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Abstract

This paper presents novel empirical evidence for the prediction from Becker's (1957) famous theory, that competition will drive discrimination out of the market. We use a comprehensive firm entry deregulation reform in Portugal as a quasi-natural experiment to study the effect of increased product market competition on gender discrimination. We use employer-employee data for the universe of private sector firms and workers, and exploit the staggered implementation of the reform across municipalities for identification. Increased competition following the deregulation reduces the gender pay gap for medium- and high-skill workers but not for the low-skilled. The gender pay gap is also reduced for workers in managerial positions, except for the CEO. We also find that the share of females in managerial positions increased in affected municipalities. Existing evidence has shown that gender discrimination reduces output; our findings suggest that deregulation can contribute to reduce inefficiencies arising from gender discrimination.

JEL Classification: J16, J31, J71

Keywords: *Deregulation, Discrimination, Entry, Gender Pay Gap, Product Market Competition, Wage Structure.*

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1 Introduction

Women earn lower wages than men in all economies, including northern European nations such as Sweden and Norway, which are among the least discriminatory countries.[1] An extensive body of empirical research has documented the wage gap between men and women.[2] Although the gender wage gap has narrowed in recent decades, the difference in average wages has been very persistent. Gender discrimination creates inefficiencies that contribute to significantly reduce output across countries (see, e.g., Cavalcanti and Tavares, 2016). Therefore, finding appropriate policies to respond to gender discrimination is important. In this paper we study how entry deregulation, and the resulting increase in product market competition, contributes to reduce gender discrimination.

Our empirical analysis is framed by Becker's (1957) classical theory of employer discrimination, in which personal prejudice is the source of discrimination. The existence of a residual gender wage gap between workers performing the same tasks with the same skills, experience and educational level has been interpreted as reflecting discrimination. That interpretation is consistent with Becker's model. Gender-biased employers have a preference for male workers even if their wages are higher than those of females with the same productivity; giving rise to segregation of workers and to a gender wage gap. Because discrimination raises costs, an implication of Becker's (1957) model is that increased product market competition will reduce discrimination. This can happen as firms that give up profits to indulge their discriminating tastes are competed away from the marker or because increased competition leads firms to submit to market pressure and change their behavior.

This paper investigates the dynamic implication from Becker (1957), that changes in competition will reduce employer discrimination. We exploit a comprehensive episode of firm entry deregulation across industries in Portugal, the "On the Spot Firm" program, as a quasi-natural experiment to investigate whether increased product market competition reduces the gender pay gap. We use linked employer-employee data for the universe of private sector firms and workers to estimate the effect of the deregulation on the gender pay gap, for workers with different skill levels and across the corporate hierarchy.

The "On the Spot Firm" program was implemented from 2005 with the aim of reducing the time, cost and bureaucracy to register a new business. Prior to 2005, an entrepreneur was required to visit several public offices and to complete 11 procedures to register a firm. It took on average 78 days and cost around 13.5 percent of GDP per capita. The "On the Spot Firm" program introduced one-stop shops where entrepreneurs can register a company in a

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[1] Hausmann et al. (2006).

[2] See, for example, Bayard et al. (2003) for evidence on the U.S. labor market; Albrecht et al. (2003) for Sweden; Arulampalam et al. (2003) for eleven European countries; Kawaguchi (2007) for Japan; among many others.

single visit, and complete the process in less than an hour at a cost of 3 percent of GDP per capita. The program was progressively rolled out across municipalities over time.[3] We exploit the cross-municipality-time variation in the implementation of the reform to identify the effect of increased competition on the gender pay gap.

Using the roll-out of the program as an exogenous source of increased firm entry and product market competition, we provide quasi-natural experimental evidence on the prediction from Becker that competition reduces discrimination, reflected in a gap between the wages of male and female workers. The unusually rich and detailed information from the employer-employee data allows us to control for workers' observable characteristics, such as gender, age, education, skill level, occupation, experience, type of contract of employment, and to obtain estimates that account for worker or firm-worker fixed effects, thus controlling for unobserved individual or match heterogeneity.

We find that the increase in competition following the entry deregulation reduced the gender pay gap for high- and medium-skilled workers in affected municipalities, but not for the least skilled. The reform had a positive and statistically significant differential effect on the pay of female workers; the coefficients on interaction terms between a female indicator, the deregulation variable and the skill category are positive and significant at the 1-percent level. Our estimates imply that for workers in high-skill jobs, while male pay increased by 1.5 percent, the pay of females increased by 2.9 percent as a result of the deregulation. The pay of medium-skilled males decreased by 0.6 percent in treatment municipalities, while that of females in the same skill category increased by 0.4 percent. Therefore, the deregulation improved women's relative pay.

We also look at the effect of the deregulation on the gender pay gap across the corporate hierarchy, and find that the reform is associated with a narrowing of the gender pay gap for executives, except for the CEO. This suggests that the labor market for the top executive still especially favors men and increased competition does not improve female CEOs relative pay. We also find that after the deregulation the share of females in managerial positions increased. This suggests that keeping women in lower positions could have been another form of discrimination and competition induced employers to upgrade their occupational status. Our results suggest that the estimates on the gender pay gap are not driven by composition effects.

Our findings are consistent with the prediction from Becker (1957) that product market competition reduces employer discrimination. In particular, by increasing the efficiency loss from discriminating against women, competition induces employers to change their behavior. However, these effects are not found for those in low-skill jobs or for CEOs.

Although previous studies investigated the relationship between product market competi-

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[3]The policy was hugely successful, and as a result Portugal rose from 113th to 26th in the World Bank "Ease of Doing Business" ranking of countries.

tion and discrimination, evidence is still scant. Most previous studies focus on cross-sectional correlations or on potentially endogenous time variation, and thus do not explicitly estimate the causal mechanism. By using the "On the Spot Firm" program as a quasi-natural experiment, we are able to identify the causal link between competition and the gender pay gap cleanly. Moreover, most previous studies investigating the relationship between competition and discrimination use industry-level concentration ratios, the Herfindahl-Hirschman index (HHI) or firm-level measures of market power to measure competition. These measures face a number of well known limitations.[4] By exploiting an exogenous source of increased competition, we avoid the caveats associated with common measures of competition and obtain clean estimates of that relationship.

The focus of most existing papers has been to investigate whether industries with higher degree of concentration or firms with more market power pay females lower wages than males or hire relatively less female workers (e.g. Ashenfelter and Hannan, 1986). Some studies focus on whether firms with lower shares of female employees have lower profits, particularly in more competitive environments (Hellerstein et al., 2002; Kawaguchi, 2007).

Our paper is more related to another branch of empirical studies that use panel data to investigate how changes in competition over time affect female wages or female employment shares. Black and Strahan (2001) exploit the deregulation in the banking industry in the US from the mid-1970s, while Black and Brainerd (2004) focus on increased competition from international trade.[5] By exploiting an episode of comprehensive entry deregulation across industries, our natural experiment allows us to obtain results that can be interpreted more generally than in the banking industry, where the structure of compensation could have been marked by idiosyncrasies. By focussing on a more recent period, characterized by deregulation in many countries and by a narrowing of the gender pay gap, we shed light on the link between the two phenomena.

Our results have important implications for policy that aims to improve product market competition through entry deregulation. Our finding that reducing entry barriers contributed to narrow the gender pay gap, particularly among medium- and high-skill and managerial workers, suggests that deregulation also contributes to reduce inefficiencies arising from gender discrimination.[6] Existing evidence shows that gender discrimination significantly reduces output across countries, therefore, our findings are relevant for future policy advice to other countries.[7]

The paper is organized as follows. The next section reviews the related literature. In section

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[4] These include potential endogeneity, correlation with omitted variables and non-monotonicity of their effects on outcome variables (Sutton, 1991).

[5] Weber and Zulehner (2014) investigate how changes in concentration affect the relationship between female employment shares and firm profit or exit probability, based on firm entry and survival in Austria.

[6] Our results are obtained for a deregulation episode in Portugal and may not generalize to other countries; however, they are consistent with findings in previous literature on competition and gender discrimination in e.g. the US, Japan or Sweden. We discuss this literature in the next section.

[7] A number of studies have also shown that entry and competition contribute to productivity growth and innovation (e.g., Djankov et al.; 2006; Aghion et al., 2009).

3 we describe the "On the Spot Firm" program. Section 4 describes the data used and presents descriptive statistics. Section 5 studies the effect of the reform on firm creation and on measures of competition. Section 6 presents the results on the effect of the quasi-natural experiment on the gender pay gap. Section 7 estimates the effect on female employment shares. The last section concludes.

2   Related literature

Our empirical analysis is framed by Gary Becker's (1957) model. His seminal work on employer discrimination focuses on personal prejudice as a source of discrimination. Discriminating employers derive disutility from hiring women. The male labour marginal revenue product is set below its input price since this type of labor increases the employer's utility, while marginal revenue product of female labor is above its input price. Discrimination is thus inefficient as it prevents equalization of marginal products. Discriminating employers hire fewer women and more men than profit maximization would imply. Since males are paid more than females with the same skills and productivity, employers give up profits to indulge their discriminating preferences. Discrimination is modeled as a wage differential required to induce employers with taste for discrimination to employ females. In the short run this leads to segregation of workers across employers and gives rise to a positive differential between male and female wages.[8]

Becker (1957) argued that as discrimination increases costs it is hard to sustain in a competitive market. With increased competition, the differential between male and female wages will narrow, as discriminating employers are forced by market conditions to change their behavior. It is this dynamic implication from Becker's theory, the narrowing of the gender wage gap following increased product market competition, that is the focus of our empirical analysis.

This paper is related to empirical studies investigating Becker's predictions on the relationship between discrimination and market competition. An important earlier paper is Ashenfelter and Hannan (1986) which analyses the relationship between product market competition and discrimination in the banking industry. The authors looked at a cross-section of geographical markets in Pennsylvania and New Jersey in 1976 and found a negative and statistically significant relation between market concentration (measured by the Herfindahl index and concentration ratios) and the share of female employees in each bank. More recently, Black and Strahan (2001) investigated how deregulation in the banking industry affected the gender wage gap, using worker-level panel data from 1977 to 1997. They found that following deregulation male wages fell by significantly more than female wages, suggesting that banks shared rents disproportionately with men and deregulation improved women's relative wages.

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[8]Borjas and Ramey (1995), Hellerstein, et al. (2002) and Black and Brainerd (2004) provide more detailed discussions of Becker's (1957) model.

Black and Brainerd (2004) also investigate the dynamic implication from Becker's theory that changes in competition affect the gender wage differential. They focus on increased competition from international trade and compare the effect of trade on the gender wage gap in concentrated and in competitive sectors. They used panel data for 1977-1994 and found that trade competition increased the relative wages of females in manufacturing industries. Heyman, Svaleryd, and Vlachos (2013) use employer-employee data from Sweden, from 1990 to 2002, to analyze how product market competition and firm takeovers affect the gender wage differential and workforce gender composition. They measure competition based on the elasticity of profits with respect to marginal costs (following Boone, 2008; and Boone et al., 2007) and find some evidence that the share of female employment increases following an ownership change when competition is weak, and that takeovers reduce the gender wage gap.

Hellerstein, Neumark, and Troske (2002) investigated whether competition reduces discrimination by testing the relationship between profits and female employment shares across firms with varying degree of market power. They found that among firms with high market power those employing higher proportions of females had higher profits, while no such relationship was found for firms with low levels of market power, as predicted by the theory. However, no evidence was found on the dynamic implication that discriminatory firms grow slower over time. Kawaguchi (2007) followed a similar strategy of testing for a correlation between female employment and profitability across firms to examine the implications of Becker's (1957) theory. Using Japanese firm-level data for the 1990's, the author found that firms that employ a larger proportion of women have higher profits. He also found that firms in less concentrated industries, measured by the Herfindahl index, employ a lower proportion of women. The results suggest that discrimination is a source of the gender wage gap.

On a similar vein, Weber and Zulehner (2014) investigate the prediction that prejudiced employers forgo profits to indulge their discriminatory tastes and in a competitive environment are competed away from the market due to their lack of efficiency. They use employer-employee data and find that competition at the industry level reduces firm survival and increases the rate at which discriminating firms exit the market. They also find that discriminatory start-up firms that manage to survive succumb to market forces and change their behavior increasing female employment.

With the exceptions of Kawaguchi (2007), Heyman et al. (2013) and Weber and Zulehner (2014), the empirical studies above focus on the US. Weichselbaumer and Winter-Ebmer (2007) use meta-analysis and argue that countries with higher degree of product market competition and those adopting equal-treatment laws have smaller gender wage gaps, while countries with laws protecting women from performing dangerous and strenuous jobs tend to have higher wage gaps. List (2004) is an influential example of the experimental literature on the impact of competition on discrimination.

Our paper is distinct from previous empirical research in several respects. First, while most studies have used measures of concentration, such as HHI and concentration ratios, which are subject to known limitations, we focus on an episode of deregulation, thus exploiting exogenous change in competition to identify the causal link. Second, studies of deregulation have focused on the banking industry in the US (Black and Strahan, 2001) whilst we exploit an episode of comprehensive entry deregulation across industries. As such, our natural experiment allows us to obtain results that can be interpreted more generally than in that industry, where the structure of compensation could have been marked by idiosyncrasies. Third, we use matched employer-employee data for the universe of private sector firms and workers and estimate the effects of competition on the gender pay gap for workers in each skill category and across the corporate hierarchy - for CEOs, department managers and non-managerial workers. This is important since competition had heterogeneous effects on the gender pay differential across the wage distribution. Fourth, by focussing on a more recent period marked by efforts to improve competition through deregulation in many countries and by a narrowing in the gender pay gap, we shed light on the link between the two. Finally, our results provide novel evidence on the causal link between increased competition following entry deregulation across industries and gender discrimination.

Our paper is also broadly related to the literature that studies the gender pay gap more generally. Blau and Kahn (2000) review that literature; more recent studies include Blau and Kahn (2016) and Bayard et al. (2003).

3   The "On the Spot Firm" entry deregulation

This section describes our quasi-natural experiment - the "On the Spot Firm" entry deregulation reform. The program was introduced in May 2005 by the newly elected government with the goal of promoting national and foreign investment by reducing the cost and bureaucracy of registering a firm. To register a new firm in Portugal prior to 2005 an entrepreneur was required to fulfil 11 procedures and to complete 20 forms. The entrepreneur would need to visit separate offices of the Ministries of Justice, Finance, Economy and Labor and Social Security to obtain the necessary documents and approvals. The process took 78 days and fees equivalent to 13.5 percent of GDP per capita.

In 2005, the newly elected government created a task force, the Unit for Coordination of Administrative Modernization (UCMA), to coordinate across ministries in order to improve the efficiency of public services and reduce the red tape associated with setting up a new firm. This resulted in the introduction of the "On the Spot Firm" (Empresa na Hora) program by the Ministry of Justice.[9] The program was intended to reduce the time and complexity of the process

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[9] http://www.empresanahora.pt/ENH/sections/EN.

of registering a firm. The business registration reform was unannounced and unanticipated.

The program introduced one-stop shops - non-profit seeking government offices - where entrepreneurs can register a company at a single office desk in less than an hour, and at a cost of around 3 percent of GDP per capita, below the OECD average of 6.8 percent.[10] The legal and commercial registration is completed in the one-stop shops, and the entrepreneur receives the firm identification card and the corporate tax payer and social security numbers in the same day. The information is internally exchanged and sent electronically by the registry authorities to all ministries and authorities involved in the process.[11]

[Figure 1 about here]

Due to resource constraints and uncertainty about its success, the "On the Spot Firm" program was not introduced simultaneously in all municipalities. Four pilot one-stop shops were opened in July 2005 in the municipalities of Coimbra, Aveiro, Barreiro and Moita.[12] The program then expanded over time to municipalities across Portugal. The policy was hugely successful; the total waiting time was reduced by 230,000 days in a year and companies saved around 16 million euros. Portugal is now one of the fastest countries in the world in starting-up a business, and was considered top reformer in business entry in the World Bank Doing Business report. By the end of 2009 there were 164 one-stop shops dispersed throughout Portugal. The geographical dispersion and opening dates of the one-stop shops are shown in Figure 1. As evidenced, the program was progressively rolled-out randomly across municipalities. We exploit this cross-municipality-time-specific variation in the implementation of the "On the Spot Firm" deregulation to identify the effect of the resulting increase in competition on the gender pay gap.

4 Data description and identification strategy

4.1 Data description

Our empirical analyses are based on the Portuguese linked employer-employee data, Quadros de Pessoal (QP), collected annually by the Ministry of Labor and Social Solidarity. All private sector firms employing at least one worker are legally required to answer the survey and to make it publicly available. This results in a high degree of coverage and reliability of the data. In the

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[10] World Bank (2006).

[11] State-owned firms or firms in industries with industry-specific requirements or permits are not allowed to be registered in the one-stop shops of the "On the Spot Firm" program. These are mainly in the finance, insurance and transportation sectors. We exclude observations in these industries from our analysis.

[12] Administratively, Portugal is divided into 308 municipalities which are the seat of local administrative and executive power.

data, each firm and each worker are assigned a unique time-invariant identifier which allows us to trace them over time.

Worker-level information includes the worker's gender, age, education level (schooling), level of skill, occupation, type of contract of employment, hiring date in the firm, promotions, monthly hours of work (normal and overtime) and earnings, which are split into the components: base wage, seniority payments, regular and irregular benefits and overtime pay. Firm-level data include the year of creation, industry, location, total number of workers, number of establishments, sales volume, legal structure and ownership structure (equity breakdown among domestic private, public or foreign). The information in each year refers to the month when the survey is collected, which is in October since 1994.

Our analysis covers the period from 2002 to 2009 and includes private sector manufacturing and services firms, excluding agriculture, fishing and mining, covering 46 industries.[13] Our employer-employee sample includes 438,755 distinct firms (contributing with 1,881,740 firm-year observations) and 3,694,017 workers (contributing 15,340,574 worker-year observations) over the period.[14] We identify when a firm enters the market using the variable that reports the year of creation of the firm. A firm is considered an entrant in year t if the reported year of creation is t.[15] Table 1 shows the distribution of incumbent firms and entrants in each year, as well as workers. Column (3) reports the share of new firms that were created in municipalities with with "On the Spot Firm" one-stop shops. In 2005, 20 percent of the newly created firms were registered in municipalities where the reform had been implemented, increasing to 76 percent in 2009. Overall, in our data, 47,716 firms were created in treatment municipalities.

[Table 1 about here]

The main dependent variable in our specifications is the monthly pay of the worker; this is obtained by summing (i) the base pay, which is the gross wage for the normal hours of work; (ii) tenure related payments; and (iii) regular and irregular benefits. We also use the information in the QP data on the educational level and occupational category of each worker. The level of education is classified according to the UNESCO International Standard Classification of Education (ISCED) of 1997.[16] Occupations are classified according to the International Standard Classification of Occupations of 1988 (ISCO-88). We exploit information on the occupational category of the workers to investigate the effect of the deregulation on the gender pay gap for

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[13] The QP data were not collected in 2001.

[14] The final estimation sample is smaller due to missing data for some variables.

[15] Since the data is collected in October each year, we recover information on firm births when the reported year of creation is $t - 1$ but the firm is first observed in t. In those cases the firm is considered an entrant in t.

[16] The correspondence between ISCED levels and years of schooling in Portugal is: ISCED 1 - first and second stages of basic education (up to 6 years of schooling); ISCED 2 - lower secondary education (9 years of schooling); ISCED 3 - upper secondary education (12 years of schooling); ISCED 5/6 - higher education (more than 15 years of schooling, corresponding to university degrees). In Portugal, there is no degree corresponding to ISCED level 4; and it is not possible to distinguish between ISCED levels 5 and 6 from the data.

CEOs, department managers and other workers. We use the 3-digit level ISCO-88 occupations to distinguish CEOs (individuals in ISCO category 121), department managers (individuals in the categories 122 and 123) and other workers (all other occupational categories).[17]

In the QP data workers are also classified into eight levels of qualification based on the position in the firm hierarchy and on the complexity, responsibility and skill requirement of the tasks they perform.[18] Appendix Table A.1 describes in detail the hierarchical levels and their skill content in accordance with the law.[19] We exploit this information to investigate the effect of the deregulation on the gender pay gap for workers in different skill categories. For that analysis, we aggregate the skill levels and define three categories: high- (levels 1 to 4), medium- (level 5) and low-skill (levels 6 to 8). We also use that variable to identify the effects of the deregulation on the gender pay gap across the corporate hierarchy: for managerial workers (those in levels 1 and 2 - top executives and intermediary executives) relative to all other workers in a corporation.

Table 2 reports detailed summary statistics for ln real pay of workers in each skill and occupational category and managerial position. Within each group, we report statistics for female and male pay separately. In all categories, female pay is always lower that male pay. We will investigate in the next sections these gender pay gaps in a regression setting; and how the increased competition following the entry deregulation affected the gender pay gap for workers in different skill categories and occupations. As shown in the table, CEOs are the group of workers with higher average real monthly pay, followed by department managers, managerial workers and high-skilled workers.

[Table 2 about here]

In our specifications, we control for the workers' observable characteristics, including gender, education, tenure and its square, the type of contract of employment (whether open-end or closed-end). Observable firm characteristic are also controlled for, including the log of firm size (number of employees), ownership status (private, public or foreign owned), whether the firm is an exporter, and whether the firm is multi-plant. To obtain information on exporters, we merge the employer employee data with data from the International Trade dataset collected by the Portuguese National Institute of Statistics. In Appendix Table A2 we present descriptive statistics of the covariates for the full sample (column 1) as well as by skill categories (columns

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[17]ISCO88 category 121 is described as "Directors and Chief Executives"; ISCO88 122 is "Production and Operations Department Managers"; and ISCO88 123 is "Other Department Managers" (including Finance and administration, Personnel and industrial relations, Sales and marketing, Advertising and public relations, Supply and distribution, Computing services, Research and development, Other). The category "Directors and Chief Executives" can include top executives other than the CEO, but firms in our sample have on average (and median) one individual in that category; and we refer to them as CEOs.

[18]The levels are: 1 – Top executives (top management); 2 – Intermediary executives (middle management); 3 – Supervisors, team leaders and foremen; 4 – Higher-skilled professionals; 5 – skilled professionals; 6 – semi-skilled professionals; 7 – non-skilled professionals; 8 – Apprentices, interns and trainees.

[19]They are established in the Law Decree no. 121/78 of July.

2-4), occupation (columns 5-7), and for managerial and non-managerial workers (columns 8 and 9). Overall, female workers account for 45 percent of the observations in our data, but in the sample of CEOs, only 19 percent are females. Although only about 9 percent of the workers have a university degree, this proportion is significantly higher in the group of high-skilled workers (36 percent), CEOs (73 percent) and managerial workers (59 percent). This suggests that our measure of the skill requirement of the tasks performed by a worker is not a direct outcome of educational attainment. Regarding the "On the Spot Firm", 36 percent of observations are located in municipalities with one-stop shops. Table A.3 reports summary statistics of firm-level covariates.

4.2   Identification strategy

To identify the effects of increased product market competition on the gender pay gap, we exploit the roll-out of the "On the Spot Firm" program across municipalities over time. We use the variation in the timing of adoption across municipalities for identification, thus obtaining difference-in-differences estimates of the effect of the deregulation on the gender pay differential. The treatment group includes firms and individuals in municipalities that introduced the "On the Spot Firm" program. The treatment variable in our empirical specifications is $Spot_{mt}$, it takes the value of 1 in the year (t) when the program was adopted in municipality m and in all subsequent years, and 0 otherwise.

As discussed above, the policy change was unanticipated, and exogenous. The empirical strategy relies on the assumption that the program was not introduced in a systematic way across municipalities; specifically, that it was not correlated with pre-existing trends in the variables of interest. In our regressions, among a host of factors that may affect the outcomes, we control for municipality fixed effects and for pre-existing trends by municipality. These absorb any differences across municipalities and potential trends in wages at the municipality level. However, we start by showing that the order of adoption of the "On the Spot Firm" across municipalities is uncorrelated with previous trends in the variables used in our analysis.

Table 3 reports pre-reform average growth (over 1996-2004) in the variables of interest, for the group of municipalities that adopt the reform in the first years, 2005 and 2006 (column 1), and for the group that adopt in later years, from 2007, (column 2); as well as the difference between the two (column 3). We test whether growth trends prior to the policy change differ between the two groups of municipalities; we report the p-value for the null hypothesis that the means are equal for both groups (column 4). We find that there are no statistically significant differences for any of the variables of interest. This evidence shows that the order in which municipalities introduced the program is not correlated with pre-reform trends, strongly supporting the identification strategy.

[Table 3 about here]

5 Effect of the "On the Spot Firm" deregulation on entry and concentration

We start by investigating the effect of the "On the Spot Firm" entry deregulation on firm entry and industry concentration. This analysis assesses the validity of the reform as an exogenous source of increased competition, for the main analysis of the paper, on the effect of increased competition on gender discrimination. In particular, the next section investigates the prediction that increased competition reduces the gender pay gap. We studied the effect of the "On the Spot Firm" program on firm entry and industry concentration in previous work (Fernandes et al., 2014) and this section draws from that work.

To study the effect of the reform on firm creation and industry concentration, we estimate the following specification, for the period from 2002 to 2009:

$$Y_{mst} = \beta Spot_{mt} + d(.) + \epsilon_{mst} \tag{1}$$

Where the dependent variable, Y_{mst}, is one of the outcomes: the number of new entrant firms by municipality-industry-year (mst), the top-five concentration ratio (CR5) or the HHI; the later two variables are (inverse) measures of competition. $Spot_{mt}$ is the "On the Spot Firm" experiment indicator variable, it is equal to one in the year when the "On the Spot Firm" reform was adopted in municipality m and in all subsequent years, and 0 otherwise. Our specifications control for industry fixed effects, which absorb any industry characteristics that may affect firm entry or concentration, d_s, and year fixed effects to control for aggregate trends, d_t. In alternate specifications we also saturate the model further by including municipality-specific linear trends, $d_m \times t$, to absorb trends at the municipality level in entry and competition. The standard errors are clustered at the municipality level, at which the reform is introduced, to account for potential correlation between observations within municipalities. We expect that the entry deregulation increased firm entry, therefore the sign of the coefficient on the *Spot* variable, β, is expected to be positive and statistically significant when the dependent variable is the number of new firms. When the dependent variable is the CR5 or the HHI, the inverse measures of competition, we expect a negative correlation with the reform variable, hence the estimated coefficient is expected to be negative in those specifications.

The results from estimating equation (1) are reported in Table 4. Columns (1) and (2) report results for firm entry, columns (3) and (4) for the CR5 and columns (5) and (6) for the HHI as dependent variables, respectively. We include different sets of fixed effects, as explained above. As shown, the entry deregulation is associated with an increase in the number of new firms:

we obtain a positive and statistically significant coefficient on the *Spot* variable. That result is obtained in both a linear model (Panel A), as well as in a negative binomial regression. The negative binomial estimates imply that controlling for municipality×time trends, the number of new firms increased by 4.2 within industries following the reform (see the marginal effect in column 2). These results show that the "On the Spot Firm" policy increased firm entry thus raising competition. Our results on entry deregulation are consistent with those in Bruhn (2011), who finds that a similar reform in Mexico increased the number of new business registrations by 5 percent and increased employment by 2.2 percent.[20]

Next we investigate the effect of the entry deregulation on competition measured by the top-five concentration ratio and the HHI. For each of these measures of concentration, we report results from a linear regression model in Panel A and from a generalized linear model in panel B. The results reported in columns (3) through (6) of Table 4 show that the coefficient on the *Spot* variable is always negative and statistically significant at the 1 percent level. This suggests that the "On the Spot Firm" reform is associated with decreased concentration. In particular, controlling for industry and year fixed effects and saturating the model further with municipality trends, we find that following the deregulation, the industry CR5 and HHI decrease, implying increased product market competition. This section shows that the "On the Spot Firm" program significantly increased firm entry and decreased industry concentration measures.

However, as discussed previously, common measures of competition such as CR5 or HHI are subject to known limitations, such as potential endogeneity, correlation with omitted variables, and non-monotonicity (see Boone, 2000; and Sutton 1991), and thus may not fully capture the increased competition that resulted from the entry deregulation. Therefore, we now proceed to use the deregulation reform as an exogenous source of increased competition to obtain difference-in-differences estimates of the effect on the gender pay gap in different skill categories and across the corporate hierarchy.

[Table 4 about here]

6 Effect of the "On the Spot Firm" deregulation on the gender pay gap

As shown in the previous section, the "On the Spot Firm" deregulation led to increased firm entry and increased measured product market competition. This section exploits the deregulation reform as a quasi-natural experiment to study how the exogenous increase in competition

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[20]Branstetter et al. (2014), use the same deregulation episode and find that it is associated with an increase in the number of new firms per 100,000 inhabitants of around 17 percent. Therefore, the "On the Spot Firm" reform has an economically important effect on firm entry.

affected compensation, in particular the pay differential between female and male workers. According to Becker's (1957) theory, since discrimination increases costs, in competitive environments employers have no room to indulge their tastes for gender discrimination. Thus, product market competition will drive discrimination out of the market. Therefore, we expect that the exogenous shock to product market competition following the "On the Spot Firm" program will have contributed to improve female workers' relative compensation.

As discussed in previous sections, the policy change was unanticipated and exogenous. We have shown that the decision to adopt the reform was not correlated with pre-existing trends in wages. This provides support for our identification strategy. Our identification exploits the cross-municipality-time variation in the implementation of the program to estimate the effect of the deregulation on the gender pay gap. We obtain difference-in-differences estimates of the effects for workers in different skill categories and occupations. The treatment group includes firms and workers in municipalities that introduced one-stop shop offices for business registration.

As a point of comparison with existing studies, we start by estimating the general gender pay gap. We estimate a compensation regression with a female dummy added:

$$\ln w_{ijmt} = \alpha + \beta Fem_i + \gamma X'_{it} + \lambda Z'_{jt} + d_{(.)} + \epsilon_{ijmt} \tag{2}$$

The dependent variable is the natural log of real monthly pay of worker i (in firm j, municipality m) in year t and Fem_i is a female dummy. We control for individual observed characteristics such education, skill level, tenure and its square, occupation and type of employment contract in matrix X'_{it}. Firm characteristics are included in matrix Z'_{jt}: the log of size, ownership (whether domestic private, public or foreign), a dummy for whether the firm is an exporter and a dummy for whether the firm is multi-plant. We also control for industry (d_s) and year (d_t) fixed effects in our specifications to absorb unobserved industry characteristics that may affect compensation and in particular the gender pay differential, and global shocks that affect all firms and workers. Our specifications also include municipality fixed effects (d_m) to parse out any municipality-specific factors that could affect the gender pay gap. ϵ_{ijmt} is a random error term. A statistically significant coefficient on the female dummy captures the wage gap between males and females, assuming that the worker controls included, such as education, tenure and skill level, account for differences in worker productivity.

The results from estimating equation (2) are reported in Table 5. Our data has the advantage, relative to most previous studies, of including information on the level of education and skill level of each worker. Therefore, we obtain results that control for a comprehensive set of workers' characteristics, accounting for differences in productivity across workers. We find that the gender pay gap is sizable. Our estimates show that after controlling for workers' background

characteristics and observed characteristics of the firm, there is a 19 percent difference in the level of pay between male and female workers. This is consistent with existing studies of the gender pay gap; for example, Blau and Kahn (2016) report very similar estimates, of around 18 percent, for the gender pay gap in the US. The differential in pay between male and female workers, obtained after controlling for worker's characteristics that capture among other things differences in productivity, is often interpreted as an estimate of employer discrimination - that is, male and female workers with equal qualifications and skills do not share equal pay.

[Table 5 about here]

Next, we investigate how the "On the Spot Firm" entry deregulation affected employer discrimination by estimating its effect on the gender pay gap for all workers. We estimate the following specification:

$$\ln w_{ijmt} = \alpha + \beta(Fem_i \times Spot_{mt}) + \delta Spot_{mt} + \gamma X'_{it} + \lambda Z'_{jt} + d_{(\cdot)} + \epsilon_{ijmt} \qquad (3)$$

where $Spot_{mt}$ is the deregulation indicator variable; it takes the value of one in the years when and after municipality m introduced the reform and zero otherwise.[21] In addition to the other variables and controls explained above, the linked employer-employee data that we use allows us to also include worker or worker-firm (match) fixed effects in our regressions, d_i and d_{ij}, respectively. Therefore, we obtain results that account for individual heterogeneity in the structure of compensation and patterns of job mobility, and for sorting of workers across firms. We cluster the standard errors by municipality, the level at which the policy was introduced. The coefficient of interest in this specification is the interaction term between the female dummy and the deregulation variable, $Fem_i \times Spot_{mt}$. A positive coefficient would be consistent with deregulation having a positive differential effect on female pay, relative to male, in affected municipalities, implying a reduction in the gender pay gap. That result would be consistent with Becker's prediction that competition reduces discrimination.

We also investigate how increased competition following the entry deregulation affected the gender pay gap for workers in different skill categories and in different occupations across the corporate hierarchy. Existing evidence has shown that the gender pay gap declined at different rates across the wage distribution; it is therefore relevant to assess how competition affects the gender pay gap for workers in jobs that require different skill levels or in different occupations. To that end, we estimate the following specification:

$$\ln w_{ijmkt} = \alpha + \beta(Fem_i \times S_{k,it} \times Spot_{mt}) + \delta Spot_{mt} + \rho S_{k,it} + \gamma X'_{it} + \lambda Z'_{jt} + d_{(\cdot)} + \epsilon_{ijmkt} \quad (4)$$

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[21] Some municipalities have more than one one-stop shop. The treatment dummy variable is set to one after the first shop was opened.

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The dependent variable is the natural log of real monthly pay of worker i (in firm j, municipality m with skill level k) in year t. As above, Fem_i is a female dummy and $Spot_{mt}$ is the deregulation treatment dummy variable. $S_{k,it}$ is a vector of k indicator variables, for the skill category of the worker or, in other specifications, the worker's occupation. As explained in Section 4, to obtain the three skill categories, we collapse the eight qualification levels based on the complexity and skill requirement of the tasks (see Table A1) into high- , medium- and low-skill levels. We control for the same observed individual characteristics as above, included in X'_{it}, and for firm characteristics in Z'_{jt}. We continue to control for industry (d_s), year (d_t) and municipality (d_m) fixed effects as well as for worker or match fixed effects, d_i and d_{ij}, in alternate specifications.

The estimation results are reported in Table 6. In column (1), we investigate the effect of the "On the Spot Firm" program on the gender pay gap across all workers (equation 3). The coefficient on the $Spot_{mt}$ variable, δ, captures the average effect of the deregulation on wages, and measures the total effect for male workers. The coefficient on the interaction term between the female dummy and the deregulation variable, $Fem_i \times Spot_{mt}$, captures the differential effect of the deregulation on female workers' pay. The stand-alone female dummy is absorbed by the worker fixed effect. We obtain a negative but statistically insignificant coefficient on the reform indicator, that is, on male workers' average pay. Importantly, the interaction of the deregulation variable with the female dummy is positive and statistically significant. The estimates imply that the reform increased female workers' relative pay, thus reducing the gender pay gap. This evidence is consistent with the prediction that competition drives discriminatory behavior out of the market. Black and Strahan (2001) report consistent evidence following banking deregulation in the U.S. The results also show that while firm size has a positive and significant effect on male wages, both economically and statistically, the effect of firm size on female workers' pay is considerably lower - the interaction of firm size with the female dummy is negative and statistically significant.

[Table 6 about here]

The average results in column (1) of Table 6 may hide heterogeneity in the effects of the deregulation for workers in different skill categories.[22] Therefore, we investigate the effect of the reform on the gender pay gap for workers in each skill level. To that end, columns (2) and (3) report results from estimating equation (4). The estimates of main interest in these specifications are those in β, the vector of coefficients on the triple interaction terms between the deregulation indicator variable, the workers' skill level and the female dummy, $Fem_i \times S_{k,it} \times Spot_{mt}$. Each element, β_k, captures the differential effect of the deregulation on the wages of female workers in

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[22]We show in previous work that although workers in the low-skill category experienced a decrease in pay following the deregulation, the reform increased the returns to skill (Fernandes et. al, 2014); Guadalupe (2007) reports consistent findings that returns to skill increase with competition.

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skill category k, relative to males in the same skill category. The interaction term $S_{k,it} \times Spot_{mt}$ captures the effect of the reform for males in each skill category. The stand-alone $Spot_{mt}$ term now captures the effect of the "On the Spot Firm" on the wages of the least skilled male workers, while its interaction with the female dummy ($Fem_i \times Spot_{mt}$) measures the differential effect for females in the low-skill category (low-skill is the omitted category).

In column (2) we control for worker fixed effects in addition to all other controls and fixed effects discussed above. We find that the stand alone $Spot$ term is negative and statistically significant, implying that the deregulation is associated with a reduction in low-skill workers' pay of around 1 percent. The interaction of the $Spot$ variable with the female dummy is positive but statistically insignificant. However, the coefficients on the interaction $S_{k,it} \times Spot_{mt}$ are positive and statistically significant. That is, workers in the high- and medium-skill categories in affected municipalities experienced a positive and statistically significant differential effect of the deregulation on pay, relative to low-skilled workers. In particular, high-skilled male workers' pay is 2.4 percent higher, and the pay of medium-skilled males is 0.3 percent higher.

Importantly, the coefficients on the triple interaction term capturing the differential effect of the reform on the pay of medium- and high-skilled female workers, $Fem_i \times S_{k,it} \times Spot_{mt}$, are positive and statistically significant at the 1 percent level. That is, skilled female workers experienced an additional increase in pay relative to males following the deregulation. The pay of females in the high-skill category increased by an additional 1.4 percent and of those in the medium-skill category by an extra 1 percent, respectively, relative to males with the same skills. The estimates imply that the overall pay of medium-skilled males decreased by 0.6 percent in treatment municipalities, while female pay in the same skill category increased by 0.4 percent. For those in high-skill jobs, while male pay increased by 1.5 percent, females saw their pay increase by 2.9 percent as a result of the increased competition following the entry deregulation. These results suggest that prior to deregulation firms may have been sharing rents disproportionately with men and the deregulation contributed to improve women's relative wages, reducing the gender pay gap (see also Black and Strahan, 2001).

Results remain robust in column (3), where we include worker-firm (match) fixed effects, and thus identify the differential impact of the deregulation on female pay from workers that remain in the same firm after the policy change. While in the individual fixed effects model of column (2) we identify the effects from individuals who stay in the same firm as well as from those that move to a different firm after the policy change, in the match fixed-effects model of column (3), the effects are identified only from variation over time for workers that remain employed in the same firm. This ensures that unobserved changes in composition of employment are not driving the results.

Overall, the results in Table 6 imply that the deregulation is associated with a narrowing of the gender pay gap, and provide empirical support for the prediction that increased product

market competition drives discrimination, reflected in lower female wages, out of the market. Our findings provide quasi-natural experimental evidence for the dynamic implication from Becker's (1957) theory; discrimination is hard to sustain in a competitive environment and surviving discriminating firms succumb to market forces and change their behavior.

Next, we investigate the effect of increased competition resultant from the entry deregulation on the gender pay gap for managerial and non-managerial workers. We estimate a specification similar to equation (4), with the same controls and fixed effects, but instead of the triple interaction with the skill categories, we include interactions with a dummy variable for whether the worker is in a managerial position. Workers in managerial positions are those in levels 1 ("Top executives") or 2 ("Intermediary executives") in the classification described in Table A1. Table 7 reports the results. In column (1) we estimate the average effect of the deregulation for all workers. We continue to find that the effect of the reform on female pay is positive and statistically significant, while the effect on male pay is negative but insignificant. As before, firm size is an important determinant of pay but the effect of firm size for females is significantly lower than for males.[23] Interestingly, we find that males that are promoted to a managerial position increase their pay by 7.4 percent on average while females' pay increases by 8.4 percent.

[Table 7 about here]

In column (2) we estimate the effect of the "On the Spot Firm" deregulation on the gender pay gap for managerial and non-managerial workers. We find that the *Spot* variable alone is negative and statistically significant while its interaction with the female dummy is positive and significant and of larger magnitude, implying a small positive effect for female non-managerial workers' pay and a negative effect for males'. That again suggests that firms shared rents disproportionately with males before the policy change. We also find that managerial workers' pay increased in treated municipalities following the deregulation. Higher demand for managers following the increased firm entry could be an explanation for the increase in managers' pay.

More importantly in our context, we find that the triple interaction capturing the differential effect of the reform on female managers' pay is positive and statistically significant at the 1 percent level, implying a reduction in the managerial gender pay gap. The magnitude of the estimates shows that while male managers' pay increased overall by 2.5 percent following the deregulation, female managers' pay increased overall by 3.8 percent. Column (3) reports results with match fixed effects. The coefficient on the female differential effect of the policy is not statistically significant in these results. This suggests that the gain for female managers relative to males is driven by those that move to a different firm after the deregulation.

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[23]See Bertrand and Hallock (2001) for a discussion about the role of firm size on the gender pay gap of executives.

In Table 8 we estimate the effect of competition on employer discrimination across the corporate hierarchy, using occupations to look at more refined managerial positions. We obtain estimates for the impact on "Directors and Chief Executives" (ISCO88 category 121; CEOs for short), "Department Managers" (ISCO88 categories 122 and 123; DM for short) and other workers in the corporation. We estimate equation (4) but where $S_{k,it}$ is now a vector of k indicator variables for whether the worker is a CEO, a DM or other ("other" is the omitted category). The results in column (1) remain the same as in the previous tables. In column (2) we find that the reform has a positive and statistically significant effect on CEOs and department managers' pay in treated municipalities. We also find that females that are promoted to the CEO position have a lower pay increase than their male counterparts: the $Fem \times CEO$ term is negative and statistically significant.

Consistent with the previous results, we find that on average male workers in the "other" category experienced a negative but insignificant effect of the reform while females experienced an increase in relative pay. However, while the deregulation reduced the gender pay gap for female department managers, the differential effect on female CEOs' pay relative to male's is not statistically significant. Existing evidence documents the relative absence of females from the top executive job. Our results show that those females that break the "high ceiling" and reach the top of a corporation still have lower pay than their male counterparts, and increased competition does not improve their relative pay. This suggests that the labor market for the top executive still especially favors men.[24] Overall, our results in this section provide empirical support for the prediction in Becker (1957) that increased competition reduces discrimination; but the reduction in the gender pay gap is observed for those in medium- and high-skill occupations and in managerial positions and is not observed for the Chief Executive or for low-skilled workers.

[Table 8 about here]

7 Effect of the "On the Spot Firm" deregulation on the share of female employees

In this section we investigate whether the entry deregulation affected the share of female employment. As discussed in Black and Strahan (2001), discriminating employers could also prefer to keep women in lower positions than implied by their skills; as a result, increased competition would increase female employment shares in managerial and skilled positions. We therefore test whether the proportion of female employment in managerial occupations and in each skill

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[24]Blau and Kahn (2016) discuss that the gender pay gap declined much more slowly at the top of the wage distribution than at the middle or the bottom and by 2010 was noticeably higher at the top.

category increased following the "On the Spot Firm" deregulation. We estimate a specification similar to equation (1), at the municipality-industry-year level, where the dependent variable is the (logged) share of female employment in managerial positions and in each skill category.[25] The explanatory variable of main interest is the "On the Spot Firm" deregulation indicator. We control for industry and year fixed effects and for municipality time trends. This also follows Black and Strahan (2001), who regress the share of females in managerial positions at the state-level on deregulation indicators in the US banking sector.

Table 9 reports the results. As shown in column (1), the share of managerial positions held by females increased following the deregulation. The coefficient on the "On the Spot Firm" indicator is positive and statistically significant. The estimated effect represents an increase of about 1 percent in the share of females in managerial jobs. This suggests that discriminating employees kept women in lower occupations and that the increased competition forced them to upgrade their occupational status to managerial positions to reduce the cost of discrimination. The remaining columns of the table report results when the dependent variable is the share of females in high- medium- and low-skill occupations, respectively. The coefficient on the deregulation indicator is always positive but is statistically significant only for the share of females in medium-skilled employment. Overall these results suggest that a form of discrimination was to keep women in lower occupations, in particular non-managerial, and that increased competition led to an increase in the share of females in managerial positions. However, the decline in the gender pay gap estimated in the previous section is not arising from composition effects since, as shown, the difference between the effects of the deregulation on male and female pay is statistically significant. If there were only compositional effects, male and female wages within each occupation or skill category would change by the same amount.

[Table 9 about here]

8 Conclusion

In this paper we investigate empirically the dynamic implication from Becker's (1957) theory that increased product market competition reduces the gender pay gap. Discriminating employers hire fewer women and more men than profit maximization would imply. Males are paid more than females with the same skills and productivity, and thus employers give up profits to indulge their discriminating tastes. Since discrimination increases costs, it is hard to sustain in a competitive market. Increased competition forces discriminating employers to change their behavior, reducing the wage differential between male and female workers. Increased product market competition thus drives discrimination out of the market.

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[25]We use as dependent variables the ln(share+1) to account for cases where the share is zero.

We exploit the "On the Spot Firm", a comprehensive firm entry deregulation reform introduced in Portugal from 2005, as a quasi-natural experiment, as an exogenous source of increased competition. Prior to 2005, to register a new business entrepreneurs would need to fulfil 11 procedures in a process that took on average 78 days and cost 13.5 percent of GDP per capita. The "On the Spot Firm" reform was introduced with the purpose of cutting red tape, reducing the time, cost and complexity of registering a new firm. The program established one-stop shops where entrepreneurs can register a company in a single office desk in less than a hour at a cost of around 3 percent of GDP per capita. The program was initially introduced in a few municipalities and was progressively rolled-out randomly across municipalities over time. The deregulation was very successful, and as a result Portugal rose from 113th to 26th in the World Bank "Ease of Doing Business" ranking of countries.

We use matched employer-employee data for the universe of private sector firms and workers in Portugal to investigate the effect of the increased competition following the deregulation on the pay differential between men and women. We exploit the cross-municipality-year variation in the implementation of the program for identification. In addition to unusually detailed observable worker and firm characteristics, we control for worker or worker-firm fixed effects and thus identify the impact of the deregulation accounting for unobserved worker characteristics or from individuals who stay in the same firm after the deregulation. We start by investigating the effect of the deregulation on firm entry and measured competition within industries and municipalities. We show that the deregulation increased firm entry and decreased measured competition (concentration ratios and the HHI).

We obtain difference-in-differences estimates of the effect of increased competition following the reform on the gender pay gap, for workers in different skill categories and across the corporate hierarchy. We find that the entry deregulation reduced the gender pay gap for medium- and high-skilled workers in affected municipalities. The differential effect of the reform on female workers' pay in treatment municipalities is positive and statistically significant. Our estimates imply that for workers in high-skill jobs, while male wages increased by 1.5 percent, females' increased by 2.9 percent as a result of the deregulation, thus reducing the gender pay gap. Overall pay of medium-skilled males decreased by 0.6 percent in treatment municipalities, while that of females in the same skill category increased by 0.4 percent.

We look at the effect of the reform on the gender pay gap across the corporate hierarchy, and find that the reform is associated with a reduction in the gender pay gap for workers in managerial positions, except for the CEO. We also find that the share of females in managerial positions increased following the deregulation, suggesting that discriminating employers kept women in lower positions than implied by their skills, and competition induced them to upgrade their occupational status. Our results suggest that the decline in the gender pay gap is not arising from composition effects.

Overall, our results are consistent with the prediction from Becker (1957) that product market competition reduces employer discrimination. In particular, firms change their behavior as increased competition leads to a higher efficiency loss from discriminating against women. However, these effects are not found for those in the lowest skill jobs or for CEOs. The labor market for the top executive still especially favors men and increased competition does not improve females' relative pay.

Our results have important policy implications. Discrimination has been shown to create inefficiencies that contribute to significantly reduce output across countries (e.g. Cavalcanti and Tavares, 2016). Our findings that reducing entry barriers in Portugal contributed to reduce the gender pay gap, particularly among medium and high-skilled and managerial workers, suggest that deregulation contributes to reduce inefficiencies arising from gender discrimination. Over the last decades many countries have sought to increase product market competition through entry deregulation. Existing evidence shows that entry and competition contribute to productivity growth and innovation (e.g. Djankov et al., 2006; and Aghion et al., 2009). At the same time, the differential between male and female wages has decreased in recent decades. Our results suggest a link between competition and the narrowing of the gender pay gap.

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10 Tables

Table 1: Sample size

Year	All firms	Entrants	% Entrants "On the Spot"	Workers
	(1)	(2)	(3)	(4)
2002	211,113	13,389		1,796,261
2003	215,354	15,603		1,756,603
2004	218,817	14,593		1,790,370
2005	233,514	16,509	20.01	1,925,115
2006	235,094	17,147	42.32	1,933,797
2007	255,757	20,182	51.24	2,050,843
2008	258,943	20,413	66.42	2,085,363
2009	253,148	17,382	76.26	2,002,222

Own calculations based on Portugal, MTSS (2002-2009).

Table 2: Detailed summary statistics of logged monthly real pay, by group of workers and gender

ln(monthly real pay)	Mean	Median	Std. Dev.	P10	P90	Nb. Obs.
Skill levels						
High skill	7.182	7.155	0.683	6.369	8.049	2,266,012
Males	7.255	7.233	0.705	6.408	8.151	1,446,880
Females	7.053	7.038	0.621	6.303	7.823	819,132
Medium skill	6.543	6.493	0.490	6.071	7.147	5,277,133
Males	6.623	6.574	0.500	6.121	7.246	3,242,480
Females	6.416	6.373	0.444	6.016	6.936	2,034,653
Low skill	6.321	6.300	0.488	5.950	6.866	4,720,471
Males	6.450	6.413	0.486	5.992	7.041	2,108,187
Females	6.217	6.238	0.465	5.791	6.680	2,612,284
Executives						
CEOs	8.145	8.195	0.856	6.008	7.305	22,089
Males	8.252	8.318	0.833	7.129	9.232	17,685
Females	7.714	7.686	0.807	6.725	8.732	4,404
Department managers	7.625	7.650	0.796	6.560	8.612	208,991
Males	7.700	7.741	0.803	6.610	8.685	149,931
Females	7.435	7.429	0.744	6.447	8.366	59,060
Other workers	6.555	6.471	0.587	7.009	9.180	12,032,536
Males	6.677	6.597	0.591	6.089	7.441	6,629,931
Females	6.404	6.336	0.546	5.984	7.062	5,402,605
Managerial						
Managerial	7.362	7.361	0.759	6.382	8.304	992,382
Males	7.442	7.466	0.795	6.396	8.415	638,589
Females	7.217	7.221	0.666	6.351	8.041	353,793
Non-managerial	6.507	6.445	0.545	6.007	7.188	11,271,234
Males	6.627	6.565	0.546	6.078	7.323	6,158,958
Females	6.361	6.315	0.508	5.984	6.943	5,112,276
All workers	6.576	6.481	0.612	6.013	7.354	12,263,616
Males	6.704	6.610	0.621	6.095	7.504	6,797,547
Females	6.416	6.340	0.560	5.986	7.094	5,466,069

Own calculations based on Portugal, MTSS (2002-2009). These statistics are computed using the estimation sample.

Table 3: Pre-reform average growth rates of outcome variables

	Late adopters	Early adopters	Difference	P-value
	(1)	(2)	(3)	(4)
ln Compensation				
Skill levels				
High-skill	0.024	0.029	-0.005	0.506
	(0.004)	(0.005)	(0.007)	
Medium-skill	0.005	0.013	-0.008	0.111
	(0.003)	(0.003)	(0.005)	
Low-skill	0.008	0.014	-0.006	0.243
	(0.003)	(0.003)	(0.005)	
Executives				
CEOs	0.041	0.045	-0.004	0.914
	(0.025)	(0.020)	(0.037)	
Department managers	0.038	0.058	-0.020	0.261
	(0.010)	(0.012)	(0.018)	
Other workers	0.009	0.017	-0.008	0.060
	(0.002)	(0.002)	(0.004)	
Managerial work				
Managerial	0.032	0.043	-0.010	0.347
	(0.006)	(0.008)	(0.011)	
Non-managerial	0.008	0.015	-0.007	0.075
	(0.002)	(0.002)	(0.004)	
Firm entry	0.155	0.114	0.040	0.615
	(0.046)	(0.030)	(0.080)	
Gender pay gap	-0.196	-0.196	0.000	0.998
	(0.008)	(0.003)	(0.009)	

The table reports initial growth trends (between 2002 and 2004) of average wages and number of new firms at the municipality level. For the gender pay gap, we report the coefficient of a female dummy from compensation regressions, for early and for late adopters, controlling for all workers' characteristics, over the pre-reform period. Standard errors are reported in parentheses. The p-value relates to the test of the null hypothesis of equality between the means (proportions).

Table 4: Effect of the "On the Spot Firm" program on firm entry and industry concentration

Panel A

Dependent variable:	Firm Entry		CR5		HHI	
	(1)	(2)	(3)	(4)	(5)	(6)
Spot	3.786***	3.778***	-0.224***	-0.223***	-0.154***	-0.152***
	(0.751)	(0.751)	(0.020)	(0.020)	(0.014)	(0.014)
Constant	0.588***	0.789***	0.553***	0.515***	0.152***	0.123***
	(0.073)	(0.278)	(0.018)	(0.022)	(0.009)	(0.013)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality trends		Yes		Yes		Yes
R^2	0.185	0.185	0.464	0.467	0.322	0.324
No. Observations	56,782	56,782	55,043	55,043	56,782	56,782

Panel B

Dependent variable:	Firm Entry		CR5		HHI	
	(1)	(2)	(3)	(4)	(5)	(6)
Spot	1.208***	1.207***	-1.365***	-1.359***	-0.918***	-0.914***
	(0.164)	(0.164)	(0.108)	(0.109)	(0.084)	(0.084)
ME	4.242***	4.245***	-0.232***	-0.230***	-0.141***	-0.141***
Constant	-0.238***	-0.091	0.237***	0.015	-1.758***	-1.940***
	(0.074)	(0.146)	(0.074)	(0.115)	(0.076)	(0.093)
Industry FE	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Municipality trends		Yes		Yes		Yes
R^2	0.136	0.136				
Log-Likelihood			-22,717	-22,644	-23,867	-23,820
No. Observations	56,782	56,782	55,043	55,043	56,782	56,782

The dependent variable in columns 1 and 2 is the number of new firms; in columns 3 and 4 it is the CR5 concentration ratio of sales; and in columns 5 and 6 it is the Herfindahl-Hirschman Index (HHI) of sales. Observations are by municipality-industry-year. Panel A reports results from OLS estimation, while Panel B reports negative binomial regression for firm entry, and generalized linear model estimation for CR5 and HHI. ME stands for the marginal effect of the "On the Spot Firm". Robust standard errors, clustered by municipality are reported in parentheses. * $p<0.10$, ** $p<0.05$, *** $p<0.01$.

Table 5: Overall gender pay gap

Dependent variable:	ln Compensation
	(1)
Female	-0.190***
	(0.003)
Medium-skill	0.137***
	(0.004)
High-skill	0.484***
	(0.009)
ISCED2	0.093***
	(0.003)
ISCED3	0.172***
	(0.006)
ISCED56	0.478***
	(0.006)
ln(firm size)	0.032***
	(0.004)
Year FE	Yes
Industry FE	Yes
Municipality trends	Yes
R^2	0.460
No. observations	12,263,616

The dependent variable is the natural log of real monthly pay. ISCED are the educational categories, defined in Section 4.1. Skill categories are also defined in section 4.1. Other covariates include the worker's tenure and its square, the type of employment contract (whether open-ended or fixed-term), the instrument of collective regulation, the natural log of firm size (number of employees), the share of female workers in total firm employment, the share of low skilled workers in total firm employment, whether the firm is an exporter, whether it is multi-establishment, and ownership. Robust standard errors, clustered by firm in parentheses. * $p<0.10$; ** $p<0.05$; *** $p<0.01$.

Table 6: Effect of the "On the Spot Firm" program on the gender pay gap, by skill levels

Dependent variable:	ln Compensation		
	(1)	(2)	(3)
Stop	-0.002	-0.009***	-0.008***
	(0.002)	(0.002)	(0.002)
Female×Stop	0.005**	0.001	-0.002
	(0.002)	(0.003)	(0.004)
Medium-skill×Stop		0.003*	0.002
		(0.002)	(0.002)
High-skill×Stop		0.024***	0.027***
		(0.003)	(0.003)
Female×Medium-skill×Stop		0.010***	0.010**
		(0.004)	(0.005)
Female×High-skill×Stop		0.014***	0.010**
		(0.005)	(0.005)
Medium-skill	0.060***	0.059***	0.036***
	(0.002)	(0.002)	(0.002)
High-skill	0.134***	0.125***	0.076***
	(0.003)	(0.003)	(0.003)
Female×Medium-skill	-0.015***	-0.019***	-0.007*
	(0.005)	(0.004)	(0.003)
Female×High-skill	-0.005	-0.012**	-0.005
	(0.007)	(0.005)	(0.004)
ln(firm size)	0.054***	0.054***	0.061***
	(0.005)	(0.005)	(0.003)
ln(firm size)×Female	-0.047***	-0.047***	-0.030***
	(0.002)	(0.002)	(0.005)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	
Municipality trends	Yes	Yes	Yes
Worker FE	Yes	Yes	
Match FE			Yes
R^2	0.054	0.054	0.036
No. observations	12,263,616	12,263,616	12,263,616

The dependent variable is the natural log of real monthly pay. Skill categories are as defined in Section 4.1. Other covariates include the workers' tenure and its square, the level of education, the type of employment contract (whether open-ended or fixed-term), the instrument of collective regulation, the natural log of firm size (number of employees), the share of female workers in total firm employment, the share of low skilled workers in total firm employment, whether the firm is an exporter, whether it is multi-establishment, and ownership. Robust standard errors, clustered by municipality, in parentheses. * p<0.10; ** p<0.05; *** p<0.01.

Table 7: Effect of the "On the Spot Firm" program on the gender pay gap, managerial workers

Dependent variable:	ln Compensation		
	(1)	(2)	(3)
Stop	-0.002	-0.005**	-0.003
	(0.002)	(0.002)	(0.002)
Female×Stop	0.005**	0.006**	0.002
	(0.002)	(0.003)	(0.002)
Manager×Stop		0.030***	0.032***
		(0.004)	(0.003)
Female×Manager×Stop		0.007***	0.001
		(0.002)	(0.002)
Manager	0.074***	0.063***	0.038***
	(0.002)	(0.003)	(0.003)
Female×Manager	0.010***	0.006**	0.001
	(0.003)	(0.003)	(0.003)
ln(firm size)	0.054***	0.054***	0.064***
	(0.005)	(0.005)	(0.003)
ln(firm size)×Female	-0.047***	-0.047***	-0.029***
	(0.002)	(0.002)	(0.006)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	
Municipality trends	Yes	Yes	Yes
Worker FE	Yes	Yes	
Match FE			Yes
R^2	0.051	0.051	0.034
No. observations	12,263,616	12,263,616	12,263,616

The dependent variable is the natural log of real monthly pay. Workers in managerial positions are those in levels 1 ("Top management") or 2 ("Middle management") in the classification described in Table A1. Other covariates include the workers' tenure and its square, the level of education, the type of employment contract (whether open-ended or fixed-term), the instrument of collective regulation, the natural log of firm size (number of employees), the share of female workers in total firm employment, the share of low skilled workers in total firm employment, whether the firm is an exporter, whether it is multi-establishment, and ownership. Robust standard errors, clustered by municipality, in parentheses. * $p<0.10$; ** $p<0.05$; *** $p<0.01$.

Table 8: Effect of the "On the Spot Firm" program on the gender pay gap, by occupation

Dependent variable:	ln Compensation		
	(1)	(2)	(3)
Stop	-0.002	-0.003	-0.001
	(0.002)	(0.002)	(0.002)
Female×Stop	0.005**	0.006**	0.002
	(0.002)	(0.002)	(0.002)
Dept.Mng×Stop		0.025***	0.037***
		(0.005)	(0.004)
CEO×Stop		0.041***	0.043***
		(0.007)	(0.006)
Female×Dept.Mng×Stop		0.013***	0.004
		(0.005)	(0.005)
Female×CEO×Stop		-0.013	-0.009
		(0.013)	(0.013)
Dept.Mng	0.105***	0.095***	0.049***
	(0.004)	(0.003)	(0.004)
CEO	0.151***	0.137***	0.069***
	(0.008)	(0.010)	(0.009)
Female×Dept.Mng	0.004	-0.002	0.005
	(0.005)	(0.005)	(0.005)
Female×CEO	-0.032***	-0.029**	-0.006
	(0.012)	(0.013)	(0.013)
ln(firm size)	0.054***	0.054***	0.064***
	(0.005)	(0.005)	(0.003)
ln(firm size)×Female	-0.047***	-0.047***	-0.029***
	(0.002)	(0.002)	(0.005)
Year FE	Yes	Yes	Yes
Industry FE	Yes	Yes	
Municipality trends	Yes	Yes	Yes
Worker FE	Yes	Yes	
Match FE			Yes
R^2	0.051	0.051	0.034
No. observations	12,263,616	12,263,616	12,263,616

The dependent variable is the natural log of real monthly pay. CEOs are workers whose 3-digit ISCO88 occupation is 121, Department mangers are those in the 3-digit occupations 122 or 123. Other covariates include the workers' tenure and its square, the level of education, the type of employment contract (whether open-ended or fixed-term), the instrument of collective regulation, the natural log of firm size (number of employees), the share of female workers in total firm employment, the share of low skilled workers in total firm employment, whether the firm is an exporter, whether it is multi-establishment, and ownership. Robust standard errors, clustered by municipality, in parentheses. * $p<0.10$; ** $p<0.05$; *** $p<0.01$.

Table 9: Effect of the "On the Spot Firm" program on female employment shares

Dependent variable:	female employment share			
	managerial	high-skill	medium-skill	low-skill
	(1)	(2)	(3)	(4)
Stop	0.008**	0.004	0.006*	0.001
	(0.004)	(0.004)	(0.003)	(0.004)
Constant	0.242***	0.261***	0.309***	0.474***
	(0.010)	(0.008)	(0.007)	(0.007)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes	Yes	Yes	Yes
Municipality trends	Yes	Yes	Yes	Yes
R^2	0.286	0.377	0.546	0.538
No. observations	33,825	39,734	46,770	47,390

Observations are by municipality-industry-year. The dependent variables are the shares of women in total employment in each skill or managerial category. We use the natural log of the shares plus 1 to account for cases in which the share is zero. Robust standard errors, clustered by municipality, in parentheses. * $p<0.10$, ** $p<0.05$, *** $p<0.01$.
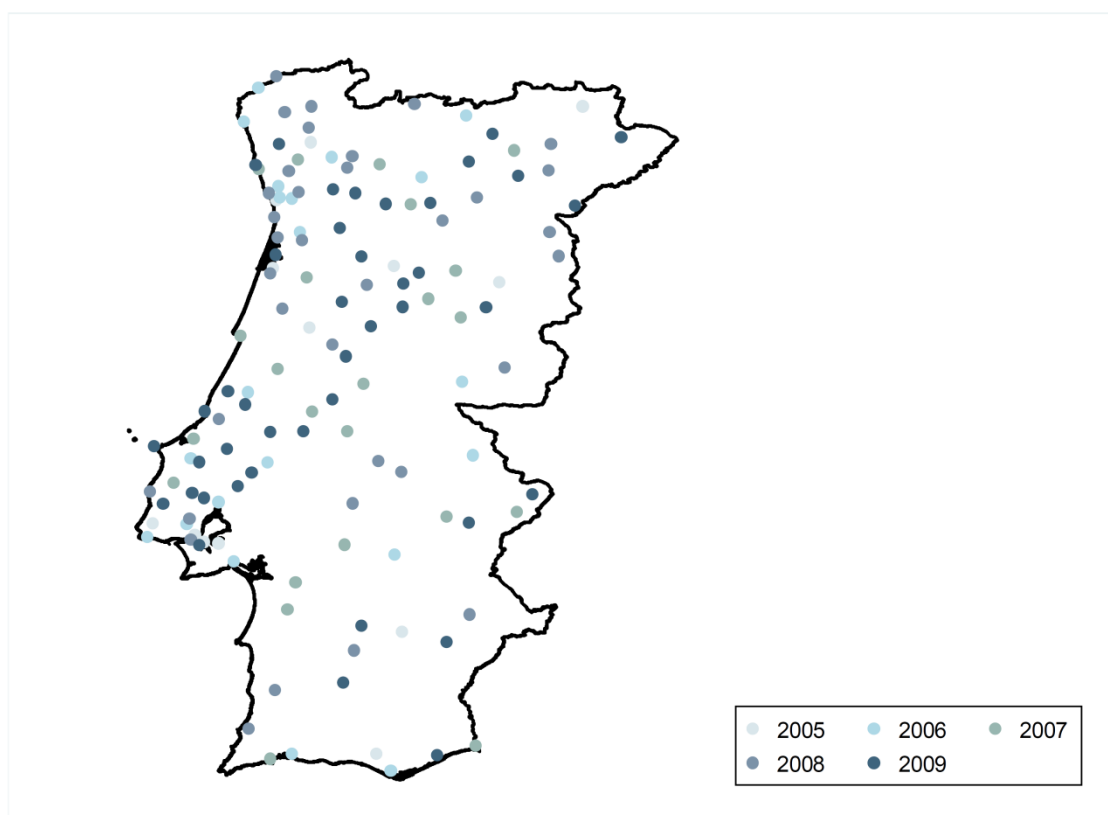
11 Figures

Figure 1: Introduction of "On the Spot Firm" offices by year and municipality

A Appendix

Table A.1: Classification of workers according to the skill requirement of the tasks

Level	Tasks	Skills
1. Top executives (top management)	Definition of the firm general policy or consulting on the organization of the firm; strategic planning; creation or adaptation of technical, scientific and administrative methods or processes	Knowledge of management and coordination of firms' fundamental activities; knowledge of management and coordination of the fundamental activities in the field to which the individual is assigned and that requires the study and research of high responsibility and technical level problems
2. Intermediary executives (middle management)	Organization and adaptation of the guidelines established by the superiors and directly linked with the executive work	Technical and professional qualifications directed to executive, research, and management work
3. Supervisors, team leaders	Orientation of teams, as directed by the superiors, but requiring the knowledge of action processes	Complete professional qualification with a specialization
4. Higher-skilled professionals	Tasks requiring a high technical value and defined in general terms by the superiors	Complete professional qualification with a specialization adding to theoretical and applied knowledge
5. Skilled professionals	Complex or delicate tasks, usually not repetitive, and defined by the superiors	Complete professional qualification implying theoretical and applied knowledge
6. Semi-skilled professionals	Well defined tasks, mainly manual or mechanical (no intellectual work) with low complexity, usually routine and sometimes repetitive	Professional qualification in a limited field or practical and elementary professional knowledge
7. Non-skilled professionals	Simple tasks and totally determined	Practical knowledge and easily acquired in a short time
8. Apprentices, interns, trainees	Apprenticeship	

Hierarchical levels defined according to Decreto Lei 121/78 of July 2nd (Lima and Pereira, 2003).

Table A.2: Summary statistics for all workers and by type, estimation sample

	All workers	Skill levels			Executives			Managerial	
		High	Medium	Low	CEO	Dept.Mng.	Other	Managerial	Other
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)
Covariates:									
ln(monthly real pay)	6.576	7.182	6.543	6.321	8.145	7.625	6.555	7.362	6.507
Spot	0.356	0.409	0.336	0.353	0.345	0.390	0.356	0.412	0.351
Female	0.446	0.361	0.386	0.553	0.199	0.283	0.449	0.357	0.454
Tenure	7.678	9.722	8.039	6.293	11.093	10.093	7.630	8.437	7.611
Closed-end contract	0.259	0.176	0.229	0.332	0.130	0.117	0.262	0.183	0.266
Education (baseline: ISCED1)									
ISCED2	0.216	0.158	0.223	0.236	0.070	0.123	0.218	0.098	0.226
ISCED3	0.182	0.251	0.187	0.144	0.115	0.222	0.182	0.189	0.182
ISCED56	0.085	0.357	0.029	0.016	0.732	0.483	0.077	0.592	0.040
Instrument of collective regulation (baseline: Multi-employer agreement)									
Association agreement	0.880	0.787	0.930	0.868	0.727	0.755	0.882	0.725	0.894
Labour regulation directive	0.042	0.078	0.034	0.034	0.086	0.079	0.042	0.109	0.037
Company-level agreement	0.021	0.046	0.013	0.019	0.015	0.018	0.021	0.041	0.020
Other	0.046	0.071	0.016	0.066	0.161	0.137	0.044	0.107	0.040
Exporter	0.465	0.564	0.438	0.447	0.680	0.596	0.462	0.532	0.459
Multi-plant	0.305	0.373	0.272	0.310	0.353	0.374	0.304	0.352	0.301
Ownership status (baseline: private national)									
Public	0.021	0.041	0.009	0.024	0.025	0.015	0.021	0.045	0.019
Foreign	0.103	0.155	0.084	0.098	0.175	0.146	0.102	0.151	0.098
No. observations	12,263,616	2,266,012	5,277,133	4,720,471	22,089	208,991	12,032,536	992,382	11,271,234

Own calculations based on Portugal, MTSS (2002-2009). Statistics computed using the estimation sample.

Table A.3: Summary statistics of firm-level variables, estimation sample

	Mean	Median	Std.dev.	Nb. Obs.
Covariates:				
ln(size)	1.457	1.386	1.072	1,455,516
Share of female workers	0.460	0.400	0.418	1,455,516
Share of low skilled workers	0.379	0.286	0.389	1,455,516
CR5	0.118	0.035	0.211	1,455,516
HHI	0.029	0.005	0.094	1,455,516

Own calculations based on Portugal, MTSS (2002-2009). Statistics computed using the estimation sample.