Trade and Labor Market Segregation in Colombia

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Abstract

Gary Becker's theory of discrimination argues that increasing competition will reduce discrimination by reallocating market share to less discriminatory firms. We develop a simple model in which increased competition can also affect discrimination by affecting firm-level hiring decisions. We use the 1984–91 Colombian trade liberalization episode to investigate this claim on plant-level data in two ways. First, we examine whether increased foreign competition disproportionately drove discriminating plants from the market. Second, we investigate whether trade liberalization affected discrimination by making firms more likely to hire women.

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1 Introduction

There is significant interest on the issue of gender equality in development economics. Partly this reflects long-standing research showing strong correlations between female earnings and childhood outcomes, especially with regard to education and health (e.g., see Thomas (1990), Duflo (2003) and Qian (2008)), suggesting a link between gender equality and long-run development. Since many developing countries have undergone significant opening to trade in the past several decades, this leads us to the question of how trade liberalization has affected the labor market for female workers. Specifically, we are interested in whether trade liberalization (and increased foreign competition) has a differential impact on female labor by reducing employment discrimination as in Gary Becker's (1957) canonical model.

This paper makes three main contributions to the large literature on the link between trade and gender inequality. First, the Becker model of competition and discrimination argues that firms that have a "taste for discrimination" (i.e., place a negative valuation on hiring women) tend to have higher costs and thus lower profits than their less discriminating counterparts. To the extent that capital investment only flows to more profitable, non-discriminating firms, competition will, in the long run, result in the expansion of non-discriminating firms and the eventual exit of discriminating firms. Thus, competition reduces *industry-level* discrimination by reallocating market shares across firms. However, it is noteworthy that the Becker framework provides no mechanism by which a marginal change in competition would affect *firm-level* discriminatory behavior. Specifically, in the Becker model, firm-level hiring decisions are a function of preferences (the disutility of hiring female workers), technology (the marginal rate of substitution between male and female workers) and wages (the wage differential). A marginal change in market competition does not directly affect any of these, and so it would not be predicted to affect firm-level hiring decisions. However, as we show in a brief theoretical section, competition, including increased foreign competition, can potentially reduce firm-level discrimination in the short run by increasing the marginal cost of discriminating behavior. That is, firms that perceive a tradeoff between profits and the female share of their workforce could potentially respond to increased competition by hiring more women. Intuitively, to the extent that increased competition results in an increase in the elasticity of demand for a firm's products, such competition will also result in an increased cost

to firm-level discriminatory behavior since the higher costs resulting from discrimination will result in a greater loss in market share. Thus, we provide a theoretical mechanism by which competition can not only reduce discrimination through traditional selection effects (e.g., by forcing discriminating firms from the market), but can also reduce *firm-level* discriminatory behavior by influencing firm-level hiring decisions.

Second, previous studies of employment in developing countries have typically found that women are concentrated in the export-oriented industries of the manufacturing sector such as textiles and food products (e.g., Catagay and Berik (1991) and Ozler (2000)).[1] Given that our theoretical framework suggests that competition can influence *firm-level* discriminatory behavior, it seems that since exporting firms face more competition than firms that produce only for the domestic market, exporters should discriminate less than non-exporters. However, it is difficult to determine if female concentration in export industries is due to the exporting nature of those industries, or to some unobserved industry characteristics. In this paper we investigate whether women are more likely to be employed in exporting *firms* within an industry. Using Colombian manufacturing data we find that this is the case: the female share of employment is higher among exporting firms, and is increasing in the amount of exporting done by a firm.

Finally, in contrast to previous studies, we use plant-level data to directly examine the impact of changes in foreign competition on firm selection and hiring decisions. Previous research on the gender-specific affects of trade on the labor market have relied, almost exclusively, on household- or individual-level data (e.g., see Berik, Rodgers, and Zveglich (2004), Black and Brainerd (2004), Hazarika and Otero (2004), Menon and Rodgers (2009), Gaddis and Pieters (2017), Keller and Utar (2022) and Benguria and Ederington (2023)). The main focus of these papers is to estimate the effect of increased trade competition on gender-specific wages (at either regional or sectoral levels) or labor market outcomes (e.g., labor force participation).[2] However, the primary implication

[1] Although Ozler (2000) has plant-level data from Turkey, the data do not include the export status of the plant. She shows that the female share of labor tends to be higher in plants that are in industries that export more of their output. Our data allow us to directly link the female share of labor in a plant with the export status of that plant.

[2] An exception of a paper that uses a more firm-level approach is Bølen, Javorcik, and Ulltveit-Moe (2018) which utilizes matched employer-employee data from the Norwegian manufacturing sector to exhibit a higher gender wage gap among exporting firms. They argue this is due to exporting firms requiring more employee flexibility.

of the Becker model concerns the effect of competition on industry hiring: increases in competition in a sector leading to the growth of less discriminatory firms which proportionally hire more women. The impact on relative wages or labor force participation occurs only indirectly through the relative growth in demand for female workers, and need not occur at all if there are a sufficient number of nondiscriminatory employers. Thus, our use of plant-level data allows us to more directly investigate Becker-type impacts of trade, and also differentiate between two mechanisms through which competition may reduce discrimination: the traditional Becker mechanism of reallocating market shares across firms, and our proposed mechanism (see Section 2) of firm-level hiring decisions. Specifically, we can measure the extent to which increased foreign competition induces discriminating plants (i.e., plants with low female shares) to exit relative to the extent to which it induces all plants to increase the female share of their labor force. Our primary conclusion is that increased competition (in the form of exogenous trade liberalization) reduced discrimination primarily by affecting the hiring practices of firms. That is, we find that firms in industries that faced the greatest reductions in tariff protection increased the female share of their workforce more than firms in industries that saw little or no reduction in tariffs. In contrast, we find little evidence that trade liberalization drove discriminating firms from the market.

In this paper, we exploit a natural experiment: the Colombian trade liberalization episode of 1984. Starting in 1985, and following its entry into the GATT/WTO, Colombia undertook major unilateral trade liberalization of its manufacturing sector. This liberalization entailed both a reduction in the average level of protection, but also a collapsing of the distribution of protection as Colombia moved to a more uniform tariff structure. In this paper, we exploit this cross-sectional variation in tariff reductions to see if a greater increase in foreign competition (i.e., a larger tariff reduction) resulted in less gender discrimination across Colombian firms. Both of these differences enable us to more directly examine the implications of the Becker model.

The most related research in the literature is a sequence of papers (Aguayo-Tellez, Airola, and Juhn (2013), Juhn, Ujhelyi, and Villegas-Sanchez (2013) and Juhn, Ujhelyi, and Villegas-Sanchez (2014)) that argue that access to export markets might induce firms to acquire new technologies that are more complementary to female labor. As evidence for their channel, they use the North American Free Trade Agreement (NAFTA)

to demonstrate how tariff reductions induced both firm investment and improved female labor market outcomes (in terms of both labor share and earnings). Clearly, our mechanism (decreased discrimination) and theirs (technology upgrading) are not mutually exclusive,[3] but there are important differences. First, they utilize a Melitz (2003)/Bustos (2011) export-pull type model in which firm dynamics are driven by the export side (i.e., it is increased access to foreign markets that induces firm selection effects and technology upgrading). Thus, their empirics concentrate on bilateral trade agreements and how reductions in U.S. tariffs affected the Mexican labor market.[4] In contrast, our model and empirics provide a channel through which an episode of unilateral trade liberalization (such as the Colombian experience) can differentially impact the female labor market. Second, our model provides a mechanism by which trade liberalization can reduce gender inequality even in the absence of "technology upgrading." Thus, in Section 4, we show that exporting firms hire a larger percentage of women employees, even after controlling for a range of firm-level characteristics and in Section 6, we show that domestic tariff reductions increase the female labor share, even after controlling for changes in firm inputs. Thus, we see our mechanism (decreased discrimination) as working in concert with technology upgrading to explain how trade liberalization might impact female labor market outcomes.

In what follows, Section 2 provides a model of how increased trade competition can influence firm-level hiring decisions by firms with a "taste for discrimination". In Section 3 we discuss the data and the Colombian trade liberalization episode, and then, in Section 4 we look at the relative female shares of exporting and non-exporting firms. In Section 5 we utilize the Colombian trade liberalization to investigate the impacts of increased foreign competition on firm selection and in Section 6 we look at firm-level hiring. Finally, in Section 7 we conclude.

[3]Nor are they the only possible mechanisms; for example, Keller and Utar (2022) show, using individual-level data from Denmark, that women were more likely than men to leave the formal labor market for family reasons in response to increased imports from China, and Bølen et al. (2018) argue that exporting firms might be biased against female workers since they require more commitment and flexibility from employees in order to work with firms in other time zones.

[4]Juhn et al. (2013, 2014) do control for changes in Mexican tariffs but do not get statistically significant results.

2 Gender Discrimination: Theory

In this section we present a model of competition and gender discrimination. We follow Becker (1957) and Arrow (1973) in assuming that firms are not strictly profit maximizers but rather maximize a utility function that evidences a tradeoff between profits and the number of male and female employees. However, in contrast to Becker (1957) and Arrow (1973), we explicitly assume a monopolistically competitive environment that allows both discriminating and non-discriminating firms to coexist in equilibrium. The question of interest is the effect of an increase in competition on the equilibrium.

We assume an economy with two sectors: one sector consists of a numeraire good, x_0, while the other sector is characterized by differentiated products. The preferences of a representative consumer are defined by the following utility function:

$$U = x_0 + log\left[\int_0^n y(j)^\rho dj\right]^{1/\rho} \tag{1}$$

where x_0 is consumption of the numeraire good, $y(j)$ represents consumption of brand j of the differentiated product good and n represents the number of available varieties (firms) in the differentiated product sector. Note that we adopt a CES specification, which reflects tastes for variety in consumption and also imposes a constant (and equal) elasticity of substitution between every pair of goods. Indeed, it is straightforward to show that with these preferences, the elasticity of substitution between any two products is $\sigma = 1/(1-\rho) > 1$, and aggregate demand for brand i is given by:

$$y(i) = \frac{p(i)^{-\sigma} E}{\int_0^n p(j)^{1-\sigma} dj} \tag{2}$$

where $p(i)$ is the price of good i and E represents the total number of consumers in the country.

We assume that production of the differentiated product good requires a sequence of tasks to be performed (for example, in the automobile sector, one task might involve installing the brakes and another might be installing the windshield). This treatment of production is similar to that of Becker and Murphy (1992) and Kremer (1993). Rather than assuming a discrete set of tasks, it will be convenient to assume production is defined by the completion of a continuum of tasks along the unit interval. Letting t be the index for tasks and letting the cost of task t be given by $w(t)$, then the marginal cost

of producing a variety of the differentiated product good is given by:

$$c = \int_0^1 w(t)dt. \tag{3}$$

We assume that either a male employee can be hired to complete a task at cost w_m or a female employee can be hired at cost w_f where $w_m > w_f$ (thus, we assume that male and female employees are equally productive in producing the differentiated product, but that a wage differential exists in the economy).[5] Defining $z_i \in [0, 1]$ as the female share employed by firm i, the marginal costs of firm i are given by:

$$c_i = w_m - z_i(w_m - w_f). \tag{4}$$

It should be clear that, given the existence of a wage differential, a cost-minimizing firm will choose to hire only women (i.e., set $z_i = 1$). However, as discussed previously, we assume firms maximize a utility function that encompasses both profits and a "taste for discrimination," which we capture by assuming that the firm owner/manager derives extra disutility from hiring female workers, defined by $\phi_i(z_i)$. Note that we assume the Arrow version of Becker's model, in which firms care only about the fraction of their workforce that is female (i.e., firms care about z_i). Thus, firms choose price, p_i, and the female share of the labor-force, z_i, to maximize:

$$\max_{p_i, z_i} (p_i - c_i)y_i - \phi_i(z_i) \tag{5}$$

where $\phi_i'(z_i) > 0$ and $\phi_i''(z_i) > 0$. From the first-order condition with respect to p_i, one can derive that firms use a constant mark-up pricing rule where:

$$p_i = \frac{\sigma}{\sigma - 1} c_i \tag{6}$$

From the first-order condition with respect to z_i, one can derive that z_i is implicitly defined by:

[5]This wage differential is simply taken as exogenous in the differentiated product sector. It can be generated either by discrimination or by productivity differences in the numeraire product sector. For example, assuming each male employee can produce w_m units of the numeraire good and each female employee can produce w_f units of the numeraire good, production of the numeraire good in positive amounts would fix wages in the economy at w_m and w_f respectively.

$$\phi_i'(z_i) = \frac{\sigma - 1}{\sigma} \frac{(w_m - w_f)E[w_m - (w_m - w_f)z_i]^{-\sigma}}{\int_0^n (c_j)^{1-\sigma} dj}. \tag{7}$$

The left hand side of (7) represents the marginal cost to the firm of increasing the female share of its employees while the right hand side represents the marginal benefit (in lower costs of production). Firms will choose to employ men (i.e., $z_i < 1$) if and only if the marginal disutility of hiring women is sufficiently high (and outweighs the cost of the wage differential).[6]

There are two items to note about the above derivations. First, firms with the greatest "taste for discrimation" (i.e., with the highest values of $\phi_i'(z_i)$ for any z_i) will employ the lowest share of female workers (i.e., choose the lowest z_i). As in Becker (1957) and Arrow (1973), the female share of the workforce will vary across firms, with more discriminating firms employing a lower share of women and less discriminating firms employing a higher share. In addition, the more discriminating firms, since they have higher marginal costs of production (i.e., higher c_i), will be less profitable than the less discriminating firms. As Becker (1957) and Arrow (1973) note, one would expect that, in a competitive environment, capital would flow to the more profitable (less discriminating firms), driving the more discriminating firms out of the market in the long run. Thus, the traditional theory of discrimination argues that competition reduces discrimination in the long run through a selection effect where only the most profitable (least discriminating) firms survive.

However, these derivations suggest a second mechanism through which competition can affect discrimination: by affecting firms' hiring decisions (i.e., by affecting the optimal choice of z_i). For expositional simplicity, assume that firms are symmetric and have identical utility functions (i.e., $z_i = z$ in equilibrium). In this case, the first-order condition (7) reduces to:

$$\phi_i'(z_i) = \frac{\sigma - 1}{\sigma} \frac{(w_m - w_f)E}{[w_m - (w_m - w_f)z]n} \tag{8}$$

Now assume there is an exogenous increase in competition captured by an increase in the elasticity of substitution, σ (note that as $\sigma \to \infty$, the CES preferences take the linear

[6]There also exists a second-order condition on $\phi_i''(z_i)$, which we assume is satisfied, that ensures an interior solution.

form: the goods become perfect substitutes and the market mimics perfect competition). Taking a derivative of the right hand side of (8) with respect to σ one derives that:

$$\frac{\partial RHS}{\partial \sigma} = \frac{1}{\sigma^2} \frac{(w_m - w_f)E}{[w_m - (w_m - w_f)z]n} > 0 \tag{9}$$

An increase in competition will increase the marginal benefit of employing more women, increasing the female share of a firm's workforce (i.e., increasing z_i). This negative impact of competition on discrimination is due to an elasticity effect: firms that face a more elastic demand for their product will incur a higher cost to discriminating behavior, as the resulting increase in costs and prices causes a correspondingly greater loss of market share. To the extent that greater competition increases the elasticity of demand for a firm's product, such competition will increase the cost of discriminating behavior resulting in the hiring of more female employees.

However, one could also think of an increase in competition as an exogenous increase in the number of firms in the market (perhaps due to a decline in entry costs). Taking a derivative of the right hand side of (8) with respect to n (and holding σ constant) yields:

$$\frac{\partial RHS}{\partial n} = \frac{1 - \sigma}{\sigma n^2} \frac{(w_m - w_f)E}{[w_m - (w_m - w_f)z]} < 0 \tag{10}$$

In this case, an increase in competition (modeled as an exogenous increase in the number of firms), decreases the marginal benefit of hiring women and so decreases the share of female employees (increasing gender discrimination). This positive effect of competition on discrimination is due to a scale effect: larger firms suffer a greater cost to discriminating behavior since the increased marginal costs of production resulting from such behavior affect a larger volume of production. To the extent that greater competition reduces firm size, it might reduce the costs of discrimination and result in the hiring of more male employees. Differentiating between these different types of increases in competition is, to our knowledge, a unique feature of our model.

To summarize, the overall effect of competition on discrimination reflects a combination of elasticity and scale effects. Note that the force of these effects depends partially on the degree of existing competition in the market. For example, it is direct to derive from the above calculation that the elasticity effect is decreasing in σ (see equation (9)) and the scale effect is increasing in σ (see equation (10)). Thus, in industries that are already sufficiently non-competitive (i.e., have a sufficiently small σ), the elasticity effect

will tend to dominate, and competition should reduce the degree of gender discrimination. This might not be the case in industries that are sufficiently competitive (i.e., have a sufficiently large σ), where the scale effect will tend to dominate. In other words, the impact of competition on hiring decisions and the degree of gender discrimination could be a function of the existing degree of competition in the industry.[7] Some empirical evidence for this conditional result can be found in Black and Brainerd (2004), in which the impact of trade volume on gender wage differentials depends on the degree of concentration of the industry. While we do not have industry-level data on elasticity, we do control for changes in firm size in Section 6.

The implications of our theoretical model for empirical work on discrimination are clear. First, our model suggests that increased competition reduces firm-level discriminatory behavior *to the extent that it increases the elasticity of demand* for a firm's products. In the empirics that follow, we consider an episode of significant trade liberalization as a proxy for increased competition. Krugman (1979) shows that, under reasonable parameter assumptions, one of the pro-competitive aspects of international trade is that it increases the elasticity of demand faced by firms.[8] Second, our model suggests that competition does not simply affect industry-level discrimination by reallocating market shares across firms, but can also affect firm-level discriminatory behavior. Thus, in our empirics, we use plant-level data to investigate whether increased foreign competition does in fact affect plant-level hiring decisions.

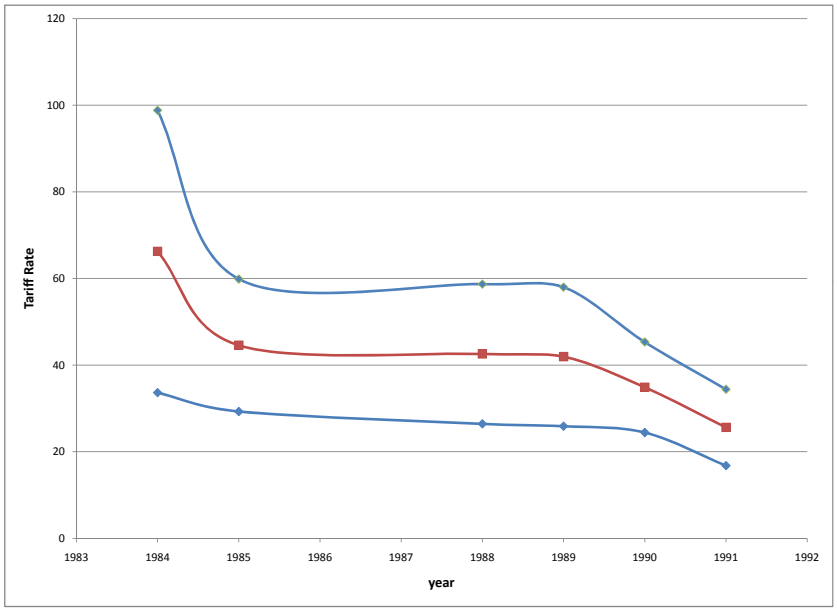
3 Data: Colombian Trade Liberalization

In this paper we use plant-level panel data from Colombia to examine the prediction of the Becker model that changes in the level of competition reduces discrimination in the labor market. Like many developing countries, Colombia followed a policy of import substitution in the 1950s and 1960s. In the 1970s, this policy was reconsidered as Colombia sought entry into the GATT. Starting in 1985 and culminating in 1991,

[7]Both the scale and elasticity effects are decreasing as one increases the number of firms, n, in the market.

[8]Krugman (1979) models a monopolistically competitive industry as we do in this paper. Similarly, Markusen (1981) shows that trade can increase the "perceived" elasticity of demand in oligopolistic industries.

Figure 1: Mean Tariff ± 1 Standard Deviation by Year



Colombia systematically lowered its trade barriers with the aim of creating a relatively uniform structure of protection comparable to those in developed countries. Since high tariffs shield domestic producers from competitive pressures from producers in other countries, we treat changes in tariffs as changes in the level of competition faced by firms in Colombia.

This episode of trade liberalization has been extensively studied in the international trade literature since several of its features make it attractive from an empirical standpoint.[9] First, prior to liberalization, Colombia had relied primarily on tariffs as a means of trade protection and so the decline in tariffs was significant (the average tariff reduction was 31.4 percentage points between 1984 and 1991), and also provides an accurate measure of the overall change in trade policy.[10] Second, the Colombian trade liberal-

[9] A partial list of papers that have studied Colombia's trade liberalization includes Roberts and Tybout (1997), Fernandes (2007), Goldberg and Pavcnik (2005), Brooks (2006) and Goldberg and Pavcnik (2007).

[10] Unfortunately, while non-tariff barriers were also reduced as part of the reform, complete data on the reductions in such barriers is not available. However, as mentioned, tariffs were the primary policy

ization had a significant impact on the structure of protection, with some industries receiving extensive tariff cuts while other industries were not significantly affected. It is this variation in tariff reductions that we exploit in our empirics. Finally, the main policy objective of the Colombian government was to achieve uniformity in tariff levels across industries, and to make their tariff levels comparable to those of other WTO members as part of Colombia's entry into the GATT/WTO.[11] Thus, the Colombian tariff reductions were less susceptible to industry pressure or governmental preferences, and can be plausibly treated as exogenous (see Goldberg and Pavcnik (2003), Attanasio, Goldberg, and Pavcnik (2004) and Goldberg and Pavcnik (2007) on this point as well as for a more detailed description of the reforms). Evidence on both the decline in overall tariffs and the narrowing of tariff differences across sectors is provided in Figure 1, which shows the mean tariff, and the mean tariff plus and minus one standard deviation, by year across the plants in our sample. Note both the significant average decline, and the narrowing of the dispersion of tariffs.

All data come from a plant-level dataset produced from the Colombian Manufacturing census by DANE (National Statistical Institute) for the years 1977 through 1991.[12] This is an unbalanced panel covering industrial production in all 3-digit ISIC industries in Colombia. For each year, the survey has collected data on production, sales, inputs, inventories, exports and the industry code (4-digit ISIC) of each Colombian plant. It should be noted that plants with fewer than 10 employees are included in the census prior to 1982, but excluded after 1983 (although a small proportion are included following 1985). Our sample includes a total of 6,035 plants in 1984; 3,760 remain in the sample in 1991, which totals 6,972 plants.[13] The Colombian manufacturing industry is

instrument and the available data suggest that tariff levels (and changes) are positively correlated with NTB levels (and changes) across industries in our dataset. See Goldberg and Pavcnik (2005) for more details.

[11]Colombia entered the GATT in 1981, but used developing-country exemptions to avoid tariff reductions until the trade liberalization episode studied in this paper. For an overview of the evolution of trade policy in Colombia see Goldberg and Pavcnik (2005) and Fernandes (2007).

[12]We would like to thank Mark Roberts for making the Colombian manufacturing census data available to us. For a complete description of all the variables used in our estimation, see Appendix A, and see Roberts (1996) for a description of this dataset.

[13]In some of the analysis that follows, sample sizes are reduced due to missing data. In addition, we drop approximately 2% of the sample classified as "other" types of enterprise (cooperatives, collectives, etc.) in the analyses that follow.

Table 1: Summary Statistics

	1984	1991	Change
Variable	Mean (s.d.)	Mean (s.d.)	Mean (s.d.)
Female share, total	0.365 (0.286)	0.355 (0.265)	0.007 (0.145)
Female share, unskilled	0.341 (0.354)	0.314 (0.333)	-0.005 (0.164)
Female share, skilled	0.497 (0.301)	0.504 (0.269)	0.024 (0.261)
Exports	0.018 (0.101)	0.042 (0.151)	
Firm age	14.55 (12.23)		
Employment (log)	3.55 (1.02)	3.34 (1.15)	
Salary (log)	5.25 (0.43)	6.83 (0.46)	
Skill ratio	0.213 (0.168)	0.269 (0.213)	
Energy use (log)	2.67 (1.15)	4.65 (1.30)	
Productivity (log)	6.31 (0.80)	8.19 (0.93)	
Capital/labor (log)	4.94 (1.41)	6.58 (1.58)	
Office equipment	0.083 (0.111)	0.094 (0.128)	
Female management	0.202 (0.283)	0.237 (0.295)	
Corporation	0.170 (0.376)	0.174 (0.379)	
Proprietorship	0.139 (0.346)	0.123 (0.329)	
Partnership	0.691 (0.462)	0.703 (0.457)	
Tariff	0.662 (0.328)	0.257 (0.088)	-0.403 (0.269)
4-firm concentration	0.400 (0.192)		
Observations	6,035	6,972	3,760

Notes to Table: See Appendix A for variable definitions. Changes are the average of the changes for plants for which we have data in both 1984 and 1991.

characterized by relatively small-scale plants (70% of production is by plants employing fewer than 50 workers), and high levels of entry and exit (with average entry rates of 11% and exit rates of 10%).[14] However, the distribution of plants across industries is relatively constant over time, with the major industries being food, apparel, textiles, printing, and metal products. For measures of trade liberalization, we employ ad-valorem tariff levels at the 4-digit ISIC level from the Departamento Nacional de Planeación.[15]

Since we investigate discriminatory behavior at the firm level, we concentrate on the female share of workers in Colombian plants. Note that our analysis follows the conventional Becker treatment of discrimination in which male and female wages are set by the aggregate labor market, and individual firms take these wages (and the presumed wage differential) as given in making employment decisions. Thus, in this framework, discriminatory behavior is revealed by the more discriminatory firms being less willing to hire the (cheaper) female workers relative to an otherwise similar firm.

Table 1 presents summary statistics for our data. Most of our analysis concentrates on the change between 1984 and 1991, so Table 1 includes means for both years where applicable, as well as the mean change in the relevant variables. Some trends stand out: between 1984 and 1991, average tariffs dropped dramatically; exports (as a share of production) increased; and plants became more productive, used more energy, and paid higher wages.[16] There was virtually no change, however, in the average female share of total workers over this period, although the female share of skilled workers increased slightly.

Since we are examining the female share of workers in Colombian plants, it is worth briefly discussing female labor force participation in Columbia more generally. Colombia's female labor force participation was higher than that of most Latin American countries: in the early 1990s, it was 43%, approximately ten percentage points higher than the Latin American average. This is generally attributed to more widely available contraception in Colombia (between 1964 and 1994, fertility rates fell from 7.4 to 2.7 children per woman) and very high violent crime rates for men, leading to a high probability of widowhood.[17] In addition, between 1984 and 1991 female labor force participation rates rose fairly

[14] See Fernandes (2007).

[15] We would like to thank Jorge Garcia-Gracia at the World Bank for making these data available.

[16] All wages are measured in nominal dollars, so it is not surprising that wages rose over this period.

[17] "Women in Colombia Move to Job Forefront," *The New York Times*, July 15, 1994.

dramatically, particularly for younger women (see Arango and Posada (2005a, 2005b)). Female workers are, not surprisingly, concentrated in the apparel and textile industries; in 1984, the female share of workers in these (4-digit) industries was as high as 80%, relative to the overall average of 35%.

4 Exports and the Female Labor Share of Colombian Plants

As mentioned in the Introduction, one interpretation of exporting firms is that they face higher degrees of competition than non-exporting firms, because they compete in international markets. Thus, according to our model, one might expect exporters to discriminate less than non-exporters. Studies of employment in developing countries have typically found that women are concentrated in the export-oriented industries of the manufacturing sector (e.g., Catagay and Berik (1991) and Ozler (2000)), which typically includes the textile, garment, electronics, leather and agricultural processing industries. However, it is difficult to determine if this female concentration is due to the exporting nature of those industries, or simply to unobserved industry characteristics. Indeed, Catagay and Berik (1991) and Ozler (2000) also find that women in developing countries are typically employed in low-paying, low capital-intensity, small-scale firms, hardly the standard characteristics of exporting firms (see Roberts and Tybout (1997) for empirical evidence on the types of firms that export). While Ozler (2000) has plant-level data from Turkey on male and female employment, as well as some other plant-level characteristics, her measure of export status is the export intensity of the industry (her data do not include export status at the plant level). Our data allow us to investigate whether, in a given industry, women are more likely to be employed by exporting firms.

Table 2 provides the results of a set of regressions where we regress the plant's female share of labor on a variety of plant-level characteristics (as well as 4-digit ISIC industry fixed effects to control for industry-level characteristics and year dummies to control for year effects). The dependent variable in column 1 of Table 2 is the female share of total employment in the plant.[18] As explanatory variables, we include the age of the plant,

[18] All signs and significance levels are identical when we use the fractional logit model of Papke and Wooldridge (1996).

total employment in the plant (to proxy for size), and productivity of the plant (value added per employee). For this analysis, we use the full panel of firms from 1984 to 1991.[19] Given that existing literature suggests that women are concentrated in low-paying jobs, we include a measure of average wages of workers in the plant (the log of the total salary and wages of all workers in the plant divided by total employment in the plant). As additional explanatory variables, we include the energy share, capital share, skilled-labor share (skilled workers out of total employment) and office equipment share of the plant (as a measure of new technology used in the plant). Finally, the variable of interest is the export intensity of the plant (plant exports as percentage of total sales).[20]

Column 1 of Table 2 suggests that the more a plant exports, the higher its share of female employees. This is consistent with our hypothesis that firms facing more competition are less likely to discriminate: since exporting plants face more competition, we expect them to hire more women. This is particularly interesting because other factors correlated with a higher percentage of women employees — lower wages, lower capital intensity, lower energy intensity — are exactly opposite the typical description of exporting firms in developing countries (e.g., see Roberts and Tybout (1997)). Another potential explanation is that firms that hire more women are more efficient (in our model, non-discriminating firms can produce the same output at lower cost), and more efficient firms are more likely to select into exporting. See, for example, Bernard and Jensen (1995), Roberts and Tybout (1997), and Bernard, Eaton, Jensen, and Kortum (2003), who provide empirical evidence (from both developing and developed countries) that exporting is an activity primarily undertaken by successful firms. However, it is intriguing that the characteristics of plants that hire more women (in terms of wage, capital intensity and energy intensity) differ substantially from the standard characteristics of export-oriented firms.

The negative coefficient estimate on salary is consistent with our theoretical model, as well as standard models of discrimination in Becker (1957) and Arrow (1973), where the benefit of hiring female workers is precisely that a firm can pay them lower wages. These results are also consistent with work examining inter-firm segregation in the U.S. (e.g., Carrington and Troske (1998) and Hellerstein, Neumark, and Troske (2002)). However,

[19]We do not include plant-level fixed effects, since our interest is in the within-industry variation in female share as a function of exports.

[20]Results are comparable with a dummy variable indicating exporting firms.

Table 2: OLS: Which Firms are More Female?

	(1)	(2)	(3)
	Total	Unskilled	Skilled
Variable	$\hat{\beta}$ (s.e.)	$\hat{\beta}$ (s.e.)	$\hat{\beta}$ (s.e.)
Exports	0.090 (0.014)***	0.109 (0.019)***	-0.032 (0.016)**
Firm age	-0.0003 (0.000)*	-0.001 (0.0002)***	0.0003 (0.000)
Employment (log)	0.012 (0.002)***	0.031 (0.003)***	-0.071 (0.003)***
Salary (log)	-0.044 (0.005)***	-0.018 (0.006)***	-0.072 (0.008)***
Skill ratio	0.053 (0.009)***	-0.121 (0.014)***	-0.300 (0.015)***
Energy use (log)	-0.013 (0.002)***	-0.019 (0.002)***	-0.010 (0.003)***
Capital/labor (log)	-0.007 (0.001)***	-0.007 (0.002)***	-0.001 (0.002)
Productivity (log)	-0.005 (0.002)**	-0.006 (0.003)**	0.015 (0.003)***
Office equip	0.018 (0.014)	0.019 (0.019)	0.075 (0.021)***
Female mgnt	—	0.064 (0.007)***	0.014 (0.009)*
Corporation	-0.021 (0.005)***	-0.025 (0.007)***	0.010 (0.006)
Proprietorship	-0.018 (0.005)***	-0.033 (0.006)***	0.030 (0.009)***
Observations	53,497	52,228	49,065
Plants	10,933	10,798	10,144
Industries	96	96	95
R^2	0.648	0.651	0.218

Notes to Table: The dependent variable is the plant's female share of workers; annual data are pooled 1984-91. Time and industry fixed effects are included, and standard errors are clustered by plant. See Appendix A for data definitions and notes.

"Total" includes owners and managers, in addition to skilled and unskilled workers, in the calculation of the female share variable.

*** indicates statistical significance at the 99% level or better; ** at 95%; and * at 90%.

note that while establishments that employ more women tend to be less capital- and energy-intensive, they have, on average, higher stocks of office equipment (as a share of total capital). The positive coefficient on plant size is also consistent with our model, since large firms produce more output and therefore suffer larger losses by hiring men.

Since women tend to be concentrated in clerical occupations, which are classified as skilled workers in these data, in regressions 2 and 3 of Table 2, we present results when the dependent variable is the female share of unskilled and skilled labor, respectively. Note that regression 1 includes owners and managers, in addition to skilled and unskilled workers, so regression 1 is not simply an average of regressions 2 and 3.

In both regressions 2 and 3, we also add the female share of managers and owners as explanatory variables, since women managers and owners may have less taste for discrimination of female workers; this seems to be the case, since in both regressions, the coefficient estimate on female management share is positive and statistically significant (although the effect seems to be stronger for unskilled workers than for skilled workers). The results for the unskilled labor share (regression 2) are quite similar to the overall sample: the coefficient estimate on exports is quantitatively very similar, and remains highly statistically significant. The main change is that the coefficient estimate on the skill ratio is negative and statistically significant, suggesting that plants with proportionally fewer skilled workers tend to have higher female shares of unskilled workers. While this effect does not show up in regression 1 for the total female share, it fits with the finding that women are concentrated in firms that are less capital- and energy-intensive.

The results for the female share of skilled labor are also similar, with the notable exceptions of exports and size. Column 3 suggests that larger plants and plants that export more — although they hire proportionally more women overall, and proportionally more female unskilled workers — tend to have *lower* female shares of skilled workers. One possible reason for this effect is that large plants and exporting plants tend to have multiple establishments with separate headquarters and production facilities, and clerical workers are located in the headquarters, rather than in the plants that appear in our data.[21]

[21]Proprietorships may be less likely than partnerships or corporations to have multiple establishments. When we restrict the sample to only proprietorships (approximately ten percent of our sample), the coefficient estimate on exports in this regression becomes positive, although it is not statistically significant.

5 Competition and Plant Exit

As mentioned previously, both Becker (1957) and Arrow (1973) argue that competition should reduce discrimination by inducing the exit of discriminating firms (which would have higher costs and lower profits than non-discriminating firms). While this is primarily a long-run argument, our interest is whether we can observe this effect in the short run. That is, does an exogenous increase in the degree of foreign competition (as we observe with the Colombian trade liberalization episode) induce discriminating firms (i.e., firms with lower female shares) to exit the market? Indeed, the recent literature on firm heterogeneity and trade stresses the ability of trade to improve aggregate industry productivity through exactly such selection effects. Specifically, trade can induce productivity improvements by causing more productive firms to expand while less productive firms shrink or exit the market (e.g., see Melitz (2003)). The obvious parallel is the potential for trade competition to reduce discrimination by inducing discriminating (i.e., less efficient) firms to shrink or exit the market.[22]

That competitive forces will drive discriminating employers from the market is one of the strongest predictions of the Becker model. The typical approach to testing this prediction is by comparing employment or wage discrimination in in highly concentrated markets to discrimination in markets with a less concentrated market structure (e.g., see Haessel and Palmer (1973), Oster (1975), Ashenfelter and Hannan (1986), Jones and Walsh (1991), Hellerstein et al. (2002), Black and Brainerd (2004) and Kawaguchi (2007)). However, this approach has been critiqued by Ederington and Sandford (2016) who formalized the Becker model in a dynamic context and showed there was no consistent theoretical relationship between the degree of market concentration within an industry and the degree of discrimination. Thus, we follow their suggestion in utilizing a natural experiment, in this case the Colombian trade liberalization episode of the 1980s.[23]

[22]It should be noted that these models of trade competition and productivity typically work through the export side of the market. Thus, the parallel to the Colombian trade liberalization episode is not direct, as unilateral trade liberalization in Melitz (2003) has no impact on the productivity distribution of firms.

[23]Other papers using natural experiments include Black and Strahan (2001) and Heyman, Svaleryd, and Vlachos (2008), albeit not in a trade context. Black and Strahan (2001) examine deregulation in the banking industry and find that women's relative wages increased after deregulation, as did their share of managerial positions. Heyman et al. (2008) use firm data on takeovers in Sweden to examine the

Table 3: Industry Exit Rates 1984–91

Variable	(1) $\hat{\beta}$ (s.e.)
Exit rate 1977–81	0.076 (0.108)
Tariff change 1984–91	-0.141 (0.057)**
constant	0.259 (0.038)***
Observations	92
R^2	0.074

Notes to Table: The dependent variable is the industry exit rate between 1984 and 1991. *** indicates statistical significance at the 99% level or better; ** at 95%; and * at 90%. Mean probability of exit: 0.340 (0.163). 2 industries (3842, 3902) have all firms exit between 1984 and 1991.

In Table 3, we regress industry exit rates on the tariff change induced by the Colombian trade liberalization episode of 1984–91, as well as past exit rates to control for industry-specific effects. As can be seen, industries that experienced the most significant tariff reductions (largest *negative* tariff change) also saw higher exit rates, so the increase in foreign competition does appear to have induced exit by Colombian firms. The question of interest in this section is whether plants with low female shares are disproportionately represented among these exiting plants. To investigate this question, we run a logit regression predicting the probability of plant exit (between 1984 and 1991) with the plant's female share of its labor force as an explanatory variable. Results appear in Table 4.

In regression 1 of Table 4, we regress the probability of exit on the female share of the labor force and include 3-digit SIC dummy variables. As can be seen, an establishment with a higher female share was, on average, *more* likely to exit the industry between 1984 and 1991. Recall that women also tend to be concentrated in less capital-intensive, low-wage plants, so it is possible that women are overrepresented in exiting plants simply due to the fact that they are concentrated in the types of plants that would be most likely to exit. In regression 2 of Table 4 we include the vector of plant characteristics used in Section 4, adding tariffs and an interaction term between tariffs and the female share.

change in firm-level female employment, and find that, particularly in less competitive industries, firm takeovers result in a significant increase in female shares of employment.

Table 4: Logit: Probability of Firm Exit

Variable	(1) $\hat{\beta}$ (s.e.)	(2) $\hat{\beta}$ (s.e.)
Female share	0.324 (0.143)**	-0.234 (0.476)
Tariff		-0.007 (0.003)**
Tariff × female share		0.006 (0.005)
Exports		0.707 (0.252)***
Years of existence		-0.002 (0.003)
Total employment (log)		-0.625 (0.058)***
Salary (log)		0.015 (0.107)
Productivity (log)		-0.474 (0.067)***
Skill ratio		-0.123 (0.219)
Energy use (log)		-0.049 (0.031)*
Capital-labor ratio (log)		0.026 (0.039)
Office equipment		0.611 (0.403)
Corporation		0.488 (0.129)***
Proprietorship		-0.028 (0.071)
Observations	6,044	6,032
Of which, exited	2,281	2,273
Log likelihood	-3921.2	-3604.0

Notes to Table: The dependent variable is the probability that the plant exits between 1984 and 1991 (note: change in SIC not treated as exit).

All explanatory variables are measured in 1984. See Appendix A for data definitions.

3-digit industry dummy variables are also included in both regressions, and standard errors in Column 2 are clustered by 4-digit industry (tariffs are measured at the 4-digit level).

*** indicates statistical significance at the 99% level or better; ** at 95%; and * at 90%.

Controlling for other plant characteristics causes the coefficient estimate on female share to become negative and no longer statistically significant.[24] It remains the case that we fail to find evidence for the proposition that an exogenous increase in competition drives discriminating firms from the market, at least in the short run.

6 Competition and Firm Hiring Decisions

While the previous section fails to find evidence that increased competition due to trade liberalization forced discriminating plants from the market, a second possibility suggested by our model is that the increase in foreign competition influenced plant hiring decisions. In this section, we look for evidence that an exogenous increase in foreign competition induced plants to increase the female share of their workforce. To investigate this question, we use differences in the change in plants' female labor shares between 1984 and 1991. 1984 corresponds to the high point of average protection in Colombia, while 1991 is the final year of data available to us. We regress this change in the female share on the tariff change in the industry.[25] Thus, we are exploiting cross-sectional variation in the degree of trade liberalization across industries to see if establishments in industries that experienced a greater decline in tariff protection responded by increasing the female share of their labor force. To control for plant-level characteristics that might influence hiring decisions, we include the female share of the plant in 1984. We also include the change in firm size (measured by employment) to control for the scale effect discussed in Section 2. To control for industry-level characteristics, we include 3-digit industry dummy variables.[26] Results of this estimation are presented in Table 5.

[24]Results are very similar for both subsamples when we estimate regression 2 on exporting and non-exporting plants separately.

[25]For this analysis, our sample consists of plants that are in operation both in 1984 and 1991. One possibility is that the change in female share is related to plant exit which, if true, would lead to a bias in our estimated coefficients. To investigate this possibility, we estimated a standard two-stage selection model where the first stage regression estimates the probability of plant exit. Since the results from the two-stage model are largely identical to the results reported in Table 5, and since a standard Hausman test fails to reject the hypothesis of no selection, we have chosen to report the results from the single equation model. Results from the two-stage model are available from the authors on request.

[26]Note that the inclusion of the plant's 1984 female share also partially corrects for censoring, in that a firm with an already high female share (i.e., close to 1) cannot increase its female share further. Also note that we can only include 3-digit industry dummies since our tariff-change variable is at the 4-digit

Table 5: Effect of Tariff Change on Firms' Female Share of Workers

	(1)	(2)	(3)
Variable	$\hat{\beta}$ (s.e.)	$\hat{\beta}$ (s.e.)	$\hat{\beta}$ (s.e.)
tariff change 1984-91	-0.167 (0.057)***	-0.161 (0.054)***	-0.265 (0.069)***
female share 1984	-0.322 (0.043)***	-0.318 (0.041)***	-0.322 (0.043)***
4-firm concentration	—	—	0.122 (0.044)***
tariff chg*conc4	—	—	0.249 (0.082)***
log employment change	0.051 (0.014)***	0.021 (0.010)**	0.019 (0.009)**
change in exports	—	0.003 (0.028)	0.008 (0.027)
years of existence	—	-0.000 (0.000)**	-0.000 (0.000)**
change in log salary	—	-0.030 (0.009)***	-0.029 (0.008)***
change in log prody	—	-0.006 (0.004)	-0.006 (0.004)
change in skill ratio	—	-0.004 (0.028)	-0.003 (0.028)
change in log energy	—	-0.007 (0.003)**	-0.007 (0.003)**
change in log K/L	—	0.000 (0.000)	0.001 (0.002)
change in office equip	—	0.002 (0.018)	0.006 (0.017)
corporation	-0.014 (0.006)***	-0.013 (0.006)**	-0.014 (0.006)**
proprietorship	0.011 (0.011)	0.006 (0.008)	0.005 (0.008)
Observations	3,763	3,677	3,677
R^2	0.248	0.232	0.238

Notes to Table: The dependent variable is the change in the plant's share of (total) female workers between 1984 and 1991. 3-digit industry dummy variables are also included. Standard errors are clustered at the 4-digit industry level. Tariffs and concentration ratios are measured at the 4-digit industry level. R^2 does not include the effects of the constant terms.

As can be seen from regression 1 of Table 5, an increase in foreign competition (as captured by a decline in tariff protection) is associated with plants increasing their share of female employees. Recall that over this period, industries experienced (on average) a significant decrease in tariffs. Indeed, from Table 1, the average industry experienced a tariff change of -0.403, which corresponds to an increase in the female labor share of their workforce of 0.067 relative to an industry which received no change in tariff protection.[27] As a point of comparison, the average female share in 1984 of firms in the dataset is 0.365, so an increase of 0.067 is quite large. The Colombian trade liberalization episode appears to have had a significant impact on plants' hiring decisions and women's employment.

The coefficient estimate on the change in plant employment (the "scale effect" discussed in Section 2) has the predicted sign and is highly statistically significant, implying that an increase in employment is correlated with an increase in a plant's female share of workers. The intuition from our model is that in a larger firm, the cost of discriminating is higher, since the increased marginal costs of discriminating affect a higher volume of production. Including the change in firm size as an explanatory variable also allows us to better isolate the "elasticity effect," since we cannot measure the change in elasticity directly.

Of course, it is possible that trade liberalization induces some change in the production process (e.g., a change in the capital-labor ratio) which, in turn, affects the female share of the labor force (e.g., similar to the mechanism of Juhn et al. (2014)). Thus, in the second specification, we include changes in the plant-level determinants of the female share of the labor force from Table 5.[28] As can be seen, including additional variables to control for potential changes in the firm's production process does not change our results: trade liberalization increased the female share of the labor force at the plant level.

As discussed in the theoretical section, the effect of competition on hiring could also be a function of the existing degree of competition in the industry. To examine this hypothesis, in the third specification, we also include an interaction term between the 4-firm concentration of the industry and the tariff change. Presumably, plants in more

level.

[27] Of 92 4-digit industries in the sample, five actually received increases in tariff protection over this period.

[28] We also repeated the analysis with the control variables entered in levels, which yielded similar results.

concentrated industries face less competition and should be more affected by any given change in tariffs. The sign on the interaction term suggests that the marginal effect of a tariff change on the female share is, somewhat surprisingly, lower in absolute value for firms in more concentrated industries. Specifically, at the 25th percentile of concentration (0.252) the marginal effect of a tariff change is -0.20, while at the 75th percentile (0.531), it is only -0.13.

In Table 6, we present regression results examining the impact of tariff changes on plant-level female shares of skilled and unskilled workers separately. These results largely mirror the results seen in Table 5, particularly in the case of unskilled workers. The coefficient estimates on the change in tariffs suggest that the female share of unskilled workers is more responsive to a change in tariffs than is the female share of skilled workers. However, in the lower panel of Table 6, we take into account the interaction between tariff changes and industry concentration: the marginal effect of a change in tariffs is identical, at -0.21, for the two groups when evaluated at the median concentration ratio (0.39), although the interaction with concentration is much stronger for unskilled workers.

To further examine the hypothesis that the effect of tariffs could vary by the degree of competition in the industry prior to the tariff change, in Table 7 we estimate the regressions from Tables 5 and 6 separately by the exports status of plants in 1984. Since exporting plants already compete in international markets, it seems plausible that a decline in domestic tariffs would have a more significant impact on the competition facing non-exporting plants. Our results support this hypothesis in the case of skilled workers: as shown in the last row of each panel, evaluated at the mean of industry concentration, the marginal effect of a tariff change on the female share of skilled workers is larger in magnitude and more strongly statistically significant for non-exporting plants than for exporters. This is true for all workers, as well as for skilled and unskilled workers evaluated separately.

7 Conclusion

In this paper, we exploit plant-level data to show that Colombia's trade liberalization episode between 1984 and 1991 resulted in proportionally more women being hired by Colombian plants. This evidence is consistent with Becker's theory of discrimination, as well as with our slightly modified version of Becker's theory. We also find that this

Table 6: Effect of Tariff Change on Firms' Female Share by Skill Level

	(1)	(2)
	Unskilled Workers	Skilled Workers
Variable	$\hat{\beta}$ (s.e.)	$\hat{\beta}$ (s.e.)
tariff change 1984-91	-0.348 (0.102)***	-0.223 (0.070)***
female share 1984	-0.282 (0.048)***	-0.571 (0.030)***
4-firm concentration	0.185 (0.065)***	-0.003 (0.051)
tariff chg×conc4	0.360 (0.119)***	0.037 (0.114)
log employment change	0.037 (0.017)**	-0.013 (0.010)
corporation	-0.020 (0.007)***	-0.064 (0.010)***
proprietorship	-0.002 (0.013)	0.062 (0.019)***
Observations	3,667	3,423
R^2	0.200	0.338
Marginal effects:		
at Q25:	-0.257 (0.075)***	-0.213 (0.052)***
at median:	-0.209 (0.062)***	-0.208 (0.046)***
at Q75:	-0.157 (0.049)***	-0.203 (0.046)***

Notes to Table: The dependent variables are the change in the plant's share of female unskilled and skilled workers, respectively, between 1984 and 1991. 3-digit industry dummy variables are also included. Female share is the share of unskilled and skilled labor, respectively. Concentration and tariff change are at the 4-digit industry level. Standard errors are clustered at the 4-digit industry level. Marginal effects give the marginal effect of a tariff change evaluated at the 25th percentile, median, and 75th percentile of concentration (0.253, 0.387, and 0.531 respectively). R^2 does not include the effects of the constant terms.

Table 7: Effect of Tariff Change by Export Status

	(1)	(2)	(3)
Exporting Firms Only			
	All Workers	Unskilled	Skilled
Variable	$\hat{\beta}$ (s.e.)	$\hat{\beta}$ (s.e.)	$\hat{\beta}$ (s.e.)
tariff change 1984-91	-0.29 (0.17)*	-0.46 (0.22)**	-0.05 (0.09)
female share 1984	-0.25 (0.06)***	-0.21 (0.06)***	-0.52 (0.06)***
4-firm concentration	0.19 (0.05)**	0.30 (0.13)**	-0.05 (0.05)
tariff chg*conc4	0.34 (0.20)*	0.52 (0.27)*	-0.01 (0.12)
log employment change	0.05 (0.02)**	0.07 (0.03)**	0.01 (0.01)
corporation	-0.02 (0.01)	-0.02 (0.02)	-0.03 (0.02)*
proprietorship	0.09 (0.05)*	0.07 (0.06)	0.13 (0.09)
Observations	519	518	511
R^2	0.382	0.393	0.338
Marginal effect	-0.14 (0.10)*	-0.24 (0.12)**	-0.06 (0.07)
Non-exporting Firms Only			
	All Workers	Unskilled	Skilled
Variable	$\hat{\beta}$ (s.e.)	$\hat{\beta}$ (s.e.)	$\hat{\beta}$ (s.e.)
tariff change 1984-91	-0.25 (0.06)***	-0.32 (0.08)***	-0.21 (0.07)***
female share 1984	-0.34 (0.04)***	-0.29 (0.04)***	-0.58 (0.03)***
4-firm concentration	0.11 (0.04)***	0.17 (0.06)***	-0.00 (0.06)
tariff chg*conc4	0.19 (0.07)***	0.32 (0.10)***	-0.03 (0.13)
log employment change	0.05 (0.02)***	0.03 (0.01)**	-0.02 (0.01)*
corporation	-0.01 (0.01)	-0.02 (0.01)*	-0.06 (0.01)***
proprietorship	0.01 (0.01)	-0.00 (0.01)	0.06 (0.02)***
Observations	3,244	3,149	2,912
R^2	0.254	0.192	0.345
Marginal effect	-0.18 (0.04)***	-0.20 (0.05)***	-0.22 (0.05)***

Notes to Table: The dependent variable is the change in the plant's share of (total) female workers between 1984 and 1991. 3-digit industry dummy variables are also included. Concentration and tariff change are at the 4-digit industry level. Standard errors are clustered at the 4-digit industry level. Marginal effects give the marginal effect of a tariff change evaluated at the median concentration ratio (0.43 for exporting firms; 0.37 for non-exporters). R^2 does not include the effects of the constant terms.

change occurs primarily because increasing competition leads existing plants to hire more women, not because they exit the market. The effect of tariff liberalization on the female share of workers is quantitatively large: the average decrease in tariffs over this period corresponds to a 6.9 percentage point increase in a firm's female share of employment, relative to a firm in an industry with no change in tariffs. Consistent with the predictions of our model, we find that large firms employ a higher share of women. We are also able to elaborate on earlier research that found that women are concentrated in exporting industries, by showing that women are also concentrated in exporting plants. Finally, we show that the effect of tariff liberalization is larger for non-exporting plants than for plants that were exporting prior to liberalization — a finding that is consistent with the prediction of our model that the impact of increasing competition will be greater for firms that initially face little competitive pressure.

Importantly, our findings provide some evidence on how changes in competitive pressure can lead to less labor market discrimination and help resolve a puzzle in the existing literature. In Becker's original model, competition leads to less discrimination by driving discriminating firms from the market. However, despite evidence that discrimination leads to lower wages and higher levels of employment for women and that discriminating firms earn higher profits (see Hellerstein, Neumark, and Troske (1999), Black and Strahan (2001), Hellerstein et al. (2002), and Black and Brainerd (2004)), there is little evidence that competition drives discriminating firms from the market (see Hellerstein et al. (2002)). In our modified version of the Becker model, we show that increases in competition can also reduce discrimination by raising the cost of discrimination, which pushes discriminating employers to hire more women. Thus, our results suggest the potential importance of enhancing competition as a way of reducing the extent of discrimination in the labor market.

A Data

All data are taken from a plant-level dataset produced from the Colombian Manufacturing census by DANE (National Statistical Institute) for the years 1977 through 1991. From 1983 on, the census covers industrial production for plants with greater than 10 employees. Our empirics concentrate on plants that were operating in both 1984 and 1991. For a thorough description of this dataset see Roberts (1996).

All variables are measured at the plant level unless otherwise noted.

Female share: female share of workers (total, unskilled, and skilled as described in text).

Productivity: value added for the plant divided by total employment.

Employment: total employment.

Firm Age: years since the plant's establishment until 1984.

Exports: plant exports scaled by total sales.

Salary: total payroll divided by total employment.

Skill Ratio: share of skilled employment in skilled and unskilled employment.

Capital/Labor Ratio: ratio of fixed capital to total employment. A small number of plants with fixed capital reported as zero are dropped. (In Table 4, for example, this reduces the sample size by 23.)

Energy Use: one plus the ratio of energy consumed to total employment.

Office Equipment: office equipment's share of total capital equipment.

Female Management: percentage of management and owners that is female.

Type of Enterprise: The data set classifies plants by 10 different enterprise types. We omit firms classified as collectives, cooperatives, official entities, and religious communities (overall, these comprise less than 2% of the sample). We construct dummy variables for *Corporations* (this includes plants classified as corporations, de facto corporations, and joint stock companies), *Proprietorships*, and *Partnerships* (including limited partnerships and joint partnerships).

Industry Tariff: ad-valorem tariff at the 4-digit ISIC level. Provided by Jorge Garcia at the World Bank. The tariff change for a 4-digit industry is simply the difference between 1991 and 1984 ad-valorem tariffs.

Industry Concentration: 4-firm concentration ratio for the 4-digit industry.

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