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Centre for European
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Gender Wage Discrimination and Trade Openness. Prejudiced Employers in an Open Industry

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Abstract

I introduce taste-based discrimination in a trade model with imperfect competition and provide an explanation for the heterogeneous effects of international trade on the gender wage gap within sectors. Firms operate in an oligopoly where prejudiced employers can use their rents to pay men a premium in line with Becker's theory. On one hand, import competition reduces local rents and with them the average gender wage gap in sectors that were sheltered from competition prior to trade liberalization. On the other hand, easier access to foreign markets can increase domestic firms' profits and enable discriminatory firms to maintain wage gaps. Evidence from the Uruguayan trade liberalisation supports the empirical relevance of the taste-based discrimination mechanism at the sectoral level.

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1 Introduction

Research on the labour market effects of international trade finds increased wage inequality, not only between different skill groups but also among workers with similar observable skills. In this paper, I investigate the effects of international trade on wage differences between men and women, controlling for observable skills, in a framework with firm heterogeneity and taste-based discrimination. I show that when there is imperfect competition in the product market, taste-based discrimination provides a consistent explanation of the varied impact of trade openness on the gender wage gap within sectors. Becker's theory of employer discrimination suggests that, in sectors with rents, the prejudice of some employers can produce a wage gap between equally-productive men and women due to the unequal sharing of production revenues across groups. In such sectors, greater competition puts downward pressure on the wage gap, and ultimately no wage discrimination should pertain as firms' profits tend to zero. Hence trade liberalisation should help to drive out wage discrimination via foreign competition. Yet, empirical research has also found a positive association between export shares and the gender wage gap in concentrated sectors.[1] I argue that the effect of trade on the wage gap is more complex than its simple identification with tougher competition in Becker's theory. Trade has not only a pro-competitive effect but also a market-size effect that impacts positively profits and thus the ability to discriminate.

The first contribution here is to provide an explicit trade model under imperfect competition where both trade patterns and the gender wage gap are endogenous. I can then derive the conditions under which trade openness curbs wage discrimination. There is a single international oligopoly à la Cournot, where two countries produce and trade a homogeneous good. Firm output decisions and export opportunities are determined by their

[1] Berik et al. (2004), Menon and Rodgers (2009).

relative costs of production, which in turn depend on the firm's position in the distribution of prejudice over all incumbents. Oligopolists are sensitive to the gender-composition of their workforce, as in Becker (1957). To hire male workers, prejudiced employers use their rents and offer men a wage premium. Different levels of prejudice against women thus lead to heterogeneity in firm's labour costs. In this partial-equilibrium model with an oligopsonistic labour market, even a small number of discriminatory employers can generate a gender wage gap.

The pro-competitive impact of international trade on discrimination results from the selection of the most-competitive (least-discriminatory) firms. As discrimination is costly, discriminatory firms are less productive than non-discriminatory firms. Discriminatory firms can afford their labour cost disadvantage in markets sheltered from competition, but higher import penetration spurs discriminatory firms to align their costs to those of non-discriminatory firms. As a result, demand for male labour dwindles while that for female labour increases, reducing the wage gap.

The role of market-size for wage discrimination in a Beckerian setting is a novel finding of this paper. Trade integration offers new sales opportunities abroad and the selection of firms into the foreign market determines the effect on the gender wage gap. If only most-competitive (least-discriminatory) firms are able to export, the gender wage is reduced with better access to foreign markets. If discriminatory firms are also able to export and earn profits abroad, there is no selection effect and trade openness results in a widening of the wage gap in the domestic country. The latter scenario requires that the domestic country has a considerable competitive advantage over the foreign country, and that the number of domestic firms is not too high.

The second contribution of the work here is to test these theoretical predictions using a novel empirical strategy. In most of the work on the impact of trade openness on the gender wage gap, foreign competition is captured by import penetration.[2] However, import penetration alone may not be the best measure. First, higher import penetration does not necessarily reduce rents if export profit opportunities are high enough. Second, import penetration can increase either because imports rise or domestic production falls; in the latter case, changing domestic market conditions can mislead us into thinking that foreign competition has become sharper. Some authors have also regressed the wage gap on export shares[3] or a measure of global openness combining both imports and exports. Even if it is true that more competitive firms are better at exporting, it does not necessarily hold that higher export shares reflect tougher competition for domestic firms. As for global openness, this variable does not allow us to disentangle the wage effect of import penetration from that of export orientation. To partly deal with these issues, one should control for both sector specific import and export shares in the same regression. But in fact, the theory suggests another empirical approach: the size of the sectoral gender wage gap does not depend primarily on trade volumes but rather on market access, as defined in economic geography models.[4] The model presented in this paper differs from standard economic geography models as it features restricted entry of firms and because the labour market is not fully competitive. However, market access influences firms' profits, and thus firm ability to discriminate, in the same way. Both the access to foreign markets (export potential) and the access to the domestic market by foreign firms (import potential) are used to disentangle the market-size and the pro-competitive effects of trade openness on the gender wage gap.

I use data from Uruguay, which dramatically opened its economy to international trade with the creation of a common market agreement, the Mercosur, in the 1990s. Over

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

[3]Berik et al. (2004), Menon and Rodgers (2009).

[4]See Fujita et al. (1999), who first presented the "New Economic Geography wage equation" where the wages paid by a firm in a given region depend on regional access to other markets.

this period, gender prejudices on labour market access and pay remained frequent among employers. According to the World Value Survey, in 1996, 49% of male mangers agreed that "when jobs are scarce, men should have more right to a job than women" and 38% of them agreed that "if a woman earns more money than her husband, it's almost certain to cause problems". I first estimate the part of the gender wage gap due to different male and female returns to observable characteristics using individual data from the household survey *Encuesta Continua de Hogares*. The gender wage gaps are estimated for each sector and year between 1983 and 2003. I then estimate measures of market potentials for each sector and year with a gravity equation using bilateral trade data and information on trade costs. In the model, the effect of trade integration depends on the number of domestic firms operating in the sector. I interact the market access variables with a measure of production concentration at the sector level and investigate how the effect of trade differs depending on the initial level of domestic competition in a sector. I find evidence of the pro-competitive effect of trade. Greater market penetration by foreign competitors in a concentrated sector reduces the sectoral gender wage gap. Better access to foreign markets also reduces the gender wage gap in sectors that were already competitive (had a low concentration level) prior trade liberalisation. This is consistent with the selection of least discriminatory firms into export markets in sectors with a high number of firms. However, I also find evidence of the market-size or profit-enhancing effect of trade integration in concentrated sectors. Concentrated sectors that gain easier access to foreign markets exhibit a rising gender wage gap.

The work here is related to two strands of literature. It contributes first to the literature on competition and gender inequality (Black and Strahan, 2001; Hellerstein and Neumark, 2006; Heyman et al., 2013; Weber and Zulehner, 2014) and second to the literature on international trade and gender inequality (Ederington et al., 2009; Ben Yahmed, 2012;

Sauré and Zoabi, 2014; Juhn et al., 2014). I focus on the impact of international trade on the gender wage gap through changes in competition level (Black and Brainerd, 2004) and investigate not only the impact of greater import penetration but also the impact of greater export potential. Both the theory and the empirics show that both channels matter for gender wage inequality.

The remainder of this paper is organised as follows. In the next section I develop a model of oligopolistic competition and wage discrimination in a closed economy. Section 3 features the open-economy version. In section 4 I describe the empirical methodology, the data and descriptive statistics on gender gaps and trade in Uruguay over the 1990s. The empirical results are presented in Section 5. Last, Section 6 concludes.

2 Oligopolistic competition and discrimination in a closed economy

2.1 The model

The implication of firm concentration and costly trade on the sector specific gender wage gap can be brought out in a partial equilibrium analysis. I consider a single industry with restricted entry and oligopolistic competition. I assume that there are an exogenous fixed number N of potential firms that can produce the same homogeneous good [5].

Demand

The inverse demand function is linear and the price depends positively on the size of

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

demand b[6] and falls 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 captures the downward pressure on prices and markups due to tougher competition (more firms serving the market), and thus highlights the effect of competition on employers' ability to discriminate.

Production

Firms, indexed by i, are *ex ante* heterogeneous in the employer's prejudice against women $d_i \in [0; \bar{d}]$, and the distribution of prejudice is exogenously given. The equilibrium wage gap d^*, however, is endogenous and ultimately determines the type of worker a firm hires along with its wage bill. The *ex post* distribution of firms' outcomes, e.g. marginal cost and production, is thus endogenous.

Labour is the only factor of production and is inelastically supplied at the sectoral level $\bar{L}$. Male and female labour supplies are denoted by $\bar{L}_m$ and $\bar{L}_f$, neither of which is influenced by the level of discrimination. Firms' technologies are identical and represented by a linear production function

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

where male l_m and female labour l_f are perfect substitutes. The cost function features constant returns to scale once the firm operates in the market: $C(q_i) = c_i q_i$ where c_i is firm i's unit cost of production. Employers not only take into account the wages paid to

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

employees but also their personal distastes for certain types of workers. Employer i will hire women if the gender wage gap compensates the utility loss, i.e. $w_f + d_i < w_m$. The *perceived* unit labour cost is given by:

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

This setting leads to complete gender segregation across firms.[7]

2.2 The firm's output decision

The setting is a standard one-stage game in which N firms compete in quantity. The price p depends on the production of all incumbent firms, and firm i takes the output of other firms as given while maximizing its profits adjusted for discriminatory preferences.[8] The firm's maximization problem is as follows, where the objective function is concave in q_i:

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

Firms are wage-takers, and choose the quantity produced, i.e. the number of workers they hire. The first-order conditions for the N different firms can be written as:

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

[7] Alternatively, I could use Arrow's (1973) version of taste-based discrimination theory where employers' satisfaction depends on the share of women in firm employment instead of the absolute number of women. This setting would generate mixed firms which is a more realistic feature. The quantitative results of the model, however, are not affected by the specification choice. From here on, I denote "‘female firms"' the firms that employ women, while "‘male firms"' are those that employ men.

[8] Employer i maximises a utility function equal to profits minus the monetary value of the disutility of employing women. Employer i removes $d_i \times l_f$ which corresponds to the utility loss from employing l_f women.

Among the N firms, N_f firms hire women at a perceived cost of $c_{if} = w_f + d_i$ and N_m firms hire men at an identical cost of $c_m = w_m$. There are thus $N_f + 1$ equations for firm output. The number of workers firms hire falls with an increase in their specific costs c_i. As $w_f + d_i \leq w_m$ for all i, female firms have lower costs and hence produce more than do male firms. Among female firms, those with lower levels of prejudice employ more women and produce more.

Firms' reaction functions

Substituting the value of p given by the demand function (1) into the first-order condition gives us the reaction function of each firm: $q_i = \frac{1}{2}(b - Q_{-i} - c_i)$ where Q_{-i} is the sum of production from all firms except firm i and can be expressed as $Q_{-i} = (N-1)(q_i + c_i) - \sum_{j \neq i} c_j$ using the N first order conditions. Substituting this expression for Q_{-i}, the firm reaction function can be written as a function of the average cost of its competitors $\tilde{c}_{-i}$ and its own cost c_i only.[9]

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

Equations (1) and (2) can be combined to express the price of the homogeneous good as:

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

where $C(Q,N) = \sum_i^N c_i$ is the sum of production costs over all operating firms. The pro-competitive effect of market size N that transits via market fragmentation and the fall

[9]Note that since firms are heterogeneous in their unit costs, I need to check whether all of them produce in equilibrium. This yields conditions on the size of demand b and the number of operating firms N, which are exogenously fixed. Appendix A sets out the conditions ensuring an interior solution.

in competitors' average unit costs. The price is positively related to demand $\frac{b}{N}$, which explains why firms thrive by penetrating new markets.

2.3 The marginal discriminator

The equilibrium gender wage gap is determined by the level of prejudice of the last firm which hires women N_f, which is called the marginal firm. N_f is the only firm to be indifferent between employing men and women:

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

There is a continuum of equilibrium gender wage gaps comprised between the prejudice of the marginal employer d_{N_f} and the prejudice of the next firm $d_{N_{f+1}}$. In order to simplify some of the ensuing analysis, I use a particular parametrization of this distribution among employers. In particular, I 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 $d_i - d_{i+1} = \frac{\bar{d}}{N-1}$ and the gender wage gap is:

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

Note that this general case $d^* = d_{N_f} + \nu$ can be reasonably reduced to $d^* = d_{N_f} + \epsilon$ as all firms i with $d_i > d_{N_f}$ can hire men by setting a wage just above that which renders the previous firm indifferent between men and women. Without loss of generality, the wage gap can thus be expressed as:

$$d^* = (N_f - 1)\frac{\bar{d}}{N-1} \tag{6}$$

Firms' perceived costs can now be written as:

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

The marginal firm may possibly have a mixed labour force. The analysis below considers the case where the N_f firms exactly absorb female labour supply so that there are no mixed firms. This hypothesis does not alter the results of the model and facilitates the resolution of the labour-market clearing conditions.

2.4 Labour-market equilibrium

The wages of both men and women adjust until full employment is reached. The demand for female (male) labour is a function of the total output of the female (male) firms. Using the first-order condition, the labour-market clearing conditions can be written as:

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

The sum of the utility loss faced by discriminatory employers of female firms is, under the assumption that the distribution of d is discrete uniform over $[0; \bar{d}]$, an arithmetic series: $\sum_1^{N_f} d_i = \sum_{i=1}^{N_f} d_i = \frac{N_f(N_f-1)}{N-1}\frac{\bar{d}}{2}$

Using the labour-market clearing conditions, the equilibrium wages w_f and w_m and wage gap are:

$$w_f = p - \frac{N_f - 1}{N - 1}\frac{\bar{d}}{2} - \frac{\bar{L}_f}{N_f} \tag{7}$$

$$w_m = p - \frac{\bar{L}_m}{N_m} \tag{8}$$

$$d^* = \frac{\bar{L}_f}{N_f} - \frac{\bar{L}_m}{N_m} + \frac{N_f - 1}{N - 1}\frac{\bar{d}}{2} \tag{9}$$

Having previously defined d^* as a function of N_f in equation (6), I can implicitly define d^*:

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

The proofs of the existence and uniqueness of d^* appear in the Appendix.

We recapitulate below the equations that define the equilibrium in the economy:

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

The first two equations give the wages of women and men as a function of the price, the total number of firms in the sector and the number of female firms, while the third equation defines the wage gap. The fourth equation shows the number of female firms, which depends on the distribution of prejudice across firms $\frac{\bar{d}}{N-1}$ and the wage gap. The price is determined by the size of demand and average firm unit costs, as given by the fifth equation. The last two equations define firm output levels, which depend on their *perceived* unit costs. The output of female firms depends on their d, while all male firms produce the same amount as they have the same perceived cost of production, w_m.

Evolution of the wage gap

The standard predictions from the Beckerian model can be derived by applying the implicit function theorem to Φ, which is defined as:

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

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

Moreover, it follows that d^* falls with N, $\frac{\partial d^*}{\partial N} < 0$. Suppose the range of prejudice does not widen, then a rise in the number of firms, uniformly distributed in the segment $[0; \bar{d}]$, has two opposite effects. On the one hand, the difference in prejudice between two firms $\frac{\bar{d}}{N-1}$ is reduced. Keeping N_f constant, this reduces the wage gap as the last firm employing women, the marginal discriminator, now has lower prejudice than before the entry of new firms. On the other hand, an increase in N reduces the level of output produced by each firm. The full employment of women requires a higher number of firms. Higher N_f corresponds to a higher level of prejudice for the marginal discriminator and thus a larger wage gap. The reason why the first effect dominates is as follows. Less-discriminatory firms have lower unit costs, so their market share falls less than that of more discriminatory firms after new firm entry. The demand for female workers increases relative to that for male workers with firm entry, and the wage gap is reduced. This effect highlights the role of the number of firms in reducing the incidence of taste-based discrimination.

Selection effect

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

$$\bar{c} = b - \left(\frac{V^2}{\bar{d}}(N-1) + V \right) \tag{10}$$

where $V = \frac{d_{N_f}}{2}$ is the average perceived-cost difference between female and male firms. In other words, V is the perceived cost disadvantage of discriminatory firms. Tougher competition, in the sense of more firms producing, reduces the cost threshold above which no firms can produce: $\frac{\partial \bar{c}}{\partial N} < 0$. The pro-competitive effect is more pronounced when the number of producers is initially small $\frac{\partial^2 \bar{c}}{\partial N^2} < 0$. Furthermore, $\frac{\partial^2 \bar{c}}{\partial N \partial \bar{d}} > 0$ shows that the 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 where there are stronger stereotypes against women.

3 The Open Economy

3.1 Import penetration, export opportunities and discrimination

This section considers the case where two countries D and F (for the domestic and foreign country) trade a homogeneous good under oligopolistic competition. Firms in both countries engage in intra-industry trade to capture some of the rents that exist in the foreign market. Brander (1981) first formalised how strategic interactions among Cournot oligopolists in two countries lead to intra-industry trade.[10] The country characteristics may differ. Domestic and foreign consumers' inverse demand functions are respectively

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

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

There are N_F foreign firms which are assumed to be homogeneous, so that all firms in F produce at the same unit cost of c_F.[11] The markets are segmented, although firms can export by incurring a transport cost. Foreign firms have to pay an iceberg trade cost τ_D to sell in market D while domestic firms have to pay τ_F to export to market F[12]. As firms produce under constant returns to scale, they maximise separately the profits (adjusted for their preferences) that they make on the domestic and foreign markets taking as given the production of other domestic firms that export q_{DF}, and the production of foreign firms q_F.

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

where q_{iDF} are the sales of domestic firm i in market F, q_{DF} are the sales of other domestic firms in market F and q_F are the sales of foreign firms in market F. Optimal sales in market

[10]This type of model was subsequently used and developed by Combes et al. (1997), Neary (2002) and Neary (2003), among others.

[11]I abstract from heterogeneity in costs among foreign firms, and in particular from differences due to discrimination. This assumption has no implications for the determinants of the wage gap in the domestic country, as what matters for discriminators to be able to sell are the final equilibrium prices in the domestic and foreign markets.

[12]Iceberg trade costs were used by Brander (1981) in an oligopolistic-competition context. Alternatively, if the transport cost is additive, the first-order conditions become: $q_{iDF} = p_F - w_f - d_i - \tau_F$ and $q_{iDF} = p_F - w_f - d^* - \tau_F$. A unit trade cost would no longer enter the cost difference between discriminatory and non-discriminatory exporting firms. Consequently, as we will see later, trade liberalization no longer affects the wage gap via the intensive margin (the volume of exports) but the results for the effect of trade via the extensive margin (the type of firms which export) remain unchanged.

F for firm i are given by:

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

Production for each market is then:

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

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

Domestic sales and exports of firm i are:

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

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

with $\tilde{c}_{-ih}$ being the average unit cost of both domestic and foreign competitors selling in market h. N_D is the number of domestic firms and N_{Df} is the number of domestic female firms. The conditions for output to be positive in both markets for a firm of type i are derived in Appendix A.2.

3.2 The labour market

The wage gap is defined as under autarky by equations (5) and (6). Using the assumption that the distribution of d is discrete uniform over $[0; \bar{d}]$ to substitute for $\sum_i d_i$, the labour-market clearing conditions for women and men in the open-economy case are given by:

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

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

where N_{Df} is the number of domestic female firms and N_{Dm} the number of domestic male firms. The equilibrium wages and the wage gap under trade are:

$$w_f = \frac{1}{1+\tau_F}(p_D + p_F - \frac{\bar{L}_f}{N_{Df}}) - \frac{N_{Df}-1}{N_D-1}\frac{\bar{d}}{2} \tag{6-T}$$

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

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

The proofs of the existence and uniqueness of d^* appear in the Appendix.

Defining $\Phi^T \equiv d^* - \frac{2\bar{d}}{1+\tau_F}\left(\frac{\bar{L}_f}{\bar{d}+(N_D-1)d^*} - \frac{\bar{L}_m}{(N_D-1)(\bar{d}-d^*)}\right) = 0$, and applying the implicit function theorem, simple comparative statics show that:

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

In a sector with discriminatory firms, and holding the number of producing firms constant, a fall in export costs τ_F further increases the gender wage gap. With trade liberalization and the fall in export barriers τ_F, the wage gap in the domestic labour market increases because discriminatory (higher-cost) firms benefit from new sales opportunities which increase their ability to discriminate. This result is in line with Becker's model regarding the role of competition, and stems from the fact that trade openness may reduce or increase firm profits: in some circumstances, even higher-cost firms can benefit from new profit opportunities in foreign markets. Previous work had assumed that openness increases competition, and overlooked the fact that by facilitating access to foreign markets it may also raise profitability. Note that this effect applies to a concentrated sector where the number of firms is low enough so that firms enjoy rents and are able to discriminate already prior trade liberalization. This exercise keeps the number of producing firms constant. The next subsection looks at the impact of foreign trade costs τ_F and domestic trade costs τ_D on the gender wage gap when higher-cost firms may cease production, keeping the number of *potential* firms constant.

3.3 Foreign competition and firm selection

To further understand how foreign competition affects wage discrimination via the selection of firms, I make use of the cost threshold above which a firm cannot sell in a market. The lower is this cost threshold, the smaller the firms' profits, and the lower the gender wage gap. In the open-economy framework, firms face different zero-profit conditions depending on the market in which they operate. Those conditions define the maximum level of factor prices the firm can afford in each market. Equation (9a-T) establishes the production-cost threshold to sell in the domestic market while equation (9b-T) shows that to export to market F.

The cost threshold at home

Let $\bar{c}_D$ denote the cost threshold above which a domestic firm cannot break even in its domestic market. This cost threshold is equal to the selling price $\bar{c}_D = p_D$.

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

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

The impact of a fall in trade costs τ_D highlights the competitive effect of trade openness. When country D reduces its trade barriers, its domestic cost cut-off falls, $\frac{\partial \bar{c}_D}{\partial \tau_D} > 0$.

Proposition 1. ***The competition effect of domestic market openness.***
In a sector with discriminatory firms, a fall in the costs to enter the domestic market τ_D *reduces the gender wage gap.*

This reflects two different effects. First, foreign firms pay lower trade costs to enter country D's market so that the average cost of competitors falls. Second, as foreign firms sell now at lower cost they are able to sell more, this generates a fragmentation effect. The cost cut-off also falls with the number of foreign firms exporting to the domestic market, $\frac{\partial \bar{c}_D}{\partial N} < 0$. This effect operates through the two channels cited above: the fragmentation effect, as more firms sell in market D, and an indirect effect as an increase in the number of incumbent firms exerts downward pressure on average cost. Last, $\frac{\partial \bar{c}_D}{\partial c_F} > 0$. It is obvious that competition is fiercer when foreign competitors are more productive, i.e. when c_F is low.

The cost threshold abroad

Let $\bar{c}_{DF}$ denote the cost threshold above which a domestic firm does not export to the foreign market F. Firms cannot compete in market F if their production costs multiplied by the iceberg trade costs are greater than the price in market F:

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

The greater the number of domestic and foreign firms, the lower the cost cut-off: $\frac{\partial \bar{c}_{DF}}{\partial N_F} < 0$. The lower the unit-cost of foreign firms, the smaller is the cost threshold: $\frac{\partial \bar{c}_{DF}}{\partial c_F} > 0$. So that for high enough N_F and c_F, domestic male firms, that have higher production costs, are not able to export.

A change in the trade barriers τ_F has opposing effects on the cost cut-off, as it affects firms decisions on both production levels for the foreign market (the intensive margin) and entry into the export market (the extensive margin).

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

The first term captures a competition effect of trade liberalisation via the intensive margin. Reduced export barriers correspond to lower unit costs for exporting firms; as a result of firms' strategic interactions in the foreign market, the foreign price falls and so does the cost threshold for exporting. The second term captures a market-size effect of trade liberalisation via the entry of firms in the foreign markets, the extensive margin. 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 (as in Melitz (2003)). Lower τ_F raises the cost-threshold. This effect is proportional to the cost disadvantage of discriminatory firms V. As transport costs fall, their cost disadvantage represents less of a hindrance to exporting.

The market-size effect dominates when the cost difference between discriminatory and non-discriminatory firms is large, corresponding to an industry with few firms. The effect of trade liberalisation on the equilibrium gender wage gap depends on the number of domestic firms. Taking the cross-partial derivative, one can show that $\frac{\partial^2 \bar{c}_{DF}}{\partial \tau_F \partial N_D} > 0$.[13] When a small number of firms operate in a sector, trade liberalisation in partner countries offers export opportunities to discriminatory firms and the gender wage gap widens. However, as the number of domestic firms increases, the extensive margin effect is offset by that of the intensive margin. Trade liberalisation in partner countries benefits most lower-cost non-discriminatory and the selection of firms into exporting contributes to a reduction in the gender wage gap .

Proposition 2. ***The competition and market-size effects of foreign market openness.***

In a sector with discriminatory firms, a fall in the costs to enter the foreign market τ_F
i) reduces the gender wage gap if the number domestic of firms is large enough (competition effect),
ii) increases the gender wage gap if the number domestic of firms is small (market-size effect).

This is a particularly interesting result, as it emphasises the profit-enhancing effect of foreign-market access that has been overlooked in previous empirical analysis of the effect of trade openness on the gender wage gap. To sum up, profit opportunities may rise with trade. When access to foreign markets becomes easier, if domestic firms have a significant cost advantage, $c_D < c_F$, and the number of domestic competitors is low, export opportunities benefit both non-discriminatory and discriminatory firms and the latter can maintain their discriminatory practices. However, if foreign competitors N_F produce at lower cost and put competitive pressure on domestic firms, there is a selection of firms into exporting. In this case, trade integration favors low-cost non-discriminatory firms over

[13]This is obtain from $\frac{\partial^2 \bar{c}_{DF}}{\partial \tau_F \partial N_D} = (b_F + N_F c_F) - (N_D + N_F + 1)(N_{Df}\frac{\partial V}{\partial N_D} + V\frac{\partial NDf}{\partial N_D}) - N_{Df}V$ with $\frac{\partial V}{\partial N_D} < 0$, $\frac{\partial N_{Df}}{\partial N_D} < 0$ and $N_D V > N_{Df} V$.

discriminatory firms, reducing the demand for male labour and hence the gender wage gap.

4 An empirical investigation

The theoretical model sets out the ability to discriminate in imperfectly-competitive sectors which are opened to trade. I now proceed to test the model's prediction about the effect of trade integration on the sectoral gender wage gap with data for Uruguay, a country which experienced considerable trade liberalisation in the 1990s. In Section 4.1, I estimate gender wage discrimination at the sectoral level using individual data with information on industry affiliation. Section 4.2 then presents the domestic competition variable, and Section 4.3 explains how market access is calculated to obtain a measure of trade openness. The empirical specification implemented in the last step is described in Section 4.4.

4.1 Calculating the gender wage gaps

4.1.1 Data

I use data from the Uruguayan longitudinal household survey (Encuesta Continua de Hogares, hereafter ECH) over the 1983-2003 period. The survey covers all urban areas in the country which represent 87% of the population in the late 1980s, and 92% in 2004. Given that I am interested in the gender wage gap due to employer discrimination, I restrict the sample to employees, aged from 18 to 65, excluding unpaid workers, the self-employed and employers.

Table 1 shows that between 67% and 75% of the working population are employees. Female employees receive on average lower hourly wages than male employees although the raw gender wage gap has decreased over the period. The following analysis focuses on employees in the manufacturing sector as it is the most exposed to international trade. It represents between 22.5% and 11.7% of all employees over the 1990s. Men have higher employment shares in the manufacturing sectors compared to women. The bottom panel of Table 1 provides descriptive statistics on the sample of employees in the manufacturing sector. Female employees in the manufacturing sector earn less than men and the gender wage gap is higher in the manufacturing sector than in the overall economy. There is a slow convergence between male and female average wages in the manufacturing sector. While the raw wage gap was 0.4 log points in 1990, it declined to 0.27 log points in 2002. Female employees are slightly younger than male employees but the difference has faded out over the period. However, women have on average a higher level of education than men and the difference has even increased over time. There has been an increase in the educational level for both men and women but the increase in the share of employees with some tertiary education has been stronger for females than for males.

Table 1: Descriptive Statistics from the household survey

	Gender	1990	1992	1994	1996	1998	2000	2002
Share of employees in	Male	66.9	67.8	66.4	64.9	65.8	65.4	65.1
the working population	Female	69.2	68.3	68.0	69.2	70.9	72.3	75.1
Mean real hourly wage	Male	2.96	3.04	3.13	3.11	3.15	3.20	2.97
(in logarithms)		(0.66)	(0.70)	(0.72)	(0.74)	(0.73)	(0.74)	(0.89)
	Female	2.73	2.86	2.95	2.96	3.01	3.09	2.93
		(0.73)	(0.73)	(0.75)	(0.76)	(0.74)	(0.74)	(0.83)
[0.6em] Share of employees in	Male	25.9	25.1	23.5	20.6	20.2	17.8	15.4
manufacturing	Female	17.6	17.4	14	11.3	11	9.8	7.5
Mean real hourly wages	Male	2.98	3.11	3.14	3.11	3.12	3.15	2.88
(in logarithms)		(0.63)	(0.65)	(0.66)	(0.69)	(0.70)	(0.71)	(0.73)
	Female	2.59	2.75	2.78	2.77	2.88	2.92	2.61
		(0.73)	(0.70)	(0.72)	(0.72)	(0.66)	(0.68)	(0.77)
Age	Male	36.8	37.0	36.2	36.1	36.8	36.2	37.1
	Female	35.7	35.8	35.4	35.8	35.0	36.0	37.9
Level of education								
Primary or less	Male	40.9	38.4	35.3	32.6	31.9	27.5	26.9
	Female	38.4	31.1	32.9	29.1	24.2	22.1	21.3
Secondary	Male	32.5	31.4	34.5	35.3	34.8	42.1	42.3
	Female	44.0	47.5	44.3	47.1	53.3	52.1	48.9
Technical	Male	21.4	23.3	23.5	24.7	25.2	21.8	21.1
	Female	9.8	13.8	13.0	13.0	11.6	9.8	12.4
Tertiary	Male	5.2	6.8	6.6	7.4	8.1	8.6	9.7
	Female	7.8	7.5	9.8	10.7	10.8	16.0	17.4
Number of observations	Male	*2452*	*2386*	*2235*	*1901*	*1719*	*1492*	*1222*
Employees in manufacturing	Female	*1199*	*1185*	*976*	*828*	*756*	*701*	*540*

Source: Based on the Household survey, ECH, INE, Uruguay. Real hourly wages, base year 1997, are computed for employees only and include bonuses.

4.1.2 Methodology

To obtain a measure of wage discrimination, I first estimate male and female wage equations separately. I then decompose the total gender wage gap following Oaxaca (1973) and Blinder (1973), and retrieve the part of the wage gap that is due to differences in the treatment of individuals with identical productive characteristics. For each year t and sector j:

$$\ln W_{mjt} = X'_{mjt}\beta_{mjt} + \epsilon_{mjt}$$

$$\ln W_{fjt} = X'_{fjt}\beta_{fjt} + \epsilon_{mjt}$$

where $\ln W_{gjt}$ is the logarithm of the hourly wage rate for a worker of gender $g \in \{f, m\}$, working in sector j during year t. The vector of individual characteristics, X, includes the number of years of education, potential experience (age minus 6 minus the number of years of education) and its square, and a dummy for the individual living in Montevideo to control for wage differences between the capital and other urban areas.[14] Estimating the wage gap for private-sector employees only does not change the results. Arguments can be made for the inclusion or exclusion of occupational controls. I here consider that human-capital characteristics should determine the job position, hence I do not control for occupation.[15] Male and female wage equations are estimated separately for each year and 2-digit manufacturing sector, so that the returns to characteristics vary by sector and over

[14] Potential experience might however be only a poor proxy for actual experience. More importantly, for our purpose, the gap between potential and actual experience is certainly larger for women, who have both more and longer career interruptions, mainly due to maternity leave. Any gender difference in actual experience which is not captured by potential experience would lead to the overestimation of the wage gap due to unequal treatment, as shown by Wright and Ermisch (1991) for Britain. Unfortunately, the unemployment-duration and job-tenure variables are missing for many years in our data, preventing us from calculating real experience on the labour market.

[15] Controlling for occupation increases the share of the wage gap resulting from differences in coefficients, especially at the beginning of the period in the following industries: food, machinery, paper and printing, and chemicals. This comes from bigger differences in the returns to education within occupation as compared to the mean difference when occupation is not controlled for.

time. I include sectors for which there are enough female and male observations, namely the food and beverage industry, the machinery industry, the chemicals industry, the paper and printing industry, and the textile, apparel and leather industry.

The following wage decomposition is then calculated for each year t and sector j:

$$\overline{\ln W}_{mj} - \overline{\ln W}_{fj} = (\overline{X}_{mj} - \overline{X}_{fj})\widehat{\beta}_{mj} + \overline{X}'_{fj}(\widehat{\beta}_{mj} - \widehat{\beta}_{fj}) \quad (10)$$

where $\overline{\ln W}_{gj}$ denotes the mean log wage for group g in sector j, $\overline{X}_{gj}$ denotes the average level of characteristics of group g in sector j and $\widehat{\beta}_{gj}$ the estimated parameter from the wage equation. The total wage difference is decomposed into two terms. The first term on the right-hand side captures the "endowment effect", i.e. the part of the wage gap due to differences in worker characteristics. The second term reflects the "coefficient effect", i.e. the differences in returns to similar characteristics. It is also referred to as the adjusted wage gap (WG) and is subsequently used as a measure of wage discrimination:

$$\widehat{WG}_{jt} = \overline{X}_{fjt}(\widehat{\beta}_{mjt} - \widehat{\beta}_{fjt})$$

Table 2 provides the female share, the raw gender wage gap and the adjusted gender wage gap for the whole economy, the manufacturing sector at the 1-digit level and each 2-digit manufacturing sector for every second year in the 1990s.

Overall, both the raw wage gap and the adjusted wage gap fell in the early 1990s when the Mercosur was first introduced, and fell further in the mid-1990s, corresponding to a period of consolidation of the trade agreement. The rise in the wage gap over the early 2000s is concomitant with the Uruguayan banking and currency crisis. Table 2 also reveals that the adjusted wage gap is always bigger than the raw wage gap. Between 1990 and 2002, the raw gender wage gap range from 26% to 11% while the gender wage differential due to differences in returns ranges from 29% to 21% on average in the whole economy.[16] A higher adjusted wage gap compared to the raw wage gap means that differences in productive characteristics such as human capital between men and women do not help explain the raw wage gap. In fact, Table 1 shows that women have higher levels of education than that of men. The differences in returns to characteristics are here the only source of gender differences in wages.

Looking at sectoral variation, both the raw wage gap and the adjusted wage gap are substantially larger in the manufacturing sector. At the beginning of the period, the wages of men were over double those of women, with the gap being unexplained by differences in characteristics. During the first half of the 2000s, the raw wage gap was around 25% and remained unexplained by observable characteristics. Despite the fact that the wage gap has fallen in all manufacturing sectors, there remains substantial sectoral variation. Gaps are higher in the textile and garment industry, followed by the food, beverage and tobacco industry, where the female shares of employment are the highest. In the Machine and Equipment sector, the raw and the adjusted wage gaps are particularly low; this is also the sector for which the wage gap is less precisely estimated due to a small number of observations.

[16]Other research find similar magnitudes for the adjusted wage gap. For example, Nopo et al. (2010) estimate the wage gap with a non-parametric matching approach, and find that in 2005 around 20% of the gap could not be explained by returns on characteristics which is close to the estimate I have for 2002.

Table 2: Gender Employment and Wage Gaps

		1990	1992	1994	1996	1998	2000	2002
Whole	Female share	0.42	0.42	0.42	0.44	0.45	0.46	0.48
economy	Raw Wage Gap	0.23	0.19	0.18	0.14	0.14	0.11	0.04
	$\ln W_m - \ln W_f$	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
	Wage Gap	0.26	0.27	0.25	0.23	0.20	0.19	0.13
	$\overline{X}_f(\widehat{\beta}_m - \widehat{\beta}_f)$	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)	(0.01)
Manufacturing	Female share	0.33	0.33	0.30	0.30	0.31	0.32	0.31
sector	Raw Wage Gap	0.40	0.35	0.36	0.34	0.24	0.22	0.27
	$\ln W_m - \ln W_f$	(0.02)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
	Wage Gap	0.44	0.40	0.41	0.40	0.26	0.29	0.30
	$\overline{X}_f(\widehat{\beta}_m - \widehat{\beta}_f)$	(0.03)	(0.02)	(0.03)	(0.03)	(0.03)	(0.03)	(0.04)
Food	Female share	0.25	0.26	0.26	0.26	0.31	0.31	0.28
Beverage	Raw Wage Gap	0.22	0.27	0.31	0.29	0.33	0.23	0.24
	$\ln W_m - \ln W_f$	(0.04)	(0.04)	(0.04)	(0.04)	(0.04)	(0.05)	(0.05)
	Wage Gap	0.25	0.33	0.51	0.35	0.30	0.33	0.36
	$\overline{X}_f(\widehat{\beta}_m - \widehat{\beta}_f)$	(0.06)	(0.07)	(0.07)	(0.05)	(0.07)	(0.05)	(0.07)
Textile	Female share	0.60	0.62	0.59	0.60	0.56	0.55	0.61
Garment	Raw Wage Gap	0.67	0.54	0.54	0.58	0.40	0.41	0.60
	$\ln W_m - \ln W_f$	(0.04)	(0.04)	(0.05)	(0.06)	(0.05)	(0.07)	(0.08)
	Wage Gap	0.72	0.54	0.52	0.63	0.40	0.38	0.58
	$\overline{X}_f(\widehat{\beta}_m - \widehat{\beta}_f)$	(0.04)	(0.04)	(0.05)	(0.06)	(0.05)	(0.07)	(0.15)
Chemicals	Female share	0.25	0.27	0.28	0.29	0.31	0.30	0.34
Plastic	Raw Wage Gap	0.16	0.06	0.15	0.12	0.11	0.22	0.09
	$\ln W_m - \ln W_f$	(0.06)	(0.07)	(0.07)	(0.08)	(0.09)	(0.09)	(0.11)
	Wage Gap	0.28	0.15	0.24	0.22	0.09	0.29	0.18
	$\overline{X}_f(\widehat{\beta}_m - \widehat{\beta}_f)$	(0.10)	(0.13)	(0.10)	(0.09)	(0.11)	(0.08)	(0.11)
Machines	Female share	0.12	0.11	0.13	0.13	0.10	0.16	0.15
	Raw Wage Gap	0.01	0.06	-0.12	0.08	0.06	-0.02	0.16
	$\ln W_m - \ln W_f$	(0.10)	(0.10)	(0.09)	(0.10)	(0.11)	(0.12)	(0.21)
	Wage Gap	-0.03	0.01	-0.20	0.02	-0.11	0.04	0.27
	$\overline{X}_f(\widehat{\beta}_m - \widehat{\beta}_f)$	(0.14)	(0.31)	(0.18)	(0.10)	(0.28)	(0.12)	(0.37)
Paper	Female share	0.26	0.27	0.27	0.31	0.24	0.38	0.30
Printing	Raw Wage Gap	0.02	0.15	0.37	0.35	0.05	0.12	0.22
	$\ln W_m - \ln W_f$	(0.09)	(0.10)	(0.12)	(0.13)	(0.15)	(0.10)	(0.13)
	Wage Gap	0.21	0.17	0.41	0.31	0.20	0.19	0.40
	$\overline{X}_f(\widehat{\beta}_m - \widehat{\beta}_f)$	(0.16)	(0.12)	(0.14)	(0.23)	(0.19)	(0.11)	(0.19)

Source: Author's calculations based on the Encuesta Continua de Hogares, INE, Uruguay. Wages include bonuses. The raw and adjusted wage gaps are expressed in logarithm. The wage difference in percentage points is $(exp(wage\ gap) - 1) \times 100$. The wage gaps are calculated for sectors that have enough observations per year. Because there are too few women, I cannot estimate the gaps in three 2-digit manufacturing sectors: Wood and Products of Wood, Non-Metallic Mineral Products and Basic Metal Industries.

4.2 The measure of domestic competition

As proxy for industry competition, I use the Herfindahl index calculated as $C_{jt} = \sum_e^N s_{ejt}^2$, where s_{ejt} is firm e's share of production in industry j and year t. The index values range from 1, for a monopoly, to $\frac{1}{N}$ if firms have equal market shares. The concentration index is computed based on a firm surveys from the National Statistics Institute (INE), the *Encuesta Industrial Anual* for 1988-1996 and the *Encuesta de Actividad Económica* for 1998-2003. Data for 1997 are taken from the Economic Census.[17] Table 3 presents the summary statistics for the sectoral concentration of market shares at the two-digit level. Even at this fairly aggregated level, the index varies widely across sector and over time. The most concentrated sector in the early 1980s was the paper industry, while in 2000, the food and beverages industry and the machinery industry were the most concentrated.

Table 3: The Herfindahl index of production concentration in manufacturing industries

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

Source: INE, Uruguay. $C_{jt} = \sum_e^N s_{ejt}^2$, where s_{ejt} is firm e's share of production in industry j and year t.

4.3 The measures of market access

Uruguay experienced considerable trade liberalisation in the 1990s. A number of liberalisation agreements were implemented, at the regional level with the founding of Mercosur in 1991 and its amendment in December 1994, and at the multilateral level with the GATT

[17] I am grateful to Carlos Casacuberta for his help with the data on Herfindhal indexes.

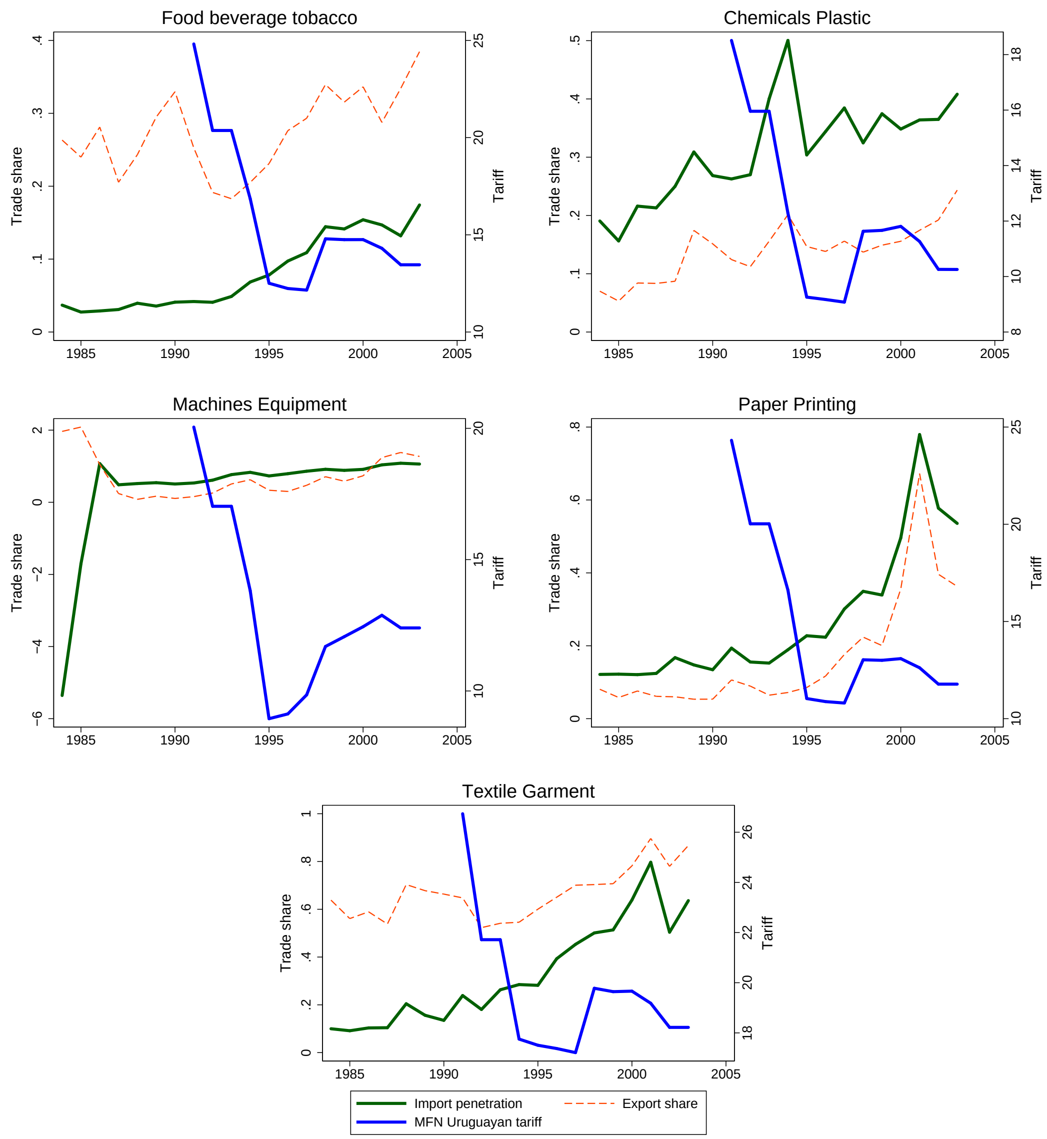
and WTO. The 1990s differ from the previous decades during which sectors were protected by tariffs. Figure 2 shows how the level and the dispersion of Uruguay's MFN tariffs have fallen across five 2-digit sectors. At the end of 1990s, the MFN tariffs increased again as Mercosur members agreed in December 1997 to increase temporarily their common external tariff by 3 percentage points. The reduction in tariffs resumed after 2000. Uruguay is a small open economy whose export and import shares have been rising as depicted in Figure 2. Besides having comparative advantage in sectors which intensively use natural resources, such as food-processing, textile and leather, Uruguay competes also internationally in modern manufacturing sectors.

4.3.1 Methodology

I use market potentials as defined in economic geography models to measure the market-size effect and the competition effect of trade integration on gender wage gaps. I prefer market potential measures over trade shares for two reasons. First, market potentials use information on the economic mechanism that the model presented in Section 2 intends to stress. The model shows that the effect of trade liberalisation on the gender wage gap depends on discriminatory firms' ability to make profits at home and abroad which in turn depends on trade costs to penetrate the domestic and the foreign markets and the level of competition in those markets. Similarly, 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 (Fujita et al., 1999). Second, it is possible to construct market potential measures that are exogenous to local characteristics, as explained below.

The first step consists in computing market potentials is to estimate a gravity equation for each sector j and year t (Fally et al., 2010; Hering and Poncet, 2010).

Figure 1: Export share, import penetration and tariff



Source: Author's calculations based on trade data from the *TradeProd Database*, CEPII and data on MFN tariff from the Latin American Integration Association (LAIA) also known as ALADI. Uruguayan import penetration is calculated as a share of domestic absorption $\frac{Imports}{Production+Imports-Exports}$. The export share is $\frac{Exports}{Production}$.

Total sales from country D to country F are expressed as:

$$lnX_{DFjt} = \sum_{kt} \beta_{kjt}\tau_{k,DFjt} + FX_{Djt} + FM_{Fjt} + \epsilon_{DFjt} \tag{11}$$

where X_{DFjt} is the flow of good j from country D to country F in year t. The variable FX_{Djt} is an exporter fixed effect which is sector-country-year specific: this captures characteristics such as the number of firms and the average cost of production. Analogously, the importer fixed effect FM_{Fjt} captures characteristics particular to each sector of the importing country in a given year. The vector $\tau_{k,DFjt}$ includes k variables of the trade costs of entering market F. I use bilateral distance, contiguity and common language that vary across trade partners, and regional trade agreements that vary across trade partners and years. Tariffs additionally provide variation in trade costs across both sectors and years. I have access to tariff information at the sector level only from 1991. Thus I construct two MA variables, one without tariffs for 1983-2003, and another with sectoral tariff for 1991-2003. Note however that the benchmark MA calculated for 1983-2003 without sectoral tariff does vary across sector and time even if distance and language do not. The gravity equation is estimated separately for each sector j and year t so that it allows the effect of distance and language to vary across sectors and time. For instance, distance represents a bigger trade barrier for perishable products than non-perishable ones but the effect of distance may be reduced over time as technological progress reduces transportation time.

In a second step, I use the estimated coefficients of Equation (11) to compute Uruguay's market access (MA) and foreign competitors access to the Uruguay market (CA) at the sector level. The market access of Uruguayan firms exporting good j is denoted by $\widehat{MA}_{URY,jt}$ and captures the market-size effect of trade. It is the sum of the market accesses to all of Uruguay's trade partners F. In this case, Uruguay is the exporter country D and the trade partners are the importer countries F. Uruguayan firms' access to market F depends on the costs to enter this market $\tau_{k,URY,Fjt}$ and on the size of the demand and the level of competition in the foreign market F captured by the importer fixed-effects $\widehat{FM}_{Fjt}$.

$$\widehat{MA}_{URYjt} = \sum_F \widehat{MA}_{URY,Fjt} = \sum_F \left(\widehat{FM}_{Fjt} \prod_k (\tau_{k,URY,Fjt})^{\widehat{\beta}_{kt}} \right)$$

Note that the characteristics of the Uruguayan sector are not included in the MA variable, but they are controlled for in the gravity equation (11). By excluding the sector-year-specific exporter fixed-effect $FX_{URY,j,t}$, I ensure that this measure is exogenous to all domestic factors that affect the sector's export supply capacity, such as its competitive advantage or changes in the labour supply. In particular, I eliminate the concern of reverse causality between a sector's gender wage gap and its export shares as it may be argued that a reduction in the gender wage gap reduces labour costs and thus increases competitiveness and exports.

Foreign firms' access to Uruguay is denoted by CA_{jt} and captures the pro-competitive effect of trade. It is the sum of all of trade partners' access to the Uruguayan market. In this case, Uruguay is the importer country F and the trade partners are the exporter country D. The competitors' access depends on the costs to enter the Uruguayan market $\tau_{k,F,URY,jt}$ and on the competitive advantage of competitors captured by the exporter fixed-effects $\widehat{FX}_{Fjt}$.

$$\widehat{CA}_{URYjt} = \sum_F \widehat{CA}_{F,URYjt} = \sum_F \left(\widehat{FX}_{F,jt} \prod_k (\tau_{k,F,URYjt})^{\widehat{\beta}_{kt}} \right)$$

Note that the characteristics of the Uruguayan sector are not included in the CA variable, but they are controlled for in the gravity equation (11). By excluding the sector-year-specific importer fixed-effect $FM_{URY,j,t}$, I ensure that the CA measure is exogenous to all domestic factors that affect import penetration. Again, this measure is free from concerns of reverse causality between the gender wage gap of a sector and the import shares of that sector. In this case, reverse causality would imply that a fall in the gender wage gap reduces the entry of foreign goods by reducing labour costs and increasing Uruguayan firms competitiveness.

4.3.2 Trade data

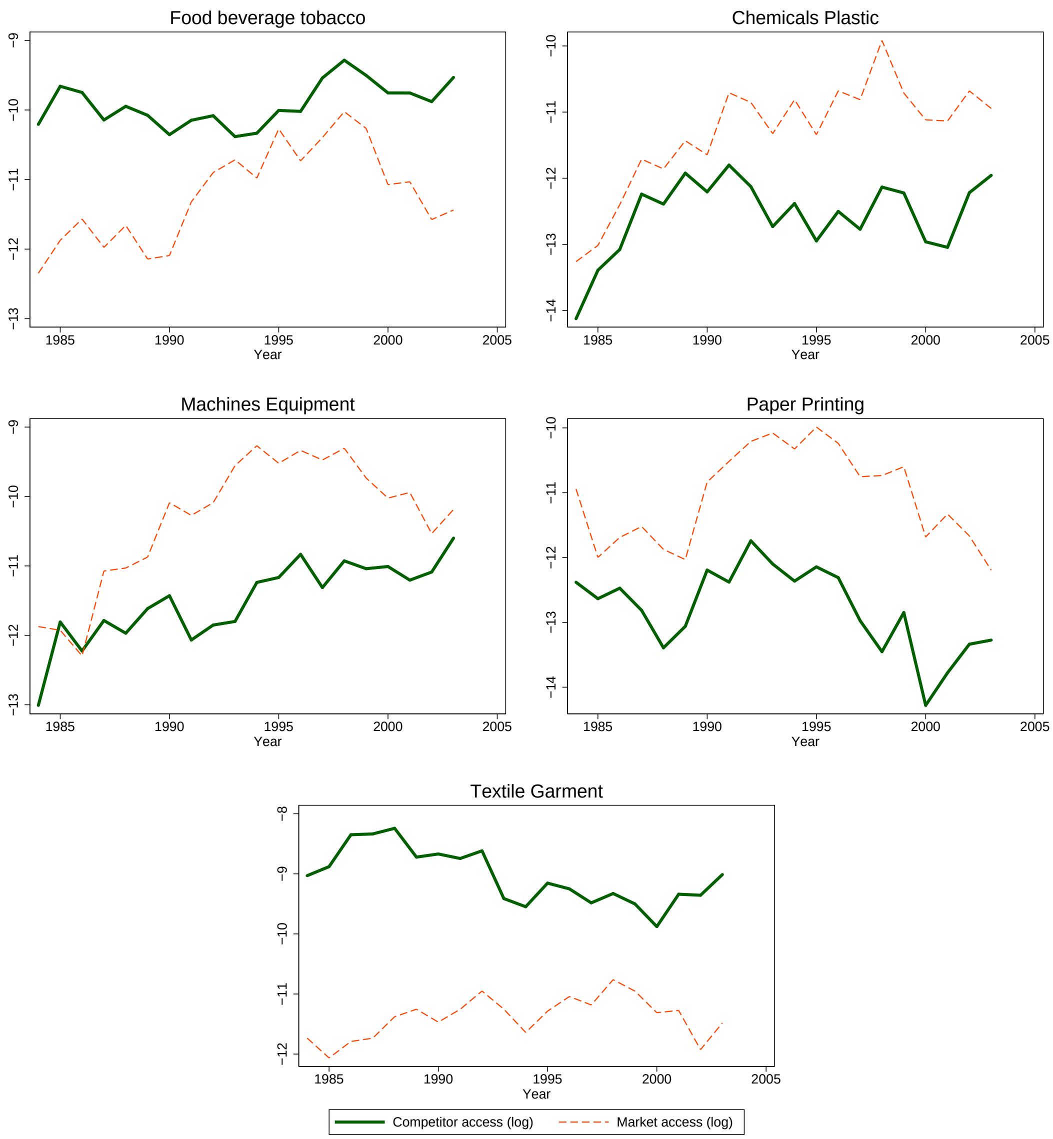
To compute the market access and competitor access measures, I use bilateral trade and production data from the *TradeProd database* from the CEPII (Mayer et al., 2008). CEPII also provides the *Distances database* with bilateral distances and common official language, which are used to capture part of trade costs. As additional information on trade costs I use Uruguayan MFN tariffs at the 2-digit sector level from the Latin American Integration Association (LAIA).[18]

Figure 2 depicts the evolution of the estimated market access variables $\widehat{CA}$ and $\widehat{MA}$ in five manufacturing sectors.[19] Both variables rose in the 1990s in the Food and Beverage industry, Chemicals Products industry, Machines and Equipments industry. In the Textile and Garment industry Uruguay's market access remained constant while $\widehat{CA}$ slightly decreased. Most sectors suffered from a fall in $\widehat{MA}$ in the late 1990s, reflecting the crisis in neighboring countries. The financial crisis began in 1999 in Argentina, spread to Uruguay and persisted in the region until the early 2000s.

[18] I am grateful to Carlos Casacuberta for sharing with me data on MFN tariffs.

[19] The choice of the manufacturing sectors is dictated by the size of the survey data ECH that does not provide enough observations to estimate yearly wage gaps and extent the analysis to the other 2-digit sectors i.e. Wood and Products of Wood, Non-Metallic Mineral Products and Basic Metal Industries.

Figure 2: Market Access



Source: Author's calculations based on the *TradeProd Database*, CEPII. Uruguyan firms' access to foreign markets (Market access) and foreign firms' access to the Uruguayan markets (Competitors access) shown here are calculated based on all of Uruguay's trade partners.

4.4 Empirical specification

To identify empirically the heterogeneous effects of trade openness, I employ the following specification:

$$\begin{aligned}\widehat{WG}_{jt} &= \beta_0 + \beta_1 \ln \widehat{MA}_{jt-1} + \beta_2 \ln C_{j0} \ln \widehat{MA}_{jt-1} \\ &\quad + \beta_3 \ln \widehat{CA}_{jt-1} + \beta_4 \ln C_{j0} \ln \widehat{CA}_{jt-1} + \theta_t + \mu_j + \epsilon_{jt} \qquad (12)\end{aligned}$$

where $\widehat{WG}_{jt}$ is the estimated adjusted gender wage gap at time t.[20] $\widehat{MA}_{jt-1}$ captures the profit opportunities in foreign market j at time $t-1$, $\widehat{CA}_{jt-1}$ captures foreign competitive pressure due to the entry of foreign products, C_{j0} is the level of concentration of sector j in the first period, θ_t is a vector of year fixed-effects, and μ_j is a vector of industry fixed-effects. The first-period level of sectoral concentration C_{j0} is picked up by the sector fixed-effects.

Gender wage gaps may vary across sectors for reasons that have nothing to do with competition. Sector fixed-effects net out any impact of time-invariant industry-specific factors such as social norms regarding female employment (which may be less accepted in machinery or oil industries than in textile and garment). The year fixed-effects capture shocks or policies affecting labour-market conditions equally across all manufacturing sectors. These include, for example, macroeconomic shocks such as the financial crisis in the early 2000s or government policies which influence female labour supply such as childcare or parental-leave reforms. The effect of trade openness is identified from within-industry changes. In some specification, I also control for past concentration levels $C_{j,t-1}$ to capture

[20] Given that the dependent variable is estimated for each year and sector in the first stage, the point estimates are affected by sampling variation. To correct for heteroscedasticity, I estimate this specification by weighted least squares, where the weights are the inverse of the standard errors from the estimation of the gender wage gaps.

differences in ability to discriminate across sectors with different market power. I also add the share of women in the sector FLS_{jt-1} to control for the effect of female concentration on female relative wages. Section 5.2 addresses further endogeneity concerns.

5 Empirical results

5.1 Market access, competitors acces and the gender wage gap

Table 4 shows the results from the estimation of equation (12) for the period 1983-2003. Columns (1) to (4) show the results with MA and CA computed on for all Uruguayan trade partners, while columns (5) to (8) show results with MA and CA computed on the set of Mercosur members only (Argentina, Brazil, Paraguay and Uruguay). Columns (4) and (8) additionally account for the sector concentration level $lnC_{j,t-1}$ and the sector female labour share $lnFLS_{j,t-1}$.

In columns (1),(2), (5) and (6) the wage gap is explained by either CA or MA. However, all sectors exhibit two-way trade within Mercosur, firms in the same sector enjoyed new market opportunities and, at the same time, had to deal with new product entry from their trade partners. As the two phenomena have opposing effects on the ability to discriminate, I also control for both in the same regression.

The effect of foreign competition $lnCA_{j,t-1}$ is associated with a higher adjusted wage gap in non-concentrated sectors. The point estimate here reveals the impact of competitors' access in sectors with an initial Herfindahl index of zero (i.e. sectors with a very large number of firms), which does not correspond to the oligopolistic framework developed in the model. The model developed in Section 2 cannot explain why a jump in the entry of foreign goods would be positively associated with the wage gap in sectors with a large number of firms.[21]

[21] A similar result pertains in Black and Brainerd (2004) in their regression of the gender wage gap on

Table 4: Market Access and the Gender Wage Gap.

1983-2003

	Dependent variable: Adjusted wage gap							
	All trade partners				Mercosur trade partners			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\ln CA_{j,t-1}$	0.790*		1.344***	1.559***	0.970**		0.911***	0.953***
	(0.338)		(0.264)	(0.214)	(0.294)		(0.187)	(0.197)
$\ln CA_{j,t-1} \times \ln C_0$	-0.218*		-0.365***	-0.428***	-0.272**		-0.246***	-0.260***
	(0.099)		(0.074)	(0.058)	(0.083)		(0.051)	(0.056)
$\ln MA_{j,t-1}$		-0.420*	-0.796***	-0.776***		-0.498***	-0.337*	-0.289*
		(0.163)	(0.088)	(0.130)		(0.089)	(0.123)	(0.109)
$\ln MA_{j,t-1} \times \ln C_0$		0.122*	0.205***	0.199***		0.141**	0.077	0.066
		(0.055)	(0.023)	(0.030)		(0.031)	(0.047)	(0.042)
$\ln C_{j,t-1}$				0.164***				0.114**
				(0.029)				(0.036)
$\ln FLS_{j,t-1}$				0.148				0.089
				(0.110)				(0.160)
Observations	96	96	96	96	96	96	96	96
R-squared	0.222	0.177	0.303	0.363	0.262	0.216	0.315	0.343

Note: All regressions include year and 2-digit sector fixed-effects. Weighted least squares regressions where the weights equal the inverse of the standard errors in the gender wage gap estimation. C_0 is the average value of the Herfindahl index for 1983-1985. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

Table 5: Market Access and the Gender Wage Gap.

1991-2003

	Dependent variable: Adjusted wage gap							
	All trade partners				Mercosur trade partners			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\ln CA_{j,t-1}$	0.768***		1.567**	1.453***	0.866***		1.326**	1.284***
	(0.156)		(0.426)	(0.300)	(0.158)		(0.294)	(0.241)
$\ln CA_{j,t-1} \times \ln C_0$	-0.236***		-0.474**	-0.443**	-0.263***		-0.401**	-0.393***
	(0.049)		(0.138)	(0.099)	(0.048)		(0.097)	(0.076)
$\ln MA_{j,t-1}$		-0.010	-0.845**	-0.880**		-0.180	-0.619**	-0.701***
		(0.104)	(0.279)	(0.211)		(0.130)	(0.191)	(0.138)
$\ln MA_{j,t-1} \times \ln C_0$		-0.003	0.248*	0.263**		0.048	0.182*	0.212**
		(0.029)	(0.093)	(0.075)		(0.041)	(0.067)	(0.049)
$\ln C_{j,t-1}$				0.089				0.076
				(0.057)				(0.067)
$\ln FLS_{j,t-1}$				-0.081				-0.122
				(0.159)				(0.159)
Observations	60	60	60	60	60	60	60	60
R-squared	0.320	0.272	0.391	0.418	0.341	0.284	0.420	0.442

Note: All regressions include year and 2-digit sector fixed-effects. Weighted least squares regressions where the weights equal the inverse of the standard errors in the gender wage gap estimation. C_0 is the average value of the Herfindahl index for 1990-1991. Standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1

The main coefficient of interest for the test of taste discrimination is the interaction of foreign competition (CA) with domestic concentration. This interaction $lnCA_{j,t-1} \times lnC_{j,0}$ consistently attracts a negative estimated coefficient: in concentrated sectors, the wage gap falls as firms face new competitive forces due to the easier entry of foreign products. This effect can be interpreted as the result of less market power, which employers previously used to discriminate against women.

I now turn to the effect of export potential, measured here by Uruguayan firms' access to foreign markets (MA). The negative and significant coefficient on $lnMA_{j,t-1}$ reveals that in sectors with low concentration, export potential does not translate into a greater ability

import penetration.

to discriminate but on the contrary help reduce the gender wage gap. This is consistent with the model prediction on the effect of trade integration in sectors with a large number of firms prior liberalisation. Only the most-productive non-discriminatory firms export. The expansion of those firms make it harder for discriminatory firms to break even in their own domestic market, which explains the lower gender wage gap.

Second, the positive and significant coefficient on $lnMA\_j, t-1 \times lnC_{j,0}$ reveals that, in concentrated sectors, better sales opportunities abroad increase the adjusted wage gap. Here the "extensive-margin effect" dominates: less-productive discriminatory firms can now enter foreign markets and earn profits abroad that discriminatory employers may use to pay men a premium.

5.2 Alternative channels and identification threats

In this section, I explore alternative channels that may be driving the results. Note that any alternative story would have to explain i) the fall in the gender wage gap in concentrated sectors with an increase in competitors access to the Uruguayan market, ii) the fall in the gender wage gap in competitive sectors with an increase in export potentials and iii) the increase in the gender wage gap in concentrated sectors with an increase in export potentials.

It is possible that trade liberalisation affects the returns to unobserved skills such as the field of study or foreign language skills. Unobserved skills may affect the gender wage gap and be correlated with trade liberalisation. However, the change in returns to those skills with trade integration should not depend on the level of production concentration of a sector. Unobserved skills are thus unlikely to drive the results. Even so, to account for the potential differences in male and female unobserved skills across sectors I adopt an approach used by Glaeser and Maré (2001) and Fallah et al. (2011) who argue that unmeasured ability is highly correlated with measured ability such as occupation and educational attainment. I control for the average female skill shares ($\text{FSLS}_{j,t-1}$) and male skill shares ($\text{MSLS}_{j,t-1}$) at the sector level as well as the female and male shares of skilled white collars at the sector level ($\text{FWC}_{j,t-1}$ and $\text{MWC}_{j,t-1}$). When I include these controls to the benchmark model in columns (1), (2), (5) and (6) of Table 6, the coefficients of market potential and its interaction with concentration are only moderately affected, which adds confidence that gender differences in unobserved skills correlated with trade integration are not driving the results.

If certain skills are unobserved to the econometrician, some skills are also unobserved by the employer, creating scope for an alternative source of gender wage gap: statistical discrimination. In statistical discrimination models, employers are imperfectly informed about some characteristics of the individuals that are relevant for their productivity. The absence of perfect knowledge motivates employers to use group statistics as proxies of these unobserved characteristics. Uncertainty about labour market attachment is the most common source of gender discrimination as women work on average fewer hours than men and are more likely to interrupt their participation to the labour market. In fact, Goldin (2014) documents that the gender wage gap tends to be largest in jobs where the returns associated with working long hours are the biggest. Many models of have shown that trade liberalisation increases the demand for skills but what about unobserved characteristics that strongly differs across gender? In a statistical discrimination setting, Ben Yahmed (2012) shows that trade liberalisation can increase the gender wage gap among skilled workers in tradable sectors if job commitment, as well as skills, are complement to technological upgrading. However, this mechanism would not explain why the effect of trade liberalisation differs across concentrated *vs.* non-concentrated sectors. Still, I

Table 6: Market Access and the Gender Wage Gap.

	Dependent variable: Adjusted wage gap							
	1983-2013				1991-2013			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
$\ln CA_{j,t-1}$	1.537***	1.567***	1.569***	1.501***	1.555**	1.539**	1.527***	1.483**
	(0.212)	(0.224)	(0.208)	(0.191)	(0.347)	(0.376)	(0.331)	(0.369)
$\ln CA_{j,t-1} \times \ln C_0$	-0.420***	-0.429***	-0.430***	-0.408***	-0.474**	-0.469**	-0.466**	-0.452**
	(0.058)	(0.062)	(0.058)	(0.051)	(0.111)	(0.122)	(0.108)	(0.121)
$\ln MA_{j,t-1}$	-0.719***	-0.773***	-0.770***	-0.664**	-0.962**	-0.954**	-0.933**	-0.912**
	(0.110)	(0.127)	(0.149)	(0.229)	(0.295)	(0.284)	(0.221)	(0.292)
$\ln MA_{j,t-1} \times \ln C_0$	0.179***	0.195***	0.197***	0.160*	0.288**	0.286**	0.280**	0.274*
	(0.025)	(0.032)	(0.036)	(0.068)	(0.096)	(0.094)	(0.077)	(0.100)
$\ln C_{j,t-1}$	0.179**	0.178***	0.159***	0.131**	0.101	0.099*	0.083	0.081
	(0.039)	(0.036)	(0.027)	(0.029)	(0.050)	(0.043)	(0.061)	(0.051)
$\ln FLS_{j,t-1}$	0.154	0.154	0.117	0.131	-0.079	-0.082	-0.101	-0.110
	(0.127)	(0.124)	(0.114)	(0.090)	(0.175)	(0.180)	(0.166)	(0.185)
$\ln MSLS_{j,t-1}$	0.112				0.075			
	(0.073)				(0.086)			
$\ln FSLS_{j,t-1}$	-0.050				0.006			
	(0.029)				(0.051)			
$\ln FWCS_{j,t-1}$		-0.181				0.096		
		(0.314)				(0.426)		
$\ln MWCS_{j,t-1}$		0.116				0.075		
		(0.068)				(0.087)		
Male overwork$_{j,t-1}$			0.271				0.183	
			(0.301)				(0.362)	
Min wage$_{j,t-1}$				0.897				-0.262
				(0.952)				(0.697)
$\ln FLS \times$ Min wage$_{j,t-1}$				-0.545				0.695
				(0.774)				(0.996)
Observations	96	96	96	96	60	60	60	60
R-squared	0.378	0.374	0.366	0.378	0.426	0.428	0.420	0.419

All regressions include year and 2-digit sector fixed-effects. Weighted least squares regressions where the weights equal the inverse of the standard errors in the gender wage gap estimation. C_0 is the average value of the Herfindahl index for 1983-1985 in columns (1) to (4) and for 1990-1991 in columns (5) to (8). Standard errors in parentheses. *** $p<0.01$, ** $p<0.05$, * $p<0.1$

control for the sector-specific share of male workers working more than 45 hours a week to capture sectoral differences in the probability to discriminate because of the use of overtime and lower working hours among women *on average*. Note that overall increase in female labour market attachment over the 1990s that would be correlated with Uruguayan trade liberalisation is netted out be year fixed-effects. Columns (3) and (7) in Table 6 show that a higher share of male employees working long hours in a sector is positively correlated with the gender wage gap in that sector although not significantly so. The effect of market access does not change. Further interactions of the share of overtime with market access measures are not significant and do not affect the coefficients of the main variables of interest.

Finally, institutional factors can shape the distribution of female and male wages in different ways. In particular, minimum wages can reduce the gender wage gap at the bottom of the wage distribution as women are more likely to receive lower pay compared to men. Given that sectors have different shares of workers affected by minimum wage regulation, and that the minimum wage changes over time, the effect of the minimum wage on the gender wage gap could be correlated with changes in sectors' market potentials. Columns (4) and (8) Table 6 control for the share of employees earning the hourly minimum wage at the sector level and its interaction with the female labour share of the sector. Again, the effects of market access and competitors access, and how they depend on the level of concentration of a sector, are robust to the addition of these controls.

6 Conclusion

This paper has developed a model of wage discrimination with intra-industry trade to highlight the possible channels through which trade openness affects the wage gap resulting from employers' prejudice against women. As far as I know, this is the first theoretical model where both the wage gap and the patterns of trade are endogenously determined. The model formalises the pro-competitive effect of trade on the wage gap, but also highlights the potential profit-enhancing effect of trade openness on the gender wage gap, and by doing so explains otherwise puzzling results.

Trade openness can have more than one effect on the ability to discriminate. First, trade liberalisation makes it easier for foreign firms to enter the domestic market, yielding tougher foreign competition at home. This drives down oligopoly profits, reduces production by high-cost discriminatory firms, and may even force them to close down. This selection of firms reduces the gender wage gap.

Second, the liberalisation of trade partners' markets can have two opposite effects. If domestic firms have a competitive advantage over foreign firms, and competition among domestic firms is not too fierce, trade liberalisation enables less-productive firms to enter foreign markets by reducing the cost of exporting. This boosts domestic firms' rents instead of exerting a pro-competitive effect. In other words, trade liberalisation makes it easier for prejudiced employers to employ and pay workers according to their preferences. This market-size effect dominates if the number of competitors is small enough. However, if discriminatory firms are not able to sustain their cost disadvantage abroad, better export opportunities benefit only the most-productive domestic firms which increase their demand for female labour, and thus reduce the wage gap. This selection effect dominates when the number of firms is large enough.

To provide some empirical evidence for these mechanisms, I take advantage of the considerable liberalisation that took place in Uruguay following the creation of Mercosur in 1991, and its consolidation in 1995. Uruguay is an interesting country for which to explore the impact of market access, as it is a small economy which is less likely to influence the outcome of trade-agreement negotiations. This ensures the exogeneity of changes in trade policies with respect to domestic-industry characteristics. To provide a measure of the pattern of competitive advantage between trade partners, I compute market-access variables that are exogenous to local characteristics and are closer to the theory compared to trade shares.

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

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Appendix

A Conditions for an interior solution for firm production levels

The output of firm i depends on c_i its own cost, N the number of competitors, $\tilde{c}_{-i}$ the average cost of its competitors and b the size of demand :

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

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

A.1 The Closed-Economy Case

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

$$q_m > 0 \Leftrightarrow b > w_f + d^* + \frac{N_f d^*}{2}$$

where $d^* = d_{N_f} \frac{\bar{d}}{N-1}$ and $N_f \frac{d^*}{2}$ is the cost disadvantage of discriminatory firms (that hire men) compared to non-discriminatory firms (tose that hire women). High wage gaps are sustainable in markets with large enough demand. The greater the number of firms, the higher the demand b needed for discriminatory firms to sustain their cost disadvantage.

If all women are hired by the non-prejudiced employer, there is no cost difference between male and female firms, $d^* = 0$ and $w_f = w_m = w$. All firms produce the same amount $q = \frac{b-w}{N+1}$ and an interior solution requires that demand be large enough:

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

A.2 The Open-Economy Case

In the open-economy setting, domestic firms can either produce locally and export to foreign markets, produce only for the domestic market, or cease production altogether. Given the separation of markets, I examine all posible situations sequentially.

Are discriminatory firms able to export?

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

with $\tau_F N_f \frac{d^*}{2}$ being the cost disadvantage of domestic discriminatory compared to non-discriminatory firms, and $\tau_F(w_f + d^*) - c_F$ the cost difference between domestic discriminatory and foreign firms.

If discriminatory firms have a susbtantial competitive advantage over foreign firms $c_F > \tau_F(w_f + d^*) + S$, they are then able to export to F. $\tau_F(w_f + d^*)$ here represents the production cost to export and $S = \frac{\tau_F}{N_F}(w_f + d^*(1 + \frac{N_f}{2}))$ reflects the cost disadvantage generated by discrimination. Discriminatory firms need to compensate for their higher costs compared to non-discriminatory domestic firms that export to the foreign market.

If discriminatory firms do not have a competitive advantage, they are able to export to market F only if few foreign firms N_F operate in the destination market F. If $\tau_F(w_f + d^*) + S > c_F$, then $q_{mDF} > 0$ if $N_F < \frac{b_F - \tau_F(w_f + d^*(1 + \frac{N_f}{2}))}{\tau_F(w_f + d^*) - c_F}$

Are non-discriminatory domestic firms able to export?

If discriminatory firms are not competitive enough and foreign firms N_F are too numerous, the former do not export. We then need to see whether non-discriminatory firms are able to enter the foreign market. Non-discriminatory firms employ women but can be prejudiced against women; this situation takes place whenever there is a positive wage gap at home, and the discrepancy between male and female wages compensates the employer for the discomfort of hiring women. The following condition thus depends on the prejudice of each specific firm. For every firm i with $d_i < d^*$:

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

A firm with female employees and an employer of prejudice d_i exports if $c_F > \tau_F(w_f + d_i) + S_i$, with $S_i = \frac{\tau_F}{N_F}(w_f + d_i - d^*(N_D + \frac{N_f}{2}))$. The rationale behind the condition remains the same: higher demand b_F in market F makes it easier for domestic firms to export; the cost advantage of domestic firms has to compensate for transport costs and the impact of their prejudice d_i. Note that having positive exports is easier for less-prejudiced firms as they perceive that they bear lower labour costs and are ready to hire more women: we can see this as S_i falls in d_i.

If $c_F < \tau_F(w + d_i) + S_i$, then $q_{iDF} > 0 \Leftrightarrow N_F < \frac{b_F - \tau_F(w+d_i) + d^*(N_D + \frac{N_f}{2})}{\tau_F(w+d_i) - c_F}$
A smaller number of competitors compensates for the absence of a strong competitive advantage over foreign firms.

Are discriminatory firms able to sell on the domestic market?

Discriminatory firms able to sell on the domestic market if:

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

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

The Homogeneous-Firm Case

I consider the case where there is no cost difference between male-type and female-type firms, $w_f=w_m=w$ **Are domestic firms able to export?**
Domestic firms' exports are $q_{DF}=\frac{b_F-\tau_F w+N_F(c_F-\tau_F w)}{N+1}$. They are positive if $N_F<\frac{b_F-\tau_F w}{\tau_F w-c_F}$. Greater demand in market F makes it easier for domestic firms to export. On the other hand, more foreign competitors makes it harder.

Are domestic firms able to sell on their market?
Sales at home are $q_{DD}=\frac{b-w+N_F(\tau_D c_F-w)}{N+1}$ and they are positive if $N_F<\frac{b-w}{w-\tau_D c_F}$.

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

The wage gap d^* is defined by $d=F(d)$. To make sure this equation has a solution, we need to define the conditions under which the function F crosses the 45° line. As F falls in d, we thus have to show that $F(0)>0$ and $F(\bar{d})<\bar{d}$.
First, $F(0)=2(L_f-\frac{L_m}{(N-1)})$ so that $F(0)>0$ if $L_f>\frac{L_m}{N-1}$. Second, $F(\bar{d})<0$ so that $F(\bar{d})<\bar{d}$ for all d. Moreover F is strictly decreasing, $F'(d)<0$, which implies that $F(d)$ crosses the 45° line only once. Hence d^* is unique.
To sum up, $d=F(d)$ has a unique solution if $L_f>\frac{L_m}{N-1}$, which requires that the female labour force is not employed by one firm only. If $L_f\leq\frac{L_m}{N-1}$, the equilibrium wage gap

equals the prejudice level of the least-prejudiced employer which is zero in this version of the model.