The gendered labor market impacts of trade liberalization: evidence from Brazil*

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Abstract

This paper investigates the impact of Brazil's trade liberalization on gender differences in labor market outcomes. To identify the causal effect of trade reforms we use difference-in-difference estimation exploiting variation across microregions in pre-liberalization industry composition. We find that trade liberalization reduced male and female labor force participation and employment rates, by reducing tradable sector employment rates, particularly among the low-skilled population. As the effects on men are larger, liberalization contributed to a reduction in the percentage point gender gap in employment and participation rates. However, as men and women were equally affected in proportionate terms, women's employment and participation did not increase relative to men's, and we find no evidence that women benefitted from the pro-competitive effects of free trade.

JEL Classification: F13, F16, J16, J21, O15

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1. Introduction

Women's rising economic activity is an ongoing phenomenon across advanced and many developing countries, particularly in Latin America. At the same time, men's labor force participation, which has traditionally been much higher than female labor force participation, is declining in all regions of the world, further contributing to a convergence of male and female labor force participation rates in almost every region. Over the past three decades, gender convergence in labor force participation occurred against the backdrop of globalization, one of its most notable features being rapid trade liberalization and the increasing integration of world product markets. The sharp decline in international tariff barriers in developing countries since the 1980s has motivated a rich literature to analyze the distributional impacts of trade reforms, typically across the income or skill distribution (see Goldberg and Pavcnik 2007 for an overview). However, so far there is only very limited empirical evidence on the gender-specific effects of trade liberalization in developing countries. This is the focus of the present paper, which investigates the impact of Brazil's trade liberalization in the early 1990s on gender-specific labor force participation rates and other labor market outcomes.

Recent empirical work at the cross-country level on the gendered effects of globalization and trade has been inconclusive. Some authors have analyzed the empirical relationship between trade flows and female labor force participation across countries (e.g. Wood 1991; Bussman 2009; Wacker et al. 2015). These studies often find heterogeneous effects of trade on women's economic activity, contingent on the country's income level and economic structure and the time period considered. However, these analyses also face significant methodological challenges – particularly regarding the quality and international comparability of labor force data, and the difficulty to establish causality in a cross-country framework, where trade flows may be correlated with other factors determining female economic activity. Using micro data from household, labor force and establishment surveys, several studies have documented a positive association between export-orientation and female employment at the establishment level (e.g. Ozler 2000; Ederington et al. 2009; Aguayo-Tellez et al. 2013). But based on simple OLS regressions, these studies also lack a meaningful causal interpretation. An exception is the recent paper by Juhn et al. (2014), who show that new export opportunities in Mexican manufacturing reduced gender inequality in blue-collar manufacturing jobs, through technology upgrading by exporting firms.

While studies based on micro data provide more scope for uncovering the mechanisms through which trade affects gender inequality, they are typically confined to the formal

manufacturing sector, focusing on impacts within industries or firms directly affected by trade reforms. This paper, instead, presents empirical evidence on the economy-wide labor market impacts of trade liberalization, analyzing Brazil's trade reforms in the 1990s. Studying impacts beyond the formal manufacturing sector is important, we believe, to better understand how aggregate outcomes such as labor force participation rates are affected. Furthermore, previous research on Brazil has demonstrated that trade liberalization led to labor reallocation across industries (Ferreira et al. 2010), and in particular out of formal manufacturing, into informal jobs, the non-tradable sector, unemployment or inactivity (Meñezes-Filho and Muendler 2011, Dix-Carneiro and Kovak 2014). This means an analysis of the formal manufacturing sector can only draw a very partial picture of the impacts of trade liberalization.

To analyze the local economy-wide impacts across all sectors we use a local labor market approach pioneered by Topalova (2007), which exploits variation across microregions in exposure to tariff reductions that stems from differences in microregions' pre-liberalization industry composition. By comparing the change in trade protection across microregions we can identify the relative impact of trade liberalization on men's and women's labor market outcomes, whilst controlling for secular trends and time-invariant regional unobservable factors. The strategy we use in this paper has been previously applied to estimate the impact of trade policy changes on poverty, child labor, human capital, and unemployment in India, Vietnam, and Indonesia (Topalova 2007, 2010; Edmonds et al. 2010; McCaig 2011; Kis-Katos and Sparrow 2011 and 2015; Hasan et al., 2012) and inequality and regional wages in Brazil (Castilho et al. 2012; Kovak 2013). However, this is to our knowledge its first application to estimate the impact of trade reforms on gender-specific labor market outcomes.

A second contribution of the paper is that we not only estimate the effect of trade liberalization on female labor force participation and employment, but examine labor market outcomes for both men and women, and disaggregate outcomes by education level. We are thus able to draw a complete picture of the gender-specific local labor market impacts of Brazil's trade liberalization. We thereby contribute to the empirical literature on trade and female labor force participation discussed above, as well as to the broader literature on the distributional effects of trade liberalization (e.g. Goldberg and Pavcnik 2007; Topalova 2010).

We should emphasize from the outset that we analyze medium- to long-term differences in outcomes (over a nine-year period). Liberalization-induced opportunities and incentives can cause equalizing cross-regional migration, dampening the immediate regional labor market effects of the reforms. This is important to keep in mind when interpreting the results.

Focusing on the medium- to long-term effects of trade liberalization also has advantages, however. Our approach is essentially a two-period difference-in-difference estimation, which means we do not face problems due to serial correlation in our outcome and independent variables, while the large number of microregions gives enough power to detect the impacts of liberalization (see Bertrand et al. 2004).

Our results show that microregions more exposed to trade liberalization experienced faster reductions (or slower growth) in labor force participation and employment rates of men as well as women, with most if the impacts concentrated in the tradable sector and among the low-skilled population. Because the effects on men are larger than on women, liberalization contributed to a reduction in the low-skilled gender gap in employment and participation rates in absolute terms (i.e. in percentage points). The larger impact on men, however, largely reflects their larger share in initial tradable sector and total employment. In proportionate terms, male and female tradable sector and aggregate employment rates are affected similarly. This suggests that pro-competitive effects of trade liberalization did not improve the relative position of women in the labor market. Our results are in line with persistent segmentation of male and female workers, as also recently analyzed by Borrowman and Klasen (2015), which may be due to complementarity of male and female workers or due to persistent social norms and differences in preferences.

This paper is structured as follows. Section 2 briefly discusses related theoretical and empirical literature. Section 3 describes the data sources used in this study, presents a short narrative of the Brazilian trade liberalization and shows descriptive trends in men's and women's labor market outcomes. Section 4 describes our trade protection measure and the empirical framework. Estimation results and robustness checks are discussed in section 5. Section 6 concludes.

2. Theory and Existing Empirical Evidence

Trade liberalization can influence gender differences in labor market outcomes through three main channels.[1] The first two channels are related to the so-called pro-competitive effects of trade. First, increased competition induced by trade liberalization should reduce the scope for taste-based discrimination, a potentially important source of gender inequality in employment and wages (Becker, 1957). Black and Brainerd (2004) provide empirical evidence supporting this channel using data for US manufacturing industries in the 1980s.[2] A

[1] The focus lies here on demand-side effects; labor supply might also be directly affected via income effects.
[2] Ederington et al. (2009) find supporting evidence for Colombian manufacturing firms, exploiting import tariff reductions between 1984 and 1991.

related effect of increased competition is that employers may seek more flexible, irregular, part-time workers and favor young women's "youthful diligence" in semi-skilled and low-paid assembly jobs (Standing, 1989).

Second, increased competition (but also access to imported inputs and improved export opportunities) can induce technical change.[3] If technical change is skill-biased (Acemoglu 2003; Thoenig and Verdier 2003) and men and women differ in terms of their education levels, this may have an effect on gender inequality. In a similar vein, technical change can be gender-biased due to male-female differences in endowments of brain versus brawn (see e.g. Galor and Weil 1996; Weinberg 2000; Juhn et al. 2014). Analyzing tariff reductions associated with NAFTA, Juhn et al. (2014) show that liberalization-induced technical change reduced gender gaps in wages and employment of blue-collar workers in Mexican exporting firms, because these firms adopted new technologies that would have reduced the physical strength required in blue-collar occupations. Similar to the discrimination channel, these impacts will be most salient within (exporting) firms in industries directly affected by trade liberalization, and may have limited general equilibrium effects in the local labor market.

A third channel is the sectoral reallocation of labor, given factor-intensity differences between sectors. Standard Heckscher-Ohlin trade theory predicts that trade liberalization induces a structural change in production and reallocation of factors from import-competing to exporting (comparative advantage) sectors. Reallocation of production factors has gender implications if male and female workers are imperfect substitutes, as in the models of Galor and Weil (1996), Sauré and Zoabi (2009), and Do et al. (2014). Yet even if male and female labor are perfectly substitutable, sectoral reallocation may have gender implications if there is persistent sectoral segregation of male and female workers. Goldin (1995) argues that society often stigmatizes female industrial workers, especially if they work in heavy industries. Similarly, gender differences in social and competitive preferences (Croson and Gneezy 2009) or in care-giving responsibilities (Becker 1985) can lead to a situation where female workers are concentrated in particular sectors. It has indeed been widely observed that in virtually all countries women are clustered in particular occupations and sectors of the economy (Anker et al. 2003; World Bank 2011), and that there is remarkably little change in segregation as countries grow richer or engage in exporting (Borrowman and Klasen, 2015). Given this type of gender segregation, or imperfect substitutability, trade liberalization is

[3] See Topalova and Khandelwal (2011) for evidence from Indian manufacturing.

expected to improve women's labor market outcomes relative to men's if a country has a comparative advantage in relatively female-intensive sectors, and vice versa.[4]

Few studies have explored the gender effects of trade-induced labor reallocation empirically, and the empirical evidence on sectoral labor reallocation in response to trade liberalization is mixed.[5] Yet previous studies for Brazil demonstrate that trade liberalization has been associated with significant employment flows across sectors. Ferreira et al. (2010), for example, show that the main impact of liberalization on income inequality was through employment shifts across industries and formality status. However, the nature of labor reallocations following Brazil's liberalization does not correspond to neoclassical trade theory. Using matched employer-employee panel data for the formal sector, Meñezes-Filho and Muendler (2011) find that trade liberalization led to employment shifts out of formal manufacturing with neither exporting firms nor comparative advantage industries absorbing displaced workers. Displaced workers instead ended up in informal manufacturing, the non-tradable sector, unemployment or inactivity. Similar findings are presented in Dix-Carneiro and Kovak (2014), who additionally show that the liberalization-induced reduction in labor demand persisted for more than a decade. These patters are in line with McMillan and Rodrik (2011), who show that in the period 1990-2005, employment expanded most rapidly in relatively unproductive non-tradable sectors.

What implications can this have for gender-specific labor market outcomes? Rather than the female-intensity of comparative advantage sectors, the difference between the tradable and non-tradable sector is more relevant in the Brazilian case. Women in Brazil – as in most other countries – are disproportionately represented in the non-tradable sectors. It is thus likely that liberalization-induced displacement of workers from the tradable sector mostly affected men, though the direction of the overall impact is not clear a priori. If sectoral segregation of men and women is persistent, we expect liberalization to have a stronger impact on men compared to women: workers are displaced mainly from the male-intensive tradable sector, and successful reallocation to the female-intensive non-tradable sector would be relatively easier for women. Men would thus be more likely to end up unemployed or inactive. This way, liberalization contributes to feminization of Brazil's workforce - albeit in a rather negative way. On the other hand, if segregation is not as persistent, displaced men may

[4] This is the prediction Do et al. (2014) derive in a specific-factors model. Sauré and Zoabi (2011) arrive at the exact opposite conclusion, in a model with capital-skill complementarity: as men move into female-intensive exporting sectors, the capital-labor ratio declines and this increases the gender wage gap.

[5] Aguayo-Tellez et al. (2013) show descriptively that in Mexico, 40 percent of the growth in women's wage bill share between 1990 and 2000 – when NAFTA came into effect – could be accounted for by employment growth in female-intensive sectors. Most studies find little evidence of a substantial reallocation of labor across sectors after trade reforms: see Goldberg and Pavcnik (2007) and Wacziarg and Wallack (2004).

also easily reallocate to the non-tradable sector and could even crowd out women in traditionally female-intensive activities.

Uncovering the gendered labor market impact of trade liberalization when workers move from tradable to non-tradable activities, or from work to inactivity and unemployment, requires analysis beyond the tradable sector. A number of studies have analyzed the economy-wide relationship between trade and female economic activity on the basis of cross-country data, mostly focusing on trade flows, rather than trade policy changes. This literature (e.g. Bussman 2009; Wacker et al. 2015) suggests that aggregate analyses hide significant heterogeneity across countries, age cohorts and time spells, which is consistent with the notion that the effects of trade liberalization on women's labor market outcomes depend on the pattern of structural change and other country-specific factors.[6] This highlights the need for micro-oriented analyses to better understand the various factors at work in the context of a specific country, yet focusing on impacts beyond the exporting firm or tradable industries. To the best of our knowledge, we are the first to apply this type of analysis to the link between trade and gender-specific labor market outcomes. We furthermore consider female as well as male labor market outcomes, to be able to directly compare the impacts of trade liberalization between men and women. Before describing our empirical approach in detail, we now turn to a description of Brazil's trade liberalization and labor market developments in the 1990s.

3. Data and Descriptive Evidence

3.1 Data Sources

The data for the analysis are drawn from two different data sources. First, we use the Demographic Census for 1991 and 2000, fielded by the Brazilian Census Bureau (Instituto Brasileiro de Geografia e Estatística, IBGE). The census includes a labor market module that collects data on employment status, industry, informality, and wages, for all individuals aged 10 years or above. Our measure of employment includes paid and unpaid work, formal as well as informal. In all of our analyses we focus on the population age 25 to 55.

Our second data source consists of data on nominal tariffs and effective rates of protection by industry based on Kume et al. (2003) and tabulated in Abreu (2004) for the period 1987 to 1998. Compared to nominal tariffs, the effective rate of protection considers both tariffs on output products and imported intermediate goods and is thus a better measure of sectoral protection induced by the overall tariff structure (see Goldberg and Pavcnik 2007 for a discussion). However, nominal tariffs are the most commonly used indicator to measure

[6] See also Gaddis and Klasen (2014) and Klasen and Pieters (2015) on the effects of sectoral growth on female labor force participation.

changes in trade policy (Kovak 2013; Kis-Katos and Sparrow 2011; Topalova 2007). We therefore use nominal tariffs as our main indicator of trade policy, but test whether our results hold when using the effective rate of protection instead. We use concordance tables developed by Ferreira et al. (2010) to match the census activity codes with the tariff data.

3.2 The Brazilian Trade Liberalization

Until the late 1980s, Brazil was one of the most heavily protected economies in the world. Despite the fact that the country was among the founding members of the General Agreement on Trade and Tariffs (GATT) in 1947, it made extensive use of GATT article XVIII:B, which allowed developing countries to impose trade restrictions to address balance of payment difficulties (Abreu 2004). In 1987, just before the onset of trade liberalization, average nominal tariffs stood at 54.9 percent, with significant variations between industries. Apparel, automobiles, and textiles were the most heavily protected sectors, with tariffs between 87 and 102 percent. The lowest tariffs were between 15 and 25 percent, for oil, gas and coal; mining products; and chemicals. Due to the structure of tariffs, effective rates of protection showed even greater dispersion – varying between 308.1 percent in the automobile sector and just 8.3 percent for oil, gas and coal (Abreu 2004).

In the late 1980s, after the transition from military rule to a civilian government, Brazil embarked on an ambitious liberal reform agenda, whose central elements were a comprehensive trade liberalization program and macroeconomic stabilization to curb inflation. Between 1987 and 1994 average nominal tariffs were unilaterally lowered from 54.9 to 10.5 percent and most non-tariff trade barriers were lifted. Because binding non-tariff barriers were not abolished until 1990, tariff reductions became effective only from 1990 onwards, whereas the tariff cuts before 1990 effectively served to eliminate tariff redundancy (see Carvalho 1992 for Brazil; see Goldberg and Pavcnik 2007 for a more general discussion).

Figure A1 documents tariff levels between 1987 and 1999 for 20 industries and shows that, besides tariff levels, tariff dispersion across industries was reduced as well. After 1994, the Brazilian government partially slid back on trade reforms, particularly in the automobile sector, where tariffs rebound from 18.7 percent in 1994 to 32.9 percent in 1997. Across industries, the average tariff increased from 10.5 percent in 1994 to 14.8 percent in 1997, after which tariff levels remain stable. Given this pattern and the fact that non-tariff barriers were binding until 1990, we use tariff changes between 1990 and 1998 in our analysis.[7]

[7] We do test for the robustness of our results using tariff changes between 1990 and 1995, as in Kovak (2013).

The Brazilian trade reforms of the late 1980s and 1990s did not include special or new incentives for export promotion. On the contrary, the mounting public deficit had already forced the Brazilian administration to abolish several exports subsidy schemes in the mid-1980s, prior to import tariff liberalization reforms (GATT 1993a, b; Pereira 2006). To illustrate the competitive impact of the tariff reductions, Figure A3 in the appendix shows 1990-1998 tariff cuts and changes in import penetration and export shares at the industry level. Tariff reductions are clearly associated with increased import penetration (the correlation coefficient equals -0.66), while there is a small negative correlation with exports (-0.24).

Brazil's move to a more liberal trade policy stance was triggered by a series of external and internal events. Even though trade reforms were implemented unilaterally, they were embedded in multilateral trade negotiations under the Uruguay Round (Castilho et al. 2012). Trade policy changes were also designed to have tariff levels converge towards the Mercosur Common External Tariff (CET), which came into effect with the establishment of Mercosur customs union in January 1995 (Abreu 2004). Yet the fundamental reversal in trade policy also had deeper causes. After the experiences of the 1970s oil crises as well as macroeconomic and debt crises in many Latin American economies during the 1980s, elites in Brazil, as in other countries in the region, felt disaffected with the protectionist import-substitution policies of the past. As described in Abreu (2004) and Kovak (2013) trade liberalization became an explicit objective of the Brazilian government, which also managed to curb protectionist interests. The implications of this for the present analysis are that tariff reductions during the early 1990s can be considered reasonably exogenous to industry performance and labor market outcomes, which is an important element of the identification strategy in this paper. Although the exogeneity of trade policy changes to private sector interests is difficult to test formally, the pattern and magnitude of tariff reductions over this phase of trade liberalization is consistent with the stated policy objective of systematically reducing the level and spread of import tariffs. Figure A2 in the appendix plots the reduction in tariffs between 1990 and 1998 against the initial (1990) level for 20 industries, illustrating that tariff cuts are strongly predicted by the initial levels in tariffs.

Trade liberalization was not the only macroeconomic change taking place in the Brazilian economy in the 1990s. The country was hit by a recession and record inflation in 1990-1992, which may have affected employment and unemployment. In 1994, after several failed attempts to curb inflation, the government of Brazil launched the Real Plan that introduced a new currency and brought prices under control, which again could have triggered labor

market responses. The government's series of steps towards capital account convertibility and liberalization further included the creation of foreign capital investment companies and funds, stock and bond portfolios (Goldfajn and Minella 2005). As a result, the stock of FDI in Brazilian industry, which was rather constant in the early 1990s, picked up significantly after 1992 (Muendler 2003a; see also Appendix figure A5). Section 4 sets out to isolate the causal impact of trade reforms on labor market outcomes, exploiting the fact that the Brazilian microregions were differentially exposed to tariff changes. The potentially confounding effect of FDI is further discussed in section 5.4.

3.3 Labor Market Outcomes

This section turns to the evolution of economic activity and other labor market outcomes amongst Brazilian men and women aged 25-55. Table 1 summarizes labor force participation, employment and unemployment in 1991 and 2000. We view these three measures as important and complementary indicators of labor market engagement. However, employment is arguably measured more reliably than the other two variables because of the empirical difficulty to distinguish unemployed (who per definition must be actively searching for employment) from non-participating individuals, where the latter includes discouraged workers no longer actively searching for a job.[8] Because male-female differences are much smaller in the highly educated population, all measures (and later on, all estimation results) are also presented separately by education group. In this table and throughout the paper, high-skilled is defined as having completed high-school education or higher, following Ferreira et al. (2010). In 1991, 21 percent of the population age 25-55 was high-skilled. Their share increased to 27 percent in 2000.

Table 1: Participation rates of men and women age 25-55

	All		Low skilled		High skilled	
	Women	Men	Women	Men	Women	Men
1991						
Labor force	43.6	94.0	36.2	93.5	70.8	95.9
Unemployed	2.1	2.4	2.0	2.5	2.7	2.1
Employed	41.5	91.5	34.2	91.0	68.1	93.7
Tradable	8.3	39.2	8.9	43.6	6.0	21.5
Non-tradable	33.0	51.9	25.2	46.9	61.9	71.9
2000						

[8] Note that all labor market participation rates in this paper are normalized on the total population age 25-55. Hence the employment rate is the share of the population working and the unemployment rate is the share of the population unemployed. This differs from the usual concept of unemployment rates, which are normalized on the economically active population.

Labor force	57.9	88.4	50.4	86.6	76.7	94.2
Unemployed	8.9	7.7	9.2	8.5	8.5	5.6
Employed	49.0	80.7	41.2	78.1	68.3	88.6
Tradable	9.4	27.1	10.8	30.4	5.9	16.1
Non-tradable	39.0	52.5	30.0	46.7	61.5	71.3

Note: Numbers are in percentage of the population age 25-55. Tradable and non-tradable employment rates may not add up to the total employment rate because the sector of employment is missing for some observations. *Source*: Brazil Demographic Census

Though part of a longer-term trend, Brazil's trade liberalization period is characterized by a sharp increase in female labor force participation, while the male labor force participation rate, which started out more than twice as high as for women, declined.[9] The gender gap in labor force participation is largest for the low-skilled population and declines substantially, from 57 to 36 percentage points. In relative terms, the ratio of male to female labor force participation declined from 2.6 to 1.7.[10] Gender convergence is less pronounced in the high-skilled population, where the female labor force participation was already more than 70 percent in 1991. The high-skilled gender gap in labor force participation declined from 25 to 17.5 percentage points, and from a male/female ratio of 1.4 to 1.2.

The employment rates across sectors convey the typical pattern of gender segregation, with female workers more concentrated in the non-tradable sector than male workers. For ease of comparison, Table 2 summarizes the sectoral distribution of workers in percentages of employment. Sectoral segregation of men and women declined between 1991 and 2000, mainly due to a shift of the male workforce (in particular low-skilled men) from the tradable to the non-tradable sector. The sectoral distribution of women has been remarkably stable.

Table 2: Sectoral distribution of workers

	All		Low-skilled		High-skilled	
	Women	Men	Women	Men	Women	Men
1991						
Tradable	20.1	43.1	26.1	48.2	8.8	23.0
Non-tradable	79.9	56.9	73.9	51.8	91.2	77.0
2000						
Tradable	19.5	34.0	26.5	39.4	8.8	18.4
Non-tradable	80.5	66.0	73.5	60.6	91.2	81.6

Note: Distribution of the workforce age 25-55. *Source*: Brazil Demographic Census.

[9] The trend of increasing female labor force participation in Brazil is consistent with secular patterns in many developing countries in Latin America, the Middle East and parts of Asia (Gaddis and Klasen 2014).

[10] It is common (though not universal) practice to measure gender differentials in economic participation in absolute terms, e.g. as the percentage point difference between male and female labor force participation rates, (see ILO 2012, World Bank 2011). Proportional changes are more relevant for assessing the relative position of women, as the initial participation and employment rates of women are substantially lower. They are also better suited to assess economic hypotheses, such as the pro-competitive effects of trade liberalization, which tend to predict changes in the gender composition of the workforce and relate more closely to relative gender gaps.

In terms of age and educational attainment, the male and female population aged 25 to 55 are very similar. Considering only employed men and women, however, women are more educated than men, and they are slightly younger (Table A1 in the appendix summarizes worker characteristics). In our empirical analysis we check to what extent educational attainment accounts for any gender differences in the impact of liberalization.

4. Empirical Approach

The key econometric challenge in identifying the causal effect of trade liberalization is that national tariff reforms affect the whole country, leaving the analyst without a control group that could be suitably compared to workers exposed to trade liberalization. However, geographic variation in the pre-liberalization industry structure and variation across industries in tariff reductions in Brazil suggest that there is variation in the intensity with which microregions were exposed to the reforms. Hence by comparing microregions more or less exposed to trade reforms we can identify the relative impact of trade liberalization on labor market outcomes. This identification strategy was pioneered by Topalova (2007, 2010).

4.1 Measuring Trade Protection at the Microregion Level

Following Topalova (2007, 2010) we construct a region-level time-varying measure of trade protection (*TP*), which reflects the region-specific pre-liberalization industry composition of employment and time- and industry-specific tariff rates. Throughout the analysis, the geographic unit of analysis is the microregion. Microregions are groups of neighboring municipalities with similar economic and geographic characteristics, constituting local labor markets relevant to our analysis (IBGE 1990; Kovak 2013).[11] We can distinguish 494 microregions across Brazil's 27 states. *TP* measures the level of trade protection for 494 microregions of Brazil in 1990 and 1998, the first and last year of tariff data we use. In a first step, we aggregate the Demographic Census industry codes into 21 broad sectors (20 tradable sectors and the non-tradable sector) that can be matched to the tariff data, based on the concordance table in Ferreira et al. (2010), but with minor adjustments.[12] We then use the census data to calculate sector-level employment shares by microregion for the start of the liberalization period. These 'base-year' employment shares act as weights for the industry-

[11] Some of the administrative boundaries changed between the 1991 and 2000 census. We thank Brian Kovak for kindly sharing details on the aggregation required to define consistent areas over time.

[12] In particular we combine the sub-sectors 'processing of vegetal products' and 'meat packing, dairy industry, vegetal and other food products'; we also merge 'leather and skins' with 'footwear', and 'manufacturing of synthetic materials' with 'unclassified manufacturing'.

level tariff changes and thus capture the cross-sectional variation in exposure to trade reforms.[13] In a second step, we merge these with the sectoral tariff data described in Section 3, and compute the microregion-level trade protection measure according to the following formula:

$$TP_{r,t} = \sum_{s=1}^{S} \frac{Emp_{r,s}^{1991}}{Emp_{r}^{1991}} * Trf_{s,t} \quad [1]$$

Where $Trf_{s,t}$ is the nominal tariff rate of sector *s* at time *t* (1990, 1998). Note that *TP* is scaled in such a way that a high value indicates high levels of protection.

Computing [1] requires a decision regarding the treatment of the non-tradable sector, for which two different approaches have been taken in the literature. One approach is to let non-tradables enter the trade protection measure as an additional sector, with tariffs being assigned zero over the entire period (e.g. Topalova 2007). Denote this measure TP^{inNT}. Variation in TP^{inNT} will reflect the fact that microregions with a large share of employment in the non-tradable sector are less exposed to trade liberalization than those with a large share of the labor force employed in the tradable sectors. The second approach is to exclude the non-tradable sector from the analysis and to rescale employment shares to sum to unity over the 20 traded sectors only. Kovak (2013) shows that from a theoretical perspective, the latter measure, which we denote TP^{exNT}, is the right measure in a neoclassical model with perfectly mobile labor across sectors (not regions) and full employment, because non-tradable sector prices will move in line with a weighted average of tradable sector prices.

There is a second consideration that determines the choice between the two measures. TP^{inNT} is mechanically affected by the size of the non-tradable sector, which can potentially confound the estimates if the initial size of the non-tradable sector has an impact on subsequent changes in gender-specific labor market outcomes or is correlated with unobserved determinants of labor market outcomes. This holds for the initial size of all tradable sectors as well, but is more likely to be a problem for the non-tradable sector, because non-tradable sector 'tariffs' do not change over time (effectively being assigned zero) so that the portion of the variation in TP^{inNT} that is due to the non-tradable sector only mirrors differences in the initial employment shares. Initial employment in the non-tradable sector is highly correlated with initial female labor force participation and therefore likely to be correlated with subsequent changes in women's labor market outcomes if for example a process of mean reversion takes place. Furthermore, regions more specialized in the non-

[13] Note that the employment shares are based on the Demographic Census in 1991 and refer to the year ending on August 31st 1991, which is after the start of tariff reductions in March 1990. Since earlier employment data are not available at the microregion level, we use the 1991 data assuming the regional employment structures were not affected significantly in the first year after tariff reductions.

tradable sector are likely to have a higher level of overall development, which in itself may predict slower employment growth if there is regional convergence over time.

Given these considerations we follow Hasan et al. (2012) and Kovak (2013) in using TP^{exNT} as our main measure of trade liberalization, which is a well-defined, exogenous variable. Note that within the tradable sector, tariff changes are only weakly correlated with industries' female-intensity. Figure A4 in the appendix shows that male-intensive tradable industries were not systematically more or less liberalized than female-intensive tradable industries, which means that TP^{exNT} will not be picking up the initial female share of employment in the microregion.

4.2 Empirical Framework

To estimate the relationship between trade protection and male and female labor market outcomes, we construct a panel dataset by aggregating all individual-level census data for 1991 and 2000 to the microregion level. The effect of trade liberalization on labor market outcomes is estimated using within-microregion variation, according to the following equation:

$$\Delta y_{r,91-00} = \alpha + \beta\, \Delta TP_{r,90-98} + \sum_k \gamma^k\, E^k{}_{r,1991} + \Delta\varepsilon_{r,91-00} \qquad [2]$$

Here, y_r is the microregion-level outcome of interest – i.e. the female or male labor force participation rate or employment rate, always calculated as a percentage of the population aged 25-55 years. We also run estimations with dependent variables in logs, in order to assess proportional changes (rather than percentage point changes) in employment rates. In addition, trade liberalization effects are estimated separately for low-skilled and high-skilled men and women, to verify that any male-female differences in estimates are not driven by differences in education levels and to allow for differential effects across skill levels.

Relying on within-microregion variation accounts for time-invariant unobserved regional heterogeneity, while the constant term α captures trends affecting Brazil as a whole. For the main estimation outcomes, we additionally show results with controls for state-specific trends (state fixed effects in the differenced equation), so that β is identified from variation in ΔTP across microregions within the same state. TP is measured as TP^{exNT} as described above, and ΔTP will be negative if the regional level of tariff protection declined.[14] A positive coefficient β thus reflects a negative impact of trade liberalization on the dependent variable.

[14] We use a fixed-effects estimator for equation (2), by matching the 1990 and 1998 TP measures to the 1991 and 2000 census aggregates, respectively.

We allow for a differential trend in (fe)male labor market outcomes across regions with different initial employment shares in agriculture, industry, construction, trade, and other services ($E^k{}_{r,1991}$). This broad employment structure captures the initial share of the non-tradable sector, as well as shares of agriculture and industry within the tradable sector, to control for unobserved microregion characteristics that could predict labor market developments.

As discussed previously, an important advantage of this identification strategy is that it does not restrict the analysis to the tradable sector, but allows a focus on economy-wide changes across all sectors. In fact our econometric set up should reveal general equilibrium effects taking place within microregions, though not any effects operating between them. If people tend to migrate from regions more affected by liberalization to those less affected, for example, this dampens the link between changes in *TP* and changes in labor market outcomes. It is unlikely, however, that this will affect the estimates for men and women differently, and Kovak (2013) and Dix-Carneiro and Kovak (2014) show large local general equilibrium effects pointing at the limited role of migration across regions as an adjustment mechanism.

Another important implication of our identification strategy is that we can only estimate the differential impact of tariff reforms on labor market outcomes across microregions, net of any country-wide 'level' effects of trade liberalization (Topalova 2007, 2010). The median change in TP^{exNT} between 1990 and 1998 equals -0.059 or a reduction of 5.9 percentage points, and there is considerable variation in this change across microregions (Table 3). By our measure of local trade protection, a one standard deviation difference in liberalization across microregions is close to 7 percentage points, and the p25-p75 difference is 13.2 percentage points. In other words, a microregion at the 25th percentile experiences a 13.2 percentage point stronger tariff reduction than a microregion at the 75th percentile. Table 3 also summarizes the changes in male and female employment rates, and changes in the male-female gap.

Table 3: Summary statistics

	Mean	Median	St. dev.	p75-p25	N
Δ*TP* (1990-1998)	-0.061	-0.059	0.067	0.132	494
ΔEmployment rate (1991-2000)					
Women	0.076	0.069	0.041	0.051	494
Men	-0.109	-0.087	0.061	0.038	494
Male-female gap	-0.185	-0.160	0.069	0.073	494
Low-skilled women	0.069	0.061	0.043	0.054	494
Low-skilled men	-0.126	-0.113	0.062	0.039	494

Male-female gap	-0.196	-0.172	0.065	0.064	494
High-skilled women	0.001	-0.001	0.037	0.034	494
High-skilled men	-0.052	-0.050	0.023	0.015	494
Male-female gap	-0.053	-0.053	0.038	0.029	494

Note: Statistics weighted by microregions' population *Source*: Brazil Demographic Census and Abreu (2004)

5. Results

5.1 Trade liberalization and labor market outcomes of men and women

Table 4 shows the estimation results for labor market outcomes of women and men. We find that declining trade protection is associated with a decline in the labor force participation and employment rates of women as well as men. In the first four columns, the dependent variables are the labor force participation and employment rates, and the estimates show the percentage point change in these outcomes due to changes in trade protection. In percentage points, employment rates are affected more than participation rates, which is due to increased unemployment (not shown). Still, the labor force participation effects are large, indicating that most of the reduction in employment has translated into increased inactivity.

We further find that the effects on men are two to three times larger compared to the effects on women, and these differences are statistically significant.[15] Controlling for state specific trends (in columns three and four) reduces the size of the estimates, suggesting there are some state-specific unobserved factors that correlate with the change in *TP*. Yet we find similar labor market impacts, including significantly stronger impacts on men than on women.

The last two columns in Table 4 show results for proportional changes, with the dependent variables in logs, also controlling for state-specific trends. As the male labor force participation and employment rate were more than twice as high as the female rates at the start of the period, men and women were affected similarly in proportional terms. The effects on log labor force participation and employment rates are still larger for men, but gender differences are smaller and not statistically significant.

Table 4: Trade liberalization and gender-specific labor market outcomes

	Dependent variables in levels				Dependent variables in logs	
	Women	Men	Women	Men	Women	Men
	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.: labor force participation rate						
TP	0.221***	0.480***	0.145**	0.359***	0.358*	0.467***
	(0.077)	(0.083)	(0.069)	(0.083)	(0.215)	(0.106)

[15] We estimated the same equation on pooled data for men and women, including a full set of interaction terms with gender, to directly compare the estimates for men and women. All differences for the dependent variables in levels are statistically significant at the five percent level at least.

N	988	988	988	988	988	988
R-squared	0.95	0.76	0.97	0.85	0.95	0.82
Dep. var.: employment rate						
TP	0.283***	0.604***	0.155*	0.436***	0.278	0.577***
	(0.080)	(0.095)	(0.080)	(0.094)	(0.229)	(0.125)
N	988	988	988	988	988	988
R-squared	0.85	0.86	0.91	0.92	0.88	0.89
State trends	-	-	Yes	Yes	Yes	Yes

Note: Microregion fixed-effects estimations. All estimations control for year-fixed effects and initial broad employment structure. Standard errors are clustered by microregion; regressions are weighted by microregions' 1991 population.

Our finding that microregions more exposed to trade liberalization experienced slower growth in employment and labor force participation rates, compared to microregions less exposed, is in line with previous evidence in Meñezes-Filho and Muendler (2011) and Dix-Carneiro and Kovak (2014). What are the implications for gender gaps in employment? In percentage points, our estimates in columns 3 and 4 of Table 4 indicate that a 13.2 percentage point larger reduction in *TP* (the p75-p25 difference across microregions) is associated with a 2.1 percentage point (5.8 percentage points) larger reduction in female (male) employment rates, and somewhat smaller effects on labor force participation rates. This constitutes a 3.7 percentage point reduction in the male-female employment rate gap, which is roughly half of the p75-p25 difference reported in Table 3. Liberalization can thus account for a sizeable share of the spatial variation in the closing of the absolute gender employment gap. In relative terms, the 13.2 percentage point reduction in *TP* implies a 3.7 percent (7.6 percent) decline in the employment rate of women (men), but the gender difference is not statistically significant at conventional levels.

5.2 Low-skilled and high-skilled men and women

As discussed in section 3, gender gaps and gender convergence in the labor market have been most pronounced in the low-skilled population, and female workers are on average more educated than male workers. To shed more light on skill-specific gender differences and the role of education, Tables 5 and 6 report estimation results by gender and education level. We find that the overall effects of liberalization as well as male-female differences are concentrated in the low-skilled population (Table 5). In percentage points terms, the effects on low-skilled men are more than twice as large as the effects on low-skilled women, and even three times as large when we control for state-specific trends in columns three and four. The proportional impacts (last two columns of Table 5) differ less. Women's labor force

participation declines proportionately slightly more than men's. The effect on men's employment rate is about 50% stronger than the effect on women's employment rate, but the difference is not statistically significant.

Table 5: Trade liberalization effects, low-skilled population

	Dependent variables in levels				Dep. variables in logs	
	Women	Men	Women	Men	Women	Men
	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.: labor force participation rate						
TP	0.231***	0.495***	0.112	0.377***	0.547**	0.494***
	(0.076)	(0.094)	(0.070)	(0.088)	(0.259)	(0.114)
N	988	988	988	988	988	988
R-squared	0.94	0.77	0.97	0.85	0.94	0.82
Dep. var.: employment rate						
TP	0.332***	0.684***	0.163*	0.522***	0.473*	0.701***
	(0.081)	(0.109)	(0.084)	(0.100)	(0.284)	(0.136)
N	988	988	988	988	988	988
R-squared	0.79	0.87	0.87	0.92	0.85	0.90
State trends	-	-	Yes	Yes	Yes	Yes

Note: Microregion fixed-effects estimations. All estimations control for year-fixed effects and initial broad employment structure. Standard errors are clustered by microregion; regressions are weighted by microregions' 1991 population.

Table 6: Trade liberalization effects, high-skilled population

	Dependent variables in levels				Dep. variables in logs	
	Women	Men	Women	Men	Women	Men
	(1)	(2)	(3)	(4)	(5)	(6)
Dep. var.: labor force participation rate						
TP	-0.011	0.001	0.061	-0.074**	0.117	-0.078**
	(0.082)	(0.032)	(0.066)	(0.036)	(0.095)	(0.039)
N	988	988	988	988	988	988
R-squared	0.77	0.64	0.84	0.69	0.84	0.68
Dep. var.: employment rate						
TP	-0.011	0.067	0.034	-0.031	0.054	-0.034
	(0.090)	(0.045)	(0.070)	(0.048)	(0.101)	(0.054)
N	988	988	988	988	988	988
R-squared	0.11	0.84	0.40	0.86	0.40	0.85
State trends	-	-	Yes	Yes	Yes	Yes

Note: Microregion fixed-effects estimations. All estimations control for year-fixed effects and initial broad employment structure. Standard errors are clustered by microregion; regressions are weighted by microregions' 1991 population.

High-skilled male and female employment rates (Table 6) are not affected, with estimates very close to zero and not statistically significant. Liberalization slightly increased high-skilled men's labor force participation, which reflects a combination of small and insignificant increases in the employment rate and the unemployment rate (not shown).

The difference between liberalization's impacts on low- and high-skilled workers is quite striking.[16] We run additional estimations to verify that results are not driven by changes in the denominator in our dependent variable – the relevant population. If education levels increased less in regions more exposed to liberalization or if the highly educated were more likely to migrate, the low-skilled (high-skilled) population would grow relatively fast (slow), translating into lower (higher) participation rates for the low-skilled (high-skilled).

The results show that female and male average years of education increased less in microregions more exposed to liberalization, but there is no significant impact on the high-skilled share of the population (see appendix Table A2). Furthermore, although years of education are affected more among the low-skilled than the high-skilled (appendix Table A3), controlling for years of education does not affect any of the results presented in tables 4-6.

We thus have robust evidence that the negative effects of trade liberalization on employment and participation rates are concentrated in the low-skilled population, where the percentage point effects are significantly stronger for men, thus contributing to a closing of the absolute gender gap in employment and participation rates. Yet since we cannot reject the null of equal *proportional* impacts on men and women, there is no evidence that trade liberalization improved the relative position of women in local labor markets.

5.3 Sectoral reallocation

Meñezes-Filho and Muendler (2011) find that liberalization led to a movement of workers from the tradable sector into unemployment, inactivity, and the non-tradable sector. Similarly, Dix-Carneiro and Kovak (2014) show that liberalization caused a reallocation of workers from the tradable to the non-tradable sector and the informal sector. Both studies suggest that the negative impact of liberalization on employment rates was concentrated in the tradable sector. Consequently, if male and female employment rates *within* the tradable sector were proportionately equally reduced, this would have translated into proportionately much larger declines in the male employment rate, given the initial sectoral distribution of male and female workers (Table 2). The results so far therefore suggest that women were disproportionately affected within the tradable sector, or that men were better able to reallocate to the non-tradable sector (hence mitigating the effect on the aggregate male employment rate).

[16] Previous research on wage differentials has found that liberalization reduced the skilled wage premium (Gonzaga et al. 2006, Dix-Carneiro and Kovak 2015), because tariff reductions were slightly larger in more high-skilled intensive industries.

To shed more light on the sector-specific impacts and the role of sectoral reallocation, we now turn to a more disaggregated anal**y**sis. Table 7 repeats the estimates for the male and female log employment rate (Panel A) and then shows estimation results for the impact of liberalization on log employment rates in the tradable and the non-tradable sector (panel B).[17] The results in panel B show that the negative employment effects of liberalization (the positive coefficients) are entirely concentrated in the tradable sector, in line with Meñezes-Filho and Muendler (2011) and Dix-Carneiro and Kovak (2014). Low-skilled tradable sector employment rates are affected most and the effect is largest for low-skilled women, but the male-female difference is not statistically significant (the p-value of the difference is 0.125). At the same time, we find that low-skilled men reallocate partly to the non-tradable sector, unlike low-skilled women, for whom there is no significant change in non-tradable sector employment. This explains why equal proportional effects on tradable sector employment rates do not translate in to stronger impacts on men's aggregate employment rate. For the high-skilled population, we find quite large coefficient estimates for tradable sector employment, though only significant for men at the 10 percent level. There is no evidence of significant increases in non-tradable employment, nor is there any significant difference between high-skilled men and women in these estimates.[18]

Table 7: Trade liberalization and sectoral reallocation

	Low-skilled		High-skilled	
	Women	Men	Women	Men
	(1)	(2)	(3)	(4)
Panel A: total economy				
Dependent variable: log *employment rate*				
TP	0.473*	0.701***	0.054	-0.034
	(0.284)	(0.136)	(0.101)	(0.054)
N	988	988	988	988
R-squared	0.85	0.90	0.40	0.85
Panel B: tradable and non-tradable sector				
Dependent variable: log *tradable sector employment rate*				
TP	2.679***	1.469***	1.009	0.998*
	(0.712)	(0.349)	(0.853)	(0.523)
N	987	988	943	984
R-squared	0.67	0.92	0.56	0.75
Dependent variable: log *non-tradable sector employment rate*				

[17] We focus on log estimates because of the emphasis on the proportionality of the effects.

[18] In additional regressions, we also confirm earlier findings that trade liberalization increased informality. We find significant reallocations from formal tradable sector employment to informal employment in the tradable and non-tradable sector, as well as some formal to informal reallocation within the non-tradable sector. Formality thus declined significantly, but there is no clear gender component to this process, which is why we do not report or further analyze these results.

TP	-0.001	-0.388**	-0.162	0.012
	(0.221)	(0.176)	(0.121)	(0.165)
N	988	988	988	988
R-squared	0.89	0.76	0.48	0.34
State trends	Yes	Yes	Yes	Yes

Note: Microregion fixed-effects estimations. All dependent variables are measured as the log share of the relevant population, age 25-55. All estimations control for year-fixed effects, initial broad employment structure, and state-specific trends. Standard errors are clustered by microregion; regressions are weighted by microregions' 1991 population.

One important implication of our results is that liberalization did not significantly affect the ratio of male to female workers in the tradable sector.[19] This could suggests that male and female workers are complements in production, or that the low female share of workers persists due to other factors, including individual preferences and social norms. Recent research across Brazilian cities suggests that male and female workers are not perfect substitutes (Freire 2011). Likewise, participatory research conducted in Sao Paolo during the late 1990s and early 2000s documents employers' perceptions that men and women have different comparative advantages and tend to work in different stages of the production process, thus limiting substitutability (Buechler 2014).[20] But it is of course entirely possible that male-female complementarity applies in certain parts of the tradable sector, while men and women are substitutes in other parts. The outcome, either way, is that tariff reductions did not significantly affect the gender composition of the tradable sector workforce, suggesting that the pro-competitive effects of trade liberalization (female-biased technological change, reduced discrimination, or increased demand for the "youthful diligence" of young women) did not improve or even shield women's employment. As a corollary, this cautions against the notion that the low share of female workers in Brazil's tradable sector is primarily driven or sustained by lack of competition.

This finding seems to contrast with other recent studies on Latin America, which found significant improvements in the employment share of women in industries or firms affected by trade liberalization (notably Juhn et al. 2014 on Mexico and Ederington et al. 2009 on Colombia). As discussed in section 2, however, the pro-competitive effects of trade may not significantly affect gender inequality in equilibrium even if they affect particular firms or

[19] If anything, the female share of low-skilled tradable sector workers declined in more affected regions, relative to less affected regions, but not significantly so.

[20] For instance, the manager of a chocolate factory reported that the firm hired more men than women, because "women were not allowed to carry heavy boxes or work with heavy dough" (Buechler, 2014, p. 103). On the other hand, the human resource director of an electronics company argued that "women had better skills in manual assembly since they had more delicate hands and could concentrate more than men" (Buechler, 2014, p. 108). These statements, though of course only anecdotal evidence, support the notion that women's and men's labor input was often regarded a complementary by hiring company officials.

industries. Our findings therefore do not rule out similar impacts of Brazil's trade liberalization at the firm- or industry-level, but do show that those impacts would have been too small to affect the tradable sector as a whole.

Since the literature suggests that these types of firm- or industry-level effects are stronger for particular groups of workers, we believe it is worthwhile to probe further into the general equilibrium effects for certain segments of the labor market. In particular, technological change was found to increase the female share of workers in low-skilled, blue-collar occupations (Juhn et al. 2014), increased demand for flexible low-wage workers will also mainly affect blue-collar occupations such as assembly workers, and the argument of youthful diligence (Standing, 1989) would apply mostly to young women. This suggests that women's position is most likely to improve relative to men's among low-skilled workers, within blue-collar occupations, and among younger workers.

We have already shown results for low-skilled and high-skilled workers separately, and there is no evidence that women's position in tradable sector employment improved more for low-skilled than for high-skilled workers. We run further estimations for low-skilled tradable sector employment rates in two different occupational groups (plant and machine operators and assemblers, and other occupations)[21] and for three different age groups (25-34, 35-44, and 45-55). The results, presented in the appendix Tables A4 and A5, show that even in subgroups of workers most prone to the "pro-female" pro-competitive effects of trade liberalization, women's relative position did not improve. We find that in microregions more exposed to liberalization, female employment rates in assembly occupations declined (or grew slower) relative to microregions less exposed, while the male employment rate in these occupations increased. We also find that the effects on women are stronger than on men within the youngest age group while the effects are more similar for older men and women.

Taken together, while we do not rule out significant increases in the female share of workers within particular firms, our analyses consistently show that trade liberalization did not lead to an improvement of women's relative position in the tradable sector as a whole, nor in the total labor force. In the low-skilled population, liberalization is associated with reduced tradable sector employment rates of both men and women, while we find an increase in non-tradable employment rates only for men.

5.4 Robustness Checks

[21] We match occupational codes in the census data to harmonized occupational codes available through IPUMS (Minnesota Population Center, 2014) – these distinguish nine occupational groups according to the ISCO 2008 classification. Plant and machine operators and assemblers constitute the ISCO 2008 group 8.

In this section we test the robustness of our results with respect to our measures of employment and trade protection, our empirical specification, and FDI inflows. To start with, we note that an important change in Brazil's Demographic Census was a reduction in the reference period for employment, from the entire last year (September 1, 1990 to August 31, 1991) in the 1991 census to a week (the last week of July) in the 2000 census. This could bias our estimates if, for example, liberalization increased temporary employment at the cost of permanent jobs, so that people are more likely to be out of work in a particular week even if they still worked most of the preceding year. We verify this by analyzing the effect of liberalization on paid employment, which we can measure in two ways. The first is based on the question whether the respondent worked in the reference period, but excludes those who do unpaid work. This measure is subject to any bias induced by the change in reference period. The second definition uses reported earnings, and counts those with positive earnings only. Since earnings were recorded for the same reference period (one month) in both the 1991 and the 2000 census, this measure is not affected by a change in reference period. Table 8 shows results for the two measures of the paid employment rate. We see that the results are very similar, indicating that the change in the reference period does not affect the estimated impact of liberalization. Furthermore, the effects on paid employment are similar to the effects on total employment reported in Table 5.

Table 8: Robustness across different measures of employment

	All		Low-skilled		High-skilled	
	Women	Men	Women	Men	Women	Men
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable*: log paid employment rate*						
TP	0.200	0.601***	0.389	0.731***	0.049	-0.048
	(0.216)	(0.131)	(0.282)	(0.142)	(0.102)	(0.055)
N	988	988	988	988	988	988
R-squared	0.88	0.89	0.83	0.89	0.40	0.85
Dependent variable*: log share of population with positive earnings*						
TP	0.079	0.555***	0.256	0.695***	0.010	-0.096*
	(0.215)	(0.126)	(0.282)	(0.137)	(0.104)	(0.055)
N	988	988	988	988	988	988
R-squared	0.90	0.88	0.85	0.89	0.42	0.81

Note: Microregion fixed-effects estimations. All estimations control for year-fixed effects, initial broad employment structure, and state-specific trends. Standard errors are clustered by microregion; regressions are weighted by microregions' 1991 population.

Our results are also robust to changes in the measure of trade protection. We repeat our estimations using effective rates of protection instead of nominal tariffs. While nominal tariffs have been used in much of the existing empirical literature (e.g. Topalova 2010; Edmonds et

al. 2010; Kovak 2013), the effective rate of protection is another common measure of trade protection, which better reflects indirect effects through the protection of intermediate inputs. The results using effective rates of protection (not shown but available on request) come out similar to those using tariff rates. Though the estimates are smaller in magnitude, effective rates of protection show a larger decline over time, translating into very similar impacts. In addition, we estimate the effects of liberalization using tariffs in 1990 and 1995, instead of 1990 and 1998. Tariffs slightly increased after 1995 and stabilized only after 1997, which is why we prefer to analyze the impact of tariff changes between 1990 and 1998. If we take the shorter period up to 1995, as in Kovak (2013), we find virtually identical results.

As discussed in section 3, the stock of FDI in Brazilian industry picked up significantly after 1992. Since there is some previous research showing an effect of FDI on women's employment, rising capital inflows from abroad could also have affected employment and participation rates (see Wacker et al. 2015). If FDI flows were correlated with tariff changes at the sector level, this would contaminate our estimates of the effect of trade liberalization. To rule out the effect of FDI to some extent, we run our estimations with an additional control variable for local FDI, which is measured as a microregion-specific index similar to *TP*. That is, we take a weighted average of sectoral FDI stocks in 1990 and 2000, where the weights are the shares of sectoral employment in total manufacturing employment within the microregion in 1991. We exclude agriculture, mining, and the non-tradable sector, because FDI data (from Muendler 2003a) are available only for manufacturing industries. This index thus predicts the microregion-level stock of FDI based on the sectoral FDI stocks for the whole of Brazil and the microregion's 1991 structure of manufacturing employment. Within-microregion variation reflects the predicted net inflow of manufacturing FDI. The estimation results (available on request) are very close to the estimates in our main specification, so there is no sign that trade liberalization effects are picking up the effects of FDI inflows in manufacturing.

As a further robustness check, we check whether our main results are sensitive to the use of regression weights. Without weights, as shown in Table 9, we find similar effects of liberalization on the log sectoral employment rates, but with larger standard errors. A difference compared to the weighted estimates is that we find larger effects on the non-tradable sector employment rates of low-skilled men and women, though still statistically insignificant for women. Thus, whether or not we apply regression weights, we find statistically equal proportional impacts in the tradable sector and a larger proportionate increase in men's non-tradable employment rate – both concentrated in the low-skilled population and without signs this is crowding-out women from non-tradable employment.

Table 9: Non-weighted results

	Low-skilled		High-skilled	
	Women	Men	Women	Men
	(1)	(2)	(3)	(4)
Dependent variable: log *tradable sector employment rate*				
TP	2.185*	1.506***	1.375	0.988
	(1.128)	(0.461)	(1.621)	(0.830)
N	988	988	988	988
R-squared	0.66	0.89	0.45	0.43
Dependent variable: log *non-tradable sector employment rate*				
TP	-0.489	-1.015***	0.138	0.069
	(0.357)	(0.215)	(0.221)	(0.242)
N	988	988	988	988
R-squared	0.84	0.73	0.35	0.21

Note: Microregion fixed-effects estimations. All dependent variables are measured as the log share of the relevant population, age 25-55. All estimations control for year-fixed effects, initial broad employment structure, and state-specific trends. Standard errors are clustered by microregion.

Finally, an important issue of concern is the potential correlation of changes in *TP* with pre-liberalization trends in labor market outcomes, which would violate an important assumption underlying our identification strategy. While the political economy of Brazil's trade liberalization and the strong industry-level correlation of pre-liberalization tariff levels and tariff reductions lend considerable reason to believe that tariff cuts were exogenous to industry performance, there is still the possibility that microregions with stronger reductions in trade protection were already experiencing slower growth in employment rates before 1990. Ideally we would test this formally using microregions' pre-liberalization employment rates, but we do not have access to the original 1980 census data that would allow this analysis.[22]

Looking instead at industry-level pre-liberalization employment trends in Brazil's National Household Sample Surveys (PNAD), we find a negative correlation between employment growth before liberalization (either 1985-1990 or 1976-1990[23]) and tariff reductions during 1990-1998. This is in large part driven by the slow growth of agricultural employment, where tariff rates actually increased. Since we control for the initial agricultural employment share in all our estimation, the within-manufacturing variation is most important for our identification. Across manufacturing industries, the correlation coefficient is -0.27 (also see appendix Figure A6), indicating that manufacturing industries with larger tariff cuts had somewhat stronger employment growth before 1990. A continuation of pre-liberalization employment trends

[22] We have access to Brazil's 1980 Demographic Census through IPUMS. This dataset does not contain the original municipality identifiers, and therefore does not allow us to construct consistent microregion identifiers.
[23] The 1976 survey is the earliest year of PNAD data we have access to.

after 1990 would therefore produce higher employment growth in microregions more exposed to liberalization, which runs counter to our estimates. Dix-Carneiro and Kovak (2014, Table 5) indeed find that the estimated effect of liberalization on employment rates is slightly stronger when dependent variable pre-trends (1980-1991) are controlled for. Taken together, the results in this section confirm that our main findings are robust to a number of specification and measurement issues, and we are fairly confident that pre-liberalization trends are not driving our results.

6. Conclusions

While there is a large literature analyzing the distributional impacts of trade reforms across the income or skill distribution, very little is known about the gender effects of trade reforms. This paper seeks to fill this gap by examining the impact of Brazil's trade liberalization in the 1990s on male and female labor force participation and employment rates. Brazil was one of the most heavily protected economies in the world until the late 1980s, when reforms were initiated that drastically reduced import tariffs and lifted most non-tariff trade barriers. We relate microregion-level exposure to tariff reductions in the 1990s to changes in local labor market outcomes between 1991 and 2000, using data from Brazil's Demographic Census.

Previous research on Brazil's trade liberalization has shown that tariff reductions led to job losses in the tradable sector and reallocation of workers into other sectors of the economy and into unemployment and inactivity (Dix-Carneiro and Kovak 2014, Meñezes-Filho and Muendler 2011). In line with those studies, we find that microregions with greater exposure to trade liberalization experienced a slow-down (or reduction) in female as well as male labor force participation and employment rates, compared to microregions less exposed. The impacts are concentrated mainly in the low-skilled population (those with less than secondary schooling), and are driven by reductions in tradable sector employment. As male workers account for the majority of the tradable sector and the labor force as a whole, the slowdown of tradable and aggregate employment growth affected the *level* of male employment more than female employment. As a result, liberalization contributed to a closing of the gender gap in employment and participation rates in absolute terms, and can in fact account for a sizeable share of the spatial variation in this absolute gender convergence.

Yet in proportionate terms, tradable sector as well as aggregate employment rates of men and women were affected equally. We find no evidence that women's employment in the tradable sector benefitted from pro-competitive effects of free trade, nor that women were more easily absorbed in the (relatively female-intensive) non-tradable sector. An important

conclusion, therefore, is that trade liberalization did not improve the relative position of women in local labor markets.

While previous studies have shown that increased competition can improve women's position within firms and industries through reduced discrimination (Black and Brainerd, 2004) and gender-biased technical change (Juhn et al. 2014), our findings suggest that the low share of female workers in Brazil's tradable sector and the total workforce is not primarily driven by lack of competition. The persistence in Brazil's gendered employment patterns is in line with recent cross-country panel evidence for developing countries in Borrowman and Klasen (2015), who show that the export to GDP ratio has no effect on the sectoral segregation of men and women. Do et al. (2014) show that the female share of labor within industries is remarkably similar across countries, and find that fertility is lower in countries with a higher female-intensity of their export basket. This suggests that specialization in female-intensive industries improves the economic opportunities of women, and therefore trade liberalization will improve women's labor market position only in countries with a comparative advantage in female-intensive industries. Persistent sectoral segregation can be explained by complementarity between male and female workers, but also by norms and preferences sustaining gender differences in the sectoral structure of employment. To better understand the gendered impacts of trade will require further research into the dynamics of both these forces and at different levels, i.e. combining the analysis of firm- and industry-level impacts with general equilibrium analysis.

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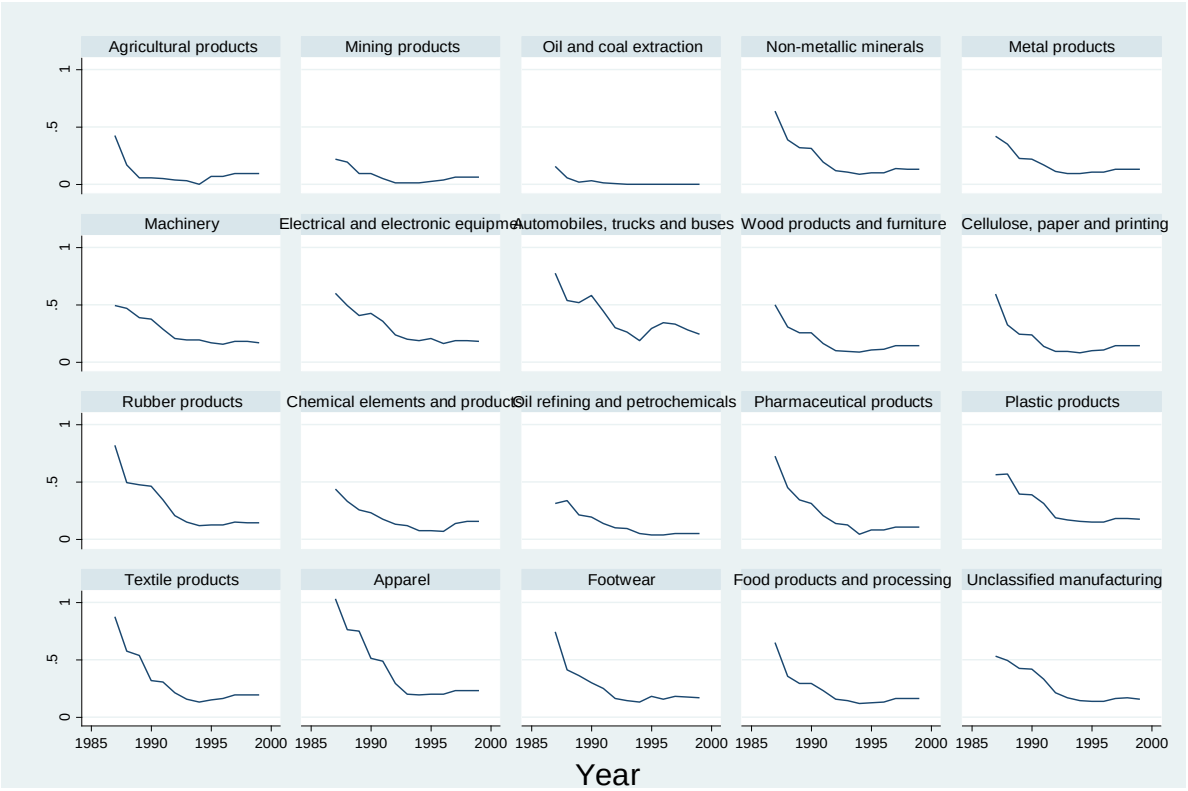
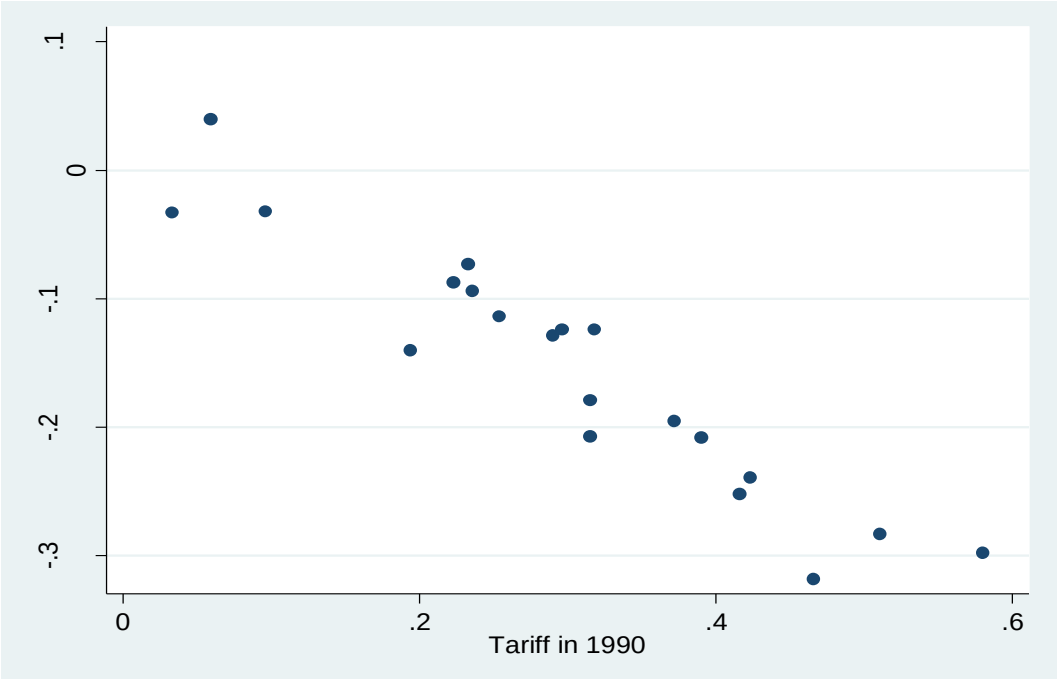
Appendix

Figure A1: Tariffs by sector, 1987-1999



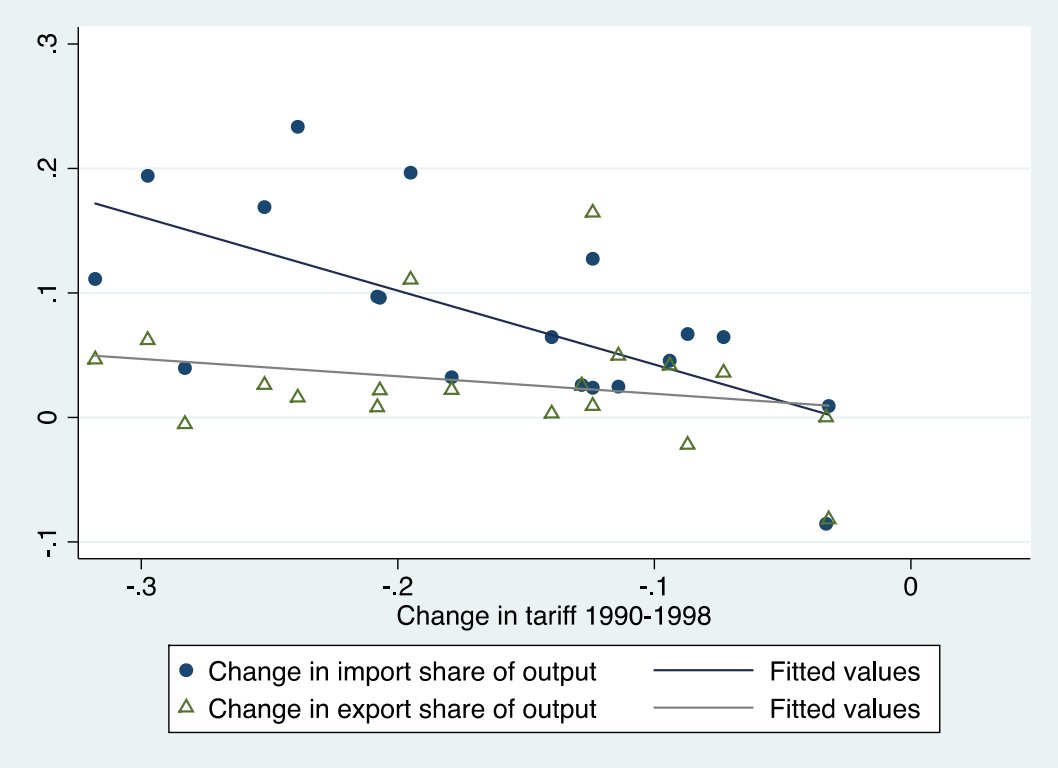
Source: Tariffs from Kume, Piani and de Souza (2003), tabulated in Abreu (2004).

Figure A2: tariff changes 1990-1998 and 1990 tariff levels by industry



Source: Tariffs from Kume, Piani and de Souza (2003), tabulated in Abreu (2004).

Figure A3: tariff changes, import penetration, and export shares 1990-1998

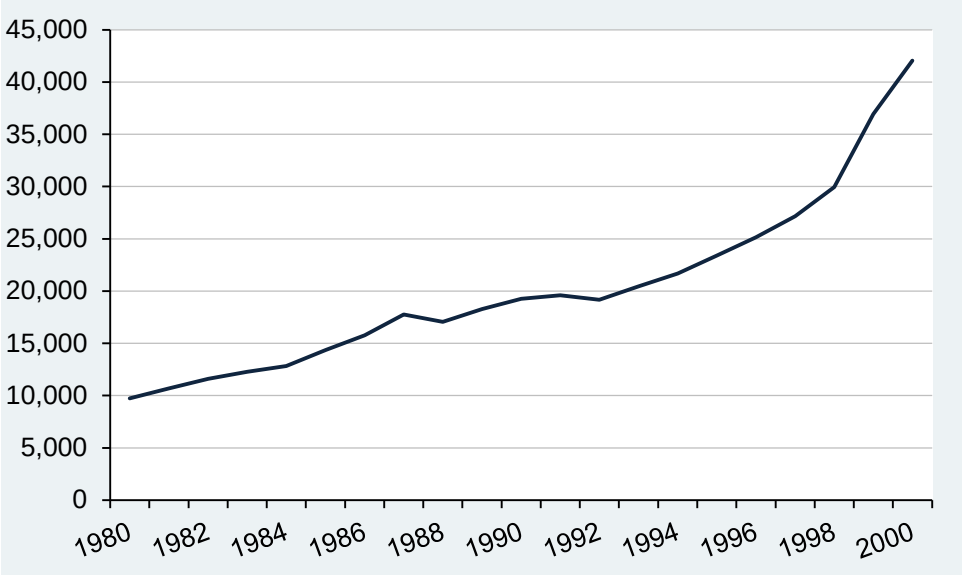


Note: Figure excludes agriculture. *Source:* Nominal tariffs from Kume, Piani and de Souza (2003), tabulated in Abreu (2004). Import and export shares from Muendler (2003b).

Figure A4: tariff changes 1990-1998 and 1991 female-intensity by industry

Source: Nominal tariffs from Kume, Piani and de Souza (2003), tabulated in Abreu (2004). Female share of workers from Brazil Demographic Census.

Figure A5: Foreign direct investment (FDI) in Brazilian manufacturing



Note: vertical axis measures the stock of FDI in Brazilian manufacturing in current Mio USD.
Source: Muendler (2003a).

Figure A6: tariff changes 1990-1998 and 1985-90 employment growth by industry

Source: Nominal tariffs from Kume, Piani and de Souza (2003), tabulated in Abreu (2004); employment data from PNAD.

Table A1: Mean years of education and age of workers

	All workers		Low skilled		High skilled	
	Women	Men	Women	Men	Women	Men
1991						
Education	7.11	5.54	4.02	3.66	12.79	12.75
	4.91	4.54	2.79	2.78	2.07	2.13
Age	36.39	36.96	37.33	37.31	34.63	35.50
	8.04	8.39	8.26	8.52	7.27	7.65
2000						
Education	7.99	6.75	4.82	4.50	12.67	12.56
	4.60	4.47	2.77	2.80	2.07	2.10
Age	37.41	37.51	38.21	37.74	36.21	36.92
	8.11	8.33	8.24	8.44	7.76	8.00

Note: Averages for workers age 25-55. *Source*: Brazil Demographic Census

Table A2: Trade liberalization and education

	Years of education		High-skilled share of population	
	Women	Men	Women	Men
TP	1.385***	1.920***	0.060	0.056
	(0.345)	(0.340)	(0.040)	(0.041)
N	988	988	988	988
R-squared	0.98	0.98	0.98	0.96

Note: All estimations control for microregion- and year-fixed effects, initial broad employment structure, and state-specific trends. Standard errors are clustered by microregion; regressions are weighted by microregions' 1991 population.

Table A3: Trade liberalization and years of education by skill group

	Years of education – low skilled		Years of education – high skilled	
	Women	Men	Women	Men
TP	0.741***	0.968***	-0.395	0.155
	(0.223)	(0.220)	(0.277)	(0.310)
N	988	988	988	988
R-squared	0.99	0.98	0.47	0.73

Note: see notes Table A2.

Table A4: Tradable sector employment by occupational group

	Low-skilled: machine operators and assembly workers		Low-skilled: other occupations	
	Women	Men	Women	Men
	(1)	(2)	(3)	(4)
Dependent variable: *log tradable sector employment rate*				
TP	4.927***	-3.848***	6.744***	2.269***
	(1.795)	(0.859)	(0.927)	(0.392)
N	894	982	987	988
R-squared	0.93	0.40	0.84	0.93

Note: see notes Table A2.

Table A5: Tradable sector employment by age group

	Low-skilled: 25-34		Low-skilled: 35-44		Low-skilled: 45-55	
	Women	Men	Women	Men	Women	Men
	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable: *log tradable sector employment rate*						
TP	3.161***	1.679***	2.386***	1.659***	1.183	0.706**
	(0.778)	(0.395)	(0.771)	(0.357)	(0.879)	(0.354)
N	987	988	986	987	975	976
R-squared	0.62	0.91	0.61	0.91	0.78	0.90

Note: see notes Table A2.