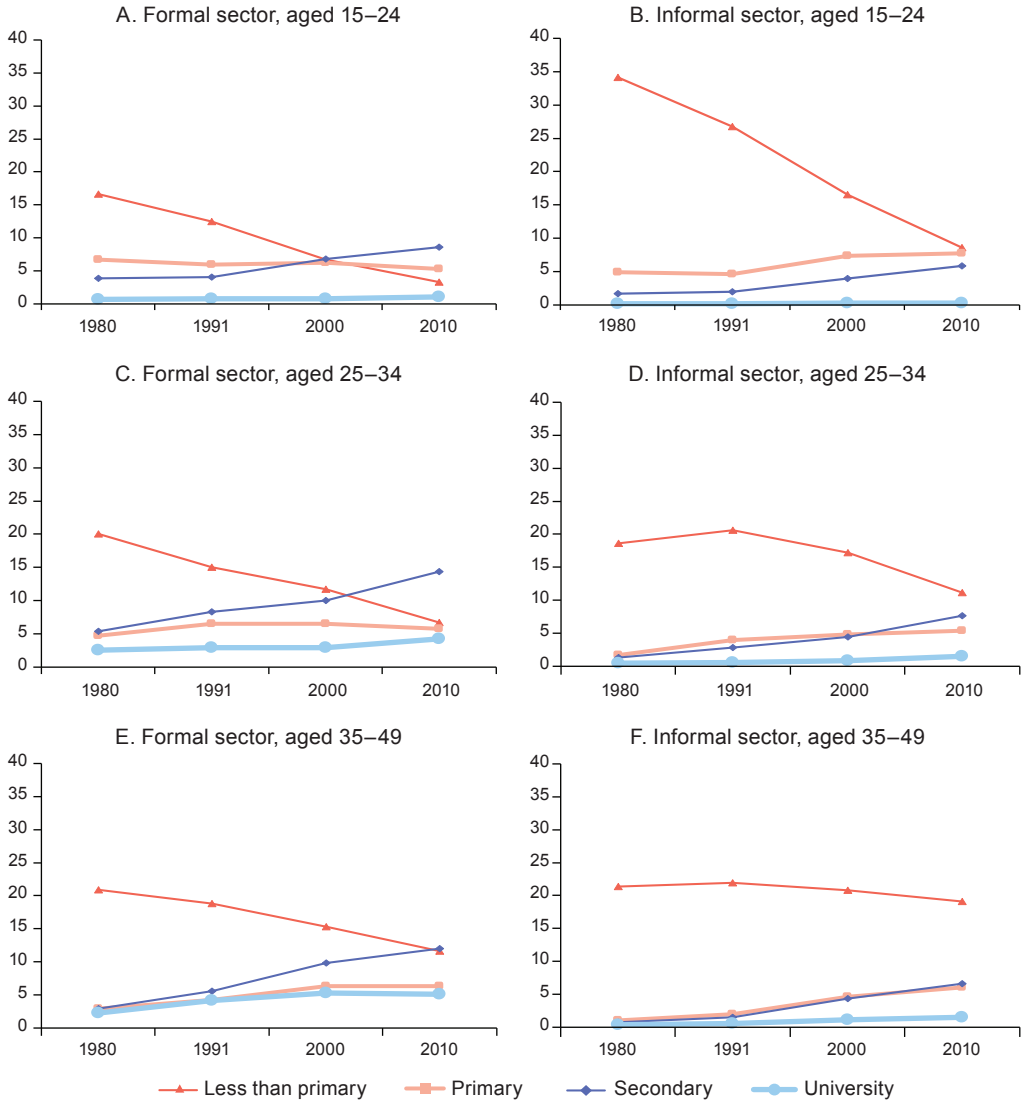
Source: Brazilian Institute of Geography and Statistics (IBGE), Brazilian Demographic Censuses of 1980, 1991, 2000 and 2010.
Note: Incomes are adjusted by the IBGE national consumer price index (INPC) to correct for currency movements and inflation (https://www.ibge.gov.br/estatisticas/economicas/precos-e-custos/9258-indice-nacional-de-precos-ao-consumidor.html?=&t=o-que-e)_.

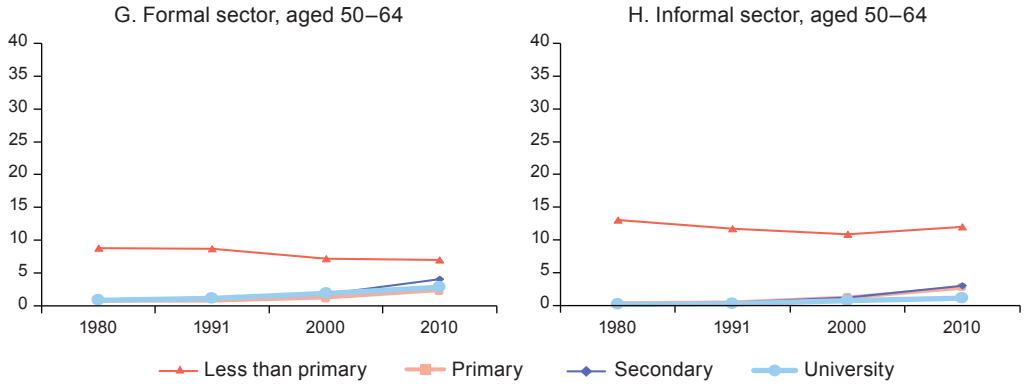
Figure 2 provides an illustration of changes in the distribution of the male working population by formal versus informal sector, age-education group and year. Overall, the proportion of these men with less than complete primary education decreased between 1980 and 2010. For example, the proportion of males aged 15–24 with formal jobs and less than complete primary education fell considerably, from 16.6% in 1980 to 3.3% in 2010 (see figure 2 and table A1.1 of the annex). This trend is also observed for those with less than complete primary education in the other age groups. In addition, the proportion of those with complete secondary and university education 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.

The proportion of non-white males in the formal sector increased from 34.4% in 1980 to 46.1% in 2010, while the proportion of white males decreased from 65.7% in 1980 to 53.9% in 2010 (table A1.1 of the annex). This result could have been driven by an increase in the overall share of the non-white population in the country. However, the 3.8 percentage point rise (from 52.2% in 1980 to 56.0% in 2010) in the proportion of informal workers from this group was much less pronounced than the 11.7 percentage point rise (from 34.4% to 46.1% over the period) in the proportion of formal workers. Declining marriage rates in the country meant that the proportion of unmarried workers increased in the formal and informal sectors over time. The percentage of Protestants increased between 1980 and 2000, rising from 5.2% in the informal sector and 6.0% in the formal sector to 19.5% and 20.5%, respectively. The majority of the male urban population continued to be concentrated in the

South-East. However, the proportion of informal sector workers living in this area decreased from 44.3% in 1980 to 39.6% in 2010. There was a similar trend in the formal sector, indicating a slight decentralization of the population from the South-East to other regions. Lastly, the informal sector accounts for a large share of jobs in Brazil, but this has been decreasing in recent years: the proportion of men in urban areas working in the informal sector increased from 22.7% in 1980 to 40.9% in 2000, but had decreased to 33.8% by 2010.

Figure 2
Brazil: urban male workers by formal or informal sector and age-education group, 1980–2010
(Percentages)





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

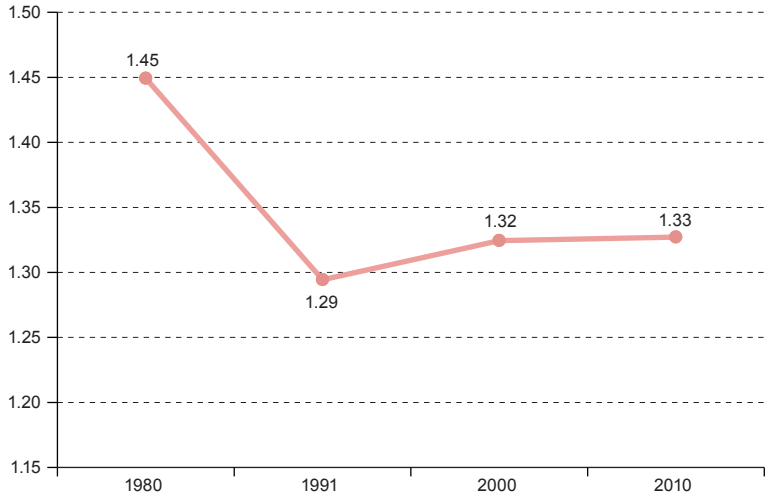
Table A1.2 of the annex shows average earnings differentials between the formal and informal sectors decreasing over time. Overall earnings in the informal sector were only 47% of earnings in the formal sector in 1980 (749.18 reais versus 1,590.31 reais), but the share increased to 48% in 1991, 50% in 2000 and 59% in 2010. The results also indicate higher earnings for older, better-educated, white, married and non-Protestant men, and for those living in the South-East and Centre-West regions.

The exponentials of the coefficients from equation (4) for employment in the formal sector relative to the informal sector each year are presented graphically in figure 3 (the full estimates are given in table A1.3 of the annex). This model indicates a positive association between individual earnings and formal sector employment across all years. The exponentials of the coefficients fluctuated through time but increased overall from 1991 to 2010, indicating rising earnings for male workers in the formal sector. More specifically, formal sector workers' earnings were 1.45 times as high as informal sector workers' in 1980, controlling for the other independent variables. This advantage declined to 1.29 in 1991 before rising back to 1.33 in 2010. As detailed in table A1.3, the coefficients for the age-education indicators suggest that earnings are higher for those with more education within each age category. Earnings also prove to be higher for older men within each educational group. These estimates are consistent with what we know about the association of age and education with earnings (Mincer, 1974; Hamermesh, 1993).

As regards the distribution of males by age-education group, given by equation (4) (see table A1.3 of the annex), higher proportions for particular groups tend to be associated with stronger negative effects on the earnings of less educated individuals (those with less than complete primary education and complete primary education). In other words, higher proportions of workers in particular age-education groups are associated with lower earnings precisely for those whose earnings are already low. More specifically, among males aged 15–24, higher proportions of workers with less than complete primary education are associated with stronger negative effects on earnings (except in 1980). For men aged 25–34 and 35–49,

group proportions tend to have positive associations with earnings over time for those with at least complete primary education. For men aged 50–64, positive associations are observed for those with at least complete secondary education. These estimates suggest that the Brazilian labour market has not required as many less educated men in recent years as it did in previous decades. Local labour markets seem to have been absorbing higher proportions of men in groups with complete secondary and university education in recent years, without this having any negative effect on their earnings.

Figure 3
Brazil: earnings of urban male workers in the formal sector relative to the informal sector, 1980–2010
(Exponentials of coefficients from equation (4))



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

Positive coefficients for age-education group proportions are stronger for workers with university education than for those with secondary education. These findings suggest that the Brazilian labour market is better at absorbing workers with higher levels of education (complete university) than with mid-level education (complete secondary). Lastly, table A1.3 also indicates higher earnings for white, married, non-Protestant male workers and those living in the South-East and Centre-West regions, when all other independent variables are controlled for.

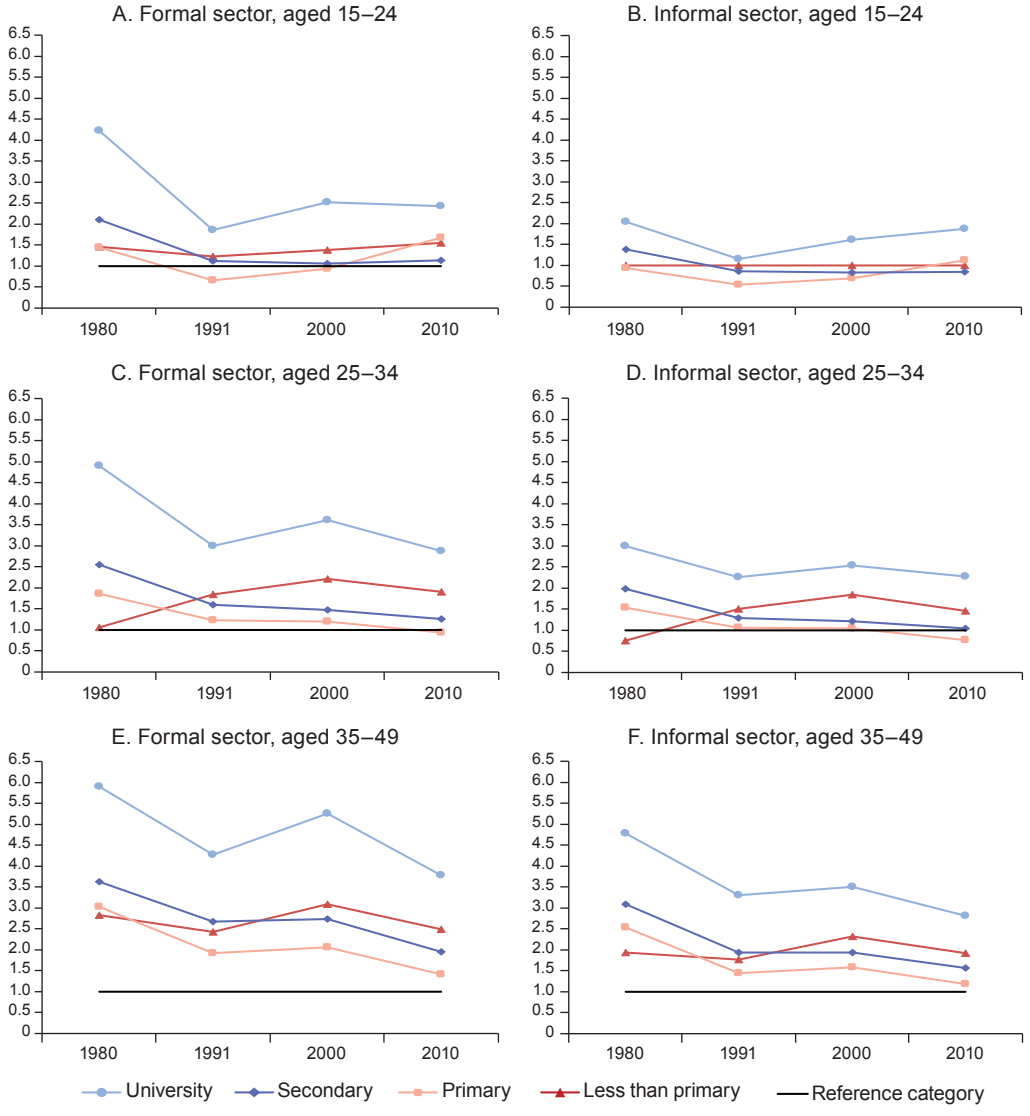
Equation (5) included interactions between age-education indicators and the formal sector. For each year, we add binary variable coefficients for the formal sector (taking the informal sector as the reference category), age-education groups (taking the 15–24 age group with less than primary education as the reference category) and the interaction of the formal sector with the age-education group (taking the 15–24 age group with less than complete primary education in the formal sector as the reference category). Figure 4 shows

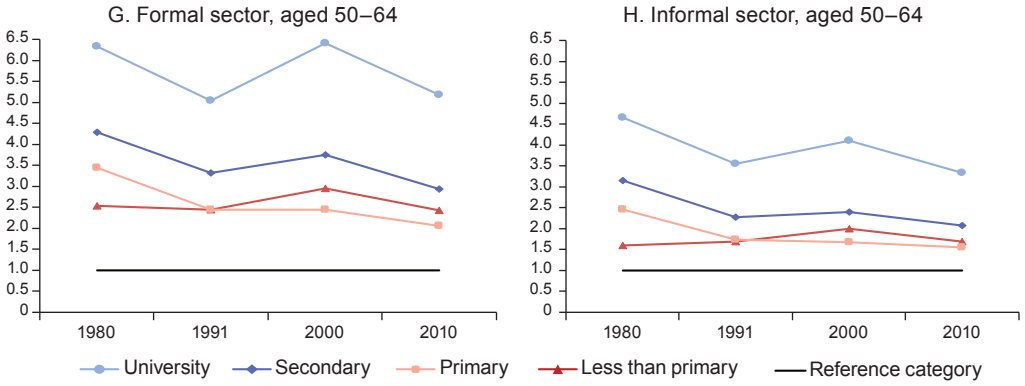
the exponentials of these combinations of coefficients for each age-education group and the formal versus the informal sector, taking the 15–24 age group with less than primary education in the informal sector as the reference category. Complete equation (5) estimates are available in table A1.4 of the annex.

Figure 4

Brazil: earnings of formal and informal urban male workers by age-education group relative to the reference category of informal workers aged 15–24 with less than primary education, 1980–2010

(Exponentials of coefficients from equation (5))





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

Comparison of the figure 4 charts for each age-education group indicates that formal sector employment has stronger positive associations with earnings. In 2010, for example, formal workers aged 35–49 with a university education earned 3.78 times as much and those in the informal sector 2.81 times as much as the reference category (informal workers aged 15–24 with less than primary education).

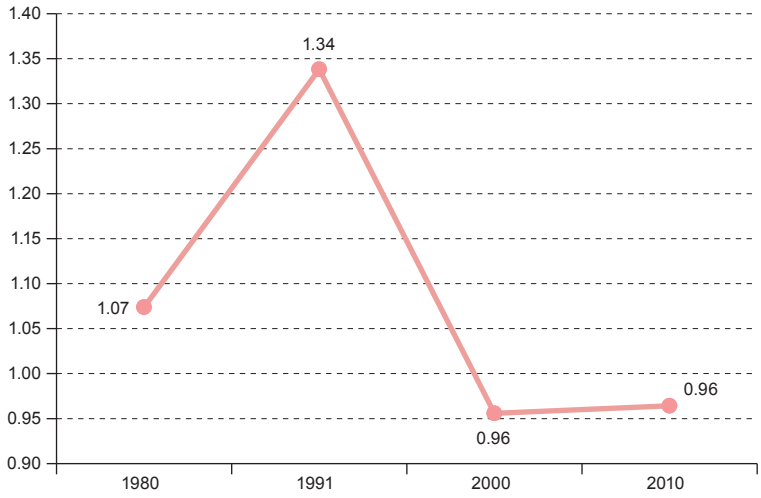
Furthermore, figure 4 indicates that older workers and those with higher education usually have higher earnings than others. For almost all age-education and economic sector groupings, the time trends of the exponentials of the coefficients follow those observed in figure 3. An important distinction is that, for workers aged at least 25, the coefficients are smaller in 2010 than in 2000.

Only for informal sector workers aged 15–24 with primary and secondary education and workers aged 25–34 with less than primary and primary education are the exponentials of the coefficients ever smaller than 1 (figure 4). In other words, these groups have lower earnings than the reference category in specific years.

Equation (6) included the proportion of male workers in the formal sector as a control variable instead of the binary formal versus informal sector variable (complete estimates can be found in table A1.5 of the annex). Figure 5 presents elasticities calculated as the product of the coefficients of the proportion of formal male workers given in table A1.5 of the annex and the proportion of formal male workers given in table A1.1 of the annex over time.[5]

[5] With a view to better understanding the estimates, we calculate elasticities to demonstrate the impact of the proportions of workers employed in the formal sector on earnings over time. Elasticity describes the relationship between two variables and is defined as the ratio of a percentage change in a dependent variable to a percentage change in an independent variable. Since we aim to understand how earnings (the dependent variable) change in response to a percentage change in the independent variables, we multiply the product of the coefficients of the proportion of workers employed in the formal sector (table A1.5 of the annex) and the proportion of male workers employed in the formal sector (table A1.1 of the annex) by 0.01. We also calculate the exponential of this product, since we used the logarithm of earnings in our models. Lastly, we subtract 1 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 as per table A1.5 * proportions as per table A1.1 * 0.01) – 1) * 100.

Figure 5
Brazil: effects on the earnings of urban male workers of the proportion employed in the formal sector (P_a), 1980–2010
(Elasticities from equation (6))



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

For 1% increase in male workers employed in the formal sector, individual earnings increased by 1.07% in 1980, when the other independent variables are controlled for (figure 5). This positive association rose to 1.34% in 1991 before decreasing to 0.96% in 2000 and 2010. However, the results indicate that the association remained positive even with the increase in the proportion of urban male workers employed in the formal sector from 59.1% in 2000 to 66.5% in 2010 (table A1.1 of the annex). This is a sign that the Brazilian labour market is absorbing the increasing share of workers in the formal sector.

Lastly, we estimated models from equations (7) and (8) that included the proportions of male workers in the different age-education groups employed in the formal sector (table A1.6 of the annex) and the informal sector (table A1.7 of the annex). Like figure 5, figure 6 presents elasticities calculated as the product of the coefficients of the proportions of the different age-education groups for the formal sector and the informal sector (tables A1.6 and A1.7 of the annex) and the distribution of male workers by age-education group in the formal sector and the informal sector (table A1.1 of the annex) over time.

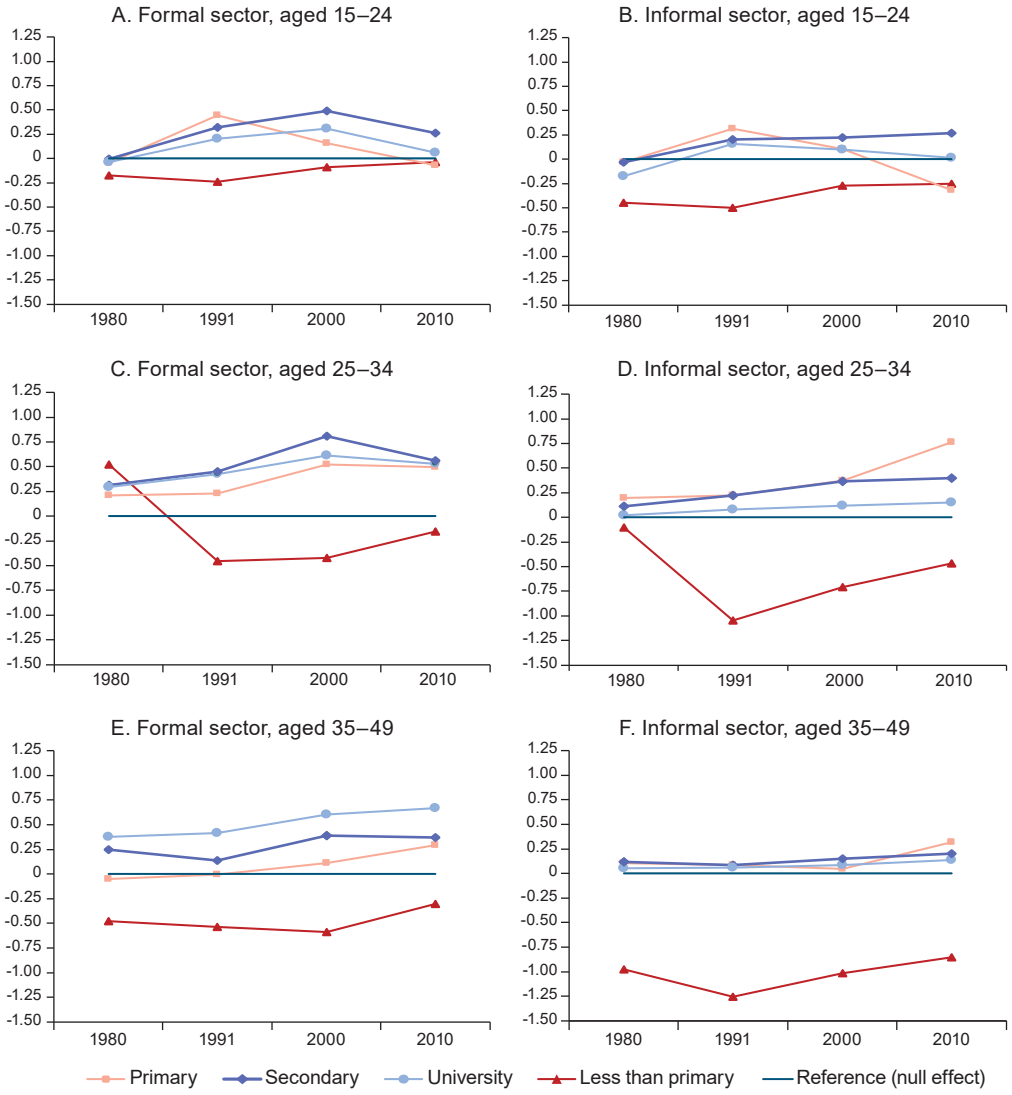
Figure 2 shows that the proportions of workers employed in the formal sector have been increasing over time, especially in the case of those with secondary and university education. We might expect these increases to lead to more competition in the labour market between workers with these characteristics, which could translate into lower individual earnings. However, as illustrated in figure 6, a 1% increase in formal male workers aged 35–49 with secondary education was associated with a 0.37% increase in individual earnings

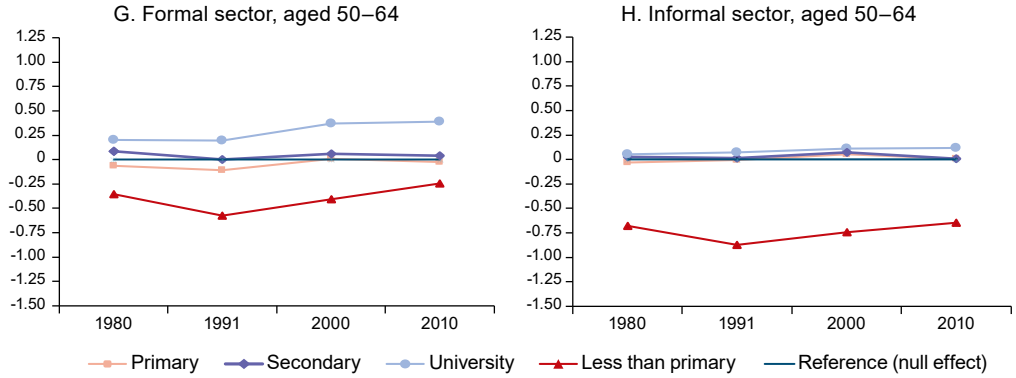
in 2010. This positive association rose to 0.67% for those with a university degree in the same age group in 2010. These results indicate that the Brazilian labour market has been absorbing increasing proportions of workers into the formal sector without negative effects on earnings. These associations had smaller magnitudes among informal workers aged 35–49: 0.20% in the case of secondary education and 0.14% in the case of university education.

Figure 6

Brazil: effects on the earnings of formal and informal urban male workers of the proportions of the different age-education groups (Xga), 1980–2010

(Elasticities from equations (7) and (8))





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

Furthermore, the results in figure 6 indicate that an increase in the proportion of male workers from the groups with less than primary education is negatively associated with individual earnings. These results are estimated over a time period in which the proportions of workers with less than primary education declined (figure 2). Such workers, earning less than other individuals to begin with, have not benefited from being a smaller group in recent years. The individual earnings of these least educated workers experience the strongest negative effects from group proportions, especially in the informal sector. More specifically, when elasticities for the least educated workers are compared by formal or informal sector for the same age groups and years, the negative associations are strongest for informal workers. This finding is an indication that labour markets are not absorbing the least educated workers even as they become a smaller group.

Negative associations in the lowest education group have diminished 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 over the period (figure 1) reduced competition between them in the labour market. Nonetheless, these elasticities remained negative in 2010 for all age-education groups in both the formal and the informal sectors.

Differentials between elasticities across education groups within each age group are found to be larger among informal workers (figure 6). This might be an indication of greater economic inequality by educational attainment in the informal sector than in the formal sector.

D. Final considerations

Our study estimates variations in the individual earnings of men in Brazilian urban locations on the basis of a number of individual-level and area-level characteristics. In respect of contextual information, we move beyond the preceding literature by considering not only the influence of demographic and educational composition (the proportions of males in

the different age-education groups) but also formal versus informal sector composition (formal and informal jobs). Where individual-level variables are concerned, older and better-educated workers have higher earnings. White, married and non-Protestant men have higher earnings than other groups, as do those living in the Centre-West and South-East regions. Moreover, formal workers tend to have higher earnings than informal ones.

Considering area-level variables, the estimations suggest that workforce composition is associated with earnings. Of the age-education groups, a higher proportion of workers tends to be most strongly associated with a negative effect on individual earnings among the least educated (those with less than complete primary education and complete primary education). Thus, a higher proportion of workers is associated with even lower earnings for the least-educated individuals who earned less to begin with. These results for proportions of low-educated workers are consistent with previous studies indicating that age-education groups are not perfect substitutes but that there are negative associations between cohort size and the incomes of individual workers.

Group proportions are more positively associated with individual earnings for workers with a university education than for those with secondary education. We also know that higher proportions of male workers have secondary education than university education. These results indicate that there is greater demand in labour markets for workers with higher qualifications (university) than with mid-level qualifications (secondary). The models capture two sets of disadvantages for workers with secondary education: (i) they already earn less than those with a university education, as shown by the age-education indicators (individual-level variables); and (ii) they are competing with a bigger cohort in the labour market, something that the effects of age-education group proportions (area-level variables) suggest is not conducive to their earning as much as workers with a university education. There has been an increase in the demand for highly educated workers in Brazil over recent decades, and this has decreased the negative effects of the rise in the supply of workers with secondary or university education over time.

As regards differences between the formal and informal sectors, the results show formal workers earning more than informal ones. The interactions of age-education indicators with formal versus informal sector employment 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 a university education in the formal sector.

Our estimates also show that recent increases in the proportion of formal workers in the labour market have not generated negative associations with individual earnings. This result is an indication that the labour market is absorbing the increasing share of formal workers.

The models estimated separately for the formal and informal sectors indicate that higher group proportions have the strongest positive associations with individual earnings for formal workers with secondary and university education. These effects are not as strong

among informal workers. Higher proportions of workers with less than primary education are negatively associated with individual earnings, especially for those in the informal sector. The proportions of these least educated workers have been decreasing over time, but they are not benefiting from the lessening of competition in labour markets. This is an indication that Brazilian labour markets are not absorbing the labour of the least educated workers. Furthermore, the results suggest stronger individual earnings differentials across education groups for informal workers. This finding suggests that economic inequality by educational attainment is greater in the informal sector than the formal sector.

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

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