

Determinants of Changing Informal Employment in Brazil, 2000–2010

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Article History

Received : 14 May 2020

Revised : 20 May 2020

Accepted : 16 June 2020

Published : 14 Sept. 2020

Key words

Brazil, informal employment, labor law enforcement, Bolsa Família

JEL Classification

J21, J46, O17

Abstract: This paper explores possible causal determinants of changing wage and salary informality in Brazil over the period 2000–2010. We utilize the demographic census and other institutional data sources from the opening and closing years of the decade to estimate informality regressions that exploit variation across workers and municipalities in informality rates and their causal determinants. The change in mean informality over the period is studied by a Blinder-Oaxaca decomposition. We find that two of the most important policy changes over this period – the increase in the real value of the minimum wage and the dramatic expansion of conditional cash transfer programs – contribute positively to informality. Among the factors accounting for the decline in mean informality rates over this time are rising rates of labor law enforcement, rising education levels, increased numbers of workers with spouses in the formal sector, and changes in industry composition, which explain between 16% and 57% of the mean decline in informality over the period. However, most of the decline is accounted for by the changing estimated coefficients on the industry categorical variables – that is, by the changing way in which industrial composition translates into informality.

1. INTRODUCTION

Brazil witnessed a rather significant decline in labor informality over the first decade of the 21st century – a decline that brought informality from roughly 50% to 40% of the urban labor force. Economic growth was rapid over much of the period; enforcement of labor law violations was made more efficient; the real value of the minimum wage more than doubled; and the largest conditional cash transfer program in the world – *Bolsa Família* – was begun. In addition, industrial composition changed

over the period, as did several demographic features of the labor force, including average education levels and age. How have these factors contributed to changing informality over the period?

Using Demographic Census data and other institutional data sources over the period 2000 to 2010, we explore the determinants of informality by exploiting variation in informal employment across workers and municipalities and estimating cross-sectional informality regressions in both years. The change in mean informality rates over the period are decomposed using a Blinder-Oaxaca decomposition. We employ an instrumental variables analysis to identify the causal impact of enforcement efforts, conditional cash transfers, and the minimum wage.

The first insight from analysis of the data is that while informality fell by about 10 percentage points over this period, over 80% of the decline took place among wage and salary workers as opposed to the self-employed. We tailor our model to capture the determinants of informality in this particular segment of the informal economy and focus our empirical analysis on this segment only. We begin with a review of the literature on the determinants of informality.

2. DETERMINANTS OF WAGE AND SALARY INFORMALITY IN BRAZIL

Two major policy changes during the first decade of the 2000s in Brazil, with potentially major consequences for the extent of informality in the country, were the emergence and growth of the conditional cash transfer program *Bolsa Família* and the near doubling of the real value of the minimum wage.

(i) The Introduction of Bolsa Família

Bolsa Família originated in 2003 with the new Lula administration in Brazil. It brought together under one umbrella existing municipal and federal cash transfer programs¹ and expanded the federal conditional cash transfer (CCT) component significantly, growing within a brief period of time to become the single largest CCT program in the world. By decade's end, *Bolsa Família* was serving roughly one-quarter of the poorest households in the country, sending cash to many families conditional on their achieving targeted goals for the health, nutrition, and education of their children, but also granting unconditional cash transfers to the very poorest households.

Evidence is clear that the program had a significant impact on rising school attendance and ultimately educational levels in Brazil (Cardoso and Souza, 2003;

Glewwe and Kassouf, 2012). Empirical research on informality suggests most strongly that rising education levels tend to depress informal sector employment. However, there is an additional channel through which *Bolsa Família* may affect informality. Program rules establish clear per capita family income maxima for eligibility, but income is self-reported and verification is possible only when workers' income is independently reported to federal authorities – that is, only for workers in the formal sector of the economy. Hall (2008) argues that this feature of the program might cause some workers to shun formal sector employment and to choose, instead, work in the informal sector, where they would be more likely to qualify for benefits, possibly through fraudulent reporting of income. He cites anecdotal evidence from a Brazilian study (2008, p. 815) showing precisely this sort of incentive operating among temporary rural workers. De Brauw, Gilligan, Hoddinott, and Roy (2015) employ household panel data and a difference-in-differences identification strategy to establish credible evidence that urban area recipients of the program reduce labor hours in the formal sector and increase hours in the informal sector in comparison to a control group of nonparticipants.

(ii) Increases in the Minimum Wage

The real value of the minimum wage doubled in the first decade of the 21st century in Brazil, as policy increasingly focused on reducing poverty, including among the working population. In a conventional two-sector model, with a covered and uncovered sector, theory predicts that an increase in the minimum wage should raise wages and reduce employment in the covered (formal) sector, and, as workers gravitate to the uncovered (informal) sector, wages should fall and employment should rise therein. However, in Brazil – as is true of several other Latin American economies – the impact of the minimum wage on wages in the formal and informal sectors is more complex.

There is significant evidence to suggest that the minimum wage has so-called “lighthouse” and “numeraire” effects on wages in both sectors (Maloney and Nuñez 2004). That is, the minimum wage appears to be viewed as a (lighthouse) signal of fairness in wage setting and as a useful (numeraire) index for wage increases over time, for workers both above and below the actual statutory minimum in the formal and informal sectors alike. Evidence of wage clustering around multiples of the minimum wage can be found in both the formal and informal sectors in several Latin American economies (Neri et al. 2001; Amadeo et al. 2000; Fairris et al. 2008).

Several empirical investigations into the minimum wage in Brazil confirm the existence of wage increases above and below the minimum, in both the formal and informal sectors, following a minimum wage hike (e.g., Fajnzylber 2001 and Lemos 2009). Moreover, there is some evidence to suggest that the impact on wages is greatest in the informal sector (Maloney and Nuñez 2004). This obviously complicates the story of the likely employment impact of the minimum wage. Is the conventional prediction still correct – in this case, implying that informal employment growth due to spillover effects is offset by rising informal sector wages due to lighthouse and numeraire effects? Evidence to date seems to suggest that indeed minimum wages decrease formal sector employment and increase informal sector employment, consistent with the dominance of the spillover effect (Fajnzylber 2001, Carneiro 2004), but the estimated impacts are not always statistically significantly different from zero (Lemos 2009).

The extent of informality in a society is influenced by the costs and benefits firms face in operating formally versus informally. Several factors are at play in this regard, three of which changed rather significantly over this period of time in Brazil.

(iii) Increased Labor Law Enforcement

One cost of informality is the risk of being caught and fined by the authorities for violating labor law in operating informally. The issue of labor law enforcement in Brazil is a complicated one. Until the late 1980s, there appears to have been little enforcement of laws affecting work and workers. This changed when a new set of labor standards was included in the 1988 Constitution, and by the early 1990s there existed a staff of roughly 3,000 highly-paid and professional inspectors – a number that would remain largely unchanged in the two decades to follow (Berg 2010). Compliance with labor regulations is the responsibility of the Ministry of Labor in Brazil, and enforcement is delegated to ministry offices which are sprinkled throughout the country.

Despite relative stasis in the number of inspectors the effectiveness of inspections was enhanced enormously in the period from the late 1990s to the late 2000s through two developments. First, a system of incentive pay was introduced which linked inspector income to the achievement of specific performance targets. Second, teams of inspectors were given increased freedom to work with non-compliant firms to explore ways of bringing firms into compliance that would prove beneficial to both workers and firms – an approach that moved away from repeated inspections and enforcement to one focusing on making compliance “sustainable” in the long run

(Pires 2008). Labor Ministry data reveal that between 1996 and 2008 the number of workers brought into formal sector status through labor inspections more than doubled (Berg 2010, p. 15).

Experts on labor standards compliance in Brazil are clear that much of the progress in enhancing formality during this period was accomplished through the formalization of informal workers in large, formal sector firms, since inspectors focused their energies during this period almost exclusively on such firms (Cardoso and Lage 2007). There may be an unintended, positive impact on formality stemming from stepped-up compliance with constitutionally-mandated benefits such as severance pay or health and safety standards as well. If improvements in these areas attract informal workers to formal sector jobs, and if wages fall as a consequence, formal sector firms might be encouraged to expand their workforces (Almeida and Carneiro 2012).

The empirical evidence linking inspections to formality is relatively sparse. Simulations with Brazilian data, employing a two-sector matching model with formal and informal sectors, suggest that increased enforcement reduces informality (Ulyssea 2010). Almeida and Carneiro (2009) use a rich data set on the intensity of inspections across Brazilian cities and data on formal-sector firms to show that enforcement reduces firm size, which, because small firm size is a major identifier of likely informal sector status, suggests that costly compliance may push firms into informality. Almeida and Carneiro (2012) utilize the same Brazilian inspections data and the 2000 Brazilian Census to explore directly the link between inspections and informality, and find evidence of increased formality in cities with high levels of enforcement. This same result is found in a more recent paper by Meghir, Narita, and Robin (2015) utilizing a wage-posting model of the Brazilian labor market.

(iv) The Simples Program

Informal sector firms considering a move to the formal sector will face registration costs and tax payments that affect negatively their bottom line. Many developing countries with sizeable informal sectors have experimented with ways to reduce such costs as an incentive for firms to become formalized. The Simples program, enacted in 1996, created a system of tax simplification and sizeable reduction (up to 8%) in the tax burden for small and micro enterprises that are registered with the government. There exist two empirical studies of the effect of the Simples program on formal-sector firm formation in Brazil over the period following its enactment. One, by Monteiro and Assuncao (2012), utilizes a difference-in-differences approach,

based on the fact that the program's reach was limited to certain industries, to explore the impact on informality, and found a higher trend of formal-sector firm formation, but only among retail industries. However, the empirical approach does not allow the authors to rule out the possibility that this results from an unobserved shock to the retail industry. Fajnzylber, Maloney, and Montes-Rojas (2011) explore this question using a regression discontinuity design, and find that indicators of formality (such as firm licensing rates and rates of registration as a legal entity) are higher for firms emerging immediately after program implementation as compared to firms emerging immediately before. This was true across a host of eligible industries, but also could be the result of nonrandom selection into firm entry.

Rocha, Ullysea, and Rachter (2018) explore this issue with a follow-up formalization program introduced in Brazil in 2009, and with data that allow them to focus specifically on the impact of the program on the transition of firms from informality to formality. They find evidence that the program did indeed foster such a transition, but that the effects are rather small (e.g., halving monthly taxes led to a 1.9 percentage point increase in the formal sector firm registration rate) and, moreover, that the effect was transitory (falling back to zero following six months of program implementation). Finally, de Mel, McKenzie, and Woodruff (2013) take up this question of the transition from informality to formality using an experimental empirical design to explore the impact of a similar program in Sri Lanka. They find no impact on transitions to formality due to better information about the registration process or when registration costs are eliminated. However, they find that when a portion of the ex post tax burden is eliminated there is a rather significant movement of firms into the formal sector from the informal sector. Interestingly, follow-up surveys revealed that few of the transitioning firms appear to have benefited significantly from the move to formality.

(v) Increased Availability of Credit

A benefit to firms operating in the formal sector is enhanced access to credit. Banks and other lending institutions are generally reticent to loan to informal-sector firms. The availability of credit for formal-sector firms increased significantly over this period in Brazil. Catão et al. (2009) show that credit to firms expanded dramatically over the period 2003–2008, from roughly 15% of GDP to around 22%, and their analysis offers suggestive evidence, using data covering the period 2002–2006, that this credit deepening contributed to declining informality. D'Erasmus (2016) cites not just the enhanced availability of credit over this period but also the decline in

borrowing costs, particularly in the form of interest rates, and utilizes a general equilibrium model with endogenous firm sector status (formal versus informal) and a calibration exercise showing the causal link between changes in credit conditions and the rise in formal sector firms.

However, there is a growing body of evidence suggesting that changing credit conditions do not affect the choice of sector status for informal sector firms. The central claims of much of this literature is that informal sector firms are characterized by low productivity, relatively incompetent management, and accounting practices that are relatively lax (e.g., La Porta and Shleifer 2014). Thus, according to this view, informal sector firms are largely unable to take advantage of improved credit conditions because their poor management and lax accounting practices make them too great a risk for lenders. Moreover, such firms are unlikely to survive in the formal sector, should they relocate there, due to their comparatively lower productivity. The research of de Mel, McKenzie and Woodruff (2013) and Fajnzylber, Maloney, and Montes-Rojas (2011) support this view. For example, they find that new formal sector firms (whether newly-emerging or those transitioning from informality) do not experience greater access to credit as a result.

(vi) The Changing Demographic Characteristics of Workers

Turning now to the characteristics of workers, and in particular to the relationship between certain characteristics and formal- versus informal-sector employment status, the literature reveals numerous correlations between demographic characteristics such as age, education, and gender and location in the informal sector.² Thus, to the extent Brazil witnessed changes in the demographic composition of the labor force along these various dimensions during the period of exploration, this might also have contributed to declining informality.³ The level of education is commonly found to be positively correlated with formal sector status, while older workers and female workers are relatively more common in the informal sector. The explanations for these observed correlations are varied and controversial. We take no strong view on whether the correlations reflect labor market segmentation, and thus the forced relegation of a subset of workers to informal sector status, or instead competitive labor markets, and thus a setting in which workers freely choose to locate among the informal wage labor force.⁴

Leaving aside the contending explanations for these observed correlations, what has happened to these demographic features of the labor force over the course of the decade 2000–2010? Well before the first decade of the current century, Brazil

was undergoing a rather significant demographic shift in the age of the population. Declining fertility rates and rising life expectancy were leading to an aging of the population. By the 2000s, the declining fertility rates were impacting the working age population. Berg (2010) reports that household data in Brazil reveal a fall in the percentage of the population ages 15–24 from 18.6% to 17.7% over just the few years 2005–2008. We find an increase in the average age of the labor force in our data, consistent with the trends observed on fertility and life expectancy rates.

Another factor limiting the youth population in the labor force is increased school enrollments, making young people less available for work. The percentage of youth ages 15–17 enrolled in school has climbed steadily since the early 1990s. As noted above, the *Bolsa Família* program of the 2000s had a marked impact on this trend; Berg (2010) reports that the percentage of youth in this age category economically inactive increased from 57% in 1999 to 65% in 2008. This shows up in our data not just on the aging of the labor force, but also in rising education levels of those engaged in active employment. We find an increased percentage of women in the labor force, as well as an increased percentage of individuals with spouses working in the formal sector. The aggregate effect of these changes, as well as those discussed above, awaits statistical analysis.

(vii) Trade Liberalization and Rapid Economic Growth of the Economy

Annual growth in GDP was very rapid (4.2%) during the period 1999–2008, and exports grew by almost 80% over the period (Paz, 2012). Export-led growth expansions are known to be particularly conducive to employment growth in the formal sector (Corseuil and Foguel 2012). Thus, some of the decline in informality over the period in question might be caused by trade liberalization and export-led growth.

While we do not explicitly account for expansion in the economy owing to trade liberalization and export led growth dynamics, we believe that changes in industry composition over the period may allow us to pick up some of this otherwise uncaptured factor. We control for municipal-level industry composition in our regressions, and for its changes over time in our decomposition analysis, but are obviously unable to parse out the various causal mechanisms that are at work behind the scenes of these changes in industrial structure and composition.

However, two possible determinants found in the literature and cited above go completely unaccounted for in the empirical analysis to follow – the rising availability of credit and the Simples program. Regarding the first, we take some solace in the

fact that much of the empirical evidence on this issue seems to suggest that new, small formal sector firms (whether newly-emerging or having recently transitioned from the informal sector) do not appear to have received significantly greater access to credit. De Mel et al. (2013) and Fajnzylber et al. (2011) both find no improved access to credit for such firms in their analyses, which is consistent with the view of La Porta and Shleifer (2015), who find that informal sector firms (and by extension, newly-emerging formal sector firms who, absent government incentives, would have otherwise located in the informal sector) are run by weak managers with lax accounting practices, and would be insufficiently productive to compete successfully in the formal sector and therefore unlikely to attain credit as a result.

Regarding the Simples program, once again the empirical results to date in the literature do not lead one to expect a robust decline in informality and rise in formalization as a program outcome. Some of the evidence points to a very small decline in informality (as in Monteiro and Assuncao, 2012), while those papers finding a somewhat more robust decline either suffer from competing explanations (as in Fajnzylber et al., 2011) or suggest that the results are largely temporary (as in Rocha, et al., 2018). The latter is important for our analysis in that the Simples program was initiated in 1996 – roughly four years prior to the onset of our empirical analysis.

We turn, now, to the specifics of our empirical methodology and data.

3. EMPIRICAL METHODOLOGY AND DATA

3.1. Empirical methodology

To analyze the drivers of changing informal wage and salary employment over the first decade of the 21st century in Brazil, we estimate probability models using worker- and municipal-level data, one for 2000 and one for 2010, based on data drawn from the Demographic Census of these two years, and from various institutional data sources to be discussed below. Using the probability regression results from the two periods, we decompose the change in mean informality rates over the period into changes in the means of explanatory variables and changes in the estimated regression coefficients. We use a linear probability model specified as follows;

$$Prob(is_{im} = 1) = X_{im}\beta + Z_m Y + \epsilon_{im} \quad (1)$$

$Prob(is_{im} = 1)$ denotes the probability that worker i in municipality m is employed in the informal sector (employment in the formal sector = 0). X denotes a vector of worker characteristics, including education, age, and gender – many of which are

hypothesized to be related to likelihood of informal employment – and Z is a vector of municipal characteristics, including variables capturing labor law enforcement, conditional cash transfers, minimum wage effects, and industrial composition, each of which are hypothesized to affect the likelihood of municipal-level informal employment. β and γ are vectors of coefficients to be estimated and ε is an error term, assumed to follow a normal distribution with zero mean and variance σ .

We use a linear probability model, whose estimated regression goes through the means, since we are interested in decomposing the changing mean informality rates over time.⁵ The model gives the following relationship between the independent variables and the dependent variable:

$$\overline{IS} = \overline{X}\hat{\beta} + \overline{Z}\hat{\gamma} \quad (2)$$

Upper bars indicate means and hats indicate estimated coefficients. Let subscripts 0 and 1 denote year 2000 and year 2010, respectively. Using a Blinder-Oaxaca decomposition, the change in the mean informality rate over the period is given by:

$$\overline{IS}_1 - \overline{IS}_0 = (\overline{X}_1\hat{\beta}_1 + \overline{Z}_1\hat{\gamma}_1) - (\overline{X}_0\hat{\beta}_0 + \overline{Z}_0\hat{\gamma}_0) \quad (3)$$

By adding and subtracting terms, expression (3) can be re-stated as:

$$\overline{IS}_1 - \overline{IS}_0 = [(\overline{X}_1 - \overline{X}_0)\hat{\beta}_0 + (\overline{Z}_1 - \overline{Z}_0)\hat{\gamma}_0] + [(\hat{\beta}_1 - \hat{\beta}_0)\overline{X}_1 + (\hat{\gamma}_1 - \hat{\gamma}_0)\overline{Z}_1] \quad (3')$$

The first term in square brackets is the change in mean informality accounted for by changes in elements of the X and Z vectors, and the second term is the change accounted for by changes in the structural parameters, or estimated coefficients.⁶ These two terms are commonly referred to in the literature as the “explained” and “unexplained” parts, respectively, of a decomposition of the difference in means of the dependent variable. The second term is “unexplained” in the sense that none of the existing independent variables in the model – the variation of which explains the variation in informality – accounts for the difference in estimated coefficients. Only if some additional explanatory variables are introduced into the estimating equations, and this addition renders the estimated coefficients statistically similar across the two informality regressions, would we have some explanation for the differing estimated coefficients formerly observed across the two equations.

Some of the independent variables are unlikely to be exogenous to the variation in informality rates, and so we utilize instrumental variables techniques to render

them causally determinative. This is clearly the case for labor law enforcement and conditional cash transfers. Labor law enforcement may be successful in reducing informal employment, but, to the extent enforcement is targeted accordingly, municipalities with high degrees of informality will also contain inordinately high enforcement efforts. Our discussion above suggests that conditional cash transfers influence informality rates through their impact on the informal/formal relative wage, which is clearly endogenous in the informality regression. The expansion of conditional cash transfers might be expected to shift relative labor supply to the informal sector, thereby lowering the informal/formal relative wage.

3.2. Worker-level variables

Variable definitions appear in Table 1. We relegate to a “appendix” more specificity regarding variable measurement and sources. The dependent variable in the analysis is a binary variable, taking the value of 1 if the worker is employed in the informal sector and 0 if the worker is employed in the formal sector. We define workers as part of the formal sector if they possess a signed labor card (*carteira de trabalho assinada*) and as informal otherwise. As discussed by Henley et al. (2009), there are alternative ways of defining informal employment in Brazil, based on, for example, employer size or social security contributions. Using the PNAD survey from 2004, they show that the correlation between the labor card definition and the social-security definition is 0.85, suggesting a large overlap between the two definitions. The correlation between the labor card definition and the definition based on employer size (workers in firms of less than six employees and self-employed) is 0.65. The Demographic Census provides no information on employer size, which prevents us from using a firm-size based measure of informality. Such measures, however, are sensitive to substantial miss-classification, since many small employers may hire all their employees on an entirely formal basis, and some large employers employ a portion of their workforces on an informal basis. As for social-security contributions, the Census data only provide this information for the self-employed and for employers. Irrespective of data availability, we prefer the labor-card definition since a signed labor card is mandated by law for all employees and since this is what entitles workers to several social benefits.

As explanatory worker characteristics (X) we include gender (female=1), age, education, a vector of race and ethnicity categories, and disability. The first three are discussed in some detail in the literature review, and are hypothesized to affect informality in precisely the ways discussed therein. Race and disability may relate to

Table 1. Variable definitions

<i>Variable</i>	<i>Description</i>
<i>Worker-level variables</i>	
Informal employment ^d	Worker is employed in the informal sector (=1, 0 otherwise).
Age	Worker's years of age.
Primary education or less ^d	Worker has primary education or less (base variable in regressions).
Secondary education ^d	Worker has completed secondary education.
College education ^d	Worker has completed college education.
Female ^d	Worker is female.
Female with child ^d	Worker is female with young children (10 years or younger) in the household. No other adult female in the household.
Formal-sector spouse ^d	Worker has spouse working in the formal sector.
Race ^d	Indicator variables for black, Asian, white, mixed, and indigenous (white is base variable in regressions).
Disabled ^d	Worker has reduced working ability (eyesight disability, hearing disability, permanent mental disability, or other disability).
<i>Municipal-level variables</i>	
CCT coverage	Conditional cash transfer payments per capita in municipality (R\$ per month x10).
Labor law enforcement	Number of workers inspected by labor inspections as share of total number of wage workers in municipality.
Minimum-wage bindingness	Share of formal workers paid multiples of the minimum wage minus the share of informal workers paid multiples of the minimum wage.
CCT take-up rate	Instrumental variable for <i>CCT coverage</i> . Share of eligible households receiving Bolsa Familia payments (in 2010) or payments from any cash transfer program excluding unemployment benefits and pensions (in 2000).
Drive time to labor office	Instrumental variable for <i>Labor law enforcement</i> . Traveling time from municipal seat to responsible labor inspection office.
Urbanization	Share of households in municipality residing in an urban area.
Industry categories	16 fractional (share) variables giving the share of workers in the municipality employed in agriculture, fishing, extraction, manufacturing, utilities, construction, retail trade, housing, transportation, finance, real-estate services, public administration, education, health services, other public services, and domestic services. Domestic services is the base sector in regressions.

Note: Dichotomous variables are indicated by superscript *d*.

informality status based on discriminatory placement practices as hypothesized in dual or segmented labor market models.

We include two additional explanatory variables related to worker characteristics. The first indicates whether the worker has a spouse working in the formal sector. Some have hypothesized that *formal* sector employment for one household member may encourage *informal* employment for other household members (e.g., Perry et al., 2007). This is especially possible if some benefits of formal employment cover the entire family or household, if the expected after-tax income in the formal sector is close to the (untaxed) income from informal employment, and if other household members value the flexible hours or other aspects of informality. Search theory, and especially the importance of worker referrals in employer search, offers an alternative hypothesis – namely, those with spouses in the formal sector are more likely to be offered, and perhaps to take employment in the formal sector.

The second variable is an interaction term that equals 1 if there are young children present in the household and the worker is the only adult woman in the household. This variable is included based on the hypothesis that women with young children, who do not have other (adult female) household members assisting them with childcare, are those most in need of the working time flexibility associated with an informal job.

All worker-level variables included in the empirical analysis are derived from the Brazilian Demographic Census from years 2000 and 2010. The micro data from the Census are based on the long-form questionnaire and consist of 20.4 million observations for 2000 and 20.6 million observations for 2010. The large number of observations makes the data representative at the municipal level, which is an advantage over other data sources. There were 5507 municipalities in Brazil in year 2000 and 5565 in 2010.

In our analysis we restrict the sample in several ways. We include only urban wage employees of age 15 to 65 years who report a monthly income and work in the private sector of the economy. When restricting the sample to the urban labor force in this way, informality was 40 percent in 2010, compared to 50 percent ten years earlier. In Table 2, the informal sector is decomposed into wage workers, self-employed, and domestic workers. The biggest share of the decline in informality has taken place among wage workers; the drop from 26.4 to 18.3 percent corresponds to about 80 percent of the overall decline in informality. Thus, in this study we exclude self-employed workers and focus solely on wage employees.

Table 2. Formal and informal employment, 2010 and 2000

	2010	2000
Formal employment	59.1%	49.9%
Informal employment	40.1%	50.1%
<i>of which:</i>		
Wage employees	18.3%	26.4%
Self-employed	16.1%	17.6%
Domestic employees	5.6%	6.0%

Note: Urban labor force, 15–65 years of age, excluding unpaid workers.

Sources: Demographic Census, 2000 and 2010.

3.3. Municipal variables

The vector of municipal characteristics (Z) consists of a set of institutional, policy-related variables and another set of variables capturing the industrial composition of the local economy. The variables accounting for industrial composition are constructed from the Census data and defined as the share of workers in different industries, 16 categories in all. We also include as a control variable the share of households in the municipality that are urban. The degree of urbanization is meant to control for differences in quality of and access to infrastructure, agglomeration economies, and other aspects of urbanization that may have an effect on the formalization of the labor market.

The main policy-related variables constitute municipal level measures of the reach of conditional cash transfers, the enforcement of labor regulations, and the impact of the minimum wage. For two of these, there are legitimate concerns with endogeneity bias if direct measures of these municipal-level features are employed, and so we turn to instrumental variables procedures to rid the estimated impacts of such bias.

(i) Conditional cash transfers (CCTs)

The Census data contain information on the receipt of conditional cash transfer benefits. However, exploring the relationship between CCTs and informality with direct measures of *CCT coverage* is fraught with problems of endogeneity; informality rates across municipalities might well be affected by such transfers, but transfers are also likely to be a function of the municipal level of informality, which is a likely marker for low family income and thus eligibility for CCTs. Thus, we utilize an instrumental variable (IV) procedure to capture the impact of CCTs on informal

employment. The instrument we employ is the *CCT take-up rate* among the population that is eligible for the program. One can think of this measure as capturing, across municipalities, both the awareness of the program among the eligible population and the efficiency of processing applications for social transfers by municipal authorities. We expect the IV estimate of the *CCT coverage* impact on informality to be positive. On the one hand, the program is likely to decrease informality by raising levels of education. However, on the other hand, CCTs might cause workers to opt for informal employment as a way of hiding labor earnings, the extent of which can only be verified by federal authorities when income is generated from formal employment. Having controlled for education elsewhere in the regression, it is this latter aspect of CCT programs that we expect to capture.

(ii) Labor law enforcement

Regarding labor law enforcement, we were provided, by the Brazilian Labor Ministry, with data on “the number of workers affected” by inspections (i.e., the sum total of workers in all inspected firms) in both 2000 and 2010, measured at the level of the municipality.⁷ To create the labor law enforcement variable, we divide the numbers of workers affected by the total number of employees in the municipality, which is derived from the Census data. Of course, labor law enforcement may well be endogenous in the informality equation, so long as enforcement is targeted to those areas of high informality. Therefore, we instrument this intensity measure with drive time to labor office – the time it takes to drive from each municipal seat to the local Labor Ministry office responsible for labor law enforcement, based on the procedure adopted by Almeida and Carneiro (2009, 2012). The identifying assumption is that the closer an employer is to a local labor office, the stricter is the enforcement of labor regulations. Almeida and Carneiro argue that the drive time measure serves as an ideal instrument for an “intensity of enforcement” variable in that the former is likely to be directly (negatively) related to enforcement intensity and yet affect informality only through its impact on the intensity of enforcement.

Drive times may differ over two time periods for several reasons, holding aside the issue of measurement inconsistencies. We know, for example, that the number of local labor ministry offices has changed; three offices closed and six new offices opened during the decade 2000–2010.⁸ This is likely to alter the drive time for labor inspectors as they make their way to municipalities to inspect firms. Moreover, new roads may have been built, thereby reducing drive time, or congestion may have worsened, thereby increasing drive time. It is these differences we hope to exploit in

the decomposition analysis to discern the changing contribution of enforcement efforts to changing informality over time.⁹

(iii) Minimum wage effects

Our last policy-related variable is aimed at capturing the impact of the near doubling, in real terms, of the minimum wage in Brazil over the course of the decade 2000-2010. While the minimum wage is the same throughout Brazil, and thus does not vary across municipalities, its impact on municipal labor markets is nonetheless likely to vary depending on the relation between the minimum wage and the average wage or average relative (formal/informal) wage in the municipality.

We try to capture the impact of the minimum wage on municipal labor markets, based on the now well-established finding that minimum wages have both “lighthouse” and “numeraire” effects in many Latin American countries, including Brazil. The literature has captured these normative features of minimum wages by exploring the existence of spikes or clusters around multiples or even fractions of the minimum wage in both formal and informal wage distributions. These effects are largely normative (as opposed to statutory) and we hypothesize (and show evidence to support the claim) that they vary across municipalities. In particular, we hypothesize that strong lighthouse or numeraire effects in the wage-setting process in the formal sector have a positive impact on the formal/informal relative wage. Thus, *ceteris paribus*, the stronger the lighthouse effect in the formal sector of a municipality, the higher is the formal/informal relative wage in the municipality, and the higher is the rate of informality, as employers on the margin opt for informal sector status or employ informal sector workers in outsourcing arrangements instead of employing formal sector workers directly.

We try to capture this lighthouse effect in the following manner. We first account for the share of *formal* workers in a municipality receiving exactly 1 to 4 multiples of the minimum wage, and then account for the share of workers paid one-half and 1 to 4 multiples of the minimum wage in the *informal* sector as well.¹⁰ The difference between these two shares – the formal and informal – gives us a measure of the ‘relative strength’ of the normative role of the minimum wage in the wage-setting process in the two sectors. We define *minimum wage bindingness* as the share of workers paid in multiples of the minimum wage in the formal sector minus the share of workers paid in multiples of the minimum wage in the informal sector. The rationale of the variable is the following. If the lighthouse effect is more evident in the formal sector than in the informal sector we suggest that the minimum wage has a larger

effect – stronger “bite” – in the formal than in the informal sector. As a consequence, an increase in the (national) minimum wage will affect wages more in the formal sector than in the informal sector, which increases the formal/informal sector relative wage.¹¹ A higher formal/informal sector relative wage, in turn, is likely to increase informality. We specify the informality regression by including *minimum wage bindingness* as an independent variable directly, confident that it captures, in an exogenous fashion, the impact of minimum wages on worker and employer incentives to locate in the informal sector.

Thus, going forward we create instrumental variables for labor law enforcement and conditional cash transfers, with two instruments, and the minimum wages bindingness itself appears as an independent variable in the informality regression. Tests for weak instruments are soundly rejected,¹² but because the model is just identified we are unable to test formally that the instruments satisfy the conditional moment restriction – i.e., that they are valid.

(iv) Descriptive statistics

Descriptive statistics of the variables included in the empirical analysis are provided in Table 3. Information for some of the institutional variables is not available for all municipalities. The regression samples, therefore, only include 5284 municipalities for 2000 and 5481 for 2010. A consequence of this is that the rates of informality in the wage labor force (24.4 and 29.7 percent for 2010 and 2000, respectively) are not fully consistent with the rates implied by those given in Table 2. We return to a discussion of changes in means in the decomposition analysis below, focusing here on a few important observations regarding the data.

Evident among the worker characteristics is the increased level of education. In year 2000, about 47 percent of the workforce had secondary education or more. Ten years later this share had increased to 57 percent. The female percentage of wage and salary workers increased by almost three percentage points and the mix of race and ethnicity categories changed slightly. Among the institutional variables, the most striking development over time is the increased coverage of social transfers to poor households. Between 2000 and 2010 per capita conditional cash transfer payments increased 50 fold. This, of course, is a development largely driven by the emergence and growth of the *Bolsa Família* program.

The intensity of labor inspections increased only slightly over the period – by less than two percentage points. We note that the raw numbers include multiple counting of workers, depending on the number of times a workplace is inspected.

Table 3. Descriptive statistics

<i>Variable</i>	<i>2010</i>		<i>2000</i>	
	<i>Mean</i>	<i>Std. dev</i>	<i>Mean</i>	<i>Std. dev</i>
<i>Worker characteristics</i>				
Informal employment ^d	0.244	0.43	0.297	0.46
Age	35.0	11.2	33.8	10.7
Primary education or less ^d	0.43	0.49	0.53	0.50
Secondary education ^d	0.42	0.49	0.35	0.48
College education ^d	0.15	0.36	0.12	0.32
Female ^d	0.37	0.48	0.34	0.48
Female with child ^d	0.09	0.29	0.10	0.30
Formal-sector spouse ^d	0.23	0.42	0.18	0.39
Race - black ^d	0.08	0.27	0.07	0.25
Race - white ^d	0.52	0.50	0.60	0.49
Race - Asian ^d	0.01	0.10	0.00	0.07
Race - mixed ^d	0.39	0.49	0.32	0.47
Race - indigenous ^d	0.00	0.04	0.00	0.05
Disabled ^d	0.03	0.18	0.02	0.13
<i>Institutional characteristics</i>				
CCT coverage	5.43	7.57	0.10	0.29
Labor law enforcement	0.52	0.63	0.50	0.66
Minimum-wage bindingness	0.00	0.12	-0.03	0.08
CCT take-up rate (IV)	0.28	0.17	0.02	0.04
Distance to labor office (IV)	1.15	1.64	0.74	1.22
Urbanization	0.87	0.17	0.88	0.16
<i>Industry categories</i>				
Agriculture	0.07	0.09	0.06	0.09
Fishing	0.00	0.02	0.00	0.01
Extraction	0.01	0.02	0.00	0.01
Manufacturing	0.16	0.11	0.16	0.09
Utilities	0.01	0.01	0.01	0.00
Construction	0.09	0.03	0.08	0.03
Retail trade	0.21	0.05	0.19	0.04
Housing	0.04	0.02	0.05	0.02
Transportation	0.05	0.02	0.06	0.02
Financial services	0.01	0.01	0.02	0.01
Real-estate services	0.09	0.05	0.07	0.04

contd. table 3

<i>Variable</i>	<i>2010</i>		<i>2000</i>	
	<i>Mean</i>	<i>Std. dev</i>	<i>Mean</i>	<i>Std. dev</i>
Public administration	0.04	0.03	0.06	0.04
Education	0.05	0.02	0.07	0.02
Health services	0.04	0.02	0.04	0.02
Other public services	0.04	0.01	0.04	0.01
Domestic and other services	0.09	0.03	0.09	0.03
Number of observations	3,482,077		2,574,077	
Number of municipalities	5481		5284	

Note. Categorical (dummy) variables are indicated by superscript *d*. Institutional variables are defined at municipal level. Variables for industry categories are defined as share of the municipal labor force in the respective sector.

Sources. Demographic Census 2000 and 2010; Base Estatcart de Informações Municipais 2000 and 2009; Ministry of Labor.

Even taking this into account, that inspections touch such a high percentage of the workforce is rather impressive. Finally, while the normative commitment to paying multiples (or fractions) of the minimum wage is greater in the informal sector in both periods (which is consistent with findings in the literature more generally), the difference declines over the period, portending an increase in the formal/informal relative wage.

As for changes in the composition of the labor market, sectors such as manufacturing, construction, and retail trade have increased somewhat in relative importance, whereas a smaller share of the labor force works in public administration and education. Thus informality has decreased considerably over the past decade despite the fact that the public sector – in which employment is most certainly formal – has decreased its importance as an employer.

And, finally, before moving to the empirical findings, we consider the matter of the geographical distribution of the decline in informality. As noted, informality among wage employees declined from 29.7 percent in 2000 to 24.4 percent in 2010. Table 4 gives some additional insight into the geographical dimension of this decline. In summary, the table reveals that the decline in informal employment was relatively even across macro regions and across municipalities of different size. A noticeable exception is the Northeast region – the poorest region in Brazil – in which the rate of informal wage employment remained constant at about 40 percent between 2000 and 2010. We therefore conclude that a disaggregation across regions of the aggregate

results to follow is unlikely to shed additional light on the causal determinants of the decline in informality.

Table 4. Informal employment among wage employees, Brazil, 2000 and 2010

	2000	2010	change
Brazil	29.7	24.4	-5.3
Macro regions			
North	42.9	36.8	-6.1
Northeast	39.9	40.0	0.1
Southeast	26.6	19.4	-7.2
South	23.8	16.7	-7.1
Center-West	38.4	29.2	-9.2
Major cities			
Sao Paolo	23.6	15.9	-7.7
Rio de Janeiro	21.7	15.3	-6.4
Salvador	22.0	17.0	-5.0
Brasilia	22.7	16.2	-6.5
Fortaleza	29.6	24.5	-5.0
Belo Horizonte	19.6	13.0	-6.6
Manaus	30.6	22.0	-8.6
Curitiba	17.5	11.0	-6.5
Recife	24.2	19.3	-5.0
Porto Alegre	19.4	15.1	-4.4
Municipality population			
>1MN	22.9	16.9	-6.0
500K-1MN	24.4	16.9	-7.5
250-500K	24.3	16.9	-7.4
100-250K	25.2	17.9	-7.4
50-100K	29.2	24.1	-5.2
10-50K	39.7	32.3	-7.4
<10K	46.0	36.2	-9.8

4. EMPIRICAL RESULTS

Table 5 gives the results of the estimated informality regressions for 2000 and 2010. By way of overview, we note that all of the estimated coefficients on the institutional and demographic variables are of the predicted signs, when clear predictions were made, and all are statistically significantly different from zero.¹³ Tables 3 and 5 provide

all of the relevant information required for the decomposition analysis, which can be found in Table 6.

The decomposition analysis in Table 6 allows us to explore separately the impact of changing estimated coefficients and changing means of determinative variables on the overall changing mean rate of informality over the period. This is done for two different sets of weights to ensure consistency in the findings (see the discussion in endnote 6). For each right-hand side determinative variable, we calculate the weighted impacts of the changing coefficients and the changing means on the change in mean informality over the period. This is done for weight 1 in columns 1 and 2 of Table 6, respectively. The percentage of the overall change in mean informality (0.053) accounted for by these respective changes is given in columns 3 and 4 of the table. Columns 5–8 give the same information, but using the second set of weights. For any given determinative variable, we can add the percentages in columns 3 and 4 (or 7 and 8 for the second set of weights) to give the summative change in mean informality accounted for by changes in both estimated coefficients and determinative variable means over the period.

It is common in decomposition exercises to attribute the difference in the means of independent determinative variables (in this case, over time) as an “explained” part of the difference in means of the dependent variable, and to view the changing estimated coefficients as an “unexplained” part. We follow the custom in this literature and dwell mostly on the “explained” components of the decomposition in our discussion below. In a few instances, however, we draw the readers’ attention to the contribution of changing estimated coefficients. A strong institutional understanding of the background features that structure the relationship between a given independent variable and a dependent variable, and how these structural features have changed over time, may allow the researcher to offer speculative explanations for the changing coefficients themselves. We occasionally offer speculative explanations of this sort, but in a select few cases shed actual empirical light on these hypotheses through altered specifications of the main structural equation itself. All summative analyses of the extent to which we have accounted for the declining informality over this period, however, are derived entirely by focusing on the changing means of the independent determinative variables.

Looking first at municipal level measures of the policy variables and their changes over time, we begin with the minimum wage effects. The results in Table 5 suggest that the more important the minimum wage is as a wage-setting norm in the formal sector, the larger is informal employment. This is consistent with the hypothesis

Table 5. Regression Results

	2010		2000	
	<i>Coefficient</i>	<i>Std error</i>	<i>Coefficient</i>	<i>Std error</i>
CCT coverage	0.016***	0.001	0.068*	0.035
Labor law enforcement	-0.165***	0.045	-0.583***	0.210
Minimum-wage bindingness	0.137***	0.026	0.152***	0.058
Age	-0.020***	0.000	-0.029***	0.000
Age squared	0.025***	0.000	0.035***	0.001
Secondary education ^d	-0.095***	0.002	-0.109***	0.004
College education ^d	-0.096***	0.003	-0.108***	0.005
Female ^d	0.022***	0.002	-0.002	0.002
Female with child ^d	0.021***	0.001	0.031***	0.002
Formal-sector spouse ^d	-0.079***	0.001	-0.070***	0.003
Race - black ^d	0.019***	0.003	0.032***	0.009
Race - mixed ^d	0.025***	0.003	0.048***	0.010
Race - Asian ^d	0.033***	0.004	0.045**	0.018
Race - indigenous ^d	0.057***	0.012	0.077***	0.015
Disabled ^d	0.033***	0.002	0.049***	0.004
Urbanization	0.020	0.028	0.104	0.094
Agriculture	-0.067	0.145	1.338**	0.598
Fishing	0.306*	0.181	1.673**	0.704
Extraction	0.161	0.235	0.998	0.647
Manufacturing	-0.137	0.153	1.142*	0.669
Utilities	-0.515	0.446	2.375	1.817
Construction	-0.671***	0.175	0.967	0.691
Retail trade	0.415***	0.132	1.350**	0.576
Housing	0.139	0.233	1.462***	0.554
Transportation	-0.581***	0.190	-0.292	0.668
Financial services	0.734	0.897	3.406	2.085
Real-estate services	0.464	0.318	2.336	1.708
Public administration	-0.557***	0.205	1.734*	0.943
Education	0.206	0.193	2.369***	0.784
Health services	-0.481	0.345	1.520	1.872
Other public services	0.890**	0.393	2.777	1.760
Constant	0.600***	0.142	-0.268	0.619
Sample size	3,482,077		2,574,077	

Note: The dependent variable is the categorical variable *Informal*, which equals 1 if the worker is employed informally and zero if employed formally. Coefficients are estimated in a 2SLS model, with *CCT coverage* and *Labor law enforcement* treated as endogenous variables. First-stage regression results are omitted here for brevity. Levels of statistical significance of the estimated coefficients are indicated by asterisks: 10 % (*), 5% (**), and 1% (***).

Table 6. Decomposition of change in mean informality rates, 2000–2010.

	Weight 1				Weight 2			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
	$(\beta_1 - \beta_0) \times X_1$	$(X_1 - X_0) \times \beta_0$	Change in β	Change in X	$(\beta_1 - \beta_0) \times X_0$	$(X_1 - X_0) \times \beta_1$	Change in β	Change in X
CCT coverage	-0.279	0.360	-525.1%	677.1%	-0.005	0.086	-9.8%	161.7%
Labor enforcement	0.216	-0.007	405.8%	-13.0%	0.211	-0.002	396.5%	-3.7%
Min wage bindingness	0.000	0.004	0.1%	7.5%	0.000	0.004	0.8%	6.7%
Age	0.329	-0.033	618.9%	-62.4%	0.319	-0.022	598.6%	-42.1%
Age squared	-0.144	0.032	-270.7%	59.3%	-0.134	0.022	-252.7%	41.4%
Secondary educ ^d	0.006	-0.008	10.8%	-14.4%	0.005	-0.007	9.0%	-12.6%
College educ ^d	0.002	-0.004	3.1%	-7.0%	0.001	-0.003	2.4%	-6.3%
Female ^d	0.009	0.000	16.5%	-0.1%	0.008	0.001	15.3%	1.1%
Female with child ^d	-0.001	0.000	-1.8%	-0.4%	-0.001	0.000	-1.9%	-0.2%
Formal-sector spouse ^d	-0.002	-0.003	-4.1%	-6.0%	-0.002	-0.004	-3.3%	-6.9%
Race - black ^d	-0.001	0.000	-2.0%	0.9%	-0.001	0.000	-1.6%	0.5%
Race - mixed ^d	-0.009	0.003	-17.3%	5.8%	-0.008	0.002	-14.4%	3.0%
Race - Asian ^d	0.000	0.000	-0.2%	0.4%	0.000	0.000	-0.1%	0.3%
Race - indigenous ^d	0.000	0.000	-0.1%	-0.1%	0.000	0.000	-0.1%	-0.1%
Disabled ^d	-0.001	0.001	-1.0%	1.6%	0.000	0.001	-0.5%	1.1%
Urbanization	-0.073	-0.002	-137.4%	-3.2%	-0.074	0.000	-139.9%	-0.6%
Agriculture	-0.096	0.014	-179.6%	26.4%	-0.081	-0.001	-151.9%	-1.3%
Fishing	-0.005	0.002	-8.8%	3.2%	-0.003	0.000	-6.2%	0.6%
Extraction	-0.005	0.003	-9.7%	4.9%	-0.003	0.000	-5.5%	0.8%
Manufacturing	-0.211	0.003	-396.0%	5.7%	-0.207	0.000	-389.6%	-0.7%
Utilities	-0.031	0.012	-59.1%	21.6%	-0.017	-0.002	-32.8%	-4.7%
Construction	-0.155	0.012	-291.0%	23.3%	-0.134	-0.009	-251.5%	-16.2%
Retail trade	-0.197	0.028	-370.4%	52.1%	-0.178	0.009	-334.3%	16.0%
Housing	-0.054	-0.016	-101.8%	-30.7%	-0.069	-0.002	-129.6%	-2.9%
Transportation	-0.015	0.003	-28.2%	4.8%	-0.017	0.005	-32.9%	9.5%
Financial services	-0.037	-0.007	-70.3%	-13.2%	-0.043	-0.002	-80.6%	-2.8%
Real-estate serv.	-0.159	0.037	-299.7%	69.9%	-0.130	0.007	-243.7%	13.9%
Public admin.	-0.084	-0.047	-158.2%	-87.7%	-0.146	0.015	-274.1%	28.2%
Education	-0.103	-0.045	-193.1%	-85.1%	-0.144	-0.004	-270.8%	-7.4%
Health services	-0.077	-0.003	-144.1%	-5.0%	-0.080	0.001	-150.7%	1.6%
Other publ. serv.	-0.079	-0.004	-147.6%	-6.7%	-0.081	-0.001	-152.2%	-2.1%
Constant	0.869	0.000	1632.5%	0.0%	0.869	0.000	1632.5%	0.0%
Sum	-0.388	0.335	-729.5%	629.5%	-0.147	0.093	-275.6%	175.6%

Note. “Weight 1” refers to a decomposition made according to expression (3’): $\bar{I}S_1 - \bar{I}S_0 = [(\bar{X}_1 - \bar{X}_0)\beta_1 + (\bar{Z}_1 - \bar{Z}_0)\hat{\gamma}_0] + [(\beta_1 - \beta_0)\bar{X}_1 + (\hat{\gamma}_1 - \hat{\gamma}_0)\bar{Z}_1]$. “Weight 2” refers to a decomposition made according to the following expression: $\bar{I}S_1 - \bar{I}S_0 = [(\bar{X}_1 - \bar{X}_0)\beta_1 + (\bar{Z}_1 - \bar{Z}_0)\hat{\gamma}_1] + [(\beta_1 - \beta_0)\bar{X}_0 + (\hat{\gamma}_1 - \hat{\gamma}_0)\bar{Z}_0]$. For brevity, the first term of the expression is referred above to as “ $(\beta_1 - \beta_0) \times X$ ” and the second term as “ $(X_1 - X_0) \times \beta$ ”.

that the stronger the relative impact of the minimum wage norm in the formal sector, the larger is the formal/informal relative wage and thus the higher is the rate of informality, as employers on the margin opt for informal sector status or employ informal sector workers in outsourcing arrangements instead of employing formal sector workers directly. A comparison of means at the start and end of the decade (Table 3) suggests that the relative commitment to the norm rises, thereby portending a growth in informality over the period. This increase was mostly driven by a declining importance of the norm in the informal sector. The influence of the minimum wage in wage-setting is purely normative in the informal sector but partly statutory in the formal sector, and as the minimum wage rose significantly over the decade, it is perhaps not surprising that its impact on the wage structure would diminish more forcefully in the informal sector. Focusing on the “explained” portion of the decomposition (columns 4 and 8) in Table 6, we see that the rising relative commitment to minimum wages in the formal sector pay structure over the period increased informal employment by between 7.5% (weight 1) and 6.7% (weight 2). Thus, changing minimum wages over this period would, all else constant, have portended a rise in informality of between 0.4 percentage points (7.5% of 5.32) and 0.36 percentage points (6.7% of 5.32).

Turning to the role of government conditional cash transfer payments, we hypothesize that their existence may encourage formal sector workers to move to informal-sector status in order to hide income and thereby qualify for government transfers. The results in Table 5 reveal that increased conditional cash transfers do indeed increase informality, as hypothesized. Thus, the very dramatic increase in transfers per capita over this period (by a magnitude of over 50, as seen in Table 3) portends a significant rise in informality. Focusing on the “explained” portion of the decomposition analysis, we see that the dramatic increase in transfers per capita – almost entirely accounted for by the emergence and growth of *Bolsa Familia* over the period – would, all else constant, have led to between a near seven-fold (weight 1) and a near-doubling (weight 2) of informal employment.

Regarding labor law enforcement and its impact on informality, we find, as hypothesized, that increased enforcement lowers informal employment. However, comparing the effects over time, while enforcement efforts appear to have slightly increased over the period (Table 3), the effectiveness of these enforcement efforts (as judged by the changing coefficients in Table 5), at least so far as they concern rooting out and reducing informal employment, appear to have declined rather dramatically. However, recall that we are worried about the integrity of the estimated

coefficient in 2000 due to mismeasurement of the drive time variable, an issue we discuss in the appendix. Focusing on the “explained” portion of the change, we see that rising enforcement efforts account for between 13% (weight 1) and 3.7% (weight 2) of the decline in informal employment over the period.

Changing demographics also account for some of the observed decline in informal employment over this period. Two demographic features with strong negative estimated impacts on informality (as seen in Table 5) are years of schooling and whether or not an individual possesses a spouse working in the formal sector. The means of these demographics features also change over the period in rather dramatic ways – the percentage of the population having completed secondary school rises by 7 percentage points, the percentage having completed college by 3 percentage points, and the percentage with a formal-sector spouse by 5 percentage points (as seen in Table 3).

It is widely known that schooling is one way of increasing the chances of attaining a formal sector wage and salary position. Brazil, like many Latin American countries over this period, set in motion policies to expand formal education, including increased direct government expenditures on education but also conditional cash transfers to encourage parents to keep their children enrolled in school. The regression results in Table 5 suggest that having a secondary degree decreases the probability of being in the informal sector by roughly 10 percentage points, and having a college degree by roughly a similar amount, with minor differences in estimated impacts over time. Looking at Table 6, and focusing solely on the growth in educational attainment over this period, the enhanced numbers of workers with secondary and college degrees combined accounts for between 21.4% (weight 1) and 18.9% (weight 2) of the decline in informality.

Having a spouse in the formal sector also decreases the probability of informal sector employment (Table 5), and the very significant increase in the mean incidence of this demographic over time (Table 3) accounts for between 6% and 7% of the mean decline in informality, depending on which weights are used (Table 6). We suspect the explanation for this result is grounded in job search theory. Spouses who work in the formal sector may earn higher wages, which would allow for enhanced time spent in search for a non-working spouse, but they are also able to offer positive referrals for their spouses to employers looking to hire. Formal sector employers are keen to hire productive employees, and especially so in societies like Brazil where it is costly to fire a worker. The job search literature is clear that internal referrals are an inexpensive and efficient way for employers to screen for quality in a job search.

The observed increase in the percentage of individuals reporting having formal sector spouses is probably largely a demand-side story – the growing availability of formal sector positions goes to spouses of existing formal sector workers. But, there may be a causal component to this observed relationship as well: to the extent formal sector workers increasingly possess spouses, and especially ones that desire employment in the formal sector, this reduces job search costs for employers and may nudge some firms to opt for formality as a result.

Few of the other demographic variables account for a truly significant portion of the decline in informal employment over the period. Looking at Table 6, it may appear that the changing age composition of the workforce – due, in part, to younger workers staying on for more schooling – is a major factor in the declining informal employment. However, the quadratic specification of this variable means that the *Age* and *Age*² impacts must be combined, and so the shift to an older workforce only accounts for between 3.1% (59.3-62.4) and 0.7% (41.4-42.1) of the decline in informality.

The impact of women's labor force participation on the extent and changing nature of informal employment is interesting. While, as hypothesized, women with children do possess a statistically greater tendency to opt into the informal sector (Table 5), there is little change in the magnitude of this demographic over the period (Table 3), and so its impact on changing informality is negligible. The *Female* variable itself is even more interesting. While Table 3 reveals that there was an increase – from 35% to 37% – in female representation among the wage and salary workforce over the decade, Table 5 suggests that being female had no discernable and statistically significant impact on the likelihood of informal employment in 2000, but was a positive and significant indicator of informality in 2010. Thus, while the “explained” impact of changing determinative variable means accounts for little of the change in informality over the period, the changing estimated coefficients portend a very significant rise in informality, all else constant. Many of the estimated coefficients on the demographic variables change over time, and some statistically significantly so, but none change positively and with such magnitude as this estimated coefficient. In the aggregate, incorporating both changing estimated coefficients and changing means of the determinative variable, the impact of this variable in the decomposition analysis portends a rise in informality, all else constant, of 16.4%, or 0.85 percentage points.¹⁴

This is an instance in which an exploratory explanation of the changing estimated coefficients would be most useful. One way of unpacking this finding might be to

introduce some interactive terms into the specification. Could this result, for example, have something to do with the expansion of transfer programs over the period? Could women, especially, be shifting from formal to informal sector status in order to qualify for the *Bolsa Familia* conditional cash transfer program, thereby rendering the relationship between female and informality positive in 2010 when before, in 2000 when conditional cash transfers were largely absent, it was insignificantly different from zero? When we interact *Female* and *CCT coverage* in the 2010 specification, the coefficient for female becomes insignificantly different from zero, whereas the interaction term is positive and statistically significant. Hence, all of the positive estimated impact of gender on informality in 2010 is accounted for by women living in municipalities where per capita CCT payments are positive. And this positive impact is greater, the larger the extent of CCT payments per capita. Put differently, the 2000 and 2010 estimated coefficients on the *Female* variable would be roughly equal in the two estimations if CCTs had remained at the very low levels witnessed in 2000. While speculative, this explanation of the changing estimated coefficient on the *Female* variable is nonetheless informative.

Turning, finally, to changing industry composition, if we add up the changing mean composition effects in column 4 (using weight 1) and then in column 8 (using weight 2), we find that the changing industry mix over the period explains 16.5% of the decline in informality in the first case and yet portends a rise in informality of 32.5 percent in the second. Significant in both cases, but not consistent. The changing estimated coefficients over this period, however, tell a very different story. In fact, among all the components in the decomposition analysis, it is the changing way in which industry translates into informality (i.e., changes in the estimated coefficients) that accounts for the largest portion of the decline in informality over this time period. Between 2000 and 2010, six of the estimated coefficients on the industry composition variables switch signs from positive to negative, and all of the remainder that were positive in 2000 fall in absolute value (see Table 5). The one estimated coefficient that is negative in 2000 becomes more so in 2010. In every industry, the propensity toward informal employment falls and does so sizeably and often statistically significantly. If the employment mix had remained unchanged over the period, the changing estimated coefficients alone would portend a decline in informality that accounts for well over 100% of the actual decline. Future research on this period of rather significant decline in informal employment in Brazil should focus on explanations for why, across a broad swath of industries, labor transitioned from informal to formal employment.

By way of summary, then, our empirical analysis sheds only a dim light on the determinants of declining informality over the decade 2000–2010. In the aggregate, and focusing only on changes in demographic and industry composition effects – the “explained” components in the decomposition analysis – rising rates of labor law enforcement, rising education levels, increased numbers of workers with spouses in the formal sector, and changes in industry composition explain between 57% or roughly 3 percentage points (weight 1) and 16% or roughly 0.85 percentage points (weight 2) of the decline in informality over the period. Our results suggest that a very significant portion of the decline in informal employment over the period is accounted for by the changing estimated coefficients on the industry mix variables – that is, by the changing way in which industry composition translates into informality. An important additional finding in the analysis is that two of the most important policy changes over this period – the increase in the real value of the minimum wage and the dramatic expansion of conditional cash transfer programs – contribute positively, not negatively, to informality over the period.

5. CONCLUSION

This paper explores the significant decline in wage and salary informal employment over the period 2000–2010 in Brazil. We utilize census data from the beginning and ending years of the decade along with other institutional data sources, informality regressions that exploit variation in informality across workers and municipalities for these two years, and then decompose the changing mean informality rate over the decade into its determinants using a Blinder-Oaxaca decomposition. Among the determinants considered are: enhanced labor law enforcement, a near doubling of the real value of the minimum wage, the emergence and growth of conditional cash transfer programs (and most importantly *Bolsa Família* – the largest conditional cash transfer program in the world), and changing industry composition and labor force demographics.

We find that two of the most important policy changes over this period – the increase in the real value of the minimum wage and the dramatic expansion of conditional cash transfer programs – contribute positively, not negatively to informality. Among the various determinants of informality analyzed in this paper, four – namely, rising education levels, increased incidence of workers having a spouse in the formal sector, increased labor law enforcement, and the changing mix of industries – account, collectively, for between 16% and 57% of the decline in the

mean informality rate over the period. The single largest factor explaining the decline in informality in our results are changes in the set of estimated coefficients on the industry categorical variables – that is, by the changing ways in which industry translates into informality.

Acknowledgement

We acknowledge the assistance of Celso Amorim Araújo, Pedro Aratanha, Régis B Oliveira, Rubens Morita, Marcos de Almeida Rangel, Hélio Zylberstajn, Tania Costa, Pedro Carneiro, Rita Almeida, and Steven Helfand in helping us to attain data and to better understand their institutional meaning and context. Steven Helfand and Pedro Aratanha offered useful comments on an earlier version of this research, as did participants in presentations at the Eastern Economic Association Meetings in New York and the International Conference on Developments in Economic Theory and Policy in Bilbao, Spain. Rubens Morita, Régis B Oliveira, and Amber Qureshi provided excellent research assistance.

Notes

1. *Bolsa Escola* was one such program. It became a federal conditional cash transfer program in 2001, following experimentation with conditional cash transfers in several municipalities dating back to the early 1990s (Soares 2012).
2. See Perry et al. (2007) for evidence from Latin America and the Caribbean and McCaig and Pavcnik (2015) for evidence from Vietnam.
3. Mello and Santos (2011) offer evidence suggesting that increased educational attainment accounts for part of the decline in informality over the period of our investigation.
4. Maloney (2004) reports that roughly 30% of surveyed informal salary workers in Brazil would not wish to work in the formal sector. The part-time nature of much work in the informal sector may be attractive to women with children and to older workers who have retired with pension benefits from the formal sector. Almost 20% of those women who prefer working in the informal sector in Brazil cite household chores or needing time for other activities as the reason for choosing to work informally (Maloney 2004). The young may not find value in the pension and health benefits common to formal-sector status. And those who have spouses working in the formal sector, and thus qualifying for family benefits by virtue, may be free to locate in the informal sector without significant loss. On the other hand, the less educated are almost assuredly there by force and not choice. Perry et al. (2007, p. 62) state: "...graduation to formal salaried work is unlikely for youth who drop out of school before completing at least a full course of secondary education." Arguably, a portion of the women, elderly, and younger workers in the informal sector are also likely to be there not by choice.
5. We are aware of the drawbacks of utilizing such a model for estimation with a dichotomous dependent variable. However, a further exploration of our results with those from a probit

estimation technique, which is arguably superior when the dependent variable takes on the value of either 0 or 1, revealed little difference across the two sets of estimated coefficients. These results are cited below in the “empirical results” section of the paper.

6. The choice of weights in the decomposition is arbitrary. β_0 and γ_0 can be replaced by β_1 and γ_1 , with the corresponding changes in the second term, so that expression (3') becomes $\overline{IS}_1 - \overline{IS}_0 = [(\bar{X}_1 - \bar{X}_0)\hat{\beta}_1 + (\bar{Z}_1 - \bar{Z}_0)\hat{\gamma}_1] + [(\hat{\beta}_1 - \hat{\beta}_0)\bar{X}_0 + (\hat{\gamma}_1 - \hat{\gamma}_0)\bar{Z}_1]$.
7. The numbers reflect each inspection, even if a given firm is inspected more than once, and even if the repeated inspection regards the same, initial violation.
8. There were 143 labor ministry offices in 2010.
9. We note that drive time is not some constant multiple of distance, based for example on an average speed measure for the country or region, and thus represents expected elapsed time in driving between two distances.
10. As shown in the appendix figures there are spikes in the wage distribution at multiples of R\$151 in 2000 and R\$510 in 2010, which were the levels of the minimum wage in those two respective years.
11. In cross-municipal regressions not reported here, the minimum wage bindingness variable was associated positively with the municipal formal/informal sector relative wage, controlling for a series of other municipal characteristics.
12. The F-tests for joint significance of the three instruments in each of the first-stage runs are well over 10 – the rule of thumb proposed by Staiger and Stock (1997).
13. In endnote 5 we made reference to the similarity of the linear probability and probit estimates. We have compared the linear probability model estimated coefficients with the marginal effects from a probit estimation for the 2010 sample, available as Table A1 in the “Appendix.” We find that only three of the 31 coefficient estimates are statistically significantly different across the two model estimations. This gives us some solace in moving forward with the linear probability model for purposes of this analysis, which as we make clear above is helpful for decomposing the causal factors accounting for changing mean informality rates over time.
14. Note that the combined impacts, i.e. columns 3 + 4 and columns 7 + 8, are by construction necessarily the same regardless of the weights used.
15. Soares (2012) contains an excellent history of CCT programs in Brazil.
16. We follow Cardoso and Souza (2003) in isolating conditional cash transfer recipients using the 2000 Demographic Census.

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To cite this article:

David Fairris and Erik Jonasson. Determinants of Changing Informal Employment in Brazil, 2000–2010. *Journal of Development Economics and Finance*, Vol. 1, No. 1, 2020, pp. 1–43

APPENDIX

A1. Variable definitions and data sources

a) Conditional cash transfers

Federal conditional cash transfer (CCT) programs grew dramatically during the first decade of the 21st century in Brazil. The first CCT program in Brazil emerged in 1991, and throughout the 1990s CCTs spread rapidly, but largely at the municipal level.¹⁵ The Federal government initiated its first conditional cash transfer program in 1996 which was targeted at reducing child labor in especially dangerous industries. Municipal-level programs spread rapidly in the later years of the decade, and in 1998 the Federal government began subsidizing the transfers in a host of these municipal-level CCTs. The first nationwide CCT program targeted to increase children's education and health status emerged in Brazil in 2001. It was referred to as *Bolsa Escola*, and was a precursor to the *Bolsa Família* CCT program which began in 2003. The growth in both benefit levels and reach during the remainder of the decade was dramatic.

The Census data contain information on households receiving conditional cash transfer payments. In order to measure the municipal-level “take-up rate,” our primary task is to capture the eligible population. We assume that reported income in the Census is a more accurate reflection of true income than what is reported to local authorities in order to qualify for *Bolsa Família*. Thus, some households who are not eligible for CCTs according to Census data may nonetheless report receiving such payments (see et al. 2010, for a discussion of targeting issues with *Bolsa Família* and for estimates of the high percentage of recipients who are in fact ineligible for the program). Despite the fact that some recipients are ineligible, our measured take-up rate should still reflect both the extent to which the program is well-known and the efficiency of processing by local authorities.

In 2010, we begin by eliminating households from our sample that contain individuals who are not family members, since eligibility involves family (not household) income per capita. There is great agreement in the literature that “household” and “family” are fairly synonymous in Brazil, and indeed our analysis of these exclusion restrictions suggest this is the case; less than 0.5% of households contain members who are not related to the household head. This includes households with domestic servants, relatives of domestic servants, boarders, and individuals living in collective domiciles. We then turn to the derivation of household (i.e., family) income per capita. Pension benefits are excluded from the calculation of household earned income, and pensioners are not counted in the “per capita” number for purposes of eligibility. Earned income – including earnings from employment as

well as rental income, income from investments, and interest income – is the primary category here, excluding direct and conditional cash transfer payments. This is captured as monthly income in the month of July of the survey year, and household income is the aggregation of the monthly income of family members. Household income is then divided by the number of family members.

Eligibility criteria for Bolsa Familia are clearly stated: for the year 2010, very poor families (with a per capita household income of 70 Reais or less) are eligible, as are poor households (with per capita household income greater than 70 but less than or equal to 140) so long as they have a child present in the household who is 17 years of age or less. For each municipality, we calculate, using Census data, the take-up rate among the eligible households – that is, the number of eligible families receiving Bolsa Familia benefits divided by the number of eligible families in the municipality. We employ this variable to capture knowledge of the program by municipal residents and the efficiency of local administrative authorities in submitting applications (and also perhaps the lack of scrutiny of these authorities in pursuing those who do not meet the “conditions” involving school attendance and health exams of children). We believe this variable to be truly exogenous in the informality equation.

For the year 2000, the information in the Demographic Census data is less precise concerning conditional cash transfers received by households. Individuals are asked only for the total monthly amount of social transfers received, regardless of transfer program or type of transfer. In deriving the municipal take-up rate in 2000 we begin by excluding households with individuals who are disabled or unemployed. By doing so, we avoid the inclusion of disability and unemployment benefits in our measure of cash transfers received. We then sum all forms of income (labor income, rental income, income from alimony etc.) – except cash transfers – in the household and divide by the number of household members.¹⁶ If this per-capita household income is less than R\$90 *and* if there are children 7–15 years old in the household, we consider the household eligible for CCTs. The municipal take-up rate is then defined as the number of eligible households receiving cash transfers divided by the total number of eligible households in the municipality, in the same way as for 2010.

b) Minimum wage effects

Regarding the *minimum wage bindingness* measure, Figures A1 and A2 in the appendix show selected segments of the wage distribution for fulltime workers in the informal sector for 2000 and 2010, respectively. In year 2000 the minimum wage was 151 real. Spikes can be observed, in Figure A1, at half the minimum wage (75 real) and at the minimum wage. But, there are also spikes in the distribution at exactly twice the minimum

wage, 302 real. In 2010, the minimum wage was 510 real. Figure A2 reveals a certain spike at 255 real – exactly one-half the wage minimum – despite a well-known tendency for surveyed workers to round off reported salary measures – in this case, perhaps to 250 real. The spikes appear to be real phenomena; they take place at the exact minimum wage and at multiples thereof. This provides evidence, at the national level, of “lighthouse” and “numeraire” effects of the minimum wage in Brazil, as has been observed in the previous literature. Figure A3 and A4 show the corresponding wage distributions in the formal sector, with similar spikes at multiples of the minimum wage, both for year 2000 and 2010. The strength of the minimum wage as a wage-setting norm in the informal sector does seem to vary across municipalities, both in absolute terms and in relative terms (compared to the formal sector). On average, 23 percent of the informal work force was paid in multiples of the minimum wage in 2010. This share, however, varies from a few percent in some municipalities to over 60 percent in other municipalities. The *difference* between the informal and formal sectors in the strength of this norm also varies across municipalities, which is key to our analysis. In some municipalities the share of workers paid multiples of the minimum wage in the *informal* sector is much lower than the corresponding share in the formal sector. In other municipalities the reverse is true.

A2. Robustness checks

Two robustness checks are presented in this section. The first accounts for inconsistencies in drive time differences across the period of examination. The second accounts for instances in which municipalities changed fundamental character over the period due, for example, to mergers or separations between communities.

a) *Drive Time Inconsistencies*

There are three reasons why drive times may differ across the two time periods under examination in this paper: (1) systematic difference in the programs used to calculate drive times in the two periods; (2) the fact that in 2000 Almeida and Carniero calculate drive time between any given municipality and the nearest labor ministry office (instead of the actual labor ministry office in charge of inspections in that municipality); and (3) legitimate changes in drive time due, for example, to the construction of new roads, altered speed limits, increased congestion, and the closure or opening of labor ministry offices. We would like our estimates of the impact of enforcement on informal employment to be identified off of legitimate changes in drive times over the period.

We have strong suspicions that the programs used to derive drive times are different over the two periods. When drive time in 2010 is regressed on a constant and drive time

in 2000, while the correlation is very high – indeed the estimated coefficient on drive time in 2000 is virtually equal to 1 – there is a constant of 0.3, or roughly one-third of an hour, which amounts to about 15% of the average drive time of two hours in 2000. One possible explanation for an average increase in drive times is the error cited in (2) above – we would expect drive times to be lower in 2000 because they are calculated for the nearest labor ministry office rather than the one truly responsible for inspections in a particular municipality. But, when we run the same regression on a sub-sample of municipalities for which the nearest labor ministry office is indeed the one responsible for labor inspections (to be discussed further below), we find similar results: an estimated coefficient equal to 1 and a constant that, in this case, is over two-thirds of an hour. We would not expect average drive times to rise so significantly over time, and therefore conclude that the programs used to calculate drive times differ across the two time periods. It is important to note, however, that so far as this type of programming inconsistency results in a linear transformation of true drive time (as suggested by the regression results discussed above), it can be shown that our structural estimates of the impact of enforcement on informality are unaffected. We thus leave aside this issue.

In order to shed light on the extent of the error committed by Almeida and Carneiro, and its effect on the estimated impact of enforcement on informality, we gathered drive times to the *nearest* labor ministry office for each municipality in those nine states with only two labor ministry offices in 2010. Coupled with drive time data to the *accurate* office, we are able to identify the subset of municipalities in these states for which the nearest labor ministry office is indeed the accurate one responsible for labor conditions and inspections. Of the 1330 municipalities in the 9 states with only two labor ministry offices, there are 216 instances (or roughly 16% of the sample) for which the nearest office is *not* the one responsible for inspections. It is difficult to know to what extent this translates to the larger group of states with more than two labor ministry offices, but it gives us a sense of the possible extent of the error committed by Almeida and Carneiro.

To this sample, we add municipalities in the five states with only one labor ministry office, in which case the nearest office is, by necessity, the accurate office. This adds over 100 municipalities (including Brasilia) to the sample. With these data we can hazard an answer to the question, “How, if at all, would our main results change if drive times in 2000 reflected distances to the accurate labor ministry office rather than to the nearest?” We should begin by noting that these samples are roughly 15% the size of samples for the main results (Table 5). Compared to the main results, the estimated coefficient on the enforcement variable is -0.067 in 2010 and -0.55 in 2000. While the estimated coefficients in 2000 are reasonably similar (-0.55 versus -0.58), the coefficient in 2010 with the new, smaller sample is less than half the size of that in the main results

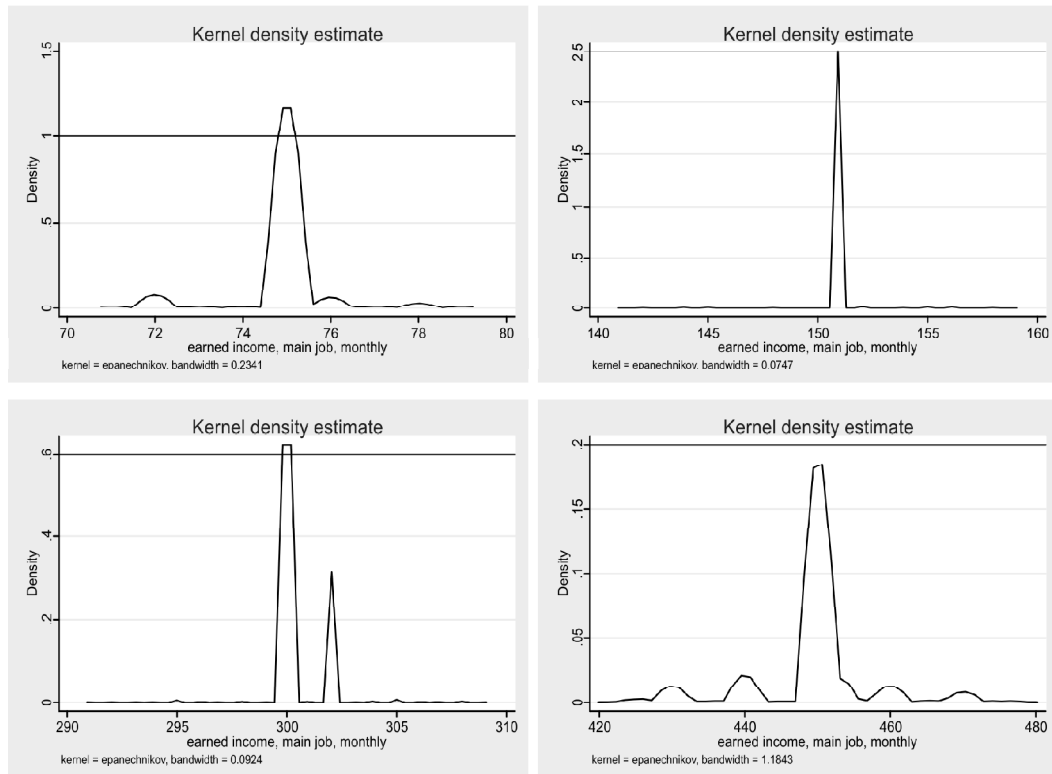
(-0.067 versus -0.17). Thus, this is further evidence to suggest that the effectiveness of enforcement efforts in reducing informality declined rather significantly over the period 2000 to 2010.

A different approach to detecting possible contamination of our main results due to differences in the measurement of drive time is to trim the main sample to eliminate outliers that are likely to be the result of various measurement inconsistencies. We eliminate any changes in drive times over the period representing more than 20% (in absolute value) of the average drive time (of two hours) in 2000. The sample sizes fall significantly (but by nowhere as much as in the exercise above) – by roughly 40% for the 2010 sample and by roughly 30% for the 2000 sample. The estimated coefficient on enforcement in 2010 for this sub-sample is less, by almost half, than the one in Table 5 (-0.09 versus -0.17). For 2000, the estimated coefficients for the sub-sample and main set results are virtually identical (-0.58 versus -0.6). The efficiency of labor law enforcement in reducing informal employment falls over the period in these results as well. Thus, we conclude that, while the precision of the estimates of the decomposition may be compromised, it appears to be the case that increased labor law enforcement over the period had a reduced impact on lessening informality during these years.

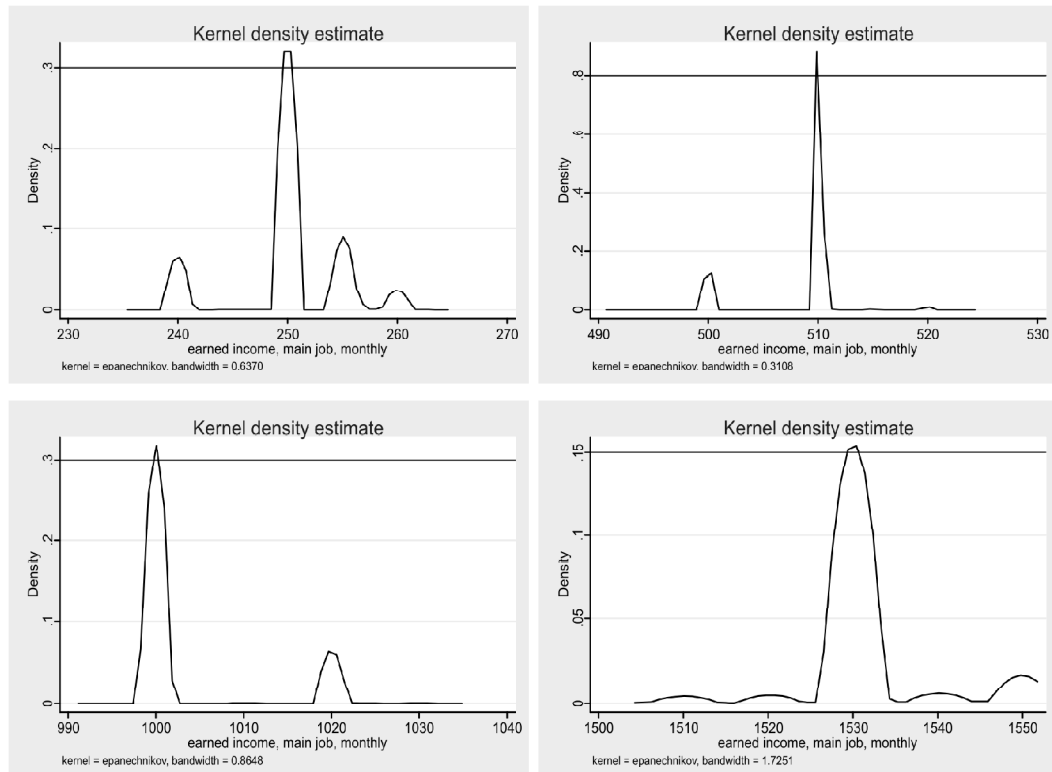
b) The Changing Character of Municipalities over the Period

The number of municipalities in Brazil grew from 5507 in year 2000 to 5565 in 2010. These new municipalities emerged either as separations from single existing municipalities or as mergers of parts of two, or in some cases even three, existing municipalities. In total, 130 of the municipalities existing in 2010 were “affected” by municipal re-organizations between 2000 and 2010, either as being newly-created or as an existing municipality losing part of its original land. A concern here is that this re-organization of municipalities might have changed fundamentally the character of some of the original municipalities between the two periods. This, in turn, could mislead an analysis explaining the change in informal employment in terms of changing observable municipal characteristics. As a robustness check we excluded these 130 municipalities affected by re-organizations in our regression analysis. This reduced the sample by only about 2.5%. Coefficient estimates did not change notably.

Figure A1. Wage distribution in the informal sector, 2000

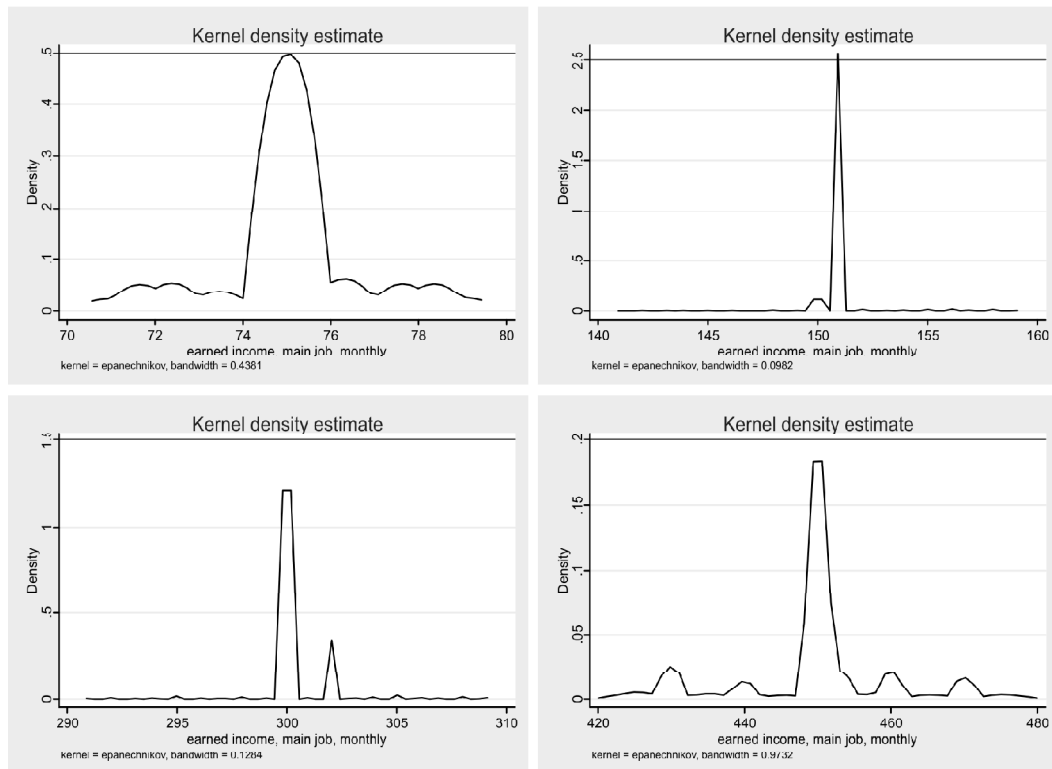


Source: Demographic Census, 2000.

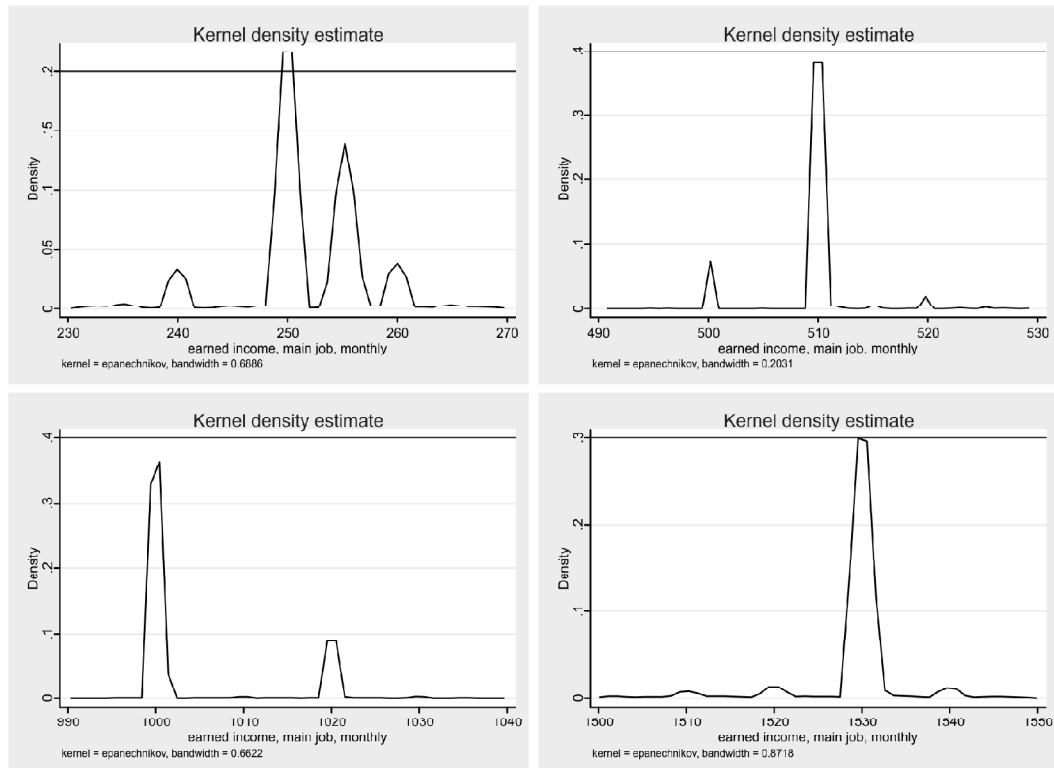
Figure A2: Wage distribution in the informal sector, 2010

Source: Demographic Census, 2010.

Figure A3: Wage distribution in the formal sector, 2000



Source: Demographic Census, 2000.

Figure A4: Wage distribution in the formal sector, 2010

Source: Demographic Census, 2010.

Table A1. Comparing linear probability and probit model estimation results using the 2010 sample

	<i>Linear probability</i>	<i>95% confidence interval</i>		<i>Probit marginal effects</i>	<i>95% confidence interval</i>	
CCT coverage	0.016	0.014	0.019	0.013	0.012	0.015
Labor law enforcement	-0.165	-0.253	-0.077	-0.089	-0.159	-0.020
Minimum-wage bindingness	0.137	0.087	0.187	0.075	0.039	0.111
Age	-0.020	-0.020	-0.019	-0.018*	-0.018	-0.018
Age squared	0.025	0.024	0.025	0.023*	0.022	0.023
Secondary education ^d	-0.095	-0.099	-0.091	-0.088	-0.092	-0.085
College education ^d	-0.096	-0.103	-0.090	-0.097	-0.103	-0.091
Female ^d	0.022	0.019	0.025	0.025	0.022	0.028
Female with child ^d	0.021	0.019	0.023	0.020	0.018	0.022
Formal-sector spouse ^d	-0.079	-0.082	-0.076	-0.088*	-0.090	-0.085
Race - black ^d	0.019	0.013	0.024	0.015	0.012	0.019
Race - mixed ^d	0.025	0.019	0.030	0.020	0.016	0.024
Race - Asian ^d	0.033	0.025	0.040	0.028	0.022	0.035
Race - indigenous ^d	0.057	0.034	0.080	0.047	0.029	0.066
Disabled ^d	0.033	0.030	0.036	0.029	0.026	0.031
Urbanization	0.020	-0.036	0.076	0.011	-0.029	0.050
Agriculture	-0.067	-0.352	0.218	-0.206	-0.407	-0.004
Fishing	0.306	-0.049	0.661	0.041	-0.211	0.293
Extraction	0.161	-0.300	0.621	-0.091	-0.418	0.235
Manufacturing	-0.137	-0.437	0.163	-0.321	-0.544	-0.098
Utilities	-0.515	-1.388	0.359	-0.662	-1.244	-0.080
Construction	-0.671	-1.014	-0.328	-0.645	-0.877	-0.414
Retail trade	0.415	0.157	0.672	0.264	0.088	0.440
Housing	0.139	-0.318	0.596	-0.054	-0.369	0.260
Transportation	-0.581	-0.953	-0.210	-0.686	-0.953	-0.420
Financial services	0.734	-1.024	2.492	0.142	-1.111	1.394
Real-estate services	0.464	-0.160	1.088	-0.012	-0.486	0.462
Public administration	-0.557	-0.960	-0.155	-0.650	-0.943	-0.358
Education	0.206	-0.173	0.585	-0.051	-0.309	0.206
Health services	-0.481	-1.158	0.196	-0.641	-1.098	-0.183
Other public services	0.890	0.120	1.659	0.634	0.120	1.148

Note: The dependent variable is the categorical variable *Informal*, which equals 1 if the worker is employed informally and zero if employed formally. Asterisk (*) indicates that the IV probit marginal effect estimate is statistically significantly different from 2SLS coefficient estimate. Number of observations: 3,482,077.