UMR 8184
Thema
THéorie Économique, Modélisation et Applications

THEMA Working Paper n°2017-03
Université de Cergy-Pontoise, France

Gender, Informal Employment and Trade Liberalization in Mexico

Sarra Ben Yahmed, Pamela Bombarda

Février 2017

UNIVERSITÉ de Cergy-Pontoise
CNRS CENTRE NATIONAL DE LA RECHERCHE SCIENTIFIQUE

Gender, Informal Employment and Trade Liberalisation in Mexico*

Sarra Ben Yahmed† and Pamela Bombarda‡

February 19, 2017

Abstract

We study how trade liberalisation affects formal employment across gender. We propose a theoretical mechanism to explain how trade liberalisation generates labour reallocation in formal jobs differently for men and women. Linking the Mexican labour force survey with data on tariffs at the 4-digit level from 1993 to 2001, we find that tariff reductions increase the probability of holding a formal job for both men and women within industries. Constructing a regional tariff measure, we find that the impact of regional exposure to Mexico's trade liberalisation on formal employment differs across gender. At the regional level, trade liberalisation increases the probability of working formally only for highly educated women. Controlling for sectoral differences, we find that manufacturing sectors experience a formalisation of jobs for both men and female, and in particular for highly educated men. While in the service sectors, men and low-skilled women have higher probabilities to work informally.

JEL classification: F11, F16, F63, O17

Keywords: Formal and informal labour, gender, trade liberalisation, Mexico.

*Acknowledgements: We would like to thank Clément Bosquet, Elisa Gamberoni, Stefania Marcassa, Gianluca Orefice and Philipp Sauré for helpful comments and suggestions. We thank Benjamin Aleman-Castilla, Mariano Bosch, and Marco Manacorda for helping us with the ENEU data and Eric Verhoogen for sharing with us the correspondence between Mexican industry classification, CMAP, and ISIC. Remarks from participants at the ETSG Conference in Helsinki, EEA Conference in Geneva and seminar participants at Cergy University contributed to improve this paper. All errors are ours. This research has been conducted as part of the project Labex MME-DII (ANR11-LBX-0023-01).

†ZEW Centre for European Economic Research, Mannheim, Germany email: benyahmed@zew.de

‡Université de Cergy-Pontoise, THEMA, 33 Boulevard du Port F-95011. Tel.: +33 1 34 25 67 59, email: pamela.bombarda@u-cergy.fr

1 Introduction

Trade integration episodes, by reallocating resources towards more productive sectors and firms, are expected to foster economic development. But the impact of international trade on labour markets is controversial, as it can also contribute to an increase in inequality (see Goldberg and Pavcnik (2007) and Hanson (2007) among others). Labour markets in developing countries are characterised by low female labour force participation and a dual system where formal and informal jobs coexist. Informal jobs tend to offer lower earning opportunities, worse working conditions and little social safety nets compared to formal jobs. Gender differences in labour force participation depend on culture and social norms, but those differences can also respond to economic incentives, in particular following reforms in trade policies. However, so far the potential impact of trade liberalisation on gender differences in formal employment has been overlooked. This is the focus of the present paper, which investigates the impact of Mexico's trade liberalisation on gender-specific formal employment.

In Mexico, the gender gap in employment to population ratio has been around 40 percentage points for decades. At the same time, informal employment is an important phenomenon since it affects more than 50 percent of all workers Jütting and De Laiglesia (2009). Analysing jointly informal labour and its gender composition is necessary to improve our understanding of the impact of globalisation on the labour market, and it is motivated by several observations. Firstly, sectors have different female labour shares as well as different shares of formal jobs. As trade integration benefits some sectors at the expense of others, it is likely to change formal employment shares, and differently for men and women. Secondly, trade liberalisation is likely to generate a "formal-biased technological change" since it favors most productive firms, which, because of their size and technology, are more intensive in formal labour. Finally, there is evidence in support of a stronger complementarity between capital and female labour than between capital and male labour.[1] Gender differences in substitution with capital also affects the pattern of labour allocations across sectors following macroeconomic changes such as trade.

Our analysis is developed in three steps. First, we present some facts on employment patterns in Mexico over the period 1993 and 2001. Considering both manufacturing and service industries, we observe that: (i) employment and formal employment shares have declined in service sectors while they increased in manufacturing;

[1] Black and Spitz-Oener (2010) show how technological change can increase women's productivity relative to men's through a decline in routine task inputs. Juhn et al. (2014) develop a model where firms upgrade their technology with trade integration which lowers their need for physically demanding tasks and thus increase their demand for female labour.

(ii) formal labour shares are greater for women than men both in manufacturing and in service sectors; and (iii) the female intensity in formal jobs has increased only in the manufacturing sectors.[2]

In the second step, we develop a general equilibrium model where trade liberalisation affects the formal labour share of employment. We follow Blum (2008) and Kovak (2013) and use a multi-sector Ricardo-Viner model with labour reallocation across tradable and non-tradable sectors in a set up with regional economies. We extend this framework to allow for formal and informal jobs and introduce sectoral heterogeneity in formal job intensity. We derive the conditions under which the formalisation of jobs at the regional level differs across men and women. More specifically, we find that trade liberalisation increases by a larger amount the demand for male relative to female labour in formal jobs if comparative advantage sectors are relatively more intensive in formal jobs, and if male labour is relatively more substitutable for capital than female labour.[3]

Finally, we analyse empirically how the probability to hold a formal job has evolved differently for men and women as a result of the Mexican trade liberalisation. Mexico represents an interesting case study for at least three reasons. First, among NAFTA members, Mexico was the country with the highest tariffs and experienced the largest cut during the NAFTA phase in. Over the period 1993-2001, Mexican import tariffs on U.S. products declined on average by 14 percent. Second, Mexico has a large informal sector which increased in the 1990s. Finally, female labour force participation is extremely low in Mexico, it was below 40 percent in the early 1990s and remained below 50 percent in the early 2000s.

We use individual data from the Mexican labour force survey which is the Encuesta Nacional de Empleo Urbano (ENEU). This survey enables us to identify whether working individuals belong to the formal or informal segment of the labour market. To characterise the informal segment, we first focus on wage employment and define informal employees as those who do not have access to health insurance and social security coverage that are mandated benefits of legal labour contracts. A broader definition of informality, used in a robustness check, also includes self-employed individuals. Additionally, the ENEU provides information on individual industry affiliation at the 4-digit level, and location at the municipality level. This enables us to match precisely individuals to tariff changes at the sectoral level and also to construct a measure of local exposure to trade liberalisation at the municipality level. This local approach allows us to disentangle the effects of trade liberalisation across tradable

[2]We consider both manufacturing and service industries. These are also called tradable and non-tradables industries respectively.

[3]This is a common assumption since the seminal article of Galor and Weil (1996).

and non-tradable sectors. The non-tradable industry it is indirectly affected by the change in tariffs, through labour reallocation across sectors.

We choose a linear probability model to examine the effect of trade on the probability to hold a formal job at different level of aggregation: industry and municipality level. At the 4-digit industry level, our findings show that individuals working in an industry experiencing the average reduction in tariffs, 14 percentage points, saw the probability of holding a formal job increase by 2 percentage points relative to individuals in industry facing no reduction in tariffs. The effect of trade liberalisation on the overall labour market, allowing for labour reallocation between industries, is captured by constructing a local measure of exposure to tariffs at the municipality level, where the sectoral tariffs are weighted by sectoral employment shares in each municipality. Exploiting the regional variation in tariffs, we find that women living in a municipality experiencing the average reduction in tariffs, 14 percentage points, saw their probability of holding a formal job decrease by almost 6 percentage points, relative to women in municipalities facing no reduction in tariffs. On average, men's probability to find a formal job was not significantly affected at the local level. We then explore whether the impact of regional tariff reductions on formality differs in tradable versus non-tradable sectors. We find that, in the manufacturing sectors, both women and men benefited from trade liberalisation. While in the service sector, the probability of working informally increased for women especially for those with a low educational attainment. Finally, our results highlight that the formalisation of jobs at the local level was mostly driven by high-skilled workers.

The paper is structured as follows. Section 2 describes the novel contributions of this paper with respect to the existing literature. Section 3 provides a description of the data, and an industry decomposition of changes in the formal employment share. Section 4 proposes a theoretical framework and derives predictions to be tested. Section 5 describes the empirical strategy. The estimation results and robustness checks are discussed in sections 6 and 7. Finally, section 8 concludes.

2 Related Literature

This paper is related to several strands of literature. Firstly, our paper relates to studies on informality in the labour market. Maloney (1999) analyses the labour market in Mexico and argues that both formal and informal jobs offer desirable characteristics that worker may choose depending on their situation. Gong and Van Soest (2002) and Galli and Kucera (2008) document how informality varies across gender in Latin American countries. A very small group of studies on informality considers the

effect of international trade. Goldberg and Pavcnik (2003) study how the informal sector adjust to liberalisation in Brazil and Columbia. Only for Columbia, they find that trade contributes to an increase in informal employment in those sectors where the tariff cuts were the largest. McCaig and Pavcnik (2015) find different results for Vietnam. Exploiting sector-specific changes in tariffs, they show that in industries experiencing larger declines in tariffs, labour is reallocated from small household businesses towards employment in the formal enterprise sector. We contribute to this literature by investigating whether changes in informality rates induced by trade liberalisation differ by gender.

Secondly, our work also relates to the labour market literature analysing the relationship between regional trade exposure and labour market outcomes. Chiquiar (2008) studies the effect of trade liberalisation on wages across Mexican regions. Topalova (2010) evaluates the effect of trade liberalisation on regional poverty using variation in sectoral composition across Indian districts. Kovak (2013) uses a specific-factors model of regional economies to empirically study the relationship between regional wage changes and liberalisation. Autor et al. (2013) study the effect of rising imports from China on employment outcomes in U.S. local labour markets. Our paper creates a link between informality and liberalisation to investigate local exposure to changes in trade openness on gender sorting across employment (formal and informal) and sectors.

Finally, our approach closely relates to a growing number of papers that emphasizes the gender-specific effects of international trade. This literature investigates how trade liberalisation affects gender gaps in labour force participation and in wages looking at different channels. Trade liberalisation can contribute to a reduction in the gender gap due to taste-based discrimination through a competition effect (see Black and Brainerd (2004) and Ben Yahmed (2012) among others). Other papers stress the importance of male and female differences in productive characteristics and how their returns evolve with trade integration (see Juhn et al. (2014) and Sauré and Zoabi (2014)). This literature has focused on gender gaps in participation and wages, but it has overlooked the potential effect of trade integration on gender gaps in informality rates, which is an important dimension of labour markets in developing countries. The aim of this paper is to draw attention to this additional channel. To the best of our knowledge, this is the first paper to investigate the effects of trade integration on formal and informal employment distinguishing between men and women.

3 Formal Employment Shares in Mexico

3.1 Data

The data used in this study come from the Encuesta Nacional de Empleo Urban (ENEU), which is a quarterly labour force survey conducted by the Mexican National Statistic Institute (INEGI). This survey provides highly disaggregated information on industry affiliation at 4-digit level and on location at the municipality level.[4] ENEU is a rotating panel, in which each individual can be surveyed for a maximum of 5 consecutive quarters. Each quarter a new cohort of individuals is selected, and one fifth of existing individuals leave the sample. The survey is representative of cities with over 100.000 inhabitants, and covers only the urban areas. The primary sampling units are municipalities.[5] Over time the sample size of the survey has constantly increased since cities were added every year. To avoid any selection issue, we decided to take the most conservative approach, and keep all 216 municipalities over the period 1993-2001.[6]

Our sample is restricted to working individuals between the ages of 16 and 60. Among those individuals, we distinguish three occupational statuses: formal and informal wage workers and self-employment. Informal wage workers are employees who report to be without health insurance or social security coverage although their status should entitle them to access those mandated benefits. Self-employed are those individuals who report that in their main job they are "own-account workers" (trabajador por su cuenta). These individuals are considered self-employed since they own very small businesses: more than 80% of them have no employees. It is important to notice that the ENEU survey does not allow us to clearly distinguish between formal and informal self-employment. Therefore, our preferred measure for formal employment only considers wage workers. This definition is extended in the robustness checks where we use a broader definition of informality which includes both informal wage employment and self-employment. Descriptive statistics on formal and informal employees, and self-employed are provided in Appendix A.

To capture trade liberalisation, we merge the ENEU data with Mexican import tariffs data at the 4-digit industry level. Since Mexican import tariff data follow CMAP classification, as explained in Iacovone and Javorcik (2010), we use a corre-

[4] This survey has been used by several authors, including for example Robertson (2004), Verhoogen (2008), and Bosch and Manacorda (2010).

[5] In this paper, for notational purposes, we use the terms "municipality" and "region" interchangeably.

[6] Alternative approaches suggest to focus on the subset of municipalities always surveyed in the sample period. We checked and our results are not affected by the sample choice which indicates that the composition of municipalities in the ENEU is not correlated to changes in trade policy.

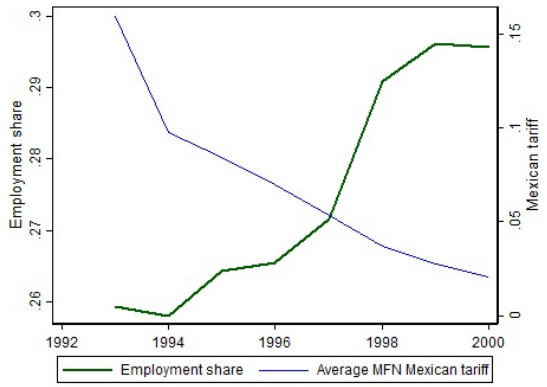
spondence table to link tariffs classification (CMAP) to ENEU product classification (CAE).[7] More details on tariffs data are provided in Section 5.1.

3.2 Trade liberalisation and Employment Shares

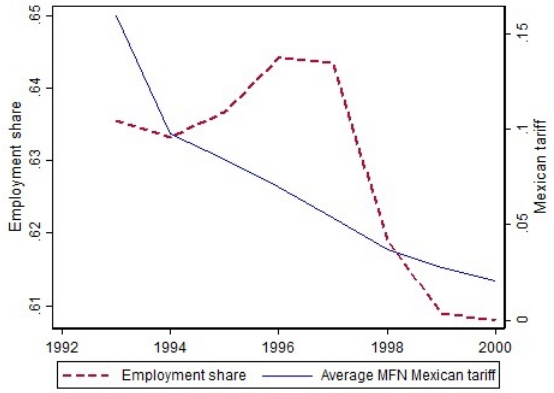
After a long period of import substitution strategy, in the 1980s Mexico started to move toward a liberalized trade regime. In 1994 it joined NAFTA and substantially lowered its tariffs to the U.S. and Canadian markets. Figure 1 shows the evolution of employment and formal employment shares in manufacturing and service sectors, and the drop in the average Mexican import tariff during the 1990s.

[7] We thank Beata Javorcik for providing us with the Mexican tariff data. Tariff data was available originally at the 8-digit Harmonized System (HS) classification and was matched to the Mexican CMAP class classification as explained in Iacovone et al. (2015) and Iacovone and Javorcik (2010). The correspondence table was kindly provided by Eric Verhoogen.

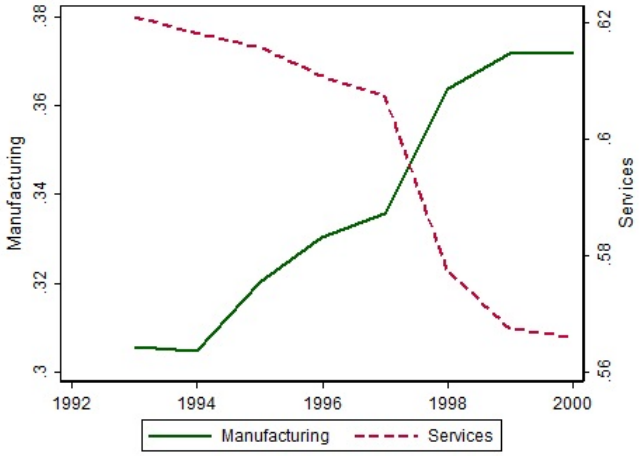
Figure 1: Employment Trends and Mexican tariffs



(a) Employment share in manufacturing sectors



(b) Employment share in service sectors



(c) Formal employment shares in Manufacturing & Services

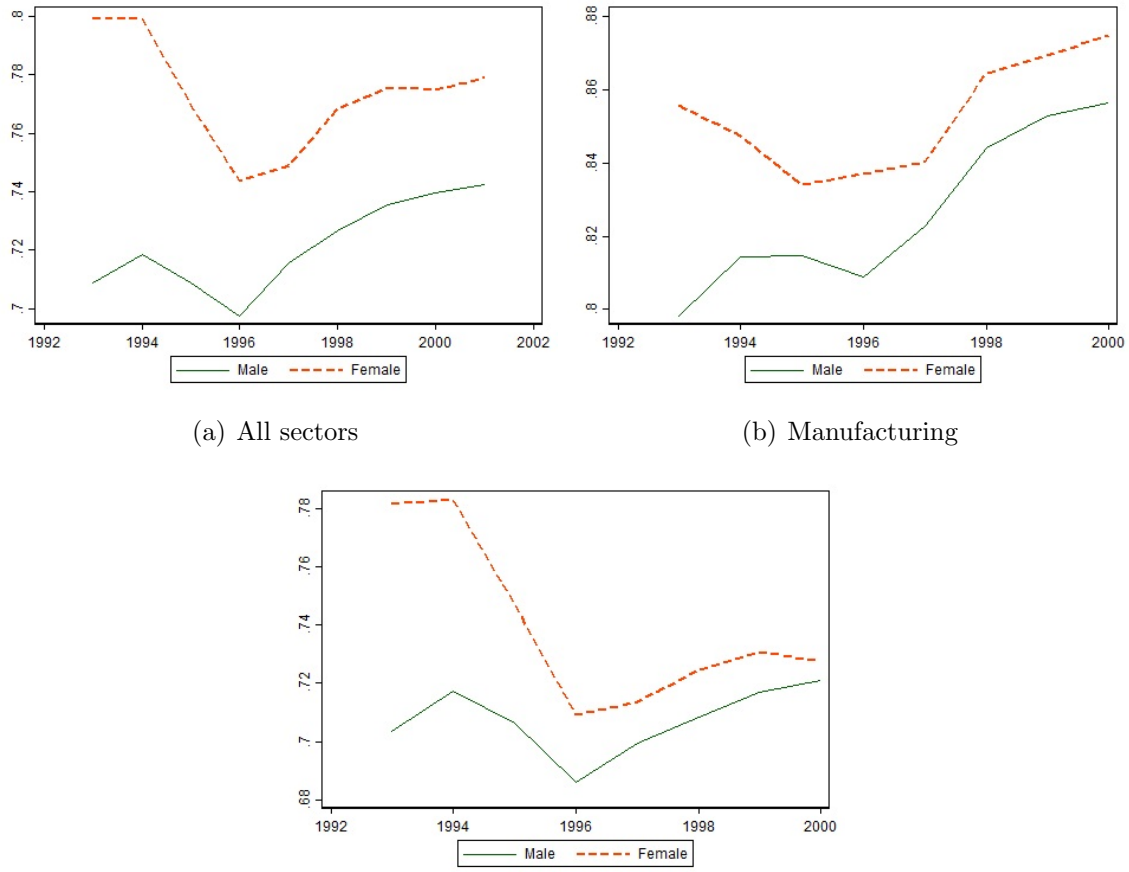
Source: ENEU, Mexico.

The average reduction in Mexican import tariff is around 14 percentage points, from more than 15 in 1993 to less than 1.5 percent in 2003. Panels *a* and *b* show that from the second part of the 1990s the employment share in the manufacturing sector has increased at the expense of the employment share in the service sector. The employment reallocation from manufacturing to service sectors coincides with the drop in the Mexican average tariff applied to U.S. products. Panel *c* confirms similar trends for formal employment shares in manufacturing and service sectors.

Figure 2 shows how formal employment has changed differently for male and female employees during the trade liberalisation period. Overall, female employees have a higher formality rate (between 80 and 75% across the period) than male

employees (between 70 and 74%). However, the gender gap in formality rate among wage workers has been shrinking. It was almost 10 percentage points in 1993, and became about 4 percentage points in 2001. Panel *b* in Figure 2 shows that the formality rate has increased in the manufacturing sectors for both men and women. Differently, Panel *c* shows that in the service sector the formality rate has decreased for women, while it has remained fairly stable for men. The next section provides a decomposition analysis of changes in the female share in formal employees.

Figure 2: Formality rate among wage workers



(a) All sectors

(b) Manufacturing

(c) Services

Source: Authors' calculations based on the ENEU, Mexico.

3.3 Between and Within-Industry Decomposition

In this section, we decompose the change in the formal employment shares of men and women into within and between industry changes. The decomposition is expressed

as follows:

$$\Delta FS_{gt} = \sum_i \Delta FS_{git} \times E_{gi} + \sum_i \Delta E_{git} \times FS_{gi} \tag{1}$$

for $i = 1, ..., N$ industries and where FS_{gt} denotes the share of formal employees in total employment of group $g = \{f, m\}$ where f denotes female and m denotes male. $\Delta FS_{gt} = FS_{gt} - FS_{gt-1}$ is the change in the formal employment share over the period. FS_{git} is the share of formal employees in industry i's employment for group g while E_{gi} is industry i's employment of group g.

Equation (1) decomposes the aggregate change in formal labour share (FS) into within-industry changes, and between-industry changes. The first term is the within-industry component and represents the part of the aggregate change in FS due to changes in the industry specific FS, holding constant the employment shares of industries. The second term is the between-industry component. It reflects how the aggregate FS changes due to changes in the employment shares of industries, holding constant the industry specific FS.

We present two tables with different level of industry disaggregation and different sample of industries. To better capture the effect of liberalisation, the decomposition is done over the entire sample period and then also splitting the sample period in two different sub-samples: 1994-1998 and 1998-2001. Table 1 presents the decomposition into between and within industry changes at the 1-digit level of disaggregation using the sample of workers in the manufacturing and the service sectors. The first column

Table 1: Decomposition across 1-digit (all sectors)

	Total	Within	Between
		1994-2001	
Female	-.02	-.027	.007
Male	.024	.021	.003
		1994-1998	
Female	-.031	-.038	.007
Male	.008	.004	.004
		1998-2001	
Female	.011	.011	-.001
Male	.016	.016	0

of Table 1 shows that the share formal employees among male employees has increased

in the overall economy by 2.4 percentage points but it has decreased among women by 2 percentage points. These changes are driven by within 1-digit industry changes. In the manufacturing sector the FS has substantially increased over the period, especially for men, while the FS in the service sector has fallen until 1996 and more so for women (Figure 2). Changes in employment shares of 1-digit sectors has contributed to a small increase in the overall FS for both gender.

Table 2 focuses on the manufacturing sector and shows how the FS can be explained by between and within 4-digit industries changes. Between 1994 and 2001, the FS among women has increased by more than 2 percentage points and by almost 4 percentage points among men in the overall manufacturing industry. At the 4-digit level of disaggregation, the change in the formal employment share is explained by both within and between-industry changes. Within-industry changes contribute positively to the increase in the FS for both men and women. The reallocation of labour into manufacturing industries with a high FS has also contributed to the increase in the aggregate FS except between 1994 and 1998 for women.

Table 2: Decomposition across 4-digit manufacturing sectors

	Total	Within	Between
		1994-2001	
Female	.021	.028	-.007
Male	.039	.027	.012
		1994-1998	
Female	.006	.017	-.011
Male	.028	.017	.011
		1998-2001	
Female	.012	.011	.002
Male	.011	.007	.004

Both within and between industry changes are important to explain changes in the share of formal jobs in wage employment. Therefore, in the following sections we investigate theoretically and empirically how trade liberalisation contributes to those changes. In line with the above decompositions, we propose a model able to generate changes in female share of formal employment through both within and between industry reallocation.

4 Theoretical Framework

The setup developed in this section follows Kovak (2013) in using Jones (1975) to model each region within a country as a specific-factor economy.[8] Then, similarly to Blum (2008), we consider a structure with two labour factors, female and male labour, to analyse labour reallocation across tradable and non-tradable sectors. Finally, to study the effect of trade on the size of the formal segment in the labour market, we use exogenous shares of formal and informal jobs.

4.1 The setup

We consider a country composed of several regions, indexed by r, that produce N goods, M of which are internationally tradable and can be either imported or exported. Since the focus is on a particular region, we suppress the subscript r on all terms. Production uses capital, K, and two types of labour, female and male labour, L_f and L_m. Labour is assumed to be supplied inelastically, fully employed, and perfectly mobile across industries but not across regions. Capital is assumed to be region and sector specific and fixed in the short-run. Technologies may differ across sectors, but are the same across regions within each sector. Production exhibits constant returns to scale, and factors and goods markets are competitive. All regions face the same prices for the tradable goods, which are taken as given on the international market.

We introduce jobs heterogeneity by assuming that each sector s, either tradable and non-tradable, is characterised by an exogenous share of formal jobs, α_s. More specifically, men and women can be hired as formal or as informal workers within the same sector. Formal employment for each gender g and sector s, is defined as $L_{\varphi gs} = \alpha_s L_{gs}$, where φ indicates formal and g indicates female or male workers, $g = (f, m)$. The term α_s captures sector heterogeneity in formal labour intensity.[9]

The model is entirely presented in Appendix B, where we explicitly solve for the endogenous variables, such as factor returns, sectoral employment allocations, sectoral output, and prices of non-tradable goods.[10] The following sections highlight different aspects of employment allocations in our model. Section 4.2 describes the effect of trade liberalization on male and female employment and on formality rates at the sectoral level. Sections 4.3 analyses the effect of trade on formality rates across

[8] For notational purposes we decided to use the word "region". But notice that these regions in the model correspond to "municipalities" in the ENEU data.

[9] We assume that formal labour intensity in a sector is the same across gender. Our results would hold if we allow the formal labour intensity to differ between men and women within each sector.

[10] See equations (11) to (14) for more details.

gender at the regional level.

4.2 Trade and employment at the sectoral level

Letting hats represent proportional changes, we can derive the determinants of changes in female and male labour demand in each sector s as:

$$\hat{L}_{fs} = \Theta^{f}_{fs}(\hat{p}_s - \hat{w}_f) + \Theta^{m}_{fs}(\hat{p}_s - \hat{w}_m) \tag{2}$$

$$\hat{L}_{ms} = \Theta^{m}_{ms}(\hat{p}_s - \hat{w}_m) + \Theta^{f}_{ms}(\hat{p}_s - \hat{w}_f) \tag{3}$$

where w_g is the wage of g-workers, and p_s is the price of the good produced in sector s. Θ^{h}_{gs} is a collection of terms:

$$\Theta^{h}_{gs} = \sigma^{g}_{gk,s}\frac{\theta_{ks} + \theta_{hs}}{\theta_{ks}} + \sigma^{h}_{gk,s}\frac{\theta_{g,s}}{\theta_{ks}} \tag{4}$$

where $\sigma^{g}_{gk,s}$ is the elasticity of substitution between factor g and the specific factor K_s in sector s with respect to the relative prices of factors g and K_s. Finally, θ_{ks} and θ_{gs} are the cost shares of factors L_g and K_s respectively.[11]

The effects of trade on female and male employment at the sector level. Equations (2) and (3) show that the demand for labour g in sector s increases with the price of good s and decreases with the wage paid to factor g. As standard in RV set up, the magnitude of the wage change is always smaller than the price change, so that the change in sectoral labour demand follows the sign of the price change. To discuss the effect of an increase in good price on labour demand we use equilibrium wage equations (28) and (29) reported in Appendix B.

Following an increase in the price of good s, factors demands increase in sector s. Labour is mobile across sectors, therefore workers move to sector s until wages are equalized across sectors. Since capital is sector-specific and fixed in the short run, it becomes a scarce resource in sector s. Thus, the rental rate of capital, r_s, increases more than the price, p_s. Therefore, the wage increases but proportionally less than the price.

The price increase in sector s, raises the amount of both types of labour hired by sector s, but not necessarily in the same proportion. If in sector s, male labour is relatively more substitutable for capital than female labour, and the fraction of male labour is bigger than the fraction of female labour, the price raise leads to larger

[11] See equations 23 and 24 in Appendix B for more details.

increase in w_m than in w_f (see equations (28) and (28) in Appendix B). Under these conditions, sector s hires relatively more male labour.[12]

Moving from autarky to trade integration corresponds to an increase in the price of the comparative advantage (henceforth CA) goods, $\hat{p}_s > 0$. Accordingly, trade liberalization leads to a larger increase in male labour compared to female labour in those CA sectors where the male labour demand is relatively more elastic than female labour demand and the fraction of male labour is bigger than the fraction of female labour.

The effect of trade on formal employment at the sector level.
The model can capture within-industry changes in formal employment shares only through exogenous shocks to formal sector labour intensity, $\hat{\alpha}_s = \frac{\hat{L}_{\varphi gs}}{\hat{L}_{gs}}$. The change in α_s can be considered a "formal-biased technological change". Therefore, trade liberalization can increase the share of formal labour intensity at the sectoral level by reallocating employment to trade-oriented firms, which are more intensive in formal jobs (see Nataraj (2011) and McCaig and Pavcnik (2015) among others). In fact, it is well established that trade integration induces employment reallocation across heterogeneous firms within sectors. Since trade-oriented firms tend to be larger and employ more skilled workers, they should be also more likely to hire formal workers.

This paper does not focus on changes in α_s. Rather, we use our model to explore the effects of trade liberalization on regional gender gap in formality rates through labour reallocation *between* sectors. We discuss in section 4.3 how trade liberalization may differently affect the formality rate of men and women at the regional level.

4.3 Trade and employment at the regional level

This section adopts a local labour market approach and investigate how the demand for formal labour evolves with trade liberalization in a regional economy.

The effect of trade on formal employment.
The share of formal employment of group g in a particular region is given by:

$$\frac{L_{\varphi g}}{L_g} = \frac{\sum_s \alpha_s L_{gs}}{\sum_s L_{gs}} \tag{5}$$

and its change can be express as: $\hat{L}_{\varphi g} - \hat{L}_g$. Since labour supply is fixed at the regional

[12]The fact that male labour is more substitutable than female can also be stated in terms of labour demand elasticities: in this case the demand for male labour is more elastic than the demand for female labour. The labour demand elasticity for labour factor g is defined as $\frac{\partial L_{gs}}{\partial (w_g/p_s)} \frac{w_g/p_s}{L_{gs}}$.

level, $\hat{L}_g = 0$, the change in formal labour share is equal to the change in the formal labour level:

$$\hat{L}_{\varphi g} = \sum_s \lambda_{\varphi g s} \hat{L}_{gs} \tag{6}$$

where $\lambda_{\varphi gs} = \frac{\alpha_s L_{gs}}{L_{\varphi g}}$ represents the fraction of group g's formal employment employed in industry s. As explained in section 4.2, trade liberalization affects differently the amount of labour used in each sector, $\hat{L}_{gs}$. To understand what happens to employment (and wages) at the regional level, we need to consider the endowment of industry specific factors across regions. In our model, if region r is relatively well endowed with the industry s specific factor, then that region should allocate a greater share of its labour to industry s. This implies that the impact of an increase in industry s price (CA sector) is greater in that region with respect to the other regions. In turns there will also be a larger effect on employment in that regionally important industry s. If in this region, those sectors experiencing a price increase (which are also increasing their labour demand $\hat{L}_{gs}$), are characterised by relatively larger shares of formal employment, $\lambda_{\varphi gs}$, then in this region formal employment will also raise for both labour groups, $\hat{L}_{\varphi g} > 0$.[13] The formalisation of regional employment is greater if the CA sectors are larger, more intensive in formal labour (i.e. large $\lambda_{\varphi gs}$) and if their labour demand is more elastic, so that they absorb larger amount of labour from non-CA sectors.

Prediction 1. *At the regional level, formal employment increases if CA sectors in that region are larger, more intensive in formal labour, and have more elastic labour demands than the comparative disadvantage sectors.*

The effect of trade on the gender gap in formal employment.
We now use our model to deliver predictions about changes in female and men formal employment shares at the regional level. We use equation (6) to compute the differential change in formal employment :

$$\hat{L}_{\varphi m} - \hat{L}_{\varphi f} = \sum_s \lambda_{\varphi m s} \hat{L}_{ms} - \sum_s \lambda_{\varphi f s} \hat{L}_{fs} \tag{7}$$

where $\hat{L}_{ms}$ and $\hat{L}_{fs}$ are functions of prices as expressed in equations (2) and (3). Equation (7) will be used to analyse how a particular region's gender gap in formal employment is affected by changes in good prices. The effect of trade in a partic-

[13] Note that equation (6) can be expressed for all sectors s, and for a subset of sectors such as the tradable sectors only.

ular region is related to its amount of specific factors, combined with other relative characteristics of CA sectors.

Let's consider CA sectors in which male labour is relatively more substitutable for capital than female labour, and where the fraction of male labour is bigger than the fraction of female labour. In this case, a price increase implies that the CA sectors experience a stronger increase in male labour demand compared to female labour demand.[14] Additionally, if these CA sectors are more intensive in formal labour than the non-CA sectors, trade liberalization generates more male formal jobs than female formal jobs.

Prediction 2. *Within a region, trade liberalization increases by a larger amount the share of male formal employment relative to female if: a) male labour is relatively more substitutable for capital than female labour in CA sectors, and b) CA sectors are larger and more intensive in formal labour than non-CA sectors.*

Although all regions face the same changes in international prices, the fact that each region has a different industry mix alters the effect of trade on the gender gap in formal employment. The magnitude of the change in the regional gender gap in formal employment depends on the size of the CA sectors and on the concentration of men and women across sectors. More specifically, in a given region, men experience a larger increase in formal employment if they are concentrated in relatively large CA sectors in that region.[15]

We now move to the empirical investigation and study the effects of trade liberalization on formal employment across gender in Mexico. We will use Predictions 1 and 2 to interpret our results.

5 Empirical Strategy

This section describes how we identify the causal effect of trade liberalisation on the probability to work as a formal employee. The benchmark results include two types of workers, formal and informal workers, excluding self-employment. Then, in the robustness checks we consider a broader definition of informal employment, where we account for both informal workers and self-employment. Section 5.1 describes how we measure trade liberalisation at the sectoral and at the regional level, and section 5.2

[14] See labour demand equations (2) and (3).

[15] Moving from short to long run by letting capital free to move across sectors will highlight the complementarity between female and capital.

describes the empirical specification. In sections 6 and 7 we discuss our main results and the robustness checks.

5.1 Measures of Trade liberalisation

We compute two different tariff measures to capture trade liberalisation. First, we take the average ad-valorem Mexican import tariff at the 4-digit sector level of the CAE classification. We use these Mexican import tariffs, denoted τ_{st}, to study the effect of trade policy on gender sorting across formal and informal jobs within 4-digit manufacturing industries.

Second, we compute a local measure of exposure to tariffs at the municipality level to study how trade liberalisation affects differently each local labour market including the non-tradable sector. A municipality exposure to tariff is computed as the employment weighted average tariffs of manufacturing industries active in that municipality. The weight is given by the number of employees working in each sector of that municipality. To avoid endogeneity issues, we use employment structures at the beginning of the period in 1993 as weights.[16] Following Topalova (2010) our approach does not account for employment in the non-tradable sectors from the weighted average.[17] The municipality tariff is thus:

$$\tau_{rt} = \frac{\sum_s^M Empl_{rs,1993} \times \tau_{st}}{\sum_s^M Empl_{rs,1993}} \tag{8}$$

where r indicates the municipality, s the industry within the subset of manufacturing industries, $s = 1, ..., M$, and t is time. This tariff measure varies across municipalities and time because of regional differences in the sectoral composition and tariff changes across sectors and time.

5.2 Regression Analysis

Industry-specific tariffs and within-industry formalisation

We start by assessing the importance of increased trade openness on male and female employment in formal and informal jobs within sectors. The following linear

[16] We have also computed the municipality average tariff using alternative weights. Firstly, we have used as weights the employment structures in 1992. Secondly, we have constructed a local exposure to tariffs using employment in the first sample year of each municipality as weights. The latter approach enables us to include municipalities that entered the ENEU survey after 1993 and uses different years as weights depending on when the municipality started to be surveyed. All the results confirmed our benchmark results and are available upon request.

[17] Alternatively, one could assign a zero tariff to the non-tradable industries. But in this case the local tariff measure is sensitive to the amount of people hired in non-traded sectors.

probability model is estimated on the sample of workers in manufacturing industries:

$$F_{isrt} = \alpha x_{isrt} + \beta_1 \tau_{st}^{Mex} + \beta_2 \tau_{st}^{Mex} \times female + \mu_s + u_r + v_t + \epsilon_{isrt} \tag{9}$$

where F_{isrt} is an indicator that takes the value one if individual i is employed as a formal worker in industry s and region r at time t, and zero if the individual works as an informal employee. x_{isrt} is a vector of specific individual characteristics which includes a female dummy, age, age square and the number of years of education. τ_{st}^{Mex} is the Mexican import tariff at the CAE 4-digit industry level, and $\tau_{st}^{Mex} \times female$ is the interaction term between the import tariff and the female indicator. μ_s, u_r, and v_t are a full set of 4-digit sector, municipality, and year fixed-effects. To allow for different effects of trade liberalisation on high versus low-skilled workers, we also interact the tariff variable with an indicator variable equals to one if the individual has more than 9 years of education.

The coefficient β_2 captures the differential effect of trade liberalisation on female probability to hold a formal job relatively to men. The sum between the coefficients β_1 and β_2 gives the average marginal effect of a change in the Mexican import tariff on the female probability to be a formal employee within a tradable sector. To limit the risk of omitted variable bias, we also include gender-specific sector fixed effect. This should control for industry specific differences in male and female formality rates and any other time-invariant industry characteristics that affect the probability to get a formal job for men and for women and may be correlated with tariff reduction. Moreover, endogeneity due to reverse causality should not be an issue for two reasons. Firstly, we use tariffs and not trade volumes; this latter are more strictly interconnected to labour markets. Secondly, we use individual level data, therefore we are confident that changes at the individual level are unlikely to exert any impact on industry level aggregates.

Region specific tariffs and formalisation in local labour markets

To estimate the effect of regional exposure to trade liberalisation on the formalisation of jobs, we use regional weighted tariffs which vary across municipalities and years. The probability of individual i living in municipality r to be working in a formal job is then given by:

$$F_{irt} = \alpha x_{irt} + \beta_1 \tau_{rt}^{Mex} + \beta_2 \tau_{rt}^{Mex} \times female + u_r + v_t + \epsilon_{irt} \tag{10}$$

where F_{irt} is an indicator that takes the value one if individual i is employed as a formal worker in region r at time t, and zero if the individual works as an informal employee. x_{irt} is a vector of specific individual characteristics which includes a female

dummy, age, age square and education. τ_{rt}^{Mex} is the regional Mexican import tariff, and $\tau_{rt}^{Mex} \times female$ is the interaction term between the regional import tariff and the female dummy. u_r and v_t are municipality and year fixed effects respectively. β_2 captures the differential effect of regional trade liberalisation on female probability to hold a formal job. Since we want to identify the average local effect within a municipality, and not the average change within an industry, we do not control for industry fixed-effect.

We allow for different effects of trade liberalisation on high versus low-skilled workers by interacting the regional tariff variable with an indicator variable equals to one if the individual has more than 9 years of education. Additionally, to disentangle the effects of local exposure to trade liberalisation across the tradable and non-tradable sectors, we interact the regional tariff variable with a 1-digit service sector dummy. We also control for the effect of trade on high and low skilled workers within the 1-digit service and manufacturing sectors.[18] We thus estimated equation (10) on employees working in manufacturing and service industries.

6 Empirical Results

6.1 Trade liberalisation within tradable industries

We begin by examining the effect of sector specific tariffs on the probability to hold a formal job within 4-digit tradable sectors. Our estimates of equation (9) are reported in Table 3.

We can see that the education level and potential experience as proxied by age increase the probability to hold a formal job. The negative coefficients associated with sectoral tariffs τ_{st} indicates that trade liberalisation leads to a formalisation of jobs within 4-digit manufacturing industries. The magnitude of the coefficient in column (1) indicates that individuals working in an industry that experienced the average reduction in tariffs, 14 percentage points, saw the probability of holding a formal job increase by 2 percentage points relative to individuals in industry facing no reduction in tariffs. To evaluate whether the effect of trade liberalisation differs across gender, we interact the tariff with the female dummy. As reported in column (2), the interaction is insignificant which suggests that the change in the probability to hold a formal job with trade integration is identical across gender.

In columns (3) and (4) we consider the role of education and interact the tariff measure with the worker's level of education. Column (3) shows that within sectors

[18] Finally, as an additional control we use gender-specific municipality fixed effects. Results are not affected and are available upon request.

Table 3: Within-industry Tariff Changes

	Manufacturing sectors				
Dependent variable	Probability of being a formal employee				
	(1)	(2)	(3)	(4)	(5)
age	0.022***	0.022***	0.022***	0.022***	0.022***
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)
age^2	-0.000***	-0.000***	-0.000***	-0.000***	-0.000***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
years of education	0.001***	0.001***	0.001***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
female	0.000	-0.001	-0.001	0.001	-0.031***
	(0.004)	(0.004)	(0.004)	(0.005)	(0.012)
he			-0.005***	-0.003	-0.003
			(0.002)	(0.002)	(0.002)
τ_{st}	-0.149***	-0.155***	-0.150***	-0.147***	-0.166***
	(0.054)	(0.052)	(0.053)	(0.053)	(0.055)
$\tau_{st}\times$ female		0.016	0.015	0.008	0.057
		(0.035)	(0.035)	(0.037)	(0.042)
he$\times$ female				-0.006*	-0.007**
				(0.003)	(0.003)
$\tau_{st}\times$ he			-0.013	-0.021	-0.023
			(0.018)	(0.020)	(0.020)
$\tau_{st}\times$ he $\times$ female				0.022	0.029
				(0.032)	(0.031)
Observations	674,222	674,222	674,222	674,222	674,222
R-squared	0.251	0.251	0.251	0.251	0.252
Year FE	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes
4-digit sector FE	Yes	Yes	Yes	Yes	Yes
Gender 4-digit sector	No	No	No	No	Yes

Notes: The regressions are LPM estimations of equation (9) for the period 1993-2001. Only manufacturing sectors. The dependent variable equals 1 if the individual is in formal wage employment and 0 if in informal wage employment. Individuals with a high level of education have more than 9 years of education (he). Heteroskedasticity-robust standard errors clustered at sector-year level are reported in parentheses. $***, **$, and $*$ indicate significance at the 1, 5 and 10 percent levels respectively.

trade liberalisation does not affect differently high and low skilled workers. Column (4) confirms a similar result by gender. Column (5) controls for gender-specific sector fixed effect, and the results do not change. Overall, both men and women, regardless of their level of education, have higher chances to be formal employees if they work in an industry whose tariff declines. The finding that workers benefit from trade liberalisation in terms of formal jobs is in line with a "formal-biased technological change" discussed in Section 4.2.

6.2 Trade liberalisation and local labour market

In what follows we adopt a local labour market approach and estimate the effect of changes in the regional tariff on formal employment, as in equation (10). Since we do not control for disaggregated industry fixed-effects, we explore in this specification how formal wage employment changes within a region allowing for between-sector labour movements. The construction of the regional tariff measure, which varies across time and municipality, is discussed in Section 5.1. The estimates of equation (10) are reported in Table (4).

Columns (1) shows no significant effect of changes in local exposure to tariffs on the average probability to work formally. Column (2) allows for heterogeneous effects between men and women, and shows that women's probability to work formally is significantly affected by changes in regional tariff barriers. Women living in a region experiencing the average reduction in tariff, 14 percentage points, saw the probability of holding an formal job decrease by almost 6 percentage points relative to women in regions facing no reduction in tariffs. Columns (3) and (4) control for the individual level of education and its interaction with the tariff measure. Column (3) shows that in a local labour market trade liberalisation affects differently high and low skilled workers. Column (4) finds that trade liberalisation generates a formalisation of high-skilled jobs for both men and female. However, for women the negative coefficients on $\tau_{rt} \times he$ and $\tau_{rt} \times he \times female$ do not compensate the positive coefficient on $\tau_{rt} \times female$. Even high-skilled women saw their probability to work formally decrease by 3 percentage points with the increase in the exposure to trade liberalisation.

As Figure (2) indicates, over the 1990s the formality rate has evolved differently in the manufacturing and in the service sectors. Thus, we exploit the regional variation in tariffs to analyse whether regional tariff reductions affect differently workers in the manufacturing and in the service sectors. The results are shown in column (5). Focusing first on the manufacturing sector, the coefficient associated with regional tariffs is negative and statistically significant, and its interaction with female is positive, significant but smaller in magnitude. Conditional on working in the manufacturing

sector, the probability to work formally increased in regions experiencing a reduction in their average tariff. This formalisation of employment is greater for male workers whose probability to be formally employed increased by 8 percentage points with a fall in local tariffs of 14 percentage points. While the female probability increased by less than 6 percentage points. Additionally, the magnitudes of the point estimates of the regional tariff are bigger than the ones of the 4-digit tariff lines in Table 3. The formalisation effect of trade in the overall manufacturing sector is greater than the average formalisation effect within 4-digit sectors. This suggests that regional liberalisation generated labour reallocation across 4-digit manufacturing industries, which contributed to a formalisation of employment in manufacturing industries, especially for men.

The service sector is affected differently by a change in regional exposure to tariffs compared to the manufacturing sector. In column (5) the coefficients associated with $\tau_{rt} \times serv$, and $\tau_{rt} \times serv \times female$ are both positive and significant. For men, it compensates the negative coefficient associated with τ_{rt}, so that men's formal job probability in the service sector is not significantly affected by regional trade liberalisation.[19] Differently, women employed in the service sectors experienced a reduction in the probability to work formally by less than 6 percentage points.

Column (6) allows the effect of regional tariffs to differ across gender, sectors and levels of education. In the manufacturing sector, high-skilled men have higher chances to find a formal job by about 10 percentage points with a fall in the municipality tariff of 14 percentage points.While for high-skilled women, this formalisation effect is smaller, and their probability to hold a formal job increases only by 8 percentage points.[20] In the service sector, the probability to hold a formal job has *decreased* with trade liberalisation and the effect is especially strong for low-skilled women. More specifically, the female probability to work formally falls by 14 percentage points for women with a low level of education, and by 9 percentage points for women with a high level of education.

To summarize, we find that higher education increases the chances to benefit from trade liberalisation in the tradable sectors for both men and women. In the non-tradable sector, even though the exposure to trade liberalisation increases the probability to work informally, women with a high educational attainment have a lower probability of working informally following a fall in regional tariffs compared to women with a low educational attainment.

[19]The linear combination of the coefficients τ_{rt} and $\tau_{rt} \times serv$ is negative and not significantly different from zero.

[20]The linear combination $\tau_{rt} + \tau_{rt} \times female + \tau_{rt} \times he + \tau_{rt} \times he \times female$ is significant at the 1% level.

Overall our results suggest that women and men have been differently affected by trade liberalisation. On one hand, in the manufacturing sectors formalisation of jobs has benefited all workers but with different magnitudes. On the other hand, in the service sectors the fall in regional tariffs has decreased the chances to hold a formal job for women, especially for those with a low level of education. The reallocation of employment across sectors has led to a stronger increase in formal employment for men in the overall tradable sector. Using our theoretical framework, this corresponds to a situation in which CA sectors, which expand through trade, are intensive in formal labour relatively to non-CA and non-tradable sectors. The finding that men have benefited more from liberalization can be explained using the mechanisms highlighted in our model. The CA sectors are characterized by relatively more male formal labour than female, and in these sectors male labour is relatively more substitutable for capital than female labour (see Prediction 2).

Table 4: Municipality Exposure to Tariffs

	Manufacturing and Service sectors					
Dependent variable	Probability of being a formal employee					
	(1)	(2)	(3)	(4)	(5)	(6)
years of education	0.004***	0.004***	0.002***	0.002***	0.001***	0.001***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
female	0.049***	0.027***	0.047***	0.045***	0.044***	0.039***
	(0.002)	(0.004)	(0.004)	(0.004)	(0.004)	(0.004)
τ_{rt}	-0.190	-0.333	-0.274	-0.288	-0.585**	-0.515**
	(0.232)	(0.231)	(0.235)	(0.235)	(0.222)	(0.227)
τ_{rt} × female		0.410***	0.396***	0.432***	0.161**	0.153**
		(0.042)	(0.042)	(0.053)	(0.059)	(0.061)
τ_{rt} × he			-0.149***	-0.118**		-0.208***
			(0.052)	(0.057)		(0.059)
τ_{rt} × he × female				-0.089*		-0.027
				(0.051)		(0.063)
τ_{rt} × serv					0.459***	0.432***
					(0.094)	(0.098)
τ_{rt} × serv × female					0.400***	0.576***
					(0.071)	(0.087)
τ_{rt} × serv × he						0.101
						(0.074)
τ_{rt} × serv × he × female						-0.362***
						(0.083)
Observations	2,676,734	2,676,734	2,676,734	2,676,734	2,676,734	2,676,734
R-squared	0.092	0.092	0.093	0.093	0.120	0.120
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
4-digit sector FE	No	No	No	No	No	No

Notes: The regressions are LPM estimations of equation (10) for the period 1993-2001. The local tariff is calculated as in equation (8) with the municipality and sectoral employment of 1993 as weights. The sample is composed of workers in both the tradable and non-tradable sectors. The dependent variable equals 1 if the individual is in formal wage employment and 0 if in informal wage employment. Additional controls include age and age^2. Columns (3), (4) and (6) also include a high level of education dummy (he) for individuals with more than 9 years of education. Columns (4) and (6) include the interaction between he and the female dummy. Columns (5) and (6) include a dummy for the service sectors and all necessary interactions with the female and the high education dummy. Heteroskedasticity-robust standard errors clustered by municipality-year pairs are reported in parentheses. $***, **$, and $*$ indicate significance at the 1, 5 and 10 percent levels respectively.

7 Robustness Checks

In this section we conduct different robustness checks to deal with potential concerns. First, we control for gender-specific five-year age cohorts to better account for changes in the composition of the male and female labour force. Second, to tackle the potential endogeneity issue related to changes in tariff and industry characteristics we use lagged Mexican import tariff. Finally, we account for a broader definition of informality which also includes self-employment. All the robustness checks confirm our benchmark results.

7.1 Five-year cohort fixed-effects

We create a 5-year cohort variable for men and for women to control for cohorts unobserved characteristics. In this way, we can avoid any bias due to the labour market entry of new cohorts in the 1990s that may have had certain preferences in terms of formal status. Table 5 presents estimates of equation (9) controlling for cohorts unobserved characteristics, and confirms our benchmark findings discussed in Section 6.1. In particular, Table 5 shows that a fall in tariff contributes to the formalisation of jobs within 4-digit industries for all individuals. This effect does not vary depending on gender or on the education level. Table 6 presents the estimated results for equation (10) adding cohort fixed-effects. Results confirm our benchmark regional estimation discussed in Section 6.2.

Table 5: Within-industry changes with cohort fixed-effects

	(1)	(2)	(3)	(4)
τ_{st}	-0.152***	-0.161***	-0.165***	-0.162***
	(0.054)	(0.053)	(0.053)	(0.054)
τ_{st} × female		0.023	0.025	0.018
		(0.036)	(0.036)	(0.038)
τ_{st} × he			0.011	0.004
			(0.017)	(0.019)
τ_{st} × he × female				0.020
				(0.031)
Observations	674,222	674,222	674,222	674,222
R-squared	0.254	0.254	0.255	0.255
Year FE	Yes	Yes	Yes	Yes
Municipality	Yes	Yes	Yes	Yes
4-digit sector FE	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes

Notes: The regressions are LPM estimations of equation (9) for the period 1993-2001. The dependent variable equals 1 if the individual is in formal wage employment and 0 if in informal wage employment. Main controls are the same as in Table (3). Columns (1) to (4) provide estimates of the effect of 4-digit sector tariff lines on the probability to hold a formal job within manufacturing sectors. We control for age and age^2, years of education and a female dummy in all columns. Columns (3) and (4) also include a high level of education dummy (he) for individuals with more than 9 years of education, and its interaction with the female dummy in columns (4). Standard errors are clustered at the sector-year level. $***, **$, and $*$ indicate significance at the 1, 5 and 10 percent levels respectively.

Table 6: Municipality exposure with cohort fixed-effects

	(1)	(2)	(3)	(4)	(5)	(6)
τ_{rt}	-0.208	-0.362	-0.330	-0.341	-0.591***	-0.562**
	(0.233)	(0.233)	(0.237)	(0.236)	(0.227)	(0.227)
τ_{rt} × female		0.440***	0.440***	0.467***	0.233***	0.154**
		(0.043)	(0.043)	(0.054)	(0.059)	(0.060)
τ_{rt} × he			-0.081	-0.055	-0.051	-0.140**
			(0.051)	(0.056)	(0.057)	(0.057)
τ_{rt} × he × female				-0.098*	-0.321***	-0.052
				(0.051)	(0.046)	(0.063)
τ_{rt} × serv					0.452***	0.423***
					(0.093)	(0.096)
τ_{rt} × serv × female					0.499***	0.620***
					(0.071)	(0.086)
τ_{rt} × serv × he						0.094
						(0.074)
τ_{rt} × serv×he × female						-0.353***
						(0.084)
Observations	2,676,734	2,676,734	2,676,734	2,676,734	2,676,734	2,676,734
R-squared	0.095	0.096	0.096	0.096	0.123	0.123
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Metropolitan areas	Yes	Yes	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes
4-digit sector FE	No	No	No	No	No	No

Notes: The regressions are LPM estimations of equation (10) for the period 1993-2001. The dependent variable equals 1 if the individual is in formal wage employment and 0 if in informal wage employment. Main controls are the same as in Table (4). Columns (1) to (4) provide estimates of the effect of municipality tariff allowing for between-sector reallocation. Columns (3) and (4) also include a high level of education dummy (he) for individuals with more than 9 years of education, and its interaction with the female dummy in columns (4). Standard errors are clustered at the municipality-year level. $***, **$, and $*$ indicate significance at the 1, 5 and 10 percent levels respectively.

7.2 Lagged Tariff

Tables 7 and 8 replicates the empirical analysis using lagged tariffs and lagged regional average tariffs. These results confirm our benchmark findings in Tables 3 and 4. Tables 7 shows that the formalisation effect of trade liberalization within industry is robust and even stronger in magnitude when we use lagged tariffs. Similarly, Table 8 shows that the formalisation effect of liberalisation is always significant at the regional level and stronger, specifically in the manufacturing sector. However the differential effect across levels of education, although of the same sign, it is not estimated precisely in the manufacturing sector (columns (4) and (6)).

Table 7: Within-industry changes with lagged tariff

	(1)	(2)	(3)	(4)
$\tau_{s,t-1}$	-0.272***	-0.257***	-0.264***	-0.260***
	(0.084)	(0.080)	(0.080)	(0.081)
$\tau_{s,t-1}$ × female		-0.029	-0.027	-0.034
		(0.037)	(0.037)	(0.039)
$\tau_{s,t-1}$ × he			0.019	0.012
			(0.020)	(0.023)
$\tau_{s,t-1}$ × he × female				0.020
				(0.031)
Observations	622,122	622,122	622,122	622,122
R-squared	0.260	0.260	0.260	0.260
Year FE	Yes	Yes	Yes	Yes
Municipality	Yes	Yes	Yes	Yes
4-digit sector FE	Yes	Yes	Yes	Yes
Cohort FE	Yes	Yes	Yes	Yes

Notes: The regressions are LPM estimations of equation (9) for the period 1993-2001. The dependent variable equals 1 if the individual is in formal wage employment and 0 if in informal wage employment. Main controls are the same as in Table (3). Columns (1) to (4) provides estimates of the average effect of 4-digit sector tariff lines on the probability to hold a formal job within 4-digit manufacturing sectors. Columns (3) and (4) also include a high level of education dummy (he) for individuals with more than 9 years of education, and its interaction with the female dummy in columns (4). Standard errors are clustered at the sector-year level. $***, **$, and $*$ indicate significance at the 1, 5 and 10 percent levels respectively.

Table 8: Municipality exposure with lagged tariff

	(1)	(2)	(3)	(4)	(5)	(6)
$\tau_{r,t-1}$	-0.561**	-0.687***	-0.667***	-0.680***	-0.892***	-0.874***
	(0.240)	(0.239)	(0.244)	(0.244)	(0.231)	(0.231)
$\tau_{r,t-1}$ × female		0.357***	0.342***	0.375***	0.152***	0.096
		(0.044)	(0.045)	(0.056)	(0.058)	(0.061)
$\tau_{r,t-1}$ × he			-0.048	-0.019	-0.023	-0.104
			(0.069)	(0.075)	(0.078)	(0.067)
$\tau_{r,t-1}$ ×he × female				-0.083	-0.346***	-0.114
				(0.057)	(0.045)	(0.071)
$\tau_{r,t-1}$ × serv					0.449***	0.434***
					(0.087)	(0.099)
$\tau_{r,t-1}$ × serv × female					0.500***	0.588***
					(0.073)	(0.089)
$\tau_{r,t-1}$ × serv ×he						0.078
						(0.089)
$\tau_{r,t-1}$ × serv× he × female						-0.298***
						(0.090)
Observations	2,401,296	2,401,296	2,401,296	2,401,296	2,401,296	2,401,296
R-squared	0.099	0.099	0.100	0.100	0.127	0.128
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality	Yes	Yes	Yes	Yes	Yes	Yes
4-digit sector FE	No	No	No	No	No	No
Cohort FE	Yes	Yes	Yes	Yes	Yes	Yes

Notes: The regressions are LPM estimations of equation (10) for the period 1993-2001. The dependent variable equals 1 if the individual is in formal wage employment and 0 if in informal wage employment. Main controls are the same as in Table (4). Columns (1) to (4) provide estimates of the effect of municipality tariff on the average probability to hold a formal job in the regional economy Columns (3) and (4) also include a high level of education dummy (he) for individuals with more than 9 years of education, and its interaction with the female dummy in columns (4). Standard errors are clustered at the municipality-year level. $***, **$, and $*$ indicate significance at the 1, 5 and 10 percent levels respectively.

7.3 Self Employment

Informality can be defined in different ways. So far we have adopted the approach that focuses on wage employment and distinguishes formal from informal employees using the fact that the labour contract is or not registered by their employer. Under this definition, informal workers are unprotected salaried workers who do not benefit from labour rights and social coverage through the employment contract. An alternative definition of informality also includes self-employed workers who own unregistered firms (see Henley et al. (2009)). In this section, we use the broader definition of informality and also include self-employed individuals in the informal employment category. Specifically, we consider self-employed those individuals who report that in their main job they are "own-account workers" (trabajador por su cuenta). Notice that the ENEU survey reports very small businesses, in fact more than 80 percent of self-employed have no employees. Tables 9 and 10 report the results for industry and regional approaches respectively.

Table 9 shows that the formalisation of employment within 4-digit industries remains significant when we include self-employment in the informality category. Columns (2) to (4) shows that now the effect is stronger for women, especially low-skilled women. This can be explained by the lower propensity of women to enter self-employment compared to men.

Table 10 confirms our benchmark results for the effect of trade liberalisation on the regional labour market. A fall in local tariffs decreases the probability of being a formal employee for women but increases it for highly educated men. Columns (5) and (6) distinguish between the impact of local tariffs in tradable and in non-tradable sectors. The results are similar to the benchmark results shown in Table 4 and stronger in magnitude especially for men. This is consistent with the fact that this type of employment is particularly relevant for men. Indeed, Figure 5 in Appendix A shows that the self-employment share is greater in the male population.

Table 9: Within-industry changes with self-employment in the informal segment

	(1)	(2)	(3)	(4)
τ_{st}	-0.481***	-0.395***	-0.411***	-0.397***
	(0.113)	(0.092)	(0.093)	(0.093)
τ_{st} × female		-0.182**	-0.177**	-0.213**
		(0.083)	(0.082)	(0.083)
τ_{st} × he			0.043**	0.009
			(0.020)	(0.022)
τ_{st} × he × female				0.112***
				(0.035)
Observations	738,638	738,638	738,638	738,638
R-squared	0.349	0.349	0.349	0.349
Year FE	Yes	Yes	Yes	Yes
Municipality	Yes	Yes	Yes	Yes
4-digit sector FE	Yes	Yes	Yes	Yes

Notes: The regressions are LPM estimations of equation (9) for the period 1993-2001. The dependent variable equals 1 if the individual is in formal wage employment and 0 if in informal wage employment or in self-employment. Main controls are the same as in Table (3). Columns (1) to (4) provides estimates of the effect of changes in 4-digit sector tariff lines on the probability to hold a formal job within 4-digit manufacturing sectors. Columns (3) and (4) also include a high level of education dummy (he) for individuals with more than 9 years of education, and its interaction with the female dummy in columns (4). Standard errors are clustered at the sector-year level. $***, **$, and $*$ indicate significance at the 1, 5 and 10 percent levels respectively.

Table 10: Municipality exposure with self-employment in the informal segment

	(1)	(2)	(3)	(4)	(5)	(6)
τ_{rt}	-0.047	-0.180	-0.117	-0.130	-0.630***	-0.550***
	(0.163)	(0.164)	(0.168)	(0.168)	(0.181)	(0.180)
τ_{rt} × female		0.389***	0.376***	0.411***	0.173***	0.160***
		(0.040)	(0.041)	(0.051)	(0.059)	(0.061)
τ_{rt} × he			-0.141***	-0.112**		-0.213***
			(0.052)	(0.056)		(0.062)
τ_{rt} ×he× female				-0.085*		-0.014
				(0.049)		(0.063)
τ_{rt} × serv					0.491***	0.460***
					(0.101)	(0.100)
τ_{rt} × serv × female					0.347***	0.517***
					(0.071)	(0.086)
τ_{rt} × serv × he						0.112
						(0.075)
τ_{rt} × serv× he × female						-0.352***
						(0.082)
Observations	2,678,911	2,678,911	2,678,911	2,678,911	2,678,911	2,678,911
R-squared	0.092	0.092	0.093	0.093	0.120	0.120
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality	Yes	Yes	Yes	Yes	Yes	Yes
4-digit sector FE	No	No	No	No	No	No

Notes: The regressions are LPM estimations of equation (10) for the period 1993-2001. The dependent variable equals 1 if the individual is in formal wage employment and 0 if in informal wage employment or in self-employment. Main controls are the same as in Table (4). Columns (3) and (4) also include a high level of education dummy (he) for individuals with more than 9 years of education, and its interaction with the female dummy in columns (4). Standard errors are clustered at the municipality-year level. $***, **$, and $*$ indicate significance at the 1, 5 and 10 percent levels respectively.

8 Conclusions

In this paper we analyse the link between trade liberalisation and formal employment allowing for gender differences both at the industry level and at the municipality level. We estimate how changes in trade policy affects men's and women's probability to hold a formal job using Mexican individual data and tariff information at the 4-digit industry category. We find that a fall in the Mexican tariff generates a formalisation of employment within 4-digit manufacturing sectors for both men and women. Constructing a weighted average of tariffs at the municipality level, we show that the local effects of changes in trade policy vary across gender and sectors. We find that, in the manufacturing sector, both women and men benefit from trade liberalisation but men benefit the most. While in the service sector, women experience an increase in informality.

In this paper we propose a general equilibrium model where trade liberalisation affects the formal labour share of employment across gender. Following our theoretical predictions, we interpret the within-industry empirical findings as evidence of a "formal-biased technological change" within disaggregated tradable sectors. Our results at the local level, explain the reallocation of employment into comparative advantage sectors relatively more intensive in formal jobs, and where male labour is relatively more substitutable for capital than female labour.

The increase in informality in the service sector for women following trade integration can be detrimental to gender equality in the labour market and poverty reduction measures. Nevertheless, this work also shows that trade liberalisation contributes to the formalisation of jobs in tradable sectors and may help improving high-skill women's position in those sectors. This paper creates a link between formality and liberalisation and investigates how local exposure to changes in trade openness affects gender sorting in formal and informal employment across both tradable and non-tradable sectors. Its main contribution is to extend previous studies on globalisation and gender by looking at the effect of trade liberalisation on gender differences in access to formal jobs. The paper remains silent about the potential impacts of trade liberalisation on male and female wages in formal and informal jobs. Exploring this channel can further improve our understanding of gender inequality in the labour market and additional research is needed in this direction.

References

Aguayo-Tellez, E., Airola, J., Juhn, C., 2010. Did Trade liberalisation Help Women? The Case of Mexico in the 1990s. Research in labour Economics, 38, .

Aleman-Castilla, B., 2006. The Effect of Trade liberalisation on Informality and Wages: Evidence from Mexico. Centre for Economic Performance (CEP), Discussion Paper 763.

Alesina, A., Giuliano, P., 2010. The Power of the Family. Journal of Economic Growth, 15, 93–125.

Alesina, A., Lotti, F., Mistrulli, P.E., 2013. Do Women Pay More for Credit? Evidence from Italy. Journal of the European Economic Association, 11(s1), 45–66.

Autor, D., Dorn, D., Hanson, G., 2013. The China Syndrome: Local labour Market Effects of Import Competition in the United States. American Economic Review, 103(6), 2121–2168.

Ben Yahmed, S., 2012. Gender Wage Discrimination and Trade Openness. Prejudiced employers in an open industry. Aix-Marseille School of Economics Working paper series, 2012-33.

Batini, N., Young-Bae, K., Levine, P., Lotti,E., 2010 Informal Labour and Credit Markets: A Survey, IMF Working Papers, 1–41.

Black, S. E., Brainerd, E., 2004. Importing equality? The impact of globalization on gender discrimination. Industrial and labour Relations Review, 57(4), 540–559.

Black, S. E., Spitz-Oener, A., 2010. Explaining Women's Success: Technological Change and the Skill Content of Women's Work. Review of Economics and Statistics, 92(1), 187–194.

Blum, B. S., 2008. Trade, technology, and the rise of the service sector: The effects on US wage inequality. Journal of International Economics, 74(1), 441–458.

Bosch, M., Manacorda, M., 2010. Minimum Wages and Earnings Inequality in Urban Mexico. American Economic Journal: Applied Economics, American Economic Association, 2(4), 128–49.

Bustos, P., 2011. Trade liberalisation, Exports, and Technology Upgrading: Evidence on the Impact of MERCOSUR on Argentinian Firms. American Economic Review, 101(1), 304–340.

Chiquiar, D., 2008. Globalization, regional wage differentials and the Stolper-Samuelson theorem: evidence from Mexico. Journal of International Economics, 74(1), 70–93.

Dabla-Norris, E., Gradstein, M., Inchauste, G., 2008. What causes firms to hide output? The determinants of informality. Journal of Development Economics, 85 (1), 1–27.

Do, Q., Levchenko, A., Raddatz, C., 2011. Comparative Advantage, International Trade, and Fertility. Journal of Development Economics, 119 (March 2016), 48-66.. 119(1), 48–66.

Duflo, E., 2012. Women Empowerment and Economic Development. Journal of Economic Literature, 50(4), 1051–79.

Feenstra, Robert C. and John Romalis and Peter K. Schott2002. U.S. Imports, Exports, and Tariff Data, 1989-2001 NBER Working Paper No. 9387

Fontana, M., Joekes, S.P., Masika, R., 1998. Global trade expansion and liberalisation: gender issues and impacts, BRIDGE Institute of Development Studies Brighton, Report No 42.

Fox, L., Sohnesen, T.P., 2012. Household Enterprises in Sub-Saharan Africa. Why They Matter for Growth, Jobs, and Livelihoods. World Bank Policy Research WP No.6184.

Gaddis, I., Pieters, J., 2014. The Gendered labour Market Impacts of Trade liberalisation: Evidence from Brazil. World Bank Policy Research WP No.7095.

Galli, R., Kucera, D., 2008. Gender, informality and employment adjustment in Latin America. International labour Office Working paper No. 85.

Galor, O., Weil, D.N., 1996. The Gender Gap, Fertility, and Growth. American Economic Review, 86(3) 374–387.

Goldberg, Pinelopi KoujianouPavcnik, Nina, 2003. The response of the informal sector to trade liberalisation. Journal of development Economics, 72(2), 463–496.

Goldberg, Pinelopi KoujianouPavcnik, Nina, 2007. Distributional effects of globalization in developing countries. Journal of economic Literature, 45(1), 39–82.

Gong, X., Van Soest, A., 2002. Wage differentials and mobility in the urban labour market: a panel data analysis for Mexico. labour Economics, 9(4), 513–529.

Hanson, Gordon H,2007. Globalization, labour income, and poverty in Mexico. in: Ann Harrison, ed., Globalization and poverty, University of Chicago Press 417–456.

Henley, A., Arabsheibani, G. R. , Carneiro, F.G., 2009. On defining and measuring the informal sector: Evidence from Brazil. World Development, 3(7), 992–1003.

Kovak, B., 2013, Regional Efects of Trade Reform: What is the Correct Measure of liberalisation?, American Economic Review, 103(5) 1960–1976.

Iacovone, L., Javorcik, B., Keller, W.,Tybout, J., 2015. Supplier Responses to Walmart's Invasion in Mexico. Journal of International Economics, 95(1), 1–15.

Iacovone, L., Javorcik, B., 2010. Multi-product Exporters: Product Churning, Uncertainty and Export Discoveries. Economic Journal, 120(544) .

International labour Office,2002. Decent work and the informal economy. Report VI submitted to the 90th Session of International labour, Geneva.

Jones, R. W., 1975, Income Distribution and Effective Protection in a Multicommodity Trade Model, Journal of Economic Theory, 11(1) 1–15.

Juhn, C., Ujhelyi, G., Villegas-Sanchez, C., 2013. Trade liberalisation and Gender Inequality. American Economic Review, Papers and Proceedings, 3(103).

Juhn, C., Ujhelyi, G., Villegas-Sanchez, C., 2014. Men, Women, and Machines: The Impact of Trade on Gender Inequality. Journal of Development Economics, 106, .

Jütting, J., De Laiglesia, J. R.,2009. Is Informal is Normal? Towards more and better Jobs in Developing Countries. in: OECD Development Centre, ed., , OECD Publishing , .

La Porta, R., La Porta, A., 2014. Informality and Development. Journal of Economic Perspectives, 28(3), 109-126.

Maloney, W.F., 1999. Does informality imply segmentation in urban labour markets? Evidence from sectoral transitions in Mexico. The World Bank Economic Review, 13(2), 275–302.

McCaig, B., Pavcnik, N., 2014. Export Markets and labour Allocation in a Low-Income Country. NBER Working Paper No. 20455.

McCaig, B., Pavcnik, N., 2015. Informal employment in a growing and globalizing low-income country. American Economic Review: Papers and Proceedings, 105(5), 545–550.

Nataraj, S., 2011. The impact of trade liberalisation on productivity: Evidence from India's formal and informal manufacturing sectors. Journal of International Economics, 85(2), 292–301.

Robertson, R., 2004. Relative prices and wage inequality: evidence from Mexico. Journal of International Economics, 64(2), 387–409.

Sauré, P., Zoabi, H., 2014. International Trade, the Gender Wage Gap and Female labour Force Participation. Journal of Development Economics, 111, 17–33.

Topalova, P., 2010. Factor immobility and regional impacts of trade liberalisation: Evidence on poverty from India. American Economic Journal: Applied Economics, American Economic Association, 2(4), 1–41.

Verhoogen, E., 2008. Trade, Quality Upgrading and Wage Inequality in the Mexican Manufacturing Sector. Quarterly Journal of Economics, 123(2), .

Appendix

Appendix A provides data information and additional descriptive statistics. Appendix B provides the derivations of the model.

A Data

Our sample includes formal and informal employees and self-employed over the period 1993-2001. Since agricultural and mining sectors have very few observations in urban areas, we decided to exclude them from the analysis. Moreover, there are very few women in those sectors and gender differential effects could not be precisely estimated. The agricultural sector is also excluded because the ENEU surveys concerns urban areas only. Non-manufacturing sectors include thus only services sector. Table 11 provides summary statistics on the number of observations in our data set by municipality and CAE 4-digit sector.

Table 11: Summary Statistics on the data set

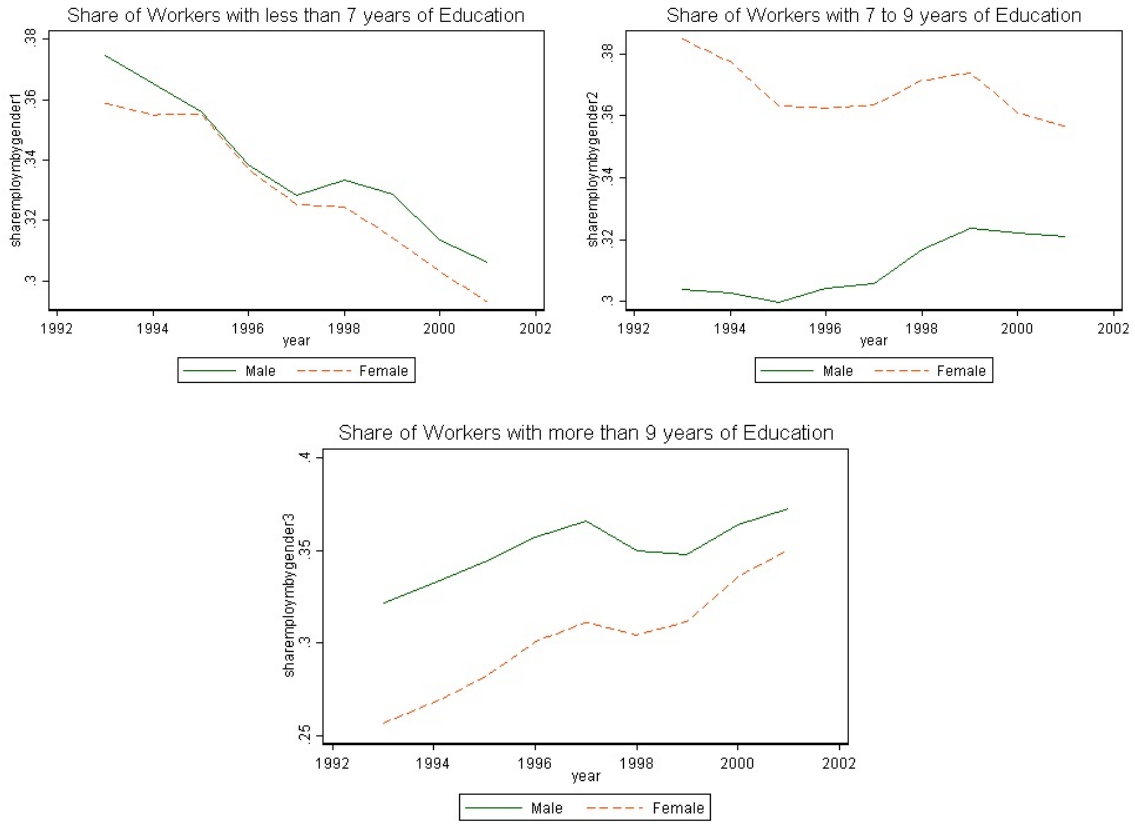
Dependent variables	Number per year			Observations per year			Observations
	mean	max	min	mean	max	min	1993-2001
Industry (4-digit)	256	258	253	16,042	50,037	1	2,685,624
with import tariff	113	126	90	2,841	10,918	1	674,222
Municipality	216	216	216	5,061	11,832	1	2,685,624

Notes: Our sample is composed of formal and informal employees and self-employed indivudals over the period 1993-2001. We exclude the agricultural construction and mining sectors. This table provides statistics about number of 4-digit industries, those with information on tariffs and municipalities in our sample.

Figure 3 shows the evolution of the educational level in the working population. Compared to women, the male working population displayed in the early 1990s higher shares of workers at the bottom and at the top of the education distribution, indicating that selection into the labour force followed very different patterns for men and women. However, those differences have shrunk in the 1990s and the female and male working population become more similar in terms of educational attainment. Moreover, the level of education has increased for the overall working population. The share of people with less than 7 years of education has been falling steadily during the 1990s and represents around 30% of both the female and the male labour force in 2000. This fall has been slightly more important for women. In the meantime, the share of workers with high levels of education, above 9 years, has strongly increased.

It went up from 27% (respectively 20%) of the female (male) working population in 1989 to around 35% of the female and the male labour force in 2000.

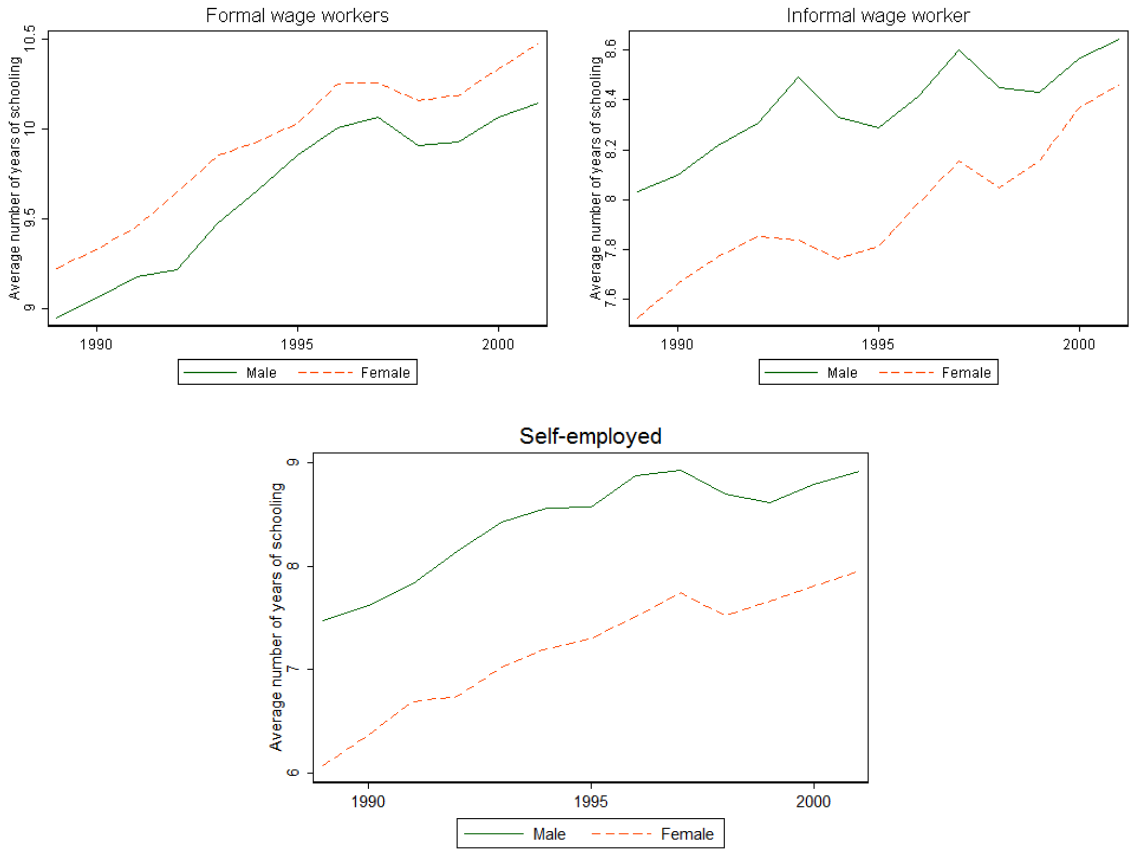
Figure 3: Evolution of educational level among employed individuals by gender



Source: ENEU, Mexico.

In figure 4, we can see that the increase in the average level of education has been pervasive for all types of occupations.

Figure 4: Evolution of the average educational level by formality status and gender

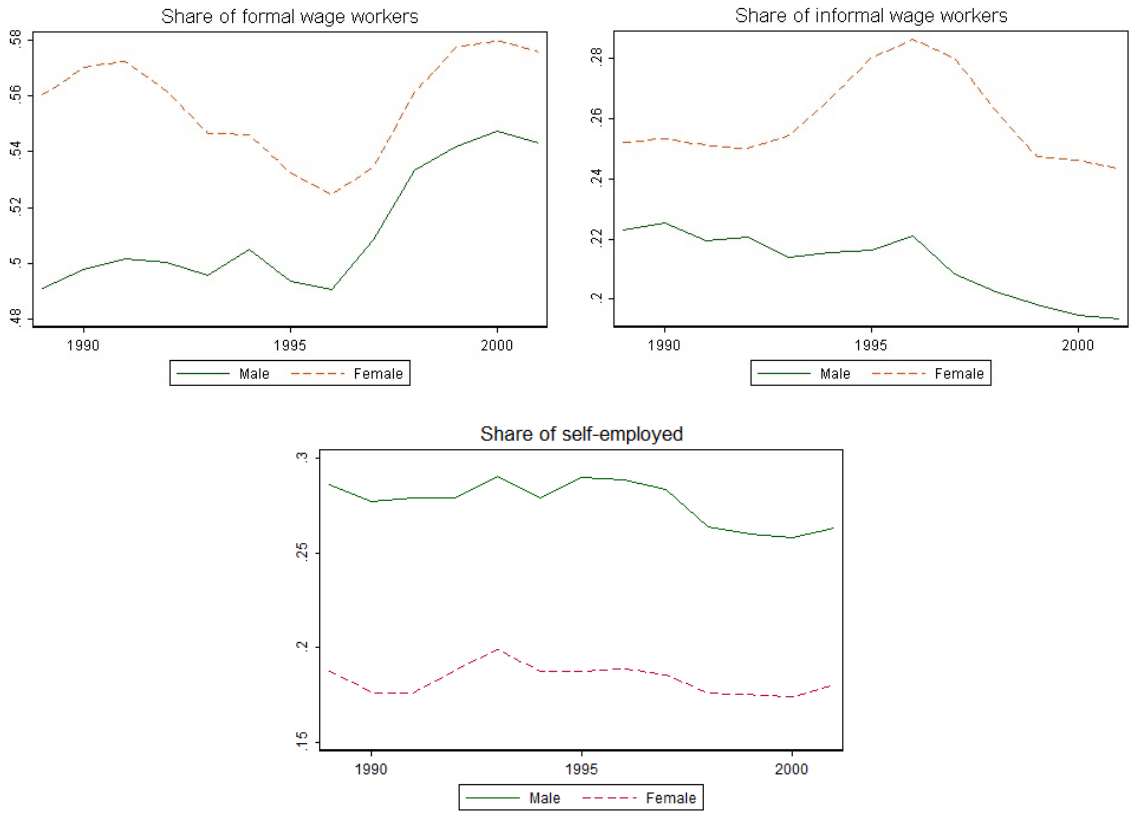


Source: ENEU, Mexico.

Figure 5 plots the female and male formal, informal and self- employment shares in the working population. The share of wage workers is higher in the female working population, especially among formal wage workers. Formal wage employment represents between 56 and 58 percent of the female working population, and only 49 to 54 percent of the male working population. The gender employment gap in formal wage employment was bigger at the start of the period, i.e. 10 percentage points in 1989. It was reduced to 5 percentage points in 2000. Women are also more often in informal wage employment, however we dot not observe here a convergence in the male and female informality share.The gender gap in informal wage employment has increased from 3 percentage points in 1989 to 6 percentage points in 2001. This is due to a much more rapid increase in informal employment for women in the first part of the 1990s,

while the fall in informality in the second part of the 1990s has benefited both gender groups. Men are more often self-employed than women. Self-employment accounts for 26 to 30% of the male working population, while it represents between 16% and 20% of the female working population.

Figure 5: Employment shares by formality status and gender



Source: ENEU, Mexico.

Table 12: Descriptive Statistics on the sample of working individuals

	Formal		Informal		Self-employed	
	Men	Women	Men	Women	Men	Women
Age	32.39	29.52	29.67	29.30	38.64	38.97
Years of schooling	9.22	9.65	8.31	7.85	8.14	6.74
Share of workers with						
... primary education or less	0.33	0.23	0.41	0.45	0.49	0.62
... some secondary education	0.47	0.58	0.45	0.42	0.32	0.28
... some tertiary education	0.20	0.19	0.14	0.13	0.19	0.10
Number of children	.	1.13	.	1.44	.	3.22
Border region	0.21	0.24	0.20	0.15	0.21	0.14
Has migrated	0.01	0.00	0.01	0.01	0.01	0.00
Work less than 35 hours a week	0.07	0.16	0.13	0.25	0.18	0.41
between 35 and 48 hours a week	0.73	0.71	0.60	0.58	0.44	0.27
more than 48 hours a week	0.17	0.07	0.23	0.14	0.30	0.18
Log hourly earnings	3.65	3.60	3.48	3.32	3.89	3.58
Work in a firm less than 6 empl.	0.01	0.01	0.10	0.33	.	.
... with 6 to 50 employees	0.18	0.16	0.51	0.35	.	.
... with51 to 250 employees	0.22	0.18	0.12	0.09	.	.
... with more than 250 people	0.07	0.05	0.02	0.02	.	.
N	71809	42750	31658	19020	40070	14310

Notes: Calculation based on the ENEU data for 1992

Table 13 illustrates the sectorial composition of men and women in 1992.

Table 13: Sectorial distribution (in %)

	Men	Women
Administration	9.63	11.64
Business and Financial services	2.20	3.38
Construction	13.38	1.56
Electricity	1.06	0.50
Health, Education, Social and Personal Services	30.18	46.99
Hotels, Restaurants	4.43	8.81
Manufacturing	27.64	22.27
Trade	4.32	2.81
Transport, storage and communication	7.16	2.05
Total	100.00	100.00

Notes: Calculation based on the ENEU data for 1992

Table 14 shows statistics for the local tariff measure computed with 4-digit tariffs and employment weights using municipality×4-digit sector employment in the first sample year. The average and median change in local tariff is 14% but there is substantial variation across municipalities in the exposure to trade policy changes. Their initial industry composition has exposed some municipalities to changes in average tariff as small as 2% while other municipalities have experienced a fall in their local tariff of 22%.

Table 14: Change in municipality tariff between 1993 and 2001 (in %)

mean	min	p50	max
-0.14	-0.02	-0.14	-0.22

Notes: The tariff at the 4-digit levels come from Iacovone et al. (2015). Employment weights are constructed using the ENEU survey.

B The model

This section develops the general equilibrium model from which we obtain equations (2) and (3) in section 4. We follow closely Blum (2008) and Kovak (2013), but we deviate from the latter by having two types of labour, male and female labour, and from both papers by having two types of jobs within sectors, formal and informal jobs.

We consider a country composed of several regions r and suppress that subscript on all terms. A region is composed of several industries indexed s={1,...N}. Production uses capital, K, female labour L_f and male labour L_m. Labour is assumed to be perfectly mobile across industries but not across regions, supplied inelastically, and fully employed. Capital is assumed to be region and sector specific in the short-run. We also assume that production technologies exhibit constant returns to scale, and that factors and goods markets are competitive. Technologies may differ across sectors but are the same across regions for each sector.

The set of exogenous variables is composed by: prices of tradable goods, factor supplies, sectoral capital allocation, preferences, and technologies. The endogenous variables to be determined are: factor returns, prices of non-tradable goods, sectoral employment allocations, and sectoral output. In what follows, we only consider a particular region and suppress the subscript r on all terms. The equilibrium is characterized by the following set of equations:

$$a_{ks}y_s = K_s \qquad \forall s, \qquad s = 1, 2, ..., N \tag{11}$$

$$\sum_{s=1}^{N} a_{gs}y_s = L_g \qquad g = (f, m) \tag{12}$$

$$a_{fs}w_f + a_{ms}w_m + a_{ks}r_s = p_s \qquad \forall s \tag{13}$$

$$c_s = \frac{\kappa I}{p_s} \qquad s = M + 1, M + 2, ..., N \tag{14}$$

where a_{gs} is the unit input coefficient for labour factor g, with $g = (f, m)$ indicating female or male labour, in sector s. w_f and w_m are female and male wage respectively, r_s is the specific factor return in each sector, y_s and p_s are respectively the output and output price in industry s. Equations (11) and (12) represent full employment conditions for the specific factor in sector s, K_s, and for mobile factors, L_g. Equation (13) represents the zero profit condition. Equation (14) is the aggregate demand for non-tradable goods, with c_s the Cobb-Douglas demand of the non-tradable good in sector s. Tradable and non-tradable goods are indexed $s = 1, ..., M$ and $s = M + 1, ..., N$ respectively. The exogenous share of formal jobs in sector s is α_s. Therefore, gender-g's formal employment in sector s is defined as:

$$L_{\varphi gs} = \alpha_s L_{gs} \tag{15}$$

Differentiating the above equilibrium conditions and using Jones' algebra, we ob-

tain:

$$\hat{p}_s = \theta_{fs}\hat{w}_f + \theta_{ms}\hat{w}_m + \theta_{ks}\hat{r}_s = \sum_g \theta_{gs}\hat{w}_g + \theta_{ks}\hat{r}_s \tag{16}$$

$$\hat{L}_{gs} = \hat{a}_{gs} - \hat{a}_{ks} + \hat{K}_s \tag{17}$$

$$\hat{K}_s = \hat{a}_{ks} + \hat{y}_s \tag{18}$$

where hats represents proportional change, $\theta_{gs} = \frac{a_{gs}w_g}{p_s}$ is the cost share of factor L_g in sector s. Using equation (18) inside equation (17), gives the labour demand in industry s:

$$\hat{L}_{gs} = \hat{a}_{gs} - \hat{a}_{ks} \tag{19}$$

For each sector s, the elasticity of substitution between a factor g and the specific factor K_s with respect to the relative returns of factors f and K_s is defined as:

$$\sigma^h_{gk,s} = \frac{\hat{a}_{ks} - \hat{a}_{gs}}{\hat{w}_h - \hat{r}_s} \tag{20}$$

We can rewrite the female and male labour demands in sector s, equation (19), using the elasticity of substitution in equation (20), to get:

$$\hat{L}_{fs} = -\sigma^f_{fk,s}(\hat{w}_f - \hat{r}_s) - \sigma^m_{fk,s}(\hat{w}_m - \hat{r}_s) + \hat{K}_s \tag{21}$$

$$\hat{L}_{ms} = -\sigma^m_{mk,s}(\hat{w}_f - \hat{r}_s) - \sigma^f_{fk,s}(\hat{w}_m - \hat{r}_s) + \hat{K}_s \tag{22}$$

We want now to express the change in female and male labour demands in sector s as functions of prices. Using the differentiated zero-profit condition, equation (16), the fact that K_s is specific to each sector (so that $\hat{K}_s = 0$, $\forall s$), and that cost shares add up to one, the change in labour demands in sector s becomes:

$$\hat{L}_{fs} = -\left[\sigma^f_{fk,s}\frac{\theta_{ks}+\theta_{fs}}{\theta_{ks}} + \sigma^m_{fk,s}\frac{\theta_{f,s}}{\theta_{ks}}\right](\hat{w}_f - \hat{p}_s) - \left[\sigma^m_{fk,s}\frac{\theta_{ks}+\theta_{ms}}{\theta_{ks}} + \sigma^f_{fk,s}\frac{\theta_{f,s}}{\theta_{ks}}\right](\hat{w}_m - \hat{p}_s) \tag{23}$$

$$\hat{L}_{ms} = -\left[\sigma^m_{mk,s}\frac{\theta_{ks}+\theta_{ms}}{\theta_{ks}} + \sigma^f_{mk,s}\frac{\theta_{m,s}}{\theta_{ks}}\right](\hat{w}_m - \hat{p}_s) - \left[\sigma^f_{mk,s}\frac{\theta_{ks}+\theta_{ms}}{\theta_{ks}} + \sigma^m_{mk,s}\frac{\theta_{m,s}}{\theta_{ks}}\right](\hat{w}_f - \hat{p}_s) \tag{24}$$

where $\sigma^h_{gk,s}$ is the elasticity of substitution between factor g and the specific factor K_s with respect to the relative prices of factors h and K in sector s, θ_{gs} is the cost share of factor L_g in sector s, and $\hat{w}_f$ and $\hat{w}_f$ are given as functions of p_s in equations (28) and (29). Equations (23) and (24) describe how female and male labour demand in sector s are affected by a change in wages and in the price of good s.