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Precarization or protection? The impact of trade and labour policies on informality

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Abstract: Several episodes of market-oriented reforms in developing countries have been accompanied by a significant rise in work outside of the formal economy. This paper investigates whether the impact of increased exposure to trade on formal employment is mediated by the strength of labour regulations. We rely on data from the Brazilian Census which provides information on workers' demographics and employment, including job formality status. Our estimation strategy exploits quasi-exogenous changes in industry-level real exchange rates to explore the likelihood of informality across employers exposed to varying degrees of *de facto* labour regulations. To instrument for labour enforcement, we utilize two key features of Brazilian labour institutions—budgetary decisions about the availability of resources occur at the federal level, while decisions about where to inspect occur at the local level. Our instrumental variables results suggest that strict labour regulations may lead to a precarization of employment, rather than offering protection for workers.

Key words: Brazil, enforcement, informality, trade, labour regulations, instrumental variables

JEL classification: C26, F16, J46, J80

Figures and tables at the end of the paper

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1 Introduction

Recent market-oriented reforms, such as trade liberalization, have coincided with a substantive rise in work outside of the formal economy. In Brazil, for example, estimates for 2010 suggest that approximately 30 per cent of employment is not formal—that is, these jobs are held by either informal or self-employed workers who do not pay into the tax system and do not receive government benefits. Much research has documented the relationship between trade policy and informality in the Brazilian context, with mixed results (e.g., Goldberg and Pavcnik 2003; Menezes-Filho and Muendler 2011; Paz 2014). The ultimate impact of trade on formal and informal employment opportunities, however, will be mediated by the flexibility that businesses have *de facto* to adjust their workforces following shocks. While labour market institutions exist to protect workers, when too stringent, they may also hamper the firm's incentives to adjust the workforce by raising the costs of labour. In fact, research has shown that rigid labour regulations constrain firm size (Almeida and Carneiro 2009, 2012) and firm productivity (Almeida and Poole 2017). In addition, in stark contrast to the best policy intentions, evidence in Almeida et al. (2019) points to the idea that rigid labour market regulations differentially benefit the employment of a skilled workforce, at the expense of low-wage, low-skilled workers who may need these protections the most.

In this paper, we combine these different lines of research to consider the implications of rigid labour market policies on informality in the aftermath of trade liberalization. First, we investigate the impact of trade on informality. Next, we exploit the within-country differences in the strength of enforcement of Brazilian labour regulations to study the role of labour policy in influencing these effects. Given the previous evidence, we hypothesize that strict labour policy may, in fact, reinforce trends toward widening wage dispersion and job polarization, and contribute to rising lower-tier informality, in part, as low-wage, low-skilled job opportunities in low-productivity formal establishments diminish. In this sense, our paper speaks to a growing public policy debate on the trade-off between economic growth and job security for workers. More flexible labour markets allow workers to reallocate to their most efficient use, enhancing the productivity gains associated with a globalizing world. The fact that rigid labour policy may unintentionally amplify the income inequality effects of these shocks, pushing workers into the informal economy and increasing the precarization of jobs, should give policy makers serious pause. Our research will offer insights for Brazil and other middle-income countries that face similar challenges in an increasingly integrated global economy.

Our empirical strategy to identify the impact of labour market regulations on informal employment status relies on a number of data sets from Brazil which exhibit substantial variation across many different dimensions: municipal locations, industrial categories, and time. We rely on detailed individual-level data from the decennial Population Census (IBGE n.d.), which cover the entire country and includes information on workers' demographics and employment status (formal, informal, or self-employed). With information on the individual worker's industry and location of employment, we match this census data on employment outcomes to industry-specific trade information from Brazilian Ministry of Foreign Trade (n.d.). Specifically, we exploit quasi-exogenous changes in trade exposure as proxied by industry-specific real exchange rate changes.

We explore how these shocks, which require significant labour market adjustment, impact workers' informality across Brazilian employers exposed to varying degrees of *de facto* labour regulations, as measured by Ministry of Labour inspections. While the *de jure* labour regulations in Brazil established by the 1988 Federal Constitution are effective throughout the country, the Ministry of Labour was designated with having enforcing compliance with the regulations during the period

under analysis. As such, there is significant heterogeneity both within the country and over time in terms of how binding is the labour law.

As the enforcement of labour regulations may be endogenous to local conditions in the municipality (Sen et al. 2013), we instrument for city-specific *de facto* labour regulations relying on two key features of Brazilian institutions. First, decisions about the amount of enforcement are taken at the federal level; that is, when budgets are flush, enforcement increases in all states. Second, the vast geography of the country suggests that local inspectors will not be able to reach all cities; therefore, the geodesic distance from the state capital (from where local inspectors depart and local labour offices are located) to a city will be a good proxy for the likelihood that inspectors can reach that city (Almeida and Carneiro 2012). Thus, the core instrumental variable in our analysis is calculated as the average labour enforcement in other states interacted with the inverse of the geodesic distance between the city's state capital and the city itself.

Our results suggest that labour market regulatory enforcement may lead to a precarization of jobs instead of offering protection to workers. As predicted by our conceptual framework, we find that exchange rate depreciations, leading to expansions in output and employment, decrease the informal economy and increase the formal economy. However, these changes are significantly weaker in strictly enforced municipalities across the country. Additionally, in strictly regulated areas, firms forego relatively expensive formal workers by employing relatively cheaper self-employed workers. At the end of the day, stricter enforcement attenuates the effects of globalization on the quality of jobs available to workers.

The rest of this paper is organized as follows. Section 2 offers a detailed overview of the main economic literatures associated with our research question linking trade, labour policies, and informality. In Section 3, we present the data sets and provide some descriptive statistics. Section 4 offers some theoretical predictions based on the background literature relating changes in exposure to international markets and the subnational enforcement of labour regulations to labour market outcomes, such as informality and self-employment. Section 5 describes the main empirical strategy and reports our results for the effects of international trade on informality across distinct regulatory environments alongside. We offer concluding statements for policy in the final section.

2 Background literature

This section offers a brief overview of the background literature linking trade, labour policies, and informal labour markets. We start with a brief discussion of the definition of informal employment. Second, we review the literature on the impact of labour market regulations on informality. We then turn to the large literature on the role of international trade in influencing informal labour markets. Finally, we describe the limited evidence on the interactions between trade and labour policies on labour market outcomes like informal employment.

Our work offers several key contributions to these literatures. First, and most importantly, we are aware of only a few papers that study the implications of international trade on informality in the presence of heterogeneous labour market regulatory enforcement. This paper complements those structural models by relying on our reduced-form empirical strategy to assess a causal relationship with fewer assumptions. Second, we examine whether self-employment is an additional margin of adjustment to changes in the trade environment. Third, we investigate the moderating role of *de facto* labour regulations in the effects of trade on the type of employment. Finally, we investigate the effects of these policies on the employment levels in addition to the rates of formality.

2.1 Informal employment

Our definition of informal employment is tailored to the Brazilian labour market and has substantial overlap with the International Labour Organization (ILO 2019) definition, although there is an important difference in that we only consider paid employment.[1] Following Fields (2020), we next distinguish workers between self-employment and wage employment.

Self-employment is characterized by income volatility, since workers are commonly paid by piece, task, hour, or by commission. This type of labour contract is also characterized by low attachment of the worker to the employer because of the absence of firing costs and the possibility of multiple employers, albeit that having a single employer is typical in the Brazilian context. Unfortunately, the census data used in this study do not provide sufficient information to classify self-employed workers into formal and informal status by tax compliance.

Wage employment, by contrast, has a much smaller exposure to income risk. Workers are typically paid a salary and have a single job and employer. This creates a strong attachment between workers and employers. Wage workers are considered formal when they have a signed labour card or contract. This definition is widely used in the literature on informality for Brazil (see, for example, Goldberg and Pavcnik 2003).[2] This means that these workers are covered by social security and labour regulations like severance payments. Informal workers, therefore, are those wage earners without signed labour cards and contracts.

These three types of employment follow distinct regulations and, therefore, have distinct costs to employers. Formal wage employment is the most regulated type of job and has the highest out-of-pocket costs for the employer, who is also in charge of remitting social security contributions and withheld taxes to the government. Self-employment has fewer regulations and by law cannot be covered by employer benefits. This makes self-employed workers a less-costly, but legal, alternative to formal workers. It is the self-employed worker's duty to remit social security contributions and taxes to the government. Finally, though informal wage workers are subject to the same regulations, in practice, the benefits they receive depend on the specific informal arrangement that has been agreed to with the employer. As the workers are 'off the books', tax evasion by the employer and by the worker is common and, therefore, illegal. This job type has the lowest out-of-pocket cost to employers; however, employers are subject to a significant fine if they are caught neglecting the labour laws.

2.2 Labour enforcement and informality

While there is a large literature on the implications of *de jure* regulations on the labour market,[3] Bertola et al. (2000) suggest that *de facto* regulation is as important, or even more important, in determining labour market outcomes. This may be particularly so in developing countries, where there is often significant heterogeneity concerning *de facto* regulation across localities. Almeida and Carneiro (2009) quantify the effects of *de facto* regulation on firm outcomes within Brazil for the

[1] Our definition also draws upon the job-based concept adopted by the Transforming Informal Work and Livelihoods Project of the United Nations University World Institute for Development Economics Research (UNU-WIDER).

[2] Paz (2014) employs a social security contribution compliance measure of job informality. However, as the author points out, the overlap between these two definitions of informality is above 95 per cent of workers. In our context, though, such contributions are not enforced by the Ministry of Labour but, rather, by Social Security inspectors. It is for this reason that we opt to rely on the *carteira assinada* definition of informality in this paper.

[3] See, for example, Ahsan and Pagés (2009), Kugler (1999), Kugler and Kugler (2009), Petrin and Sivadasan (2013), and several other studies cited in Heckman and Pagés (2004).

year 2002. Although stricter enforcement produces greater compliance with labour regulations, the authors find that higher levels of *de facto* regulation result in lower output, smaller firms, and lower labour turnover, leading to an increase in unemployment as the higher labour costs inhibit labour market flexibility. However, a limitation of the study is that the effect on informal firms remains unknown. In this respect, it may very well be that stricter enforcement, while reducing informal labourers amongst formal firms, contributes to a further displacement of workers. In fact, the higher unemployment rate may be associated with an increase in the size of the informal economy.

In order to assess this, in a follow-up paper, Almeida and Carneiro (2012) directly address labour market outcomes across formal and informal sectors over time as a result of labour inspections. Their model asserts that the standard view—that is, that higher enforcement results in a shift in employment toward the informal sector—neglects the fact that the value that workers place on mandated benefits is higher than the cost to employers. Therefore, given stricter *de facto* regulations, the formal sector becomes more attractive, leading to an increase in the supply of formal workers and a decrease in the supply of informal workers. Indeed, their findings suggest that stricter enforcement is associated with an increase in formal sector employment and a decrease in employment in the informal sector.

2.3 Trade and informality

Theoretically, under perfect labour market flexibility, we may not see an increase in informality because of trade liberalization, as factors are reallocated to more-productive firms and exporters. However, the empirical literature concerning trade and formality points to an ambiguous relationship, as labour market flexibility is, of course, imperfect, particularly within developing countries. In this respect, Goldberg and Pavcnik (2003) were the first to demonstrate that tariff declines in Colombia are associated with an increase in informal employment. The increases in informality were largest in the industries which experienced the largest reductions in tariffs for the period preceding more flexible labour market reforms. The evidence for the case of Brazil is much weaker in that there is no statistical relationship between trade liberalization and informality in the Brazilian context, according to Goldberg and Pavcnik (2003). The authors, therefore, assert that labour market institutions are imperative in assessing the effects of trade policy on the labour market.

It is possible that productivity rises faster than output as a result of trade liberalization. Thus, as product–market reallocations move toward more-productive firms, we may see a simultaneous shift of the workforce away from these firms. Such a phenomenon is suggested by Menezes-Filho and Muendler (2011). They show that foreign import penetration and tariff reductions throughout Brazil's trade liberalization episode resulted in worker displacements that neither comparative advantage industries nor exporters immediately absorbed. In turn, the authors demonstrate that trade liberalization is associated with significantly more transitions to informal work in the country.

Paz (2014) develops a theoretical model of a small open economy with informal labour markets and heterogenous firms, in which the firm-level decision to employ informal workers depends on the likelihood of enforcement, which is proportional to the firm's size, and on the magnitude of the financial penalty if the firm is found to have violated labour laws. Besides the role of firm heterogeneity in the decision to hire informal workers, this model also innovates relative to Goldberg and Pavcnik (2003) by considering the effect of exports on informality. In Paz's (2014) model, a cut in the tariffs of Brazil's trade partners leads to a decline in informality, since it induces smaller firms (those that are prone to employ informal workers) to exit the market. The effect of a reduction in import tariffs increases the informality share in industries that initially had a small share, while it curbs informality in industries that had an initially large share of informal workers.

Paz (2014) relies on the Brazilian trade liberalization episode in the 1990s to test the theory. The empirics confirm that lower trade-partner tariffs reduce informality, and cuts in Brazilian import tariffs have the opposite effect. This latter result is at odds with Goldberg and Pavcnik's (2003) finding of no effects of imports on the informality share in Brazil. This is because Paz's (2014) empirical work innovates on previous empirical work by assessing the effects of Brazil's trading partner tariffs, by accounting for the endogeneity of Brazilian import tariff changes and by controlling for state-level trends (which partially addresses changes in state-level enforcement over time). By contrast, the Paz (2014) finding that, as tariffs for Brazilian exports fall, the informal labour share also falls—as firms are able to expand output and employment—is reinforced in work by McCaig and Pavcnik (2018). They find that employment shifts from the household business (informal) sector to the formal enterprise sector in Vietnam, in the aftermath of large US tariff reductions as part of the US–Vietnam bilateral trade agreement.

2.4 Trade, enforcement, and informality

Almeida and Poole (2017) provide the first evidence of the impact of trade openness on formal employment in a developing country when firms are exposed to varying degrees of labour market regulatory enforcement. The authors find that, following trade liberalization, Brazilian plants facing stricter enforcement of the labour law increased formal employment by less than plants facing weaker enforcement. In this setting, increasing the flexibility of *de jure* regulations may allow for broader access to the gains from trade and increased formal job creation.

The work on the impact of the interaction of trade and enforcement on labour market outcomes has largely focused on formal employment due to data constraints. However, Ulyssea and Ponczek (2018) argue that heterogeneous *de facto* regulation within Brazil is an integral cause of the variation in post-trade reform labour reallocation across regions. Specifically, the authors find that regions with stricter enforcement of labour regulations observe no statistical increase in informal employment but face large total employment losses, signalling a decrease in formal employment. By contrast, those regions with weaker enforcement suffer no employment losses but substantial increases in informality.

Dix-Carneiro et al. (2019) model the structural relationship between trade liberalization, labour market regulations, and informality. They argue that import tariff movements had negligible effects on informality; as such, the focus of policy makers should be on reducing informality through greater enforcement rather than aiming to address the costs of international trade. We see these structural papers as complementary to our reduced-form framework designed to identify the causal implications of a real exchange rate depreciation on informal employment in the presence of a complete set of labour market regulations.

3 Data

The data employed in this study consist of the public use microdata samples of the Brazilian Census of 2000 and 2010 (IBGE n.d.). These data are matched to municipality-level labour market regulatory enforcement and to industry-level real exchange rates. The quasi-exogenous fluctuation of the industry-specific real exchange rate allows us to examine how trade openness impacts the share of informal employment, and how this effect may be modulated by the degree to which labour regulations are locally enforced.

3.1 Individual data

The Brazilian Population Census public microdata provide information on several worker characteristics, such as industry affiliation, earnings, hours worked in a week, job formality status, age, education, gender, marital status, race, and the Brazilian municipality and state in which the worker resides. The questions about these characteristics do not change over the two Brazilian censuses used in our study. We consider only workers in the manufacturing sector and exclude employers and those not in the labour market. Finally, we drop any observations with missing information on these key variables of interest.

Informality

In this paper, we define an informal job as an employer–employee relationship that lacks a signed labour contract (*carteira assinada*). In fact, labour inspectors most commonly visit employers to check on the formal work authorization of their employees by looking for their *carteiras*. The census questionnaires explicitly ask whether the job has a signed labour contract, and this terminology is common knowledge among employers and employees. As the data collected by the census cannot be used in court as evidence, and this is stated before the census interview starts, we have strong confidence in the individual's truthful responses. Additionally, informal employees are not punished in the event that their employer is audited by labour inspectors and found to have violated labour laws. Therefore, there is little incentive for the worker to provide false information regarding formal work registration to the census officials.

Table 1 presents descriptive statistics on the workers in our sample in 2000 and in 2010. Between 2000 and 2010, the share of informal workers fell from around 20 per cent to 13 per cent, while the share of self-employed workers remained relatively steady at approximately 17 per cent of the workforce. The formal economy, then, increased from around 63 per cent to 71 per cent of workers. Interestingly, the share of married workers fell sharply from over two-thirds of workers to only about 43 per cent. Female employment participation showed almost no change over the ten-year period (around 31 per cent), nor did the share of workers living in urban areas (approximately 93 per cent). The participation of black and Asian workers increased slightly in the manufacturing workforce, even though their participation remains very small. In terms of educational attainment, a slightly higher percentage of workers reported literacy over the ten-year period, whereas the share of workers with a completed high school education displayed a substantial increase. The share of workers with a college degree also increased in this period, albeit to a lesser extent.

In unreported statistics, available by request, we also investigate how these key demographic characteristics vary according to workers' types of jobs. The employment participation rate of blacks and Asians is similar across self-employed, formal, and informal workers. Relative to informal workers, formal workers are, on average, older and more likely to be male, married, and to live in urban areas. Unsurprisingly, formal workers are also more educated; for instance, they are twice as likely to hold a high school degree than informal workers, and three times as likely to be college graduates than informal workers. Relative to formal workers, self-employed workers are, on average, older, more likely to be married, and less likely to be male and live in urban areas. Self-employed workers are also less educated, on average, than formal workers, though more educated than informal workers. These patterns do not change much over the sample period, except for a reduction in the share of married workers and an increase in female employment participation across all employment categories.

Industries

An important feature of the census data is that the industry classification changes over time. The 2000 census relies on the *Classificação Nacional de Atividades Econômicas-Domiciliar* (*CNAE-Domiciliar*), whereas the 2010 census categorizes industries based on Revision 2 of *CNAE-Domiciliar*. Therefore, we rely on publicly available correspondence tables from the Brazilian Census Bureau to report changes over time.[4] The final classification used in this project contains 47 manufacturing industries. Nuclear fuel and automotive engine refurbishing are excluded from our sample due to a lack of international trade data.

Municipalities

Another important issue is that 58 new municipalities were created in Brazil between 2000 and 2010 (Ehrl 2017). Unfortunately, this was not always a simple case of a municipality splitting into two. For example, the new municipality of Novo Santo Antônio covers territory that used to belong to São Félix do Araguaia and Cocalinho. Similarly, the new municipality of Serra Nova Dourada encompasses land that belonged to Alto Boa Vista and São Félix do Araguaia. For these special cases, we aggregate municipalities into an artificially large municipality both in 2000 and 2010 in order to have comparable areas over time. This procedure results in a total of 5,438 municipalities in the two time periods.

The municipality-level descriptive statistics are displayed in Table 2. Across municipalities, the average share of informal workers was approximately 28 per cent in 2000 and dropped to around 22 per cent in 2010. The average share of self-employed workers fell from 27 per cent to 24 per cent in 2010. On average, therefore, formality increased from 44 per cent to 54 per cent. While the average population across cities remained roughly constant over time, the dispersion in city size increased. Median population fell by almost 1,000 people, but the population increased in the largest cities. In fact, the maximum municipal population increased from 10.4 million in 2000 to 11.3 million in 2010. The population in the smallest city, by contrast, remained steady, changing from 7,950 people in 2000 to 8,050 people 2010.

3.2 Trade exposure data

During the period under analysis in this study, Brazilian import tariffs showed very small variation over time. Figure 1 shows the evolution of average, minimum, and maximum import tariffs applied to manufactured goods over the sample period of 2000 to 2012. Despite the small variation in import tariffs, Brazilian manufacturing firms did experience a significant change in their exposure to international trade due to the strong variation in the real exchange rate. For example, Figure 2 illustrates the change in the industry-specific share of output that is exported; we observe that some industries increased export shares (like sugar, cellulose and paper, and ship building), while other industries (for instance, ceramics and vegetable oils) reduced export shares over this period. We observe similar industry-level heterogeneity in the change in import penetration, as depicted in Figure 3. Import penetration increased for pharmaceuticals and textiles, for example, but declined for leather processing and railroad vehicles.

[4] The concordance tables for these classifications, as well any other classification used in this paper, come from the CONCLA-IBGE website (CONCLA-IBGE n.d.).

Industry-specific real exchange rates

Aggregate fluctuations in the real exchange rate influence a country's competitiveness in international markets. However, the aggregate exchange rate may be less effective at capturing true changes in industry competitiveness, induced by changes in specific bilateral exchange rates, if specific trading partners are of particular importance to some industries. That is, movements in the dollar/*real*, peso/*real*, and euro/*real* exchange rates may have different implications for different industries, depending on the industry's trade with the United States, Argentina, and the Euro Zone, respectively.

Therefore, following Almeida and Poole (2017), we construct trade-weighted, industry-specific real exchange rates based on bilateral nominal real exchange rate data from the Brazilian Central Bank (n.d.), country-level consumer price indices from the International Monetary Fund (n.d.), and Brazilian imports and exports from Brazilian Ministry of Foreign Trade (n.d.). The trade data are available at the 8-digit *Nomenclatura Comum do Mercosul* (NCM) classification in the following revisions: NCM1996, NCM2002, NCM2004, and NCM2007. We concord the NCM classifications to the *CNAE-Domiciliar* industry classification available in the census data, based on correspondence tables from CONCLA-IBGE (n.d.).

Using these series for 141 of Brazil's trading partners, we build import-weighted ($mrer_t^k$) and export-weighted ($xrer_t^k$) industry-specific real exchange rates following Goldberg (2004), as follows:

$$mrer_t^k = \sum_c \left(\frac{M_{t-1}^{kc}}{\sum_c M_{t-1}^{kc}} * rer_c^t \right)$$

$$xrer_t^k = \sum_c \left(\frac{X_{t-1}^{kc}}{\sum_c X_{t-1}^{kc}} * rer_c^t \right)$$

where *t* indexes time, *k* indexes industry, and c indexes country, such that the bilateral real exchange rate, rer_c^t, denoted in units of *real* per one unit of foreign currency, is weighted by industry-specific and time-varying import shares ($\frac{M_{t-1}^{kc}}{\sum_c M_{t-1}^{kc}}$) and export shares ($\frac{X_{t-1}^{kc}}{\sum_c X_{t-1}^{kc}}$), respectively. Following Campa and Goldberg (2001), we lag the trade shares one period to avoid issues of endogeneity between trade and the exchange rate. By this measure, an increase in the value of the index implies a real depreciation of the Brazilian *real* in trade-weighted terms for industry *k*.

Figure 4 displays a histogram of changes in the import-weighted, industry-level real exchange rate between 2000 and 2010. Most industries experienced negative changes in the real exchange rate—that is, an appreciation of the *real* in import-weighted terms, though several industries also underwent import-weighted real depreciations. Figure 5 presents similar graphics for the export-weighted real exchange rate.

We note significant industry-level heterogeneity across both figures. The export-weighted real exchange rate displayed stronger appreciations over the ten years than did the import-weighted real exchange rate. This is so because the country-level weights used in the construction of these series vary considerably by industry and by direction of trade. As a result, the import-weighted and the export-weighted series are only slightly correlated. The correlation between the export-weighted real exchange rate and the import-weighted real exchange rate was -0.1 in 2000 and -0.2 in 2010. The simple correlation across all industries of the change in the real exchange rates is a

small 0.186. Since these two series of trade-weighted real exchange rates are largely independent, in our main econometric specifications, we include both series together.

3.3 Enforcement data

The *de jure* labour regulations in Brazil are effective throughout the entire country during this sample period and are rather detailed, stringent, and strongly pro-worker. For example, changes to the federal labour laws in 1988 increased the overtime wage premium from 20 per cent to 50 per cent of the regular wage. Additionally, it increased one month's vacation time pay from 1 to 4/3 of a monthly wage. Moreover, terminating a formal employment relationship in the early 2000s was quite costly to firms. The penalty on the plant for dismissing the worker without cause was around 40 per cent of the total contributions to the severance fund, *Fundo de Garantia do Tempo de Serviço* (FGTS). Brazilian employers who wished to terminate worker contracts needed to offer a 30-day advanced notice to workers and, during this interim period, workers were granted up to two hours per day (25 per cent of a regular working day) to search for a new job. This has been shown to considerably reduce Brazilian firms' competitiveness and productivity.

The Ministry of Labour was designated with enforcing compliance with these labour regulations at the federal level at this time. However, there is significant heterogeneity both within the country and over time in the enforcement of the law.[5] We, therefore, rely on administrative data on the enforcement of labour regulations from Brazilian Ministry of Labour (n.d.). Data for the number of inspector visits are available by city and by 1-digit broad sector for the years of 2000 and 2010. In our study, we utilize data on the total number of inspector visits to a city's manufacturing and non-manufacturing establishments.

Following Almeida and Poole (2017), we proxy the degree of regulatory enforcement with the intensity of labour inspections at the municipality level. More specifically, our main measure of manufacturing enforcement is the logarithm of one plus the number of total inspections at the municipality level per 100,000 people living in the municipality. It is important to consider municipality size in the Brazilian context because cities like Rio de Janeiro may have a large number of inspections, but they also have very large populations. Thus, this enforcement measure will better capture the perceived probability of a visit by labour inspectors to establishments within a city.

Table 2 reports average values for the number of inspections across all cities. Over the ten-year period, the average number of inspections fell by almost half from 258 in 2000 to 138 in 2010. Recall, our main measure of labour enforcement accounts for the city size in order to proxy for the probability that a given worker would be inspected. Table 2 also reports descriptive statistics for this measure of enforcement. Over time, the likelihood of inspection (enforcement) fell from 4.3 inspections per 100,000 people to 3.9 inspections per 100,000 people.

Figures 6 and 7 illustrate the across-city variation in this labour market regulatory enforcement (based on total—manufacturing and non-manufacturing—inspections) for the entire country in 2000 and in 2010, respectively. The darker the shade, the higher the enforcement strength. These two maps display the substantial geographic variation in the intensity of enforcement, and the within-city changes in enforcement over time. Most enforcement is directed to the wealthier southern and south-eastern regions of Brazil, and this geographic difference in enforcement became more salient over time. In fact, this picture becomes even clearer in Figure 8, which maps

[5] A comprehensive explanation of the enforcement of the labour regulation system and its importance in Brazil is given in Cardoso and Lage (2007).

city-specific differences in the change in labour market regulatory enforcement between 2000 and 2010. A similar pattern of enforcement can be seen when we zoom in on São Paulo state, as depicted in Figure 9. While average inspection rates fell over the ten-year period, some municipalities experienced increases in the degree of labour market regulatory enforcement, while other municipalities faced weakening *de facto* regulations. It is exactly this across-municipality variation in changes in enforcement that we exploit in this research.

4 Conceptual framework

In this section, we rely on previous literature to posit predictions for relating changes in international trade and informal employment status. We also present a summary of the theoretical predictions on the labour market implications of regulatory enforcement. Since theory offers ambiguous predictions, these are inherently open empirical research questions.

Effect of the trade shock

A real exchange rate depreciation decreases the relative price of Brazilian goods in foreign currency terms abroad and increases the price of foreign goods in the Brazilian market. Therefore, this single price change can have several different impacts on the local labour market. First, the lower relative price of Brazilian exports offers increased foreign market access (Verhoogen 2008). Second, the higher relative price of imported goods decreases foreign competition for Brazilian firms, but also increases the costs associated with imported intermediate inputs.

If the increased access to foreign export markets allows firms to expand output and employment, as was found to be true in the Mexican context in Revenga (1992) and Verhoogen (2008), we should predict that the exchange rate depreciation will decrease informality and increase formality in Brazil. This is consistent with the result in Paz (2014) for Brazil—decreased export market tariffs decrease the likelihood of informal employment—and in McCaig and Pavcnik (2018) for Vietnam—reductions in US tariffs increase transitions to the formal business sector from the household business sector.

At the same time, local firms now face weakened import competition due to the real exchange rate depreciation since foreign goods are now more costly in Brazilian *real* terms. If the protection from foreign competition allows import-competing firms to expand output and employment, we should again predict that the exchange rate depreciation will decrease informality and increase formality in Brazil. Paz (2014) and Menezes-Filho and Muendler (2011) find such an effect for the case of the Brazilian trade liberalization in the 1990s—in that period, Brazilian import tariff cuts increased informality.

In both settings, the impact of a trade shock on self-employment is ambiguous. Some workers may be drawn from informality into self-employment, while other workers will be enticed into formal employment from self-employment with the expansionary trade shock. Therefore, it is unclear what will be the net effect of the trade shock on self-employment.

Finally, the same real exchange rate depreciation that restricts import competition also makes imported intermediate inputs more expensive. Firms that rely on imported inputs for their final output will see production costs increase, potentially reducing output and employment demand (Goldberg et al. 2010; Handley et al. 2020). In fact, recent research on the Indian trade liberalization episode demonstrates that freer trade dramatically increases firms' access to cheaper, newer, and higher-quality inputs (Goldberg et al. 2010). Moreover, the authors find that these new, higher-

quality intermediate inputs allow firms to expand production (and presumably employment) in the aftermath of the trade reform, despite the increases in import competition. For this reason, the above effects might be attenuated depending on the extent to which firms rely on imported intermediate inputs.

Altogether, the total impact of a real exchange rate devaluation will depend on which of these three effects dominates. On that, we can hypothesize the following. We know from a large literature in international trade (Bernard et al. 2011) that global firms are larger in terms of size and tend to be more productive on average. That said, there will be significant firm-level heterogeneity in the effects of such an exchange rate depreciation (Berman et al. 2012). For example, exporting firms are likely to be at the top end of the firm-size and firm-productivity distributions. Given international standards and reputations, these firms are also assumed to employ a smaller fraction of informal workers (Paz 2014). On the other hand, domestic firms facing import competition are more likely to be smaller and less productive, and thus to employ higher shares of informal labour.

While our data do not allow us to identify firm-level size, productivity, or engagement with international markets, we rely on a rough proxy for these firm-level characteristics—that is, we assume export-oriented industries contain larger, more-productive firms which employ more formal labour and import-competing sectors host relatively smaller, less-productive firms which are more likely to employ informal workers. Thus, we estimate the effects of the real exchange rate shock separately, relying on the export-weighted real exchange rate and the import-weighted real exchange rate, with the idea that we can attempt to capture some of the firm-level heterogeneity, even within industries; that is, larger, more-productive, export-oriented firms are more likely to respond to an export-weighted trade shock, while smaller, less-productive, import-competing firms are more likely to respond to the import-weighted trade shock.

Effect of labour enforcement

The direction of the effect of enforcement on informality is theoretically ambiguous (see Almeida and Carneiro 2012). On the one hand, one of the main purposes of labour market inspections is to ensure formal work registrations. By design then, an increase in enforcement should reduce informality and increase formal work registrations. In addition, the labour inspections ensure that employers comply with the mandated benefits and thus increase job benefits and quality. This should increase the supply of formal workers and decrease the supply of informal workers. For these reasons, it is a plausible prediction that firms in areas of the country with heavier enforcement of labour laws will experience a decrease in informal employment, as formal employment becomes more attractive and formal work registrations increase.

On the other hand, stricter enforcement of the labour law raises the cost of formal workers for employers that now must cover mandated benefits, such as maternity leave, vacation pay, and maximum working hours. As such, plants facing stricter enforcement of the labour code will have increased difficulties in adjusting labour, decreasing formal employment, and increasing informal employment. If the cost to employers of self-employed workers is less than employing formal workers, but more than employing informal workers, we might expect that firms in strictly enforced areas of the country would increase hiring of self-employed workers as a legal means of circumventing labour regulations.

Effect of the trade shock by the stringency of labour enforcement

The extent to which a given currency shock actually changes the informal employment share will depend on the degree to which employers face labour market regulatory enforcement.

To summarize, a real exchange rate depreciation is predicted to decrease informality, as employment expands and workers move into self-employment and the formal economy. Firms located in strongly enforced municipalities could increase formal employment and decrease informal employment *by more* than plants located in weakly enforced municipalities if the first enforcement impact on informality dominates; that is, that job quality increases and workers are induced to register formally. However, the data may also show that plants located in strongly enforced municipalities will increase formal employment and decrease informal employment *by less* than plants located in weakly enforced municipalities in response to the same currency depreciation, if the second enforcement impact on informality dominates; that is, that the cost to firms of employing formal workers increases and so they hire fewer formal workers to circumvent mandated benefits.

Given the evidence in Almeida and Poole (2017), as well as Almeida et al. (2019), we hypothesize that the latter effect dominates. Strict labour regulations function as 'sand in the wheels' of economic growth. As such, strict labour policy may reinforce trends toward widening wage dispersion and job polarization, and contribute to rising informality, in part, as low-wage, low-skilled job opportunities in low-productivity formal establishments diminish. Businesses in areas of the country facing strong *de facto* regulations are predicted to decrease informality and increase formality by less than otherwise identical businesses in less-enforced areas of the country, in the aftermath of an equal expansionary trade shock. Moreover, we hypothesize that some of the relative decrease in formal employment may arise through a relative increase in self-employment, as firms opt for cheaper, but still legal, employees. We summarize the main predictions from our conceptual framework in Table 3.

5 Empirical strategy and results

Our basic framework estimates the effect of a quasi-exogenous real exchange rate devaluation on the share of informal workers in a city–industry pair. The specification relies on substantial variation across three different dimensions: municipalities, industries, and time. Furthermore, we exploit the fact that Brazilian employers are exposed to varying degrees of *de facto* labour regulations, as measured by the number of Ministry of Labour inspections per 100,000 inhabitants of the city, and we analyse how the effect of trade on informal labour shares depends on local enforcement of labour regulations.

We begin by replicating and extending the approach in Paz (2014) to estimate the effect of trade openness on the share of informal workers in a city–industry. We consider changes in the Brazilian *real*'s real exchange rate across industries and over time as the main exogenous shock to trade openness. Therefore, the effect of exposure to trade is identified using across-industry differences in real exchange rate changes over time. The main estimating equation is as follows:

$$INFORMAL_{jt} = \beta_1 RER_{jt} + \varphi_j + \delta_t + \varepsilon_{jt} \quad (1)$$

where *j* indexes the 47 manufacturing *CNAE-Domicilar* industries and *t* indexes time. We relate the share of informal workers ($INFORMAL_{jt}$) to the time-varying, industry-specific, trade-weighted real exchange rate (RER_{jt}), which serves as an exogenous shock to trade openness. We introduce the export-weighted real exchange rate and the import-weighted real exchange rate separately. We also include industry fixed effects (φ_j) to capture time-invariant factors, such as the industry's unobserved, underlying productivity or technology, which may influence the industry's size and

informality, and year dummies (δ_t) to control for the average effect on informal employment of Brazil's many policy reforms over this time period.

β_1 estimates the effect of the exchange rate shock on informal labour markets. As we remark in Section 4, a single relative price change has several possible effects on informality. However, following the literature (e.g., Revenga 1992; Verhoogen 2008), as summarized in Table 3, we hypothesize that $\beta_1 < 0$, as an exchange rate depreciation (increase in RER_{jt}) decreases informality—that is, the impact of reduced import competition and increased export market access outweighs the impact of higher-priced and lower-quality imported intermediate inputs.

Equation (1), however, considers only the industry–time shock of the real exchange rate devaluation. Brazil's large informal sector suggests significant evasion of Ministry of Labour regulations and we know from a long literature that labour market regulations and regulatory enforcement influence the degree of informality. We, therefore, alter equation (1) as follows:

$$INFORMAL_{jmt} = \beta_1 RER_{jt} + \beta_2 ENF_{mt} + \varphi_m + \varphi_j + \delta_t + \varepsilon_{jmt} \quad (2)$$

where all the notation is as in equation (1) and *m* now indexes the city (*munícipio*). ENF_{mt} represents time-varying, municipality-level enforcement of labour regulations, as captured by Ministry of Labour inspections. Recall, our measure of regulatory enforcement is the logarithm of one plus the number of inspections at the municipality level per 100,000 people living in the municipality. As we note in Section 4, the effect of enforcement on informality is theoretically ambiguous (Almeida and Carneiro 2012). For example, by design, an increase in enforcement should help authorities to decrease informality ($\beta_2 < 0$), though, because enforcement increases the cost of formal workers for firms, it may also push more workers into informality ($\beta_2 > 0$). However, as is highlighted in Table 3, we hypothesize that the latter effect dominates, given the evidence in the prior literature about Brazil (e.g., Almeida and Carneiro 2012; Almeida and Poole 2017; Almeida et al. 2019).

Given the potential cross-sectional endogeneity in enforcement—that is, that more developed areas of the country have more resources for enforcement, or areas that are likely violators of the labour law will see higher levels of enforcement—we also incorporate municipality fixed effects (φ_m) into equation (2) to account for such time-invariant, city-specific differences. With the city fixed effects, identification is based on city-specific changes in enforcement over time, which are far more exogenous than levels of enforcement. In fact, as shown in Almeida and Poole (2017), changes in enforcement are associated with very few city-specific measures of development—lagged changes in the economically active population and lagged changes in the share of households with access to electricity.

The implications of a real exchange rate depreciation for informal employment depend on the degree to which employers are exposed to labour market regulatory enforcement. We hypothesize that two identical industries will respond differently to changes in the real exchange rate depending on the *de facto* regulations they face. For this reason, we adapt equation (2) as follows:

$$INFORMAL_{jmt} = \gamma_1 RER_{jt} * ENF_{mt} + \beta_1 RER_{jt} + \beta_2 ENF_{mt} + \varphi_m + \varphi_j + \delta_t + \varepsilon_{jmt} \quad (3)$$

where all of the notation is as previously stated in equation (2). Here, γ_1, our main coefficient of interest, captures the differential impact of the exchange rate shock on industries in strictly enforced municipalities relative to weakly enforced municipalities. In response to an exchange rate depreciation, employers may employ fewer informal workers as import competition weakens and export market access expands ($\beta_1 < 0$). However, industries facing heavy inspections may be

differentially restricted from adjusting labour ($\gamma_1 > 0$)—as the cost of a formal worker increases, increasing informality by more than in weakly enforced industries.

In order to further mitigate the possibility that enforcement at the city level is endogenous, we next adjust equation (3) to include city-by-year fixed effects, as follows:

$$INFORMAL_{jmt} = \gamma_1 RER_{jt} * ENF_{mt} + \beta_1 RER_{jt} + \varphi_{mt} + \varphi_j + \varepsilon_{jmt} \quad (4)$$

where, again, all of the notation is as previously defined. Note that with the inclusion of interactive city–year fixed effects, the endogenous enforcement variable is no longer identifiable. We also note that the city–year interactive fixed effects also help to capture several political economy variables, like local governance or tax rates. The identification of the main coefficient of interest, γ_1, relies on the quasi-exogenous, industry-specific, real exchange rate shock across municipalities with strict relative to weak enforcement of labour market regulations.

Equation (4) is the baseline specification in this paper. Table 4 reports coefficients from an ordinary least squares regression in which we include both the import-weighted real exchange rate shock ($MRER_{jt}$) and the export-weighted real exchange rate shock ($XRER_{jt}$). We cluster the standard errors at the city level to account for within-city and across-time and across-industry correlations in employment. Surprisingly, counter to our theoretical predictions, the estimated effects suggest that a depreciation in the import-weighted real exchange rate actually increases the informal share of labour. There is no statistical impact on the formal employment share, either due to a devaluation in the import-weighted real exchange rate or a devaluation in the export-weighted real exchange rate. The expansionary shock in the import-weighted real exchange rate is predicted to decrease self-employment, while a similar shock in the export-weighted real exchange rate increases self-employment. Across the board, labour market regulations have the expected mitigating effect.

5.1 Instrumental variables

Though our baseline specification includes city-by-year fixed effects to help control for the across-city endogeneity of changes in enforcement, we next consider instrumenting for the city–year enforcement variable to further alleviate such concerns. The excluded instrument used in this study relies on two main ideas present in Brazilian labour institutions. First, the availability of resources to conduct inspections occurs at the Federal Ministry of Labour. Second, and by contrast, the decision regarding which establishments to visit is made at the state-level branch office (*delegacia do trabalho*) of the Ministry.

Availability of resources

The Ministry of Labour operates under an annual budget approved by the Brazilian Congress. Unexpected lower government revenues trigger across-the-board cuts in the federal budget, which are negative shocks to enforcement everywhere. These are independent of the municipality-level labour market. The number of inspections in state *s* can be predicted by the number of inspections conducted in the remaining states (call this, $otherenforcement_{st}$) because of unexpected across-the-board budget cuts or expansions conducted by the federal government. Therefore, we calculate the level of enforcement outside of state *s*, as follows:

$$otherenforcement_{st} = log\left(1 + \frac{otherinspection_{st}}{otherpopulation_{st}}\right)$$

where S is the set of all 26 Brazilian states and the Federal District, $otherinspection_{st} = \sum_{m \in S-\{s\}} inspections_{mst}$, and $otherpopulation_{st} = \sum_{m \in S-\{s\}} population_{mst}$. That is, we rely on the number of inspections and population in all municipalities outside of state *s*.

Inspection decision

The sheer geographic size of the country signals that local Labour *delegacias* must make decisions regarding how to use their (often limited) resources to inspect all local establishments within the state. The farther away a municipality is from the state capital local labour office, the more costly it will be for inspectors to visit, which makes the visit less likely given the *delegacias*' fixed annual budgets (Almeida and Carneiro 2012). For instance, the simple correlation between distance and enforcement is -0.26 for 2000. We use this information to proxy for the likelihood that a given municipality *m* will be inspected. Let $distance_{ms}$ equal the geodesic distance between municipality *m* and the capital of state *s* in which the municipality is located.[6] Further, let $maxdistance_s = \max_{m \in s} distance_{ms}$, the distance of the farthest municipality in the city. Then, we generate a distance index, such that larger numbers imply an increased likelihood that the municipality will be visited by inspectors, as:

$$distanceindex_{ms} = log(1 + maxdistance_s - distance_{ms})$$

Instrument

Our main instrumental variable relies on these two important features of labour institutions in Brazil. First, that budgetary decisions regarding the amount of resources available for inspections are made at the federal level, such that average increases and decreases over time in inspections in other states can proxy for the general level of inspections in a municipality's state. Second, that decisions regarding where to inspect in a state will depend on the distance between that state's capital (the location of the main local labour office) and the municipality. We, therefore, instrument for a municipality's level of enforcement in time *t* with the interaction between enforcement in other states in that year and the inverted distance between the municipality and the state capital, as follows:

$$instrument_{mt} = otherenforcement_{st} \times \text{distanceindex}_{ms}$$

Table 5 reports coefficients from our main estimating equation (4), in which the city–year enforcement variable is instrumented as described above. The first stages are reported in Appendix Table A1. This is the core table of our paper and the main evidence is strongly in support of our predictions.

First, we focus our discussion on the impact of an import-weighted real exchange rate devaluation (the first row). As discussed in Section 4, the import-weighted real exchange rate shock is more likely to impact the smaller, lower-productivity, import-competing firms, which tend to employ higher shares of informal workers. The exchange rate depreciation reduces import competition, allowing these firms to expand output and employment, and potentially increase formal employment shares. In fact, the results in the first row confirm this hypothesis. While the point estimate on the coefficient for the effect on the informal employment share is negative (signalling a decrease in informal employment as predicted), it is statistically indistinguishable from zero. However, in column (2), we see a large and statistically significant positive effect on the formal employment share, as predicted. A 1 per cent depreciation in the import-weighted real exchange

[6] The geodesic distance comes from IPEA (2020) and is calculated using latitude and longitude of the cities.

rate increases the formal employment share by 0.6 percentage points. In columns (3) and (4), we consider adjustments from the self-employed workforce into both informal labour and formal labour, respectively. Interestingly, we note that the share of self-employed workers among lower-tier informal jobs and higher-tier formal jobs both decrease with reduced import competition. While this is indicative of a shift toward higher-tier jobs, it is difficult to disentangle the net effects on self-employment of the reduction in import competition.

Next, shifting discussion to the export-weighted real exchange rate shock, the more-productive firms see strong decreases in informality, increases in formality, and shifts from the self-employed workforce to formal employment. The estimated effects are all in line with our theoretical predictions and the magnitudes of the effects are reasonable. A 1 per cent depreciation in the export-weighted real exchange rate reduces the informal labour share by 0.2 percentage points, increases the formal labour share by 0.4 percentage points, and decreases the share of self-employed workers among higher-tier formal jobs by 0.3 percentage points.

Finally, as suggested by the previous literature and discussed in our conceptual framework, labour market regulatory enforcement appears to act as 'sand in the wheels' of such expansionary economic and employment growth. While the trade shocks are estimated to expand output and formal employment as export market access increases and import competition weakens, the coefficients on the interaction terms always have the opposite coefficients. That is, the decreases in the informal economy and the increases in the formal economy are weaker in strictly enforced municipalities. The shifts out of self-employment into the formal economy are also diminished by labour institutions. Firms forego relatively expensive formal workers and increase employment of relatively cheaper self-employed workers in strictly regulated areas. In doing so, the firms are able to circumvent the strongest labour laws, while acting legally. At the end of the day, strict labour regulations limit the growth in high-quality formal employment associated with trade liberalization.

5.2 Robustness

The previous evidence suggests that a positive, expansionary trade shock, along the lines of increased export market access, as in Paz (2014), leads to lower informality and increased formality. However, simply because informal labour *shares* decrease does not imply a welfare improvement if total employment increases, such that the *level* of informal employment either increases or remains the same (recall the evidence in Ulyssea and Ponczek 2018). To test for these ideas, we re-estimate our main specification in equation (4), instrumenting for changes in enforcement as in Table 5, but replacing the main dependent variables of employment shares with employment levels. We consider total employment, informal employment, formal employment, and self-employment levels as separate outcomes. We note that our preferred outcomes remain the share variables, as these are the outcomes that would be predicted by models of international trade reallocating labour resources.

We report the results from these robustness checks in Table 6. The main ideas from Table 5 are robust to the use of levels instead of shares. As expected, total employment increases with the exchange rate devaluations, but by less in areas of the country facing strict labour market regulations. The increases in total employment are wholly driven by increases in the formal economy, even more so in response to an export-weighted real exchange rate shock (as would be predicted by heterogeneous firm models of international trade). Import-competing firms also expand into the formal economy by reducing their reliance on self-employed workers.

5.3 Heterogeneous responses by industry

Returning to the employment shares as outcome variables, in Table 7, we take the ideas of heterogeneous firms one step further. Recall that, until now, we have proxied for the impact of a real exchange rate shock on higher productivity exporters with the export-weighted shock and the effect on lower productivity firms with the import-weighted shock, as the first should more closely follow increased export market access and the latter should more closely represent weakened import competition. However, as we know from the heterogeneous firm literature, even within narrowly defined industrial categories, which may broadly be import-competing, there are more-productive and less-productive firms. We attempt to explore this heterogeneity in Table 7 by estimating our main equation (4) with instruments for changes in enforcement for two broad industry categories—the set of import-competing industries (Panel A) and the set of export-oriented industries (Panel B)—separately.

The effect of reduced import competition should be largest for the import-competing industries shocked with a devaluation in the import-weighted real exchange rate. Similarly, the effect of expanded export market access should be largest for export-oriented industries shocked with a devaluation in the export-weighted real exchange rate. In fact, the largest effects on the informal economy are found precisely where we expect informal employment to be important—low-productivity firms in the import-competing sectors. It is for these firms that we see large and positive effects out of informal employment and self-employment and into the formal economy. However, across the board, these positive employment effects are significantly reduced in strictly regulated municipalities. Moreover, labour market enforcement appears to have a differentially large impact on increasing self-employment. In areas of the country with stronger enforcement of regulations, the differential increase in self-employment almost exactly offsets the differential decrease in formality.

6. Conclusions and future work

Populist, protectionist trade and labour policies are gaining influence in global politics, in large part because of the belief that globalization harms local labour market conditions. Policy makers often position and propose labour market policies, such as firing restrictions and severance payments, to protect vulnerable workers from negative employment shocks. In this paper, we investigate the idea that policies designed to connect developing country firms with developed country markets—via access to export markets—can promote higher-quality employment in less-developed countries, as workers shift from informal employment to self-employment to formal employment. Our work makes clear that flexible labour market policies may in fact protect workers and help the transition to the formal economy in the aftermath of employment shocks.

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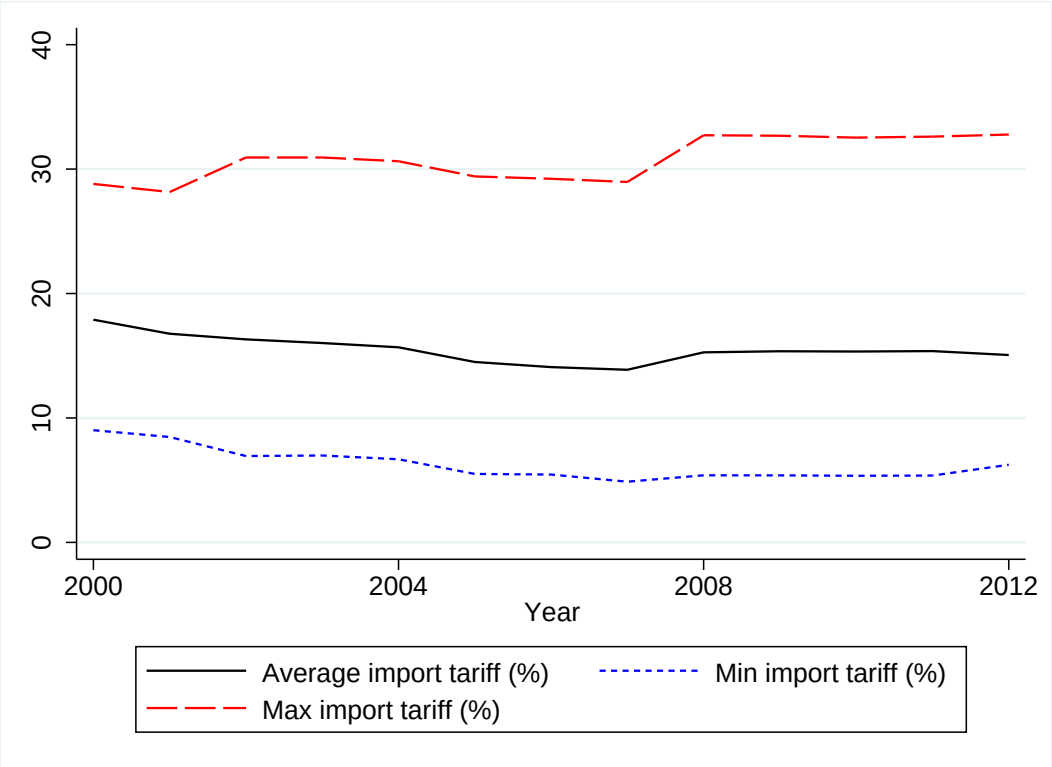
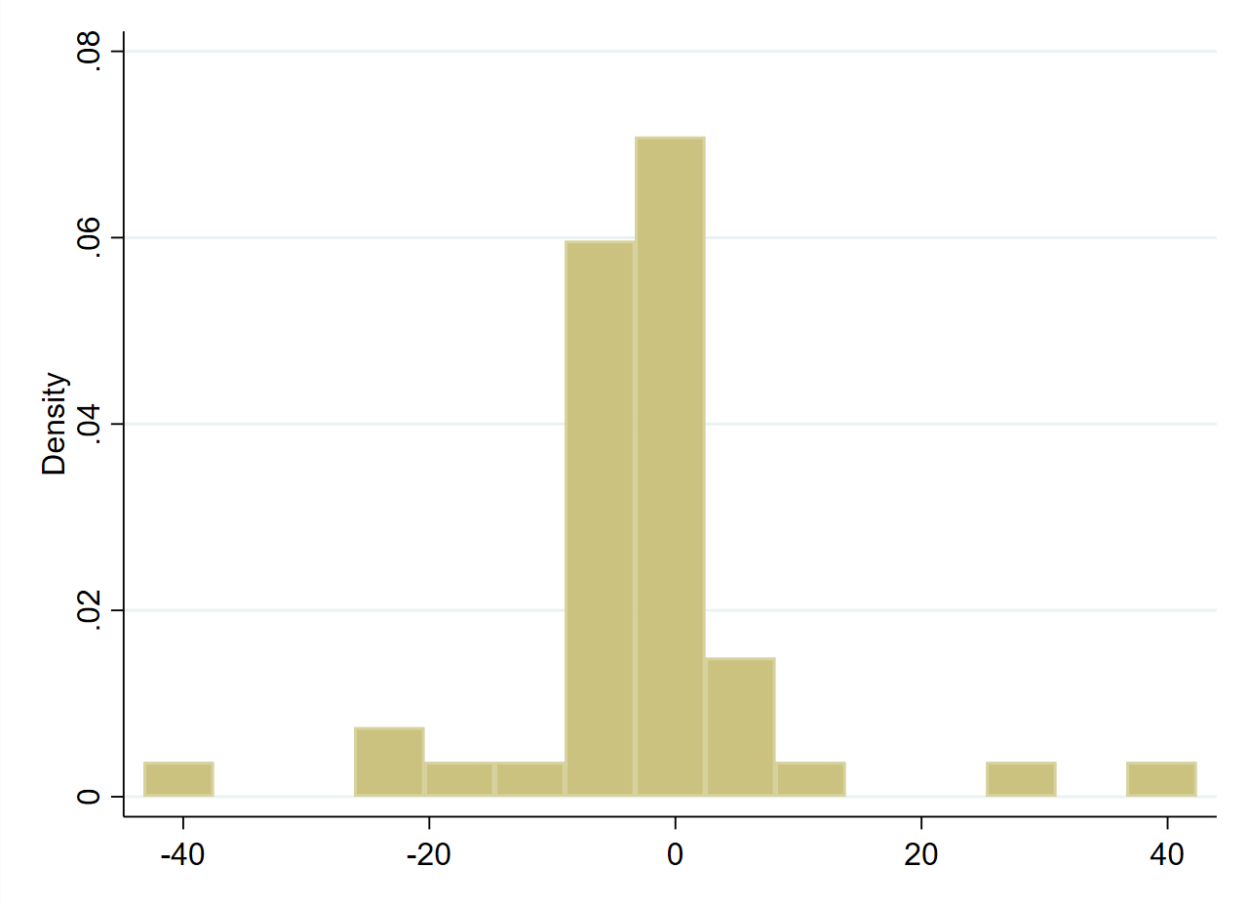
Figure 1: Average import tariff, 2000–12



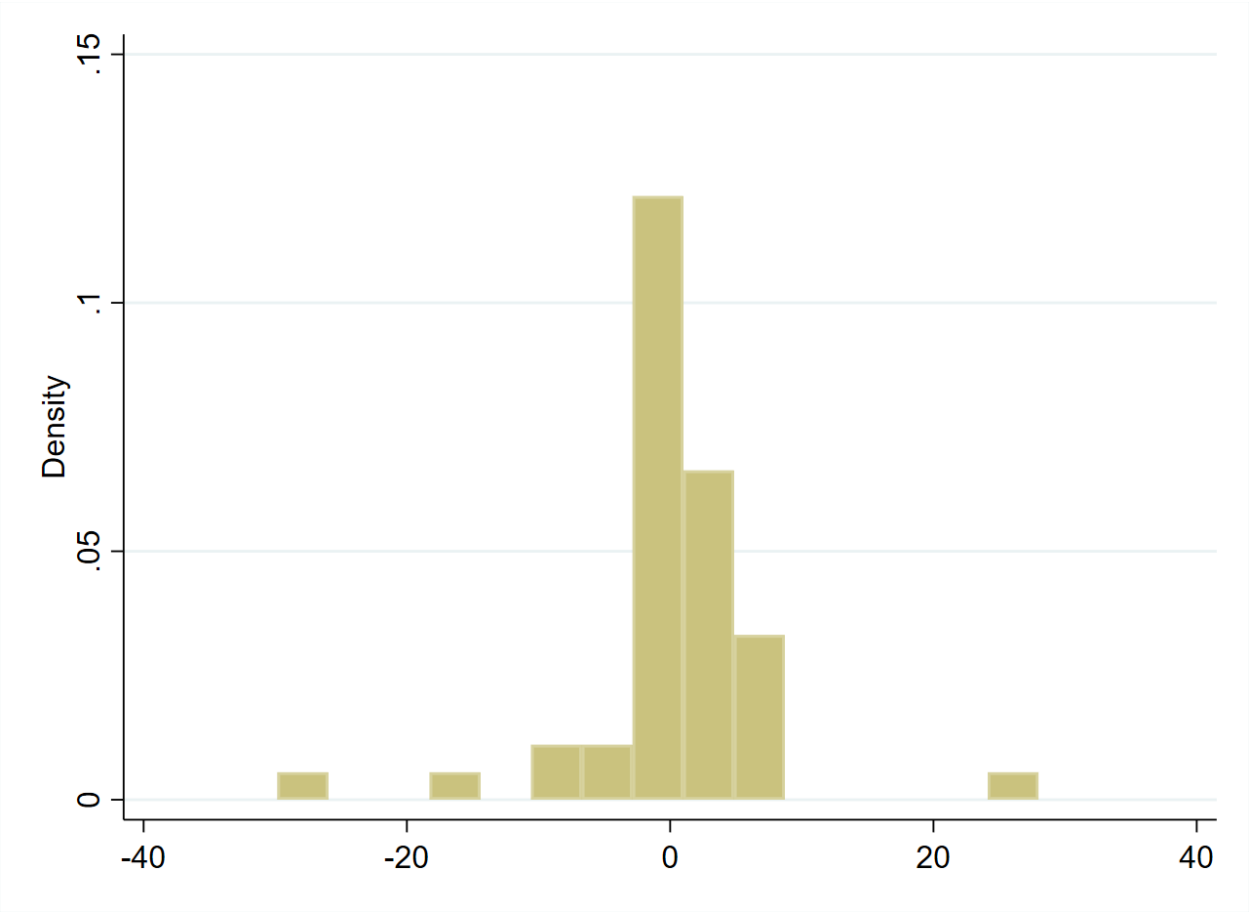
Source: authors' illustration based on Brazilian Ministry of Foreign Trade data.

Figure 2: Change in industry-specific export shares, 2000–10



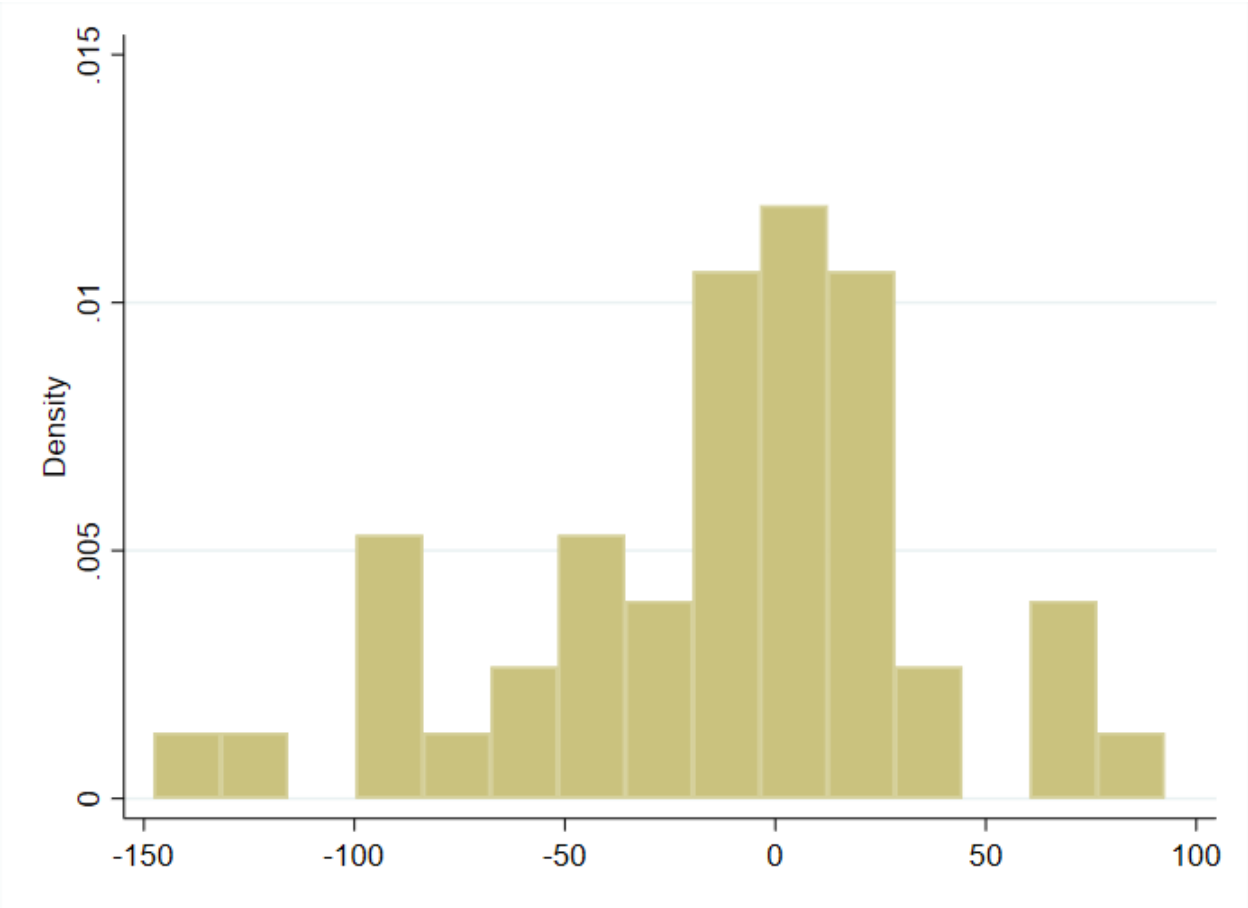
Source: authors' illustration based on Brazilian Ministry of Foreign Trade data.

Figure 3: Change in industry-specific import penetration, 2000–10



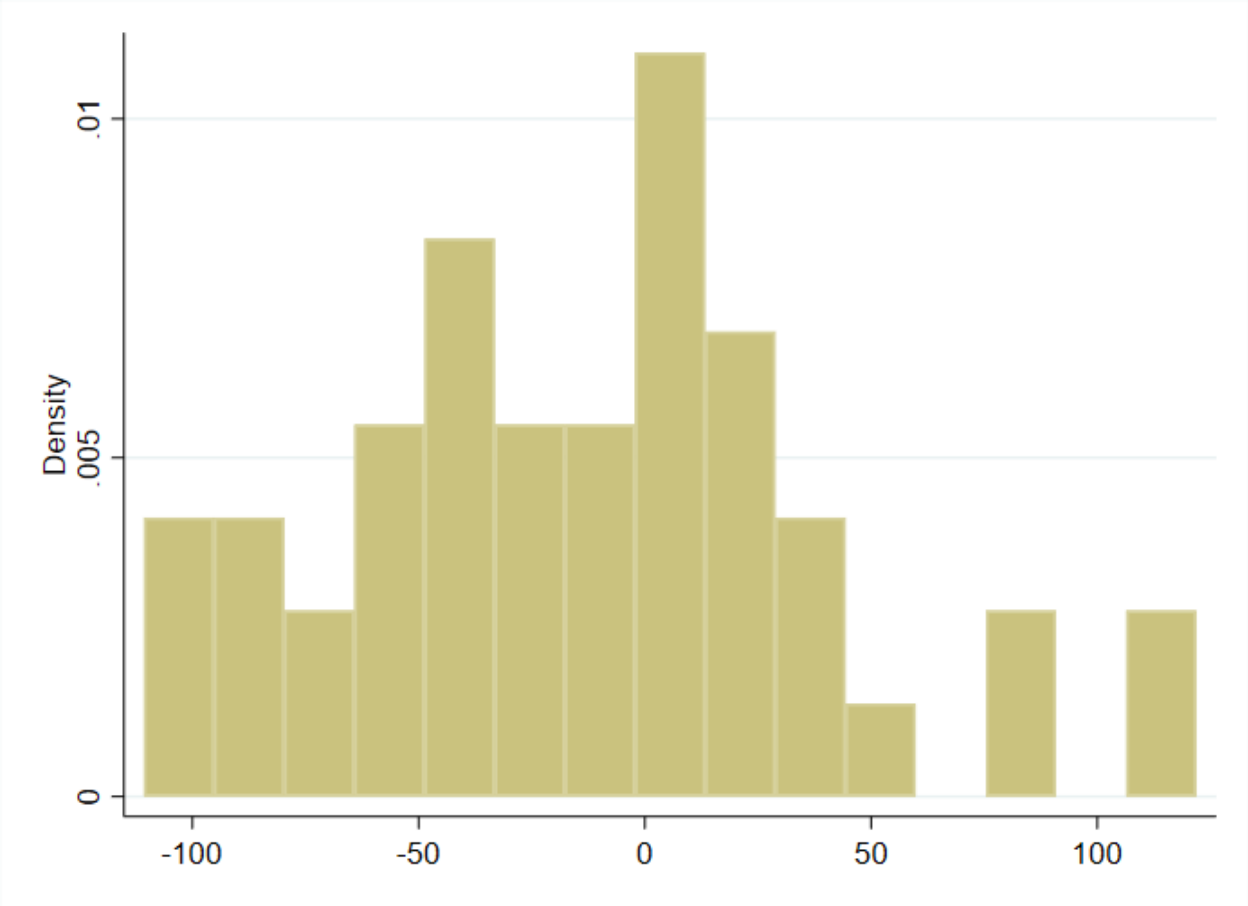
Source: authors' illustration based on Brazilian Ministry of Foreign Trade data.

Figure 4: Change in industry-specific import-weighted real exchange rate, 2000–10



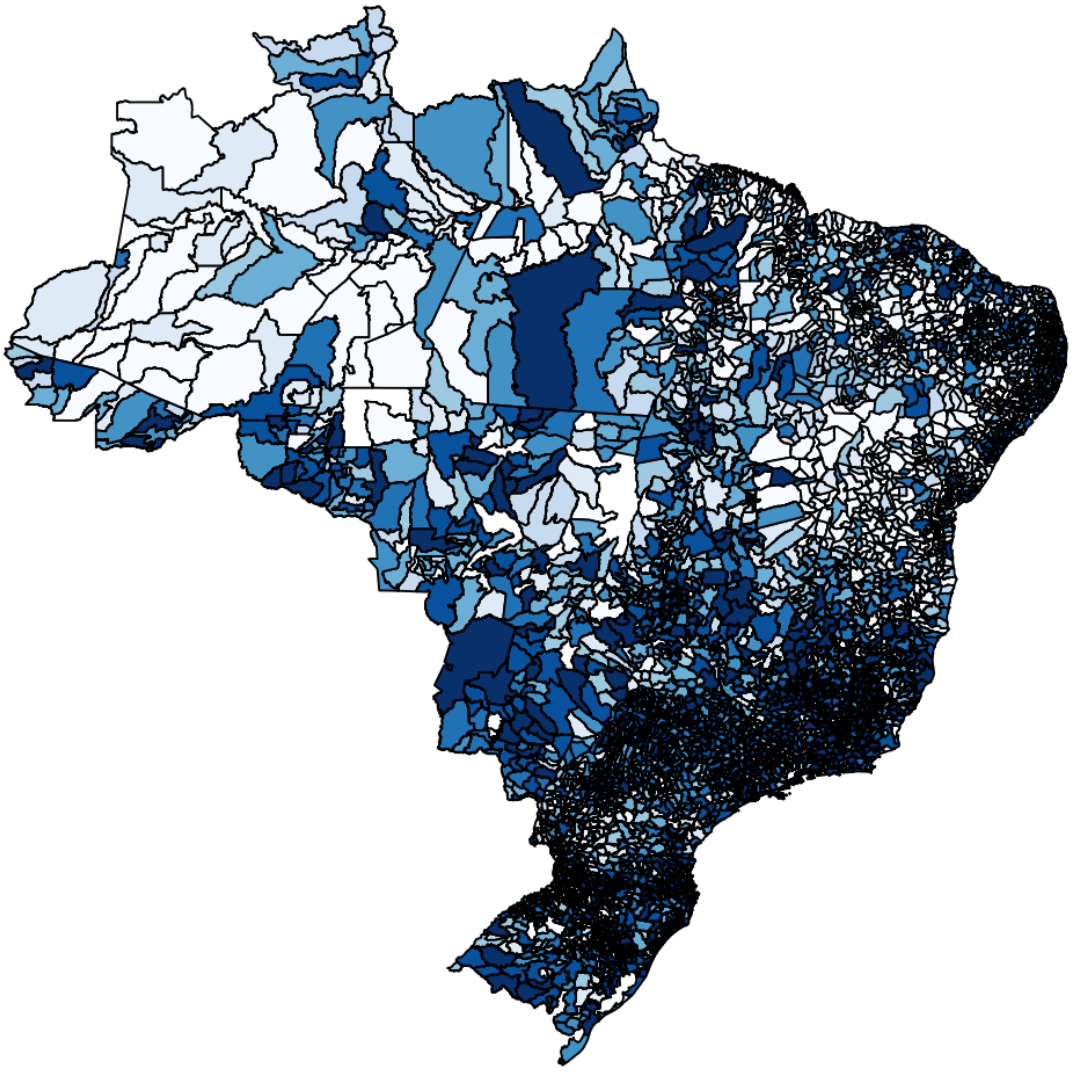
Source: authors' illustration based on Brazilian Central Bank data.

Figure 5: Change in industry-specific export-weighted real exchange rate, 2000–10



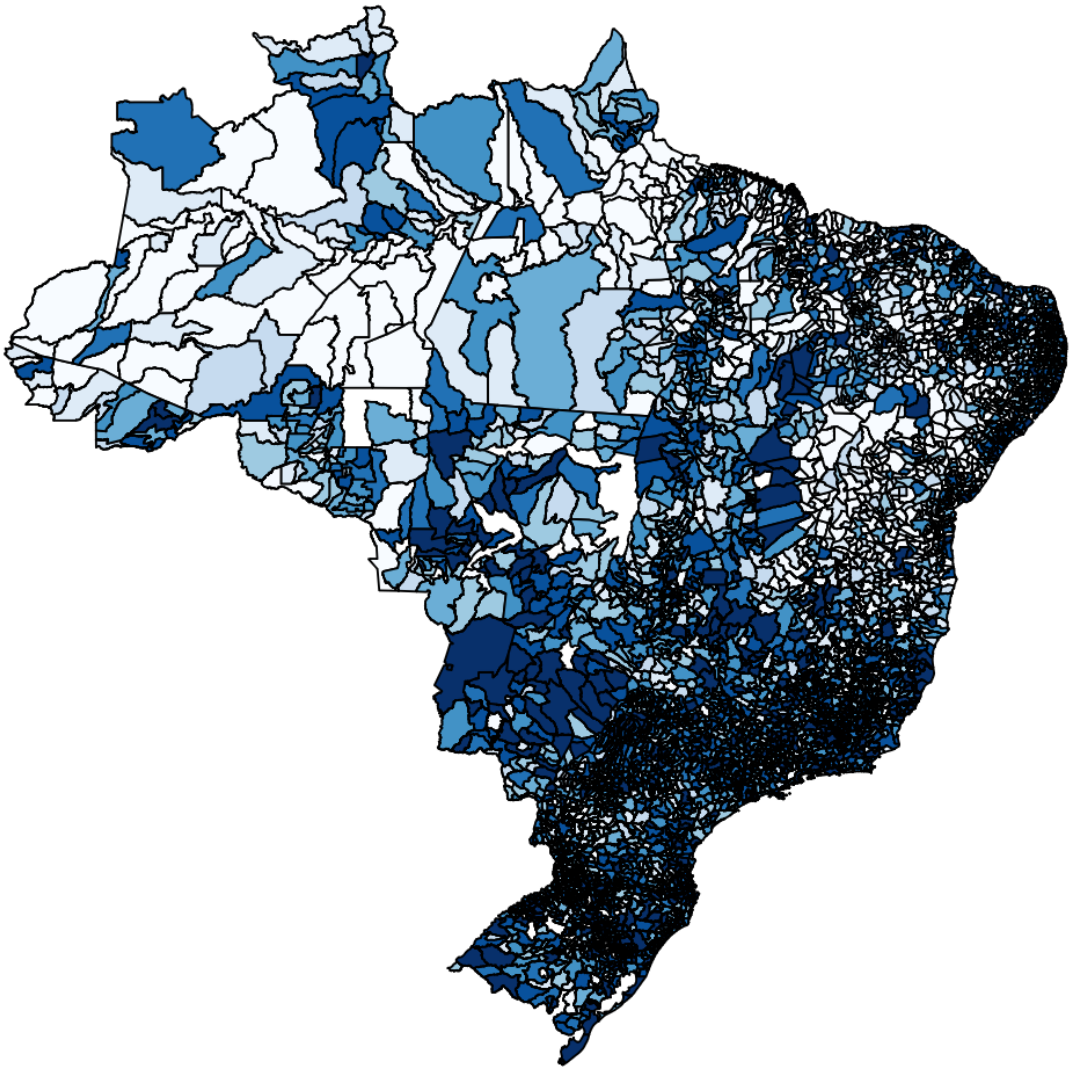
Source: authors' illustration based on Brazilian Central Bank data.

Figure 6: Municipality-level labour enforcement, 2000



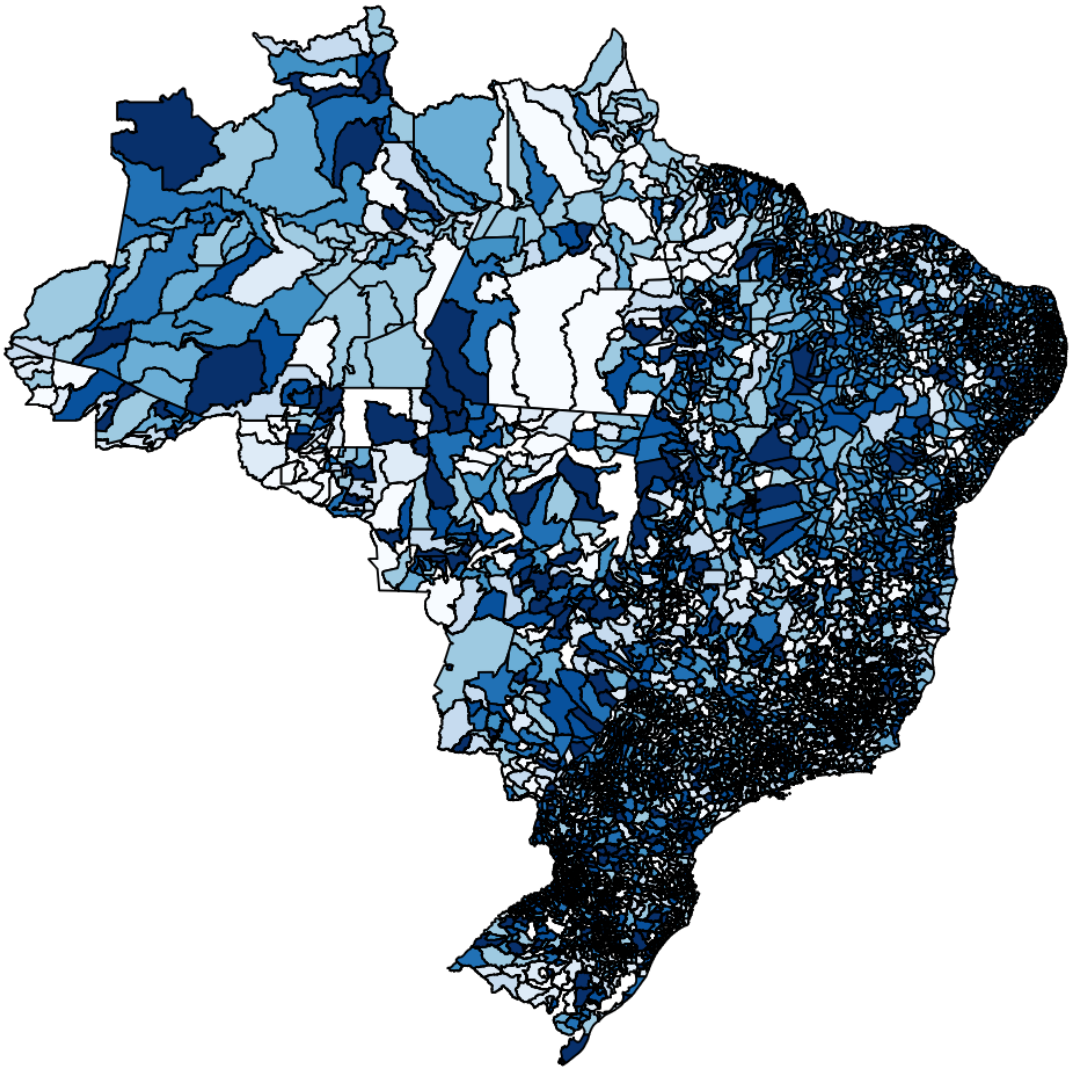
Source: authors' illustration based on Brazilian Ministry of Labour data.

Figure 7: Municipality-level labour enforcement, 2010



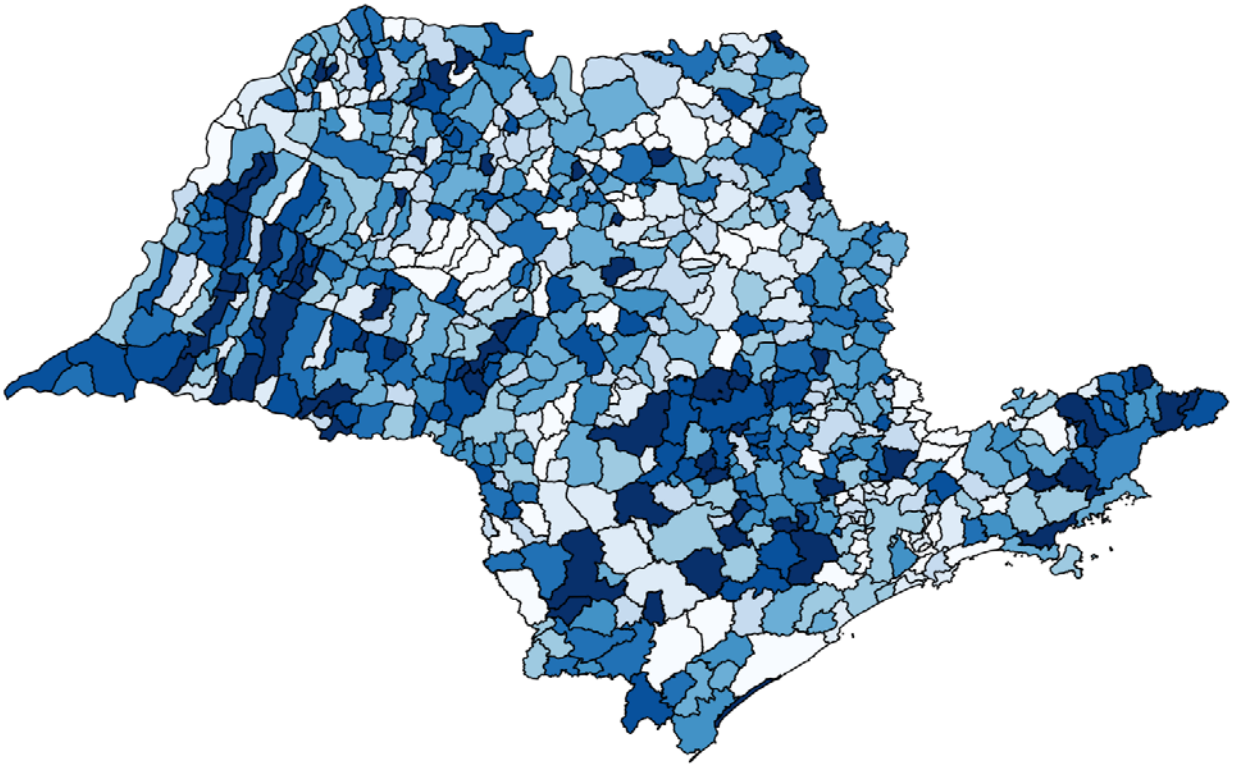
Source: authors' illustration based on Brazilian Ministry of Labour data.

Figure 8: Municipality-level changes in labour enforcement, 2000–10



Source: authors' illustration based on Brazilian Ministry of Labour data.

Figure 9: Municipality-level changes in labour enforcement, São Paulo state, 2000–10



Source: authors' illustration based on Brazilian Ministry of Labour data.

Table 1: Individual descriptive statistics

2000	Observations	Mean	SD	Min	Median	Max
Formal	7,866,138	0.628	0.483	0.000	1.000	1.000
Informal	7,866,138	0.197	0.398	0.000	0.000	1.000
Self-employed	7,866,138	0.175	0.380	0.000	0.000	1.000
Age	7,866,138	33.013	11.223	15.000	31.000	65.000
Married	7,866,138	0.706	0.455	0.000	1.000	1.000
Urban	7,866,138	0.922	0.269	0.000	1.000	1.000
Female	7,866,138	0.311	0.463	0.000	0.000	1.000
Black	7,866,138	0.059	0.235	0.000	0.000	1.000
Asian	7,866,138	0.004	0.066	0.000	0.000	1.000
Literate	7,866,138	0.956	0.206	0.000	1.000	1.000
High school	7,866,138	0.221	0.415	0.000	0.000	1.000
College	7,866,138	0.041	0.198	0.000	0.000	1.000
2010	Observations	Mean	SD	Min	Median	Max
Formal	7,909,609	0.705	0.456	0.000	1.000	1.000
Informal	7,909,609	0.129	0.336	0.000	0.000	1.000
Self-employed	7,909,609	0.166	0.372	0.000	0.000	1.000
Age	7,909,609	34.802	11.689	15.000	32.000	65.000
Married	7,909,609	0.425	0.494	0.000	0.000	1.000
Urban	7,909,609	0.929	0.257	0.000	1.000	1.000
Female	7,909,609	0.321	0.467	0.000	0.000	1.000
Black	7,909,609	0.076	0.264	0.000	0.000	1.000
Asian	7,909,609	0.009	0.096	0.000	0.000	1.000
Literate	7,909,609	0.970	0.170	0.000	1.000	1.000
High school	7,909,609	0.363	0.481	0.000	0.000	1.000
College	7,909,609	0.064	0.246	0.000	0.000	1.000

Note: household survey weights are used.

Source: authors' calculations based on the Brazilian Decennial Censuses.

Table 2: Municipality–industry descriptive statistics

2000	Obs	Mean	SD	Min	Median	Max
Informal share	67,883	28.364	35.730	0.000	11.261	100.000
Formal share	67,883	44.269	41.607	0.000	40.314	100.000
Self-employed share	67,883	27.367	37.486	0.000	0.000	100.000
Inspections	67,883	258.267	1609.515	0.000	13.000	32074
Enforcement	67,883	4.308	1.334	0.268	4.506	7.736
Population in 100,000	67,883	0.743	3.542	0.008	0.182	104.343
Import-weighted RER	67,883	1.100	0.517	0.245	1.142	2.912
Export-weighted RER	67,883	1.366	0.523	0.230	1.258	2.607
2010	Obs	Mean	SD	Min	Median	Max
Informal share	75,380	21.509	33.249	0.000	0.000	100.000
Formal share	75,380	54.496	42.533	0.000	63.066	100.000
Self-employed share	75,380	23.995	35.900	0.000	0.000	100.000
Inspections	75,380	138.295	789.911	0.000	8.000	16790
Enforcement	75,380	3.948	1.191	0.074	4.028	7.122
Population in 100,000	75,380	0.763	3.671	0.008	0.181	112.535
Import-weighted RER	75,380	1.067	0.454	0.252	1.124	2.048
Export-weighted RER	75,380	1.173	0.434	0.290	1.108	2.172

Source: authors' calculations based on the Brazilian Decennial Censuses.

Table 3: Summary of main predictions

Independent \ Dependent variables	informal all workers	formal all workers	self-employed informal + self-employed	self-employed formal + self-employed
Real exchange rate	-	+	indeterminate	indeterminate
Real exchange rate * Enforcement ('sand in the wheels')	+	-	indeterminate	indeterminate

Source: authors' calculations.

Table 4: Trade, enforcement, and employment shares

Dependent variable:	Informal/all workers	Formal/all workers	Self-employed/ SE + informal	Self-employed/ SE + formal
Import-weighted RER_{jt}	0.089***	0.012	-0.095***	-0.065***
	(0.009)	(0.008)	(0.011)	(0.010)
$MRER_{jt}$ * $Enforcement_{mt}$	-0.015***	0.002	0.008***	0.004**
	(0.002)	(0.002)	(0.002)	(0.002)
Export-weighted RER_{jt}	-0.014	-0.011	0.067***	0.044***
	(0.009)	(0.009)	(0.013)	(0.011)
$XRER_{jt}$ * $Enforcement_{mt}$	0.001	-0.004**	0.000	0.000
	(0.002)	(0.002)	(0.002)	(0.002)
Number of observations	143,263	143,263	103,578	125,422
City–year fixed effects	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES

Note: this table reports coefficients from an ordinary least squares regression, where the dependent variable is as in the column headings. Enforcement is measured as the logarithm of the total number of inspections in the city (plus one) per 100,000 inhabitants of the municipality. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Robust standard errors, clustered at the city level, are reported in parentheses.

Source: authors' calculations based on Brazilian Decennial Censuses and Ministry of Labour administrative data on inspections, 2000–10.

Table 5: Trade, enforcement, and employment shares

Dependent variable:	Informal/All workers	Formal/All workers	Self-employed/ SE + informal	Self-employed/ SE + formal
Import-weighted RER_{jt}	-0.025	0.599***	-0.368***	-0.699***
	(0.054)	(0.085)	(0.083)	(0.084)
$MRER_{jt}$ * $Enforcement_{mt}$	0.013	-0.137***	0.074***	0.151***
	(0.013)	(0.020)	(0.020)	(0.020)
Export-weighted RER_{jt}	-0.240***	0.379***	-0.005	-0.238***
	(0.050)	(0.060)	(0.062)	(0.056)
$XRER_{jt}$ * $Enforcement_{mt}$	0.051***	-0.091***	0.018	0.062***
	(0.011)	(0.014)	(0.014)	(0.012)
Number of observations	143,157	143,157	103,495	125,345
City–year fixed effects	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES
Enforcement instrumented	YES	YES	YES	YES

Note: this table reports coefficients from an instrumental variables regression, where the dependent variable is as in the column headings. Enforcement is measured as the logarithm of the total number of inspections in the city (plus one) per 100,000 inhabitants of the municipality, and is instrumented by the interaction between enforcement in other states in that year and the inverted distance between the municipality and the state capital. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Robust standard errors, clustered at the city level, are reported in parentheses.

Source: authors' calculations based on Brazilian Decennial Censuses and Ministry of Labour administrative data on inspections, 2000–10.

Table 6: Trade, enforcement, and employment levels

Dependent variable:	Total employment	Formal employment	Informal employment	Number of self-employed
Import-weighted RER_{jt}	0.007***	0.007***	-0.002	-0.005**
	(0.002)	(0.002)	(0.002)	(0.002)
$MRER_{jt}$ * $Enforcement_{mt}$	-0.002***	-0.002***	0.0004	0.0005
	(0.0004)	(0.0005)	(0.0005)	(0.0004)
Export-weighted RER_{jt}	0.009***	0.011***	-0.005***	0.0008
	(0.001)	(0.002)	(0.002)	(0.002)
$XRER_{jt}$ * $Enforcement_{mt}$	-0.002***	-0.003***	0.001***	0.0003
	(0.0003)	(0.0005)	(0.0004)	(0.0004)
Number of observations	143,157	122,444	122,444	143,157
City–year fixed effects	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES
Enforcement instrumented	YES	YES	YES	YES

Note: this table reports coefficients from an instrumental variables regression, where the dependent variable is as in the column headings. Enforcement is measured as the logarithm of the total number of inspections in the city (plus one) per 100,000 inhabitants of the municipality, and is instrumented by the interaction between enforcement in other states in that year and the inverted distance between the municipality and the state capital. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Robust standard errors, clustered at the city level, are reported in parentheses.

Source: authors' calculations based on the Brazilian Decennial Censuses and Ministry of Labour administrative data on inspections, 2000–10.

Table 7: Trade, enforcement, and employment shares, across industry-type

Dependent variable:	Informal/all workers	Formal/all workers	Self-employed/ SE + informal	Self-employed/ SE + formal
	PANEL A: IMPORT-COMPETING INDUSTRIES			
Import-weighted RER_{jt}	-0.332**	1.291***	-0.444***	-1.244***
	(0.135)	(0.260)	(0.145)	(0.203)
$MRER_{jt}$ * $Enforcement_{mt}$	0.079***	-0.286***	0.085**	0.262***
	(0.031)	(0.059)	(0.033)	(0.045)
Export-weighted RER_{jt}	-0.649***	1.121***	-0.153	-0.916***
	(0.149)	(0.238)	(0.167)	(0.203)
$XRER_{jt}$ * $Enforcement_{mt}$	0.142***	-0.252***	0.045	0.203***
	(0.033)	(0.052)	(0.038)	(0.044)
Number of observations	77,709	77,709	56,508	68,839
	PANEL B: EXPORT-ORIENTED INDUSTRIES			
Import-weighted RER_{jt}	0.159**	0.126*	-0.304***	-0.292***
	(0.065)	(0.070)	(0.103)	(0.076)
$MRER_{jt}$ * $Enforcement_{mt}$	-0.031**	-0.028*	0.062**	0.062***
	(0.015)	(0.017)	(0.025)	(0.017)
Export-weighted RER_{jt}	-0.159***	0.224***	-0.013	-0.117**
	(0.053)	(0.058)	(0.068)	(0.059)
$XRER_{jt}$ * $Enforcement_{mt}$	0.032***	-0.055***	0.023	0.037***
	(0.012)	(0.013)	(0.015)	(0.013)
Number of observations	64,457	64,457	46,167	55,738
City–year fixed effects	YES	YES	YES	YES
Industry fixed effects	YES	YES	YES	YES
Enforcement instrumented	YES	YES	YES	YES

Note: this table reports coefficients from an instrumental variables regression, where the dependent variable is as in the column headings. Enforcement is measured as the logarithm of the total number of inspections in the city (plus one) per 100,000 inhabitants of the municipality, and is instrumented by the interaction between enforcement in other states in that year and the inverted distance between the municipality and the state capital. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Robust standard errors, clustered at the city level, are reported in parentheses.

Source: authors' calculations based on the Brazilian Decennial Censuses and Ministry of Labour administrative data on inspections, 2000–10.

Appendix

Table A1: First stage estimations

Dependent variable:	$XRER_{jt}$ * $Enforcement_{mt}$	$MRER_{jt}$ * $Enforcement_{mt}$
Import-weighted RER_{jt}	0.114***	3.377***
	(0.017)	(0.088)
$MRER_{jt}$ * Other $Enforcement_{mt}$	-0.009***	0.072***
	(0.001)	(0.008)
Export-weighted RER_{jt}	3.320***	0.137***
	(0.100)	(0.021)
$XRER_{jt}$ * Other $Enforcement_{mt}$	0.093***	-0.010***
	(0.008)	(0.002)
Number of observations	143,252	143,252
City–year fixed effects	YES	YES
Industry fixed effects	YES	YES

Note: this table reports coefficients from the first stage estimations. Enforcement is measured as the logarithm of the total number of inspections in the city (plus one) per 100,000 inhabitants of the municipality. 'Other Enforcement' is the main instrumental variable. ***, **, and * denote significance at the 1%, 5%, and 10% level, respectively. Robust standard errors, clustered at the city level, are reported in parentheses.

Source: authors' calculations based on the Brazilian Decennial Censuses and Ministry of Labour administrative data on inspections, 2000–10.