Exports and Localized Dynamics in the Labor Market in Brazil

**Abstract**

This paper examines the impact of foreign demand shocks on local labor markets in Brazil. Between 1997 and 2022, Brazilian exports tripled, and the exposure to foreign demand shocks varied significantly across different regions of the country. By exploiting variations in global export growth and the exposure of each local labor market to various industries, the paper demonstrates that a 10 percent exogenous increase in exports leads to a 2.5 percent increase in formal local employment in the short run. Additionally, real average wages rise by 1 percent in the year following the shock. The effects are more pronounced and longer lasting for highly skilled workers, with only minor differences in wage and employment responses between men and women. Data from the population census also suggest that regions with higher exposure to export shocks are less likely to experience increases in informal employment.

**JEL:** D3, F16, J16, O19.

Keywords: exports shocks, labor markets, formal employment, wages, Brazil**.**

# Introduction

The academic literature has extensively documented the positive welfare effects of trade openness worldwide. Increases in exports have been closely linked to higher gross domestic product (GDP) (Balassa, 1978; Heitger, 1987; Lee, 1993; Dollar, 1992; Frankel and Romer, 1999; Noguer and Siscart, 2005). Alongside this, trade has shown beneficial impacts in other macroeconomic areas, such as reducing poverty and improving living standards (Harrison, 1999), prompting many developing countries to pursue trade liberalization policies in recent decades. These policies have led to significant growth in exports, resulting in substantial increases in labor demand (Robertson et al., 2009; Lopez-Acevedo et al., 2016). This growth has been somewhat associated with better labor market outcomes, such as higher wages, reduced informality rates, and increased female labor force participation (FLFP) (Artuc et al., 2019; Robertson et al., 2020).

While there is broad agreement that trade and economic growth are positively correlated, the specific interactions between trade policy, trade flows, and labor market outcomes remain complex and not fully understood. In some instances, these relationships are straightforwardly positive (Robertson et al., 2020). However, other recent studies (Bezerra de Goes et al., 2023; Roche Rodriguez et al., 2023) have found mixed results under certain conditions. These variations can be attributed to internal factors, such as industrial policies, or external ones, like export competition. These factors, when combined with trade policies, may fail to enhance female labor force participation even if they tend to correlate with lower overall labor informality rates. Other studies (Robertson et al., 2022) have found no significant relationship between rising exports and local labor market outcomes, possibly due to a weak comparative advantage in the exported goods. Therefore, examining individual country cases is crucial to understanding the factors that lead to better labor outcomes following trade liberalization.

Brazil's trade landscape has undergone significant transformations over the past two decades. The early 2000s saw a period of robust export growth, largely driven by commodities such as soybeans, iron ore, and oil. The rise of China as a global economic powerhouse significantly boosted Brazilian exports, making China a critical trading partner. However, this reliance on commodities made Brazil vulnerable to global commodity price fluctuations. The global financial crisis of 2008 and the subsequent decline in commodity prices posed challenges to Brazil’s export-led growth strategy, leading the country to seek diversification of its export basket by focusing on manufactured goods and higher-value products. Efforts were made to enhance competitiveness through industrial policies and infrastructure development. While progress has been made, Brazil still faces challenges in reducing its reliance on commodities and increasing its participation in global value chains.

This paper explores the impact of exports on localized labor markets in Brazil, with a focus on green transitions. It employs two approaches. The first approach uses the shift-share "Bartik" (1991) method to deepen our understanding of the effects of exports on local labor market outcomes in Brazil between 20xx and 20xxx. The second approach xxx.

The following sections outline Brazil’s economic integration into global markets, highlighting the relationship between exports and local labor markets with an emphasis on green transitions. Section 2 provides an overview of Brazil’s main trade and labor market patterns. Section 3 presents the data. Section 4 discusses the literature as it pertains to the relevance of this paper. Section 5 outlines the methodology and presents the shift-share Bartik analysis on how increasing exports relate to local labor market outcomes. Finally, Section 6 concludes by summarizing the main insights derived from this study.

# Trade and labor market trends

Over the last 25 years, Brazil’s exports of goods increased by about three times in real terms. More specifically, the exports figures were close to USD 170 billion (at 2022 prices) in 1997, then reached a peak of more than USD 400 billion in 2010 and declined to slightly more than USD 300 billion in 2023. Figure 1 depicts the historic evolution considering the 1997-2023 period with data separately for some categories (Agriculture, Forestry and Fishing, Manufacturing and Mining and quarrying). There has been, thus, an increase in exports in real terms comparing 1997 with 2023, but with an important reduction from 2010 to 2023 of about 25 percent. Overall, we note that the trend of the Brazilian export cycle in this period is a combination of a continuous expansion of the agricultural sector, with a large cycle of oil and a volatile manufacturing sector.

Figure 1. Evolution of Brazilian exports, separately by sector

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Source: elaborated by the authors using data from the Brazilian Ministry of Industry and Commerce (MDIC), the Brazilian NSO (IBGE) and the Federal Reserve Economic Data (FRED). Notes: Values are denominated in billions of U.S. dollars at 2022 prices.

Figure 2 presents the distribution of exports per person in U.S. dollars at 2022 free-on-board prices in Brazilian municipalities both in 2002 and 2022. It is interesting to observe that, in the first years of the Brazilian exports boom of the 2000s, only a few municipalities has exports as an important feature of their economics. Less than 20 percent of the municipalities in 2002 used to have non-negligible values of exports per person and this share grew to almost 40 percent in 2022, with more than 10 percent of them exporting at least USD 2,000. Appendix Figure A.1 complements the analysis by showing the spatial distribution of the exporting cities in the same period. The map demonstrates that, in 2002, exports used to be concentrated in the old manufacturing hubs of the Southeast and South and – while they are still important in 2022,  
the Midwest now has an outsized imprint.

Figure 2. Exports incidence in Brazilian municipalities in selected years

|  |  |
| --- | --- |
| 1. 2002 | 1. 2022 |
| A graph with numbers and dots  Description automatically generated | A graph with numbers and dots  Description automatically generated |

Source: elaborated by the authors using data from the Brazilian Ministry of Industry and Commerce (MDIC), the Brazilian NSO (IBGE) and the Federal Reserve Economic Data (FRED). Notes: values are denominated in U.S. dollars at 2022 prices. Municipality-level population data comes from the official estimates relative to the year of 2022. Bubbles are proportional to total municipal exports and the vertical axis is truncated at USD 1,000.

Brazil's labor market has undergone significant transformations over the past two decades, characterized by regional, gender, and ethnic disparities. The economic boom of the early 2000s led to substantial job creation, particularly in the Southeast and South regions, where industrial and service sectors thrived. This period also witnessed a notable reduction in poverty rates and increased female labor force participation. However, the benefits of this growth were unevenly distributed, with the Northeast and North regions lagging in terms of job creation and income levels.

The economic downturn that began in 2014 exacerbated existing regional disparities. The Southeast and South regions, while impacted, showed greater resilience compared to the Northeast and North, where unemployment rates surged, and informal employment increased. The crisis disproportionately affected young people, women, and Afro-Brazilians, who were more likely to lose jobs or enter the informal economy.

While the Brazilian economy has shown signs of recovery since 2017, the labor market continues to face challenges. The service sector, dominated by female employment, has been a major driver of job creation, but the quality of these jobs often remains precarious. The gap in unemployment rates between white and black workers persists, reflecting historical inequalities and ongoing discrimination. Additionally, rural areas have experienced outmigration as young people seek better opportunities in urban centers, leading to labor shortages in agriculture and related sectors.

The COVID-19 pandemic amplified existing vulnerabilities in the labor market. Women, particularly those in informal sectors such as domestic work and caregiving, were disproportionately affected by job losses and increased care burdens. The pandemic also highlighted the digital divide, with individuals from lower socioeconomic backgrounds facing greater challenges in accessing remote work opportunities.

# Literature background

Trade agreements generally lead to increased trade by lowering trade costs through the reduction of barriers such as tariffs, quotas, and non-tariff obstacles. However, the specific channels through which trade influences labor market outcomes, especially in the context of exports and in developing countries, remain underexplored. Our approach builds upon recent empirical studies. Pioneering research by Topalova (2010) investigated the impact of tariff changes on poverty rates across districts in India. Topalova measured effective changes in tariff rates by weighting industry-level changes based on the number of workers in each district. A key contribution of Topalova's work was applying the Bartik (1991) approach, which utilizes the concentration of production in local labor markets to identify the relationship between globalization and local labor market outcomes. Specifically, Topalova calculated the effective change in import protection for Indian districts following the 1991 trade reform, with variation arising from differences in industry and import compositions. Districts with a higher share of import-competing sectors, and those experiencing greater tariff reductions, faced more significant exposure to trade liberalization shocks. Topalova assumed that tariff reductions were exogenous to the districts since they were implemented by the central government through international agreements.

Several studies have used variations of this approach, yielding different conclusions. Topalova (2010) found that poverty rates increased or declined more slowly in districts more exposed to trade shocks. A critique of Topalova’s study is the assumption of zero tariffs for nontraded sectors like services, which were included in the analysis. In reality, nontraded sectors face prohibitive trade costs, akin to infinite tariffs. Hasan, Mitra, and Ural (2007) argue that adjusting zero tariffs to prohibitive levels suggests trade shocks might have reduced poverty in India, contrasting with Topalova's findings. Despite the differing results, both studies employ a similar Bartik (1991)-based instrument.

Using an empirical approach suggested by Hasan, Mitra, and Ramaswamy (2007), Krishna, Mitra, and Sundaram (2010) found that the positive impact of trade liberalization on poverty reduction is less pronounced in lagging regions of India, Sri Lanka, Bangladesh, Pakistan, and Nepal. Relatedly, Hasan et al. (2012) discovered that trade protection is negatively correlated with state-level unemployment, especially in states with high employment in export-oriented industries.

In Brazil, Menezes-Filho and Muendler (2011) found that low tariffs on intermediate inputs correlated with a lower likelihood of unemployment and higher formal sector employment. Kovak (2013) used an instrument based on tariff changes, similar to Topalova (2010), to study the impact of trade liberalization on Brazil’s labor markets. Unlike earlier research, Kovak employed a semi-structural approach grounded in a theoretical model, demonstrating that trade shocks have a more substantial impact on local labor markets when regions have higher producer prices, a greater share of employment in import-competing sectors, and higher labor demand elasticities. Dix-Carneiro and Kovak (2017) found that lower tariffs increased informality in Brazilian micro-regions more exposed to tariff reductions, even two decades after the trade reform. Similarly, Sarra and Bombarda (2018) observed that regional exposure to Mexican tariff reductions raised the likelihood of formal employment in tradable sectors, particularly for men, likely due to cheaper intermediate inputs benefiting export-oriented sectors.

Empirical evidence shows that Brazilian workers faced significant adjustments following trade liberalization, with notable declines in wages and employment over time. Between 1991 and 2002, Kovak (2013) found that Brazilian micro-regions experiencing liberalization-induced price declines greater than 10 percent saw wage declines of 4 percent. Dix-Carneiro and Kovak (2017) extended this work, showing that micro-regions facing more substantial tariff cuts experienced prolonged reductions in formal sector employment and earnings, with the impact on regional earnings 20 years post-liberalization being three times that observed after 10 years. Workers initially employed in tradable sectors tended to shift to non-tradable sectors, though not sufficiently to offset the steep declines in formal employment within tradable sectors. Spillover effects also negatively impacted workers in non-tradable sectors in these regions. The authors suggest that imperfect interregional labor mobility and dynamics in labor demand, influenced by slow capital adjustment and agglomeration economies, contribute to these outcomes. These findings align with Góes et al. (2019), who utilized a general-equilibrium model to aggregate data on production, employment, wages, prices, imports, and exports across 57 Brazilian economic sectors.

Much of Brazil's adjustment to trade liberalization occurs through the informal sector, which serves as a buffer for workers displaced by trade. Dix-Carneiro and Kovak (2017) showed that, in the medium term, micro-regions more exposed to foreign competition experienced higher unemployment than the national average, but in the long term, foreign competition had no effect on unemployment, instead significantly increasing informal employment locally. Ponczek and Ulyssea (2018) corroborated this, showing that the medium-term unemployment impact of liberalization-induced foreign competition was more significant in micro-regions with stricter labor market regulations, which made labor shifts more challenging. The role of the informal sector as a crucial margin of labor market adjustment to trade has gained increasing attention in recent literature.

The effects of import and export shocks on migration across micro-regions and labor reallocation from formal employment to non-employment within these regions are also critical. Brummund and Connolly (2019) used an instrumental-variable approach to study Brazil's trade relationship with China and found that export exposure reduced transitions from the traded sector to non-employment and increased shifts from non-employment to the non-traded sector, primarily driven by the manufacturing sector. This contrasts with negative impacts in micro-regions more exposed to imports, which showed more reallocation from manufacturing to non-employment and less movement from traded to non-traded sectors. These findings suggest that Brazilian labor markets responded more dynamically to the trade shock from China than to the 1990s trade reforms.

Trade liberalization has had mixed effects on poverty in Brazil. While some studies indicate that trade has helped reduce poverty by lowering consumer goods prices and creating job opportunities, others note that these benefits are unevenly distributed, often favoring those already better off. Consequently, while some individuals have moved out of poverty, others have experienced little change or worsening conditions due to job displacement or wage reductions in vulnerable sectors.

# Data

**Formal Employment**

To analyze the formal labor market in Brazil, we utilize the Brazilian matched employer-employee data set known as RAIS (Relação Anual de Informações Sociais). RAIS is an annual census of formal workers administered by the Brazilian Ministry of Labor, containing detailed information about all formal employees in the country. Employers are required to submit information about their employees to RAIS every year and face penalties for non-compliance with submission deadlines. For our main analyses, we use RAIS data sets from the period 1995 to 2021, employing the sectoral classification based on CNAE 95 at the 5-digit level.

**Population Census**

We use data from the Brazilian Population Censuses of 2000 and 2010 to examine both formal and informal labor markets at the microregion-sector level, using the 5-digit CNAE 95 classification. While census data is available from as early as 1960, our focus is on the most recent period of export expansion in Brazil, so we restrict our analysis to the 2000 and 2010 censuses. We do not include the 1991 census because the CNAE 95 sectoral classification used in RAIS data was established after the 1991 census, and no official concordance exists between the 1991 classification and CNAE 95. Creating an ad-hoc concordance would require numerous assumptions, potentially introducing additional noise into the analysis. The formal labor market is defined based on whether a worker has a formal job contract (i.e., “carteira assinada”) or contributes to social security.

**Exports Data**

<Carlos to fill in>

**Emissions Data**

Greenhouse gas (GHG) emissions data by sector are derived from the dataset developed by Cirera and Martins-Neto (2021). This dataset compiles GHG emissions information at the 3-digit CNAE 95 level, based on the Brazilian Initial National Communication to the United Nations Framework Convention on Climate Change for the reference year 1994. Emissions are measured in tons. To align with the sector classification used in RAIS and census data, we converted the 3-digit CNAE 95 data into 5-digit CNAE 95 data.

**CNAE correspondances**

# Methodology

**Empirical strategy**

A common empirical strategy to evaluate distributional impacts across geographical areas is to exploit the differential exposure of local labor markets of a given country to international trade shocks. Conceptually, these shocks typically happen at some aggregate level—say, at the industry level—and local labor markets are differentially exposed to aggregate shocks by some pre-existing characteristic—say, by the industry composition of the labor force. A weighted average of its exposure to each shock provides an estimate of local labor market exposure to industry-specific shocks.

Suppose, for instance, that there are two regions (north and south) and two industries (manufacturing and agriculture) in a country. Suppose further that the south has most of its labor force employed in agriculture and the north has most of its labor force employed in manufacturing. If foreign demand for agriculture increases exogenously, then the south will be more exposed to this international trade shock. We capture distributional effects of trade across regions by measuring the relative effect of the most exposed region relative to the least exposed region, which can be thought of as a simple differences-in-differences estimator like the in the previous section.

Methodologically, when there are many regions and sectors, we estimate the distributional effects of trade through shift-share (Bartik) regressions (for details on the methodology, see Borusyak et al., 2020). The intuition above still follows through, and the estimator can still be interpreted by DiD (cf. Chodorow-Reich, 2020). This method has become a standard in the literature used both for import shocks (Autor et al., 2013 and Dix-Carneiro and Kovak, 2015) and export shocks (Robertson et al., 2021 and Góes et al., 2023).

Formally, to measure how exports affect local labor markets, we interact export growth in different industries with differential exposure to industry-specific shocks across different local labor markets. Formally, we define local labor market exposure to exports growth as:

where denotes log total exports of industry at period ; denotes total employment in region and industry ; and is total aggregate employment in region r.[[1]](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Fworldbankgroup-my.sharepoint.com%2Fpersonal%2Fgacevedo_worldbank_org%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F306340a708be462da987acccfdc94789&wdenableroaming=1&mscc=0&wdodb=1&hid=0D2548A1-602C-6000-1E76-78CE242C68B4.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=5645e7ab-269d-e84a-da09-62ed908a6eff&usid=5645e7ab-269d-e84a-da09-62ed908a6eff&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Fworldbankgroup-my.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdorigin=Other&instantedit=1&wopicomplete=1&wdredirectionreason=Unified_SingleFlush#_ftn1)

Given the shares, our objective is to estimate the dynamic treatment effect of a regressor, which can be done provided that the shifters are as good as random. If this were true, we would be able to recover the dynamic treatment effect by estimating a sequence of local projection regressions as in Jordà (2005).

Given a time-series for some outcome of interest and a vector of control variables , one could estimate a sequence of OLS regressions using:

Note that, in this sequence of regressions, for each t, the right-hand variables are fixed at the time of the shock while the dependent variable changes and denotes the cumulative change of the outcome variable since the reference period. The path of shows a cumulative impulse response function, which can be interpreted as the dynamic average treatment effect of the outcome variable.

Provided that estimation is consistent, as shown by Plagborg-Møller and Wolf (2021), local projections like the one above retrieves impulse response functions that are asymptotically identical to the ones from vector autoregressions (VARs), but with the advantage of being fully flexible models for instrumental variable estimation and not requiring identifying the full matrix of autoregressive coefficients.

Furthermore, more recently, Dube et al. (2023) have shown that a local projections design like this can be generalized as a dynamic DiD estimator. While their paper focuses primarily on a case with binary treatment, the authors argue that it extends to the continuous treatment case, the one we consider in this study with .

These results hinge on the consistency of the estimator. However, there are many reasons to believe that exposure to exports can be endogenous, including the fact that they depend on local human capital, technology, and other factors of production, which can be naturally correlated with unobserved local labor market characteristics. Therefore, one needs to use some plausibly exogenous shifters that are not correlated with domestic demand to consistently estimate.

We propose an instrument that tries to isolate an exogenous part of exports by leveraging the correlation between changes in exports and changes in foreign demand. The idea is that some regions are more exposed to industries and, furthermore, some industries are exposed to particular destinations. For instance, if most of Indonesian exports in agriculture go to China but most of manufacturing exports go to the US, changes in demand in China (such as a fiscal stimulus) will impact agriculture more than manufacturing. Similarly, those regions with most of their employment in agriculture will be more exposed to China than to the US.

Similar to Aghion et al. (2018), we use global demand in each particular industry as a source of exogenous variation. The application by Hummels et al (2014) is closely related to our approach in that they use the growth in global demand interacted with pre-period shares to instrument for exports. Our exposure measure, however, varies over time, as we show here.

Let be the set of countries in the world and let denote the source country, Indonesia. Indonesian exports are its sales to the set of all countries other than itself: . Formally, we define the instrument as:

where denotes country d’s share of industry i’s exports; and is the change in log U.S. dollar GDP in country d. Note that this instrument incorporates every country that Indonesia exports to in every industry, with a higher weight to the higher export partners—likely the six partners emphasized in Figure 2.2—but can differ for industry-specific exports.

Estimation now takes the form of two-stage least squares, with the first stage being:

and the second stage:

where are the predicted values of the first stage regression. Estimation of is consistent if for every d and r pair at every horizon h; that is, if past changes in foreign demand are uncorrelated with the distribution of unobserved factors that drive changes in local labor markets in Indonesia.

Intuitively, global foreign demand shocks can affect small open economies, like individual Indonesian districts. Furthermore, each Indonesian district is itself a small open economy. Therefore, it is unlikely that changes in foreign demand are correlated with the distribution of unobserved factors that differentially drive changes in local labor markets.

[[1]](https://usc-word-edit.officeapps.live.com/we/wordeditorframe.aspx?ui=en-US&rs=en-US&wopisrc=https%3A%2F%2Fworldbankgroup-my.sharepoint.com%2Fpersonal%2Fgacevedo_worldbank_org%2F_vti_bin%2Fwopi.ashx%2Ffiles%2F306340a708be462da987acccfdc94789&wdenableroaming=1&mscc=0&wdodb=1&hid=0D2548A1-602C-6000-1E76-78CE242C68B4.0&uih=sharepointcom&wdlcid=en-US&jsapi=1&jsapiver=v2&corrid=5645e7ab-269d-e84a-da09-62ed908a6eff&usid=5645e7ab-269d-e84a-da09-62ed908a6eff&newsession=1&sftc=1&uihit=docaspx&muv=1&cac=1&sams=1&mtf=1&sfp=1&sdp=1&hch=1&hwfh=1&dchat=1&sc=%7B%22pmo%22%3A%22https%3A%2F%2Fworldbankgroup-my.sharepoint.com%22%2C%22pmshare%22%3Atrue%7D&ctp=LeastProtected&rct=Normal&wdorigin=Other&instantedit=1&wopicomplete=1&wdredirectionreason=Unified_SingleFlush#_ftnref1) For some countries, there is a time-series of observed exports by district. We could not find a time series of these data spanning the sample time we used in this work. There are, however, advantages in using the indirect measure of exposure to exports because we are directly instrumenting for production through labor force shares. In other countries regional exports are typically recorded at the last point of invoicing. If there is intermediation, then there might be some record distortion, particularly at a lower level of geographic disaggregation.

Relevance of the instrument

One assumption of the proposed methodology is that the variable used to instrument the observed growth in exports by region is relevant in the sense that they are strongly correlated. The usual way of testing the relevance of the instrument is by checking the F-statistic of a statistical test on whether the instrument is significantly different from zero. Reassuringly, the F-statistic of the proposed instrument in the first-stage regression is greater than 280, which is remarkably high and suggests a nonnegligible correlation. To further inspect the relevance of the instrument, Figure XXXX depicts a binscatter where the instrument is presented in the horizontal axis, while the endogenous variable is shown in the vertical axis using municipality-level data. As can been seen, there is an unequivocally strong and positive relationship between those variables and a relatively low dispersion of observations around the fitted line.

Figure XXXX. Relevance of the instrumental variable



Notes: this binscatter reproduces the slope of regressing the observed growth in exports on the instrument. The underlying regression has N=34,670, Beta = 2.25 and t-stat=16.76.

## **Exclusion restriction**

Another assumption of the proposed methodology is that the instrument used only affects the outcomes variables through its impacts on the endogenous variable. This assumption is known as the exclusion restriction and in our context requires that changes in the foreign demand are uncorrelated with the distribution of unobserved factors that drive changes in the local labor markets analyzed.

# Results

**6.1 Main results**

To shed light on the impacts of foreign demand shocks on formal employment, Figure XXXXX shows the dynamics of the stock of formal workers in Brazil before and after the exports growth in the 1995-2021 period by comparing more exposed with less exposed regions. We observe that in the five years leading up to the shock, there are no sizable differences among them, suggesting that their evolution in the number of formal workers was similar. However, precisely when the shock hits, an 1-percent exogenous increase in exports growth is associated with an average formal employment rise of approximately 0.25 percent and a persistent effect of approximately 0.15 percent in the next year. In the third and fourth year, these estimates are still statistically different zero and greater than 0.1 percent. Finally, the estimated coefficient declines to around 0.5 percent around the fifth and sixth year following the shock. These results suggest that even though effects on formal employment reduce over time they are persistently positive in a six-year horizon.

Figure XXXXX. Impacts on formal employment



Source: elaborated by the authors using RAIS data for the 1995-2021 period. Notes: xxxxxxxx

When it comes to real average wages, Figure XXXX replicates the same analysis by showing both the pre- and post-shock periods. One may think that formal employment is boosted by the exports rise to meet the increased demand and that no effects would be observed in terms of average wages and wage mass because exporting firms in more exposed regions are probably not required to raise salaries in order to expand their workforce. Although this argument is reasonable, the pattern observed in Figure XXXXX points to a different story, as the impacts on average real wages are statistically significant in at least four of the six post-shock years. Moreover, rather than vanishing over time, the effects are larger six years after the shock than in the very first period, suggesting that wages are likely sticky in the short run and need some time to adjust. One year after the foreign demand rise, average wages go up by 0.1 percent, on average, for every 1-percent exogenous increase in exports. Five years later, the estimated coefficient almost doubles, reaching approximately 0.2 percent.

Figure XXXXX. Impacts on real average wages



Source: elaborated by the authors using RAIS data for the 1995-2021 period. Notes: average wages were deflated using the yearly average deflator from IPCA, the Brazilian official CPI, at 2010 prices.

<Add result on the wage mass>

Figure XXXXX complements the investigation by showing the year-by-year effects on the stock of formal workers separately by gender. We observe that there some statistically significant differences in the employment responses between men and women in the first and fourth year following the shock. In both periods, the difference is close to 0.1 percentage points. Overall, the findings are consistent with small differences between men and women. Appendix Figure A.2 depicts the responses separately by gender in terms of average real wages and the conclusion is similar – given that there are no statistically differences between men and women in any post-shock periods.

Figure XXXX. Impacts on formal employment, separately for men and women



Source: elaborated by the authors using RAIS data for the 1995-2021 period. Notes: average wages were deflated using the yearly average deflator from IPCA, the Brazilian official CPI, at 2010 prices.

An important research question is whether there is a heterogeneity of impacts on formal employment by workers’ skill level because exporting firms are probably different from non-exporting ones in multiple observable and non-observable dimensions. To shed some light on this issue, we present in Figure XXXXXXX the estimated coefficients of the impulse response function separately for low- and high-skilled workers, as captured by their educational attainment. The former are those without a college degree, while the latter are those that do have that. As can be seen, the stock of both types of workers increases immediately after the shock hits and the differences in the point estimates become statistically different from zero from the fifth year onwards. While workers with a college degree experience an increase of about 0.2 percent for each 1-percent increase in exports in the fifth year, the impacts on less skilled ones are not significant in the medium run.

Figure XXXX. Impacts on formal employment, separately by workers’ educational attainment



Source: elaborated by the authors using RAIS data for the 1995-2021 period. Notes: educational attainment is measured as per RAIS classification.

## 6.2 Complementary results

<write about results produced with census data>

Figure XXXX. Impacts on employability and real average wages, considering formal and informal workers separately



Source: elaborated by the authors using the Brazilian Population Census data for 2000 and 2010. Notes: formal workers are employers or self-employed workers that contribute to social security, and waged private-sector workers with a formal job contract. Informal workers are those in the remaining categories.

## Analyses of green sectors

# Conclusions

his paper examines how export shocks impact labor market outcomes in Brazil by exploiting regional variations in exposure to foreign demand shocks over a 26-year period from 1995 to 2021. This timeframe was characterized by significant shifts in Brazil's trade policies and global economic integration. Our main findings show that export growth is positively associated with increases in formal employment and wages, with a more pronounced effect on high-skilled workers. Differences in outcomes by workers' gender are minimal.

While these results align with expectations, they tend to diminish over time, which may suggest that the benefits of trade dissipate as labor markets integrate and adjust. Further research is needed to assess the extent to which the effects of exports fade over time. It is also noteworthy that, although these changes have been largely positive, there has been an impact on the rate of labor informality. This indicates that trade liberalization has contributed to economic progress, but it has not been sufficient to resolve the deep-rooted issue of labor informality.

To ensure that the benefits of trade and structural transformation are more widely distributed, leading to inclusive and sustainable economic development in Brazil, sustained efforts and targeted policies are necessary. First, targeted interventions to formalize the labor market are crucial. These could include strengthening labor laws, enhancing social protection mechanisms, and providing incentives for businesses to formalize their operations. Additionally, policies focused on improving job quality and ensuring fair wages can help address the persistent high levels of informality.

# References

Cirera and Martins-Neto (2021)

Appendix A

Appendix Figure A1. Distribution of exports per person at the municipality level, selected years

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| --- | --- |
| 1. 2002 | 1. 2022 |
| A map of brazil with a graph  Description automatically generated | A map of brazil with different colored areas  Description automatically generated |

Source: elaborated by the authors using data from the Brazilian Ministry of Industry and Commerce (MDIC), the Brazilian NSO (IBGE) and the Federal Reserve Economic Data (FRED). Notes: values in the label (to the right of each map) are denominated in U.S. dollars at 2022 prices. To improve the visualization, distribution was truncated at USD 2,500+.

Appendix Figure A.2. Impacts on real average wages, separately for men and women

Source: elaborated by the authors using RAIS data for the 1995-2021 period. Notes: average wages were deflated using the yearly average deflator from IPCA, the Brazilian official CPI, at 2010 prices.

Appendix B