Gender Wage Discrimination and Trade Openness. Prejudiced employers in an open industry

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Abstract

International trade has been expected to reduce the gender wage gap by increasing competition and thus reducing the rents that allow employers to discriminate. However, some empirical assessments find an opposite effect. We provide an explanation for the puzzling result that trade openness widens the gender wage gap under certain circumstances.

This paper introduces employer taste discrimination in an open economy model with imperfect competition to shed light on the heterogeneous impacts of openness on the gender wage gap. Firms operate in an oligopoly where and prejudiced employers can use their rents to pay men a premium, in line with Becker's theory. Penetration of foreign products in the domestic market triggers a surge in competition thus heightening incentives to reduce costs differences which reduces the wage gap. However, an easier access to foreign markets is an opportunity for domestic firms to enhance profits. The model determines under which conditions new export opportunities enable discriminatory firms to maintain their discretionary expenditures. The theoretical predictions are confronted with data for Uruguayan manufacturing sectors that experienced a sharp liberalization of trade in the 1990s. Market access of Uruguayan firms as well as competitors' access to the Uruguayan market, computed at the industry level, are used for the first time to assess the impact of trade openness on the gender wage gap in a specification inspired by the theory.

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1 Introduction

Several theories of discrimination seek to understand why an important share of the gender wage gap remains unexplained. Discrimination due to prejudiced employers is one of them, though it has been somewhat overshadowed mainly because costly discrimination is not sustainable in competitive markets, which seems inconsistent with the persistence of the wage gap. Yet, once we acknowledge that imperfections in either the factor or the good markets give employers some kind of monopsonistic power, we realize that costly discriminating behaviors might not be competed away in equilibrium. This paper adopts this approach and shows that when "competition among the few"[1] prevails, taste-based discrimination provides a coherent explanation for the heterogeneous effects of openness on the gender wage gap.

Becker's theory of employer discrimination suggests that, in sectors with positive rents, the prejudice of some employers can result in a wage gap between equally productive men and women due to unequal sharing of production revenues across workers' groups. In such sectors, tougher competition puts a downward pressure on the wage gap and ultimately no wage discrimination should be observed when firms' profits tend to zero. It follows that trade openness should play a role in reducing the wage gap through its pro-competitive effect. When domestic competitive forces are too weak to curb down market power, foreign competition contributes to drive out wage discrimination. Recent empirical evidence shows that increase in trade openness leads to lower gender wage gaps in some cases while in other cases it contributes to a widening of the wage gap. This paper argues that the effect of trade openness on the wage gap is more complex that the assimilation of openness to tougher competition along with the extrapolation of Becker's theory imply. It investigates theoretically and empirically in which context trade openness curbs wage discrimination and when it does not.

The standard theory of employer taste discrimination developed by Becker (1957) is at the core of the few papers dealing with the impact of competition on wage discrimination.

Previous studies aim at isolating different competition forces to assess their impact on discrepancies in labour market outcomes between men and women. Recent firm-level anal-

[1]This expression, first used by Fellner as a title to his book on oligopoly published in 1949, refers to industries where a small number of (operating or potential) firms compete with each other. In such environments, firms often interact strategically.

yses prove to be consistent with implications of Becker's model of employer discrimination. Hellerstein and Neumark (2006) find that discrimination is observed only among plants with high levels of product market power and profitability is positively correlated with the share of female employees. However, over a five-year period, competitive market forces do not significantly drive discriminatory firms out of business. Weber and Zulehner (2010) exploit Austrian firm data to investigate whether discriminatory firms are more likely to exit the market. Firms with lower female share do have a higher exit rate, though this effect is significant among firms with a female share below the median level only. Another strand of the literature, more closely related to methodology of this paper, focuses on changes at the sectoral level. Black and Strahan (2001) use deregulation of the banking sectors in the US to isolate the competition effect. They show that the decline in rents favored more female employees so that they caught up with their male colleagues in terms of wages and job promotions. Other authors have been interested in the impact of trade liberalization as it is commonly associated with a competitive shock. Black and Brainerd (2004) show that a rise in import penetration weakens the gender wage gap in concentrated industries in the US, as Artecona and Cunningham (2002) find for Mexican industries between 1987 and 1993. Berik et al. (2004) look at the impact of both import penetration and export shares on the gender wage gap in the case of Korea and Taiwan. Especially noteworthy is the finding that export shares increase the wage gap in concentrated industries. While they conclude that foreign competition is associated with an amplification of the wage gap, especially in imperfectly competitive sectors, thus contradicting Becker's theory of taste-based discrimination. This paper makes clear that this result is consistent with a setting featuring prejudiced employers as openness is not necessary synonymous of a reduction in profits.

Despite the attempts to appraise the pro-competitive effect of trade on unexplained wage gaps, the underlying causal mechanisms at stake have not been investigated which has lead to some misstatements at the time of interpreting some results. I intend to close this gap with a theoretical proposal that clarify the conditions under which trade can reduce wage discrimination. The theoretical insights also brings novelties to the empirical assessment. Previous papers base the interpretation of their results on the idea that trade openness exerts competitive pressures by confronting domestic firms with foreign firms ignoring that it can increase domestic firms' profit opportunities on foreign markets if they have the competitive advantage. We show that, under specific conditions, openness of trade partners' markets can increase the ability to discriminate by allowing prejudiced employers

to improve their export revenues. To the best of my knowledge, there is only one attempt to integrate trade flows in a model of wage discrimination. Menon and van der Meulen Rodgers (2009) use the Borjas and Ramey (1995) oligopolistic model to illustrate the impact of trade on gender wage discrimination. Wages are negotiated according to a Nash bargaining framework and women receive a lower share of the rents of prejudiced employers in the concentrated sector. However, the relationship between trade and discrimination is given by assumption. They consider that an increase in net trade always reduces the profits of all firms, the export decision of firms is not formalized.

The first part of my contribution is to provide an explicit trade model under imperfect competition with an endogenous determination of both trade patterns and the gender wage gap. The model describes a single international oligopoly à la Cournot where two countries produce and trade a homogeneous good. Firms' output decisions and export opportunities are determined by their relative costs of production which in turn depends on firms' position on the distribution of prejudice of all incumbents. This partial equilibrium model clarifies the links between the labour market and the product market where firms use their market power to pay different wages.

In a *competitive labour market*, with a large number of firms, discriminatory employers have no effect on the wage of the minority group since its members can easily be absorbed by the unprejudiced employers. Moreover, the wage elasticity of the labour supply faced by an employer is infinite; if one tried to cut down women's wages, all female employees would leave this employer while if one tried to attract men by offering higher wages the firm would not be able to compete anymore due to higher production costs. In a competitive labour market, the law of one wage must apply. Here, only a fixed and small number of firms demand labour so that the labour market is not perfectly competitive and the labour supply is not perfectly elastic. The model features an *oligopsonistic labour market* where even a small number of discriminatory employers can generate a wage gap. Oligopolists are sensitive to the gender-composition of their workforce as in Becker (1957). Different levels of prejudice against female workers lead to heterogeneity in firms' unit costs. Costs discrepancies between firms and variations in competition within the industry shape the extent of the wage gap in each sector.

In a closed economy, a firm's market power is determined by the number of firms; while in the open economy, it depends also on the number of foreign firms and their competitiveness. The impact of openness on discrimination can be derived in the model and comes from a selection of most competitive (less discriminatory) firms into the export and

domestic markets. Firms' profits and the impact of trade liberalization on profits depend on firms' ability to compete, that is to say, on their level of unit cost. As discrimination is costly, prejudiced employers are the ones with the poorest production opportunities. While they can cope with their cost disadvantage in a market sheltered from competition, trade deregulation makes it harder to maintain market shares. Under the threat of exit, previous levels of discrimination are no longer sustainable. An easier entry of foreign products spurs high-cost discriminatory firms to align their costs to the ones of non-discriminatory firms; as a result, demand for male labour dwindles while that for female labour increases which reduces the wage gap. In other words, foreign competition operating through trade creates a selection of firms based on their human resources decision. This difference in the ability to make the most of a market can be tracked down to the "survivor principle" of Stigler (1958) and has been recently used in a trade model by Melitz (2003) and Melitz and Ottaviano (2008) where only the most productive firms reap the benefits of trade.

In the current model, the impact of trade openness on discrimination depends on partners characteristics that shape market access and thus the trade pattern. While penetration of foreign firms in the domestic market triggers a surge in competition, easier access to foreign markets can be an opportunity to enhance profits. If domestic firms have a competitive advantage, it is possible for them to increase their production and profit level. In this case, trade openness results in a widening of the wag gap even in a beckerian setting.

The model is confronted with data for Uruguayan manufacturing sectors between 1983 and 2003. In the aftermath of the creation of the Mercosur in 1991, Uruguay dramatically opened its economy to international trade. The creation of a common market took place in two steps that generated two waves of liberalization, the first in 1991, and a second and deeper one in 1995. I exploit these substantial changes to study the effect of two-way trade on gender wage discrimination. I focus on imperfectly competitive sectors defined in the empirical strategy by their higher level of concentration. As predicted by the model, sectors where Uruguayan firms enjoy easier access to foreign markets feature an increase in the gender wage gap while greater penetration of the Uruguayan sector by foreign competitors exerts a downward pressure on discrimination.

This paper is organized as follows. Next section develops a model of oligopolistic competition and wage discrimination in a closed economy. Section III provides the open economy version to understand in which conditions openness reduces wage discrimination. Section IV describes the empirical methodology, the data and presents the results. The last section concludes.

2 Oligopolistic competition and discrimination in a closed economy

2.1 The model

Demand

Consumers have access to a homogeneous good. The inverse demand function is linear and gives the -unique- price of the product. It depends positively on the size of demand b[2] and decreases with the aggregate level of production Q in the market :

$$p = b - Q = b - \sum_{i=1}^{N} q_i \tag{1}$$

A linear demand function easily features the downward pressure on prices and mark-ups stemming from tougher competition (more firms serving the market), and thus highlights the effect of competition on employers' ability to discriminate.

Production

This model consider a single oligopoly with restricted entry[3]. We assume that there is an exogenous fixed number N of potential firms that can produce the same homogeneous good. Firms, indexed by i, are ranked by their distaste for hiring women $d_i \in [0; \bar{d}]$ which is exogenous and influences employers' human resources policies. Firms are thus *ex ante* heterogeneous in there preferences, and the distribution of prejudices is exogenously given. Employer heterogeneity in d does not impact their production technology though and all firms have access to the same technology. However, the endogenous equilibrium wage gap d^* ultimately determines the type of worker a firm hires along with its wage bill; the *ex post* distribution of firms' outcomes, e.g. marginal cost and production, is thus endogenous.

Labour is the only factor of production and is inelastically supplied at its sector level $\bar{L}$. Male labour supply is denoted $\bar{L}_m$ and the female labour supply is $\bar{L}_f$; none of them are influenced by the level of discrimination in this model. Firms' technologies are identical

[2] We do not relate consumer demand for goods to the household wealth, workers' wages and entrepreneurs' profits. Not incorporating income effects is plausible as individuals working in one sector consume only a small fraction of the good they produce so that demand is not much affected by their revenues.

[3] This approach is adopted in chapter 5 of Helpman and Krugman (1987); potential explanations for the absence of free entry are stringent market regulation or deterrent start-up costs.

and are represented by a linear production function

$$q_i = l_{if} + l_{im}$$

where male labour l_m and female labour l_f are perfect substitutes.
Total costs have a simple form that features constant returns to scale once the firm is operating in the market: $C(q_i) = c_i q_i$ where c_i is firm i's unit cost of production. Employers not only take into account the wages paid to employees but also their personal distastes for certain type. Employer i is ready to hire women if the gander wage gap overweight its utility loss, i.e. $w_f + d_i < w_m$. As a consequence, firms have different *perceived* labour costs

$$c_i = \begin{cases} w_f + d_i & \text{if firm } i \text{ employs women} \\ w_m & \text{if firm } i \text{ employs men} \end{cases}$$

This setting leads to complete gender segregation across firm. Firms hiring men have the same unit labour cost $c_m = w_m$ while firm hiring women have different *perceived* labour costs, $w_f + d_i$, because of heterogeneity in their tastes.

2.2 The firm's problem. Output decisions

Employer i maximizes a utility function equals to the profits minus the monetary value derived from the disutility of employing women. If $d_i > 0$, employer i is prejudiced against women and discounts his economics profits by $d_i \times l_f$ the utility loss caused by employing l_f women. The setting is a standard one-stage game in which N firms compete in quantity. The price p depends on the production of all incumbent firms and firm i takes the output of other firms as given while maximizing its profits. They consider the following maximization problem where the objective function is concave in q_i:

$$\max_{q_i} \pi_i = q_i \left(p(q_i, \sum_{j \neq i} q_j) - c_i \right)$$

where q_j is the production level of competitor j and the unit cost c_i embeds preferences. Firms are wage-takers and choose the number of workers they hire. The first order conditions for the N different firms can be written:

$$q_i = p - c_i \qquad \forall i = 1, ..., N$$

Among the N firms, N_f firms hire women at a perceived cost $c_{if} = w_f + d_i$ and N_m hire men at the same cost $c_m = w_m$. There are thus $N_f + 1$ equations of firms' production levels :

$$q_{im} = p - w_m \qquad \text{for "male-firms"}$$

$$q_{if} = p - (w_f + d_i) \qquad \text{for "female-firms"}$$

The number of workers they hire is decreasing in their specific costs c_i. Considering how much should be produced, employer i behaves as if the true cost was $w_f + d_i$, even if the real economic cost of a firm hiring women is w_f. Consequently, the first order condition implies that employer i produces less than an employer j with $d_j < d_i$. Among firms that hire women, those with lower prejudice employ more women and produce more. Besides, firms hiring women have lower costs and hence produce more that firms employing men.

Firms' reaction functions

We have seen that employer's type pins down his *perceived* cost which in turn determines his choice of production scale. Substituting the value of p given by the demand function (1) into the first order condition gives the reaction function of each firm:

$$q_i = \frac{1}{2}(b - Q_{-i} - c_i)$$

where $Q_{-i} = \sum_{j \neq i} q_j$ is the sum of production from all firms except firm i.
Substituting Q_{-i} in the previous equation, firm i's production level can be written as a function of the average cost of its competitors $\tilde{c}_{-i}$ and its own cost c_i only:

$$q_i = \frac{b - c_i + (N-1)(\tilde{c}_{-i} - c_i)}{N+1} \tag{2}$$

Note that since firms are heterogeneous in their unit cost, it is necessary to check whether all of them produce in equilibrium. This involves conditions on the size of the demand b and N the number of operating firms which is exogenously fixed. Appendix A states the conditions that ensure an interior solution.

We can use equations (1) and (2) to give another expression for the price of the homogeneous good:

$$p = \frac{N}{N+1}\left(\frac{b}{N} + \frac{C(Q,N)}{N}\right)$$

where $C(Q,N) = \sum_i^N c_i$ is the sum of production costs of all operating firms. This expression captures the pro-competitive effect of market size N that plays through a market fragmentation effect and the reduction in the average unit cost of competitors. An increase in N reduces the price and as a consequence the mark-ups firms can enjoy. The price is also positively related to the demand size $\frac{b}{N}$; this explains why firms thrive on penetrating new markets.

2.3 The marginal discriminator

We now dwell on labour cost discrepancies across firms and relate male and female wages. We need to determine N_f the number of firms that employ women (N_m the number of firms that employ men is simply $N - N_f$). There is a continuum of prejudice degrees ($d \in R^+$). In order to simplify some of the ensuing analysis, we use a specific parametrization for its distribution among employers. In particular, let us assume that the actual prejudice of incumbents has a discrete uniform distribution over the interval $[0; \bar{d}]$. The difference in prejudice between two firms is $d_i - d_{i+1} = \frac{\bar{d}}{N-1}$. The equilibrium wage gap will be determined by the level of prejudice of the last firm hiring women N_f -called the marginal firm. N_f is the only firm to be indifferent between employing men and employing women. In equilibrium,

$$w_f + d^* = w_m \qquad \text{with } d^* \in [d_{N_f}; d_{N_{f+1}}[\tag{3}$$

There is a continuum of equilibrium gender wage gaps comprised between the prejudice of the marginal employer d_{N_f} and the prejudice of the next firm $d_{N_{f+1}}$. Under the assumption of discrete uniform distribution of d, we can express d^* as:

$$d^* = (N_f - 1)\frac{\bar{d}}{N-1} + \nu \qquad \text{with } \nu \in [0\ ; \frac{\bar{d}}{N-1}[$$

Note that this general case $d^* = d_{N_f} + \nu$ can be reasonably reduced to $d^* = d_{N_f} + \epsilon$ as all the employers i with $d_i > d_{N_f}$ can hire men by setting a wage just above the one that makes the previous employer indifferent between men and women. Without loss of

generality, we can thus express the wage gap as:

$$d^* = (N_f - 1)\frac{\bar{d}}{N-1} \tag{4}$$

We can now express employers' perceived costs in this way:

$$c_i = \begin{cases} w_m - (d^* - d_i) & \text{if } d_i \leq d^* \text{ so that firm } i \text{ employs women} \\ w_m & \text{if } d_i > d^* \text{ so that firm } i \text{ employs men} \end{cases}$$

There is a complete segregation of men and women across firms if $d^* = d_{N_f} + \epsilon$, the marginal firm being pivotal. It is possible that the marginal firm has a mixed labour force. In that case, the wage gap is exactly equal to the monetary equivalent of its prejudice level $d^* = d_{N_f}$, and the marginal employer is indifferent between hiring women or men. The exact gender composition of its labour force depends on the female and male labour supply as well as on the distribution of production levels across firms. We will consider the case where the N_f firms completely absorbed the female labour supply so that there is no mixed firm. This hypothesis does not alter the results of the model and facilitates the resolution of the labour market clearing conditions.

2.4 The labour market equilibrium

Wages of both men and women adjust until full employment is reached. The demand for female labour is given by the total production level of the female firms. Using the first order condition, the labour market clearing conditions can be written:

$$\bar{L}_f = \sum_{1}^{N_f} p - (w_f + d_i) \quad \text{and} \quad \bar{L}_m = \sum_{N_f+1}^{N} p - w_m$$

The sum of the monetary equivalent of the utility loss d_i faced by discriminatory employers who hire women is, under the assumption that the distribution of d follows a discrete uniform over $[0; \bar{d}]$, an arithmetic series:
$\sum_1^{N_f} d_i = d_1 + d_2 ... + d_{N_f} = 0 + \frac{\bar{d}}{N-1} + 2\frac{\bar{d}}{N-1} + ... + (N_f - 1)\frac{\bar{d}}{N-1}$.

$$\sum_{i=1}^{N_f} d_i = \frac{N_f(N_f-1)}{N-1}\frac{\bar{d}}{2} \tag{5}$$

Using equation (5), the labour market clearing conditions can be written:

$$\bar{L}_f = N_f(p - w_m) + N_f(\frac{N_f - 1}{N - 1}\frac{\bar{d}}{2}) \quad \text{and} \quad \bar{L}_m = N_m(p - w_m)$$

This yields the equilibrium wages w_f and w_m:

$$w_f = p - \frac{N_f - 1}{N - 1}\frac{\bar{d}}{2} - \frac{\bar{L}_f}{N_f} \tag{6}$$

$$w_m = p - \frac{\bar{L}_m}{N_m} \tag{7}$$

From the two wage equations, we can easily find the expression for the gender wage gap $d^* = w_m - w_f$:

$$d^* = \frac{\bar{L}_f}{N_f} - \frac{\bar{L}_m}{N_m} + \frac{N_f - 1}{N - 1}\frac{\bar{d}}{2}$$

Having previously defined d^* as a function of N_f in equation (4), we can define implicitly d^*:

$$d^* = 2\bar{d}\left(\frac{\bar{L}_f}{\bar{d} + (N-1)d^*} - \frac{\bar{L}_m}{(N-1)(\bar{d} - d^*)}\right) \tag{8}$$

Proofs of the existence and uniqueness of d^* are developed in the appendix.

Let us recapitulate the equations that define the equilibrium of the economy:

$$\begin{aligned}
w_f &= p - \tfrac{N_f - 1}{N-1}\tfrac{\bar{d}}{2} - \tfrac{\bar{L}_f}{N_f} \\
w_m &= p - \tfrac{\bar{L}_m}{N_m} \\
d^* &= w_m - w_f \\
N_f &= 1 + \tfrac{d^*}{\bar{d}}(N-1) \\
p &= \tfrac{N}{N+1}\left(b + w_m - \tfrac{N_f}{N}\left(\tfrac{N_f - 1}{N-1}\tfrac{\bar{d}}{2}\right)\right) \\
q_{im} &= p - w_m \\
q_{if} &= p - (w_f + d_i)
\end{aligned}$$

The first two equations give the wages of women and men as a function of the price, the total number of firms in the sector and the number of firms that hire women while the third equation defines the wage gap. The fourth equation gives the expression for the number

of firms employing women which depends on the distribution of prejudice across the firms $\frac{\bar{d}}{N-1}$ and the wage gap. The price is determined by the size of the demand and the average of firms' unit costs as given by the fifth equation. The last two equations define firms' output levels that depend on their *perceived* unit costs. Firms employing women make heterogeneous output decisions depending on their d while firms employing men produce the same amount as they have the same perceived cost of production w_m.

Evolution of the wage gap

We can derive standard predictions of the beckerian model by applying the theorem of implicit functions on Φ

$$\Phi \equiv d^* - 2\bar{d}\left(\frac{\bar{L}_f}{\bar{d}+(N-1)d^*} - \frac{\bar{L}_m}{(N-1)(\bar{d}-d^*)}\right) = 0$$

First, for a given number of firms, the wage gap expands if more women enter the labour market, $\frac{\partial d^*}{\partial \bar{L}_f} > 0$. More firms hire women so that the marginal employer has stronger prejudice and requires a wider wage differential between male and female employees. As expected, the opposite holds when it is the male labour supply that goes up, $\frac{\partial d^*}{\partial \bar{L}_m} < 0$.

Moreover, it follows that d^* decreases with N, $\frac{\partial d^*}{\partial N} < 0$. Suppose the range of prejudice does not widen ($\bar{d}$ remains unchanged), if the total number of firms increases, the number of firms managed by employers with a level of prejudice lower than d^* increases as well. As a result, the marginal discriminator, the last one to employ female workers, is an employer less prejudiced against women. This effect highlights the role of a high number of firms[4] in reducing the incidence of taste-based discrimination.

Selection effect

Another way of formalizing the effect of market structure on employers' ability to discriminate is to compute the cost threshold above which discriminatory firms cannot produce. Let $\bar{c}$ be the maximal unit cost above which a firm stops producing. The solution of a zero-operating profit condition $\bar{c} = p(\bar{c})$ defines the cost cut-off as follows:

$$\bar{c} = b - \left(\frac{V^2}{\bar{d}}(N-1) + V\right) \tag{9}$$

[4]This result holds true if

where $V = \frac{d_{N_f}}{2}$ is the average perceived-costs difference between female firms and male firms. In other words, V is the *perceived* cost disadvantage of discriminatory firms. Tougher competition, in the sense of more firms producing, reduces the cost threshold above which no firms can produce: $\frac{\partial \bar{c}}{\partial N} < 0$
The reduction in the cost threshold slows down with the number of producers $\frac{\partial^2 \bar{c}}{\partial N^2} < 0$, which means that the pro-competitive effect is more pronounced when N is small.
Furthermore, we are able to derive the implication of the spread in prejudice on the competition effect. The derivative $\frac{\partial^2 \bar{c}}{\partial N \partial d} > 0$ shows that the downward impact of an increase in N on the wage gap is stronger when the dispersion of prejudice is wider. The "disciplinary effect" of competition is more pronounced in sectors with strong stereotypes against women.

Survival of discriminatory firms
Note that the absence of a wage gap does not necessarily mean that prejudiced employers have exited the market. When women supplying labour are hired by unprejudiced employers with $d = 0$, prejudiced employers with $d > 0$ can employ men without having to pay them a premium. Thus, they can stay in the market even if competition is fierce following the entry of unprejudiced entrepreneurs. Such a situation exists when the female labour supply is low or when unprejudiced employers are numerous enough.

3 The Open Economy

3.1 Import penetration, export opportunities and discrimination

We now consider the open economy case where two countries, D and F (for domestic and foreign country respectively) trade a homogeneous good under oligopolistic competition. They do have incentives to engage in intra-industry trade to capture some of the rents that exist in the foreign market. Brander (1981) first formalized how strategic interactions among Cournot oligopolists from two countries lead to intra-industry trade[5]. Country characteristics can differ. Domestic and foreign consumers' inverse demand functions are respectively

$$p_D = b_D - Q_D \tag{1a-T}$$

$$p_F = b_F - Q_F \tag{1b-T}$$

[5]This type of model has been subsequently used and developed by Combes et al. (1997) Neary (2002) and Neary (2003) among others.

As for the product market, there are N_F foreign firms which are assumed to be homogeneous so that all firms in F produce with the same unit cost c_F[6].
Markets are segmented although domestic firms can export to the foreign market incurring a transport cost. Foreign firms have to pay τ_D to sell in market D while domestic firms D have to pay τ_F to export to market F, but they do not incur any fixed exporting cost. As firms produce under constant returns to scale, they maximize separately their profits -adjusted for their preferences- made on the domestic and foreign markets[7].

When domestic firms maximize their profits from exports to F, π_{DF}, they take into account the production of other domestic firms that export q_{DF}, the production of foreign firms q_F. To sell one unit in the foreign market F, they need to produce τ_F units, with $\tau_F > 1$.

$$\text{Max}\pi_{iDF} = q_{iDF}(p_F(q_{DF}, q_F) - c_i\tau_F)$$

where q_{iDF} is the sales of the domestic firms i in market F. The optimal sales level in market F for firm i is given by:

$$p_F + q_i p'_F(q_i, q_j) \leq c_i\tau_F$$

Production for each market is then[8]:

$$\begin{cases} q_{iDD} = p_D - (w_f - d_i) \\ q_{iDF} = p_F - (w_f + d_i)\tau_F \end{cases} \quad \text{if } \; d_i \leq d^*$$

$$\begin{cases} q_{iDD} = p_D - (w_f + d^*) \\ q_{iDF} = p_F - (w_f + d^*)\tau_F \end{cases} \quad \text{if } \; d_i > d^*$$

[6]We abstract from heterogeneity in costs among foreign firms, and in particular from differences due to discrimination; this assumption does not present implications for the determinants of the wage gap in the domestic country as what really matters for discriminators to be able to sell is the final equilibrium price in the markets.

[7]If marginal costs depended on output levels, export possibilities would influence domestic production level and the separability in firms' production strategies would not hold anymore

[8]If the transport cost is additive, the first order conditions are: $q_{iDF} = p_F - w_{if} - d_i - \tau_F$ and $q_{iDF} = p_F - w_{if} - d^* - \tau_F$. However iceberg costs are more convenient and were used by Brander (1981).

Levels of domestic sales and exports depend on the type i of the firm:

$$q_{iDD} = \frac{b - c_{iDD} + (N_D + N_{Df} - 1)(\tilde{c}_{-iD} - c_{iDD})}{N_D + N_{Df} + 1} \tag{2a-T}$$

$$q_{iDF} = \frac{b_F - c_{iDF}\tau_F + (N_D + N_{Df} - 1)(\tilde{c}_{-iF} - c_{iDF}\tau_F)}{N_D + N_{Df} + 1} \tag{2b-T}$$

with $\tilde{c}_{-ih}$ the average unit cost of both domestic and foreign competitors selling in market h. The conditions to have positive production levels in both markets for firm i, $i \in [0; \bar{d}]$, are derived in appendix B.

3.2 The labour market

The wage gap is defined as under autarky by equations (3) and (4). The labour market clearing conditions for female and male labour in the opened economy case, using equation (5) to substitute for $\sum_i d_i$, are given by:

$$\bar{L}_f = \sum_{i=0}^{d^*} q_{iDD} + q_{iDF} = N_{Df}(p_D + p_F - \left(w_m - \frac{N_{Df} - 1}{N - 1}\frac{\bar{d}}{2}\right)(1 + \tau_F))$$

$$\bar{L}_m = \sum_{i=d^*+r}^{\bar{d}} q_{iDD} + q_{iDF} = N_{Dm}(p_D + p_F - w_m(1 + \tau_F))$$

where N_{Df} is the number of domestic firms that employ women and N_{Dm} is the number of domestic firms that employ men. We can then derive the equilibrium wages and wage gap under trade:

$$w_f = \frac{1}{1 + \tau_F}(p_D + p_F - \frac{\bar{L}_f}{N_{Df}}) \tag{6-T}$$

$$w_m = \frac{1}{1 + \tau_F}(p_D + p_F - \frac{\bar{L}_m}{N_{Dm}}) \tag{7-T}$$

$$d^* = \frac{2\bar{d}}{1 + \tau_F}\left(\frac{\bar{L}_f}{\bar{d} + (N - 1)d^*} - \frac{\bar{L}_m}{(N - 1)(\bar{d} - d^*)}\right) \tag{8-T}$$

Proofs of the existence and the uniqueness of d^* are provided in the appendix.

Let us define Φ^T as:

$$\Phi^T \equiv d^* - \frac{2\bar{d}}{1+\tau_F}\left(\frac{\bar{L}_f}{\bar{d}+(N-1)d^*} - \frac{\bar{L}_m}{(N-1)(\bar{d}-d^*)}\right) = 0$$

which is equivalent to the function Φ above but for the trade regime.
Simple comparative statics shows that:

$$\frac{\partial d^*}{\partial \tau_F} = -\frac{\frac{\partial \Phi^T}{\partial \tau_F}}{\frac{\partial \Phi^T}{\partial d^*}} < 0$$

With trade liberalization and the fall in export barriers τ_F, the wage gap in the domestic labour market increases because discriminatory (higher cost) firms benefit from new sales opportunities which increases their ability to discriminate. This finding, in line with Becker's model implication on profit opportunities and ability to discriminate, had not been highlighted before. In previous studies, export shares are though of as another proxy for foreign competition taking place in foreign markets. Yet, increases in competitive pressures and lower profits do not necessarily come along with trade openness as openness also facilitates the access to foreign markets.

Trade costs to penetrate the domestic market τ_D have no effect on the wage gap when the number of operating firms is unchanged. In the next subsection, we will look at the impact of trade costs τ_D when higher cost firms may cease production but keeping the number of *potential* firms constant.

3.3 Competition and Firm Selection

To further understand how competition affects wage discrimination, let us use the cost threshold above which a firm cannot sell in a market. We consider a situation where foreign producer have homogeneous unit cost c_F and where discriminatory firms produce positive amounts in the domestic markets[9]. In the open economy framework, firms face different zero profit conditions depending on the market they operate in. Those conditions define the maximum level of factor prices a firm can afford in each market. Equation (9a-T) establishes the production cost threshold to sell in the domestic market while equation

[9]If discriminatory firms do not operate, there is no pay gap between men and women which is of low interest for the present study. The conditions for discriminatory firms to survive while paying higher wages to male employees are derived in the appendix

(9b-T) gives the cost threshold to export to market F.

The degree of competition at home

Let $\bar{c}_D$ denotes the cost threshold above which a domestic firm cannot break even in its domestic market. The lower $\bar{c}_D$, the tougher the competition in market D, the lower the profits and the gender wage gap. This cost-threshold is equal to the selling price $\bar{c}_D = p_D$.

$$\bar{c}_D = \frac{b - N_{Df}V + N_{Df}c_F\tau_D}{N_{Df} + 1} \tag{9a-T}$$

where V is again the average cost disadvantage of male firms compare to all female firms.

The impact of a fall in trade cost τ_D puts forward the competitive effect of openness. $\frac{\partial \bar{c}_D}{\partial \tau_D} > 0$ when a country reduces its trade barriers, the domestic cost cut-off diminishes ; this is due to two different effects. First, foreign firms bear lower trade costs so that the average cost of competitors falls. Second, as foreign firms sell at lower cost they are able to sell more: it generates a fragmentation effect.

The cost cut-off decreases also with the number of foreign firms exporting to the domestic market $\frac{\partial \bar{c}_D}{\partial N} < 0$. This effect operates through the two channels cited above: the fragmentation effect as more firms sell in market D and an indirect effect as an increase in incumbent firms exerts a downward pressure on the average cost.

Lastly, $\frac{\partial \bar{c}_D}{\partial c_F} > 0$ it is obvious that competition is fiercer when foreign competitors are more productive, i.e. when c_F is low.

The degree of competition abroad

$\bar{c}_{DF}$ denotes the cost threshold above which a domestic firm does not export to the foreign market F. Firms cannot compete in market F if their production costs multiplied by the iceberg trade costs τ_F are greater than the price in market F: $\bar{c}_{DF} = p_F$. The price in F depends on the number of potential exporters N_D and local producers N_F, it depends also on the production costs c_F of local producers, c_{fDF} for exporters hiring female workers and $\bar{c}_{DF}$ for exporters hiring male workers that have the highest production cost.

$$\bar{c}_{DF} = \frac{b_F - N_{Df} V \tau_F + N_F c_F}{N_D(1-\tau_F) + N_F + 1} \tag{9b-T}$$

The higher the number of domestic and foreign firms, the lower the cost cut-off $\frac{\partial \bar{c}_{DF}}{\partial N_F} < 0$. The lower the unit-cost of foreign firms, the lower the cost threshold $\frac{\partial \bar{c}_{DF}}{\partial c_F} > 0$. Hence, for high enough N_F and/or c_F, high-cost domestic firms employing men will not be able to export.

As for changes in trade barriers τ_F, it has counter-acting effects on the cost cut off as it influences firms' sells differently on the intensive and extensive margins.

$$\frac{\partial \bar{c}_{DF}}{\partial \tau_F} = N_D(b_F + N_F c_F) - (N_D + N_F + 1)(N_{Df} V)$$

The first term shows that a fall in export costs puts a downward pressure on the critical level of unit cost (τ_F and $\bar{c}_{DF}$ are positively correlated). For all exporting firms, it is now less expensive to sell in F; as a result of firms' strategic interactions, the price decreases and so does the cost threshold. This displays the effect of a fall in trade costs through the intensive margin channel.

On the other hand, a fall in τ_F has a positive effect on the cost-threshold through the extensive margin channel. As lower trade costs make it easier for firms to break even in the foreign market, new less productive firms are now able to export. The entry of less productive firms is associated with a higher cost threshold. This effect, formalized by the second term of the derivative, is proportional to the cost disadvantage of discriminatory firms V. When transport costs are reduced, their cost disadvantage hinders less their export opportunities which enable them to pay higher wages. The second effect dominates when the cost discrepancies between discriminatory and non-discriminatory firms is high, which corresponds to an industry with a small number of firms.

This is a particularly interesting result as it puts emphasis on an "anti-competitive" effect of openness that has not been though of in previous empirical analysis. Moreover, it sheds lights on the conditions under which this effect dominates. When a market is heavily concentrated, the extensive margin effect dominates and the wage gap widens. However, as the number of firms increases, the extensive margin effect is compensated by the intensive margin effect. The latter being pro-competitive, in sectors with a high enough number of

firms, trade liberalization in partner countries decreases the wage gap.

To sum up, profit opportunities can increase with trade. When partners' trade costs fall and when the number of foreign competitors is low, exports opportunities expand, which benefits both non-discriminatory and discriminatory firms. Exports are also higher if domestic firms have a significant cost advantage $c_D < c_F$.
On the other side, profit opportunities can dwindle with trade if domestic firms have not the competitive advantage. Foreign competitors N_F producing at lower costs, paying low trade costs τ_D, put a competitive pressure on domestic firms and make it harder for discriminatory firms to produce. In this case, trade will favor the low-cost non-discriminatory firms over discriminatory ones. Discriminatory firms will have to cease production, lowering the demand for male labour. Hence the wage gap will go down until full employment is restored.

3.4 Link with market access

This model shows that trade liberalization can have differential effects on the gender wage gap as it depends on the competitive advantage of domestic firms (determined by c_D, N_D, c_F, N_F) along with the trade costs (τ_D and τ_F). We have seen that the maximum labour cost a firm can incur depends on its ability to make profit at home and abroad. This brings to light a close connection with market potential as defined in economic geography models. New Economic Geography (NEG) models formalize a causal relationship between wages and market potential as the latter determines the level of profit that can be shared with employees. What is called the "NEG wage equation", first presented by Fujita et al. (1999), indicates that the wages that can be paid by a firm located in region r depend on the market access of this region MA_r which is a function of trade costs to penetrate foreign markets and the level of competition in those markets. These models typically feature competitive labour market and free entry of firms. In this paper, although the labour market is not competitive and the firms entry is restricted, market potentials influence firms' profits in the same way as in standard economic geography models.

The model hence has novel empirical implications as the size of the wage gap does not depend primarily on trade volumes but rather on market potentials. Both domestic firms' accesses to foreign markets and foreign firms' accesses to the domestic market are used for the first time to capture the pro-competitive effect of trade and geography. This model

further helps to understand how wage gaps respond to evolutions of the market access depending on the domestic market structures: an improvement in the access to foreign markets increases the wage gap when only a few firms operates at home while it decreases the wage gap when numerous firms competes at home.

4 An empirical investigation

The theoretical model determines the ability to discriminate in imperfectly competitive sectors that are opened to trade. The empirical challenge is thus to measure the degree of both domestic competition and trade openness. To explore the effects of these variables on gender wage discrimination, the empirical analysis proceeds in several steps. In section 4.1, we estimate gender wage discrimination using individual data. Section 4.2 presents the competition variables. Section 4.3 explains how market access are computed. The last step, described in section4.4, consists of regressing the wage gap due to discrimination on the domestic competition indicator and the market access variables to test the theoretical implications.

We conduct the empirical exercise on data from Uruguay, a country that witnessed an important liberalization episode in the 1990s. Several liberalization agreements took place, at the regional level with the Mercosur founded in 1991 and amended in December 1994 and also with the multilateral negotiations driven by the GATT and WTO. This period contrasted with previous decades during which sectors were protected by tariffs. Uruguay is a small open economy with export and import shares on the increase, as figure 1 shows. Besides its comparative advantage in sectors using intensively natural resources such as food processing industries, the population of Uruguay is relatively educated so that we can expect the country to be able to compete internationally in modern manufacturing sectors as well.

4.1 Computing gender wage gaps

4.1.1 Uruguayan Household Survey

We use the longitudinal Uruguayan household survey (Encuesta Continua de Hogares ECH) over the period that ranges from 1983 to 2003. The survey provides data on gross hourly wages, occupation, education, age, sector of activity (at a level of disaggregation between one and two digit). Unfortunately variables on unemployment duration and job

tenure are missing for many years which impedes us from deriving real experience on the labour market. Other individual variables allow to estimate selection into labour market (marital status, husband's income, number of children...).

Table 1 indicates that labour market participation is much lower for women than for men. Around 49% of the female working-age population was active in 1990 while almost 60% of women participated to the labour market at the end of the period. If the participation gap decreased steadily over the period, the unemployment gap however increased.

Table 1: Descriptive Statistics for the household survey

	Gender	1990	1995	2000	2004
Observations	Male	*19128*	*20217*	*18057*	*17233*
	Female	*22403*	*23156*	*20522*	*19577*
Participation rate	Male	81.3	83.6	82.1	81
	Female	48.8	54.9	58.7	59.2
Unemployment rate	Male	4.5	7.6	10.7	10.1
	Female	7.1	13	16.9	16.5
Among employees in the	Male	*2595*	*2185*	*1533*	*1385*
manufacturing industry	Female	*1225*	*941*	*706*	*637*
Mean age	Male	36.5	36	35.8	37
	Female	35.6	35.8	36	36.5
Primary Education	Male	40	59	55	27.7
	Female	38	58	51	22.5
Secondary Education	Male	33	12	15.7	39.1
	Female	44	19	24.1	48
Technical	Male	21	22	21.8	24.2
	Female	10	13	10.4	14.8
College Education	Male	5	7	6.8	5.3
	Female	8	10	14.1	10.7

Based on the Household survey, ECH, INE, Uruguay.

4.1.2 Empirical methodology: decomposition of the sectoral raw wage gaps

To obtain a measure of discrimination, we retrieve, as finely as possible, the part of the wage gap due to differences in treatment of identical productive characteristics such as educational attainment. Indeed, if the endowment in human capital of women happened to be higher, for example, in export oriented sectors compared to import competing sectors, correlations would indicate that export success contributes to the narrowing of the gender wage gap but this would not have anything to do with the mechanism at work in the model.

We restrain the sample to employees aged from 18 to 65, hence excluding employers, unpaid workers and self-employed. The individual characteristics taken into account in this analysis are: the level of education (5 categories), potential experience (age minus 6 minus the number of education years) and potential experience squared. A dummy equal to one if the individual lives in Montevideo controls for wage disparities across the urban center and the rest of the country which is far less urbanized. Estimating the wage gap on employees of the private sector only do not change the results. Besides, one can makes arguments for including or for excluding the occupational controls. Here we consider that human capital characteristics should determine the job position hence we do not control for positions[10].

We estimate the male and female wage equations separately for each sector and year so that the returns to human capital characteristics are allowed to vary across sectors and years. For each year t and sector j, we run the two following wage equations:

$$\ln W_{mjt} = \beta_{0mjt} + \beta_{mjt} X_{mjt} + \epsilon_{mjt}$$

$$\ln W_{fjt} = \beta_{0fjt} + \beta_{fjt} X_{fjt} + \epsilon_{mjt}$$

Following Oaxaca (1973) and Blinder (1973), the total wage difference can be decomposed into three terms:

$$\overline{\ln W}_{mj} - \overline{\ln W}_{fj} = \beta_{0mj} - \beta_{0fj} + \overline{X}_{fj}(\beta_{mj} - \beta_{fj}) + (\overline{X}_{mj} - \overline{X}_{fj})\beta_{mj} \qquad (10)$$

[10] Strikingly enough, controlling for job occupations increases the unexplained part of the wage gap at the beginning of the period in the following industries: food, machinery, paper and printing and chemical. This result is due to bigger discrepancies in the return to education within occupation compare to the average differences in return when we do not control for occupation.

The first term captures differences in average starting wage. The second one represents differences in returns to similar characteristics. The third term represents the explained component, due to average differences in productivity determinants (such as education or experience) of workers; it is "the endowments effect". The sum of the two first terms is referred to as the adjusted wage gap that we will use subsequently in the analysis.

$$WG_j = \beta_{0mj} - \beta_{0fj} + \overline{X}_{fj}(\beta_{mj} - \beta_{fj})$$

Table 2: Decomposition of the raw wage gap. Manufacturing industry

Year	85	87	89	91	93	95	97	99	2001	2003
Raw Wage Gap	0.31	0.41	0.43	0.38	0.33	0.27	0.21	0.21	0.27	0.22
$ln\bar{W}_m - ln\bar{W}_f$	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.04)	(0.04)
Gap due to	0.03	-0.03	-0.02	-0.06	-0.02	-0.06	-0.06	-0.04	-0.04	-0.06
endowments	(0.01)	(0.01)	(0.01)	(0.1)	(0.01)	(0.02)	(0.02)	(0.02)	(0.01)	(0.02)
Gap due to	0.26	0.43	0.44	0.42	0.34	0.32	0.26	0.25	0.30	0.25
returns	(0.03)	(0.02)	(0.03)	(0.02)	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)
Number of men	1383	2857	1863	2383	2326	2164	1975	1632	1425	1216
Number of women	666	1308	857	1261	1139	932	854	701	693	577

Source: Author's calculation based on the Encuesta Continua de Hogares, INE, Uruguay. Manufacturing employees only. Oaxaca and Blinder decomposition of the raw wage gap. Wages include bonuses.

Table 2 presents the results of the decomposition for half of the years included in the sample. For the sake of space, we just present the decomposition of the raw wage gap for the whole manufacturing industry here. We can see that both the average raw and adjusted wage gap in the manufacturing sectors dropped in the early 1990s when the Mercosur was first introduced; they further decreased in the mid 1990S which corresponds to a consolidation of the trade agreement. The Uruguayan banking and currency crisis in the early 2000s can be responsible of the rise in the wage gaps during that period. The decomposition shows that differences in human capital endowments between men and women do not contribute to the positive raw wage gap ; indeed, women have a relatively high level of education, even higher than men in some fields as shown in table 1. The decomposition highlights that the human capital endowments are on average much less remunerated for

women.

Table 3: Employment and Wage Gaps between Men and Women

		1983-1990	1991-1994	1995-1999	2000-2004
Whole economy	*Participation gap*	35	30	26	22
	Female share	40	41	44	47
	Raw wage Gap	29	18	9	3
	Wage Gap	22	24	19	10
Industry	*Employement share*	22	21	16	13
	Female share	21	33	30	32
	Raw wage Gap	57	43	29	26.8
	Wage Gap	39	38	29	27
Textile	*Employment share*	6.4	5.7	3.3	2.8
Apparel	*Female share*	57.9	60.6	57.5	57.5
	Raw Wage Gap	102	78	64	64
	Wage Gap	60	59	56	53
Food	*Employment share*	7.3	6.9	6.1	5.2
Tobacco	*Female share*	22.3	26.5	27.4	30.4
	Raw Wage Gap	46	31	30	28
	Wage Gap	27	26	26	25
Chemical	*Employment share*	2.5	2.4	2	1.9
products	*Female share*	25.8	28.4	40	33.4
Oil	*Raw Wage Gap*	5	16	12	18
	Wage Gap	27	23	20	18
Paper	*Employment share*	1.3	1.3	1.1	1
Printing	*Female share*	27.1	26.5	28.5	33.4
	Raw Wage Gap	35	28	12	18
	Wage Gap	28	27	24	27
Machines	*Employment share*	2.4	2.4	2.1	1.4
	Female share	11.6	11.7	11.4	14.1
	Raw Wage Gap	1	-4	3	-4
	Wage Gap	11	9	7	0

Source: Author's calculation based on the Encuesta Continua de Hogares, INE, Uruguay.
Variables are in percentage.

Note that for the wage gaps used in the empirical analysis are estimated for each manufacturing industry separately to build a panel of sectors from 1983 to 2003. This approach thus allows for heterogeneous returns to characteristics across industries and

years. The raw and adjusted wage gaps for the different manufacturing sectors are displayed in table 3along with gaps in employment shares.

Overall, raw wage gaps and wage discrimination have been falling since the beginning of the 1980s. The wage differentials between men and women due to differences in return ranges from 22% to 10% in the whole economy[11] but Both the raw wage gaps and the wage gaps are substantially wider in the manufacturing industries[12]. The adjusted wage gap is much higher in the manufacturing industry where it ranges from 40% to 27%.

At the beginning of the period male wages used to be more than the double of female wages and 40% of the gap remained unexplained; during the first half of the years 2000, the raw wage gap was around 27% and could not be explained by observable characteristics. Within the manufacturing industry, there are wide differences in wage gaps across sectors. The food, beverage and tobacco and the textile and apparel industries are the ones that employ more women. In both industries the raw and the unjustified wage gaps have decreased but have remained high, especially in the textile and apparel industry where more the half of the raw wage gap was due to differences in returns in the early 2000s.

4.2 Measure of domestic competition, Herfindahl index

A large literature deals with the measure of market power at the industry level. The four-firm concentration ratio or the Herfindahl index of concentration are commonly chosen proxies to capture the level of industry competition. For the present analysis, Herfindahl indexes have been computed based on a confidential firm survey. It is computed as $HH = \sum_i^N s_i^2$, $HH_i = \sum_e^N s_{ei}^2$ where s_{ei} is firm e's share of production in industry i. It ranges from 1, a monopolistic situation, to $\frac{1}{N}$ if firms have equal market shares. Table 4 presents summary statistics of the sectoral concentration of market shares at the two digit level. Even if the definition of industries is rather aggregated, the index displays wide variations across sectors and time. The most concentrated sector in the early 80s was the paper industry while in 2000, the food and beverage industry and the machinery industry are the most concentrated sectors.

[11] Other studies using different methods find higher unexplained wage gaps. For example, Atal et al. (2009) estimate the unexplained wage gap with a non-parametric matching approach ; they find that in 2005 around 20% of the gap remained unexplained.

[12] This paper focuses on the manufacturing industries, as they are the most subject to international trade.

Table 4: Herfindahl index of production concentration among manufacturing industries

Year	1983-87	1990	1991	1994	1995	2000
Textile Apparel	18	22	23	28	27	15
Chemical	28	24	26	29	30	58
Machines	29	14	12	16	20	30
Food Beverage	33	22	25	29	28	49
Paper	39	32	30	41	43	32

Source: INE, Uruguay. Here $HH = 100 \times \sum_i^N s_i^2$.

4.3 Measures of foreign competition at home and in the foreign markets

4.3.1 Trade data

To construct measures of foreign competition, this article employs bilateral trade and production data taken from the *TradeProd database* constructed by the CEPII. They cover the period 1980-2003 for Uruguayan manufacturing sectors. A detailed description of the database can be found in Mayer et al. (2008). This database has the particularity to match trade flows and production levels at the industrial level which allows us to construct trade shares and internal flows (exports minus production) easily. The CEPII provides also the *Distances database* with bilateral distances and common official language which are used to capture part of the trade costs.

4.3.2 Market access

In most of the papers dealing with the impact of trade openness on the gender wage gap, foreign competition is captured by import penetration[13]. However, import penetration alone might not be an appropriate measure. First, higher import penetration does not necessarily squeeze profitability if export opportunities are high enough. Second, import penetration can increase either because imports go up or because domestic production goes down; in the latter case, a change in domestic market conditions will mislead us into believing that foreign competition became sharper.

Some studies also regress the wage gap on export shares[14] or on global openness ($\frac{X_j+M_j}{Q_j}$ where M_j is import volume, X_j the exports volume and Q_j the level of production in

[13]See Artecona and Cunningham (2002), Berik et al. (2004), Black and Brainerd (2004), Menon and van der Meulen Rodgers (2009)

[14]Berik et al. (2004), Menon and van der Meulen Rodgers (2009)

industry j). Even if it is true that more competitive firms do better at exporting, it does not necessarily mean that higher export shares reflect tougher competition pressure on domestic firms. Export shares can also increase because trade liberalization makes it cheaper, providing higher export revenues without heightening competition.

As for global openness, this variable does not allow to disentangle the impact of import penetration from the impact of export orientation on wage gaps.

To partly remedy these issues, one should control for both import and export shares in the same regression; moreover, it is important to test for the robustness of the results by using other indicators of trade openness. We argue that market access is an appropirate measure to capture the ability of foreign firms to sell their products in the domestic market as well as the ability of domestic firms' to sell abroad.

Since the 90s, the economic geography literature has emphasized how proximity to markets with large demand shapes international trade patterns. In their seminal work, Redding and Venables (2004) estimate structurally a model where access to markets and sources of supply at the country level explain country variations in per capita income. Recent studies by Fally et al. (2010) and Hering and Poncet (2010) estimate market access at the sectoral level and look at its impact on variations in sectoral wages. We follow here their approach.

We now define two variables. Market access (MA) captures the easiness for Uruguayan firms to penetrate foreign markets (Uruguay's exports). Competitors access to the Uruguayan market (CA) captures the easiness for foreign firms to sell in Uruguay (Uruguay's imports).

A high MA corresponds to a high potential demand addressed to Uruguayan firms given their geographical position, their competitiveness and those of other exporters. MA is thus positively related to firms' potential profitability. In a setting with free entry and no economic profit, an increase in MA leads to an entry of firms. In a sector with restricted entry, an increase in MA raises the profit margin of exporters; this is the profit enhancing effect of trade. To state this in a different manner, the maximum production cost that firms can incur is increasing in their access to foreign markets.

However, profit opportunities abroad depends on the competition among all potential exporters. The oligopolistic framework features firms with heterogeneous costs that operate in the domestic market but might not be able to enter the foreign market. The high-cost discriminatory firms are more likely to enter the foreign markets if they compete with few

firms while entering the foreign market. As a result, an increase in MA enable high cost firms to make profits from exports only if the level of concentration is high. If concentration is low, only the low-cost firms will be able to enter the foreign market.

CA measures the ability of foreign producers to sell in the Uruguayan market given their competitive advantage and the transport costs they have to incur to enter Uruguay. An increase in CA increases the volume of foreign goods in the Uruguayan market and reduces the price level through the competition channel. CA captures thus the pro-competitive effect of trade. An increase in CA has a negative impact on the ability to pay some workers a premium and this impact is stronger when the domestic market is concentrated.

To compute MA and CA we first estimate the impact of trade costs and sectors' characteristics on the volume of exports for all pairs of trade partners. We estimate the following gravity equation:

$$lnX_{DFjt} = \sum_{kt} \beta_{kjt}\tau_{k,DFjt} + FX_{Djt} + FM_{Fjt} + \epsilon_{DFjt}$$

where X_{DFjt} is the volume of exports of good j from country D to country F during year t. k is the number of variables that measure trade costs Characteristics of sector j in region D such as the number of firms and the average cost of production are captured by a fixed effect specific to each sector j-country D year t: FX_{Djt}. Similarly, the importing region fixed effect FM_{Fjt} captures market characteristics specific to each sector for a given country and year such as the number of firms operating in sector j in year t and their average competitiveness.

Trade costs to enter market F $\tau_{k,DFjt}$ are captured by a set of variables: bilateral distance, contiguity, common language, regional trade agreement. Tariffs cannot be included because of too frequent missing values for Uruguay. We estimate the bilateral trade equation for each year and industry so that the impact of trade costs β vary across sectors and time for a given pair of trade partners.

The access of Uruguayan firms selling good j to all foreign markets in year t is denoted MA_{jt}. It is the sum of the market access to specific countries F :

$$MA_{URYjt} = \sum_{F} MA_{URY,Fjt} = \sum_{F} \left(FM_{Fjt} \prod_{k} (\tau_{k,URY,Fjt})^{\beta_{kt}} \right)$$

MA_j increases when the trade costs $\tau_{k,URY,Fjt}$ fall.

Foreign firms' access to the Uruguyan access are computed as follows:

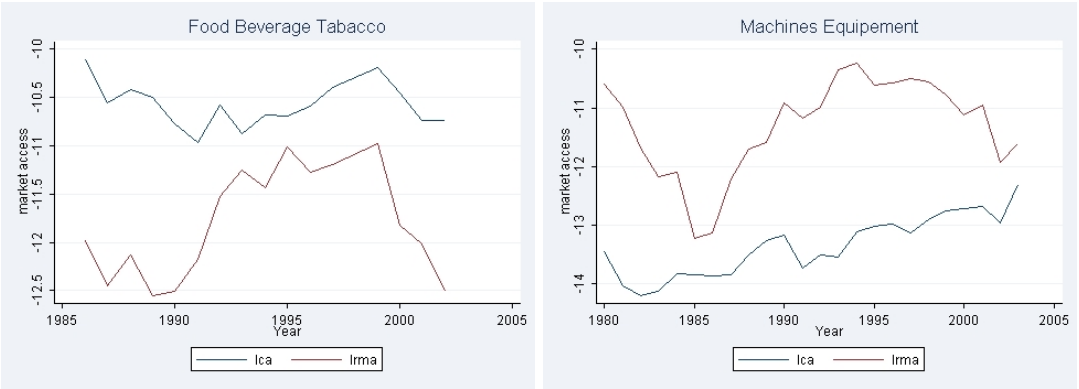
$$CA_{URYjt} = \sum_F MA_{F,URYjt} = \sum_F \left(FX_{F,URYjt} \prod_k (\tau_{k,F,URYjt})^{\beta_{kt}} \right)$$

CA increases when the trade costs to enter Uruguay fall, when the demand for good j increases, when the number and productivity of Uruguayan firms producing good j decrease.

Those two synthetic variables embeds the sectoral characteristics that determine the wage gap. Besides being closer to the theory, market access has another advantage compare to traditional outcome variable (trade shares). When looking at the impact of openness on firms' behaviour (here human resources policy), we want the openness variable to be exogenous to firms' decisions. We are in firmer ground with market access compare to trade shares.

Figure 1 displays the evolution of CA and MA in the food processing industry and the machines and equipment industry. Both MA and CA rose in the 1990s. Market access drop sharply in the aftermath of the crisis that occurred in the early 2000s in the region which makes sens as demand addressed to Uruguayan firms fell.

Figure 1: Market Access



4.4 Empirical specification: market access as a determinant of the gender wage gap

To identify empirically the pro and anti-competitive effect of trade openness, we need to separate it out from the effect of domestic competition. Furthermore, the model underlines that the impact of trade openness depends on the domestic market structure. Thus, we interact the trade openness variables with the level of domestic competition captured by the Herfindahl index. Hence we employ a strategy in line with a difference-in-differences approach as we compare the effect of trade exposure (treatment) in competitive sectors (the control group) and in imperfectly competitive sectors. As foreign competition can impact the level of concentration in an industry by leading some inefficient firms to exit, we interact the openness measure with the level of concentration prior the liberalization episode C_{j0} rather than the contemporaneous level of concentration.

$$WG_{jt} = \beta_0 + \beta_1 \ln MA_{jt} + \beta_2 \ln C_{j0} \ln MA_{jt} + \beta_3 \ln CA_{jt} + \beta_4 \ln C_{j0} \ln CA_{jt} + \theta_t + \mu_j + \epsilon_{jt} \tag{11}$$

where MA_{jt} captures profit opportunities in foreign market j at time t while CA_{jt} captures foreign competition pressures due to the entry of foreign products, C_{jt_0} is the level of concentration of sector j in the first period 0, θ_t is a time fixed effect and μ_j is an industry fixed effect. The level of sectoral concentration in the first period C_{j0} are controlled for by the sector fixed effects.

Gender wage gap can vary across sectors because of sectoral features that have nothing to do with competition pressures. To avoid any spurious correlation due to industry characteristics, sector fixed effects are included. They net out the impact of time-invariant industry-specific factors such as social norms regarding female labour (female work in machinery or oil industries may be less accepted than female work in textile and apparel). They are of primordial importance as sectors relying more on male labour force might be more male chauvinist, and could be, for some reasons, correlated with concentration or trade orientation, so that omitting them would bias the estimates.

Year fixed effects capture shocks or policies that affect labour market conditions equally in all manufacturing sectors. It includes macroeconomic shocks or government policies that influence female labour supply (child care or parental leave reforms) for example.

Since we control for industry and time fixed effects, this specification identifies the impact of trade openness through within-industry variation.

Lagged effects of the explanatory variables are also estimated:

$$WG_{jt} = \beta_0 + \beta_1 \ln MA_{jt-1} + \beta_2 \ln C_{j0} \ln MA_{jt-1} + \beta_3 \ln CA_{jt-1} + \beta_4 \ln C_{j0} CA_{jt-1} + \theta_t + \mu_j + \epsilon_{jt} \quad (12)$$

Some specification also controls for past concentration levels C_{jt-1}, which gives an insight on whether women suffer more from discrimination when they work in sectors with stronger domestic market power compare to sectors with little domestic market power. We control also for the lagged share of women in the sector FLS_{jt-1} to deal with additional determinants of the wage gap that are ignored in the theoretical model because of the fixed labour supply assumption.

Turning to the expected signs of the coefficients, an increase in MA creates new opportunities for Uruguayan firms to make profits abroad and by doing so it strengthens their ability to discriminate. This effect is expected to be significant in sectors where discriminatory firms can compete with their domestic counterparts, i.e. in concentrated sectors ($\beta_2 > 0$). However, if there is a sufficiently high number of firms in the sector prior to the liberalization period, only the most productive firms are expected to export. In that case, we do not expect any widening of the wage gap. On the contrary, as most productive non-discriminatory firms expand in the foreign markets, they put more pressure on the labour demand which reduces the gender wage gap ($\beta_1 < 0$).

An increase in CA corresponds to more entries of foreign products which increases competition pressures. We expect it to reduce discrimination only in concentrated sectors where domestic competition is low enough to allow costly hiring decisions ($\beta_4 < 0$). In sectors atomized prior to the liberalization period (low C_{j0}), incentives to cut unit costs are already very high, no costly discrimination can take place, hence the impact of trade on discrimination, if there is one, does not play through the pro-competitive effect.

4.5 The results

Table 5 and 6 report the results obtained from regressing the gender wage gap on foreign competitors' access to the Uruguayan market CA as a measure of foreign competition and Uruguayan firms access to foreign markets MA as a measure of profit opportunities. Columns (1) to (4) of each table report the results of estimating equation (11) using contemporaneous market access while columns (5) to (8) report the results of estimating the

equation (12) using the lagged explanatory variables. In order to account for some sectors' time varying characteristics that might be correlated with the gender wage gap, we control for the concentration level lnC and the female labour share $lnFLS$ in columns (4) and (8).

Table 5: Market Access on the Wage Gap. Mercosur trade partners

Dependant variable	Unexplained Gender wage gap							
Explanatory	Contemporaneous				Lagged			
variables	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnCA	0.483*		0.550***	0.496**	0.511*		0.552**	0.662***
	(0.183)		(0.099)	(0.153)	(0.205)		(0.121)	(0.090)
lnCA×lnC$_0$	-0.135*		-0.149***	-0.137**	-0.144*		-0.156**	-0.187***
	(0.052)		(0.030)	(0.047)	(0.058)		(0.035)	(0.025)
lnMA		-0.443**	-0.409*	-0.415*		-0.697*	-0.699**	-0.652*
		(0.158)	(0.165)	(0.180)		(0.292)	(0.242)	(0.260)
lnMA×lnC$_0$		0.125**	0.106*	0.110*		0.204*	0.200**	0.186*
		(0.041)	(0.048)	(0.045)		(0.080)	(0.064)	(0.070)
lnC$_{t-1}$				0.102*				0.011
				(0.044)				(0.050)
lnFLS				0.016				-0.121*
				(0.046)				(0.047)
Constant	0.573**	0.115	0.256	-0.109	0.335	0.089	0.132	0.072
	(0.133)	(0.306)	(0.309)	(0.336)	(0.158)	(0.188)	(0.265)	(0.426)
Observations	98	98	98	98	96	96	96	96
R-squared	0.352	0.343	0.392	0.420	0.345	0.365	0.399	0.418
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes

Robust s.e. in parentheses. *** p<0.01, ** p<0.05, * p<0.1 All regressions include fixed effects for the five sectors.
C is the average value of the Herfindahl index between 1983 and 1987.

In Table 5, CA and MA are computed for Mercosur countries only, namely Argentina, Brazil, Paraguay and Uruguay. In columns (1),(2), (5) and (6) the wage gap is explained by either CA or MA. Yet, all sectors feature two-way trade; with the Mercosur, firms within the same sector enjoyed new market opportunities and in the same time, had to cope with new entries of products from their trade partners. As the two dimensions have opposite effects on the ability to discriminate, it is worth controlling for the two variables in the same regression.

The effect of foreign competition $lnCA$ is stable and significant. It comes out that foreign competition is associated with an increase in the unexplained wage gap *in non-concentrated sectors*, as the positive coefficient on $lnCA$ indicates. This point estimate gives the impact of competitors access for sectors with an initial Herfindahl index equals to zero, that is to say for sectors with a very large number of firms, which does not correspond to the oligopolistic framework developed in the model. The model developed in section 2 cannot explain why a surge in the entry of foreign goods is positively correlated with the wage gap in sectors with a large number of firms. A similar results is found by Black and Brainerd (2004) when they regress the gender wage gap on import penetration. They suggest that this can be due to a second effect of trade, namely the increase in demand for skills. Yet, we should bear in mind that differences in observable skills are controlled for in the first stage of both studies so that a rise in wage inequality between skilled and unskilled workers fostered by trade is not what drives this result. An unequal access to high-skilled positions or an increase in returns of skills that are not observable by the econometrician such as tenure or vocational training are potential relevant explanations.

That being said, the principal coefficient of interest with regard to the taste discrimination framework is the interaction of foreign competition with the concentration level, considered as a proxy of market power. The robust negative sign associated with the interaction $\text{lnCA}\times\text{lnC}_0$ shows that among concentrated sectors, the wage gap is lower in sectors where firms face new competitive forces due to an easier entry of foreign products. This effect can be interpreted as the consequence of the reduction in market power that was previously used by employers to discriminate against women.

The MA variable measures Uruguayan firms' access to foreign market, or export potentials. First, the negative and significant coefficients on $lnMA$ revels that in markets with low market power, the ability to enter foreign markets does not translate into increasing ability to discriminate. This is in line with the model prediction: for a high enough number of firms, only the most productive no discriminatory firms exports. Moreover, the expansion of those firms make it harder for the discriminatory firms to break even in their own domestic market, which explains the reduction in the wage gap. This is what we refer to as the "intensive margin effect" of trade partners' liberalization.
Secondly, the positive and significant coefficients on $lnMA \times lnC_0$ makes out that, when the sector is highly concentrated, higher sales opportunities abroad correspond to higher unexplained wage gap. This is a situation where the "extensive margin effect" dominates, that is to say when less productive discriminatory firms are able to enter foreign markets

and gain profit margins abroad.

Table 6 reports the effect of competitors' access to the Uruguayan markets CA and Uruguayan sectors' access to foreign markets $lnMA$ when we consider all the trade partners of Uruguay. Results are similar to those obtain with the previous definition of market access, the estimated coefficients are stable and significant except for the contemporaneous impact of MA that is insignificant.

Table 6: Market Access on the Wage Gap. All trade partners

Dependant variable	Unexplained Gender wage gap							
Explanatory variables	Contemporaneous				Lagged			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
lnCA	0.473		0.582**	0.512**	0.536		0.635**	0.745***
	(0.249)		(0.136)	(0.116)	(0.284)		(0.149)	(0.141)
lnCA×lnC$_0$	-0.132		-0.157**	-0.140**	-0.151		-0.179**	-0.211***
	(0.070)		(0.038)	(0.036)	(0.081)		(0.043)	(0.041)
lnMA		-0.443*	-0.470*	-0.458		-0.710*	-0.769*	-0.726*
		(0.192)	(0.213)	(0.246)		(0.320)	(0.284)	(0.306)
lnMA×lnC$_0$		0.126*	0.123	0.122		0.207*	0.220**	0.207*
		(0.051)	(0.060)	(0.064)		(0.088)	(0.077)	(0.083)
lnC$_{t-1}$				0.099*				0.008
				(0.043)				(0.052)
lnFLS				0.022				-0.119*
				(0.043)				(0.046)
Constant	0.590**	0.152	0.284	-0.074	0.338	0.105	0.146	0.097
	(0.156)	(0.295)	(0.305)	(0.321)	(0.181)	(0.183)	(0.269)	(0.433)
Observations	98	98	98	98	96	96	96	96
R-squared	0.349	0.338	0.387	0.414	0.343	0.358	0.395	0.413
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes		
Year FE	Yes	Yes	Yes	Yes	Yes	Yes		

Robust standard errors in parentheses; *** p<0.01, ** p<0.05, * p<0.1 All regressions include fixed effects for the five sectors.

The last four columns show the impact of both $lnCA_{t-1}$ and $lnMA_{t-1}$. The impact of CA, lagged by one period, is of the same sign but of larger magnitude than the contemporaneous impact. The impact of MA is now significant and corroborates the model predictions on the unequivocal effect of trade partners' liberalization. An improvement in export opportunities across all destination markets does not contribute to wage disparities across employees in competitive sectors but it does in concentrated sectors.

5 Conclusion

This paper develops a model of wage discrimination with intra-industry trade to highlight the possible channels through which trade openness impacts the wage gap that arises because of employers' prejudices against women. As far as we know, it is the first explicit model where both the wage gap and the trade pattern are endogenously determined. The model formalizes the intuitive pro-competitive effect of trade on the wage gap. What is more, it puts new light on a profit enhancing effect of openness , by doing so it explains otherwise puzzling results.

Trade openness has heterogenous effects on the ability to discriminate. First, trade liberalization of the domestic economy makes it easier for foreign firms to penetrate the market which corresponds to tougher foreign competition at home. It drives down oligopoly profits, reduces the production of high-cost discriminatory firms and can even oblige them to cease production. This selection of firms puts a downward pressure on the gender wage gap.

Second, the liberalization of trade partners' markets have counteracting effects. It enables less productive firms to enter foreign markets by reducing the cost of exporting which boosts their rents instead of exerting a pro-competitive effect. This channel dominates only if the competition at home is not too fierce. To say it differently, freer trade makes it easier for prejudiced employers to employ and pay workers according to their preferences if they can sustain their cost disadvantage compare to their domestic and foreign competitors. However, if discriminatory firms are able to sustain their cost disadvantage at home but not abroad, better export opportunities benefit only the most productive domestic firms that expand abroad, increase their demand for female labour which thus reduces the wage gap. This effect dominates when the number of firms is high enough.

To provide some empirical evidence of these mechanisms, we take advantage of the sharp liberalization episode that took place in Uruguayan following the creation of the Mercosur in 1991 and its consolidation in 1995. We estimate market access variables to give a measure of the pattern of competitive advantage between trade partners, which is closer to the theory than the trade output variables used so far. Uruguay is an interesting country to explore the impacts of market access as it is a small economy that is less likely to influence the outcomes of trade agreement negotiations. This ensures the exogeneity of changes in trade policies with respect to domestic industries characteristics.

The main theoretical predictions are supported by the empirical findings. Foreign competition curbs the adjusted wage gap in sectors previously sheltered from competition. On the contrary, profit opportunities from export increase the adjusted wage gap when domestic concentration is high but not when concentration is low. However, if competition can reduce the unexplained wage gap, it does not suppress it completely. In particular, the remaining wage gap in rather competitive sectors is positively affected by an increase in foreign firms' access to the domestic market. This empirical result remains a puzzle and calls for further investigations.

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Appendix

A Conditions for an interior solutions for firms' production levels

The production level of firm i given by its reaction function depends on its own cost, the number and average cost of its competitors and the size of demand:

$$q_i = \frac{b - c_i + (N-1)(\tilde{c}_{-i} - c_i)}{N+1}$$

Firms employing men have the highest unit cost and thus the lowest production level. They are the first to cease production if competition pressures heighten. In what follows, we derive the conditions to have an interior solution for discriminatory firms' production. As non-discriminatory firms have lower cost, they necessarily produce if discriminatory firms produce. In the case where no high-cost firm can survive, there is no wage gap and I derive the condition for N identical firms incurring a unit labour cost.

A.1 The closed Economy Case

Discriminatory firms pay a wage $w_f + d^*$ to their male employees ; they produce a positive amount q_m if :

$$q_m > 0 \Leftrightarrow b > w_f + d^* + \left(\frac{d^*}{\bar{d}}(N-1) + 1\right)\frac{d^*}{2}$$

where $\frac{d^*}{d}(N-1)+1 = N_f$. High wage gaps are sustainable in markets with large enough demand. In markets with numerous firms, the critical demand level below which wage gaps cannot exist need to be higher.

If $N_f \leq \frac{N_m}{N-1}$, then all women are hired by the non prejudiced employers so that there are no cost differences between male-firms and the female firm, $w_f = w_m = w$. All firms produce the same amount $q = \frac{b-w}{N+1}$ and an interior solution requires that demand be large enough:

$$q > 0 \Leftrightarrow b > w$$

A.2 The Open Economy Case

In the open economy setting, domestic firms can either produce locally and export to foreign markets, produce only for the domestic market or cease production all together. This separation of markets requires to examine four conditions.

Positive Wage Gap. Discriminatory and Non-discriminatory firms.

Are discriminatory firms able to export?

$$q_{mDF} > 0 \Leftrightarrow b_F > w_f\tau_F(N_F+1) + d^*\tau_F(N_F+1+\frac{N_f}{2}) - c_F N_F$$

It is always the case that $q_{mDF} > 0$ if $c_F > \tau_F(w_f+d^*)+S$ with $S = \frac{\tau_F}{N_F}(w_f+d^*(1+\frac{N_f}{2}))$ That is to say, $q_{mDF} > 0$ if discriminatory domestic firms have a strong competitive advantage. $\tau_F(w_f+d^*)$ represents the production cost to export and S take into account the cost disadvantage generated by discrimination. Indeed, discriminatory firms need to compensate for their higher cost with respect to non-discriminatory domestic firms exporting in the foreign market.
If discriminatory firms do not have a competitive advantage, then it is necessary for them that few foreign firms N_F operate in the destination market F. If $\tau_F(w_f+d^*)+S > c_F$ then $q_{mDF} > 0$ if $N_F < \frac{b_F-\tau_F(w_f+d^*(1+\frac{N_f}{2}))}{\tau_F(w_f+d^*)-c_F}$

Are non-discriminatory domestic firms able to export?

If discriminatory firms are not competitive enough and foreign firms N_F are too numerous, they do not export and we need to look whether non-discriminatory firms are able to enter the foreign market. Non-discriminatory firms employ women but can be prejudice against women; this situation takes place whenever the discrepancy between male and female wages compensate employers' discomfort of hiring women. Thus, the following condition depends on the prejudice of each specific firm. For every firm i with $d_i < d^*$:

$$q_{iDF} > 0 \Leftrightarrow b_F > (N_F + 1)(\tau_F(w_f + d_i)) + \tau_F d^*(N_D - \frac{N_f}{2}) - N_F c_F$$

If $c_F > \tau_F(w + d_i) + S_i$ it is always true, with $S_i = \frac{\tau_F}{N_F}(w_f + d_i - d^*(N_D + \frac{N_f}{2}))$
The rationale behind the condition remains the same: higher demand b_F in market F makes it easier for domestic firms to export; the cost advantage of domestic firm need to compensate for the transport cost and for the impact of their prejudice d_i. Note that having positive exports is less demanding for less prejudiced firms as they perceive that they bear labour costs and are ready to hire more women: S_i decreases with d_i.
If $c_F < \tau_F(w + d_i) + S_i$, then $q_{iDF} > 0 \Leftrightarrow N_F < \frac{b_F - \tau_F(w+d_i) + d^*(N_D + \frac{N_f}{2})}{\tau_F(w+d_i) - c_F}$
A lower number of competitors compensate for the absence of strong competitive advantage over foreign firms.

Are discriminatory firms able to sell on the domestic market?

$$q_{mDD} > 0 \Leftrightarrow b > w_f(N_F + 1) + d^*(N_F + 1 + \frac{N_f}{2}) - \tau_D c_F N_F$$

if $w_f(N_F + 1) + d^*(N_F + 1 + \frac{N_f}{2}) < \tau_D c_F N_F$ it is always the case $q_{mDD} > 0$.
However, if discriminatory domestic firms have not a competitive advantage, then it is necessary for them that there are few foreign firms willing to sell in the domestic market: if $w_f(N_F + 1) + d^*(N_F + 1 + \frac{N_f}{2}) > \tau_D c_F N_F$ then $q_{mDD} > 0 \Leftrightarrow N_F < \frac{b - w_f - d^*(1 + \frac{N_f}{2})}{w_f + d^* - \tau_D c_F}$

No wage gap. The Homogeneous Firms Case

Are domestic firms able to export?

If there is no cost differences between m-type firms and f-type firms , $w_f = w_m = w$, then $q_{DF} = \frac{b_F - \tau_F w + N_F(c_F - \tau_F w)}{N+1}$ and:

$$q_{DF} > 0 \Leftrightarrow b_F > \tau_F w - N_F(c_F - \tau_F w)$$

If $c_F > \tau_F w$ it is always true. If $c_F > \tau_F w$, then $q_{DF} > 0 \Leftrightarrow N_F < \frac{b_F - \tau_F w}{\tau_F w - c_F}$

A higher demand in market F makes it easier for domestic firms to export. On the other side, a higher number of foreign competitors make it harder.

Are domestic firms able to sell on their market?

If there is no cost differences between m-type firms and f-type firms , $w_f = w_m = w$, then $q_{DD} = \frac{b - w + N_F(\tau_D c_F - w)}{N+1}$ and:

$$q_{DD} > 0 \Leftrightarrow b > \tau_F w - N_F(\tau_D c_F - w)$$

If $\tau_D c_F > w$ it is always true. If $c_F > w$, then $q_{DD} > 0 \Leftrightarrow N_F < \frac{b - w}{w - \tau_D c_F}$.

B Proofs of the existence and uniqueness of the wage gap d^*

The wage gap d^* is defined by $d = F(d)$. To make sure this equation has a solution, we need to define under which conditions the function F cross the 45° line.

As F is decreasing in d ($F'(d) < 0$), we thus have to show that $F(0) > 0$ and $F(\bar{d}) < \bar{d}$.

$F(0) = 2(L_f - \frac{L_m}{(N-1)}) > 0$ if $L_f > \frac{L_m}{N-1}$

$F(\bar{d}) < 0$ so that $F(\bar{d}) < \bar{d}$

Moreover F is strictly decreasing as $F'(d) < 0$, it implies that $F(d)$ cross only once the 45ï¿½ line. Thus d^* is unique.

To sum up, $d = F(d)$ has a unique solution if $L_f > \frac{L_m}{N-1}$ which requires that the female labour force is not fully employed by one firm only (that would be the unprejudiced one). If $L_f \leq \frac{L_m}{N-1}$ there is no equilibrium wage gap in this model.

C Descriptive Statistics

Table 7: Summary Statistics: Trade Patterns of Manufacturing Industries

Indicator	Period	Net trade	Import penetration	Export share	Openness
Industry	83-90	19	8	13	21
	91-94	-6	15	13	26
	95-99	-14	19	15	31
	00-04	-7	22	19	35
Food	83-90	78	1	11	12
Beverage	91-94	66	2	10	12
Tobacco	95-99	54	5	14	18
	00-04	50	6	17	18
	83-90	84	2	27	29
Textile	91-94	60	7	28	34
Apparel	95-99	49	12	33	43
	00-04	44	15	40	52
	83-90	-28	40	38	57
Machines	91-94	-59	70	19	56
	95-99	-72	130	23	71
	00-04	-62	220	52	89
	83-90	-51	10	4	13
Chemical	91-94	-52	25	7	26
Oil	95-99	-50	22	7	25
	00-04	-44	24	9	28
	83-90	-40	7	3	9
Paper	91-94	-40	10	4	12
Printing	95-99	-38	16	7	21
	00-04	-33	37	20	44

Source: Own computations based on the *TradeProd Database*, CEPII.
Net trade equals $\frac{X-M}{X+M}$; import penetration is $\frac{M}{Q}$ and openness is $\frac{X}{Q} + (1 - \frac{X}{Q})\frac{M}{Q+M-X}$.

Table 8: Summary Statistics: Evolution of Market Access and Competitiors' Acess between 1983-90 and 1991-2003

	Benchmark estimation		With Regional trade agreement in trade costs	
	ΔlMA	ΔlCA	ΔlMA	ΔlCA
Textile Apparel	-9	-81	59	-10
Chemical	86	44	130	85
Machines	97	71	195	141
Food Beverage	71	-37	79	-31
Paper	35	53	145	147

Source: Own computations based on the *TradeProd Database* from the CEPII.

Table 9: Table of Correlations

	wage gap	lnMA	lnCA	lnHerf	lnFLS
wage gap	1				
lnMA	-0.36	1			
lnCA	0.56	0.04	1		
lnHerf	-0.45	0.37	-0.39	1	
lnFLS	0.73	-0.20	0.52	-0.51	1