Non-traded gains from trade*

Selection in the non-traded sector: Evidence from Brazil

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First version: October 2020
This version: January 2023
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We investigate the impact of trade shocks on the labor allocation within industries at the local labor market level. Using the Brazilian import liberalization of the 1990s as the empirical setting, we uncover a novel margin for impact of trade: industrial reorganization among *non-traded* producers. We begin by showing empirically that local labor markets more exposed to the policy experienced more job reallocation across firms within traded and non-traded industries compared to those less exposed. Moreover, small establishments were less likely to survive compared to large establishments; among survivors, they were less likely to grow. To explain these empirical regularities, we provide reduced-form evidence that non-traded producers select into importing: plants in high exposure regions were more likely to start importing, with new importers originating from the middle of the size distribution but growing the most over the liberalization period. Motivated by these findings, we develop a parsimonious model of heterogeneous producers incorporating this mechanism. The theory is consistent with the empirical findings, and implies that reallocation among non-traded producers is welfare-enhancing. In contrast, in a special case where all non-traded producers make the same importing decision, this reallocation effect disappears.

*The authors thank Steve Redding and seminar participants at Toronto Metropolitan University and Princeton University. Both authors greatly acknowledge financial support from the International Economics Section at Princeton University.

1. Introduction

Trade policy and trade shocks can have widespread and varied impacts on the affected economies. In recent years, the local labor market as a channel of trade shock transmission has received considerable interest. The key insight is that, given their original composition of economic activity, local labor markets may be more or less exposed to a trade shock compared to others. This differential exposure may translate to stronger or weaker trade policy effects for the region's economic agents, regardless of the agent's own industry of activity. Differential effects especially may occur if local labor markets are not perfectly integrated with each other, as with mobility frictions or trade costs among them. In turn, a country's initial pattern of economic activity across space may ultimately have consequences for the effects of national-level of trade policy, particularly distributional.

This paper explores the role of the local labor market in a country's adjustment to trade shocks by examining the local labor reallocation response among producers within the non-traded sector.[1] The non-traded sector likely represents an economically significant channel through which the local labor market mediates trade shocks for two key reasons. First, since these industries are nontradable and thus less nationally integrated by definition, the local labor market becomes more important in determining its outcomes. Second, the non-traded sector is significantly larger than the traded sector in most countries. For example, it accounts for nearly twice the share of employment and production as the traded sector in Brazil, the empirical setting of this paper.[2] Taken together, the local labor market adjustment in the non-traded sector could have important implications for the consequences of trade shocks.[3]

We take the Brazilian import liberalization of the 1990s, a widely studied policy event,[4] as our empirical setting. At the beginning of the decade, a newly elected government announced a series of unexpected import tariff reductions coupled with the removal of most nontariff import barriers. This policy event represented a significant departure from Brazil's historically protectionist import policies. Figure 1 depicts the evolution of imports as a share of GDP alongside various measures of the average import tariff. The timing of the policy announcement is denoted by the shaded region. Following the announcement,

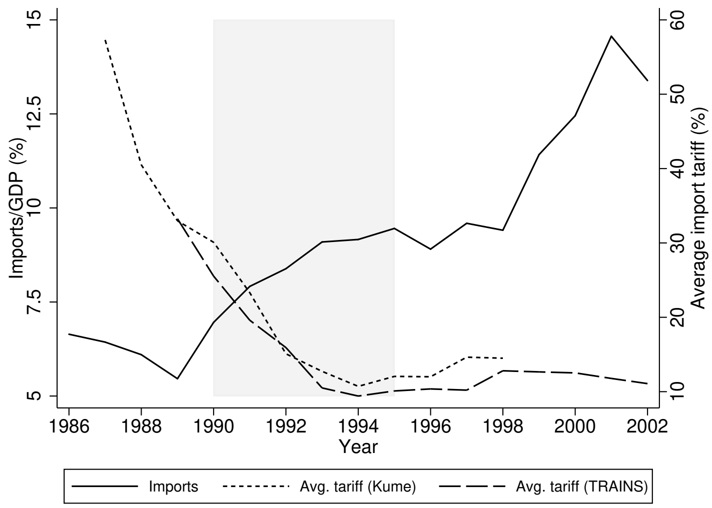
[1]For a review of the literature on the role of the local labor market in a country's adjustment to trade shock, see Autor, Dorn, and Hanson (2016) and S. Redding (2022).

[2]This pattern is not unique to Brazil. According to OECD data, over the 2000s, employment in the services sector corresponded to 6 times the employment in agriculture and manufacturing put together in the United States, 4 times in France, 3 times in Germany, 3.3 times in the Euro Area countries, 5 times in Russia, 11 times in South Africa, and 2 times in Mexico.

[3]Kovak (2013) discusses the role of the non-traded sector in understanding the local labor market effects of a trade liberalization, though his framework does not incorporate firm heterogeneity, which is the focus of our work.

[4]Aquino Menezes-Filho and Muendler (2011) studies worker displacement from the traded sector and their transition into services, unemployment, or exit from the labor force. In a related vein of research, Kovak (2013) examines the local impact on wages, Dix-Carneiro and Kovak (2017) the long-run local impacts, and Dix-Carneiro and Kovak (2019) the local impact on worker outcomes.

Figure 1: Aggregate imports versus average import tariffs.



Notes: Imports as a share of GDP (left axis) and average import tariff (right axis) during the liberalization period (shaded area). *Sources:* IBGE/SCN, Kume, Piani, and Souza (2003) and TRAINS.

imports as a share of GDP roughly doubled in the early 2000s. In the paper, we follow previous literature by interpreting variation across industries of these policy changes as plausibly exogenous to study the differential effects across local labor markets.

We begin by showing empirically that more exposed regions experienced more job reallocation compared to less exposed regions, in both traded and non-traded sectors.[5] This pattern suggests that job reallocation is an important margin on which local labor markets adjust to trade policy. Diving deeper, we find that job reallocation exhibited systematic regularities at the plant level. Comparing plants of different initial size within the same local labor market, small plants were more likely to exit and shrink in response to the policy compared to their larger counterparts. This pattern is strong in both the traded and non-traded sectors. Put together, these findings suggest that the import liberalization prompted job reallocation broadly from small to large producers. While systematic reallocation between heterogeneous producers in the traded sector has received attention in the literature, these similar regularities in the non-traded sector have received little to none.

To explain these empirical regularities, we provide reduced-form evidence that larger producers in the non-traded sector select into importing, expanding as they gain access to inputs from international markets. We show that non-traded producers in regions more exposed to the liberalization were more likely to become importers in the post-liberalization period. Moreover, these "new importers" were medium-sized plants that

[5] Our empirical findings hold true when using both the regional exposure measure proposed by Kovak (2013) as well as a model-based structural measure of regional exposure discussed in Section 3 and Appendix C.

grew the most in terms of both employment and wage bill. Meanwhile, relative to the small plants that never imported, the producers that were already sourcing their inputs from abroad before the liberalization had larger survival probabilities and employment growth.

In the last part of the paper, we develop a parsimonious model of selection into importing to analyze the welfare implications of these empirical regularities. In the model, heterogeneous producers in non-traded industries produce differentiated varieties and source intermediate inputs. They can purchase inputs locally or internationally, at a fixed importing cost. We assume that, when making their import decision, producers trade off reductions in variable costs against the fixed costs for accessing international markets. These variable costs reductions might come from accessing cheaper, higher quality, or even a larger variety of intermediate inputs. In this setup, only the largest and most productive plants will engage in importing – a prevalent feature of the data on import participation.

Moreover, when the costs of importing ease (or, equivalently, when the benefits of inputs produced abroad improve), the model predicts labor reallocation patterns consistent with the data. Namely, at the extensive margin, the import liberalization causes small establishments to exit and medium-sized plants to become importers. At the intensive margin, small producers that survive but do not import shrink, large establishments that do not change their importing status grow, and medium-sized producers that become importers grow the most. Intuitively, as importing becomes cheaper, more producers decide to do so, increasing their scale and competing away demand and labor of small unproductive plants. Highly productive plants that were already sourcing their inputs from abroad are able to do so in a cheaper way, so they expand. At the same time, plants that change importing status experience a discrete drop in variable production costs, implying a substantial expansion of employment and wage bill. Lastly, the model highlights that this reallocation of labor presents a new margin for the welfare gains from trade, as reallocating resources in the economy away from small to larger producers increases aggregate productivity of the non-traded sector. Moreover, we show that selection into importing is necessary for these distributional patterns: a counterfactual model where all heterogeneous producers make the same importing decision does not predict that plants of different size are differentially affected by the trade shock and therefore omits the accompanying welfare effects of trade.

Related literature. Our paper contributes to three main strands of literature. First, we relate to an extensive body of research studying the local labor market effects of trade shocks,[6] particularly Asquith et al. (2019). The paper studies the effects of the China shock on job flow patterns at the local labor market level in the United States. The analysis discovers that establishment death was an important channel through which the shock affected employment, and also that jobs were reallocated from import-competing indus-

[6] See, for example: Autor, Dorn, and Hanson (2013), Kovak (2013), Pierce and Schott (2016), Autor, Dorn, and Hanson (2016), Lyon and Waugh (2018), Kondo (2018), Asquith et al. (2019), Dix-Carneiro (2019), Ponczek and Ulyssea (2021) and S. Redding (2022).

tries to industries that were not import-competing. Similarly to our results, the paper finds between-establishment job reallocation within import-competing industries. However, it does not conduct plant-level analysis to investigate potential differential effects by plant characteristics.

Second, our work is related to a literature that studies the effects of trade shocks to Brazil.[7] This literature analyzes the Brazilian case in different contexts, including the trade liberalization of the 90s, the commodity shock of the 2000s, and the China shock. Dix-Carneiro and Kovak (2017) and Dix-Carneiro and Kovak (2019) are the most closely related. The first traces out the dynamic response of producers to the liberalization, finding long-lasting effects of the tariff cuts on establishments in the traded sector. On the other hand, the second studies the worker-level effects of the import liberalization to provide evidence that workers in more exposed labor markets reallocate away from traded jobs into jobs in the non-traded or informal sectors. We complement both papers by drawing out the distributional effects of the trade shock among non-traded employers.

Third, we contribute to a strand of work that studies the effects of imported intermediate inputs.[8] Particularly related to our work are Amiti and Konings (2007), Pinelopi K. Goldberg, Khandelwal, et al. (2010), and Bas and Paunov (2021). In their seminal work, Amiti and Konings (2007) highlight that, similarly to export tariffs, import tariffs have important productivity effects on firms in the traded sector. At the same time, Pinelopi K. Goldberg, Khandelwal, et al. (2010) estimate substantial gains from trade through access to new imported input varieties. Lastly, Bas and Paunov (2021) study the complementarities between high-quality inputs and high-skill labor. They show that firms upgrade the average quality of their labor force after accessing higher quality intermediate inputs from abroad. Importantly, and to the best of our knowledge, we are the first to propose the reallocation of workers in the non-traded sector as a margin for the gains from an import liberalization.

The rest of the paper is organized as follows. Section 2 presents the empirical findings. Section 3 develops a partial equilibrium model to study the welfare consequences of these reallocation patterns. Lastly, Section 5 concludes.

2. Empirical analysis

In this section, we show that regions more exposed to the Brazilian import liberalization experienced increased labor reallocation across plants in the non-traded sector. Workers were systematically reallocated away from smaller producers to larger producers. We then

[7] Kume, Piani, and Souza (2003), Aquino Menezes-Filho and Muendler (2011), Adão (2016), Costa, Garred, and Pessoa (2016), Helpman et al. (2016), Dix-Carneiro and Kovak (2017), Dix-Carneiro and Kovak (2019), Dix-Carneiro, Soares, and Ulyssea (2018) and Dix-Carneiro, Pinelopi K Goldberg, et al. (2021).

[8] Bernard, Jensen, et al. (2007), Amiti and Konings (2007), Pinelopi K. Goldberg, Khandelwal, et al. (2010), Amiti and Davis (2011), Halpern, Koren, and Szeidl (2015), Fieler, Eslava, and Xu (2018), Blaum, Lelarge, and Peters (2018), Castellani and Fassio (2019), Blaum, Lelarge, and Peters (2019) and Bas and Paunov (2021) represent some of this work.

provide evidence that importing behavior accounts partially for these empirical patterns: plants in exposed regions were more likely to become importers after the liberalization, with those new importers growing the most in terms of employment and wage bill.

2.1. Policy environment and data

We use the Brazilian import liberalization as a setting to investigate the impact of trade policy on the labor allocation within industries at the local labor market level. This policy event comprised of significant, heterogeneous, and unexpected one-sided tariff cuts between 1990–1995.[9]

In March 1990, the newly elected administration of President Collor announced a *tarificação* ("tariffication"), in which nearly all non-tariff import barriers were abolished and tariffs were set to maintain the same gap between internal and external prices to Brazil. The primary effect of this process was to convert the main trade policy instrument from non-tariff barriers to import tariffs while preserving the same level of protection. These were then steadily lowered in the next five years.

Given the above sequence of events, this trade policy has been argued to be plausibly exogenous in timing. Moreover, the import liberalization featured sizable variation industry by industry because the pre-liberalization protection level was the main determinant for how much a tariff was lowered.[10] These were set initially in 1957, a substantial time before the liberalization. Given the policy environment, it is unlikely that contemporaneous political economy factors influenced either the timing of the liberalization or the variation in tariff cuts at the industry level. The rest of this paper therefore proceeds by interpreting the variation in tariff declines as plausibly exogenous.

Our main data source is the detailed matched employer-employee panel data from Brazil's *Relação Anual de Informações Sociais* (RAIS). The data set is collected by the *Instituto Brasileiro de Geografia e Estatística* (IBGE) for administrative purposes such as verifying worker eligibility for government benefits. It contains accurate information covering the universe of formal Brazilian employees.[11] Because it is both high quality and describes all formal economic activity in the country, the RAIS has been used in many studies.[12]

The RAIS is a panel data set, so every worker and establishment has a unique identifier that persists over time. Additionally, it contains information on each establishment's geographic location (municipality) and industry, as well as each worker's age, education, and earnings. Throughout the empirical analysis, we exclude workers with faulty IDs and zero earnings. Moreover, we restrict attention to the highest-paying job for each worker.

[9] See Dix-Carneiro (2019) for a more detailed description of the Brazilian import liberalization.

[10] Pinelopi K. Goldberg and Pavcnik (2003) show that the correlation was -0.90.

[11] A limitation of the data is that it omits self-employed and informal workers. Some work that has studied Brazil's informal sector in the context of trade liberalization have been Dix-Carneiro and Kovak (2019) and Dix-Carneiro, Pinelopi K Goldberg, et al. (2021).

[12] A recent selection which study it in a trade context include Aquino Menezes-Filho and Muendler (2011), Kovak (2013), Helpman et al. (2016), Dix-Carneiro and Kovak (2017), and Dix-Carneiro and Kovak (2019).

At the establishment level, we drop producers with missing ID, municipality, or industry information. We do not consider producers in the mining, utilities, and public industries. Lastly, all nominal variables are converted to 2000 Brazilian Reais.

For the analysis in this paper, the critical feature of the data is that every observation constitutes a worker-establishment pair, where an establishment is a physical location belonging to a firm. As such, every job observed can be assigned to a geographic region. Regional job creation and destruction can then be measured by tracking the number of employees at each establishment across time. For example, if an establishment employs more employees in one period compared to the previous period, jobs are interpreted as having been created in the establishment's region. Crucially, job flows at the regional level can be inferred because the data collects information by establishment, which has a well-defined geographic location, rather than by firm, which could potentially have a presence in many physical locations. Importantly, because RAIS includes information on the universe of Brazilian formal employment, data sparsity is not a concern even with analysis at very fine geographic levels.

Other data sets are used to supplement the RAIS. First, we utilize the 1991 and 2000 *Censos Demográficos* (Demographic Censuses) to characterize the initial distribution of industrial activity, the initial share of informal workers, and its evolution across space.[13] Second, we use the evolution of industry-level import tariffs compiled by Kume, Piani, and Souza (2003). The changes in these tariffs across time are the primary measure of import liberalization used in the analysis of this paper. Third, we obtain information on imports, GDP, and the input-output (IO) table from IBGE's *Sistema de Contas Nacionais* (SCN). Fourth, we gather data on imports by product type from the *Fundação Centro de Estudos do Comércio Exterior* (Funcex). Lastly, we obtain the identity of all establishments that imported or exported over the sample period directly from the Brazilian Ministry of Economy.

2.2. Measuring local exposure to the trade liberalization

Our empirical analysis follows a differences-in-difference strategy. In particular, we compare the evolution of outcomes in local labor markets more exposed to the liberalization to outcomes in regions less exposed to the policy. Local labor markets are defined as the 404 geographic microregion units developed by the IBGE. These are groupings of economically related municipalities that border each other while also being similar geographically and in terms of productivity. The grouped municipalities are also economically integrated, allowing the microregions to be interpreted as local labor markets.[14] In what follows, the terms "local labor market", "region", and "microregion" are used interchangeably.

[13]The Demographic Cesus is only conducted every ten years. We use the 1991 sample because it is the closest in time to the liberalization announcement in 1990.

[14]Using publicly available Census data we find that only 3.4 and 4.6 percent of individuals lived and worked in different microregions in 2000 and 2010, respectively.

Our main explanatory variable is a microregion's effective exposure to the industrial tariff cuts, also sometimes interpreted as the effective regional tariff change. For comparability with previous studies on the Brazilian liberalization, we use the measure initially proposed by Kovak (2013).[15] However, in Appendix C we develop an alternative structural measure based on the model presented in Section 3, and show that the main empirical results remain qualitatively unchanged.

The effective tariff change for microregion r is constructed as:

$$\text{lib}_r = -\sum_k \frac{\lambda_{rk}/\alpha_k}{\sum_j \lambda_{rj}/\alpha_j} d\ln(1+\tau_k). \tag{1}$$

In this expression, λ_{rk} is the initial share of employees working in microregion r that are employed in industry k, while α_k is the share of industry k's non-labor inputs. We calculate the employment share using 1991 Census data and the share of non-labor inputs using the 1990 input-output matrix. Together, they provide a snapshot of the composition of industrial activity for each microregion shortly after the trade policies were announced in 1990. Because tariff changes vary at the industry level, the liberalization measure weights them by how much the microregion's workers are initially concentrated in the corresponding industry, adjusted for that industry's expenditure on labor input. By comparing the outcomes of two microregions with different values of the liberalization measure, the effect of initially being more or less exposed to the shock can be inferred. Figure A.1 in the Appendix plots the density of the effective regional tariff changes across all labor markets in the sample.

2.3. Reallocation in local labor markets

We begin by establishing that local labor markets more exposed to the liberalization experienced higher job reallocation compared to those less exposed. To study such reallocation, we calculate four outcome variables for each microregion r and industry k. The first two measure the *destruction of jobs* that existed before the import liberalization: the share of jobs in 1990 that were destroyed between 1990 and 1999 due to plant exit (s_{rk}^{exit}) or plant contraction (s_{rk}^{contract}). The second two relate to the *creation of new jobs* after the liberalization: the share of jobs in 1999 that were created between 1990 and 1999 due to the entry of new plants (s_{rk}^{entry}) or plant expansion (s_{rk}^{expand}).

For each margin $i = \{\text{exit, contract, entry, expand}\}$, we regress the following empirical specification:

$$s_{rk}^i = \alpha_0^i + \theta_{K(k)}^i \text{lib}_r + \beta^i X_{rk} + \alpha_{s(r)}^i + \alpha_k^i + \varepsilon_{rk}^i, \tag{2}$$

where each observation is a microregion-industry pair. The key explanatory variable is lib_r, the measure of exposure developed in the previous section. We allow for the trade

[15] For instance, see Dix-Carneiro and Kovak (2017), Dix-Carneiro, Soares, and Ulyssea (2018), Dix-Carneiro and Kovak (2019) and Ponczek and Ulyssea (2021).

Table 1: The effect of the trade liberalization on job flows by industry tradability.

	Exit	Contract	Entry	Expand
Traded	-0.053	0.300***	-0.397**	0.034
	(0.195)	(0.101)	(0.168)	(0.073)
Non-traded	-0.300*	0.112	-0.144	0.203***
	(0.168)	(0.090)	(0.139)	(0.058)
N	6617	6617	6617	6617

Notes: Each column reports the estimates from (2) for a different margin i=exit, contract, entry, and expand. Traded row reports the θ^i_{T} coefficient and its robust standard error in parentheses. Non-traded row conversely reports the estimated values and robust standard errors for θ^i_{NT}. All regressions include the controls discussed in the main text. ***p<1%, **p<5%, *p<10%. *Sources:* RAIS.

liberalization to affect differently industries in the traded ($K = T$) and non-traded ($K = NT$) sectors. The coefficient of interest, θ^i_K, captures the effect of a region's liberalization exposure on its job flow patterns in each sector. The nation-wide, general equilibrium effects of the liberalization are captured by the intercept in (2).

The main specification also includes a constant, α^i_0, fixed effects $\alpha^i_{s(r)}$ and α^i_k at the state and industry levels, and a vector of controls, X_{rk}. These controls include the industry k's share of microregion r's total workers in 1990, the share of total payroll in microregion r attributable to industry k in 1990, the log mean wage in industry k in 1990, and the pre-trend in these variables. The pre-trend controls are calculated over 1986 to 1989 using the RAIS. For example, if w_{rk} denotes the log mean wage of industry k workers in region r, then the pre-trend control would be $w_{rk,1989} - w_{rk,1986}$. We also control for the 1990 informal share[16] in each region-industry pair, as well as the 1990-1999 evolution of this variable. Finally, pre-trend values of each margin s^i_{rk} are included within the controls.

The estimation results are displayed in Table 1. Exposure to liberalization had qualitatively similar effects on gross job flow patterns in both the traded and non-traded industries. In particular, regions that were relatively more exposed to the tariff cuts experienced more job destruction due to contraction and less job creation due to entry compared to regions that were not as exposed to the tariff cuts. Both these effects imply fewer net jobs in these region-industries.

On the other hand, regions with higher exposure to the liberalization also saw decreased job destruction due to plant exit. These patterns work in the opposite direction as the other two effects, implying more jobs on net in the affected region-industries. Finally, in non-traded industries, there is also higher job creation due to plant expansion in more exposed areas when compared to less exposed areas. This effect also works in direction of

[16]We define an informal worker as either an employee that does not have its working card signed by its employer or a self-employed individual.

Table 2: Total jobs destroyed or created attributable to differences in exposure.

	Exit	Contract	Entry	Expand	Gross flows
Traded	-43,039	241,440	-233,250	20,242	537,971
Non-traded	-459,459	171,586	-264,075	373,800	1,268,920

Notes: Each column reports the number: $\hat{\theta}^i_K \sum_{r,k \in K} \text{lib}_r \cdot L_{rk,90}$, where i represents each column (exit, contract, entry and expand) and K represents each row (Traded and Non-traded sectors). The coefficients $\hat{\theta}^i_K$ are obtained directly from Table 1. *Sources:* RAIS.

increasing implied net jobs.

Table 2 translates the coefficients in Table 1 into how many jobs were additionally reallocated because of the import liberalization. That is, we use the estimated coefficients, the effective tariff changes, and employment patterns in each region to generate predicted changes in the allocation of labor along each margin. For example, to calculate how many jobs were created due to less plant exit, we start with an expression for the share of jobs in 1990 that were created due to this respective margin of adjustment: $s^{\text{exit}}_{rk} = L^{\text{exit}}_{rk} / L_{rk,90}$. Coupled with (2), the number of jobs in region-industry rk that were additionally created due to lower exit of plants in response to the trade shock is: $\hat{\theta}^i_{K(k)} \cdot \text{lib}_r \cdot L_{rk,90}$. We calculate the nation-wide number of jobs created in response to the liberalization by summing up across all labor markets and industries. Similar calculations are made for each margin of adjustment $i = \{\text{exit, contract, entry, expand}\}$.

The first row of the table lists the results for the traded industries and the second row for the non-traded industries. Each column represents one margin of adjustment. The last column depicts total job flows, obtained by adding the absolute values across columns. Beginning with the traded sector, nearly 240,000 jobs were additionally destroyed due to plants contracting their labor force, but around 43,000 fewer jobs were destroyed because of decreased plant exit. Moreover, over 233,000 fewer jobs were created due to decreased plant entry. When taken together, these effects imply that over half a million jobs were reallocated among establishments in the traded industries, especially from entrants to incumbents.

The second row in Table 2 presents the quantification for the non-traded sector. The immediate observation is that, even though some estimated coefficients in Table 1 are substantially larger in the traded sector, most quantified job flows are larger in the non-traded sector because this sector is much bigger than the traded sector, accounting for almost double the amount of total employment in Brazil. The qualitative patterns remain comparable across sectors, in line with the qualitative similarity of the estimated coefficients.

Overall, nearly 1.3 million jobs were additionally reallocated among establishments in the non-traded sector, with labor being redirected from entrants to incumbents. Among incumbents, there was both increased job creation due to plant expansion as well as increased job destruction due to plant contraction. Import exposure therefore caused nontrivial reallocation effects between plants within the non-traded industries.

2.4. Establishment-level employment patterns

Having established the local job reallocation effects of the trade policy, we now investigate systematic patterns of reallocation across establishments of different initial size. In particular, we show that the liberalization reallocated workers from small to large plants in both traded and *non-traded* sectors.

There are two outcomes of interest. The first is whether or not plants shut down between 1990 and 1999. Then, conditional on survival, the second is the growth rate of a plant's labor force. These outcomes directly speak to the extensive and intensive margins of adjustment that plants might undertake when they face trade shocks. Formally, we define for each establishment e:

$$\text{Surv}_e = \mathbb{1}\{e \text{ survives between 90-99}\} \quad \text{and} \quad g_e = \frac{L_{e99} - L_{e90}}{L_{e90}}, \tag{3}$$

where $\mathbb{1}$ is a dummy that equals one if establishment e survives between 1990 and 1999, and L_{et} denotes total employment in establishment e and year t.

We estimate the effects of the Brazilian trade liberalization in two steps. First, a probit model is used for the survival variable, so that:

$$\text{Surv}_e = \Phi\left(\alpha_0 + \sum_{k=1}^{4} \theta_k \mathbb{1}_{b(e)=k} \text{lib}_{r(e)} + \beta X_e + \alpha_{s(e)} + \alpha_{j(e)} + \alpha_{b(e)} + \varepsilon_e\right), \tag{4}$$

where Φ is the CDF of the normal distribution, α_0 is a constant, k and $b(e)$ denote 1990 regional employment quartiles of establishment e, X_e is a vector of plant-level controls, and the remaining α's denote fixed effects for state, industry, and employment quartiles, respectively. We control for plant e's initial share of employment and wage bill in microregion r and industry j, its log mean wage, and 1986-1989 pre-trends in these variables. We also control for the initial share and the 1990-1999 evolution of informality at the industry-regional level. Finally, we control for plant e's employment growth in the pre-period and its skill intensity in the initial period.

In the second step, we estimate the effects of the trade shock on employment growth for surviving incumbents as follows:

$$g_e = \alpha_0 + \sum_{k=1}^{4} \theta_k \mathbb{1}_{b(e)=k} \text{lib}_{r(e)} + \beta X_e + \alpha_{s(e)} + \alpha_{j(e)} + \alpha_{b(e)} + \varepsilon_e. \tag{5}$$

The variables are nearly the same as in (4). The key difference is that we now include a Heckman correction term in the controls, which is identified under the normality assumption in (4), to account for the fact that surviving incumbents are potentially a selected

Table 3: The differential effects of the trade liberalization on plants of different size by sector.

	Extensive margin		Intensive margin	
	Non-traded	Traded	Non-traded	Traded
θ_1	-0.80***	-0.75**	-3.68***	-19.30***
	(0.28)	(0.41)	(1.11)	(4.34)
θ_2	-0.18	-0.48	-1.25**	-15.10***
	(0.26)	(0.45)	(0.55)	(3.72)
θ_3	0.26	-0.53	2.83***	-14.45***
	(0.30)	(0.43)	(0.53)	(3.64)
θ_4	-0.71***	-0.72	-5.61***	-17.98***
	(0.25)	(0.44)	(1.07)	(4.19)
N	825194	178787	363200	73082

Notes: This table reports the θ_k coefficients for the extensive (4) and intensive (5) margin regressions, for the traded and non-traded sectors separately. All regressions include a constant, fixed effects for state, industry, and initial regional employment quartiles, and control for a plant's initial share of employment and wage bill in its microregion-industry, its log mean wage, 1986-1989 pre-trends in these variables, its employment growth in the pre-period, its skill intensity in the initial period, and the sector-specific regional informal share and its evolution over the 1990-1999 period. The intensive margin regressions additionally include a Heckman correction term, obtained from the extensive margin regressions. Standard errors are clustered at the microregion level. ***p<1%, **p<5%, *p<10%. *Sources:* RAIS.

group of plants.

The coefficients of interest are θ_k for $k = 1, ..., 4$. These capture the effect of liberalization exposure on a plant's probability of survival and employment growth. Importantly, we allow for liberalization exposure to have differential effects varying by the plant's initial size, measured by its regional employment quartile. This formulation is effectively a triple difference in outcomes across time, liberalization exposure, and size. The coefficients not being equal across different size bins indicates that exposure to liberalization causes labor reallocation among the size classes of plants. Note that the main effect of the establishment's initial size bin is captured by the size bin fixed effect $\alpha_{b(e)}$.

Table 3 presents the results for the extensive and intensive margins in the traded and non-traded sectors. In both sectors and along both margins, the coefficients are inverse-U shaped across the initial size distribution, peaking at the second and third employment quartiles.

Begin with the extensive margin for the non-traded sector. The coefficients are roughly monotonically increasing until the third quartile, ranging from -0.8 for smallest plants to 0.26 for the larger plants, then decreasing back to negative values in the largest establishments. The dispersion in the coefficients implies that, for otherwise similar plants of different sizes, the same level of liberalization exposure had a differential impact on survival probability. In particular, the inverse-U shaped pattern implies that liberalization had a redistributive effect towards plants in the top-middle of the size distribution, since they are more likely to survive compared to their smaller (and larger) counterparts. Importantly, Table A.1 in the Appendix makes the formal statistical comparison between the coefficients of interest, confirming that there was reallocation of labor along both margins away from small producers into large plants.

Moreover, since the liberalization measure varies by region, their coefficients compare outcomes for plants in more exposed regions with otherwise similar plants in less exposed regions. For example, the negative coefficients for plants in the first and last quartiles imply that plants of these sizes in regions more exposed to liberalization were more likely to exit than plants of similar sizes in regions less exposed to liberalization. Similarly, the positive coefficient for plants in the third quartile implies that these plants were more likely to survive if in a more exposed area than in a less exposed area.

We find similar results for the intensive margin in the non-traded sector. In response to the trade liberalization, labor is increasingly employed at larger establishments compared to smaller ones. The sign of the coefficients are negative for the first two bins, so smaller plants in high exposure areas were less likely to expand (or more likely to contract) compared to their counterparts in lower exposure areas. On the other hand, producers in the third quartile of the size distribution once again relatively gained from liberalization exposure, the positive coefficient implying they were more likely to expand (or less likely to contract) compared to similarly sized plants in microregions with lower effective tariff cuts.

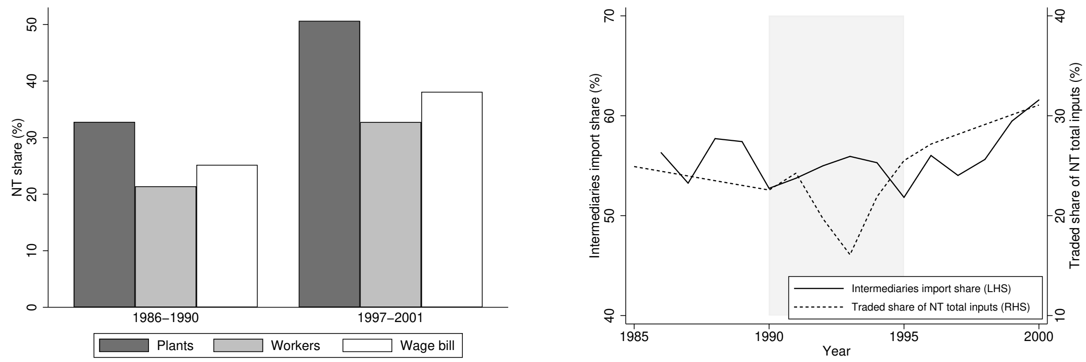
A qualitatively similar pattern holds in the traded sector. Both margins feature coefficients that are inverse-U shaped across size bins, so that the same amount of liberalization exposure had differential effects based on initial plant size. However, differently from the non-traded sector, import competition negatively affects employment throughout the size distribution, as all coefficients in the Traded columns are negative. These findings mirror those in the literature. However, to the best of our knowledge, our paper is the first to highlight that there are similar distributional consequences of trade in the *non-traded* sector.

To what extent are these smallest producers different across labor markets? Figure A.2 in Appendix A shows that the smallest plants in all regions are of similar size. Moreover, Figures A.3 and A.4 in the appendix replicates the empirical exercises industry by industry, ruling out the possibility that these patterns are driven purely by cross-industry reallocations. Put together, these findings suggest that the import liberalization induced job reallocation from small to larger producers in both traded and *non-traded* sectors.

2.5. Importing behavior and the reallocation of labor across plants

In this section, we provide reduced-form evidence of one possible explanation of our producer-level results: selection into importing intermediate inputs. We proceed in three steps. First, we draw out descriptive patterns suggesting that importing was an important

Figure 2: Descriptive statistics of importing in Brazil.



(a) The share of importers in the non-traded sector.

(b) The importing and utilization of traded intermediate inputs

Panel (a): The dark-grey bar plots the share of importers that operate in non-traded industries. The grey (white) bar displays the share of total workers (wage bill) in importing establishments that work for (belongs to) non-traded plants. Each group represents averages for the respective period. *Panel (b):* Import shares of intermediate goods (left axis) and share of total inputs in the non-traded sector that is spent on traded intermediaries (right axis). The shaded area indicates the years of the liberalization policy. *Sources:* RAIS, the Brazilian Ministry of Economy, Funcex and IBGE/SCN.

potential margin for adjustment among producers in the non-traded sector. In particular, during/following the liberalization, a large share of imported foods were intermediate inputs and a substantial share of importers in Brazil operated in non-traded industries. Moreover, imported goods were produced in industries that serve as inputs for the non-traded sector. Second, we establish that importers are qualitatively different from non-importers both before and after the liberalization, providing support for selection patterns. Third, using the liberalization measure, we provide direct evidence that otherwise similar producers in high exposure labor markets were more likely to become importers than those in low exposure regions.

We begin with the sector-level descriptive statistics of importing. Figure 3a shows that a large and increasing share of Brazilian importers operate in non-traded industries. The dark-grey bars show that between 1986-1990 over 30% of importing establishments operated in the non-traded sector, with this share growing to over half of overall importers in the post-liberalization period of 1997-2001. Moreover, Figure 3b shows that intermediate inputs account for more than half of aggregate imports in Brazil, and that inputs from traded industries account for over 20% of total input costs in the non-traded sector.

In what follows, we study how import behavior correlates with plant characteristics, survival, and growth. To do so, we categorize each plant into one of three groups: plants that imported both in 1990 and 1999 (*always importers*), those that did not import in 1990 but were listed as importers in 1999 (*new importers*), and plants that did not engage in

Table 4: Establishment characteristics versus importing status.

	$\ln(\text{Empl})_{90}$	$\ln(\text{WB})_{90}$	$\ln(\text{Wage})_{90}$	SkillShare_{90}
Importers_{90}	1.612^{***}	2.233^{***}	0.621^{***}	0.184^{***}
	(0.129)	(0.134)	(0.029)	(0.015)
NewImp_{99}	1.187^{***}	1.645^{***}	0.459^{***}	0.120^{***}
	(0.096)	(0.097)	(0.031)	(0.021)
Industry and LM FEs	✓	✓	✓	✓
N	363199	363199	363199	363199

Notes: This table regresses each outcome variable (columns) on a set of dummies for importing status (never importers, new importers, importers) controlling for industry and microregion dummies. The comparison group is that of never importers. We restrict attention to plants that survived throughout the sample period. Standard errors in parentheses are clustered at the microregion level. ***p<1%, **p<5%, *p<10%. *Sources:* RAIS and the Brazilian Ministry of Economy.

international trade throughout the sample period (*never importers*). Table 4 regresses plant-level characteristics on dummies for importers and new importers. We find that always importers were the highest performing plants in the initial period, measured by employment, wage bill, mean wage, and skill intensity. They employed on average 161% more employees, paid 62% higher wages, and hired 18 percentage points (p.p.) more college-educated workers than establishments that never engaged in international trade. Similarly, establishments that later became importers were also initially systematically higher performing than never-importers, employing on average 120% more workers, paying 46% higher wages, and having 12 p.p. more college-educated workers.

While always importers, new importers, and never importers were systematically different in the initial period, their outcomes in the post-liberalization period also diverged. In particular, we now analyze survival probability and establishment growth by regressing these outcomes on importer status, controlling for the same set of establishment-level characteristics and size bins as in (4) and (5). Table 5 displays the results, which compares outcomes for plants that are similar in observables other than import status. There are two key results. First, among all producers in 1990, importers were 9.5 p.p. more likely to survive between 1990 and 1999 than non-importers. Second, among plants that survived between periods, new importers' employment grew the most (68% more than the never importers' employment).[17]

The previous empirical exercises provide suggestive evidence that establishments that began importing experience the strongest employment growth. We close the empirical analysis by studying the causal effect of trade exposure on importing. To do so, we project

[17] The ordering of plant size, wages, and skill intensity in the initial period, and the empirical observation that producers that switch trade status are the ones that grow the most are in line with the empirical findings for Argentinean firms in Bustos (2011).

Table 5: Plant exit, growth, and importing behavior in the non-traded sector.

	Survive	dln(Empl)	dln(WB)
Importers_{90}	0.095***	0.063	0.254***
	(0.013)	(0.033)	(0.026)
NewImp_{99}		0.683***	0.843***
		(0.027)	(0.024)
Industry and LM FEs	✓	✓	✓
Size bins	✓	✓	✓
Plant controls	✓	✓	✓
N	825194	363199	363199

Notes: This table regresses each outcome variable (columns) on a set of dummies for importing status (never importers, new importers, importers). The comparison group is that of never importers. All regressions include a constant, fixed effects for state, industry, and initial employment quartiles, and control for a plant's initial share of employment and wage bill in its microregion-industry, its log mean wage, 1986-1989 pre-trends in these variables, its employment growth in the pre-period, its skill intensity in the initial period, and the sector-specific regional informal share and its evolution over the 1990-1999 period. The last two columns focus on plants that survived throughout the sample period. Standard errors in parentheses are clustered at the microregion level. ***p<1%, **p<5%, *p<10%. *Sources:* RAIS and the Brazilian Ministry of Economy.

the new importers dummy on the exposure measure at the local labor market level:

$$\text{NewImp}_e = \alpha_0 + \theta \cdot \text{lib}_{r(e)} + \beta X_e + \alpha_{s(e)} + \alpha_{j(e)} + \alpha_{b(e)} + \varepsilon_e, \tag{6}$$

where we include the same control variables and fixed effects as in specifications (4) and (5). The coefficient of interest, θ, captures how much more likely non-importing plants in exposed labor markets are to become importers in 1999 compared to similar plants in low-exposure regions.

Table 6 displays the results for different specifications of fixed effects and controls. In all specifications, import exposure increased the likelihood of import adoption. For example, the 0.033 coefficient in Column (3) implies that an establishment whose initial region faced a 10 p.p. larger effective tariff decline had, on average, a 0.33 p.p. larger probability of becoming an importer. This corresponds to comparing otherwise similar establishments in a region at the 10th percentile of exposure with those in a region at the 90th percentile of exposure. The 0.33 p.p increase is substantial, as it amounts to 48% of the overall share of new importers over the sample period.

To conclude, local labor markets that experienced stronger reductions in the effective import tariff during the 90s had different reallocation patterns of workers compared to those less exposed to the policy. In particular, workers systematically reallocated away from small plants to larger plants in the non-traded sector. Moreover, we provide reduced-form evidence that larger producers in the non-traded sector select into importing, expand-

Table 6: The effects of the trade liberalization on plants importing decision.

NewImp	(1)	(2)	(3)
θ	0.065***	0.061***	0.033**
	(0.008)	(0.008)	(0.011)
Industry and LM FEs	✓	✓	✓
Size bins		✓	✓
Plant controls			✓
N	363199	363199	363199

Notes: Each column displays the θ-coefficient for a different specification of (6). Column (1) controls for industry and microregion fixed effects. Column (2) additionally controls for the initial size bin of a plant, measured by its number of employees. Column (3) includes the full set of controls discussed in Table 5. We restrict attention to plants that survived throughout the sample period. Standard errors in parentheses are clustered at the microregion level. ***p<1%, **p<5%, *p<10%. *Sources:* RAIS and the Brazilian Ministry of Economy.

ing as they gain access to inputs from international markets, partially explaining these reallocation patterns.

3. A simple model of importing

This section develops a parsimonious model that illustrates the key economic intuition of the liberalization's heterogeneous effects on non-traded producers through selection into importing. Despite its simplicity, the model qualitatively matches the previous empirical patterns. Moreover, the reallocation of labor across plants in the non-traded sector represents a new margin for the gains from trade. In contrast, in a special case of the model without differential importing decisions across producers, these gains from trade disappear.

The rest of the paper proceeds by interpreting each Brazilian local labor market as an instance of the model's economy. For clarity, we omit the region index. In general, these economies could interact with one another through factor mobility and goods trade. However, we do not consider the migration of workers, as prior work has found little evidence that Brazilian workers migrated away from microregions that were more exposed to the import liberalization.[18] Moreover, by restricting attention to the non-traded sector, we do not consider the case in which traded firms export to different regions. The proofs for all claims and propositions are in the Appendix.

[18] See Dix-Carneiro and Kovak (2017) and Dix-Carneiro and Kovak (2019).

3.1. Framework

The economy consists of a mass L of identical households, a traded sector, and a non-traded sector. The non-traded sector is further composed by industries indexed by j. The traded sector is left intentionally general in what follows.

Households. The representative household has Cobb-Douglas preferences for non-traded industries and the traded sector:

$$U = \prod_j \left(\frac{Q_j^N}{\beta_j}\right)^{\beta_j} \left(\frac{Q^T}{1-\sum_j \beta_j}\right)^{1-\sum_j \beta_j}, \quad Q_j^N = \left[\int_{\omega \in \Omega_j^N} q_j^N(\omega)^{\frac{\sigma-1}{\sigma}} \mathrm{d}\omega\right]^{\frac{\sigma}{\sigma-1}}, \tag{7}$$

where Q_j^N is a basket of goods from non-traded industry j and Q^T is the consumption of traded goods. Within each non-traded industry j, the household aggregates differentiated varieties $\omega \in \Omega_j^N$ with a constant elasticity of substitution σ.

The household therefore spends a share β_j on non-traded industry j and a share $1-\sum_j \beta_j$ on the traded sector. Given the household's total expenditure X, its demand for a particular variety ω from industry j is:

$$x_j^N(\omega) = \beta_j X \left(\frac{p_j^N(\omega)}{P_j^N}\right)^{1-\sigma}, \quad P_j^N = \left[\int_{\omega \in \Omega_j^N} p_j^N(\omega)^{1-\sigma} \mathrm{d}\omega\right]^{\frac{1}{1-\sigma}}, \tag{8}$$

where P_j^N is the CES price index in non-traded industry j.

Non-traded industries. In every non-traded industry j, there is a continuum of monopolistically competitive producers, each associated with a unique variety ω. Production is Cobb-Douglas on intermediate inputs and labor, with a weight α_j on intermediates and $1-\alpha_j$ on labor. Producers are heterogeneous in efficiency z, with constant marginal cost:

$$\frac{w^{1-\alpha_j} P_j^T(z)^{\alpha_j}}{z}, \tag{9}$$

where w is the wage rate and $P_j^T(z)$ is the producer's unit cost of intermediates.[19] Under monopolistic competition with CES demand, the producer charges a constant markup $\sigma/(\sigma-1)$ over marginal cost. Total variable profits are therefore:

$$\pi_j(z) \equiv \pi_j\left(z, P_j^T(z)\right) \equiv \frac{1}{\sigma}\beta_j X \left(\frac{\sigma}{\sigma-1} \frac{w^{1-\alpha_j} P_j^T(z)^{\alpha_j}}{z P_j^N}\right)^{1-\sigma}. \tag{10}$$

[19]We index plants by efficiency z rather than variety ω, in anticipation of the fact that producers with the same efficiency act identically.

While the wage rate w is common among all producers, the unit price of inputs $P_j^T(z)$ crucially depends on the producer's importing decision. If the producer does not import, it faces a domestic price P_j^{Td}. On the other hand, the producer may choose to pay a fixed cost of F_j^m to engage in importing, in which case it faces a price of P_j^{Tm}. Producers therefore only import if the change in variable profits covers the fixed cost of importing. The partial equilibrium assumption in this section is that w, P_j^{Td} and P_j^{Tm} are taken as given. Moreover, we assume that $P_j^{Td} > P_j^{Tm}$ to match the empirically relevant case where some producers become importers. Then, there is an importing threshold z_j^m satisfying the zero additional profits condition:

$$F_j^m = \pi\left(z_j^m, P_j^{Tm}\right) - \pi_j\left(z_j^m, P_j^{Td}\right), \tag{11}$$

above which producers will choose to import.

Finally, producers must pay a fixed cost F_j^n in order to operate, implying a participation threshold z_j^n satisfying:

$$F_j^n = \pi_j\left(z_j^n, P_j^{Td}\right), \tag{12}$$

below which variable profits do not cover the fixed costs of operation. Producers with efficiency below this cutoff optimally choose to exit. At this point, we do not take a stand on the units in which the fixed costs are denominated, but we do assume that F_j^n and F_j^m are such that $z_j^n < z_j^m$, to match the empirically relevant case where some operating producers do not become importers.

3.2. Partial equilibrium

To enter an industry j, the producer must pay a fixed cost of F_j^e before learning their efficiency z. After the entry cost is sunk, efficiency is drawn from an exogenous distribution $G_j(z)$. We assume free entry, so the cost of entry equates expected profits:

$$F_j^e = \int_{z_j^n}^{\infty}\left[\pi_j(z) - F_j^n - \mathbb{1}_j^m\left(z > z_j^m\right)F_j^m\right]\mathrm{d}G_j(z). \tag{13}$$

Combining (10)-(13), we characterize selection outcomes $\{z_j^n, z_j^m\}$ in terms of aggregates and traded prices:

$$\frac{F_j^m}{F_j^n} = \left(\frac{z_j^m}{z_j^n}\right)^{\sigma-1}\left[\left(\frac{P_j^{Tm}}{P_j^{Td}}\right)^{\alpha_j(\sigma-1)} - 1\right] \tag{ZZ}$$

$$\frac{F_j^e}{F_j^n} = \int_{z_j^n}^{\infty} \left\{ \left[\frac{z}{z_j^n} \left(\frac{P_j^{Tm}}{P_j^{Td}} \right)^{\mathbb{1}_j^m(z)\alpha_j} \right]^{\sigma-1} - 1 - \mathbb{1}_j^m(z) \frac{F_j^m}{F_j^n} \right\} \mathrm{d}G_j(z), \tag{FE}$$

where $\mathbb{1}_j^m(z) \equiv \mathbb{1}_j^m\left(z > z_j^m\right)$. As apparent from the square bracketed term in (FE), access to importing for a producer of efficiency z affords a "pseudo-productivity advantage" of size $(P_j^{Td}/P_j^{Tm})^{\alpha_j}>1$.[20] Engaging in importing lowers the variable cost of the producer, so the strength of this effect increases as P_j^{Td}/P_j^{Tm} increases. Similarly, as α_j increases, inputs become a larger component of production, boosting the this effect as well. The producer ultimately trades off this variable benefit with the fixed cost of engaging in importing. In what follows, we call $\Delta_j \equiv (P_j^{Td}/P_j^{Tm})^{\alpha_j}$ the "importer advantage" and the augmented pseudo-productivity "effective productivity".

The solid lines in Figure 4 illustrate the partial equilibrium system. Crucially, the producer selection pattern of non-traded industry j is shaped by selection into importing through the relative variable benefit of importing P_j^{Td}/P_j^{Tm} and the relative fixed cost F_j^m/F_j^n. In the Appendix, we show that there exists a unique partial equilibrium in this economy.[21]

3.3. Import liberalization policy

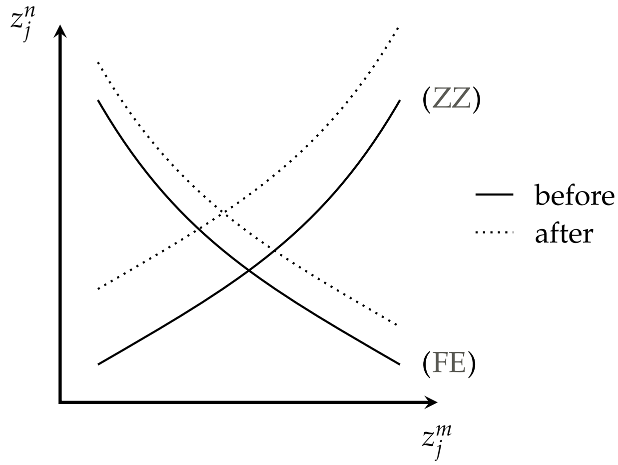
We now study how an import liberalization affects producer entry (the extensive margin of reallocation) and labor demand (the intensive margin). Through the lens of the model, an import liberalization policy can be thought of as either an increase in relative variable importing benefits P_j^{Tm}/P_j^{Td} or a decrease in relative fixed importing costs F_j^m/F_j^n. Regardless, both policies have the same qualitative effect on the system, as represented by the dotted lines in Figure 4. In particular, liberalization shifts upwards both (ZZ) and (FE).

The looser importing policy (whether on fixed costs or importer advantage) implies that importing becomes more profitable on average. However, expected profits are pinned down by the free entry condition (FE), so non-importing activity must become less profitable to compensate for it. This force pushes the participation threshold upward. The effect is amplified by the fact that the zero-profit condition (ZZ) pins down the relative variable benefits of a marginal participant with a marginal importer. The result of the policy is an increase in the participation cutoff z_j^n and decrease in the importing cutoff z_j^m

[20] From the point of view of the producer, importing is comparable to any other productivity-augmenting activity, such as technology adoption. Similar equivalences between globalization activities and productivity appear in other works. For example, Grossman and Rossi-Hansberg (2008) develop a framework where offshoring has a productivity-enhancing effect, and Bustos (2011) shows that exporters upgrade their technologies to produce at larger scales.

[21] As in Bernard, Schott, and S. J. Redding (2007), we can also characterize the partial equilibrium of this model using a single equation that relates the sunk entry cost and the expected value of entry by substituting (ZZ) into (FE). We follow these steps in the mathematical Appendix.

Figure 4: Determination of efficiency cutoffs in partial equilibrium, before and after liberalization.



Notes: This figure plots the model-implied relationship between the two cutoffs in industry j (solid lines), and how they change when there is an import liberalization (dashed lines). These are determined by equations (FE) and (ZZ), and an import liberalization is simulated as a relative decrease in either F_j^m or P_j^{Tm}.

(holding all else constant).

Extensive margin. The model's predictions are consistent with the empirical patterns in each Brazilian region. These are summarized in Figure 5. Since the participating cutoff increases following an import liberalization, the theory predicts the exit of the smallest non-importers.[22] Conversely, the importing cutoff z_j^m falls in response to the import liberalization policy. Hence, on the extensive margin, the model predicts that incumbent importers neither stop importing nor exit, and that the largest non-importers begin importing following the the import liberalization.

Intensive margin. To calculate total labor demand of producers, it is necessary to specify the units in which the fixed costs are denominated. To that end, the rest of this section assumes that fixed costs are paid in terms of labor, so that $F_j^n \equiv w f_j^n$ and likewise $F_j^m \equiv w f_j^m$.

[22]The model has a bang-bang prediction for producer exit as a function of producer size, while the relationship is not as stark in the data. However, it is trivial to introduce idiosyncratic shocks to fixed costs, which softens the bang-bang prediction while maintaining the central intuition of selection into participation and importing. We lay out this extension in the Appendix.

Figure 5: Extensive margin consequences of an import liberalization.

Notes: This figure reports the model-implied, extensive margin effects of an import liberalization. An import liberalization is simulated as a relative decrease in either F_j^m or P_j^{Tm}.

Then, for a participating non-importer with efficiency z, its labor demand is:[23]

$$\left(1-\alpha_j\right)(\sigma-1) f_j^n\left(\frac{z}{z_j^n}\right)^{\sigma-1}+f_j^n, \tag{14}$$

which decreases with the participation cutoff z_j^n. Assuming that the liberalization policy does not change the fixed cost of participation f_j^n, the labor demand of surviving non-importers, the smallest continuing producers, unambiguously decreases after an import liberalization: the average productivity of their competitors increase, competing away labor from these smaller plants.

Focusing on incumbent importers, a z-efficiency producer has labor demand:

$$\left(1-\alpha_j\right)(\sigma-1) f_j^n\left[\frac{z}{z_j^n}\left(\frac{P_j^{Td}}{P_j^{Tm}}\right)^{\alpha_j}\right]^{\sigma-1}+f_j^n+f_j^m, \tag{15}$$

which responds to changes not only in the participation cutoff z_j^n, but also in the relative benefit of importing P_j^{Td}/P_j^{Tm} as well as the fixed costs f_j^n and f_j^m. In particular, while labor demand increases in the last three, it decreases in the first. Intuitively, the fixed cost of participation f_j^n relates to the baseline labor demand of the marginal participating producer. Additional labor demand by more efficient producers is captured by the relative productivity z/z_j^n. As discussed above, importing is similar to a further productivity advantage over the marginal participating producer, captured by the P_j^{Td}/P_j^{Tm} term. Finally, a higher fixed cost to importing f_j^m mechanically pushes labor demand upward. All together, there is an ambiguous effect of import liberalization on labor demand among continuing importers.

However, we prove in the Appendix that labor demand at incumbent importers unambiguously increases in the scenario where fixed costs are unchanged while P_j^{Td}/P_j^{Tm} rises under import policy. For concreteness, let Δ_j be the importer advantage before liberaliza-

[23] See Appendix B for the derivation of the labor demand as a function of producer efficiency z.

tion and Δ'_j the importer advantage following the liberalization. Under the looser import policy, $\Delta'_j > \Delta_j$, so that the importer advantage grows. This change outweighs the increase in z^n_j precisely since profitability is skewed toward importers in response to the policy.

Finally, consider a new importer with efficiency z. While total labor demand is given by (14) before the policy, it transforms to (15) following the policy. Assuming the fixed cost of participation f^n_j is unchanged, new importers not only grow in labor demand, but *relatively more* than continuing importers. This pattern emerges since new importers experience an even larger boost to effective productivity compared to continuing importers. In particular, since new importers did not access import markets before the liberalization, their importer advantage grows from 1 to Δ'_j, compared to from $\Delta_j > 1$ to Δ'_j for incumbent importers. Intuitively, new-importers scale up not only because importing has become more advantageous, but also simply because they have started importing. Finally, the additional fixed cost f^m_j trivially increases labor demand.

To summarize, as long as importing policy leaves the fixed cost of production unchanged, the theory predicts that continuing non-importers shrink and new importers grow in terms of labor. If, further, the fixed cost of importing does not change, then continuing importers grow but relatively less than new importers. Importantly, all of these predictions are in line with the empirical evidence in Section 2.

A structural shift-share measure of exposure. We use a parsimonious general equilibrium version of the model to derive a theoretically consistent regional exposure measure. This measure considers input-output linkages, producer-level selection into imports, and the labor allocation across non-traded industries. Importantly, we find qualitatively similar effects of the trade liberalization on worker reallocation and import decision to those in Section 2. Moreover, to the best of our knowledge, we are the first to derive a shift-share regional exposure measure in models of heterogeneous firms with selection into international trade. See Appendix C for more details on the theoretical and empirical findings.

Welfare. In this framework, real expenditure completely determines household welfare. Welfare is therefore affected by the real wage rate as long as part of household income, and thus expenditure, derives from labor income. This section therefore pauses to discuss the determination of the real wage rate and the effect of import liberalization policy.

To begin, the real wage rate of the representative household

$$\frac{w}{\prod_j \left(P^N_j\right)^{\beta_j} \left(P^T\right)^{1-\sum_j \beta_j}} = \prod_j \left(\frac{w}{P^N_j}\right)^{\beta_j} \left(\frac{w}{P^T}\right)^{1-\sum_j \beta_j} \tag{16}$$

aggregates Cobb-Douglas the nominal wage rate adjusted by each non-traded price index P^N_j, together with the nominal wage rate adjusted by the price of traded goods P^T. While the partial equilibrium framework is silent on this last price, it has concrete implications for the "industry-j real wage rate" w/P_j^N as discussed below.

To set some notation, for any variable x, let x represent its value in the baseline equilibrium and x' its value in the counterfactual equilibrium. In addition, let $\hat{x} \equiv x'/x$ be its proportional counterfactual change. In what follows, the counterfactual equilibrium is interpreted as the post-liberalization economy.

As a direct implication of the operating cutoff condition (12), the proportional change in industry-j real wage rate is:

$$\widehat{\left(\frac{w}{P_j^N}\right)} = \widehat{\left(\frac{w}{X}\right)}^{\frac{1}{1-\sigma}} \widehat{\left(\frac{w}{P_j^{Td}}\right)}^{\alpha} \hat{z}_j^n. \tag{17}$$

The first term is common across all industries, encapsulating the relative importance of labor income in expenditure. If, for example, there are no other sources of expenditure beyond labor income, this term is 1 and has no impact. The second captures the industry-wide effect of import policy's impact on the price of domestically-produced traded goods. This effect therefore may be interpreted as an "import competition" effect, which has appeared in existing studies like Amiti and Konings (2007).

The last term describes the industry-level productivity consequences of intra-industry reallocation. As the participation cutoff in non-traded industry j increases, so too does the average productivity of producers in that industry. As a result, the theory suggests an additional vehicle for the welfare effects of trade beyond the standard import competition effect: within-industry reallocation in non-traded industries. Moreover, the change in the participation cutoff is a sufficient statistic for the strength of this effect.

3.4. The role of selection

This section closes with an examination of the role of selection by investigating the consequences of import liberalization in a special case of the model without differentiated producer import decisions. In this special case, producers either all choose to import or all abstain.

As an example, consider a special case of the model where importing is completely frictionless, with $F_j^m = 0$. Then, all active producers import ($z_j^m = z_j^n$), so the free entry condition becomes:

$$\frac{F_j^e}{F_j^n} = \int_{z_j^n}^{\infty} \left[\left(\frac{z}{z_j^n}\right)^{\sigma-1} - 1 \right] \mathrm{d}G(z), \tag{18}$$

where the importer advantage is absent. The above equation shows that the marginal producer's efficiency z_j^n is completely determined by the free entry condition and crucially not impacted by any changes to import prices P_j^{Tm}. In other words, import liberalization policies do not change the productivity distribution of existing producers. Intuitively, the importer advantage appears in the full model to adjust for the variable profits of an importer relative to the marginal participant with efficiency z_j^n. Since the marginal participant also imports in this special case, the relative efficiency z/z_j^n completely summarizes the difference in outcomes for a producer with efficiency z relative to the marginal producer. Hence, in this special no-selection case of the model, there are no extensive margin selection effects following a trade shock.

Following the same intuition, the labor demand of a z-efficiency producer in this special case is:

$$\left(1-\alpha_j\right)(\sigma-1)f_j^n\left(\frac{z}{z_j^n}\right)^{\sigma-1}+f_j^n, \tag{19}$$

if the fixed cost of production $F_j^n = wf_j^n$ is paid in labor units as before. As is clear from this expression, changes in import prices P_j^{Tm} have no effect on producer-level labor demand. Thus, any import price drops are absorbed through the industry's aggregate scale via producer entry – producers neither shrink nor grow, and there is no intensive margin reallocation among them.

Turning attention now to the welfare implications of trade, the expression for the change in industry-j real income remains as in (17). However, since the participation cutoff z_j^n is unaffected by the import liberalization, the last term is absent (i.e., $\hat{z}_j^n = 1$). In this special case, therefore, only the first two effects of trade remain: the economy-wide income effect and the standard import-competition effect.

This section highlights the importance of *differential effects* of import policies on producers in generating reallocation among producers through *differential outcomes*. In particular, in the full model with selection into importing, looser import policy benefits importers and new importers while having no direct impact on non-importers. Combined with the free entry condition, which fixes expected profits to the cost of entry, looser import policy necessitates a redistribution from non-importers to importers, especially new importers.

4. Quantitative framework

In this section, we extend the model in Section 3 into a quantitative framework, used to quantify the welfare effects of the Brazilian import liberalization.

4.1. Framework

We embed a model of import selection in the non-traded sector into an otherwise standard quantitative model of trade. In particular, we now assume that the traded sector is further composed by industries indexed by i. Traded goods can be produced domestically or internationally, and are used for both household consumption and as inputs in the production function. We also allow for selection into importing and exporting in the traded sector as well.

Households. The representative household has Cobb-Douglas preferences with spending shares β_j on non-traded industries $j = 1, ..., J$ and β_i on traded industries $i = 1, ..., I$. Within each industry, the household aggregates differentiated varieties in a CES fashion, with elasticity of substitution $\sigma > 1$ within non-traded industries and $s > 1$ within traded industries. Given the household's total expenditure X, its demand fortraded variety ω is:

$$x_i^T(\omega) = \beta_i X \left(\frac{p_i^T(\omega)}{P_i^T} \right)^{1-s}, \quad P_i^T = \left[\int_{\omega \in \Omega_i^T \cup \Omega_i^{T*}} p_i^T(\omega)^{1-s} \mathrm{d}\omega \right]^{\frac{1}{1-s}}, \tag{20}$$

where P_i^T is the price index in traded industry i and Ω_i^T (Ω_i^{T*}) denotes the set of domestic (foreign) goods. Demand for non-traded varieties is given by (8).

Non-traded industries. Non-traded producers aggregate inputs from different traded industries in a Cobb-Douglas fashion with spending shares η_{ji}. Within each traded industry, we assume a CES production function with elasticity of substitution $s > 1$. Hence, the producer's unit cost of intermediates, which depends on the producer's importing decision, is:

$$P_j^{Td} = \prod_{i \in T} \left[\int_{\omega \in \Omega_i^T} p_i^T(\omega)^{1-s} \mathrm{d}\omega \right]^{\frac{\eta_{ji}}{1-s}} > \prod_{i \in T} \left[\int_{\omega \in \Omega_i^T \cup \Omega_i^{T*}} p_i^T(\omega)^{1-s} \mathrm{d}\omega \right]^{\frac{\eta_{ji}}{1-s}} = P_j^{Tm}. \tag{21}$$

When importing, the non-traded producer expands the set of intermediate goods it uses, lowering unit costs of intermediates and consequently unit costs of production, which are given by (9).

Producing and importing are associated with labor-denominated fixed costs. However, differently from the previous section, we assume that producers are different along two dimensions: their labor productivity z and their fixed importing costs, f_j^m. Total profits of a producer of type (z, f_j^m) is:

$$\Pi_j(z, f_j^m) = \mathbb{1}^d \left[\frac{\beta_j X}{\sigma w f_j^n} \left(\frac{\sigma}{\sigma - 1} \frac{w^{1-\alpha_j} \left(P_j^{Td}\right)^{\alpha_j}}{z P_j^N} \right)^{1-\sigma} \Delta_j^{\mathbb{1}^m} - w f_j^n \right] - \mathbb{1}^m w f_j^m, \tag{22}$$

where $\Delta_j \equiv \left(P_j^{Td} / P_j^{Tm} \right)^{\alpha_j(\sigma-1)} > 1$ is the importer advantage discussed in the previous section. A non-traded producer will import whenever it has high productivity or low importing costs.

Traded industries. We assume that, in each traded industry i, there is a continuum of monopolistically competitive producers, each associated with a unique variety.

5. Conclusion

Brazil's import market was unilaterally liberalized in the early 1990s. Given its unexpected nature, this liberalization episode has been studied extensively to understand how an economy adjusts to import activity. In particular, a recent growing literature has investigated the role of the local labor market in this adjustment, relying on the fact that they were exposed to the policy differently depending on the initial industrial composition of their economic activity.

This study uncovers a new margin of adjustment within the local labor market: the labor reallocation between producers in non-traded industries. These patterns are qualitatively similar to those from traded industries, with large producers in import exposed areas more likely to survive and grow than their smaller equivalents in the same industry. Moreover, we provide reduced-form evidence that importing behavior of large non-traded producers partially explains these patterns. Namely, plants that were already importing before the liberalization were more likely to survive, plants that were in regions more exposed to the shock were more likely to become importers, and these new importers were the producers that grew the most over the sample period. This reorganization, and the importing channel we highlight, suggest a novel implication of importing for industrial productivity and concentration of non-traded industries.

We then propose a model where producers in the non-traded sector select themselves into the import of intermediate inputs. We show that the model is able to qualitatively generate the differential effects across producers of non-traded varieties, with the smallest producers exiting and smallest survivors shrinking. Moreover, survivors that switch importing status are the ones that grow relatively the most in response to an import liberalization. The key feature generating this effect is that only a portion of non-traded producers select into international trade. Differential participation into imports translates into differential exposure to trade shocks. As importing becomes cheaper, larger producers switch their intermediate input usage, becoming even more productive and competing away the demand of low-productivity competitors. The producer size distribution therefore tilts, similarly to in the data, with the smallest producers exiting and the smallest survivors shrinking.

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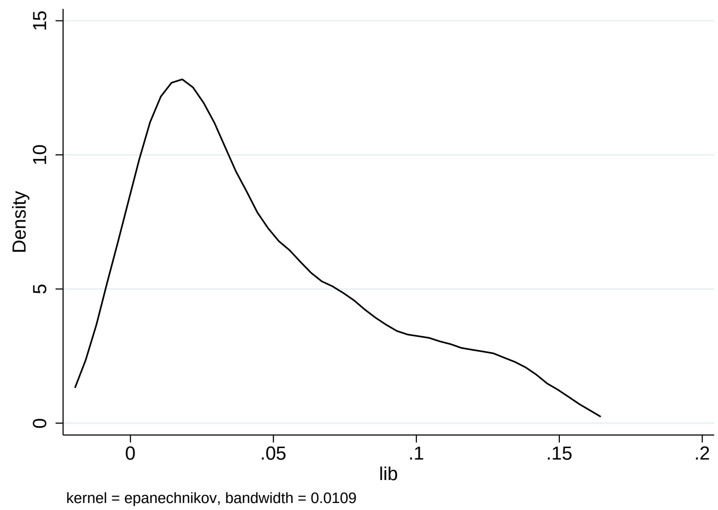
A. Additional tables and figures

This Appendix contains additional figures and tables. Figure A.1 plots the kernel density estimate for the exposure measure across all microregions in the sample. Table A.1 compares the coefficients from $k = 2, ..., 4$ in Equations (4) and (5) with that for $k = 1$. Figure A.2 plots the percentiles of firm size across regions among producers in each quartile of regional size distribution. Figures A.3 and A.4 show the industry-by-industry regression results. Figure 3b shows the breakdown of imports in terms of intermediate inputs, and the share of intermediate inputs that are traded goods.

Figure A.1: Distribution of the effective tariff reduction.



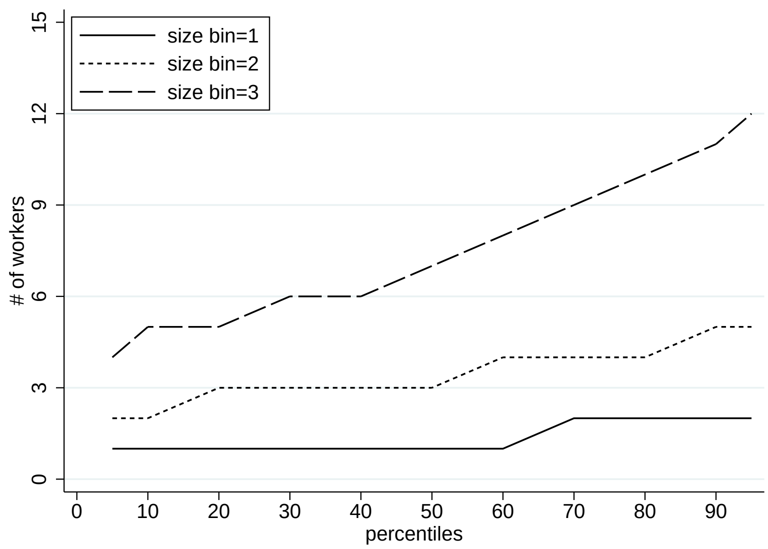
Notes: Kernel density estimate of the effective tariff reduction, lib_r, across microregions in the sample. *Sources:* Kume, Piani, and Souza (2003) and 1991 Census.

Table A.1: The differential effects of the trade liberalization on plants of different size: a statistical comparison with the smallest plants.

	Extensive margin		Intensive margin	
	Non-traded	Traded	Non-traded	Traded
θ	-0.80***	-0.75**	-3.68***	-19.30***
	(0.28)	(0.41)	(1.11)	(4.34)
θ_2	0.62***	0.28	2.43**	4.20
	(0.23)	(0.21)	(0.97)	(2.84)
θ_3	1.06***	0.22	6.51***	4.85*
	(0.33)	(0.23)	(1.23)	(2.68)
θ_4	0.09	0.04	-1.93*	1.32
	(0.21)	(0.27)	(0.99)	(3.07)
N	825194	178787	363200	73082

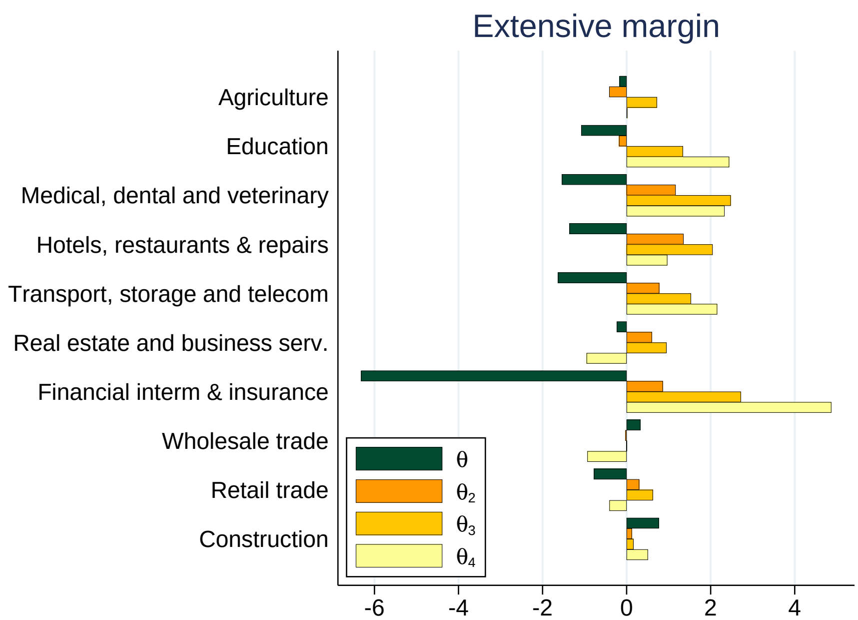
Notes: This displays the estimates for θ and θ_k for $k = 2, ..., 4$ for the following regressions: $\text{Surv}_e = \Phi\left(\alpha_0 + \theta \cdot \text{lib}_{r(e)} + \sum_{k=2}^{4} \theta_k \mathbb{1}_{b(e)=k} \text{lib}_{r(e)} + \beta X_e + \alpha_{s(e)} + \alpha_{j(e)} + \alpha_{b(e)} + \varepsilon_e\right)$ for the extensive margin and $g_e = \alpha_0 + \theta \cdot \text{lib}_{r(e)} + \sum_{k=2}^{4} \theta_k \mathbb{1}_{b(e)=k} \text{lib}_{r(e)} + \beta X_e + \alpha_{s(e)} + \alpha_{j(e)} + \alpha_{b(e)} + \varepsilon_e$ for the intensive margin. θ captures the mean effect of the liberalization on all establishments, wheres θ_k captures the additional effects of the policy on plants in each quartile $k = 2, ..., 4$. We include the same controls as those in Table 3. Standard errors are clustered at the microregion level. ***p<1%, **p<5%, *p<10%. *Sources:* RAIS.

Figure A.2: Plant size across regions, conditional on regional employment quartile.



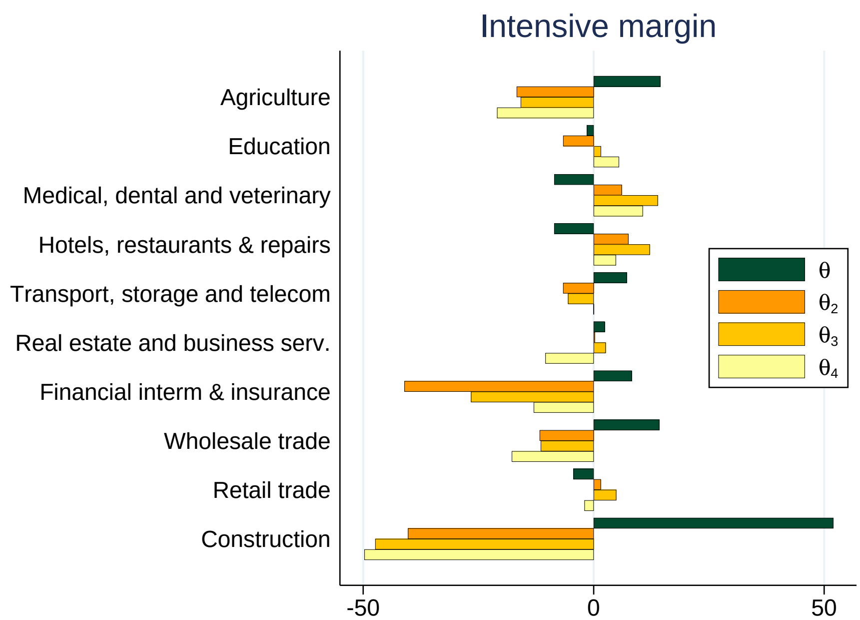
Notes: This figure shows the distribution of establishment size across microregions in Brazil conditional on regional employment quartiles. For example, the straight line shows that 95% of plants in the first quartile of regional size distribution have 2 employees or less. We omit the size distribution across regions for plants in the fourth quartile of regional size to ease visualization.

Figure A.3: Extensive margin reallocation of labor in response to the trade liberalization, by industry.



Notes: This figure displays the estimates for θ and θ_k for $k = 2, ..., 4$ for the following extensive margin regression: $\text{Surv}_e = \Phi\left(\alpha_0 + \theta \cdot \text{lib}_{r(e)} + \sum_{k=2}^{4} \theta_k \mathbb{1}_{b(e)=k} \text{lib}_{r(e)} + \beta X_e + \alpha_{s(e)} + \alpha_{j(e)} + \alpha_{b(e)} + \varepsilon_e\right)$. The control variables are the same as in specification (4). We restrict attention to non-traded industries, the focus of this paper.

Figure A.4: Intensive margin reallocation of labor in response to the trade liberalization, by industry.



Notes: This figure displays the estimates for θ and θ_k for $k = 2, ..., 4$ for the following intensive margin regression: $g_e = \alpha_0 + \theta \cdot \text{lib}_{r(e)} + \sum_{k=2}^{4} \theta_k \mathbb{1}_{b(e)=k} \text{lib}_{r(e)} + \beta X_e + \alpha_{s(e)} + \alpha_{j(e)} + \alpha_{b(e)} + \varepsilon_e$. The control variables are the same as in specification (5). We restrict attention to non-traded industries, the focus of this paper.

B. Mathematical appendix

This Appendix contains all proofs and derivations supporting the statements in Section 3. We omit industry notation j for brevity.

Proposition. *Given the parameters* $\{F_j^m, F_j^n, F_j^e, \sigma, \alpha_j, G_j(z)\}$ *and prices* $\{P_j^{Tm}, P_j^{Td}\}$*, there exists an unique partial equilibrium. That is, there exists unique thresholds,* $\{z_j^m, z_j^n\}$ *that solve the system of equations (ZZ) and (FE).*

Proof. We want to show that there exists an unique solution $\{z^m, z^n\}$ to the system:

$$\frac{F^m}{F^n} = \left(\frac{z^m}{z^n}\right)^{\sigma-1}\left[\left(\frac{P^{Tm}}{P^{Td}}\right)^{\alpha(\sigma-1)} - 1\right] \tag{ZZ}$$

$$\frac{F^e}{F^n} = \int_{z^n}^{\infty}\left\{\left[\frac{z}{z^n}\left(\frac{P^{Tm}}{P^{Td}}\right)^{\mathbb{1}^m(z)\alpha}\right]^{\sigma-1} - 1 - \mathbb{1}^m(z)\frac{F^m}{F^n}\right\}\mathrm{d}G(z) \tag{FE}$$

First, rearrange (ZZ) to find the importing cutoff z_j^m as a function of the production cutoff z_j^n:

$$z^m = \left[\left(\frac{P^{Tm}}{P^{Td}}\right)^{\alpha(\sigma-1)} - 1\right]^{-\frac{1}{\sigma-1}}\left(\frac{F^m}{F^n}\right)^{\frac{1}{\sigma-1}} z^n$$

Second, we rewrite (FE) using the properties of the producer-level importing decision:

$$\frac{F^e}{F^n} = \int_{z^n}^{z^m}\left\{\left(\frac{z}{z^n}\right)^{\sigma-1} - 1\right\}\mathrm{d}G(z) + \int_{z^m}^{\infty}\left\{\left[\frac{z}{z^n}\left(\frac{P^{Tm}}{P^{Td}}\right)^{\alpha}\right]^{\sigma-1} - 1 - \frac{F^m}{F^n}\right\}\mathrm{d}G(z),$$

we then add and subtract $\int_{z^m}^{\infty}\left\{\left(\frac{z}{z^n}\right)^{\sigma-1} - 1\right\}\mathrm{d}G(z)$ and use the relationship in (ZZ) to get:

$$F^e = F^n\int_{z^n}^{\infty}\left\{\left(\frac{z}{z^n}\right)^{\sigma-1} - 1\right\}\mathrm{d}G(z) + F^m\int_{z^m}^{\infty}\left\{\left(\frac{z}{z^m}\right)^{\sigma-1} - 1\right\}\mathrm{d}G(z)$$

Define $\Psi(x) \equiv \int_x^{\infty}\left\{\left(\frac{z}{x}\right)^{\sigma-1} - 1\right\}\mathrm{d}G(z)$, and notice that Ψ is continuous, strictly decreasing, and that $\Psi(0) = \infty$ and $\Psi(\infty) = 0$. Re-write the original system of equations as:

$$z^m = \left[\left(\frac{P^{Tm}}{P^{Td}}\right)^{\alpha(\sigma-1)} - 1\right]^{-\frac{1}{\sigma-1}}\left(\frac{F^m}{F^n}\right)^{\frac{1}{\sigma-1}} z^n$$
$$F^e = F^n\Psi(z^n) + F^m\Psi(z^m)$$

Using the properties of $\Psi(\cdot)$ and the linear relationship between the cutoffs in the top equation, it is easy to see that there exists an unique solution in partial equilibrium. $\square$

Proposition. *An import liberalization, measured by either an increase in P_j^{Tm}/P_j^{Td} or a decrease in F_j^m/F_j^n, increases the participation cutoff z_j^n and decreases the importing cutoff z_j^m.*

Proof. Recall the system of equations that determine the partial equilibrium model:

$$\frac{F^m}{F^n} = \left(\frac{z^m}{z^n}\right)^{\sigma-1}\left[\left(\frac{P^{Tm}}{P^{Td}}\right)^{\alpha(\sigma-1)} - 1\right] \tag{ZZ}$$

$$\frac{F^e}{F^n} = \int_{z^n}^{z^m}\left[\left(\frac{z}{z^n}\right)^{\sigma-1} - 1\right]\mathrm{d}G(z) + \int_{z^m}^{\infty}\left\{\left[\frac{z}{z^n}\left(\frac{P^{Tm}}{P^{Td}}\right)^{\alpha}\right]^{\sigma-1} - 1 - \frac{F^m}{F^n}\right\}\mathrm{d}G(z) \tag{FE}$$

We start with the analysis for a marginal decrease in the relative price of the imported intermediate input: (P^{Tm}/P^{Td}). Differentiate (ZZ) and rearrange to find:

$$\frac{d\ln(z^m/z^n)}{d\ln(P^{Tm}/P^{Td})} = -\alpha\frac{\left(P^{Tm}/P^{Td}\right)^{\alpha(\sigma-1)}}{\left(P^{Tm}/P^{Td}\right)^{\alpha(\sigma-1)} - 1}$$

Differentiate (FE):

$$\begin{aligned}
0 = &-(\sigma-1)d\ln z^n \int_{z^n}^{z^m}(z/z^n)^{\sigma-1}\mathrm{d}G(z) \\
&- \left[\left(\frac{z^m}{z^n}\right)^{\sigma-1}\left[\left(\frac{P^{Tm}}{P^{Td}}\right)^{\alpha(\sigma-1)} - 1\right] - \frac{F^m}{F^n}\right] g(z^m)dz^m \\
&+ (\sigma-1)\left[\alpha d\ln(P^{Tm}/P^{Td}) - d\ln z^n\right]\int_{z^m}^{\infty}(z/z^n)^{\sigma-1}\left(P^{Tm}/P^{Td}\right)^{\alpha(\sigma-1)}\mathrm{d}G(z)
\end{aligned}$$

But notice that the middle part of the right hand side is zero due to (ZZ), so:

$$\begin{aligned}
0 = &\left[\alpha d\ln(P^{Tm}/P^{Td}) - d\ln z^n\right]\int_{z^m}^{\infty}(z/z^n)^{\sigma-1}\left(P^{Tm}/P_j^{Td}\right)^{\alpha(\sigma-1)}\mathrm{d}G(z) \\
&- d\ln z^n \int_{z^n}^{z^m}(z/z^n)^{\sigma-1}\mathrm{d}G(z)
\end{aligned}$$

Divide by $\int_{z^m}^{\infty}(z/z^n)^{\sigma-1}\left(P^{Tm}/P^{Td}\right)^{\alpha(\sigma-1)}\mathrm{d}G(z) + \int_{z^n}^{z^m}(z/z^n)^{\sigma-1}\mathrm{d}G(z)$ and define

$$\theta^m \equiv \frac{\int_{z^m}^{\infty}(z/z^n)^{\sigma-1}\left(P^{Tm}/P^{Td}\right)^{\alpha(\sigma-1)}\mathrm{d}G(z)}{\int_{z^m}^{\infty}(z/z^n)^{\sigma-1}\left(P^{Tm}/P^{Td}\right)^{\alpha(\sigma-1)}\mathrm{d}G(z) + \int_{z^n}^{z^m}(z/z^n)^{\sigma-1}\mathrm{d}G(z)}$$

to find:

$$\frac{d\ln z^n}{d\ln(P^{Tm}/P^{Td})} = \alpha\theta^m > 0 \tag{23}$$

Where $\theta^m \in [0,1]$ is the importers share of wage bill (or, equivalently, employment). Back to (ZZ):

$$\frac{d\ln z^m}{d\ln(P^{Tm}/P^{Td})} = \alpha\left[\theta^m - \frac{\left(P^{Tm}/P^{Td}\right)^{\alpha(\sigma-1)}}{\left(P^{Tm}/P^{Td}\right)^{\alpha(\sigma-1)} - 1}\right]$$

But:

$$\theta^m = \frac{\left(P^{Tm}/P^{Td}\right)^{\alpha(\sigma-1)}}{\left(P^{Tm}/P^{Td}\right)^{\alpha(\sigma-1)} + \frac{\int_{z^n}^{z^m}(z/z^n)^{\sigma-1}\mathrm{d}G(z)}{\int_{z^m}^{\infty}(z/z^n)^{\sigma-1}\mathrm{d}G(z)}} < 1$$

Which implies that:

$$\frac{d\ln z^m}{d\ln(P^{Tm}/P^{Td})} < 0$$

Hence, increasing the relative variable benefits of importing increases the participation cutoff and decreases the importing cutoff.

We now analyze what happens to the (ZZ)-(FE) system when there is a marginal reduction in the importing cost F^m/F^n. As before, log-differentiate (ZZ) to find:

$$\frac{d\ln(z^m/z^n)}{d\ln(F^m/F^n)} = \frac{1}{\sigma-1}$$

Turn to (FE), we have a similar expression as in the relative prices case:

$$\begin{aligned}(F^e/F^n)d\ln(F^e/F^n) = &-(\sigma-1)d\ln z^n\int_{z^n}^{z^m}(z/z^n)^{\sigma-1}\mathrm{d}G(z)\\ &-\left[\left(\frac{z^m}{z^n}\right)^{\sigma-1}\left[\left(\frac{P^{Tm}}{P^{Td}}\right)^{\alpha(\sigma-1)} - 1\right] - \frac{F^m}{F^n}\right]g(z^m)dz^m\\ &+\int_{z^m}^{\infty}\left\{-\left[z/z^n\left(P^{Tm}/P^{Td}\right)^{\alpha}\right]^{\sigma-1}(\sigma-1)d\ln z^n - (F^m/F^n)d\ln\left(F^m/F^n\right)\right\}\mathrm{d}G(z)\end{aligned}$$

But again (ZZ) implies that the middle part of the right hand side is zero. Assuming no change in entry costs, we have:

$$\frac{d\ln z^n}{d\ln\left(F^m/F^n\right)} = -\frac{\left(F^m/F^n\right)\int_{z^m}^{\infty}\mathrm{d}G(z) + (F^e/F^n)\frac{1}{1-\frac{d\ln F^m}{d\ln F^n}}}{\int_{z^n}^{z^m}(z/z^n)^{\sigma-1}\mathrm{d}G(z) + \int_{z^m}^{\infty}\left[z/z^n\left(P^{Tm}/P^{Td}\right)^{\alpha}\right]^{\sigma-1}\mathrm{d}G(z)}\cdot\frac{1}{\sigma-1}$$

But notice that a reduction in (F^m/F^n) means that $d\ln(F^m/F^n) < 0$, which in turn means that $1 - \frac{d\ln F^m}{d\ln F^n} > 0$. Hence, a reduction in relative fixed importing costs increases the participation cutoff:

$$\frac{d\ln z^n}{d\ln\left(F^m/F^n\right)} < 0$$

We now turn to the importing cutoff. For the remaining of the proof, let us assume that there was no change in the fixed production costs F^n. In this case, the change in the participation cutoff can be written as:

$$\frac{d\ln z^n}{d\ln F^m} = -\frac{\left(F^m/F^n\right)\int_{z^m}^{\infty}\mathrm{d}G(z)}{\int_{z^n}^{z^m}\left(z/z^n\right)^{\sigma-1}\mathrm{d}G(z) + \int_{z^m}^{\infty}\left[z/z^n\left(P^{Tm}/P^{Td}\right)^{\alpha}\right]^{\sigma-1}\mathrm{d}G(z)} \cdot \frac{1}{\sigma-1}$$

Substitute the above equation in the derivation after (ZZ) to find:

$$\frac{d\ln z^m}{d\ln F^m} = \frac{1}{\sigma-1}\left[1 - \frac{\left(F^m/F^n\right)\int_{z^m}^{\infty}\mathrm{d}G(z)}{\int_{z^n}^{z^m}\left(z/z^n\right)^{\sigma-1}\mathrm{d}G(z) + \int_{z^m}^{\infty}\left[z/z^n\left(P^{Tm}/P^{Td}\right)^{\alpha}\right]^{\sigma-1}\mathrm{d}G(z)}\right]$$

But the term inside brackets is positive due to (ZZ). To see that, notice that we can add and subtract $\int_{z^m}^{\infty}(z/z^n)^{\sigma-1}\mathrm{d}G(z)$ from the denominator and use (ZZ) to find:

$$\begin{aligned}&\int_{z^n}^{z^m}\left(z/z^n\right)^{\sigma-1}\mathrm{d}G(z) + \int_{z^m}^{\infty}\left[z/z^n\left(P^{Tm}/P^{Td}\right)^{\alpha}\right]^{\sigma-1}\mathrm{d}G(z) = \\ &\int_{z^n}^{\infty}\left(z/z^n\right)^{\sigma-1}\mathrm{d}G(z) + \left(F^m/F^n\right)\int_{z^m}^{\infty}\left(z/z^m\right)^{\sigma-1}\mathrm{d}G(z)\end{aligned}$$

So, we have:

$$\frac{d\ln z^m}{d\ln F^m} = \frac{1}{\sigma-1}\left[1 - \underbrace{\frac{\left(F^m/F^n\right)\int_{z^m}^{\infty}\mathrm{d}G(z)}{\int_{z^n}^{\infty}\left(z/z^n\right)^{\sigma-1}\mathrm{d}G(z) + \left(F^m/F^n\right)\int_{z^m}^{\infty}\left(z/z^m\right)^{\sigma-1}\mathrm{d}G(z)}}_{<1}\right] > 0$$

So, as the importing fixed cost falls, the import threshold also falls. □

Proposition. *Total labor demand of a producer of productivity $z \leq z^m$ equals:*

$$LD(z) = (1-\alpha)(\sigma-1)f^n\left(\frac{z}{z^n}\right)^{\sigma-1} + f^n$$

and the total labor demand of an importer with productivity $z > z^m$ reads:

$$LD(z) = (1-\alpha)(\sigma-1)f^n \left[\frac{z}{z^n} \left(\frac{P^{Td}}{P^{Tm}} \right)^{\alpha} \right]^{\sigma-1} + f^n + f^m$$

Proof. We first look at an establishment that sources intermediate inputs domestically ("a domestic producer"). A domestic producer maximizes variable profits:

$$\pi^d(z) = \max_{p,q,m,l} \left\{ pq - \frac{w^{1-\alpha}(P^{Td})^{\alpha}}{z} q \right\}$$
$$\text{s.t.} \quad pq = \beta X \left(\frac{p}{P^N} \right)^{1-\sigma}$$

Where the marginal cost of production stems directly from the Cobb-Douglas assumption on the production function and the solution to the cost-minimization problem. The establishment will set its price as a markup over marginal cost of production:

$$p(z) = \frac{\sigma}{\sigma-1} \frac{w^{1-\alpha}(P^{Td})^{\alpha}}{z} \quad \Rightarrow \quad r^d(z) = \beta X \left(\frac{\sigma}{\sigma-1} \frac{w^{1-\alpha}(P^{Td})^{\alpha}}{P^N z} \right)^{1-\sigma}$$

where r^d denotes the revenue of that producer. We also know that, precisely because of the Cobb-Douglas assumption, the total variable labor costs a plant has ($LC(z)$) is:

$$LC(z) = (1-\alpha) \frac{\sigma-1}{\sigma} r^d(z)$$

As in Melitz (2003), variable profits directly relate to revenues: $\pi^d = r^d(z)/\sigma$, so the participation threshold can be found as:

$$z^n : \quad r^d(z^n) = \beta X \left(\frac{\sigma}{\sigma-1} \frac{w^{1-\alpha}(P^{Td})^{\alpha}}{P z^n} \right)^{1-\sigma} = \sigma F^n$$

Divide and multiply by z^n and use the above equation to write the revenue of a domestic producer as:

$$r^d(z) = \sigma F^n \left(\frac{z^n}{z} \right)^{1-\sigma}$$

Hence, variable labor costs read:

$$LC(z) = (1-\alpha)(\sigma-1)F^n \left(\frac{z}{z^n} \right)^{\sigma-1}$$

Assume that $F^n = wf^n$, include fixed costs, and divide through by the wage rate w to derive the total labor demand for a domestic establishment:

$$LD(z) = (1-\alpha)(1-\sigma)f^n \left(\frac{z}{z^n}\right)^{sigma-1} + f^n$$

We now turn to importing establishments. An importing establishment has revenues:

$$\begin{aligned} r^m(z) &= \beta X \left(\frac{\sigma}{\sigma-1}\frac{w^{1-\alpha}(P^{Tm})^{\alpha}}{P^N z}\right)^{1-\sigma} \\ &= \beta X \left(\frac{\sigma}{\sigma-1}\frac{w^{1-\alpha}(P^{Td})^{\alpha}}{P^N z^n}\right)^{1-\sigma} \left[\frac{z^n}{z}\left(\frac{P^{Tm}}{P^{Td}}\right)^{\alpha}\right]^{1-\sigma} \\ &= \sigma F^n \left[\frac{z}{z^n}\left(\frac{P^{Td}}{P^{Tm}}\right)^{\alpha}\right]^{\sigma-1} \end{aligned}$$

where the second equality rearranges the first, and the second uses the participation cutoff equaiton. Hence, variable labor costs of an importer read:

$$LC(z) = (1-\alpha)(\sigma-1)F^n \left[\frac{z}{z^n}\left(\frac{P^{Td}}{P^{Tm}}\right)^{\alpha}\right]^{\sigma-1}$$

Where, assuming $F^m = wf^m$, yields the corresponding total labor demand:

$$LD(z) = (1-\alpha)(\sigma-1)f^n \left[\frac{z}{z^n}\left(\frac{P^{Td}}{P^{Tm}}\right)^{\alpha}\right]^{\sigma-1} + f^n + f^m$$

□

Proposition. *Labor demand of an importer with productivity z increases with (P^{Td}/P^{Tm}).*

Proof. The labor demand of an incumbent importer with productivity z is:

$$LD^m(z) = (1-\alpha)(\sigma-1)f^n \left[\frac{z}{z^n}\left(\frac{P^{Td}}{P^{Tm}}\right)^{\alpha}\right]^{\sigma-1} + f^n + f^m$$

Suppose fixed costs are constant, then, given the efficienty z, effect of (P^{Td}/P^{Tm}) on FD will depend on whether the term $T \equiv (1/z^n)(P^{Td}/P^{Tm})^{\alpha}$ increases or decreases as relative prices change. Log-differentiate T to find:

$$\frac{d\ln T}{d\ln(P^{Td}/P^{Tm})} = \alpha - \frac{d\ln z^n}{d\ln(P^{Td}/P^{Tm})} = \alpha(1-\theta^m) > 0$$

where the last equality comes from using Equation (23). The above equation shows that, for a given z and fixed costs, labor demand of incumbent importers increases as the relative price of imported input falls. $\square$

C. Structural shock analysis

We extend the model in Section 3 to general equilibrium to derive a model-based regional measure for import liberalization exposure in the non-traded sector. This measure considers input-output linkages, producer-level selection into imports, and the labor allocation across non-traded industries. We then redo the empirical exercises in Section 2 and find similar reallocation patterns and evidence on the importing channel.

The model. We assume there are $i = 1, ..., I$ traded industries. Domestic producers in the traded sector operate under perfect competition, have a linear production function, and transform one unit of labor into a_i units of output at the marginal cost of w. We assume that domestic non-traded producers aggregate intermediate inputs across traded industries in a Cobb-Douglas fashion, so the unit price of domestic and imported inputs are:

$$P_j^{Td} = \prod_{i \in T} \left(\frac{w}{a_i} \right)^{\eta_{ij}}, \quad \text{and} \quad P_j^{Tm} = \prod_{i \in T} (p_i^*)^{\eta_{ij}},$$

where p_i^* is the price of the imported input, which we take as given. We maintain the assumption that $P_j^{Tm} < P_j^{Td}$ to match the empirically relevant case that some non-traded producers become importers. The η_{ij} coefficients represent the share of non-traded industry j's total spending on materials that goes to traded industry i. These parameters summarize the input-output linkages between non-traded and traded industries.

In this economy, labor is demanded for the production of non-traded goods, through variable and fixed costs, and for production in the traded sector. The equilibrium conditions are the following:

$$D = \sum_{j \in NT} \alpha_j \frac{\sigma_j - 1}{\sigma_j} \beta_j (1 - \delta_j)(wL + D), \tag{Imports}$$

$$\delta_j = \frac{\int_{z_j^n}^{z_j^m} z^{\sigma_j - 1} dG_j(z)}{\int_{z_j^n}^{z_j^m} z^{\sigma_j - 1} dG_j(z) + \left(P_j^{Td} / P_j^{Tm} \right)^{\alpha_j(\sigma_j - 1)} \int_{z_j^m}^{\infty} z^{\sigma_j - 1} dG_j(z)}, \tag{Domestic share}$$

$$\frac{F_j^m}{F_j^n} = \left(\frac{z_j^m}{z_j^n} \right)^{\sigma - 1} \left[\left(\frac{P_j^{Tm}}{P_j^{Td}} \right)^{\alpha_j(\sigma - 1)} - 1 \right], \tag{ZZ}$$

$$\frac{F_j^e}{F_j^n} = \int_{z_j^n}^{\infty} \left\{ \left[\frac{z}{z_j^n} \left(\frac{P_j^{Tm}}{P_j^{Td}} \right)^{\mathbb{1}_j^m(z) \alpha_j} \right]^{\sigma - 1} - 1 - \mathbb{1}_j^m(z) \frac{F_j^m}{F_j^n} \right\} \mathrm{d}G_j(z), \tag{FE}$$

$$P_j^{Td}/P_j^{Tm} = w \cdot \prod_{i \in T} (a_i p_i^*)^{-\eta_{ij}}. \qquad \text{(Perfect competition)}$$

The first expression equates total imports to an exogenous deficit D. The second equation pins down the share of workers in non-traded industry j that are employed by domestic producers, i.e., producers that do not import. (ZZ) and (FE) describe the import selection patterns discussed in Section 3. The last equation relates traded goods prices at home and abroad to fundamentals and the domestic wage rate.

Counterfactual analysis. We study how the equilibrium wage changes when we shock the prices of foreign inputs, p_i^*. In what follows, we assume that the productivity distribution in all non-traded industries are the same: $G_j \sim \text{Pareto}(\theta)$. The effect of an import liberalization on regional wages is:[24]

$$d \ln w = \sum_{j \in NT} \underbrace{\frac{\frac{\alpha_j}{1-\alpha_j} \alpha_j \delta_j (1-\delta_j) s_j^{wb}}{\sum_{k \in NT} \frac{\alpha_k}{1-\alpha_k} \alpha_k \delta_k (1-\delta_k) s_k^{wb}}}_{\text{regional weights}} \underbrace{\sum_{i \in T} \eta_{ij} \cdot d \ln p_i^*}_{\text{effective tariff reduction}} \tag{24}$$

The above equation captures the effects of import tariff cuts on the labor market through input-output linkages, import behavior, and the labor allocation in the non-traded sector. It considers how international prices directly affect each non-traded industry through input-output shares: η_{ij}. It depends positively on non-traded industry j's share of wage bill in region r: s_{jr}^{wb}. It increases with the Cobb-Douglas share coefficient for intermediaries, α_j. Lastly, it has an inverse-U relationship with the regional share of importers in non-traded industry j: $\delta_{jr}(1-\delta_{jr})$. This inverse-U relationship directly speaks to the importance of *differential* importing decision across producers in a given industry-region.

Empirical analysis. To map the structural shock to the data, we assume that $d \ln p_i^*$ equals the observed industrial tariff cuts in Brazil. Hence, all components on the right hand side of (24) have direct data counterparts. We obtain the materials share relative to labor, α, directly from National Accounts. We calculate the share of employment in non-importers relative to importers, δ_j, and the regional distribution of wage bill, s_j^{wb}, directly from RAIS. We use the Brazilian Input-Output table to calculate the share of materials in each traded industry, η_{ij}. Lastly, we obtain the tariff changes for each industry from Kume, Piani, and Souza (2003).

We then revisit the regression analyses in Section 2, but with the following regional

[24]We obtain this formula by log-differentiating the equilibrium conditions and solving for the change in log wages as a function of changes in log international prices. Details on this derivation are available upon request.

Table C.1: The differential effects of the trade liberalization on plants of different size: a model-based measure of exposure

	Extensive margin		Intensive margin	
	lib_r	exposure_r	lib_r	exposure_r
θ	-0.80***	-0.30	-3.68***	-1.19*
	(0.28)	(0.19)	(1.11)	(0.68)
θ_2	0.62***	0.43*	2.43**	1.38
	(0.23)	(0.22)	(0.97)	(0.88)
θ_3	1.06***	0.70**	6.51***	3.83***
	(0.33)	(0.33)	(1.23)	(0.91)
θ_4	0.09	0.03	-1.93*	-1.88**
	(0.21)	(0.18)	(0.99)	(0.88)
N	825194		363200	

Notes: This displays the estimates for θ and θ_k for $k = 2, ..., 4$ for the following regressions: $\text{Surv}_e = \Phi\left(\alpha_0 + \theta Z_r + \sum_{k=2}^{4} \theta_k \mathbb{1}_{b(e)=k} Z_r + \beta X_e + \alpha_{s(e)} + \alpha_{j(e)} + \alpha_{b(e)} + \varepsilon_e\right)$ for the extensive margin and $g_e = \alpha_0 + \theta Z_r + \sum_{k=2}^{4} \theta_k \mathbb{1}_{b(e)=k} Z_r + \beta X_e + \alpha_{s(e)} + \alpha_{j(e)} + \alpha_{b(e)} + \varepsilon_e$ for the intensive margin for two different liberalization measures: $Z_r = \{\text{lib}_r, \text{exposure}_r\}$. θ captures the mean effect of the liberalization on all establishments, wheres θ_k captures the additional effects of the policy on plants in each quartile $k = 2, ..., 4$. We include the same controls as those in Table 3. Standard errors are clustered at the microregion level. ***p<1%, **p<5%, *p<10%. *Sources:* RAIS.

exposure measure:

$$\text{exposure}_r = \sum_{j \in NT} \frac{\frac{\alpha_j}{1-\alpha_j} \alpha_j \delta_{jr} (1 - \delta_{jr}) s_{jr}^{wb}}{\sum_{k \in NT} \frac{\alpha_k}{1-\alpha_k} \alpha_k \delta_{kr} (1 - \delta_{kr}) s_{kr}^{wb}} \sum_{i \in T} \eta_{ij} \cdot d \ln(1 + \tau_i).$$

Table C.1 confirms that labor in the non-traded sector was reallocated, in response to the liberalization, towards larger producers in the middle of the initial size distribution. At the same time, Table C.2 reinforces that non-traded producers in more exposed labor markets were more likely to become importers in the post-liberalization period. Coupled with the evidence on selection into imports from tables 4 and 5, these suggest selection into imports as a mechanism explaining the reallocation of labor at the local labor market level.

Table C.2: The effects of the trade liberalization on plants importing decision: a model-based measure for exposure.

NewImp	(1)	(2)	(3)
θ	0.048***	0.045***	0.013**
	(0.001)	(0.007)	(0.005)
Industry and LM FEs	✓	✓	✓
Size bins		✓	✓
Plant controls			✓
N	363199	363199	363199

Notes: Each column displays the θ-coefficient for a different specification of (6) replacing lib_r for the model-based exposure measure exposure_r. Column (1) controls for industry and microregion fixed effects. Column (2) additionally controls for the initial size bin of a plant, measured by its number of employees. Column (3) includes the full set of controls discussed in Table 5. We restrict attention to plants that survived throughout the sample period. Standard errors in parentheses are clustered at the microregion level. ***p<1%, **p<5%, *p<10%. *Sources:* RAIS and the Brazilian Ministry of Economy.