Gender Wage Discrimination and Trade Openness

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Abstract

This paper introduces employer taste-discrimination in an open economy model with imperfect competition and endogenous gender wage gap. Firms operate in an oligopoly where rents are positive and prejudiced employers can use their market power to pay men a premium, in line with Becker's theory. Trade openness affects employers' ability to discriminate. However the direction of the impact depends on trade partners' characteristics, in particular their competitive advantage. While penetration of foreign firms in the domestic market triggers a surge in competition thus heightening incentives to reduce costs, an easier access to foreign markets is an opportunity to enhance profits and may increase discrimination. The model is 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, 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 theoretical analysis.

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1 Introduction

Gender wage discrimination is still prevalent while many markets are imperfectly competitive. Becker's theory of employer discrimination suggests that, in sectors with positive rents, the prejudice of some employers can result in wage gap between equally productive men and women due to unequal sharing of production revenue across workers' groups. In these situations, 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 labor market outcomes between men and women. 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 female employees relatively more so that they caught up with their male colleagues in terms of wages and job promotions. Hellerstein et al. (2006) carry out an analysis based on firm-level data that proves to be consistent with an implication of Becker's model of employer discrimination : discrimination is observed only among plants with high levels of product market power. 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. Other authors focus on trade liberalization as it is associated with a competitive shock. They use trade shares and especially import penetration to capture the impact of foreign competition. Different results emerge depending on the country under study. Black and Brainer (2004) show that a rise in import penetration weakens the gender wage gap in concentrated industries in

the US, as Artecona et al. (2002) find for Mexican industries. However, when Berik et al. (2004) study the case of Korea and Taiwan or when Menon and Meulen Rodgers (2009) look at India, they conclude that foreign competition is associated with an amplification of the wage gap, especially in concentrated industries. They explain this result by gender differences in bargaining power in the work place. When employers are urged to reduce costs they first cut wages of the least powerful employees, women, while leaving unchanged the wages of potential protesters, men.

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. I intend to close this gap with a theoretical proposal that 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. While intuitively appealing, the pro-competitive effect of trade has not been explicitly formalized in a trade model with endogenous determination of trade patterns. To the best of my knowledge, there is only one theoretical attempt to incorporate discrimination formally in an open economy model but trade patterns are exogenous. Menon and Meulen Roger (2009) use the Borjas and Ramey (1995) oligopolistic model to explain 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. However, they formulate an ad hoc relationship between trade and the level of discrimination considering that an increase in net trade reduces the profits of all firms.

The first part of my contribution is to provide an explicit model with intra-industry trade under imperfect competition and an endogenous gender wage gap. The model describes a single international oligopoly -featuring Cournot-Nash competition- where two countries produce a homogeneous good. Firms' output decisions and export opportunities are determined by their relative costs of production. Trade patterns depend endogenously on characteristics of both partners. This is a partial equilibrium model where the labor market is industry specific. The price level determines firms' production opportunities which in turn impact labor demand and wage discrimination.

In a *competitive labor 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 labor 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 labor market, the law of one wage must apply. Here, only a fixed and small number of firms demand labor so that the labor market is not perfectly competitive and the labor supply is not perfectly elastic. The model features an *oligopsonistic labor 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. Depending on the competitiveness of foreign firms and on the cost disadvantage of discriminatory firms, they might no longer be able to produce. 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 labor dwindles while that for female labor 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,

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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

This model consider a single oligopoly with a fixed number of firms that produce a homogeneous good. Firms, indexed by i, are ranked by their distaste for hiring women d_i. Employer heterogeneity in d_i does not impact the available production technology to though. This parameter $d_i \in [0; \bar{d}]$ 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. However, it is an endogenous pivotal level of d, equal to the equilibrium wage gap, that ultimately determines the type of worker a firm hires; the *ex post* distribution of firms' outcomes is thus endogenous.

Demand

As we do not relate consumer demand for goods to the household wealth (workers'

wages and entrepreneurs' profits), this paper does not incorporate income effects, which 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. Firms are large in their sector, exerting strategically market power, but small in the economy as a whole as they don't impact income or goods' prices of other sectors.

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 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

There is a fixed number N of operating firms, each producing the same homogeneous good. Those N firms play a Cournot-Nash game, choosing their production level under the assumption that their rivals keep their outputs fixed. Beginning production is costly because of start-up investments and firms incur a fixed cost F.

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

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

where male labor l_m and female labor l_f are perfect substitutes.

Total costs have a simple form that features increasing returns to scale when considering the fixed cost F

$$C(q_i) = F + c_i q_i$$

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. As a consequence, firms have different labor costs after having adjusted for preferences.

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

Firms hiring men have the same unit labor cost $c_m = w_m$ while firm hiring women have different *perceived* labor 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 equal to profits minus the monetary value derived from the disutility of employing women. If $d_i > 0$, employer i is prejudiced against women[1]. The setting is a standard one-stage game in which N firms compete in quantity. They choose their level of production simultaneously taking as given the quantity chosen by the other firms. They consider the following maximization problem where the objective function is concave in q_i:

$$\text{Max}_{q_i} \; \pi_i = p(q_i, \sum_{j \neq i} q_j) q_i(l_{im}, l_{if}) - c_i(q_i) - F$$

where q_j is the production level of competitor j. The price p depends on the production of all incumbent firms and firm i takes the output of other firms into account while maximizing its profits. Firms are wage-takers and choose the number of workers they hire.

The first order conditions for the N different firms can be written:

$$q_i = p - c_i \qquad \forall i = 1, ..., N \tag{2}$$

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

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[1]This setting leads to complete firm segregation. It is possible though to formalize discrimination as an increasing function of minority share in the firm's labor force. Coate and Loury (1993) offer an other framework where discrimination is stronger in some type of jobs which leads to occupational segregation. Employers have identical prejudices d which is increasing in the ratio prejudiced workers over preferred workers. Employers are moreover willing to hire for skilled jobs workers from one group only. In this setting, firms are not completely segregated

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, $w_f + d$ for firms that employ women and w_m for firms that hire men. "Male-firms" bear the same cost, hire the same number of male-workers and produce the same level of output while "female-firms" have different costs, different level of input and output.

Firms' reaction functions

As the cost structure has been fully described, we can derive the production levels of the heterogeneous firms. We have seen that employer's type (the degree of his prejudice) pins down his *perceived* cost which in turn determines his choice of production scale. 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, and consequently equation (2) 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. The distribution of prejudices thus shapes the condition of competition in the sense that it determines the production level of each incumbent firm.

Substituting the value of p given by (1) into the first order condition (2) 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.
Using the N first order conditions, we can give an expression for Q_{-i} that depends only on competitors' costs: $Q_{-i} = (N-1)(q_i + c_i) - \sum_{j \neq i} c_j$.
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:

$$q_i = \frac{b - c_i + (N-1)(\tilde{c}_{-i} - c_i)}{N+1} \qquad (3)$$

Note that since firms are heterogeneous in their unit cost, it is necessary to check whether all 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.

Lastly, all the firms charge the same price for the homogeneous good:

$$p = \frac{N}{N+1}\left(\frac{b}{N} + \frac{C(Q,N)}{N}\right) \qquad (4)$$

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

It is now essential to dwell on labor cost discrepancies across firms, and in particular to 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 -called the marginal firm. Note that there is an indeterminacy regarding the exact magnitude of the wage gap which is due to the discrete nature of the model. In equilibrium,

$$w_f + d^* = w_m \qquad \text{with } d^* \in [d_{N_f}; d_{N_{f+1}}[\tag{5}$$

There is a continuum of equilibrium gender wage gaps d^* comprised between the prejudice of the marginal employer N_f and that of the next one. The range of the differential is determined by the relative female labor supply, the number of incumbent firms and by the distribution of d_i among incumbents.

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

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

Employers with $d_i > d^*$ who are more prejudiced than the marginal discriminator employ only men while less prejudiced employers with $d_i \leq d^*$ hire women as the wage gap more than compensates the monetary equivalent of their prejudice. There is a complete segregation of men and women across firms if $d^* \in]d_{N_f}; d_{N_{f+1}}[$, the marginal firm N_f being pivotal. The situation can be different if d^* is exactly equal to the prejudice of an operating employer (the lower interval's endpoint). When $d^* = d_{N_f}$, the marginal firm N_f is indifferent between hiring women or men so that its gender composition is a-priori undetermined:

$$l_m^* + l_f^* = p - w_m$$

In that case, the gender composition of the marginal firm's labor force can be treated as given in order to facilitate the resolution of the model. We will consider the case where the fixed labor supply is such that N_f firms completely absorbed the female labor supply so that there is no mixed firm. This hypothesis is formalized below in the labor market clearing conditions.

To compute the average cost in the industry, it is necessary to sum up the monetary equivalent of the utility loss faced by discriminatory employers who hire women. Remember that, by assumption, the distribution of prejudice d among operating firms follows a discrete uniform over $[0; \bar{d}]$. The sum of the prejudice of the N_f employers hiring women is : $\sum_1^{N_f} d_i = d_1 + d_2... + d_{N_f} = 0 + \frac{\bar{d}}{N-1} + 2\frac{\bar{d}}{N-1} + ... + (N_f - 1)\frac{\bar{d}}{N-1}$. Hence, the sum of the (monetary equivalent) utility losses faced by employers who hire women is an arithmetic series equal to

$$\sum_{i=1}^{N_f} d_i = \frac{N_f(N_f - 1)}{N - 1}\frac{\bar{d}}{2} \tag{6}$$

We have previously shown that $d^* \in [d_{N_f}; d_{N_f+1}[$ which is equivalent to $d^* \in [\frac{(N_f-1)\bar{d}}{N-1}; \frac{N_f d}{N-1}[$. We can express d^* as :

$$d^* = (N_f - 1)\frac{\bar{d}}{N - 1} + \nu \qquad \text{with } \nu \in [0 ; \frac{\bar{d}}{N - 1}[\tag{7}$$

Expressing female labor costs in this way: $w_f + d_i = w_m - (d^* - d_i)$ and using the previous expression for d^*, yields $\sum_{i=1}^{N_f}(w_m - d^* + d_i) = N_f(w_m - \frac{N_f-1}{N-1}\frac{\bar{d}}{2} - \nu)$, so we can express the average cost of firm i's competitors in the following way :

$$\tilde{c}_{-i} = \begin{cases} w_m - \frac{1}{N-1}\left(N_f(\frac{N_f-1}{N-1}\frac{\bar{d}}{2} + \nu) + d_i\right) & \text{if firm } i \text{ employs women} \\ w_m - \frac{1}{N-1}\left(N_f(\frac{N_f-1}{N-1}\frac{\bar{d}}{2} + \nu)\right) & \text{if firm } i \text{ employs men} \end{cases}$$

2.4 The labor market equilibrium

Wages of both men and women adjust until full employment is reached. The labor market clearing conditions can be written, using eq (5) and (6) :

$$\bar{L}_f = \sum_1^{N_f} l_{if} \iff \bar{L}_f = N_f(p - w_m) + N_f(\frac{N_f - 1}{N - 1}\frac{\bar{d}}{2} + v) \tag{8}$$

$$\bar{L}_m = \sum_{N_f+1}^{N} l_{im} \iff \bar{L}_m = N_m(p - w_m) \tag{9}$$

Using equations (5) and (6), this yields the equilibrium wages w_f and w_m :

$$w_f = p - \frac{N_f - 1}{N - 1}\frac{\bar{d}}{2} - \frac{\bar{L}_f}{N_f} \tag{10}$$

$$w_m = p - \frac{\bar{L}_m}{N_m} \tag{11}$$

From the two wage equations, we can easily define the gender wage gap. We first give an expression for N_f by substituting w_m by its expression in (6) into equation (5):

$$N_f = 1 + 2\frac{N-1}{\bar{d}}\left(\frac{\bar{L}_f}{N_f} - \frac{\bar{L}_m}{N_m} - \nu\right)$$

Then, using the definition of d^*, we can express $N_f = 1 + \frac{d^*-\nu}{\bar{d}}(N-1)$ which can be introduced in previous equation to define implicitly d^*:

$$d^* = 2\left(\frac{\bar{L}_f}{N_f} - \frac{\bar{L}_m}{N_m}\right) - \nu \tag{12}$$

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

The equilibrium of the economy is then given by the following equations:

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\begin{aligned}
w_f &= p - \frac{N_f-1}{N-1}\frac{\bar{d}}{2} - \frac{\bar{L}_f}{N_f} \\
w_m &= p - \frac{\bar{L}_m}{N_m} \\
d^* &= w_m - w_f \\
N_f &= 1 + \frac{d^*-\nu}{\bar{d}}(N-1) \\
p &= \frac{N}{N+1}\left(b + w_m - \frac{N_f}{N}\left(\frac{N_f-1}{N-1}\frac{\bar{d}}{2} + \nu\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 number of firms in sectors 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 number of potential firms and the wage gap. The price equals 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 have 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

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To carry out comparative statics on d^* let me define Φ :

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

Applying the theorem of implicit functions allows us to derive standard predictions of the beckerian model. First, for a given number of firms, the wage gap expands if more women enter the labor market.

$$\frac{\partial d^*}{\partial \bar{L}_f} = -\frac{\frac{\partial \Phi}{\partial \bar{L}_f}}{\frac{\partial \Phi}{\partial d^*}} > 0$$

When the female labor supply increases, more employers hire women so that the marginal employer has stronger prejudice and claims a wider wage differential between male and female employees. As expected, the opposite holds when it is the male labor supply that goes up, $\frac{\partial d^*}{\partial L_m} < 0$.

Moreover, it follows that d^* decreases with N:

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

Suppose the range of prejudice does not widen ($\bar{d}$ stays the same), when the number of producing firms increases, the marginal discriminator is an employer with lower prejudice. This effect sheds light on the role of market competition in reducing discrimination due to prejudices.

Selection effect

Firms employing men have higher unit costs and produce less than firms employing women. When competition heightens, they are the first to run the risk of ceasing production. All N_m firms cannot keep producing at cost $w_f + d^*$. let us formalize this idea by computing the maximal unit cost above which discriminatory firms cannot produce and run comparative statics. As we will see in the next section, this is key to understanding the effect of openness.

The maximal unit cost above which a firm ceases to produce is the solution of a zero-(operating)profit condition which is the solution of the equation $q_m = 0$. The cost cut-off

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is thus defined as:

$$\bar{c} = p(\bar{c}) \tag{13}$$

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

We can now ask how does the cost threshold change with the number of firms operating in the market :

$$\frac{\partial \bar{c}}{\partial N} = - \left(\frac{(d^* - \nu)^2}{\bar{d}} + \frac{d^* - \nu}{\bar{d}}(N-1) \right)$$

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 (we could say in more concentrated sectors even if concentration is not the same as the number of firms).

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.

3 The Open Economy

3.1 Import penetration, export opportunities and discrimination

Consider two countries, D and F (for domestic and foreign country respectively) that produce the same homogeneous good. They do have incentives to trade within the same industry to capture some of the rents that exist in the foreign market. The foreign country is defined by its demand level and characteristics of its product markets. As for the demand side, consumers in F also present a linear inverse demand $p_F = b_F - Q$. The size of the demand b_F can differ from the size of the demand in country D. 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. This assumption allows us to abstract

from discrimination in the foreign market.

Markets are segmented although 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. Once they have payed the fixed cost f, firms produce under constant returns to scale, so they maximize separately their profits -adjusted for their preferences- made on the domestic market and on the foreign market. There is a separability in firms' production strategy in the two different markets. This property is due to the assumption of constant marginal costs; if marginal costs depended on output levels, export possibilities would influence domestic production level.

The optimal level of production on the domestic market is obtained as in the closed economy. While firms in D 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 s well as the iceberg cost τ, fully borne by the producer. To sell one unit in the foreign market F, they need to produce τ_F units, with $\tau_F > 1$.

$$\text{Max } \pi_{iDF} = p_F(q_{DF}, q_F) \frac{q_{iDF}(l_{im}, l_{if})}{\tau_F} - c_i(q_i) - F$$

The optimal number of workers dedicated to exports is determined by:

$$\frac{p_F}{\tau_F} + l_{im} \frac{p'_F(q_i, q_j)}{\tau_F} \leq w_m \quad \text{with equality for firms that hire men}$$

$$\frac{p_F}{\tau_F} + l_{if} \frac{p'_F(q_i, q_j)}{\tau_F} \leq w_f + d_i \quad \text{with equality for those that hire women}$$

Production for each market is then given by[2] :

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

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

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[2]If transport cost is additive : $q_{iDF} = p_F - w_{if} - d_i - \tau_F$ and $q_{iDF} = p_F - w_{if} - d^* - \tau_F$. However iceberg costs are more convenient and were used by Brander (1981) who explains intra-trade of a homogeneous good in a Cournot setting

3.2 The labor market

We derive again the labor market clearing conditions for female and male labor. N_{Df} and N_{Dm} represents respectively the number of domestic firms that employ women and the number of domestic firms that employ men.

$$\bar{L}_f = \sum_{i=0}^{d^*} q_{iDD} + q_{iDF} = N_{Df}\left(p_D + p_F - (1 + \tau_F)\left(w_m - \frac{N_{Df} - 1}{N - 1}\frac{\bar{d}}{2}\right)\right) \tag{14}$$

$$\bar{L}_m = \sum_{i=d^*+r}^{\bar{d}} q_{iDD} + q_{iDF} = N_{Dm}(p_D + p_F - w_m(1 + \tau_F)) \tag{15}$$

Which gives an expression for wages and for the wage gap ($w_m = w_f + d^*$):

$$w_f = \frac{1}{1 + \tau_F}(p_D + p_F - \frac{\bar{L}_f}{N_{Df}}) \tag{16}$$

$$w_m = \frac{p_D + p_F}{1 + \tau_F} - \frac{\bar{L}_m}{N_{Dm}(1 + \tau_F)} \tag{17}$$

$$d^* = \frac{2}{1 + \tau_F}\left(\frac{\bar{L}_f}{N_{Df}} - \frac{\bar{L}_m}{N_{Dm}}\right) - \nu \tag{18}$$

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

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

Let us define Φ^T as :

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

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

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

When a trade partner opens its economy so that export barriers τ_F fall, it increases the

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wage gap in domestic labor market by offering new sales opportunities to discriminatory (higher cost) firms, hence increasing their ability to discriminate. This is an interesting finding that is in line with Becker's model implication on profit opportunities and ability to discriminate. Further, it sheds light on a channel of impact that is not present in the papers dealing with trade and discrimination. In previous studies, when export shares are introduced they are though of as another proxy for foreign competition taking place in foreign markets. Yet, increase 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 the ins and outs of competition effects on market structure and wage discrimination, let us use the cost threshold and carry out new comparative statics. We consider a situation where foreign producer have homogeneous unit cost c_F. Prices in the domestic and foreign market are respectively:

$$p_D = \frac{b + N_{Df}\tilde{c}_f + N_{Dm}\tilde{c}_m + N_{Df}c_F\tau_D}{N_D + N_{Df} + 1} \tag{19}$$

$$p_F = \frac{b_F + N_{Df}\tilde{c}_f\tau_F + N_{Dm}\tilde{c}_m\tau_F + N_{Df}c_F}{N_D + N_{Df} + 1} \tag{20}$$

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

$$q_{iDD} = \frac{b - c_{iDD} + (N_D + N_{Df} - 1)(\tilde{c}_{-iD} - c_{iDD})}{N_D + N_{Df} + 1} \tag{21}$$

$$q_{iDF} = \frac{b_F - c_{iDF}\tau_F + (N_D + N_{Df} - 1)(\tilde{c}_{-iF} - c_{iDF}\tau_F)}{N_D + N_{Df} + 1} \tag{22}$$

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. We will focus on a situation where discriminatory firms are able to produce positive amounts, at least in the domestic markets, otherwise the situation amounts to equal pay between men and women. The conditions for discriminatory firms to survive while paying higher wages to male employees are derived in the appendix. In this context, let us study the comparative statics of the ability to discriminate.

The average cost of competitors in market D is:

$$
\tilde{c}_{-iD} = \begin{cases} \frac{w_f(N_D-1)+d^*(\frac{N_{Df}}{2}+N_{Dm})-d_i+\tau_D c_F N_{Df}}{N_D+N_{Df}-1} & \text{if firm } i \text{ employs women} \\ \frac{w_f(N_D-1)+d^*(\frac{N_{Df}}{2}+N_{Dm}-1)+\tau_D c_F N_{Df}}{N_D+N_{Df}-1} & \text{if firm } i \text{ employs men} \end{cases}
$$

The degree of competition in market F depends on whether all types of firms are able to sell there. If both discriminatory and non-discriminatory firms export to F, the average cost of competitors is:

$$
\tilde{c}_{-iF} = \begin{cases} \frac{\tau_F(w_f(N_D-1)+d^*(\frac{N_{Df}}{2}+N_{Dm})-d_i)+c_F N_{Df}}{N_D+N_{Df}-1} & \text{if firm } i \text{ employs women} \\ \frac{\tau_F(w_f(N_D-1)+d^*(\frac{N_{Df}}{2}+N_{Dm}-1))+c_F N_{Df}}{N_D+N_{Df}-1} & \text{if firm } i \text{ employs men} \end{cases}
$$

Otherwise, if $q_{mDF} = 0$ meaning that only non-discriminatory firms export to F, the average cost of competitors is:

$$
\tilde{c}_{-iF} = \frac{\tau_F N_{Df}(w_f + \frac{d^*}{2}) - \tau_F d_i + c_F N_{Df}}{N_{Df} + N_{Df} - 1} \qquad \text{with firm } i \text{ employing women}
$$

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. We establish the two cost thresholds for discriminatory firms as they bear the highest costs.

The degree of competition at home

Let $\bar{c}_{DD}$ denotes the cost threshold for positive sales of D discriminatory-firms in their domestic market

$$\bar{c}_{DD} = p(\bar{c}_D) \tag{23}$$

$$\bar{c}_{DD} = \frac{b - N_{Df}\frac{d^* - \nu}{2} + N_{Df}c_F\tau_D}{N_{Df} + 1}$$

The impact of a fall in trade cost τ_D puts forward the competitive effect of openness

$$\frac{\partial \bar{c}_{DD}}{\partial \tau_D} > 0$$

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 $\frac{\partial \bar{c}_{DD}}{\partial N} < 0$. 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, $\frac{\partial \bar{c}_{DD}}{\partial c_F} > 0$ 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 D discriminatory-firms do not export to the foreign market F. Intuitively, 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.

$$\bar{c}_{DF} = p_F(\bar{c}_{DF}) \tag{24}$$

The price in F depends on the number of potential exporters N_D and local producers in F N_F, it depends also on the costs c_F for local producers, c_{fDF} for exporters hiring female

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workers and $\bar{c}_{DF}$ for those hiring male workers.

$$\bar{c}_{DF} = \frac{b_F - N_{Df}\frac{d^*-\nu}{2}\tau_F + N_{Df}c_F}{N_D(1-\tau_F) + N_{Df} + 1}$$

The derivatives with respects to the determinants of competition are:

$$\frac{\partial \bar{c}_{DF}}{\partial N_{Df}} < 0 \qquad \frac{\partial \bar{c}_{DF}}{\partial c_F} > 0$$

The higher the number of domestic and foreign firms, the lower the cost cut-off. The lower the unit-cost of foreign firms, the lower the cost threshold. Hence at a certain point (for high enough N_{Df} and/or c_F), high-cost domestic firms, those employing men, won't be able to produce for the export market, and only domestic firms employing women will 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.

$$\frac{\partial \bar{c}_{DF}}{\partial \tau_F} = N_D(b_F + N_{Df}c_F) - (N_D + N_{Df} + 1)(N_{Df}\frac{N_{Df}-1}{N-1}\frac{\bar{d}}{2})$$

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 $\bar{c}_{DF} - c_{fDF} = N_{Df}\frac{N_{Df}-1}{N-1}\frac{\bar{d}}{2}$. 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 opennes that has not been though of in previous empirical analysis. Morever, 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 labor. Hence the wage gap will go down until full employment is restored.

3.4   Link with market access

This model shows that trade liberalization has no unequivocal effect on the gender wage gap as it depends on the pattern of competitive advantage along with the trade costs that influence the penetration of trade partners' markets. This theoretical setting brings to light the link between the wage gap which depends on profit opportunities, and 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 other regions and of the level of competition in those other regions. These models typically feature competitive labor market and free entry of

firms. In the model developed in this paper, although the labor market is not competitive and the entry of firms 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' access to foreign markets and of foreign firms' access to the domestic market are used for the first time to capture the pro-competitive effect of trade and geography. Differences in market structures (perfect competition without market power vs imperfect competition with positive rents) have a substantial importance regarding the evolution of wage gaps across sectors. This model helps to determine in which sectors wage gaps are more responsive to evolutions of the market access : the smaller the number of firms, the greater the impact of market access on wage gaps.

4   An empirical investigation

The theoretical model, based on beckerian taste for discrimination, determines the ability to discriminate in imperfectly competitive sectors, i.e. sectors with a limited number of domestic firms, that are opened to trade. The challenge is thus to measure the degree of domestic competition as well as the degree of openness to trade partners. To explore the effects of these variables on gender wage discrimination, the empirical analysis proceeds in several steps. First, we estimate gender wage discrimination using individual data. Second, competition variables are estimated. Concerning foreign competition indicators, the literature on gender and trade has so far used import and export shares (see Artecona et al. 2002, Berik et al. 2004, Black and Brainerd 2004). This puts forward that there are more accurate variables, in particular the theoretical analysis suggests to use Uruguayan firms' access to foreign market and competitors access to the Uruguayan market. The third and last step consists of regressing the part of the wage gap due to labor market discrimination on the competition indicators to test the theoretical implications.

We conduct the empirical exercise on data of Uruguay which witness an important liberalization episode in the 1990s. Several liberalization agreements took place, at the regional level with the Mercosur 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.

4.1 Computing gender wage gaps

4.1.1 Estimation of the wage gaps

Wage discrimination is measured as the wage gap between equally productive individuals. To obtain a measure of discrimination, we retrieve, as finely as possible, the part of the wage gap due to differences in treatment of equally productive employees. It is important to net out observable characteristics that influence the raw wage gap 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 : level of education (5 categories), potential experience (which is age minus 6 minus the number of education years) and potential experience squared. Finally, 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[3]. Note that the return to this characteristics are allowed to vary across sectors and years. Indeed, male and female wage equations are estimated separately for each sector and year as the subscript jt in equation (25) indicates.

To compute the unexplained part of the wage gap, we use the Oaxaca-Blinder decomposition:

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[3]Estimating the wage gap on 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. Strikingly enough, controling 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. Such results indicate that within each occupation women are discriminated against.

$$\overline{W}_{mjt} - \overline{W}_{fjt} = \beta_{0mjt} - \beta_{0fjt} + \overline{X}_{fjt}(\beta_{mjt} - \beta_{fjt}) + (\overline{X}_{mjt} - \overline{X}_{fjt})\beta_{mjt} \qquad (25)$$

The raw wage gap can be decomposed into three terms (Blinder 1973; Oaxaca 1973). The first term captures differences in average starting wage. The second one represents differences in returns to similar characteristics. The sum of this two terms is referred to as the (unexplained) wage gap. 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".

Table 1: First Stage Estimation. All manufacturing sectors

Years	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.

Oaxaca and Blinder decomposition of the raw wage gap. Wages include bonuses.

Table 1 presents the results of the decomposition for half of the years included in the sample. For the sake of space, we just find the decomposition of the raw wage gap for the whole manufacturing industry (all the sectors are pooled). Note however that wage gaps are also estimated for each industry separately to build a panel of sectors from 1983 to 2003. This approach thus takes into account industry effects such as demand for particular qualifications. Results of the first stage show 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. However, those endowments are, in average, less remunerated for women.

Choice of the wage structure

Neumark (1988) puts forward that the choice of the standard is not neutral and hinges on the nature of employers' discriminatory practices. Equation (18) uses men remuneration to evaluate the differences in characteristics. It corresponds to a situation where women are discriminated against (contrary to nepotism favoring men). This implies that women are under-paid compare to men whose wage structure is the standard one, the one that should be observed in the absence of discrimination, so that female wages would rise with the reduction of discriminatory behaviors. While other weights can be used to measure the discrepancy between returns of women and the normal returns, we will focus on the pure-discrimination strategy as defined in (18).

4.1.2 Uruguayan Household Survey

This study uses the Uruguayan household survey (Encuesta Continua de Hogares ECH) conducted annually by the National Institute of Statistics of Uruguay. It is a longitudinal survey of the Uruguayan population that describes both individual and household characteristics. The period we analyze here 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 labor market. Other individual variables allow to estimate selection into labor market (marital status, husband's income, number of children...).

Labor market participation is much lower for women than for men, as we can see in table 2; however the participation gap decreased steadily over the period as shown in table 1. However, 10% of the wage differentials between men and women remain unexplained according to my estimation[4]. This paper focuses on the manufacturing industries, as they are the most subject to international trade. Overall, raw wage gaps and wage discrimination have been falling since the beginning of the 80s. Both raw wage gap and wage discrimination are much wider in the manufacturing industries. At the beginning of the period male wages used to be more than the double of female wages and 40% of the

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

Table 2: 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.

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 raw and unjustified wage gap have decreased but they have remained pretty high especially in the textile and apparel industry.

4.2 Computing Domestic and Foreign Competition

4.2.1 Domestic competition: Herfindahl index of concentration as a proxy of market power

There is a large literature that deals with the measure of market power at the industry level. The four-firm concentration ratio or the Herfindahl index are commonly chosen proxies to capture the level of industry competition. For the present analysis, Herfindahl indexes are used. They are computed, based on a confidential firm survey, as $HH_j = \sum_i^N s_{ij}^2$ where s_{ij} is firm i's share of production in industry j. Table 8 in the appendix presents summary statistics of the sectoral concentration levels. It displays wide variations across sectors and across time, especially for the chemical products industry and the fodd&beverage industry.

4.2.2 Foreign competition, 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 to construct trade shares and internal flows (exports minus production) easily. The CEPII provides also a *Distances database* with bilateral distances and common official language which are used to capture part of the trade costs.

Figure 1: Evolution of trade shares
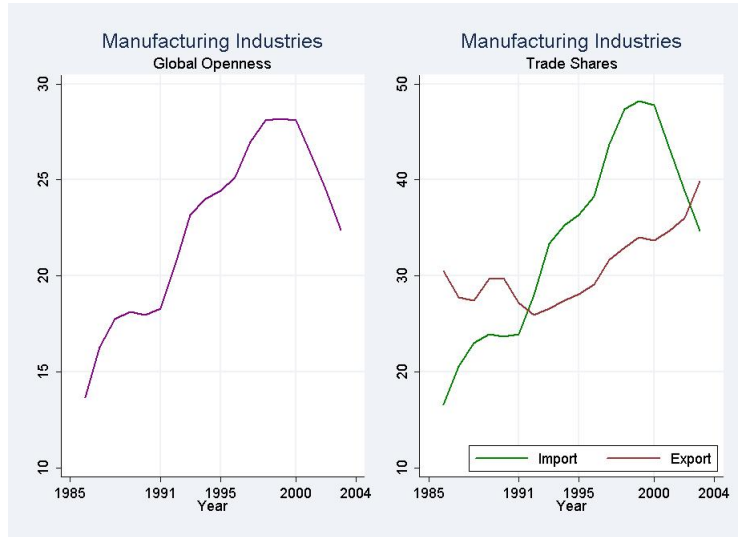
4.2.3 Measures of foreign competition

In most of the literature, foreign competition is captured by import penetration as a share of production (M_j/Q_j) or as a share of domestic absorption ($M_j/(Q_j - X_j + M_j)$) where M_j is import volume in industry i, X_j is exports volume in industry i and Q_j is production of industry i. Figure 1 shows the evolution of import penetration for the whole manufacturing sector ; it has increased dramaticaly over the 1990s; in 2000, the crisis in Argentina and the region caused a drop in import penetration.

Studies on the effect of foreign competition on wage discrimination have, almost exclusively, used sectoral import penetration as a proxy. 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 wage gaps on export share of production (X_j/Q_j) or on global openness ($(X_j + M_j)/Q_j$). It is not straightforward that higher export shares reflect tougher competition pressure on domestic firms. As for global openness, we cannot

disentangle the impact of import penetration from the impact of export orientation on wage gaps.

To partly remedy these issues, we can control for both import and export shares in the same regression; moreover, it is important to use other indicators of foreign competition and by doing so, to test for the robustness of the results.

I suggest to use other variables, namely market access. Since the 90s, this 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 explain cross-country variations in per capita income. Economic geography models formalize the market access impact on equilibrium factor prices. In most of the literature market access is estimated at the country level. However, some authors have consider market access at the sectoral level (Fally et al. 2010, Herring et Poncet 2010), and here we follow their approach.

The theoretical model shows that what matter are the relative competitiveness of trade partners and the evolution of trade costs. The two variables described below give a measure of those determinants. Market access (MA) measures the easiness to enter a foreign market. A high MA corresponds to a high potential demand addressed to Uruguayan firms given their geographical position, their competitiveness and those of other exporters. It is then positively related to firms' potential profitability. To state this in a different manner, the maximum production cost that firms can incur is increasing in their access to foreign markets. Competitors access to the Uruguayan market (CA) is an analogous measure but on the trade partners side. It quantifies import demand from Uruguayan consumers addressed to foreign producers given their competitive advantage and the transport costs they have to incur.

It is not an easy task to get average competitive characteristics of both Uruguayan firms and its trade partners for each manufacturing sectors because we do not have data to measure them. Instead, we will use the determinants of export success. Exports of good j from country D to country F during year t are :

$$X_{DFjt} = \sum_i q_{iFjt} = f(N_{Djt}, N_{Fjt}, c_{Djt}, c_{Fjt}, \tau_{Fjt})$$

Exports depend on the number of firms in D N_{Djt}, in F N_{Fjt}, on their respective average

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costs of production c_{Djt} and c_{Fjt} (or productivities that is $\frac{1}{c}$) as well as on trade costs τ_{Fjt}. Indeed the number of firms, trade policies in every sectors and for each country are not easily available and it would be a daunting task to estimate sectoral productivity for each trade partner. Instead, bilateral trade data is used to reveal observed and unobserved factors that shape trade flows.

We estimate the following gravity equation is estimated :

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

Characteristics of sector j in region D such as the number of firms and the average cost of production are captured empirically by an individual effect specific to sector j, country D and year t : FX_{Djt}. Similarly, the importing region fixed effect FM_{Fjt} captures market characteristics such as N_F and c_F. Trade costs $\tau_{k,DFjt}$ are captured by a set of variables : bilateral distance, dummies for sharing the same language. Tariffs are not included in the list because of frequent missing values. In some estimations, a dummy is introduced to capture the effect of regional trade agreements, in particular, the existence of the Mercosur after 1991.

We regress exports on those determinants for each year and industry which results in different coefficient estimates for each of them. The estimated fixed effects are used to compute access of Uruguayan goods to foreign markets MA and access of competitors's goods to the Uruguayan market CA. Thereby, MA and CA vary across sectors and years.

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

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

These estimations, based on theoretical grounds, gather in two synthetic variables the economic characteristics that are key determinants of changes in the wage gap. Figure 2 presents the evolution of both CA and MA in two manufacturing industries, namely the food processing industry and the machines and equipment industry. Identical patterns are observed: both MA and CA rose in the 1990s, market access drop sharply in the aftermath of the crisis that occurred in 2000 in the region which makes sens as demand adressed to Uruguayan firms fell.

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Besides being closer to the theory, market access has another advantage compare to outcome variable (trade shares). When looking at the impact of openness on firms' behavior (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. Trade policy and geographical characteristics are exogenous variable, embedded in market access.
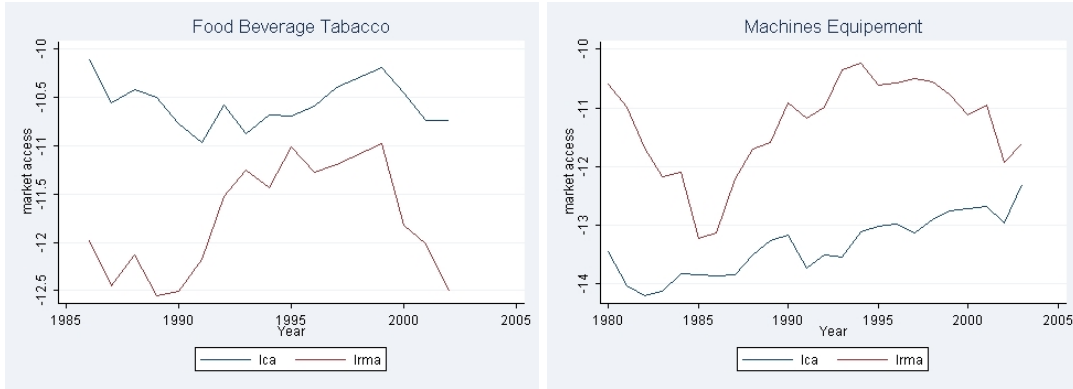
Figure 2: Market Access

Figure 2 displays the market access for two specific industries over the period. Both market access of Uruguayan firms to foreign markets and trade partners' access to the Uruguayan market rose sharply at the beginning of the 90s. The 2000 crisis impacted negatively market access, especially for Uruguayan firms, however the effect differs across sectors.

4.3   Empirical specification

The model underlines how trade can whittle discrimination down in an oligopolistic sector where employers have the ability to discriminate because of rents. To identify empirically the pro-competitive effect of trade, we need to separate it out from the effect of domestic competition.

We identify the effect of competition on discrimination through a differences-in-differences approach. Indeed, sectors feature different market structure, some are characterized by a large number of medium and small firms while others are dominated by

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few bigger firms. Moreover, trade openness has heterogeneous impacts across manufacturing sectors. The reduction in discrimination due to increased foreign competition can be witnessed only in sectors featuring low enough domestic competition to allow costly hiring decisions and that leave scope for increases in competition pressures. In sectors where the number of firms is sufficiently high to reduce profits down to zero prior to the liberalization period, no costly discrimination can take place and we do not expect any narrowing of the gap through new foreign competition pressures. Hence we compare the effect of trade exposure in competitive sectors and in imperfectly competitive sectors where new competitive forces cn further reduce the wage gap; a diminution in taste discrimination in concentrated and trade oriented sectors can be attributed to competitive forces from international trade.

We estimate the following equation:

$$WG_{jt} = \beta_0 + \beta_1 T_{it} + \beta_2 C_{jt_0} T_{it} + \theta_t + \mu_j + \epsilon_{jt} \tag{26}$$

where C_{jt_0} is the level of concentration of sector j in first period, T_{jt} is a proxy for foreign competition pressures at work in sector i at time t, θ_t is a time fixed effect and μ_j is an industry fixed effect. 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 past level of concentration; sectoral concentration levels in first period are controlled for by the sectoral fixed effects.

Lagged effect of both explanatory variables are also estimated:

$$WG_{jt} = \beta_0 + \beta_1 T_{it-1} + \beta_2 C_{jt_0} T_{it-1} + \theta_t + \mu_j + \epsilon_{jt} \tag{27}$$

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 labor (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 labor 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 labor market conditions equally in all manufacturing sectors. It includes macroeconomic shocks or government policies that influence female labor supply (child care or parental leave reforms) for example. 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. Past share of women in the sector is an additional control.

Since we control for industry and time fixed effects, this specification identifies the impact of foreign competition through differential evolution industries (industry-time variation). More importantly for the aim of this paper, it captures the different effects that foreign competition has according to the level of concentration of each sectors. For example, $\beta_2 < 0$ would indicate that sectors with domestic market power and facing high foreign competition present lower gender wage disparities than sectors with domestic market power but no foreign competition.

We identify the role played by competition in a differences-in-differences approach. We estimate the impact of foreign firms entry on the wage gap taking into account that this impact varies according to the market power firms enjoy. To say it differently, the impact of foreign competition in already competitive sectors is compared to the impact of foreign competition in sectors sheltered from competition on a domestic basis. We pay special attention to the measure of foreign competition at the sectoral level. Rather than traditional trade outcome variables, we will use indicator of market potentials that reflects better the distribution of competitive advantage among trade partners, namely market access of Uruguayan firms along with market access of foreign competitors.

4.4   Reproducing estimations with trade shares

Table 3 reproduces estimations in the line of previous studies that look at the impact of import shares and export shares on unexplained wage gap (Artecona and Cunningham 2002, Berik et al 2004, Black and Brainerd 2004, Menon and Meulen Rodger 2009). All authors make the assumption that trade shares are an accurate measure of international competition. Black and Brainerd (2004) cite several papers that back up this assumption,

among them Katics and Petersen (1994) who use industry-level data for the United States between 1976 and 1986 and find that higher import shares are associated with reduced price-cost margins. Harrison (1994) also documents that increased imports amount to tougher competition in Cote d'Ivoire. However, as we have argued, the results following this method are inconclusive.

In the case of Uruguay, import penetration has no significant effect on the gender wage gap, in spite of its sharp variations during the 1990s (results are not reported). The export share, they do have a significant effect though only when we regress discrimination on lagged export shares. When we control for both export and import shares, the estimates are no more significant. Those results of the estimation of eq.(21) are presented in table 4. The dependent variable is wage discrimination measured by differences in treatment of identical observable characteristics. The wage gap is explained by concentration levels and export shares specific to each industry-year observation. As for the concentration index, specifications control for past concentration level. We proceed this way because the entry of foreign products through trade may cause the exit of some domestic firms. It thus potentially leads to a higher Herfindahl index and overshadows competition pressure that existed before the entry of foreign products.

To differentiate the impact of foreign competition according to the level of competition prevailing in the domestic sectors, we interact export shares with sectoral concentration levels at the beginning of the sample period, $\ln\text{Herf}_{83-87}$. All regressions include sectoral fixed effects that control for time-invariant variables including the concentration level at the beginning of the period ; that is why $\ln\text{Herf}_{83-87}$ appears only interacted with trade. Columns (3) and (6) control in addition for concentration in the previous year.

The impact of exports is stable and fairly significant in most cases. It reveals offsetting effects ; the coefficient on export shares is negative which means that among competitive sectors, those with higher export shares have lower unexplained wage gap. However, this downward pressure is mitigated by a positive correlation between export shares and discrimination in concentrated sectors as the positive sign of the interaction term suggests. The downward impact of trade on discrimination is reduced as concentration goes up. In highly concentrated sectors, the gender wage gap is bigger when the industry is characterized by a high export levels relative to its production. This is in line with the prediction of a theory based on employer taste-discrimination and mobility of workers across firms as developed earlier. To illustrate the effect, let us consider the impact of trade on the wage

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gap for two sectors with different concentration levels. For example, column (3) implies that, an increase of 10 percentage point in export shares causes, a 0.25% rise in the wage gap in the paper industry, the most concentrated industry in the late 80s, while it causes a 2% fall in the wage gap for employees of the textile industry, the least concentrated industry.

According to this set of results, one can conclude that profit opportunities in foreign markets, captured by exports, bring new sources of profits that enable discriminatory employers to indulge their taste, as theoretically predicted. We will see that using other trade openness variables, closer to the theory, gives other and stronger evidence.

Table 3: The impact of Export shares on Discrimination

Dependant variable	Unexplained Gender wage gap				
	(1)	(2)	(3)	(4)	(5)
$\ln\text{Export}_{t-1}$	-1.450**	-1.142*	-1.067*	-1.104*	-1.041*
	(0.583)	(0.576)	(0.602)	(0.590)	(0.616)
$\ln\text{Export}_{t-1}\times\ln\text{Herf}_{83-87}$	0.399**	0.321*	0.300*	0.310*	0.295*
	(0.165)	(0.162)	(0.168)	(0.165)	(0.171)
$\ln\text{FLS}_{t-1}$				-0.047	-0.065
				(0.075)	(0.075)
$\ln\text{Herf}_{t-1}$					0.047
					(0.044)
Observations	80	80	80	80	80
R-squared	0.090	0.116	0.363	0.368	0.378
Year FE		Trend	Yes	Yes	Yes

The Herfindahl index varies between 0 and 100.

Robust s.e. in parentheses.*** p<0.01, ** p<0.05, * p<0.1 Regressions include sectors' fixed effects.

4.5   Market Access as a determinant of the gender wage gap

Table 5 reports the results of estimating the equation (21) using CA as a measure of foreign competition and MA as a measure of firms' profit opportunities in foreign markets. CA and MA enter the equation "on their own"s as well as interacted with the level of concentration in first period Herf_{83-87}. In order to account for sectors' time varying characteristics that might be correlated with the gender wage gap, we control in columns (2)

Table 4: The impact of Uruguayan firms' Market Access on Discrimination

Dependant variable			Unexplained Gender wage gap				
	(1)	(2)	(3)	(4)	(5)	(6)	(7)
lnCA	0.530*	0.559*	0.707**	0.625**	0.366	0.535*	0.533*
	(0.277)	(0.293)	(0.295)	(0.278)	(0.263)	(0.286)	(0.305)
lnCA×lnHerf$_{83-87}$	-0.155*	-0.166*	-0.209**	-0.175**	-0.099	-0.152*	-0.142
	(0.083)	(0.087)	(0.089)	(0.084)	(0.078)	(0.084)	(0.096)
lnMA				-0.358			-0.305
				(0.359)			(0.341)
lnMA×lnHerf$_{83-87}$				0.090			0.073
				(0.100)			(0.100)
lnHerf$_{t-1}$		0.027		0.038		0.015	0.034
		(0.045)		(0.043)		(0.056)	(0.053)
lnFLS$_{t-1}$			-0.090	-0.078		-0.097	-0.077
			(0.075)	(0.078)		(0.078)	(0.085)
Observations	84	80	80	80	84	80	80
R-squared	0.122	0.125	0.130	0.147	0.379	0.381	0.406
Sector FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Trend	Trend	Trend	Trend	Yes	Yes	Yes

Robust s.e. in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$ All regressions include sectors' fixed effects.

(4) (6) and (7) for past level of concentration lnHerf$_{t-1}$; columns (3) (6) and (7) control also for female labor share lnFLS$_{t-1}$. The table gives the results with year fixed effects or with a time-trend.

The effect of foreign competition CA is stable and significant in all specifications except one, in column (5), where the estimation loses in precision after including year fixed effects. 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 results may seem at first sight in contradiction with the theoretical prediction on the impact of competition pressures from foreign competitors on the ability to discriminate. Yet, note that this estimate gives the impact of competitors access in the case where the sector's initial Herfindahl index is null, 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. A similar results is found by Black and Brainerd (2004) when they regress the gender wage gap on import penetration. They suggest 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 rise in wage inequality

between skilled and unskilled workers due to trade does not drive. What can be relevant, however, is the 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.

That being said, the principal coefficient of interest with regard to the taste discrimination framework is the interaction of foreign competition with concentration level, considered as a proxy of market power. The robust negative sign of the interaction term's parameter shows that among concentrated sectors, the wage gap is lower in sectors where firms are confronted with more competitive trade partners. This effect can be interpreted as the consequence of the reduction in market power that was used by employers to discriminate against women. For example, in the Paper industry, foreign competitors access to the Uruguayan market was 50% higher after the Mercosur. Such an increase led to a reduction of the wage gap of over than 1% according to column (6) estimates.

The MA variable is Uruguayan firms' access to foreign market, or export potentials; its effect is insignificant. Note that it does not alter the magnitude of CA impact.

Table 6 reports the lagged effect of competitors' access to the Uruguayan markets $\ln CA_{t-1}$ and Uruayan sectors' access to foreign markets $\ln RMA_{t-1}$, along with their interaction with the initial sectoral concentration. Once more, results are stable and significant. The impact of CA, lagged by one period, is of the same sign but of larger magnitude than in the contemporaneous case. MA has now a significant effect on wage gaps.

Table 6 presents also the results of regressing the wage discrimination measure on both $\ln CA_{t-1}$ and $\ln MA_{t-1}$. Most 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 entries of new foreign products. As the two dimensions have opposite effect, it is worthy to control for them in the same regression. Indeed, point estimates are more significant.

Let us keep the same example to illustrate the impact of $\ln CA_{t-1}$, taking access to foreign markets MA as constant, an increase of 50% in the CA facing firms in the Paper industry leads to a fall of the wage gap of 3% in the following year, according to the results in column (6).

The impact of MA also corroborates the model predictions on the univocal effect of trade partners' liberalization. First, the negative and significant coefficients on $\ln MA_{t-1}$ revels that in markets with low market power, the ability to enter foreign markets does

Table 5: Market Access on the Wage Gap. Lagged effect

Dependant variable	Unexplained Gender wage gap					
	(1)	(2)	(3)	(4)	(5)	(6)
$\ln CA_{t-1}$	0.564**		0.716***	0.645**	0.845**	0.815**
	(0.256)		(0.216)	(0.287)	(0.353)	(0.369)
$\ln CA_{t-1} \times Herf_{83-87}$	-0.166**		-0.205***	-0.184**	-0.246**	-0.239**
	(0.078)		(0.068)	(0.091)	(0.111)	(0.114)
$\ln MA_{t-1}$		-0.704**	-0.867***	-0.697**	-0.655**	-0.711**
		(0.342)	(0.284)	(0.279)	(0.276)	(0.292)
$\ln MA_{t-1} \times Herf_{83-87}$		0.196*	0.241***	0.199**	0.190**	0.206**
		(0.102)	(0.087)	(0.084)	(0.082)	(0.085)
$\ln FLS_{t-1}$					-0.112	-0.117
					(0.082)	(0.083)
$\ln Herf_{t-1}$						0.033
						(0.058)
Observations	80	80	80	80	80	80
R-squared	0.125	0.166	0.267	0.435	0.454	0.457
Year FE	Trend	Trend	Trend	Yes	Yes	Yes

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

not translate into increasing ability to discriminate as 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 I previously called the "intensive margin effect" of trade partners' liberalization.

Secondly, the positive and significant coefficients on $\ln MA_{t-1} \times \ln Herf_{83-87}$ makes out that, when the sector is 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. For example, according to the estimates in column (8), an increase of Uruguayan firms MA of 10% leads to a 1% fall in the wage gap in the textile industry that was the least concentrated industry at the beggining of the period. On the other hand, the most concentrated industry between 1983 and 1987, namely the paper industry, would witness a 2% rise in the wage gap after an increase of Uruguayan firms MA of 40% (in this sector, MA increased by 40% after the creation of the Mercosur). In an imperfectly competitive sector, better sales opportunities abroad are passed on rents that

can be shared by employers according to there tastes. Export opportunities in competitive sectors does not contribute to wage disparities across emploYes as it does in concentrated sectors.

5   Conclusion

This paper develops a model of wage discrimination that integrates endogenous intra-industry trade to highlight the possible channels through which trade openness impacts wage discrimination. This formalization enables us to better understand the intuitive pro-competitive effect of trade on the wage gap due to taste-discrimination. What is more, it puts new light on the mark-up enhancing effect of openness which explained otherwise puzzling results. According to the relative competitiveness of firms, trade openness impacts differently their ability to discriminate. In one case, with limited competition domestically and tough foreign competition, freer trade drives down oligopoly profits. It reduces the production of high-cost discriminatory firms and can even oblige them to cease production. This firm selection puts a downward pressure on wage discrimination. However, if domestic firms have a competitive advantage, trade openness allows them to seize sales opportunities in foreign markets, which can boost their rents instead of exerting a pro-competitive effect. Trade partners' liberalization reduces the cost of exporting, so that freer trade makes it easier for prejudiced employers to indulge their taste for discrimination. To say it differently, when a sector enjoys a competitive advantage, profits soar because firms gain market shares abroad, allowing them to employ and pay workers according to their preferences.

To provide some empirical evidence, I take advantage of the sharp liberalization episode that took place in the Uruguayan industries following the creation and consolidation, in 1991 and 1995 respectively, of the Mercosur. I estimate market access to give a measure of the pattern of competitive advantage between trade partners, which is closer to the theory than trade output variables used so far. Uruguay is an interesting country to conduct market access estimations as this small open economy was not the driver of the negotiations; this ensures the exogeneity of changes in trade policies with respect to domestic industries particularities. The main theoretical predictions are supported by the empirical findings for the *concentrated sectors*. Indeed, results show that concentrated sectors with higher access of foreign firms exhibit lower unexplained wage gaps. Let me recall that strong

access of foreign firms into the Uruguayan market reflects a competitive disadvantage ; for concentrated sectors, sheltered from competition in autarky, it means that new competitive forces are at work. On the contrary, concentrated sectors with easier access to foreign market, indicating a competitive advantage and profit opportunities abroad, register higher wage gap.

In the line of the theoretical predictions, these results put forward that competition stemming from foreign markets has a role to play in curbing discrimination due to mere prejudice. However, foreign competition reduces discrimination only if the market was domestically sheltered from competition. If competition can reduce the unexplained wage gap, it does not suppress it completely. In particular, the wage gap remaining in competitive sectors is affected differently by a greater market access. While large rents do not seem to be beneficial to an equal treatment of men and women, surges in competition in sectors without over profits are associated with increases in the wage gap ; this can not be understand thanks to the beckerian theory of employer taste discrimination. Indeed in already competitive sectors, discrimination motivated by pure employers' prejudice cannot take place in theory as there are no rents left to be shared with men. If an unexplained wage gap is still observed, foreign competition is not supposed to influence them. Other explanations need to be found, which provides further routes of research.

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APPENDIX

APPENDIX A: CONDITIONS FOR AN INTERIOR SOLUTIONS FOR FIRMS' PRODUCTION LEVELS

The production level of firm i is determined by its reaction function:

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

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, I derive the conditions to have interior solutions 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 labor cost equal to w.

A1: Closed Economy Case

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

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

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 there is no cost differences between m-type firms and f-type firms , $w_f = w_m = w$, then $q = \frac{b-w}{N+1}$ and an interior solution requires that demand is large enough :

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

A2: Open Economy Case. Exports of domestic firms to market A

Positive Wage Gap. Discriminatory and Non-discriminatory firms.

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.

Are discriminatory firms able to export ?

$$q_{mDA} > 0 \Leftrightarrow b_A > w_f \tau_A (N_A + 1) + d^* \tau_A (N_A + 1 + \frac{N_f}{2}) - c_A N_A$$

It is always the case that $q_{mDA} > 0$ if $c_A > \tau_A(w_f + d^*) + S$ with $S = \frac{\tau_A}{N_A}(w_f + d^*(1 + \frac{N_f}{2}))$
That is to say, $q_{mDA} > 0$ if discriminatory domestic firms have a strong competitive advantage. $\tau_A(w_f + d^*)$ 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_A operate in the destination market A. If $\tau_A(w_f + d^*) + S > c_A$ then $q_{mDA} > 0$ if $N_A < \frac{b_A - \tau_A(w_f + d^*(1 + \frac{N_f}{2}))}{\tau_A(w_f + d^*) - c_A}$

Are non-discriminatory domestic firms able to export ?
If discriminatory firms are not competitive enough and foreign firms N_A 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 $d_i < d^*$:

$$q_{iDA} > 0 \Leftrightarrow b_A > (N_A + 1)(\tau_A(w_f + d_i)) + \tau_A d^*(N_D - \frac{N_f}{2}) - N_A c_A$$

If $c_A > \tau_A(w + d_i) + S_i$ it is always true, with $S_i = \frac{\tau_A}{N_A}(w_f + d_i - d^*(N_D + \frac{N_f}{2}))$
The rationale behind the condition remains the same: higher demand b_A in market A 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 labor costs and are ready to hire more women: S_i decreases with d_i.
If $c_A < \tau_A(w + d_i) + S_i$, then $q_{iDA} > 0 \Leftrightarrow N_A < \frac{b_A - \tau_A(w + d_i) + d^*(N_D + \frac{N_f}{2})}{\tau_A(w + d_i) - c_A}$
A lower number of competitors compensate for the absence of strong competitive advantage

over foreign firms.

A3: Open Economy Case. Production of domestic firms for their domestic market

Are discriminatory firms able to sell on the domestic market ?

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

if $w_f(N_A + 1) + d^*(N_A + 1 + \frac{N_f}{2}) < \tau_D c_A N_A$ 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 $w_f(N_A + 1) + d^*(N_A + 1 + \frac{N_f}{2}) > \tau_D c_A N_A$ then $q_{mDD} > 0 \Leftrightarrow N_A < \frac{b - w_f - d^*(1 + \frac{N_f}{2})}{w_f + d^* - \tau_D c_A}$

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
$q_{DA} = \frac{b_A - \tau_A w + N_A(c_A - \tau_A w)}{N + 1}$ and :

$$q_{DA} > 0 \Leftrightarrow b_A > \tau_A w - N_A(c_A - \tau_A w)$$

If $c_A > \tau_A w$ it is always true. If $c_A > \tau_A w$, then $q_{DA} > 0 \Leftrightarrow N_A < \frac{b_A - \tau_A w}{\tau_A w - c_A}$

A higher demand in market A 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
$q_{DD} = \frac{b - w + N_A(\tau_D c_A - w)}{N + 1}$ and :

$$q_{DD} > 0 \Leftrightarrow b > \tau_A w - N_A(\tau_D c_A - w)$$

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

APPENDIX B: PROOFS OF THE EXISTENCE AND UNIQUENESS OF THE WAGE GAP d^*

The wage gap d^* is defined by $d = F(d)$. Let me define under which conditions the function F cross the 45°line. F is decreasing as $F'(d) < 0$, I thus have to show that $F(0) > 0\bar{d}$ and $F(\bar{d}) < \bar{d}$.

$F(0) = 2\bar{d}(\frac{L_f}{\bar{d}-\tau(N-1)} - \frac{L_m}{(N-1)(\bar{d}+\tau)}) - \tau$ which gives $F(0) > 0$ if $L_f > \frac{L_m}{N-1}$.

$F(\bar{d}) < 0$ so that $F(\bar{d}) < \bar{d}$. To sum up, $d = F(d)$ has a solution if $N - 1 > \frac{L_m}{L_f}$ which requires that there be at least three firms if women represent more than 33% of the workforce (or 50% of the male labor force); if female labor force represents between a half and a third of male labor force, there need to be four firms and so on.

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

Appendix C: Descriptive Statistics

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 industry	Male	*2595*	*2185*	*1533*	*1385*
	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.

Table 6: 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 7: 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 8: Summary Statistics: 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. The Herfindahl index computed as $HH = \sum_i^N s_i^2$, here $\times 100$, with s_i the market share of firm i and N the number of firms in the sector. It ranges from 100, in case of monopolistic situation, to $\frac{1}{N}$ in case of equal market shares.

Table 9: 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