

Firm Entry Deregulation, Competition and Returns to Education and Skill*

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Abstract

This paper studies the effect of firm entry deregulation on the returns to skill and education. We exploit a comprehensive episode of entry deregulation, unique in the industrialized world, as a quasi-natural experiment. Using matched employer-employee data for the universe of workers and firms in Portugal, we show that increased product market competition, which resulted from deregulation, increased the returns to a university degree and the returns to skill. We verify that our results are not driven by changes in employment composition, and are unlikely to be driven by skill-biased technical change, or by workers who change skill levels after the deregulation.

Key Words: Entry, Deregulation, Product Market Competition, Wage Structure, Returns to Education.

JEL Classification Numbers: J3.

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1 Introduction

Whilst all countries regulate firm entry, the extent and nature of the regulations vary widely across the world.¹ Overly-restrictive regulations are likely to be inefficient and have knock-on effects on competition, innovation, employment, wages and economic growth. As a consequence, deregulation, and in particular the removal of restrictions on firm entry, has been a significant policy recommendation during the last few decades. These ideas also receive support in academic research. For example, Aghion et al. (2008) argue that deregulation associated with dismantling the License Raj in India led to firm entry and output growth. Aghion et al. (2009) show that policy reforms affecting firm entry conditions in the UK during the Thatcher era fostered incumbent innovation and productivity growth. Bertrand and Kramarz (2002) show that increased entry regulations in the retail trade industry in France had a negative effect on job creation and employment growth.²

This paper investigates the effects of deregulation on entry, competition, and the returns to education and skill. Using linked employer-employee data for the universe of private sector firms and workers in Portugal, we analyse the "On the Spot Firm" program, an initiative created to reduce the time, cost, and complexity of registering a new business. Prior to 2005, an entrepreneur would need to visit several public offices to start a business. In all, it took 11 procedures, 20 forms, and 78 days, making it slower than in any other EU country (World Bank, 2006). The "On the Spot Firm" program created one-stop shops where entrepreneurs could register a company in a single visit. As a result of this reform, the process of starting a business can now be completed in less than an hour. Between 2005 and 2010, business registration fees dropped from 13.5% to 3% of GDP per capita, and Portugal rose from 113 to 26 in the "Doing Business" ranking of economies.

We exploit the cross-time and cross-municipality variation in the implementation of the "On the Spot Firm" program to identify and measure changes in the returns to education and skill from firm entry deregulation.³ Using the roll-out of the "On the Spot Firm" program as an exogenous source of increased product market competition, we provide quasi-natural experimental evidence on the impact of entry deregulation on wages. The unusually rich and detailed information from the employer-employee dataset *Quadros de Pessoal* also allows us to obtain estimates that account for individual- or match (firm-worker)-specific unobserved heterogeneity, as well as changes in industry composition and regional effects.

¹Djankov et al. (2002) report that while in Italy an entrepreneur needs to follow 16 different procedures, pay US\$3946 in fees, and wait at least 62 business days to acquire the permits to start a business, an entrepreneur in Canada can finish the process in two days by paying US\$280 in fees and completing only two procedures.

²The positive effects in Aghion et al. (2008) are found in pro-employer states. In Aghion et al. (2009), sectors close to the technology frontier benefit because successful innovation allows incumbents to survive the threat. The negative effect in Bertrand and Kramarz (2002) is unambiguous.

³The program expanded over time to municipalities across the country and by the end of 2009 there were 164 one-stop shops dispersed throughout Portugal (see Figure 1 in Section 3).

In line with theoretical results linking product market competition and relative wages (see Section 2), our estimates suggest that after the reform, the relative wage of university graduates increased by around 5%, while that of high-skilled workers increased by around 3%. In our empirical specifications, we control for individual fixed effects, thus eliminating potential biases arising from unobserved individual characteristics, and we control for industry, municipality, and year effects, to parse out any industry or region characteristics or business shocks that might affect our outcomes. We further saturate the models and include trends by municipality-skill (education) to account for any differential pre-existing trends in wages. In all cases, we find that the wage premium to education and skill remains similar in magnitude and statistical significance. Finally, we control for firm-worker (match) fixed effects. In those specifications, the effect of the reform on returns to education and skill is identified from individuals who stay in the same firm after the deregulation. Therefore, the wage effect we identify reflects not merely higher wages in new jobs, but is commensurate with education and skills becoming more valuable after the reform.

We also find that the "On the Spot Firm" program had a positive and statistically significant effect on firm creation. This is consistent with results reported in other studies interested in identifying the effect of deregulation on firm entry (for example Bruhn, 2011, uses a similar firm entry deregulation in Mexico). Our estimates show that the deregulation had a negative and statistically significant effect on industry concentration ratios, and on the Herfindahl-Hirschman index (HHI), suggesting that it increased competition within industries. Because common measures of competition face a number of limitations, which include potential endogeneity, correlation with omitted variables, and non-monotonicity, we believe that the main contribution of our paper is to use the "On the Spot Firm" as an exogenous shock that increased competition to estimate its effects on the returns to skill and education.

Our results of increased wage premia for skills (and education), following an episode of increased product market competition, complement those in Guadalupe (2007). She studies the effect of increased competition on the returns to skill resulting from the UK's entry into the European Single Market Program and the 1996 appreciation of the British pound. She forcefully demonstrates that the returns to skill within an industry increase with foreign competition, whereas our analysis focusses exclusively on increased domestic competition. As such, we are able to provide independent evidence of the importance of greater product market competition on wages.

Our paper also contributes to a literature studying the effects of industry-specific deregulation episodes on wages, such as Rose (1987) and Card (1986).⁴ However, we investigate an economy-wide episode of entry deregulation, and study the effects on the returns to education and skills, a different aspect of the wage structure. Finally, a broader literature has shown

⁴See section 2 for a review of this literature.

that entry and competition spur productivity growth and innovation (e.g. Aghion et al., 2009; Djankov, 2006; Griffith and Harrison, 2004; Griffith, 2001; and Blundell et al., 1999). With most European countries experiencing poor economic performance, high unemployment, and weak fiscal positions, policies with the potential to raise growth, such as the reform studied here, are very appealing. Our results suggest that they may have implications for the distribution of income, which governments should at least be aware of.

The paper is organized as follows. The next section reviews the theoretical background and related literature. In section 3 we describe the "On the Spot Firm" program. Section 4 describes the data used and presents descriptive statistics and correlations between measures of competition and the returns to education and skill. Section 5 studies the effect of the reform on firm creation and on measured competition. Section 6 presents the quasi-natural experiment and discusses the results of the deregulation on the returns to education and skill. The last section concludes.

2 Theoretical Background and Related Literature

To the extent that the business registration reform analyzed in this paper reduced entry barriers, it increased competition in the product market. In this section, we discuss the theoretical link between product market competition and relative wages and, following Guadalupe (2007), outline a simple framework that extends the ideas in Boone (2000) to the labour market.⁵

Boone (2000) argues that with increasing product market competition efficient firms are able to exploit their cost advantage more aggressively, leading to a reallocation of output from inefficient to efficient firms. This reallocation raises both the profits and the size (total variable costs) of a firm relative to those that are less efficient. By implication, with increased competition, a given cost difference between firms is consistent with a larger difference in profits. In the labor market context, if skilled (or educated) workers are more productive than less skilled ones, and produce at lower costs, Boone's result on the profit-cost relationship implies that skills become more valuable with greater product market competition. If profits become more sensitive to skills as competition increases, firms will then have an incentive to pay more for skilled workers.

Consider the following stylized model. There are N workers, with differing levels of productivity (skill). Each worker is employed by a firm, which competes in an imperfectly competitive product market. The worker, who is treated as a quasi-fixed cost, influences the other elements of marginal costs, with greater skills permitting lower costs. Firms are assumed to first compete for workers with different skills, and after workers are allocated to firms, and

⁵Another strand of theoretical papers has examined the effect of competition on the provision of managerial incentives in a principal-agent framework (see Raith, 2003; Schmidt, 1997; Sutton, 1991; and Hart, 1983). Also see Vives (2008).

production takes place, firms compete in the product market. For simplicity, the skill level is assumed to be known by both firms and workers, and wages are posted for each skill level.

Let $\pi(c_i, \theta) = [p_i(\theta) - c_i]y_i(\theta)$ denote firm i 's profit, gross of fixed costs, where p_i is the price, y_i is output, and $c_i > 0$ is the unit production cost. The parameter θ captures the level of competition in the product market (such as the number of firms or entry barriers).⁶ With profit gross of wages increasing in the workers' productivity, we also have $\partial\pi/d\partial c_i < 0$. The model is solved by backward induction. At stage two, depending on the type of competition assumed, firms chose the gross-profit-maximizing price or quantity. At stage one, firms compete for workers by offering wages, $\omega(c_i, \theta)$, accounting for the optimized gross profit function. Workers accept an offer only if it is above their reservation wage, $b > 0$. Firms then maximize net profits, $\pi^*(c_i, \theta) = \pi(c_i, \theta) - \omega(c_i, \theta)$, subject to the workers' participation constraint. That is,

$$\max \pi^*(c_i, \theta) = \pi(c_i, \theta) - \omega_I(c_i, \theta) \quad (1)$$

$$s.t. \omega_I(c_i, \theta) \geq \min \{\omega_J(c_i, \theta), b\}, \text{ for all } J \quad (2)$$

where $\omega_J(c_i, \theta)$ is the wage offered by any firm other than I . In equilibrium, firms offer the same wage, $\omega_I(c_i, \theta) = \omega_J(c_i, \theta) = \omega(c_i, \theta)$, and profits can be expressed as,

$$\pi(c_i, \theta) - \omega(c_i, \theta) = \pi(c_j, \theta) - \omega(c_j, \theta) = \pi_N(c_N, \theta) - b, \text{ for all } i, j \quad (3)$$

$$\omega(c_i, \theta) = \pi(c_i, \theta) - \pi_N(c_N, \theta) + b \quad (4)$$

where $\pi_N(c_N, \theta)$ is the gross profit of the N^{th} firm that hires the N^{th} -skill worker, who gets paid her reservation wage. Firms have no incentive to change the wages offered since that would not increase their profits.

Imposing a zero-profit condition, $\pi_N(c_N, \theta) - b = 0$, implies equilibrium wages are such that, $\omega(c_i, \theta) = \pi(c_i, \theta)$. Note that $\partial\omega(c_i, \theta)/\partial c_i = \partial\pi(c_i, \theta)/\partial c_i$, which is negative, because gross profits are decreasing in costs and increasing in skills. As Guadalupe (2007) shows, the sufficient condition for an increase in competition to generate an increase in the returns to skill in this setting is:

$$\frac{\partial^2\omega(c_i, \theta)}{\partial c_i \partial \theta} = \frac{\partial^2\pi(c_i, \theta)}{\partial c_i \partial \theta} < 0 \quad (5)$$

Intuitively, for a given number of firms, a rise in θ causes the high-skill wage to increase relative to the low-skill wage for analogous reasons to Boone (2000): the gap between relative marginal costs to relative profits increases with competition. Our paper investigates the implic-

⁶The competition parameter depends on the model assumed, and on the way competition can increase in an industry (e.g. through an increase in the number of firms, in the elasticity of substitution between goods, or a cost reduction).

ations of (5) from an empirical perspective. By analysing the "On the Spot Firm" reform we can identify precisely how an increase in competition affects the returns to skill and education. Our finding of greater wage dispersion following increased competition is consistent with the type of reallocation effect present here.

It is also important to note that the literature on wage inequality suggests two alternative routes through which competition may affect the returns to skill. First, if increased competition promotes technical change, and if technology is biased in favor of skilled workers, increasing returns to skill arise through rising relative demand. However, we show the effect of the "On the Spot Firm" reform on the returns to skill and education is not driven by skill-biased technical change, supporting a more direct channel of increased competition. Second, if increased competition leads to less unionization, and assuming unionization generates wage compression (Card, 2001), more competition could also result in greater returns to skill. However, the labor market in Portugal is characterized by widespread collective bargaining, where wages are set for non-unionized as well as unionized workers via extension mechanisms that transfer agreements from one set of workers to another. Combined with the fact that union density remained constant throughout the period, this largely removes the concern that the reform might have affected the wage distribution via changes in union behavior in our analysis.

Finally, there is empirical evidence linking changes in domestic competition to wages, such as Hirsch and Macpherson (2000) and Card (1986), who study the effect of deregulation in the airline industry in the U.S. on relative earnings. Similarly, Hirsch (1993) and Rose (1987) analyze wage responses to deregulation in the trucking industry, and Cuñat and Guadalupe (2009), Wozniak (2007), and Black and Strahan (2001), study the effect of deregulation in the U.S. commercial banking industry on workers and executives' compensation. We focus on a different feature of the wage structure to these papers (namely, the returns to education and skills) and our paper contributes to this literature by investigating the effects of a comprehensive episode of entry deregulation.⁷

3 Entry Deregulation in Portugal: The "On the Spot Firm" Program

The "On the Spot Firm" (Empresa na Hora) program, established in 2005 by the Portuguese Ministry of Justice, was aimed at reducing red tape and alleviating the bureaucratic burden associated with setting up a new firm. Prior to 2005, to start a new firm, an entrepreneur would need to visit several public agencies, extending over a period of 78 days. In March 2005, a new Prime Minister took office, and in May the government created the Unit for Coordination of

⁷In general, there is also a vast literature on wage inequality, which informs the work we conduct here. See, for example, Autor et al. (1998) and Juhn et al. (1993). Card (2001) and Machin (1997) study the effect of labour market institutions. Katz and Autor (1999) provide a survey of this literature.

Administrative Modernization (UCMA) to bring together the Ministries of Justice, Finance, Economy, and Labour and Social Security, which were all involved in registering a new business. The main task of the UCMA was to coordinate and aggregate measures by the different ministries. The "On the Spot Firm" program established one-stop shops, where entrepreneurs were able to register a company in less than an hour. Legal and commercial registration is also completed, and the company identification card, corporate tax payer number, and social security number, are all handed over on the same day.

The law that created the "On the Spot Firm" was issued in July, and in the same month pilot one-stop shops were launched in four municipalities (Coimbra, Aveiro, Barreiro and Moita).⁸ The program expanded over time, and by the end of 2009 there were 164 shops dispersed across 308 municipalities throughout the country, covering most of mainland Portugal and the autonomous region of Madeira. Figure 1 below gives a graphical representation of the opening dates and geographical spread of the one-stop shops between 2005 and 2009.⁹

[Figure 1 about here]

In 2007, the average time to set up a company through the "On the Spot Firm" was 47 minutes, with one procedure at one office desk. By 2008, over 70% of new firms were established through the "On the Spot Firm".¹⁰ The reform in 2005-2006 became part of a larger package for administrative and legislative simplification called "Simplex". This program is one of the most successful initiatives for red tape reduction in the industrialized world.

4 Data and Descriptive Statistics

4.1 Data Description

The main data source used in this paper is the *Quadros de Pessoal (QP)*, a longitudinal data set with linked information on workers and firms based in Portugal. These data have been collected annually by the Portuguese Ministry of Labour and Social Solidarity, and answering the survey is mandatory for all firms employing at least one worker. The data include all firms with one or more employees within the Portuguese private sector. In 2009, the most recent year for which the data is available, the dataset includes over three million workers and about 400 thousand firms. Each firm and each worker have a unique registration number which allows them to be

⁸The law that established the "On the Spot Firm" program is Decreto-Lei 111/2005.

⁹Entrepreneurs can register a new company under the "On the Spot Firm" program in any of the offices located across Portugal. Branstetter et al. (2013), document that the fraction of firms registered outside their local municipality is trivially small, and also provide details on industries for which one-stop shops cannot be used (which are mainly in the finance and insurance industries). We exclude observations in these industries from our analysis.

¹⁰See http://www.empresanahora.pt/ENH/sections/EN_homepage.

traced over time.¹¹

In general, the information each year refers to the situation observed in the month when the survey is collected, and it covers the firm, each of its plants and each of its workers. Information on workers includes, for example, 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 each of its components (base wage, seniority payments, regular and irregular benefits and overtime pay). Firm level data include, for example, 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 administrative nature of the data and the legal requirement that the data is publicly accessible in the firm result in its exceptional coverage and reliability.¹²

We use data collected each year from 2002 to 2009.¹³ We restrict our analysis to private sector manufacturing and service firms, excluding agriculture, fishing and mining, distinguishing 46 industries. Table A.1 in the Appendix reports the description (and the percentage distribution of observations) of the SIC 2-digit industries considered. The resulting sample includes 431,692 distinct firms (contributing with 1,871,296 firm-year observations) and 3,899,878 workers (contributing 16,485,860 worker-year observations) over the period. We identify the creation of new firms using the reported year the firm was constituted. A firm is considered to be a start-up if the year of creation is equal to the year of analysis.¹⁴ The distribution of firms (existing firms and startups) and workers by year is shown in Table 1. Although the stock of firms and workers increased over the period, in 2009 we start seeing the effects of the global economic crisis, and observe net firm and job destruction. Regarding the "On the Spot Firm" program, 23% of the new firms were created in municipalities with one-stop shops in 2005, rising to 70% within 3 years. Overall, in our data, 42,567 firms were created within municipalities with one-stop shops.

[Table 1 about here]

The monthly wage of the worker is constructed by summing: (i) the base pay - gross wage for the normal hours of work; (ii) tenure related payments; and (iii) regular benefits. Real hourly

¹¹Each firm entering the dataset is assigned a unique, time-invariant identifying number. The Ministry of Labor and Social Solidarity ensures that firms that have already reported are not assigned a different identification number. Similarly, each worker is assigned a unique identifying number based on the social security number. We use these identifiers to follow workers and firms over time.

¹²The requirement of public availability enables monitoring by the Ministry of Labor that the firms conform to the law, for example with regard to illegal work. The QP data has been used by Cardoso and Portugal (2005) to study the difference between contractual and actual wages; by Cabral and Mata (2003) to study the evolution of the firm size distribution; by Blanchard and Portugal (2001) to compare the U.S. and Portuguese labor markets; among others.

¹³QP data were not collected in 2001, and hence our analysis starts in 2002 rather than 2000.

¹⁴Because the survey is collected in October, we recover some information on firm births if the reported year of creation is $t - 1$ but the firm is observed for the first time in t . In these cases, we set the year of creation of the firm to t .

wages, used in our specifications, are computed as real monthly wages (excluding overtime pay) divided by normal monthly hours of work (excluding overtime hours). The *QP* data includes information on both the education levels and the skill levels attained by each worker. We exploit this information and investigate the effects of the deregulation on the returns to education, and also on the returns to skill. The level of education is recorded according to the International Standard Classification of Education (ISCED), approved by UNESCO in 1997. 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).¹⁵

Workers are also classified into to 8 levels of qualification depending on the complexity and responsibility of the tasks performed and the skill requirement of the task.¹⁶ Table A.2 in the Appendix shows a detailed description of the hierarchical levels and their skill content in accordance with the law.¹⁷ For our analysis, the skill levels were collapsed into three categories: high- (levels 1 to 4), medium- (level 5) and low-skilled workers (levels 6 to 8). In order to increase our confidence that the previous data refer to skills/qualifications rather than jobs, we also include the occupation as separate control in the regression analysis.¹⁸

Our regressions include additional characteristics of the workers as covariates: gender, age and tenure (and their squares), the type of contract of employment (whether open-end or closed-end contract), and occupation. We also control for firm characteristics: log of the size (measured by the number of workers employed by the firm), ownership status (private, public or foreign owned, depending on whether more than 50% of the firms' social capital is owned by private, public or foreign investors), whether the firm is an exporter, and whether the firm is multi-plant.¹⁹ Descriptive statistics by education and skill levels are presented in Table A.3. In our sample, 12% of the workers have a university degree, and 23% are high-skilled. Medium-skilled workers represent the largest share (41%) of the labour force. Amongst the high-skilled, 42% have a university degree or higher; this confirms that our measure of skill is not a simple output

¹⁵In 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.

¹⁶The 8 levels of qualification 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.

¹⁷See the Decreto Lei 121/78 of July.

¹⁸Occupations are recorded in the *QP* data at the six-digit level in accordance with the International Standard Classification of Occupations (ISCO) 1988. We use ISCO-88's major groups: 1 - Directors; 2 - Intellectual and scientific specialists; 3 - Professional and technical; 4 - Administrative and managerial; 5 - Clerical and sales workers; 6 - Agriculture, silviculture and fishing; 7 - Production and related workers; 8 - Equipment operators and labourers, 9 - Unqualified workers. We aggregate occupations 1 and 2 into one group and occupations 6 and 7 into another single group.

¹⁹Information on exporters is from the International Trade dataset collected by the Portuguese National Institute of Statistics (INE). This dataset includes the universe of monthly export and import transactions by Portuguese firms.

of academic achievement of the workers. Conversely, 78% of highly educated workers performs more complex (high-skill) tasks. Regarding the "On the Spot Firm", 41% of observations are located in municipalities with one-stop shops.²⁰

4.2 Industry Concentration and Returns to Education and Skill

Before we study the effects of the "On the Spot Firm", we start by documenting the correlation between competition and wages. We use a common measure of competition - the fraction of industry employment by the five largest firms (CR5).²¹ To assess the relationship between competition and the returns to education and skill, we regress the logarithm of real hourly wages of individual i , in firm j , in industry s , municipality m , with educational level (skill level) k in year t on the measure of competition, and its interactions with education or skill levels (ISCED1 and low-skill are the omitted categories), among other controls. We estimate the following specification:

$$\ln w_{ijsmkt} = \alpha + \delta CI_{smt} + \rho S_{k,it} + \gamma(CI_{smt} \times S_{k,it}) + \beta X'_{it} + \lambda Z'_{jt} + d_{(\cdot)} + \epsilon_{ijsmkt} \quad (6)$$

Where CI_{smt} is the CR5 concentration ratio for industry s (SIC 2-digit), in municipality m , at time t , and $S_{k,it}$ is the educational attainment (skill level) of the worker, as described in Section 4.1. X'_{it} is a matrix of individual characteristics, and Z'_{jt} is a matrix of firm characteristics (as described in Section 4.1, Table A.3). We control for unobserved permanent individual characteristics (d_i), and include industry (d_s), municipality, (d_m), and time (d_t) dummies to account for unobserved industry and municipality characteristics and business shocks that affect all firms and workers. Our coefficient of main interest is γ . It captures the correlation between returns to education (skill) and the industry's level of competition. If competition is positively correlated with the returns to education (skill), we expect the sign of γ to be negative since concentration ratios are inverse measures of competition.

Results from estimating equation (6) are reported in Table 2. The upper part reports results for the effect of competition on the returns to skill, while the lower part reports results for the returns to education. In column (1) we include individual fixed effects, industry and year dummies, and age and tenure (and their squares) of the worker as covariates. In column (2) we also include dummies for education (skill) interacted with year, thus allowing for changes

²⁰Since we want to interpret the effect of the "On the Spot Firm" program on wages, we do not consider municipalities of the last year of introduction of one-stop shops. We removed all records (for all years) in municipalities where one-stop shops were introduced in 2009.

²¹We alternatively used the CR5 of sales, and the Herfindahl-Hirschman index of industry employment and sales. The results using these measures, available upon request, remain robust. Other measures of competition include the Panzar and Rosse (1977) H-statistic (the sum of input elasticities estimated from regressing gross revenue on a vector of input prices and other controls); the Lerner (1934) index (difference between price and marginal cost at the profit-maximizing rate of output); and Boone's (2000) competition measure based on relative profits, estimated by Boone et al. (2005). These alternative measures require data on revenues, input prices, profits, variable costs or prices, which are not available to us currently.

in returns to education (skill) over time in a flexible way. Column (3) further saturates the model with dummies for municipality, and includes the occupation and type of contract of the worker, the log of size and the ownership of the firm, as well as whether the firm is multiplant or exporter.

[Table 2 about here]

The results for returns to skill show that the coefficients of interest, on the interaction between the skill levels and the concentration ratios, are negative and statistically significant in all specifications. This is suggestive of a positive correlation between measured competition and returns to skill - increases in competition are associated with a wider gap between the wages of the high- and low-skilled. Contrary to the results for skills, which show a clear negative correlation between the CR5 and the returns to skill, we do not find a differential effect of concentration on wages by education levels (lower panel of Table 2). The coefficients on the interaction between the CR5 and education are not statistically significant in the more saturated specifications (columns (2) and (3)). The results from Table 2 are only suggestive of correlations, and should be regarded as descriptive rather than showing a causal effect. To try to establish a causal link between increased competition and returns to education and skill, in the sections that follow we use the "On the Spot Firm" program as an arguably more exogenous source of increased competition.

5 "On the Spot Firm" Program, Entry, and Industry Concentration

This section investigates the effect of the "On the Spot Firm" on firm entry and concentration, to assess the validity of the reform as a source of increased competition. Identification is based on the assumption that the "On the Spot Firm" program was not introduced over time in municipalities in a systematic way that is correlated with pre-existing trends in the outcome variables. In the following sections we conduct several robustness checks and control for pre-existing trends by municipality and skill (or education) levels when estimating the effects on the returns to skill (education).²² As a further test of our identification strategy, we first investigate whether the order in which municipalities adopted the policy is correlated with pre-reform trends in the variables of interest.

We check whether early adopting municipalities (those that implemented the reform in 2005 and 2006) differ from late adopting municipalities (those where the reform was implemented from 2007 onwards) in terms of initial growth trends (between 2002 and 2004) of average wages

²²We find no evidence of such trends, which grants validity to our experiment and identification strategy.

by education and skill levels, the number of new firms, and industry concentration.²³ Table 3 reports summary statistics for trends of the outcome variables in the pre-reform period. We report averages of the variables for the group of late adopting municipalities (Column (1)) and for the group of early adopters (column (2)). In column (3) we report the difference, and column (4) presents the p-value for the test of the null hypothesis of equality between the means (proportions). Overall, we find no statistically significant difference between the municipalities that adopted in the first two years of the program and those that adopted in the last two years in our sample.

[Table 3 about here]

To study the effects of the business registration reform on firm entry and competition, we estimate the effect of the reform on (i) the number of new firms created (positive correlation expected), and on (ii) the top-five concentration ratio (CR5) and the HHI as (inverse) measures of competition (negative correlation expected). That is, we estimate the following equations:

$$NewFirms_{smt} = f(Spot_{mt}, d_{(\cdot)}) \quad (7)$$

$$CI_{smt} = f(Spot_{mt}, d_{(\cdot)}) \quad (8)$$

In all specifications, the "On the Spot Firm" dummy variable ($Spot_{mt}$) takes the value of 1 in the years when and after a one-stop shop was introduced in municipality m , and 0 otherwise.²⁴ The dependent variable in equation (7) is the number of new firms created by municipality-industry-year; and in equation (8), CI_{smt} , is one of the measures of competition, defined in the previous section. For each analysis we regress different model specifications, which include as regressors: (1) the "On the Spot Firm" covariate along with industry indicators to parse out any industry characteristics that may affect the outcomes, and year fixed effects to control for aggregate trends ($Spot_{mt}$, d_s and d_t); (2) the reform dummy, industry fixed effects and municipality fixed effects to further control for municipality characteristics that may affect entry in particular industries ($Spot_{mt}$, d_s and d_m); (3) the reform dummy and industry, municipality and year fixed effects simultaneously ($Spot_{mt}$, d_s , d_m and d_t); (4) finally, we control for industry and year fixed effects and saturate the model further by including municipality-specific linear trends, to absorb secular trends at the municipality level in the outcomes of interest ($Spot_{mt}$, d_s , d_t and $d_m \times t$). We cluster errors by municipality, the level of introduction of the policy.

Table 4 reports results for the effect of the "On the Spot Firm" on firm creation. The top panel relates to a linear model of the number of firms created, while the bottom panel relates to a negative binomial model for the same count data. The columns of the table include different

²³We follow Branstetter et al. (2013) and Bruhn (2011) in this test of the identification strategy.

²⁴See Figure 1 for an overview of opening dates of the one-stop shops in Portuguese municipalities across the country.

sets of fixed effects as explained above. The results suggest that the entry deregulation reform increased the number of new firms created. The coefficient on the reform dummy is always positive and statistically significant at the 1% level, across all specifications, implying that the "On the Spot Firm" policy will have changed the degree of competition within Portuguese industries.

[Table 4 about here]

Our results on firm entry are in line with those obtained by Branstetter et al. (2013) and Bruhn (2011), who investigate the effect of simplified business entry registration on the number of new firms and on job creation. Branstetter et al. use the same deregulation episode as we do and find that the reform increased the number of new firms per 100,000 inhabitants by around 17%. Using a similar reform in Mexico, Bruhn finds a 5% increase in the number of registered new businesses and a 2.2% increase in employment. The effect of this type of reform on the returns to education and skills has received little attention in previous literature, however, and that is the main focus of our study.

Table 5 reports results from estimating equation (8), the effect of the reform on competition, as measured by the top-five concentration ratio (top panel), and by the HHI (bottom panel) of sales.²⁵ For each measure of concentration, we report results from a linear regression model and from a fractional dependent variable model - the fractional probit, as proposed by Papke and Wooldridge (1996). In the specifications reported in columns (1) and (2), which control for industry and year fixed effects, and industry and municipality characteristics, respectively, thus absorbing any time-invariant characteristics of the industry and the municipality that may affect concentration, we obtain negative and statistically significant coefficients on the reform variable. Results remain robust in column (4) when we saturate the model further with municipality-specific linear trends ($d_m \times t$), while also controlling for industry and year fixed effects. This suggests that the "On the Spot Firm" reform is associated with decreased concentration.

In column (3) of the table, the coefficient on the reform variable is not statistically significant. This stems from the fact that since the reform dummy variable is defined at the municipality-year level, and since concentration measures typically display little variation in these dimensions, including industry, municipality and year dummies simultaneously absorbs significant sample variation rendering the coefficient on the reform variable insignificant.²⁶ Moreover, common measures of competition such as CR5 or HHI face a number of well-known limitations, including potential endogeneity, correlation with omitted variables, and non-monotonicity (see Boone,

²⁵All results reported in Table 5 remain robust if we use CR5 or HHI of employment instead of sales. These results are available upon request.

²⁶Jointly, the variables are statistically significant. We also find evidence of collinearity in this specification, as suggested by a multicollinearity condition number greater than 100 (see Belsey, Kuh, and Welsch, 1980), which might affect the estimated coefficients and their standard errors.

2000; and Sutton 1991), and thus may not fully capture increased competition resultant from firm entry after the reform. Overall, the results reported in this section provide strong evidence that the business registration reform increased firm entry, and some evidence that it increased measured competition within industries and municipalities. Thus we now proceed to use the deregulation reform as a more exogenous source of increased competition to study the effects on returns to skill and education.

[Table 5 about here]

6 The Regulatory Quasi-Natural Experiment

The main results in this paper come from an exogenous event that reformed business registration in Portugal. As shown in the previous section, this reform has led to increased firm entry, and is associated with increased product market competition. In this section, we investigate the effect of the reform directly on the returns to education and skills. Figure 2 in the Appendix presents suggestive evidence; it shows the wage growth differential between the high- and the low-educated and between the high- and low-skilled groups for Lisbon. Wage growth differentials increase after 2005, the year when the "On the Spot Firm" was introduced in that municipality.²⁷

6.1 Empirical Strategy

We use cross-municipality-specific and cross-time variation in the implementation of the business registration reform in Portugal to identify the effect of the deregulation on the returns to skill and education. As discussed in Section 3, this policy change was an unanticipated and exogenous policy change, and progressively rolled-out across municipalities, as shown in Figure 1.²⁸ Given that the timing of adoption of the reform varied across municipalities, we can exploit this time variation in our identification strategy. We provide differences-in-differences estimates of changes in the returns to educational attainment and skill levels. Eligible firms (firms within eligible industries) and individuals in municipalities with one-stop shops for business registration constitute the 'treatment group'.

We have shown in the previous section that early adopting municipalities are not statistically different from late adopting municipalities in terms of pre-reform trends of average wages by education and skill levels (see Table 3). This supports our hypothesis, that decisions to open one-stop shops are not correlated with existing trends in wages. To investigate the effects of

²⁷ Given the staggered implementation of the reform over time, and difference-in-difference identification strategy, for illustration purposes we show the wage differentials for Lisbon, the capital of the country and where over 15% of the country's labour force is employed.

²⁸ Although there were also local elections in October 2005 for the municipality chief executive, the introduction of "On the Spot Firm" shops seems unrelated with political affiliation. As discussed in Branstetter et al. (2013), 40% of the municipalities with one-stop shops had heads from the main opposition Social Democrat party.

the entry deregulation reform on the returns to education and skill, we estimate the following equation:

$$\ln w_{ijmkt} = \alpha + \delta Spot_{mt} + \rho S_{k,it} + \gamma(Spot_{mt} \times S_{k,it}) + \beta X'_{it} + \lambda Z'_{jt} + d_{(\cdot)} + \epsilon_{ijmkt} \quad (9)$$

where the dependent variable is the log of real hourly wages of worker i (in firm j , municipality m with skill/education level k) in year t . $Spot_{mt}$ is our treatment dummy for municipalities (m) with one-stop shops; it takes the value of 1 in the years when and after a one-stop shop was introduced in the municipality, and zero otherwise.²⁹ $S_{k,it}$ is our measure of skills, or educational attainment, of the worker (the levels S_k were described in Section 4.1). X'_{it} is a matrix of individual characteristics, which include age and tenure and their squares, occupation and type of contract; and Z'_{jt} is a matrix of firm characteristics, which include the log of size, the ownership structure (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. Industry (d_s) and time (d_t) dummies are also included in all specifications to account for unobserved industry characteristics and business shocks that affect all firms and workers.

We also control for municipality (d_m) fixed effects to parse out any municipality-specific factors that may affect our outcomes. Although we exploit cross-municipality and cross-time variation in the implementation of the reform, having a panel of linked employer-employee data allows us to include individual or worker-firm (match) fixed effects in our specifications, d_i and d_{ij} , respectively. These effects help controlling for potential biases arising from individual heterogeneity on the patterns of job mobility and sorting of workers across firms.

We have argued earlier that the policy was unexpected, and we have shown that early adopting municipalities are not statistically different from late adopters in terms of pre-reform trends in wages. However, to make sure that there are no differential pre-existing trends in wages of the different skill or educational groups, we saturate the model even further and include municipality-skill (or education)-specific linear trends, $d_m \times S \times t$. These absorb any potential trends in wages at the municipality and skill (education) level. ϵ_{ijmkt} is an error term assumed to be white noise. In all of our specifications standard errors are clustered at the municipality level to account for potential correlation between observations within the same municipality, the level of introduction of the policy. All results are robust to clustering by industry.

6.2 Results

Tables 6 and 7 report results from estimating equation (9). Two sets of analyses were conducted: one to investigate the effect of the firm entry deregulation on the returns to education (Table

²⁹Some municipalities have more than one one-stop shop. Our treatment dummy is set to 1 after the first shop was opened.

6); and a similar analysis to investigate the effects on the returns to skill (Table 7). Observed characteristics of workers (X'_{it}) and firms (Z'_{jt}), as explained in the previous sections, along with industry (d_s) and year (d_t) dummies are always controlled for. The different columns in Tables 6 and 7 relate to different combinations of the other fixed effects included. In addition to industry and year dummies, column (1) also controls for worker unobserved effects (d_i); column (2) further adds in municipality fixed effects (d_m); column (3) controls for match (firm-worker) unobserved effects (d_{ij}) and municipality dummies; column (4) saturates the model even further and also includes municipality-skill (or education) specific linear trends ($d_m \times S \times t$). The coefficient on the $Spot_{mt}$ variable, δ , captures the average effect of the reform on the wages of the least educated or least skilled workers (the omitted categories). The absolute effects on other workers are given by the sum of δ and the relevant element of γ . Our main interest lies in γ , the vector of coefficients on the interaction terms between the experiment variable, $Spot_{mt}$, and the educational (skill) levels, $S_{k,it}$. Each of its elements (γ_k) captures the effect of the reform on the returns to different educational and skill levels.

[Table 6 about here]

Table 6 reports results for the returns to education. The interaction terms between the educational levels and the reform dummy are always positive and statistically significant at the 1% level. In particular, the coefficient on the interaction between the university education dummy and the treatment variable is estimated at 0.045, suggesting that the introduction of the "On the Spot Firm" program is associated with an increase in the returns to university degrees of around 4.5 percentage points. Similarly, the reform increased the returns to upper secondary education by around 2 percentage points relatively to the omitted category (primary education). Therefore, our results show that the business registration reform is associated with increased wage premia to better educated workers. The significantly negative coefficient on 'Spot' itself shows that the least educated workers lost from the introduction of one-stop shops. Thus the premia arise partly from the ability of more educated workers to avoid this shock.³⁰

These results are robust to the inclusion of worker-firm (match) unobserved effects. This is important because while in the individual fixed-effects models (columns (1) and (2)) the effect of the reform is identified from both individuals who stay in the same firm and those who move firm after the policy change, in the match fixed-effects specifications (columns (3) and (4)), the effect is identified only from variation over the time period for individuals who stay in the same

³⁰The increased skills premia and the wage losses to least skilled workers might seem difficult to reconcile with Branstetter et al.'s (2013) argument that new registrations were mostly among marginal firms - small, owned by the poorly-educated and operating in low-tech sectors - i.e. the ones most readily deterred by heavy entry costs. However, firms with no employees (only the owner) lie outside our data while marginal firms may increase the demand for skilled services (accountancy, design, etc.) and existing larger firms, feeling or fearing increased competition at the low end of the market, may have decided to upgrade their offer, and so substituted educated for less-educated labor. Either would have seen the wages of the skilled out-stripping those of the less skilled.

firm. This ensures that unobserved changes in composition of employment are not driving our results. Results remain robust when we further control for linear trends by municipality and education (column (4)); we find no evidence of pre-existing trends, which grants validity to the experiment. In sum, education and university degrees in particular became more valuable after the deregulation reform.

Table 7 reports results of similar specifications using skill levels, instead of educational attainment levels. The estimates show that the "On the Spot Firm" reform is associated with an increase in the returns to skill. The coefficient on the interaction term between the high-skill level and the experiment dummy is always statistically significant at 1% across the different model specifications. Results remain robust when we include worker-firm (match) fixed effects, thus identifying the increase in returns to skill from workers that remain in the same firm after the reform (column (3)); and also when we control for linear trends by municipality and skill (column (4)). The estimated coefficient of 0.031 implies that the reform is associated with an increase in the wage premium for high-skilled workers of around 3 percentage points. The premium for medium-skilled workers, however, is smaller and of uncertain significance, while the least skilled appear to have lower wages in treatment municipalities by half to one percent.

Our findings of increased returns to skill and education following the reform are in line with the simple theoretical framework linking competition and relative wages, outlined in Section 2. Boone (2000) shows that with increased competition a given cost difference between firms is mapped into a larger profit difference. If skilled (or educated) workers produce at lower costs, that result implies that profits become more sensitive to skills, and firms have incentives to pay more for skilled workers. Our results of wage premia for skills and education following the deregulation are consistent with that type of reallocation.

[Table 7 about here]

The validity of our experiment and identification strategy is supported by the fact that (1) we control for pre-existing trends by municipality-skill (or municipality-education) and find no evidence of such pre-existing trends; (2) there is no statistically significant difference between early and late adopting municipalities in terms of previous trends of the variables of interest; and (3) the policy was unanticipated and rolled-out randomly across municipalities over time. Ideally, we would also have been able to conduct a placebo using the period prior to the deregulation. However, the period since the data became available until the start of our sample was characterized by several trade shocks that increased foreign competition, and which have been shown elsewhere to affect the returns to skill. In particular, the period between 1989 and 1998 was characterized by several episodes of sharp exchange rate fluctuations and by the implementation of the European Single Market Program in 1992.³¹ Guadalupe (2007) shows that

³¹The Portuguese Escudo experienced a real appreciation of over 20% over 1989-1992 and several other episodes of sharp fluctuations between 1992 and 1998 under the Exchange Rate Mechanism. See Abreu, 2003; or Adão

both these events resulted in increased returns to skill in the UK. Moreover, the adoption of the Euro in 1999 has been shown to have increased foreign competition through higher foreign entry, with similar potential effects on the returns to skill. For example, Bergin and Lin (2012) show that the Euro had positive and statistically significant effects on the extensive margin of trade between 1995 and 2002.³² Exposure to these shocks will vary with municipalities' exposure to the export market, and given that the effects of such trade shocks are typically extended over time, it would not be surprising to find significant effects on the returns to skills in any placebo period.³³

6.3 Other Channels

This section is devoted to investigating the role of alternative mechanisms in explaining the effects estimated in the previous section. In particular, we investigate the potential role of skill-biased technical change (SBTC). If the deregulation led to an increase in investment in technology, and if technology is biased in favor of skilled workers, as commonly found in the literature on the effect of technology on the labour market,³⁴ this would increase returns to skill (or education) through increased demand for skills. To investigate this potential indirect mechanism underlying the effects, we control for R&D intensity and its interactions with the skill and education levels. We re-estimate the more saturated models for the quasi-natural experiment on the returns to skill and education, from columns (2)-(4) of Tables 6 and 7, adding the industry's R&D intensity ($R\&Dint_{st}$) and interaction terms between R&D intensity and the education and skill levels ($R\&Dint_{st} \times S_{k,it}$).

The results from this exercise are reported in Table 8. Columns (1) through (3) report the results for the returns to education, controlling explicitly for R&D intensity at the industry-year level.³⁵ R&D intensity is calculated as R&D expenditure per employee (in real terms). R&D expenditure data is from the OECD-STAN dataset, and the number of employees is from the QP matched employer-employee data.³⁶ The coefficients on the interaction between the reform dummy and the education levels remain positive and statistically significant at 1% level, and of

and Pina, 2003, for details.

³²The authors find that the extensive margin of trade responded several years ahead of EMU implementation and ahead of overall trade volume.

³³A significant result in such a placebo test would arise given correlation between export exposure and the location of the "On the Spot Firm" offices. Such a correlation, however, would not undermine our identification since exporting is very largely the preserve of large companies, while the increased firm entry pertains only to small firms. Moreover, the trade shocks that occurred in the previous decades had died away by 2002.

³⁴See Katz and Autor (1999) for a survey of this literature.

³⁵The columns of Table 8 include the same progression of the sets of fixed effects and other controls as those in columns (2)-(4) of Tables 6 and 7 in the previous section.

³⁶Data for production at the industry level is not available from the OECD-STAN for Portugal after 2005, so we cannot construct R&D intensity as the ratio between R&D expenditures and total industrial production. However, we construct that measure using U.S. data; and based on the assumption that the ranking of these measures is stable across countries (see Romalis, 2003; and Rajan and Zingales, 1998; among others), we estimate the models in Table 8 using the US-based measure of R&D intensity. All results, available upon request, remain robust.

similar magnitude as those reported in Table 6. The estimated effect of R&D is positive and significant but the interactions with the education levels, although positive, are not statistically significant. In sum, controlling for R&D intensity and allowing for its effects on the returns to education does not significantly affect our coefficients of interest. This suggests that the effect of the reform on the returns to education is not driven by skill-biased technical change.

[Table 8 about here]

Results for the returns to skill are reported in columns (4) through (6) of Table 8. We continue to obtain positive and statistically significant coefficients on the reform dummy interacted with skills, and of similar magnitude, even after controlling for $R\&Dint_{st}$ and $R\&Dint_{st} \times S_{k,it}$. We obtain positive coefficients on R&D intensity and its interactions, but they are statistically significant only for the medium-skilled (columns (5) and (6)). This suggests some role for SBTC, but only for the medium skilled, while the coefficients of interest are not significantly affected. The results show that the coefficients of interest remain largely unchanged after we control for R&D intensity and its interactions with skill or education. This is evidence that the increased returns to skill and education are not determined exclusively as an indirect effect of SBTC, and support increased competition as a more direct channel.

As discussed in Guadalupe (2007), R&D measures change slowly over time and are often noisily measured. Therefore, controlling for R&D intensity and its interactions with skill or education is not a conclusive test of SBTC as an underlying mechanism. Furthermore, it would be preferable to use R&D intensity at the municipality level, but data is not available at that level of geographical disaggregation.³⁷ However, in the absence of such data and better proxies for SBTC, it is still of interest to obtain an estimate of the effects of R&D. If the reform induced higher investments in R&D, the coefficients on its interactions with the skill (education) dummies would capture the potential indirect effect on the returns to skill (education).

Another potential cause of wage inequality is changes in unionization. An established hypothesis is that unions raise wages more at the bottom of the distribution and thus are thought to have a compression effect on wage inequality. The institutions that govern unionization and collective bargaining in the UK, US or Canada provide a good environment to study the link between unionization and wage inequality.³⁸ A number of studies estimate that a fall in union membership can account for a large share of the rise in male wage inequality (see Card, 2001, for evidence on the US; Machin, 1997, for the UK; and Card et al., 2003, for a comparison

³⁷There is some data availability for R&D expenditures at the firm-level, but for the period prior to 2004 this is for a sample of firms only. Furthermore, that data is reported jointly with the firms' start-up costs. However, to check the robustness of results, we re-estimated the regressions in Table 8 using R&D intensity (R&D expenditure per employee) at the firm-level. Results remain robust and are available upon request. All results also remain robust to the use of levels or logarithms of R&D.

³⁸In particular, negotiations are conducted at the firm-level and there is no general mechanism to extend union wage floors beyond the organized sector.

between Canada, UK and US). If deregulation leads to lower union power through increased competition, it could result in an increase in the returns to skill.

However, as discussed in Card (2001), it is very difficult to conduct such studies for most European countries (and Australia) because (1) there is no clear distinction in those countries between the union and non-union sectors; and (2) collective bargaining is widespread and wages are set for non-unionized as well as unionized workers, via extension mechanisms that widen provisions to most of the labor force. Portugal shares these characteristics with most European countries. As discussed in Cardoso and Portugal (2005), most collective agreements are industry-wide, guided by national framework agreements. Importantly, extension mechanisms are widespread in the economy. There are voluntary extensions whereby a party can subscribe an agreement that they did not sign initially;³⁹ and government compulsory extensions which widen the collective agreement to workers initially not covered by it, or if bargaining is prevented in any way by a party.

Therefore, under this setting, the distinction between unionized and non-unionized workers or firms is not well-defined, making a study about the effects of unionization less meaningful. Furthermore, union density data at the industry- or municipality-level is not available for Portugal. Aggregate data from the OECD, however, shows that trade union density remained constant at around 20-21% over the period covered in our paper, which suggests that the incentives for union membership did not change. This largely removes the concern that the reform might have affected the wage distribution via changes in union behavior.

6.4 Robustness Checks

In this section, we present further robustness checks for the baseline results from Section 6.2. As mentioned in Section 3, entrepreneurs are not required to register a new firm in the municipality of the company's location. Although according to official data, and also discussed in Branstetter et al. (2013), the share of firms registered outside their municipality is "trivially small", in this section we address that concern by aggregating municipalities to the district level. Portugal is divided in 20 districts which are the largest geographic subdivision of the country with administrative and judicial authority.⁴⁰ Given their size and administrative authority, it is very unlikely that an entrepreneur would register a company outside of its district.

We test the robustness of our results to defining the reform dummy at the district level, $Spot_{rt}$, which takes the value of one in the years when and after the first one-stop shop was introduced in a district, and zero otherwise. We then substitute this for $Spot_{mt}$ in equation (9), leaving everything else the same. Results from estimating this new equation with the

³⁹Also, firms that sign an agreement with a trade union generally extend its application to all their employees, independently of the worker's union membership status.

⁴⁰Municipalities are geographical sub-units of districts.

different combinations of fixed effects as described in section 6.2 are reported in Table 9. The results are consistent with those obtained previously, suggesting that the introduction of the business registration reform within districts increased the returns to education and skill. When we consider the existence of regional "On the Spot Firm" offices, we obtain a wage premium of around 5% to university graduates, and of around 4% to high-skilled workers due to the reform.⁴¹

[Table 9 about here]

The data includes observations on workers who have increased their educational level and who change skill levels (e.g. as a result of promotions within firms or between firm job mobility) over time. It can be argued that the reform might induce changes in the level of skill of the worker, thus changing the composition of each skill group. To check the robustness of our results to these potential selection effects, we now use a sample that includes only workers who have not changed education and skill levels over the period. We then estimate the more saturated models, corresponding to those reported in columns (2)-(4) of Tables 6 and 7. The results from this exercise are presented in Table 10.

[Table 10 about here]

Results for the returns to education, reported in the upper part of Table 10, remain robust for this subsample of workers. The coefficients on the interaction terms between the reform dummy and the educational levels remain positive and statistically significant. We continue to estimate a wage premium for university (high school) graduates of around 5% (2%), as a result of the reform. The results for the returns to skill are reported in the lower panel of Table 10. We obtain a positive and statistically significant coefficient on the interaction between the "On the Spot Firm" dummy and the high-skill dummy, suggesting an increase in wages of high-skilled workers of around 3%. Therefore, results reported in Table 10 remain robust for this subsample, suggesting that the effects estimated are not driven by workers that change education or skill level after the reform.

In sum, we have found a positive association between the business registration reform and increased competition. We have identified small declines in the wages of the least educated, wage premia for better educated workers, and larger premia for higher levels of educational attainment as a consequence of the reform. We have also estimated wage premia for highly skilled workers. We include worker-firm fixed effects and thus identify the effects from individuals that stay in the same firm after the reform. Results are therefore supportive of education and skills becoming more valuable, and are not driven by changes in employment composition after the reform.

⁴¹ Although due to space considerations Table 9 reports only the coefficients on the "spot" variable and on its interactions with education and skills, we continue to control for the workers skill and education levels in all regressions, as in tables 6 and 7. The coefficients on the stand-alone skill and education terms remain positive and statistically significant.

7 Conclusion

This paper uses matched employer-employee data for the universe of private sector firms and workers in Portugal and a comprehensive episode of firm entry deregulation, unique in the industrialized world, as a quasi-natural experiment. We investigate the effects of the deregulation on firm entry, and how the resulting increase in competition affects the returns to skill and education. Prior to 2005, starting a new business in Portugal involved 11 procedures and 78 days, with fees of around 13.5% of GDP per capita. In 2005, new legislation created the "On the Spot Firm" program with the purpose of reducing the time, cost and complexity of starting a business. This initiative established one-stop shops where an entrepreneur can register a company in less than an hour in one single office, and with fees of around 3% of GDP per capita.

We start by investigating the effect of the program on firm entry and on competition within industries and municipalities. Our results suggest that the reform increased the creation of new firms, and decreased industry concentration ratios and Herfindahl-Hirschman indices. We then use the business registration reform as a quasi-natural experiment to investigate the effects on the returns to education and skill. We exploit cross-municipality-year variation in the implementation of the business registration reform for identification. Our results suggest that it increased the relative wage of university graduates by around 5%, and that of high-skilled workers by around 3%. Less educated and low-skilled workers, on the other hand, appear to have lost slightly from the reform.

We estimate several specifications of the wage model, controlling for different types of time invariant unobserved effects, as well as for trends by municipality-skill (or education). In particular, we are able to allow for worker-firm (match) fixed effects and thus identify the impact of the reform solely from individuals who stay in the same firm after the deregulation. This is strongly indicative that we have identified a price effect rather than one driven by individuals' changes in employment: that is, education and skills seem to have become more valuable after the reform. The "On the Spot Firm" program implemented in Portugal in 2005 provides an exceptional context to evaluate the effect of comprehensive firm entry deregulation. Given the general evidence that competition-enhancing policies increase innovation and growth (Aghion et al., 2009), evaluating the effects of a precisely defined policy such as this is important for future policy advice to other countries.

8 References

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9 Tables

Table 1: Sample size

Year	All firms	Start ups	% Start ups "On the Spot"	Workers
	(i)	(ii)	(iii)	(iv)
2002	210,367	11,067		1,834,497
2003	217,618	13,316		1,881,599
2004	223,084	12,787		1,938,520
2005	239,992	14,677	22.94	2,103,552
2006	241,397	15,039	47.73	2,134,839
2007	246,282	16,299	57.47	2,191,564
2008	249,695	16,833	73.69	2,241,624
2009	242,861	14,049	72.97	2,159,665
Total	1,871,296	114,067	42,567	16,485,860

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

Table 2: Industry concentration (CR5) and returns to skill and education

CR5 and returns to skill			
	(1)	(2)	(3)
Medium-skill	0.059*** (0.008)	0.051*** (0.009)	0.050*** (0.007)
High-skill	0.149*** (0.009)	0.091*** (0.012)	0.078*** (0.010)
CR5	0.055*** (0.013)	0.057*** (0.013)	0.026* (0.014)
Med-skill*CR5	-0.033*** (0.010)	-0.033*** (0.010)	-0.036*** (0.009)
High-skill*CR5	-0.039*** (0.012)	-0.043*** (0.012)	-0.040*** (0.013)
R ²	0.10	0.10	0.12

CR5 and returns to education			
	(1)	(2)	(3)
SecEduc	-0.003 (0.004)	-0.010** (0.005)	-0.008 (0.005)
HscEduc	0.020*** (0.007)	-0.012 (0.014)	-0.013 (0.013)
UniEduc	0.168*** (0.010)	0.080*** (0.018)	0.049*** (0.016)
CR5	0.026*** (0.009)	0.029*** (0.010)	0.002 (0.010)
SecEduc*CR5	0.016** (0.008)	0.014* (0.007)	0.007 (0.005)
HscEduc*CR5	0.015* (0.009)	0.011 (0.007)	0.003 (0.004)
UniEduc*CR5	0.020 (0.013)	0.012 (0.015)	0.004 (0.015)
R ²	0.09	0.09	0.12

Note: Log-hourly real wages as dependent variable. CR5 is the employment top-5 concentration ratio. SecEduc - lower secondary education (ISCED2); HscEduc - high school (upper secondary) education (ISCED3); UniEduc - University education (ISCED56). Column (1) includes individual fixed effects, industry and year dummies, and age and tenure (and their squares) of the worker as covariates. Column (2) also includes dummies for education (skill) interacted with year. Column (3) further saturates the model with dummies for municipality, and includes the occupation and type of contract of the worker, the log of size and the ownership of the firm, as well as whether the firm is multiplant or exporter. Robust standard errors, clustered by industry, in parentheses. * p<0.10, ** p<0.05, *** p<0.01.

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

	Late adopters	Early adopters	Difference	P-value
	(1)	(2)	(3)	(4)
New firms	0.125 (0.039)	0.155 (0.033)	-0.030	0.596
CR5 - Employment	0.574 (0.036)	0.467 (0.047)	0.106	0.075
CR5 - Sales	0.330 (0.034)	0.251 (0.041)	0.079	0.153
HHI - Employment	0.172 (0.028)	0.191 (0.037)	-0.019	0.679
HHI- Sales	0.089 (0.021)	0.088 (0.027)	0.001	0.993
Wages				
Overall	0.013 (0.004)	0.006 (0.005)	0.007	0.262
Low-skilled	0.0130 (0.004)	0.007 (0.005)	0.006	0.301
Medium-skilled	0.008 (0.004)	0.004 (0.005)	0.004	0.449
High-skilled	-0.013 (0.006)	-0.003 (0.008)	-0.010	0.342
PrimEduc	0.011 (0.003)	0.006 (0.004)	0.005	0.320
SecEduc	0.004 (0.005)	-0.005 (0.005)	0.009	0.255
HscEduc	-0.013 (0.007)	-0.006 (0.007)	-0.007	0.529
UniEduc	0.006 (0.011)	0.004 (0.012)	0.002	0.898

Note: outcome variables are measured as initial growth trends (between 2002 and 2004) of average wages and number of new firms, and of industry concentration ratios and HHI at the municipality level. Standard errors in parentheses. The p-value relates to the test of the null hypothesis of equality between the means (proportions). SecEduc - lower secondary education; HscEduc - upper secondary (high school) education; UniEduc - University education.

Table 4: Effect of the "On the Spot Firm" program on firm creation

Effect of "On the Spot Firm" on the # of firm start-ups (linear)				
	(1)	(2)	(3)	(4)
On-the-spot-firm	3.479*** (0.722)	0.652*** (0.134)	0.404*** (0.120)	3.472*** (0.722)
Constant	0.491*** (0.069)	1.913*** (0.091)	1.568*** (0.130)	0.628*** (0.229)
Effect of "On the Spot Firm" on the # of firm start-ups (negative binomial)				
On-the-spot-firm	1.341*** (0.183)	0.190*** (0.016)	0.086*** (0.021)	1.339*** (0.183)
ME	4.262***	0.421***	0.188***	4.256***
Constant	-0.389*** (0.081)	0.168*** (0.048)	0.018 (0.054)	-0.281* (0.149)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes		Yes	Yes
Municipality FE		Yes	Yes	
Municipality trends				Yes

Note: The dependent variable is the number of new firms created. One observation per municipality, industry and year corresponding to 54,839 records. ME stands for the marginal effect of the "On the Spot Firm". Robust standard errors, clustered by municipality, in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 5: Effect of the "On the Spot Firm" program on industry concentration ratios (CR5) and HHI of sales

Effect of "On the Spot Firm" on CR5 (linear)				
	(1)	(2)	(3)	(4)
On-the-spot-firm	-0.252*** (0.021)	-0.024*** (0.002)	0.004* (0.002)	-0.250*** (0.021)
Constant	0.552*** (0.019)	0.198*** (0.012)	0.217*** (0.012)	0.506*** (0.024)
Effect of "On the Spot Firm" on CR5 (fractional dependent variable)				
On-the-spot-firm	-0.902*** (0.070)	-0.120*** (0.008)	0.008 (0.009)	-0.898*** (0.070)
ME	-0.262***	-0.024***	0.002	-0.260***
Constant	0.136*** (0.051)	-1.560*** (0.057)	-1.468*** (0.056)	-0.021 (0.073)
Effect of "On the Spot Firm" on HHI (linear)				
On-the-spot-firm	-0.182*** (0.015)	-0.022*** (0.003)	0.002 (0.004)	-0.180*** (0.015)
Constant	0.149*** (0.010)	-0.091*** (0.011)	-0.082*** (0.011)	0.111*** (0.014)
Effect of "On the Spot Firm" on HHI (fractional dependent variable)				
On-the-spot-firm	-0.637*** (0.052)	-0.098*** (0.011)	0.000 (0.014)	-0.632*** (0.053)
ME	-0.169***	-0.024***	0.000	-0.173***
Constant	-1.061*** (0.044)	-2.282*** (0.043)	-2.246*** (0.044)	-1.202*** (0.054)
Industry FE	Yes	Yes	Yes	Yes
Year FE	Yes		Yes	Yes
Municipality FE		Yes	Yes	
Municipality trends				Yes

Note: The dependent variable is the CR5 concentration ratio of sales in the top panel and the Herfindahl-Hirschman Index (HHI) of sales in the bottom panel. One observation per municipality, industry and year corresponding to 53,121 records. ME stands for the marginal effect of the "On the Spot Firm". Robust standard errors, clustered by municipality, in parentheses. * $p < 0.10$, ** $p < 0.05$, *** $p < 0.01$.

Table 6: Quasi-natural experiment: Effect of the "On the Spot Firm" on the returns to education

	Returns to Education			
	(1)	(2)	(3)	(4)
Spot	-0.009*** (0.002)	-0.009*** (0.002)	-0.010*** (0.002)	-0.010*** (0.002)
SecEduc*Spot	0.011*** (0.002)	0.011*** (0.002)	0.015*** (0.002)	0.015*** (0.002)
HscEduc*Spot	0.018*** (0.002)	0.018*** (0.002)	0.023*** (0.002)	0.023*** (0.002)
UniEduc*Spot	0.045*** (0.003)	0.046*** (0.003)	0.045*** (0.003)	0.045*** (0.003)
SecEduc	0.003** (0.002)	0.003** (0.002)	-0.005** (0.002)	-0.005** (0.002)
HscEduc	0.019*** (0.002)	0.018*** (0.002)	0.003 (0.003)	0.004 (0.003)
UniEduc	0.105*** (0.009)	0.104*** (0.009)	0.053*** (0.009)	0.054*** (0.009)
Medium-skill	0.044*** (0.002)	0.044*** (0.002)	0.027*** (0.001)	0.027*** (0.001)
High-skill	0.110*** (0.002)	0.110*** (0.002)	0.071*** (0.001)	0.071*** (0.001)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes		
Municipality FE		Yes	Yes	Yes
Worker FE	Yes	Yes		
Match (worker-firm) FE			Yes	Yes
Municipality*Educ trends				Yes

Note: Log-hourly real wages as dependent variable. SecEduc - lower secondary education (ISCED2); HscEduc - high school (upper secondary) education (ISCED3); UniEduc - University education (ISCED56). ISCED levels are explained in section 4. Further worker covariates include: tenure and age (and their squares), occupation, type of contract of employment. Further firm covariates include: the log of size of the firm, the ownership, multi-plant, and exporting status. All specifications have the same number of observations: 12,489,080. Robust standard errors, clustered by municipality, in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 7: Quasi-natural experiment: Effect of the "On the Spot Firm" on the returns to skill

	Returns to Skill			
	(1)	(2)	(3)	(4)
Spot	-0.008*** (0.002)	-0.008*** (0.002)	-0.006** (0.003)	-0.006** (0.003)
Medium-skill*Spot	0.007*** (0.001)	0.007*** (0.001)	0.002 (0.001)	0.002 (0.001)
High-skill*Spot	0.035*** (0.003)	0.036*** (0.003)	0.031*** (0.003)	0.031*** (0.003)
Medium-skill	0.042*** (0.002)	0.042*** (0.002)	0.027*** (0.001)	0.027*** (0.001)
High-skill	0.095*** (0.002)	0.095*** (0.002)	0.058*** (0.002)	0.059*** (0.002)
SecEduc	0.007*** (0.001)	0.007*** (0.001)	-0.001 (0.002)	-0.001 (0.002)
HscEduc	0.026*** (0.001)	0.026*** (0.001)	0.013*** (0.002)	0.013*** (0.002)
UniEduc	0.130*** (0.007)	0.129*** (0.007)	0.077*** (0.007)	0.077*** (0.007)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes		
Municipality FE		Yes	Yes	Yes
Worker FE	Yes	Yes		
Match (worker-firm) FE			Yes	Yes
Municipality*Skill trends				Yes

Note: Log-hourly real wages as dependent variable. SecEduc - lower secondary education (ISCED2); HscEduc - high school (upper secondary) education (ISCED3); UniEduc - University education (ISCED56). Further worker covariates include: tenure and age (and their squares), occupation, type of contract of employment. Further firm covariates include: the log of size of the firm, the ownership, multi-plant, and exporting status. All specifications have the same number of observations: 12,489,080. Robust standard errors, clustered by municipality, in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 8: Deregulation, R&D intensity and the effects on the returns to education and skill

	Returns to Education			Returns to Skill		
	(1)	(2)	(3)	(4)	(5)	(6)
Spot	-0.008** (0.003)	-0.009*** (0.003)	-0.009*** (0.003)	-0.009*** (0.003)	-0.007** (0.003)	-0.007** (0.003)
SecEduc*Spot	0.016*** (0.001)	0.018*** (0.001)	0.018*** (0.001)			
HscEduc*Spot	0.027*** (0.003)	0.029*** (0.003)	0.029*** (0.003)			
UniEduc*Spot	0.062*** (0.005)	0.060*** (0.004)	0.060*** (0.004)			
Medium-skill*Spot				0.008*** (0.002)	0.004** (0.002)	0.004** (0.002)
High-skill*Spot				0.042*** (0.004)	0.037*** (0.004)	0.037*** (0.004)
R&D intensity	0.004* (0.002)	0.005** (0.003)	0.005** (0.003)	0.004 (0.003)	0.003 (0.003)	0.003 (0.003)
SecEduc*R&Dint	0.002 (0.002)	0.002 (0.001)	0.002 (0.001)			
HscEduc*R&Dint	0.001 (0.002)	0.001 (0.002)	0.001 (0.002)			
UniEduc*R&Dint	0.003 (0.003)	0.003 (0.003)	0.003 (0.003)			
Medium-skill*R&Dint				0.003 (0.002)	0.004** (0.002)	0.004** (0.002)
High-skill*R&Dint				0.003 (0.003)	0.005 (0.003)	0.005 (0.003)
Year FE	Yes	Yes	Yes	Yes	Yes	Yes
Industry FE	Yes			Yes		
Municipality FE	Yes	Yes	Yes	Yes	Yes	Yes
Worker FE	Yes			Yes		
Match (worker-firm) FE		Yes	Yes		Yes	Yes
Municipality*Educ(Skill) trends			Yes			Yes

Note: Log-hourly real wages as dependent variable. SecEduc - lower secondary education (ISCED2); HscEduc - high school (upper secondary) education (ISCED3); UniEduc - University education (ISCED56). Further worker covariates include: tenure and age (and their squares), occupation, type of contract of employment. Further firm covariates include: the log of size of the firm, the ownership, multi-plant, and exporting status. R&D intensity (R&Dint) is total R&D expenditures (in constant terms) per employee by industry and year for Portugal. This table reports only the coefficients on the "spot" and R&D variables and on their interactions with education and skills, but we continue to control for the workers skill and education levels in all regressions, as in tables 6 and 7. All specifications have the same number of observations: 4,988,483. Robust standard errors, clustered by municipality, in parentheses. * p<0.10, ** p<0.05, *** p<0.01

Table 9: Quasi-natural experiment: Effect of the "On the Spot Firm" by region on the returns to education and skill

	Returns to Education			
	(1)	(2)	(3)	(4)
Spot	-0.011*** (0.002)	-0.010*** (0.002)	-0.012*** (0.002)	-0.012*** (0.002)
SecEduc*Spot	0.012*** (0.002)	0.012*** (0.002)	0.016*** (0.002)	0.016*** (0.002)
HscEduc*Spot	0.022*** (0.002)	0.022*** (0.002)	0.027*** (0.002)	0.027*** (0.002)
UniEduc*Spot	0.057*** (0.002)	0.057*** (0.002)	0.054*** (0.003)	0.054*** (0.003)
	Returns to Skill			
	(1)	(2)	(3)	(4)
Spot	-0.012*** (0.002)	-0.011*** (0.002)	-0.009*** (0.002)	-0.009*** (0.002)
Medium-skill*Spot	0.008*** (0.001)	0.008*** (0.001)	0.003*** (0.001)	0.003*** (0.001)
High-skill*Spot	0.045*** (0.002)	0.045*** (0.002)	0.040*** (0.002)	0.040*** (0.002)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes		
Municipality FE		Yes	Yes	Yes
Worker FE	Yes	Yes		
Match (worker-firm) FE			Yes	Yes
Municipality*Educ(Skill) trends				Yes

Note: Log-hourly real wages as dependent variable. SecEduc - lower secondary education (ISCED2); HscEduc - high school (upper secondary) education (ISCED3); UniEduc - University education (ISCED56). Further worker covariates include: tenure and age (and their squares), occupation, type of contract of employment. Further firm covariates include: the log of size of the firm, the ownership, multi-plant, and exporting status. This table reports only the coefficients on the "spot" variable and on its interactions with education and skills, but we continue to control for the workers skill and education levels in all regressions, as in tables 6 and 7. All specifications have the same number of observations: 12,489,080. Robust standard errors, clustered by municipality, in parentheses. * p<0.10, ** p<0.05, *** p<0.01

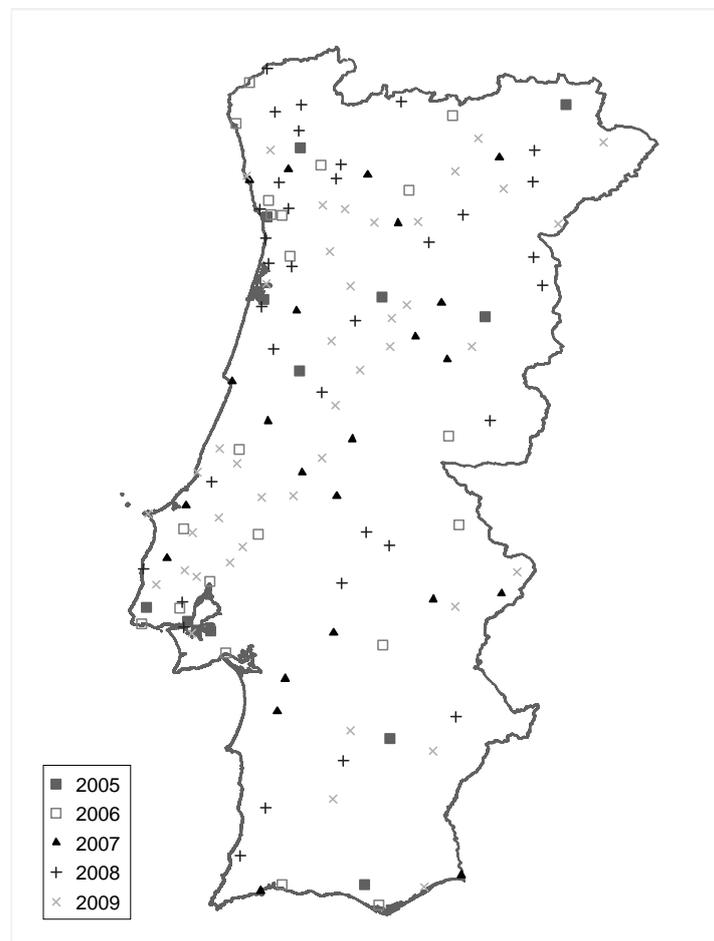
Table 10: Quasi-natural experiment: Effect of the "On the Spot Firm" on the returns to education and skill - subsample of workers that do not change education and skill levels

	Returns to Education			
	(1)	(2)	(3)	(4)
Spot	-0.010*** (0.002)	-0.010*** (0.002)	-0.010*** (0.002)	-0.010*** (0.002)
SecEduc*Spot	0.012*** (0.002)	0.013*** (0.002)	0.014*** (0.002)	0.014*** (0.002)
HscEduc*Spot	0.020*** (0.002)	0.020*** (0.002)	0.022*** (0.002)	0.022*** (0.002)
UniEduc*Spot	0.051*** (0.003)	0.052*** (0.003)	0.048*** (0.003)	0.048*** (0.003)
	Returns to Skill			
	(1)	(2)	(3)	(4)
Spot	-0.008*** (0.002)	-0.008*** (0.003)	-0.005* (0.003)	-0.005* (0.003)
Medium-skill*Spot	0.003 (0.002)	0.002 (0.002)	-0.001 (0.002)	-0.001 (0.002)
High-skill*Spot	0.038*** (0.003)	0.038*** (0.003)	0.033*** (0.003)	0.033*** (0.003)
Year FE	Yes	Yes	Yes	Yes
Industry FE	Yes	Yes		
Municipality FE		Yes	Yes	Yes
Worker FE	Yes	Yes		
Match (worker-firm) FE			Yes	Yes
Municipality*Educ(Skill) trends				Yes

Note: Log-hourly real wages as dependent variable. SecEduc - lower secondary education (ISCED2); HscEduc - high school (upper secondary) education (ISCED3); UniEduc - University education (ISCED56). Further worker covariates include: tenure and age (and their squares), occupation, type of contract of employment. Further firm covariates include: the log of size of the firm, the ownership, multi-plant, and exporting status. All specifications have the same number of observations: 7,138,634. Robust standard errors, clustered by municipality, in parentheses. * p<0.10, ** p<0.05, *** p<0.01

10 Figures

Figure 1: "On the Spot Firm": introduction of one-stop shops by year and municipality



A Appendix

Table A.1: SIC2 - Industries

Industry	% Obs.	
15	Manuf. of food, beverages & tobacco	3.32
17	Manuf. of textiles	2.52
18	Manuf. of wearing apparel; dressing and dyeing of fur	3.17
19	Tanning and dressing of leather; Manuf. of luggage, handbags, saddlery, harness & footwear	1.75
20	Manuf. of wood & prods of wood & cork, except furniture; Manuf. of straw & plaiting materials	1.35
21	Manuf. of pulp, paper and paper products	0.45
22	Publishing, printing and reproduction of recorded media	1.21
24	Manuf. of chemicals & chemical prods; Manuf. of coke, refined petroleum prods & nuclear fuel	0.92
25	Manuf. of rubber and plastic products	0.86
26	Manuf. of other non-metallic mineral products	1.89
27	Manuf. of basic metals	0.36
28	Manuf. of fabricated metal products, except machinery and equipment	2.71
29	Manuf. of machinery and equipment n.e.c	1.28
31	Manuf. of electrical machinery and apparatus n.e.c.	0.68
32	Manuf. of radio, television and communication equipment and apparatus	0.48
33	Manuf. of medical, precision and optical instruments, watches and clocks	0.21
34	Manuf. of motor vehicles, trailers and semi-trailers	1.12
35	Manuf. of other transport equipment	0.27
36	Manuf. of furniture; others manufacturing activities, n.e.c.	1.67
37	Recycling	0.12
40	Electricity, gas & water	0.47
41	Water collection, treatment and distribution	0.14
45	Construction	11.88
50	Sale, maintenance and repair of motor vehicles and motorcycles; retail sale of fuel	3.51
51	Wholesale trade and commission trade, except of motor vehicles and motorcycles	7.14
52	Retail trade, except of motor vehicles and motorcycles; repair of personal and HH goods	9.95
55	Hotels and restaurants	7.10
60	Land transport; transport via pipelines	2.80
61	Water transport	0.08
62	Air transport	0.42
63	Supporting & auxiliary transport activities; travel agencies and other tourist assistance	1.34
64	Post and telecommunications	1.50
65	Financial intermediation, except insurance and pension funding	2.77
66	Insurance, pension funding and other complementary activities of social security	0.53
67	Activities auxiliary to financial intermediation	0.24
70	Real estate activities	0.84
71	Renting of machinery and equipment without operator and of personal and HH goods	0.28
72	Computer and related activities	0.94
73	Research and development	0.10
74	Other business activities	9.77
80	Education	2.33
85	Health and social work	6.10
90	Sewage and refuse disposal, sanitation and similar activities	0.18
91	Activities of membership organizations n.e.c.	1.24
92	Recreational, cultural and sporting activities	1.10
93	Other service activities	0.92

Table A.2: Classification of workers according to skill levels

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	

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

Table A.3: Summary statistics: means of covariates by educational levels and skill groups

Covariate	All	Education levels				Skill levels		
	Workers	ISCED1	ISCED2	ISCED3	ISCED56	Low	Medium	High
Ln(real hourly wage)	1.54	1.32	1.45	1.67	2.28	1.25	1.45	2.15
Education (baseline: ISCED1)								
ISCED2	0.21					0.24	0.23	0.14
ISCED3	0.21					0.17	0.22	0.27
ISCED56	0.12					0.02	0.05	0.42
Skill level (baseline: low skill)								
Medium	0.41	0.45	0.43	0.42	0.15			
High	0.23	0.09	0.15	0.28	0.78			
Women	0.44	0.40	0.42	0.51	0.53	0.54	0.38	0.40
Age	38.03	41.98	34.89	34.29	35.52	36.68	38.20	39.92
Tenure	7.67	9.07	6.70	6.60	6.05	5.96	8.05	9.76
Closed-end contract	0.27	0.23	0.32	0.29	0.26	0.36	0.24	0.17
Occupation (baseline: non-qualified workers)								
Equipment operators	0.11	0.16	0.11	0.05	0.00	0.12	0.14	0.03
Production and related	0.22	0.37	0.20	0.07	0.01	0.18	0.34	0.08
Clerical & sales	0.17	0.16	0.25	0.20	0.04	0.20	0.21	0.07
Admin & managerial	0.16	0.06	0.18	0.34	0.16	0.12	0.21	0.13
Professional & Technical	0.11	0.03	0.10	0.21	0.25	0.03	0.07	0.31
Directors & Sc Specialists	0.09	0.02	0.03	0.07	0.53	0.02	0.01	0.37
ln(size of firm)	4.21	3.86	4.23	4.59	4.80	4.29	3.90	4.62
CR5	0.13	0.09	0.13	0.17	0.19	0.11	0.11	0.18
Ownership status (baseline: private national)								
Public	0.04	0.02	0.04	0.06	0.07	0.03	0.03	0.08
Foreign	0.10	0.07	0.11	0.15	0.15	0.11	0.08	0.14
Exporter	0.44	0.38	0.44	0.50	0.53	0.40	0.42	0.53
Multi-plant	0.37	0.28	0.40	0.49	0.49	0.37	0.33	0.46
"On-the-Spot" municipality	0.41	0.33	0.44	0.48	0.52	0.40	0.38	0.47

Note. Means were computed using only observations with non-missing values for all covariates. Source: Own calculations based on Portugal, MTSS (2002-2009).

Figure 2: Wage growth differential between high- and low-educated/skilled workers

