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Abstract

We propose a management career model where females face a gender-specific career hurdle. We show that female managers will, on average, be more skilled than male managers, since females from the low end of the talent distribution will abstain from investing in a career as a manager. The average female manager will then be better at mitigating more intense product market competition. When the intensity of product market competition increases, hirings and wages for female managers will therefore increase relative to those of male managers. Using Swedish matched employer-employee data, we find strong empirical evidence for all these predictions.

JEL-Codes: J700, L200, M500.

Keywords: career, gender wage-gap, job inflexibility, management, competition.

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1. Introduction

A recent overview article by Francine Blau and Lawrence Kahn (Blau and Kahn (2017)) shows that while the gender wage gap has declined over time, the decline has been much slower at the top of the wage distribution. Goldin (2014) suggests that a likely explanation is that many high-wage career jobs are characterized by a high cost of substitution between different employees and long, inflexible hours. Such job inflexibility is more likely to harm women more than men since women—on average—take more responsibility for the family. This implies a disadvantage for women in various inflexible high-wage occupations and presents a likely explanation for why the gender wage gap has declined much more slowly at the top. The ongoing process of making workplaces more flexible could potentially help to reduce the gender wage gap for many high-wage occupations. However, as noted by Goldin (2014): "There will always be 24/7 positions with on-call, all-the-time employees and managers, including many CEOs, trial lawyers, merger-and-acquisition bankers, surgeons, and the US Secretary of State". A high gender wage gap may therefore be a more persistent feature of such jobs.

This paper examines whether increased product market competition can serve as a measure to reduce the gender wage gap for inherently inflexible top-level occupations. To this end, we construct a management career model with a gender-specific career hurdle. We then test the model's predictions on detailed matched Swedish employer-employee data.

We first provide evidence that management occupations are characterized by many of the features that Goldin (2014) refers to as characterizing inflexible occupations (e.g., time pressure and the number of workers that the employee must regularly keep in touch with). This fact suggests that females aspiring to a management career will face a gender-specific manager career hurdle. When examining the gender wage gap for managers, it is, therefore, essential to take into account how the different management career hurdles that men and women face affect the selection into management occupations and how this, in turn, affects the skill distribution among female and male managers. The ensuing skill distribution is of great importance because many managers lead firms competing in oligopolistic markets.[1] In such industries, small skill differences between managers are crucial to firms' competitive advantage and therefore their profitability.

To capture these elements in the manager job market, we propose a theoretical model in which firms hire managers with potentially different managerial skills and the hiring of a female manager is associated with an additional cost (capturing the gender-specific career hurdle). Firms compete in an oligopolistic fashion in the product market, and hiring a manager with high managerial skills improves a firm's profitability. Managerial wages are determined via Nash bargaining, and individuals need to invest in managerial skills to become a manager.

We first establish that women are harmed by job inflexibility in that female managers are offered lower wages than male managers with the same skill. The reason is that the lower wage compensates for the employer's higher cost of hiring a female manager. However, this implies that only highly

[1] Taking into account market power effects seems highly relevant in light of the documented increase in mark-ups in many markets around the world (see for instance, De Loecker and Eeckhaut (2018)).

talented women will invest in a managerial career and, thus, that the average skill level will be higher among female managers than among male managers. This is referred to as the *skill-biased glass ceiling effect*. Crucial for this result to hold is that talented individuals of both genders aspire for these jobs; otherwise, this selection effect would not be present.

Next, we ask how changes in the intensity of product market competition affect managerial wages. The literature on discrimination and product market competition has used different measures of product market competition, such as the number of firms in an industry, the Herfindahl index, or the level of import competition as measured by import tariffs, to explore the relationship between product market competition and discrimination. Here, we will mainly focus on a more general mechanism whereby increased product market competition affects gender differences in labor market outcomes. Following Boone (2008a,b) and Norbäck and Persson (2012), we define increased product market competition as changes in industry characteristics that increase the relative profitability of more efficient firms in an industry.[2] This formalization of the intensity of product market competition has the advantage of being consistent with different types of structural changes in an industry such as reduced entry barriers, reduced product differentiation and market integration.

In our theoretical model, we then show that if a firm hires a new manager (female or male) with sufficiently strong firm-specific managerial skills, he or she can mitigate the negative impact of increased competition on the firm's profits, such that profits increase relative to a benchmark in which the firm retains its initial (male) manager with weaker managerial skills. We label this the *skill-biased competition effect*. A key result in our model is then that when the new manager is equipped with strong firm-specific managerial skills, the *skill-biased competition effect* increases the surplus generated by hiring the manager, which will increase the manager's wage in the wage negotiations. Consequently, the manager's wage will increase in product market competition. However, when the new manager has managerial skills that are only moderately better than the initial manager, increased product market competition may weaken the firm's profits relative to the benchmark under the initial manager. Increased product market competition then reduces the surplus from hiring and hence the managerial wage.

Under the assumption that an individual's ability cannot be perfectly observed in the data, we then derive empirical predictions from the model. We show that if the female career hurdle is sufficiently high, increasing product market competition will lead to a higher average increase in wages among female managers than among male managers. The reason is as follows: When the female career hurdle is sufficiently high, the *skill-biased glass ceiling effect* will imply that female managers will, on average, have higher managerial skills than male managers This is because only females with sufficiently high innate talent will then find it worthwhile to invest in a managerial career. Combining the result that female managers will, on average, be equipped with stronger managerial skills (the *skill-biased glass ceiling effect*), with the result that more skilled managers

[2] This Boone measure of product market competition is also used in the empirical analysis in Heyman, Svaleryd and Vlachos (2013).

are will benefit more from more intense product market competition (the *skill-biased competition effect*), the model predicts that female managers' wages will, on average, increase by more than male managers' wages. Moreover, since the *skill-biased competition effect* increases the return on investing in managerial skills for females, increased product market competition can also increase the incidence of female managers in firms.

We then take our model to the data. The standard approach to estimate wage gaps basically attempts to control, to the greatest extent possible, for worker and employer characteristics and then estimate the average wage difference between male and female workers. However, even with the most detailed information on personal characteristics, such as IQ or other scores on various tests, there is always a risk of omitted variable bias, as measuring all dimensions of personal characteristics is very difficult. Our empirical strategy instead builds on our theoretical prediction that when the female management career hurdle is sufficiently high, increased product market competition affects female managers' wages more positively (less negatively) than male managers' wages. The reason is yet again that the *skill-biased glass ceiling effect* implies that female managers – on average – need to be more skilled than male managers, and hence, they are more likely to gain from increased product market competition through the *skill-biased competition effect*.[3]

Using detailed matched employer-employee data for Sweden spanning the period 1996–2009, we then estimate whether male and female managers' wages are affected differently by competition for managers who remain in the same firm over time using manager-firm spell fixed effects, which control for *unobserved* individual managerial skills and firm characteristics. In line with our theory, we find that, conditional on individual characteristics, female managers' wages on average increase, while male managers' wages on average are unaffected, when product-market competition intensifies. For identification, we also use changes in import tariffs as an alternative measure of product market competition and find similar results consistent with the skill-biased competition effect.

It is worthwhile to yet again underscore the intuition behind these estimates: Male workers face a lower hurdle, and therefore, male workers with lower ability are able to become managers. The estimate on how male managers' wages react to increased product market competition will then be a weighted average of all types of managers, where managers of lower ability or skill see their wages decline in competition while high-ability managers see their wages increase in competition. In contrast, female managers face the female management career hurdle and therefore need higher skills to secure a managerial position. This implies that the estimate on how female managers' wages react to increased product market competition will contain higher weights on high-skilled managers whose wages increase in product market competition. This explains the positive effect of competition on female managers' wages. Consistent with the latter result, we also find that the share of female managers in firms rises when competition increases, indicating that the positive

[3] When the female career hurdle is low, increasing the intensity of product market competition can reduce the incentive for women to become managers. The reason being that when the hurdle is low, the glass ceiling effect is weaker, and more mediocre females become managers. As mediocre managers are less able to cope with more intense product market competition, their wages may decrease, and thereby, their incentives to pursue a training program decrease.

wage effect on female managers' wages also promotes women's career incentives.

Interestingly, we find no effect of the intensity of product market competition on the gender wage gap for lower-skilled groups. In fact, we find no effect of increased product market competition on the wages of groups other than managers. This is consistent with our theoretical model since low-skilled employees will only marginally affect the profitability of the firm, and low-skilled groups' wages are to a large extent determined jointly with the conditions in different product markets.

The asymmetric, impact of product market competition on managerial wages relies crucially on the presence of a skill-biased glass ceiling effect. We note that the skill-biased glass ceiling effect seems consistent with several stylized facts about the market for managers indicating a higher career hurdle for women. Women are underrepresented in top MBA programs. For instance, the female enrollment share of students in the top MBA programs in Sweden was 33 percent in the year 2015. The corresponding number for the top ranked schools worldwide was 27 percent.[4] Keloharu et al. (2019) find that while women's career paths are similar to men's prior to childbirth, women earn substantially less than men five years after childbirth, and this gender difference persists over the remaining course of the executives' careers. They also report that female executives tend to have much higher levels of education, are more likely to receive their degrees from tracks that produce a large number of top executives, and their male siblings attain higher cognitive ability test scores in military enlistment.

To find direct evidence of the skill-biased glass ceiling effect in our matched employer-employee data, we investigate estimated manager-firm fixed effects, which can be thought of as an imperfect measure of managers' firm-specific skills. Focusing on CEOs, we find that the distribution of proxied managers' firm-specific skills for female CEOs is heavily skewed to the right, whereas the corresponding male distribution is more symmetric, with more mass at both lower and higher values. This finding is consistent with the skill-biased glass ceiling effect, since the gender-specific hurdle implies that females with low skills will not pursue a career as a manager. We can also reject the equality of the two distributions.

The paper proceeds as follows. Section 2 discusses the paper's relationship to the literature. Section 2.1 presents evidence that management occupations are characterized by many of the features that Goldin (2014) identifies as making occupations inflexible. Section 3 presents the theoretical model that we then use to derive an estimation equation for our empirical analyses. In Section 4, we conduct the empirical analysis, giving evidence of the skill-based competition effect. In Section 5, we show that the skill-biased competition effect and the glass ceiling effect are also present when we relax the simplifying assumptions made in the benchmark model. We then allow for generalized bargaining, preference-based discrimination, and a lower labor supply by women (which create a skill-dependent gender-specific career hurdle), competition over talent between firms and competition between talent within firms, as well as different ability distributions between men and women. In Section 6 we examine the estimated manager-firm spell fixed effects

[4]See www.hhs.se/en/about-us/news/2015/sse-mba-executive-format-2015/ for Sweden. For the 100 top ranked schools globally, see http://rankings.ft.com/exportranking/global-mba-ranking-2019/pdf

serving as a proxy for unobservable skills and provide evidence for a skill-biased glass ceiling effect. Finally, Section 7 concludes.

2. Related literature

Our paper contributes to the literature on the gender wage gap by providing new theory and empirical evidence on the gender wage gap at the top of the wage distribution.[5] In their overview article, Blau and Kahn (2017) use PSID microdata over the period 1980–2010 and find that the gender wage gap in the US declined considerably over this period. However, they also report that both the raw and the unexplained gender pay gap declined much more slowly at the top of the wage distribution. They conclude that "... women's work force interruptions and shorter hours remain significant in high skilled occupations, possibly due to compensating differentials."[6] These facts suggest that the developments in the labor market for executives and highly skilled workers have some specific features.

Goldin (2014) suggests and presents empirical support for the importance of specific occupational characteristics that make flexibility extremely costly in some occupations. The wage penalty for flexibility is likely to be high in jobs that require meeting deadlines, being in contact with others to perform the job, maintaining and establishing interpersonal relationships, adhering to preset schedules, and doing work for which other workers are not close substitutes.[7] Bertrand et al. (2010) examine careers of MBAs from a top US business school and find a gender gap in that women experience more career interruptions and lower weekly work hours. Azmat and Ferrer (2017) find evidence of a gender gap in the lower number of hours billed among female associate lawyers in the United States.[8]

We contribute to the literature by proposing a manager career model that enables us to show that if the career hurdle facing female workers is sufficiently high and if both women and men aspire to become managers, only the most able females will pursue managerial careers. Female managers will, therefore, on average, be more skilled than male managers, i.e., there should be a positive selection effect for female managers. These effects imply that female managers, while having lower wages (due to the hurdle), will be more skilled (due to selection), and therefore, on average, manage firms better in response to increased product market competition. We find support

[5] See Blau and Kahn (2017) and Olivetti and Petrongolo (2016) for two recent overviews of the gender gap literature.

[6] Blau and Kahn (2017) also review the literature on psychological attributes as explanations for the gender gap, concluding that "they account for a small to moderate portion of the gender pay gap, considerably smaller than say occupation and industry effects, though they appear to modestly contribute to these differences." For a recent contribution, see, for instance, Card et al. (2016). They show that women are less likely to work in high-paying jobs and that women receive a lower share of the surplus generated at the firm level, suggesting that women have weaker bargaining power.

[7] Flabbi and Moro (2012) estimate a search model of the labor market in which jobs are characterized by wages and work-hours flexibility. Their estimation results show that more than one-third of women assign a positive value to flexibility.

[8] Bøler et al. (2018) note that exporting firms may require greater flexibility from their employees regarding working time. They use Norwegian matched employer-employee data and find that a firm's entry into exporting increases the gender wage gap by approximately three percentage points.

for these mechanisms in detailed matched employer-employee data for Sweden spanning the period 1996–2009.[9] In particular, we find that female managers have, on average, lower wages than male managers but that more intense product market competition leads to relatively higher wages for female managers.[10]

In direct comparisons between female and male managers, one cannot rule out the possibility that unobservables explain why women are paid less and less frequently hold top positions, even when researchers have access to very detailed data on individual and employer characteristics. Our empirical strategy instead builds on our theoretical prediction that when the female management career hurdle is sufficiently high, increased product market competition affects female managers' wages more positively than it affects male managers' wages. This prediction is supported in our data, but we also provide direct evidence of a female manager career hurdle by decomposing individual wages into a part predicted from observables and a part consisting of worker-firm fixed effects. The estimated spell fixed effects can serve as a proxy for manager-firm-specific skills. We then find that the female distribution is heavily skewed to the right and statistically different from the male distribution at low and medium values. As we show, this finding is consistent with the theoretical glass ceiling effect, which predicts that low-skilled female managers will not pursue a career as a manager.

Our paper also contributes to the literature on discrimination and competition. In his pioneering theoretical contribution, Becker (1971) assumes that discriminatory employers may suffer disutility from employing women and shows that these employers pay lower wages to women than to men. Moreover, in a non-segregating equilibrium, all female workers receive a lower wage than men, regardless of whether they work for an employer with or without discriminatory preferences. Arrow (1973) shows that in equilibrium, non-discriminatory employers employ more women at below-productivity wages than their discriminatory counterparts and therefore gain a competitive advantage and that increased competition will force out discriminatory corporate owners. Black (1995) constructs a search model in which some employers have a distaste for hiring minority workers and shows that although only unprejudiced firms hire minority workers, minority workers receive lower wages than workers not facing discrimination whenever any employers in the market have a distaste for minority workers. Both profits and utility are decreasing in discrimination levels, and thus, increased product market competition would force discriminators out of the market. Rosen (2003) develops a model with search frictions, wage bargaining and separation of ownership and management and shows that both utility and profits can be highest for firms with positive taste discrimination. Thus, wage differentials caused by employers having a taste for discrimination may

[9] Mulligan and Rubinstein (2008) find that selection into the female full-time full-year workforce shifted from negative in the 1970s to positive in the 1990s and that the majority of the narrowing of the gender wage gap reflects changes in female workforce composition. Olivetti and Petrolongo (2008) report that the gender wage gap is higher in countries with lower gender employment gaps and conclude that selection can explain a large share of the negative cross-country relationship between gender wage and employment gaps.

[10] The findings in Gayle et al. (2012) are also consistent with our proposed skill-biased glass ceiling effect. Gayle et al. (2012) find that, controlling for executive rank and background, women earn higher compensation than men and are promoted more quickly.

not be eliminated through market forces in such a setting. Holden and Rosen (2014) develop a search model with employment protection legislation and show that a discriminatory equilibrium may exist. The reason is that it will take a longer time for a discriminated-against worker to find another job if a bad match occurs and if other firms use discriminatory hiring. Moreover, the existence of employers with a taste for discrimination may make it more profitable to discriminate, even for firms without discriminatory preferences, and thus, increased competition might not eliminate discrimination in such a setting. We contribute to this literature by showing that increased product market competition can reduce discriminatory behavior even in a setting in which all firms discriminate. Although exit by discriminators does not play a role in our model, increased intensity of product market competition can still reduce wage discrimination (wage gaps) and make female managers more common in firms. The reason is that the cost of discriminating against high-skilled females increases when the intensity of product market competition increases in a setting where oligopolistic externalities are present.

Finally, our paper also contributes to the empirical literature on discrimination and product market competition. Black and Strahan (2001) examine the deregulation of the banking sector in the US and find that wage differentials between females and males decrease when competition increases. They also find that the share of female managers increases. Black and Brainerd (2004) find that increased import competition increases the relative wages of females but only in industries with low competitive intensity. Heyman, Svaleryd and Vlachos (2013), using the Boone (2008a,b) measure of the intensity of product market competition, find that the share of female workers increases after takeovers in industries in which the intensity of product market competition is low. They also find that increased industry-level product market competition leads to a small increase in the share of women employed in firms in these industries. We contribute to this literature by, based on the general Boone measure of product market competition, focusing on the impact on gender wage differences across executive positions. In particular, we find that more intense product market competition leads to relatively higher wages for female managers, but we find no effect of increased product market competition on the wages of groups other than managers.

2.1. Manager—an inflexible job with a high career hurdle?

Goldin (2014) shows that occupations vary substantially in terms of how inflexible the job is and notes that inflexibility on the job likely harms women more than men since women take more responsibility for the family. Below, we show that management occupations are characterized by many of the features that Goldin (2014) identifies as making occupations inflexible.

We follow Goldin (2014) and adopt the occupational characteristics used in her analysis as our starting point. She bases her analysis on occupations in the O*Net online database and focuses on "work context" (57 characteristics) and "work activities" (41 characteristics). We then use the same five characteristics that she adopts to identify inflexible occupations (listed in the notes to Table 2 in Goldin (2014)). These characteristics reflect time pressure, the need for workers to be present at particular times, the flexibility of the occupation in terms of scheduling, the groups and

workers that the employee must regularly keep in touch with, and the degree to which the worker has close substitutes. Each of the O*Net characteristics has been normalized to have a mean of zero and a standard deviation of one.

Table 1 presents basic descriptive statistics. The first four columns report the means of the five measures of job inflexibility for occupations in Technology and Science, Business, Health and Law. These are the same as those listed in Table 2 in Goldin (2014), except that we have here removed all management occupations within these broad occupational groups. These are instead presented separately in columns 5 and 6. As Table 1 shows, the management occupations score high on all five measures of job inflexibility. Relative to jobs in technology and science in particular but also to health and business occupations, those in management have less time flexibility, more client and worker contacts, more working relationships with others, and more specific projects with more discretion over them. We also separate out the top managers, chief executives and legislators and find that this occupation scores high in most characteristics.

Table 1

Next, in Table 2, we report the results of basic regressions on differences in O*Net characteristics between managerial and non-managerial occupations. Each specification has O*Net characteristics (normalized) as the dependent variable and our main explanatory variable of interest is *Manager*, which is an indicator variable equal to one if an occupation is a managerial occupation. Hence, we compare managerial occupations with non-managerial occupations for the 94 occupations included in Goldin (2014). As Table 2 shows, the estimated coefficient for *Manager* is positive and statistically significant for all O*Net characteristics. This indicates that management occupations have characteristics skewed more toward inflexible job tasks.

Table 2

To show that these results are not driven by a few management jobs in specific broad occupational groups, we provide scatter plots of the simple means of the O*Net characteristics for each of the 94 occupations for the five different characteristics. These figures are presented in Figures A1 and A2 in the Appendix. We have marked management occupations in each of the plots. The figures clearly illustrate that most management occupations are located in the upper-right corner of the plots, which is consistent with management jobs being characterized by high inflexibility.

We have thus provided basic evidence that management occupations are indeed characterized by many of the features that Goldin (2014) identifies as making some occupations inflexible. For these occupations—characterized by high costs of substitution of tasks between different employees and the requirement of long, inflexible hours at the workplace—firms will face additional costs when hiring people that need flexibility in work hours. Moreover, choosing such occupations will also come at a higher cost for people who value flexibility or have inflexible demands outside the workplace such as caring for children.

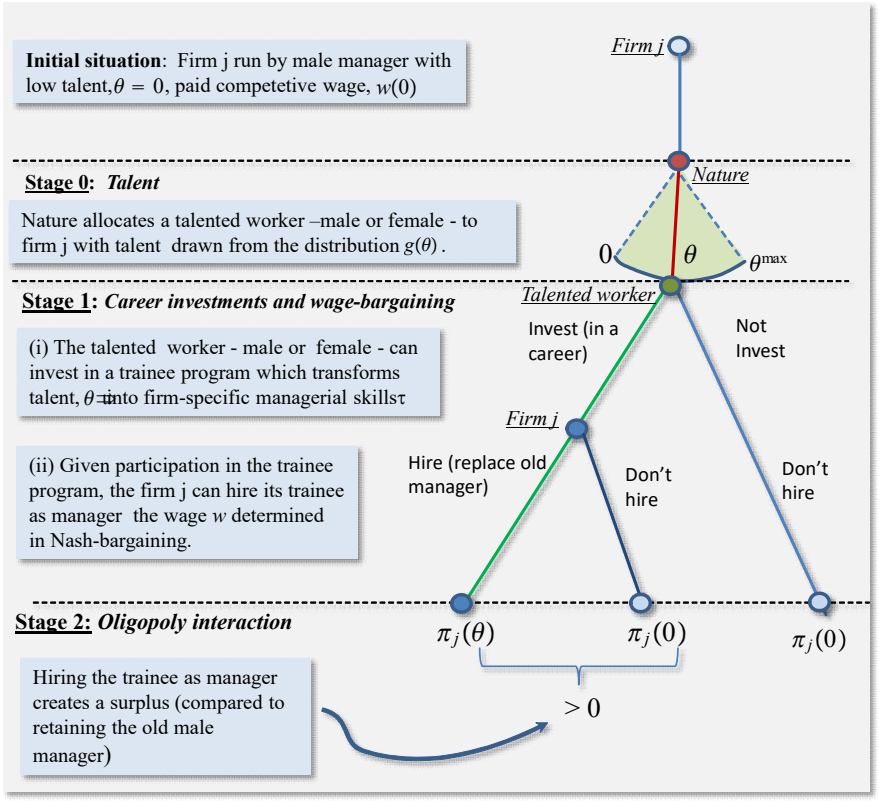


Figure 3.1: The sequence of events.

Taking these observations as a starting point, below, we develop a theoretical model, in which (i) oligopolistic firms hire managers that can be female or male, (ii) females and males' management skills are drawn from the same skill distribution, and (iii) the inflexibility or hurdle associated with management jobs is more costly for females than for males.

3. Theory

Consider a market served by a set of firms, $\mathcal{J} = \{1, ..., j, ..., n\}$. Firms hire unskilled workers for production. Production also requires the services of a manager. Initially, each firm has a *male* manager with low innate talent, $\theta = 0$. As illustrated in Figure 3.1, the following sequence of events then unfolds:

In stage 0, nature allocates to each firm a trainee who may later be offered the manager position, who then replaces the initial (male) manager. Trainees may be male or female. Denote by $\mathcal{M}$ and $\mathcal{F}$ the set of male and female trainees, respectively. A trainee has innate talent θ drawn from a distribution $g(\theta)$ over the interval $\theta \in [0, \theta^{\max}]$. The density function, $g(\theta)$, is identical for men and women.

In stage 1, the talent, θ, of each trainee is revealed. We will distinguish between talent (which we take to be innate) and firm-specific skills (which can be acquired). Each trainee can choose to

invest in a trainee program to generate firm-specific managerial skills. For simplicity, the trainee program is associated with a fixed effort cost, I (arising from, for example, training, education, or overtime).

In stage 2, provided that the trainee has invested in firm-specific skills, each firm chooses whether to replace the old male manager with its now experienced and educated trainee. If a firm chooses to hire its trainee as the manager, wage negotiations take place according to a Nash bargaining protocol in a setting in which female managers face a hurdle associated with an exogenous fixed cost, D.

In stage 3, firms compete in an oligopolistic product market with an exogenous intensity of product market competition denoted C. We now solve the model by backward induction.

3.1. Stage 3: Product market

In the product market interaction, firm j chooses an action (a quantity or a price), $x_j \in R^+$, to maximize its direct product-market profit, $\pi_j(x_j, x_{-j} : \varphi_j)$, which depends on its own and its rivals' actions, x_j and x_{-j}, and the firm-specific skill of its manager, $\varphi_j = \varphi_j(\theta|Z)$. Thus, we let $\varphi_j(\theta|Z)$ be the firm-specific management skill of firm j's manager, where θ is the manager's innate talent, and $Z = \{0, I\}$ is an indicator for whether he – or she – has invested in the trainee program. The firm-specific management skill level of the manager in firm j, φ_j, equals zero if $Z = 0$ (i.e., if the potential trainee did not invest in managerial skills) or if $\theta = 0$ (i.e., the initial manager remains in charge). However, if the trainee has invested in the trainee program, the management skill level in firm j equals $\varphi_j(\theta|Z = I) = \theta$.

Each firm's specific management skill level is common knowledge. The vector $(\varphi_j, \varphi_{-j})$ captures the management skill levels at firm j and at firm j's rivals. We assume that there exists a unique Nash equilibrium in actions, $\mathbf{x}^* \left(\varphi_j, \varphi_{-j}\right)$, defined from

$$\pi_j(x_j^*, x_{-j}^* : \varphi_j) \geq \pi_j(x_j, x_{-j}^* : \varphi_j), \quad \forall x_j \in R^+. \tag{3.1}$$

We will assume that product market profits are always positive. Using expression (3.1), firm j's reduced-form profit is $\pi_j\left(\varphi_j, \varphi_{-j}\right) \equiv \pi_j(x_j^*\left(\varphi_j, \varphi_{-j}\right), x_{-j}^*(\varphi_j, \varphi_{-j}) : \varphi_j)$. We make the following assumption regarding reduced-form profits:

Assumption A1 *Firm j's reduced-form profit is increasing in its own manager's firm-specific skill* $, (\frac{\partial \pi_j\left(\varphi_j, \varphi_{-j}\right)}{\partial \varphi_j} > 0)$, *and decreasing in rival firms' management skill levels,* $(\frac{\partial \pi_j\left(\varphi_j, \varphi_{-j}\right)}{\partial \varphi_{-j}} < 0)$.

Recall that the firm-specific skills of firm j's manager, $\varphi_j = \varphi_j(\theta|Z)$, depend on his or her innate talent (θ) and his or her investment in managerial skills (Z). To simplify notation, we will write profits directly as functions of the manager's talent. The firm's profit then equals $\pi_j(\theta)$ if the manager has both high innate talent and has invested in the trainee program and $\pi_j(0)$ if the manager is either of low talent (the old manager) or did not invest in the trainee program. Intuitively, Assumption A1 then implies that firm j earns a *higher profit* if it employs a manager

with *higher firm-specific managerial skills*: $\pi_j(\theta) > \pi_j(0)$. We may think of a more skillful manager reducing variable costs or increasing the quality of the firm's product by using better management practices, better motivating the workforce or establishing more efficient production. In standard oligopoly models, this will increase the profits of the own firm and decrease the profits of rival firms.

3.2. Stage 2: Wage setting and hiring decisions

In stage 2, conditional on having invested in firm-specific managerial skills, the trainee bargains with the firm over the wage for employment as the manager. If they agree on a wage that leaves both parties with a positive surplus, the trainee is hired. If no agreement can be reached, or if the trainee has not invested in managerial skills, the firm retains its current manager at wage $w(0)$.[11] The latter wage is a competitive wage determined in the economy-wide labor market. It is therefore also the outside option for the trainee.

3.2.1. Hiring a female skilled manager

If the trainee is a woman, the Nash bargaining product is

$$\max_{w_j}[\pi_j(\theta) - \alpha D - w_j - (\pi_j(0) - w(0))]^{1/2} \times [w_j - (1-\alpha)D - w(0)]^{1/2},\ \theta \in \mathcal{F} \tag{3.2}$$

where we assume equal bargaining power.

The wage negotiation in (3.2) takes into account that female managers face a hurdle. This is captured by a fixed hurdle cost, D. This capture the idea that there is an extra cost for females working as managers due to the requirement of inflexible working hours. Disutility may be due to a family situation in which women take greater responsibility for their family and children, resulting in a stressful situation when coping with overtime and greater responsibilities. It may also stem from the firm needing to pay the additional cost of finding substitute when the female manager is absent or from the firm forgoing sales that it might have been able to generate had the manager worked longer unconventional hours. We assume that the firm bears a fraction $\alpha \in (0,1)$ of the hurdle cost, D. We assume that the female manager faces a cost from the hurdle that is the remaining fraction, $1-\alpha \in (0,1)$, of the fixed hurdle cost, D.

If an agreement is struck, firm j pays the female manager wage w_j and earns profit $\pi_j(\theta)$. Note that since firm j bears a cost from the hurdle, $\alpha D > 0$, it will never employ a female trainee who did not invest in obtaining firm-specific management skills. Thus, if no agreement is reached, the initial *male* manager with low talent remains at wage $w(0)$, in which case the firm earns profit $\pi_j(0)$. We further discuss the wage of the initial male manager below. The female trainee may work in the firm, or elsewhere, at the outside wage, $w(0)$.

To proceed, it is convenient to define $S_j(\theta)$ as the surplus created by a manager with firm-specific skills θ in a *benchmark without a hurdle*, $D = 0$:

[11] If the trainee has not invested in managerial skills, the firm may also hire this worker at the same wage, $w(0)$.

$$S_j(\theta) = \tfrac{1}{2}\left[\pi_j\left(\theta\right)) - \pi_j\left(0\right)\right]. \tag{3.3}$$

Note that the surplus must be increasing in the firm-specific skills of the manager from Assumption 1, $S_j'(\theta) > 0$.

Solving the bargaining problem in (3.2), the negotiated wage for a hired *skilled female manager* is then

$$w_j^*(\theta \in \mathcal{F}) = w(0) + S_j(\theta) - \left(\tfrac{2\alpha-1}{2}\right) D \tag{3.4}$$

where the first term is the outside wage, the second term is her share of the increase in profits generated by improved management quality, and the third term reflects how the cost of the hurdle is shared between the firm and the female manager. Note that if the firm takes on a higher share of the costs of the hurdle, $\alpha > 1/2$, she will have to take a pay cut. If, by contrast, she is more adversely affected than the firm, $\alpha < 1/2$, the firm will need to compensate her for this disutility.

3.2.2. Hiring a male skilled manager

If the trainee is a male and has invested in firm-specific managerial skills, his negotiated wage if hired as the manager is simply

$$w_j^*(\theta \in \mathcal{M}) = w(0) + S_j(\theta), \tag{3.5}$$

since there is no hurdle for male managers, $D = 0$.

If no agreement is made, the initial male manager again remains in charge. Assuming that there are many male individuals of innate low ability, it is easy to verify that the wage negotiation between the firm and the old manager will then yield the outside wage, $w(0)$. The simple reason is that the old manager cannot create a surplus, i.e., $S_j(0) = 0$ from (3.3).

Using the negotiated wages in (3.4) and (3.5), we arrive at the following result.

Lemma 1. *Suppose that a trainee replaces the old male manager. If female managers face a hurdle, $D > 0$, and the larger share of the hurdle cost falls on the firm, $\alpha > 1/2$, a hired male manager earns more than a hired female manager with identical firm-specific skills, $w_j^*(\theta \in \mathcal{M}) > w_j^*(\theta \in \mathcal{F}) > w(0)$.*

3.3. Stage 1: Career decision

In stage 1, the trainee in each firm makes his or her career choice, i.e., he or she makes the decision of whether to invest in firm-specific managerial skills at cost I, internalizing that skilled managerial work will lead to a wage increase from $w(0)$ to $w_j^*(\theta|\theta \in h)$ for $h \in \{\mathcal{M}, \mathcal{F}\}$.

It follows that the trainee will choose the career path if the surplus generated from the Nash bargaining exceeds the investment cost, that is, if

$$\begin{cases} w_j^*(\theta \in \mathcal{F}) - (1-\alpha)D - w(0) > I, \\ w_j^*(\theta \in \mathcal{M}) - w(0) > I. \end{cases} \tag{3.6}$$

Using the negotiated wages (3.4) and (3.5) in (3.6) and replacing each inequality with an equality, we can obtain the critical level of innate talent necessary to make the costly investment in firm-specific skills for a career as a manager worthwhile:[12]

$$\begin{cases} S_j(\theta^{\mathcal{F}}) = I + \frac{D}{2}, \\ S_j(\theta^{\mathcal{M}}) = I. \end{cases} \quad . \tag{3.7}$$

This leads to the following proposition:[13]

Proposition 1. *Suppose that female managers face a hurdle, $D > 0$. Then, in equilibrium, a female trainee will, all else being equal, need a higher threshold level of talent than a male trainee to pursue a career as a manager (invest in the trainee program), $\theta^{\mathcal{F}} > \theta^{\mathcal{M}}$.*

Equation 3.7 reveals that since female managers face the cost of the hurdle ($D/2$), female trainees face a glass ceiling when pursuing a career as a manager. Female trainees will, in equilibrium, need to possess a higher minimum level of talent than male trainees to be hired as a manager, $\theta > \theta^{\mathcal{F}} > \theta^{\mathcal{M}}$. It is only when a woman has very high talent that the firm can compensate her through a high wage (generated by a higher surplus, $S_j(\theta)$). The result that female trainees need greater talent to invest in firm-specific skills and pursue managerial work will be referred to as the "*glass ceiling effect*". The glass ceiling effect is illustrated in Figure 3.2(i). In the next section, we will explore how product market competition affects the glass ceiling.

3.4. Product market competition and managerial wages

We begin this section by introducing product market competition into the model. In the next section, we will show how variation in product market competition can be used to identify the female career hurdle in the data.

3.4.1. Intensity of product market competition

How does the intensity of product market competition affect the gender gap in the wages of managers?[14] Let C denote the intensity of product market competition in the industry in stage 3.[15] We may think of the intensity of product market competition being determined by nature in stage 0 and then being common knowledge for all players. Alternatively, we can assume that the agents

[12] If firm j agrees to hire a female manager, the net surplus is $S_j(\theta) - \frac{D}{2}$, and thus, if a female talented worker invests in managerial skills, there will always be an agreement.

[13] Note that this result is independent of which of the parties bears the cost of the hurdle, i.e., independent of α. The reason is that the trainee will always obtain half of the surplus in the wage bargaining, and thus, the cost of the hurdle is always shared equally.

[14] Several measures of the intensity of product market competition are used in the literature. Greater product market competition may come from having more firms in the market, reduced collusion, or import competition from firms that supply goods or services at lower wage costs. Greater product market competition may also stem from reduced product differentiation. Here, we do not specify the source of the variation in product market competition but instead model the impact of competition on the reduced profit function.

[15] The intensity of product market competition can be thought to be determined in stage 0, before the career choice in stage 1, the subsequent wage negotiation in stage 2 and the product market interaction in stage 3.

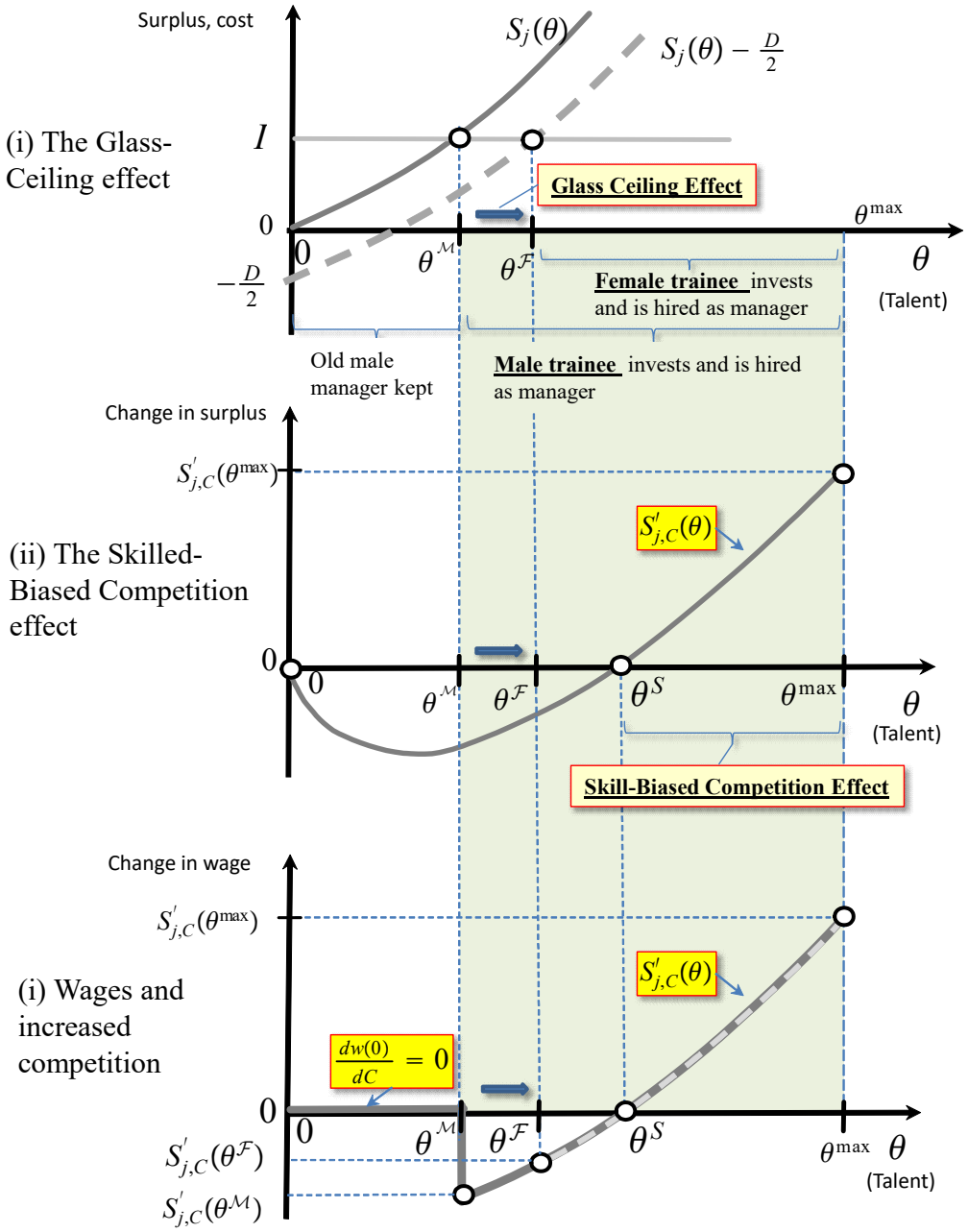


Figure 3.2: Investing in firm-specific skills: the Glass-Ceiling Effect and the Skill-Biased Competition effect.

form expectations over the level of product market competition in stage 3. In the latter case, nature would determine the amount of product market competition before the actual product market interaction in stage 3 but after the trainee has made his or her investment decision in stage 1 and the wage negotiations have taken place in stage 2.

The impact of the intensity of product market competition on a manager's wage, $w_j^*(\theta \in h)$, will depend on how the intensity of product market competition affects the surplus created by the manager, $S_j(\theta)$. From (3.3), this will, in turn, depend on how the intensity of product market competition, C, affects a firm's profits, $\pi_j(\theta)$. We will make the following assumption, which builds on the work in Boone (2008a,b) and Norbäck and Persson (2012).

Assumption A2: *A firm with a manager that has a sufficiently high firm-specific skill can mitigate the negative impact of stronger product market competition on the firm's profits: (i) There exists a unique* $\delta \in (0, \theta^{\max})$ *such that* $\frac{d}{d\theta}\left(\frac{d\pi_j(\theta)}{dC}\right) < 0$ for $\theta < \delta$ *and* $\frac{d}{d\theta}\left(\frac{d\pi_j(\theta)}{dC}\right) > 0$ for $\theta > \delta$, *and (ii)* $\frac{d\pi_j(\theta^{\max})}{dC} > \frac{d\pi_j(0)}{dC} < 0$.

The first part of Assumption A2 captures the notion that if a firm has a manager with sufficiently strong firm-specific managerial skills, he or she can dampen the negative impact of increased competition on the firm's profits compared to the *benchmark* case in which the firm retains its initial manager with weak managerial skills. Conversely, with weaker firm-specific skills, stronger competition leads to a reduction in the surplus, that is, product market profits under a manager with low firm-specific skills will decline more in competition than in the benchmark case with the initial manager. We may think of a skilled manager reducing costs or creating a more innovative organization. Norbäck and Persson (2012) provide an extensive analysis of the circumstances under which Assumption A2 hold in a model in which cost-reducing innovations and product market competition affect product market profits.

Using equation (3.3) and Assumption A2, we can derive the following Lemma.

Lemma 2. *Suppose that Assumption A2 holds. Then, there exists a unique firm-specific skill level of the manager,* $\theta^S \in (0, \theta^{\max})$, *such that (i)* $S'_{j,C}(\theta^S) = S'_{j,C}(0) = 0$, *(ii)* $S'_{j,C}(\theta) < 0$ *for* $\theta \in (0, \theta^S)$ *and* $S'_{j,C}(\theta) > 0$ *for* $\theta \in (\theta^S, \theta^{\max}]$.

Lemma 2 is illustrated in Figure 3.2(ii). Note that the change in the surplus from increased competition, $S'_{j,C}(\theta)$, is a strictly convex function in the talent of the manager, θ. Importantly, the surplus first declines in competition, $S'_{j,C}(\theta) < 0$, when the manager lacks sufficient talent ($\theta < \theta^S$). The direct effect of stronger competition then dominates any strategic effects, $S'_{j,C}(\theta) = \frac{d\pi_j(\theta)}{dC} - \frac{d\pi_j(0)}{dC} < 0$. However, when the manager has a sufficiently high talent ($\theta > \theta^S$), the surplus created is increasing in competition, $S'_{j,C}(\theta) = \frac{d\pi_j(\theta)}{dC} - \frac{d\pi_j(0)}{dC} > 0$. Profits then decline less from stronger competition with a highly skilled manager (or may even increase) than without him or her, as a highly talented manager endowed with strong firm-specific skills gives the firm an advantage

over its competitors.[16] We will label this result, whereby the surplus increases in competition when the manager has sufficiently strong firm-specific skills, the *skill-biased competition effect.*

We can now combine the *glass ceiling effect* associated with Proposition 1 and the *skilled-biased competition effect* in Lemma 2 to determine how managers' wages react to increasing competition. For illustrative purposes, suppose that $\theta^{\mathcal{F}} < \theta^{S}$ holds. As a benchmark, start with the case in which the firm has a male manager. From (3.5), when varying the level of his innate ability, competition then has the following effect on the manager's wage:

$$\frac{dw_j(\theta \in \mathcal{M})}{dC} = \begin{cases} \frac{dw(0)}{dC} = 0, \ \ \theta \in [0, \theta^{\mathcal{M}}), \\ S'_{j,C}(\theta) < 0, \ \ \theta \in [\theta^{\mathcal{M}}, \theta^{S}), \\ S'_{j,C}(\theta) = 0, \ \ \theta = \theta^{S}, \\ S'_{j,C}(\theta) > 0, \theta \in (\theta^{\mathcal{M}}, \theta^{\max}]. \end{cases} \tag{3.8}$$

Expression (3.8) is illustrated in Figure 3.2(i): A male trainee will only find it worthwhile to invest in firm-specific managerial skills if his innate talent exceeds $\theta^{\mathcal{M}}$. In the region $\theta \in [0, \theta^{\mathcal{M}})$, he will not invest in firm-specific skills, and the firm will retain the initial male manager with low firm-specific skills, $\theta = 0$. The (initial male) manager is then simply paid the outside general equilibrium wage, $w(0)$, which – by definition – is independent of the level of competition in a particular industry. Thus, whenever firm j has a trainee with low innate ability, $\theta \in [0, \theta^{\mathcal{M}})$, the managerial wage will not be affected by competition, $\frac{dw(0)}{dC} = 0$.[17]

However, the male trainee will invest in firm-specific managerial skills when his innate talent exceeds $\theta^{\mathcal{M}}$. If his innate ability is still below the threshold θ^{S}, his acquired firm-specific skills will not be sufficient to take advantage of increasing competition, and his wage will decline in competition, $\frac{dw_j(\theta \in \mathcal{M})}{dC} = S'_{j,C}(\theta) < 0$. In contrast, when his innate talent is above θ^{S}, the trainee program provides him with strong firm-specific skills. As this gives the firm a strong advantage over its rivals, the surplus is now increasing in competition, and subsequently, his wage will be increasing in competition, $\frac{dw_j(\theta \in \mathcal{M})}{dC} = S'_{j,C}(\theta) > 0$.

The impact of competition on a female manager's wage is very similar but exhibits an important difference: The hurdle cost and the *glass ceiling effect* imply that a firm will not hire female managers of low innate talent, $\theta < \theta^{\mathcal{F}}$. Therefore,

$$\frac{dw_j(\theta \in \mathcal{F})}{dC} = \begin{cases} S'_{j,C}(\theta) < 0, \ \ \theta \in [\theta^{\mathcal{F}}, \theta^{S}), \\ S'_{j,C}(\theta) = 0, \ \ \theta = \theta^{S}, \\ S'_{j,C}(\theta) > 0, \theta \in (\theta^{\mathcal{F}}, \theta^{\max}]. \end{cases} \tag{3.9}$$

[16] Typically, the impact of competition on a firm's profit can decomposed into a direct effect and a strategic effect. The direct effect is negative and stems from a reduction in the product market price. Since a firm that has a more skilled manager will sell and produce more, this negative direct effect is more detrimental for a larger firm. However, the strategic effect is typically positive: When the manager has strong firm-specific skills, the firm obtains a relative advantage over its weaker competitors. These effects are analyzed in detail in Norbäck and Persson (2012).

[17] Again, since there are many such potential managers available in the economy, no surplus is created, $S_j(0) = 0$.

3.5. Identifying the female career hurdle effect from product market competition

Let us now make predictions on how competition affects managerial wages and, in particular, whether the impact of competition on the managerial wage differs between male and female managers. When taking these predictions to the data, we will need to take into account that in the empirical analysis, we will not have perfect information on managers' firm-specific skills or knowledge (generated, for example, by their innate talent, trainee programs and education). We will instead make use of the distribution of innate talent, $g(\theta)$, and derive our predictions in terms of expected changes in managerial wages from stronger competition.

3.5.1. The intensive margin

Suppose that we take the trainee's investment choice in stage 1 as given, treating the cutoffs $\theta^{\mathcal{F}}$ and $\theta^{\mathcal{M}}$ as fixed, and vary the actual product market competition in stage 3. How does this affect the managerial wage? As we will show below, this will correspond to the estimates in a wage regression in which we apply worker-firm *spell fixed effects*, i.e., we examine the impact over time of competition on managers who stay with the same firm. As noted above, treating the cutoffs $\theta^{\mathcal{F}}$ and $\theta^{\mathcal{M}}$ as fixed can also be thought of as the trainees making their investment decision based their expected level of future competition.

To proceed, let $\mathbb{E}[w_j^*|\theta \in \mathcal{M}]$ be the expected wage of a male manager in firm j, and let $\mathbb{E}[w_j^*|\theta \in \mathcal{F}]$ be the expected wage in firm j if it has a female manager. Using Proposition 1, and Equations 3.4 and 3.5, we have

$$\mathbb{E}[w_j^*|\theta \in \mathcal{F}] = w(0) - (2\alpha - 1)\frac{D}{2} + \int_{\theta^{\mathcal{F}}}^{\theta^{\max}} S_j(\theta) g(\theta|\theta \in \mathcal{F}) d\theta, \tag{3.10}$$

$$\mathbb{E}[w_j^*|\theta \in \mathcal{M}] = w(0) + \int_{\theta^{\mathcal{M}}}^{\theta^{\max}} S_j(\theta) g(\theta) d\theta. \tag{3.11}$$

Note that while a male manager can have any innate ability $\theta \in [0, \theta^{\max}]$ and hence be represented by the density $g(\theta)$ over its full support, female managers can only be present in the interval $\theta \in [\theta^{\mathcal{F}}, \theta^{\max}]$, as they are subject to discrimination. Hence, we use a truncated density, $g(\theta|\theta \in \mathcal{F})$, for female managers in (3.10), i.e.,[18]

$$g(\theta|\theta \in \mathcal{F}) = \frac{g(\theta)}{1 - G(\theta^{\mathcal{F}})} > g(\theta), \text{ for } \theta \in [0^{\mathcal{F}}, \theta^{\max}]. \tag{3.12}$$

[18] This truncated distribution is also shown in Figure 3.3(ii) below. Consider the cutoff for female trainees, $\theta^{\mathcal{F}}$, in Figure 3.3(ii). Label the area under density $g(\theta)$ to the left of $\theta^{\mathcal{F}}$ as "A" and the area under density $g(\theta)$ to the right of $\theta^{\mathcal{F}}$ as "B". For $g(\theta)$ to be a probability distribution, areas A and B must sum to unity. Since female trainees cannot be managers unless their innate talent is at least $\theta^{\mathcal{F}}$, area A is not feasible for female managers. For the truncated distribution $g(\theta|\theta \in \mathcal{F})$ to be a probability distribution, we need to multiply $g(\theta)$ by $1/\left(1 - G(\theta^{\mathcal{F}})\right) > 1$, where $g(\theta|\theta \in \mathcal{F})$ is only feasible in the region $\theta \in [0^{\mathcal{F}}, \theta^{\max}]$. In essence, this procedure "adds" area A "on top" of area B.

We can then state our main proposition in this paper:

Proposition 2. *If the hurdle cost is substantial, i.e., if D is sufficiently large, stronger product market competition, C, will*

(i) *increase the expected wage for a female manager,* $\frac{d\mathbb{E}[w_j^*|\theta\in\mathcal{F})]}{dC} > 0$,

(ii) *decrease gender wage-gap for managers,* $\frac{d\mathbb{E}[w_j^*|\theta\in\mathcal{F})]}{dC} - \frac{d\mathbb{E}[w_j^*|\theta\in\mathcal{M}]}{dC} > 0$, *and,*

(iii) *have an ambiguous effect on the expected wage of a male manager,* $\frac{d\mathbb{E}[w_j^*|\theta\in\mathcal{M}]}{dC} \lessgtr 0$.

This proposition shows that when female managers face a substantial hurdle, increasing competition will increase the expected wage of a female manager relative to that of a male manager. The intuition stems directly from the *glass ceiling effect*, which forces female managers to possess significantly higher firm-specific skills than male managers. However, then female managers are also more likely to reap the benefits from the *skill-biased competition effect*, which states that it is only the most skilled managers who benefit from competition in terms of a rising wage. Below, we provide a detailed proof of the proposition before turning to testing it in the data.

Male managers Start with the expected wage of a male manager. Combining (3.8) and (3.11), the expected change in the wage of a *male manager* from increasing competition is

$$\frac{d\mathbb{E}[w_j^*|\theta\in\mathcal{M}]}{dC} = \underset{\theta^{\mathcal{M}}}{\overset{\theta^S}{\int}} \underset{(-)}{S'_{j,C}(\theta)}g(\theta)d\theta + \underset{\theta^S}{\overset{\theta^{\max}}{\int}} \underset{(+)}{S'_{j,C}(\theta)}g(\theta)d\theta. \tag{3.13}$$

The intuition behind (3.13) is shown in Figure 3.3. Figure 3.3(i) depicts the investment decision for the trainee (male or female). Figure 3.3(ii) depicts the density, $g(\theta)$, by which the change in wage for each innate talent type, θ, is weighted in the integral (3.13). Figure 3.3(iii) depicts the change in the weighted managerial wage, $S'_{j,C}(\theta)g(\theta)$.

Again, for all realizations of innate talent below threshold $\theta^{\mathcal{M}}$, the trainee does not invest in firm-specific skills. The firm retains the old male manager who is paid the outside wage, which is not affected by competition. From Figure 3.2(iii), we know that if the trainee invests in firm-specific skills, while the skills he brings to the firm are below threshold θ^S, the surplus – and, hence, his wage – declines in competition, $S'_{j,C}(\theta) < 0$. Male managers of medium innate talent therefore see their wages declining in competition. However, when we are above threshold θ^S, the surplus is increasing in competition, $S'_{j,C}(\theta) > 0$, thereby increasing the wage of male managers with high innate talent.

Female managers Combining (3.9) and (3.10), the expected change in the wage of a *female manager* from increasing competition is

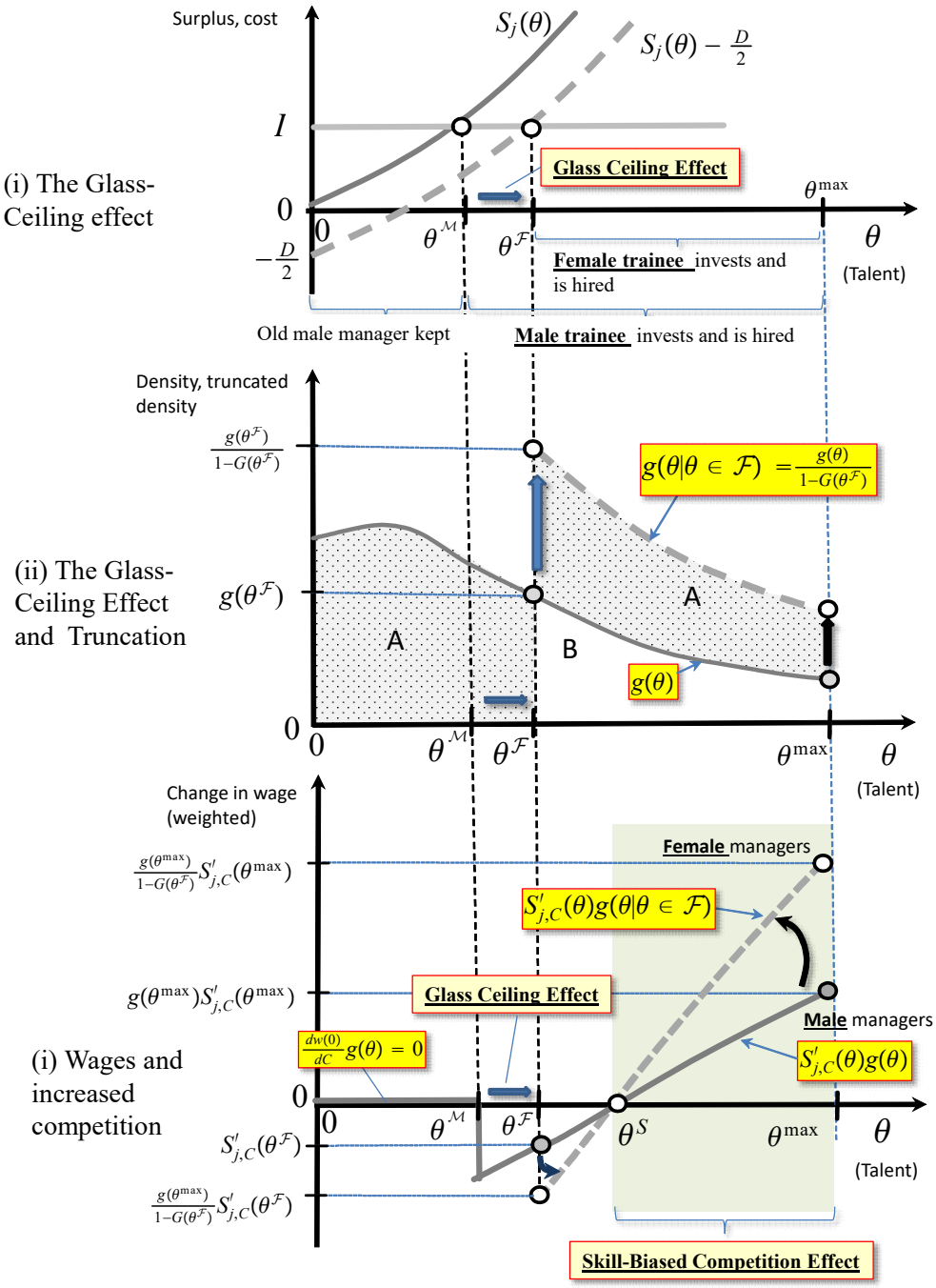


Figure 3.3: Illustrating how the Glass-Ceiling Effect and the Skill-Biased Competition Effect in combination cause increased product market competition to have different impacts on the expected wage of female and male managers.

$$\frac{d\mathbb{E}[w_j^*|\theta\in\mathcal{F})]}{dC} = \int_{\theta^{\mathcal{F}}}^{\theta^S} \underset{(-)}{S'_{j,C}(\theta)} g(\theta|\theta\in\mathcal{F})d\theta + \int_{\theta^S}^{\theta^{\max}} \underset{(+)}{S'_{j,C}(\theta)} g(\theta|\theta\in\mathcal{F})d\theta. \tag{3.14}$$

The expression (3.14) is deceivingly similar to that for male managers in (3.13). However, note that the *glass ceiling effect* implies that *female trainees need higher innate talent than male trainees* to invest in firm-specific skills, $\theta^{\mathcal{F}} > \theta^{\mathcal{M}}$. This is key to understanding how increased competition will tend to reduce the wage gap between male and female managers.

Suppose that the female job inflexibility hurdle implies that female managers, on average, earn less than male managers, $\mathbb{E}[w_j^*|\theta\in\mathcal{F})] - \mathbb{E}[w_j^*|\theta\in\mathcal{M})] < 0$.[19],[20] We can then use (3.13) and (3.14) to calculate the impact of stronger competition on the wage gap between female and male managers:

$$\begin{aligned}\frac{d\big(\mathbb{E}[w_j^*|\theta\in\mathcal{F})]-\mathbb{E}[w_j^*|\theta\in\mathcal{M})]\big)}{dC} &= -\int_{\theta^{\mathcal{M}}}^{\theta^{\mathcal{F}}} \underset{(-)}{S'_{j,C}(\theta)} g(\theta)d\theta \\ &\quad + \int_{\theta^{\mathcal{F}}}^{\theta^S} \underset{(-)}{S'_{j,C}(\theta)} \underbrace{[g(\theta|\theta\in\mathcal{F}) - g(\theta)]}_{(+)} d\theta \\ &\quad + \int_{\theta^S}^{\theta^{\max}} \underbrace{\underset{(+)}{S'_{j,C}(\theta)}}_{\text{Skill-biased comp}} \underbrace{[g(\theta|\theta\in\mathcal{F}) - g(\theta)]}_{\substack{(+)\\ \text{Glass ceiling}}} d\theta.\end{aligned} \tag{3.15}$$

Since male trainees face no hurdle, they require a lower critical innate talent to invest in firm-specific managerial skills than do female trainees, $\theta^{\mathcal{M}} < \theta^F$. Furthermore, since increased competition leads to a lower surplus, $S'_{j,C}(\theta) < 0$, for wages in the interval $\theta \in \left[\theta^{\mathcal{M}}, \theta^F\right]$, the wage of male managers declines in this region. Hence, the expected wage difference between female and male managers must also decline. This is shown by the first line in (3.15) and illustrated in Figure 3.3(iii).

The last line in (3.15) also contributes to a decline in wage discrimination: When the manager has strong firm-specific skills, $\theta > \theta^S$, the skill-biased competition effect contributes to generating a larger surplus, $S'_{j,C}(\theta) > 0$, and the wage of a manager increases. In the last line of (3.15), we see that this skill-biased competition effect is amplified by the glass ceiling effect for female managers, as the truncated talent distribution in (3.12) assigns a larger weight to female managers in this region, $g(\theta|\theta\in\mathcal{F}) > g(\theta)$. This is also shown in Figure 3.3(iii), where the locus of the weighted change in wage for a female manager, $S'_{j,C}(\theta)g(\theta|\theta\in\mathcal{F})$, twists counter-clockwise around θ^S, making the density-weighted increase in wage larger for females, $S'_{j,C}(\theta)\left[g(\theta|\theta\in\mathcal{F}) - g(\theta)\right] > 0$.

Turning to the middle line in (3.15), truncation finally gives a higher weight to the reduction in

[19] I.e., let $D > 0$, and assume that a larger share of the discrimination cost falls on the female manager, $\alpha > 1/2$, such that female managers, conditional on firm-specific managerial skills, earn less, $w_j(\theta\in\mathcal{F}) < w_j(\theta\in\mathcal{M})$.

[20] As we show, truncation effects may imply that the average female manager earns more than the average male manager. The data in the next section show, however, that this is not the case.

wages for female managers when the skill-biased competition effect is negative, $S'_{j,C}(\theta) < 0$. This effect, which is shown in Figure 3.3(iii) for the interval $\theta \in [\theta^F, \theta^S)$, introduces ambiguity in the sign of (3.15).

Let us now turn to the main claim of the proposition: Under sufficiently high female job inflexibility hurdles, stronger product market competition must lead to a decline in the wage gap between male and female managers. To see this, note that if we increase the hurdle cost, D, it is clear from Figure 3.3(i) that female trainees will need to possess greater innate talent to invest in firm-specific skills (i.e., shifting down the locus $S_j(\theta) - D/2$, not shown in Figure 3.3(i)). Formally, differentiating the upper line in (3.7), we obtain

$$\frac{d\theta^{\mathcal{F}}}{dD} = \underbrace{\frac{1}{2S'_{j,\theta}(\theta)}}_{(+)} > 0 = \frac{d\theta^S}{dD}, \tag{3.16}$$

where the latter equality follows from the fact that the cutoff θ^S is independent of the cost of the hurdle.

Thus, when shifting the cutoff $\theta^{\mathcal{F}}$ toward θ^S in Figure 3.3(iii), fewer and fewer female managers are subject to a negative skilled-biased competition effect, $S'_{j,\theta}(\theta) < 0$. A higher hurdle will eventually eliminate the middle line in (3.15), such that the wage gap – as measured by the difference in expected wage between male and female managers, $\mathbb{E}[w_j^*|\theta \in \mathcal{F})] - \mathbb{E}[w_j^*|\theta \in \mathcal{M})]$ – must unambiguously decrease in competition, i.e., $\frac{d\left(\mathbb{E}[w_j^*|\theta\in\mathcal{F})]-\mathbb{E}[w_j^*|\theta\in\mathcal{M})]\right)}{dC} > 0$. Note that this effect results from the fact that a female manager's expected wage will unambiguously increase in competition due to (3.14), as a higher hurdle eliminates the first term as $\theta^{\mathcal{F}}$ moves toward θ^S. Since male managers face no hurdle, the impact of stronger competition on the wage of male managers in (3.15) remains ambiguous.[21]

3.5.2. The extensive margin

Proposition 2 shows that the female job inflexibility hurdle may lead female managers' wages to increase relative to those of male managers under increasing competition. This suggests that stronger competition should also make women more likely to choose the career path and pursue managerial work.

We have the following proposition:

Proposition 3. *If the female career hurdle is sufficiently high, i.e., if D is sufficiently high, an increase in the level of product market competition ,C, will increase the probability that a firm has a female manager.*

To derive this result, we assume that a share $\phi_{\mathcal{F}}$ of all firms are endowed with a female trainee, whereas a share $1-\phi_{\mathcal{F}}$ are endowed with a male trainee. Then, the probability that a firm will have

[21] If the investment cost, I, declines, while the hurdle cost, D, increases, so as to reduce the threshold $\theta^{\mathcal{M}}$at an unchanged threshold $\theta^{\mathcal{F}}$, the region where a male manager's wage is unaffected by competition shrinks. This would increase the first term in (3.15) and strengthen our result that the wage gap declines in competition.

a female manager is simply the cumulative probability that female trainees invest in firm-specific skills times the share of firms endowed with female trainees:

$$\text{Prob}_j[\theta \in \mathcal{F}] = [1-G(\theta^{\mathcal{F}})] \times \phi_{\mathcal{F}}. \tag{3.17}$$

Differentiating (3.17) with respect to competition (or the expected competition that trainees, in stage 1, perceive to be present in stage 3), we then have

$$\frac{d\text{Prob}_j[\theta \in \mathcal{F}]}{dC} = -\phi_{\mathcal{F}} \times g(\theta^{\mathcal{F}}) \times \frac{d\theta^{\mathcal{F}}}{dC}. \tag{3.18}$$

We can now sign the change in the cutoff $\theta^{\mathcal{F}}$ by differentiating the upper line (3.7) with respect to the intensity of competition, C, and talent, θ,

$$\frac{d\theta^{\mathcal{F}}}{dC} = -\underset{(+)}{\frac{S'_{j,C}(\theta)}{S'_{j,\theta}(\theta)}}. \tag{3.19}$$

From Lemma 2, we have that the surplus increases in competition if the manager has sufficiently high firm-specific skills, $S'_{j,C}(\theta) > 0$ if $\theta > \theta^S$. From (3.16), we know that the minimum talent necessary to make an investment in firm-specific skills worthwhile for female trainees increases in the hurdle cost, $\frac{d\theta^{\mathcal{F}}}{dD} > 0$. Thus, if the hurdle is sufficiently high, such that $\theta^{\mathcal{F}} > \theta^S$ holds, the probability that a firm has a female manager increases in competition, $\frac{d\text{Prob}_j[\theta \in \mathcal{F}]}{dC} > 0$.[22]

4. Empirical Analysis

We now turn to the empirical analysis. We first describe the Swedish matched employer-employee data and provide some descriptive statistics. We then describe how we take the model's predictions to the data.

4.1. The Swedish linked employer-employee data

To examine how product market competition affects the gender wage gap, we will use detailed, register-based, matched employer-employee data from Statistics Sweden (SCB). The database comprises firm, plant and individual data, which are linked with unique identification numbers and cover the period from 1990 to 2009. The firm data contain detailed information on all Swedish firms, including variables such as value added, capital stock (book value), number of employees, wages, ownership status, sales, and industry. Moreover, the Regional Labor Market Statistics (RAMS) provide plant-level information on education and demographics, which we aggregate to the firm level. RAMS include data on all Swedish plants. The data on individuals originate from Sweden's official wage statistics and contain detailed information on a representative sample of the labor

[22] Note, however, that if $\theta^{\mathcal{M}} < \theta^{\mathcal{F}} < \theta^S$, we could actually find that female participation as managers declines in competition since the marginal female trainee's relative wage compensation is declining in competition.

force, including full-time equivalent wages, education, occupation, and gender.[23]

All data sets are matched by unique identification codes. To make the sample of firms consistent across the time periods, we restrict our analysis to firms with at least 20 employees in the non-agricultural private sector, which are available throughout the period.

4.1.1. Relative wages and the share of women

Before presenting the econometric analysis, let us first briefly explore the main differences between men and women in the data. Panel A of Table 3 reports descriptive statistics at the firm level for the firms in our matched employer-employee data set over the period 1996–2009 (firms with at least 20 employees). For these firms, we have detailed information at the worker level on, e.g., education and occupation status, implying that we can calculate the share of women at the firm level with different occupations and education levels.

Panel A reveals a slight increase in the share of women over the period (comparing the two sub-periods 1996–2002 and 2003–2009). Approximately one-third of the workers are females. A number of additional interesting observations can be made from Panel A: The share of women with high education is higher than the total share of highly educated workers. Hence, women are, on average, more educated than males. The share of women with higher education also increases significantly over the period, from approximately 29 percent in 1996 to approximately 42 percent in 2009 (32 percent in the 1996–2002 period and 38 percent in the 2003–2009 period). Even more interesting is that the share of female managers shows a distinct increase: During the period 1996–2002, the average share of female managers was 16 percent. By the later period, 2003–2009, this share had increased to 21 percent. Nevertheless, the share of female managers remained considerably below the total share of women, 34 percent, in the latter period. Furthermore, only 13 percent of the firms had a female CEO during this period.

Table 3

Panel B adds descriptive statistics at the worker level. The panel illustrates that there are significant differences in the wages of male and female workers. During the period 1996–2002, the average male worker had an approximately 16 percent higher wage than his female counterpart (the average monthly wage for a man was approximately SEK 20,300 per month, whereas the corresponding wage for a woman was SEK 17,500).[24] This wage difference declines somewhat during the later period, 2003–2009, where the wage advantage for men is approximately 15 percent.

[23] The worker data originate from the Swedish annual salary survey (*Lönestrukturstatistiken*). The survey's sampling units consist of firms included in Statistics Sweden's firm data base (FS). A representative sample of firms is drawn from FS and stratified according to industry affiliation and firm size (number of employees). The sample size consists of between 8,000 and 11,000 firms. The Central Confederation of Private Employers then provides employee information to Statistics Sweden on all its member firms that have (i) at least ten employees and (ii) are included in the sample. Firms with at least 500 employees are examined with probability one. The final sample includes information on approximately 50 percent of all employees in the private sector and is representative of the Swedish labor force. See www.scb.se for further details on the data.

[24] Wages are expressed as full-time equivalent monthly wages (in 1995 prices).

One important and difficult question is of course what lies behind observed gender wage differences. One explanation is based on human capital theory, focusing on productivity differences and on gender differences in observed characteristics such as formal education and labor market experience. Another explanation is based on discrimination, where observed wage gaps are taken as evidence of gender discrimination in wages. This would be the case if the gap were to persist after controlling for a variety of characteristics that measure individual productivity. In terms of the explained and unexplained components of the gender wage gap, the unexplained component is sometimes interpreted as evidence of discrimination, but it could of course also reflect unobserved heterogeneity.

To see how observed and unobserved characteristics influence gender wage gaps in Sweden, we examine whether the wage difference between male and female workers is due to factors such as education, work experience, occupation and firm or industry characteristics. We run the following regression:

$$\log(w_{ijt}) = \gamma_0 + \gamma_1 \cdot wom + \mathbf{X}'_{it}\boldsymbol{\gamma} + \mathbf{Z}'_{jt}\boldsymbol{\lambda} + \theta_t + \vartheta_h + \varepsilon_{ijt} \tag{4.1}$$

where $\log(w_{ijt})$ is the log wage of worker i in firm j at time t, $\mathbf{X}_{it}$ is a vector of observable time-varying worker characteristics, $\mathbf{Z}_{jt}$ is a vector of observable time-varying firm characteristics, θ_t is a year fixed effect, ϑ_h is an industry fixed effect, and ε_{ijt} is the error term. Our main interest is in the estimated coefficient on γ_1, which gives us the percentage difference in wages for female and male workers.

The dependent variable is measured as full-time equivalent wages. Time-varying worker characteristics include experience, experience squared, and dummy variables for educational attainment and occupation. Turning our attention to the firm, time-varying characteristics include capital intensity, firm size (number of employees), and the share of high-skill workers (i.e., the share of the labor force with at least 3 years of post-secondary education).

The results from the individual wage regressions for the period 1996–2009 are presented in Table 4a. Column 1 reports results for the estimated gender wage gap when only year fixed effects are included. We then add different controls. Inspecting the various specifications reported in Table 4a reveals that adding detailed controls only reduces the wage differential from approximately 15 percent to slightly below 10 percent ($\hat{\gamma}_1 \approx -0.147$ in column one but $\hat{\gamma}_1 \approx -0.094$ in column six in Table 4a). Similar results are also found in Table 4b, where we analyze different managerial positions. For all types of managerial positions, we find large and significant estimated gender wage gaps that persist after controlling for a variety of firm and individual characteristics.

Table 4*a* and 4*b*

Recent studies have shown that even with very detailed information on individuals (extracted from sibling data and using information from military test scores, among other sources) $\gamma_1 < 0$ cannot

be rejected.[25] A fundamental problem in all studies that attempt to identify unexplained gender wage differences from the estimates of different versions of Equation (4.1) is that individual fixed effects cannot be used.

We will circumvent this problem by using our theoretical framework to test predictions of our model, which if supported would be consistent with a female career hurdle being present. In particular, we will make use of Proposition 2, which states that under a significantly high female career hurdle, the expected wage of female managers should increase relative to that of male managers. Thus, when females aspiring to a top managerial job face a sufficiently high gender specific hurdle, increased product market competition should reduce the gender wage gap. As we will see below, the fact that we estimate the effect on increased product market competition on wages for individuals remaining in the same firm over the entire time period allows us to control for pairwise individual worker and firm fixed effects (i.e., spell fixed effects).

4.1.2. Estimating the level of competition

The explanatory variable that we are mainly interested in is product market competition. Measuring product market competition is no easy task. The level of product market competition is affected by the number of firms in the market, the degree of product differentiation, the level of tacit or explicit collusion between firms, and whether firms compete in prices or quantities. The empirical literature has attempted to measure competition using aggregate measures such as the Herfindahl index or the aggregate market share of the largest firms in the industry. These measures have been subject to substantive criticism. For instance, an industry with two firms may be very competitive if the two firms are competing intensely in prices. However, an industry with ten firms may exhibit little competition if firms sell products that consumers do not perceive to be close substitutes or if the firms collude.

We will use a relatively new measure of product market competition developed by Boone (2008a,b). It has been used extensively in the finance literature, and it is produced by the World Bank as a measure of banking competition.[26] Boone's measure of competition focuses on how firm profits react to changes in marginal cost, positing that in a more competitive industry, firms should, on average, react more negatively to shocks to own costs. Boone's profit elasticity is estimated in each industry r and year t from the following firm-level regression:

$$\log(\pi_{jt}) = \mu_j + \mu_t + C_{rt} \times \log(AVC_{jt}) + \varepsilon_{jt}, \tag{4.2}$$

where π_{jt} is the profit of firm j in industry r in year t. Profits are measured as the log of value added net of the firm's wage bill. Ideally, we would use the log of a firm's marginal cost as a regressor to obtain the profit elasticity with respect to costs, C_{rt}. However, due to the problem of isolating

[25] See, e.g., Keloharju et al. (2016), who use detailed Swedish data. See also Albrecht et al. (2015), who analyze glass ceiling effects in Sweden using detailed micro data. They report a narrowing of the gender gap during the period from 1998 to 2008, but that there is still a distinct glass ceiling phenomenon for white-collar workers in 2008.

[26] See http://www.worldbank.org/en/publication/gfdr/background/banking-competition. See also Heyman et al. (2013) for another study that uses the Boone measure of product market competition.

marginal costs in accounting data, we will need to use average variable cost (measured as a firm's total wage bill plus the cost of materials as a share of total sales). We also control for unobserved heterogeneity by adding firm-specific effects, μ_j, and time-specific effects, μ_t. Note that a higher estimated elasticity (higher absolute value), C_{rt}, indicates that the industry is characterized by a higher degree of competition.

As a check on the performance of our estimate of the intensity of product market competition, we first correlate our estimates of industry-level competition, $\hat{C}_{rt}$,with firms' logged profits. The results are presented in Table 5. The two first columns in Table 5 show this partial correlation to be negative and highly statistically significant. A more involved correlation stems from Assumption 2: the skilled-biased competition effect suggests that increased competition should have a less negative impact on the profits of more-productive firms relative to less-productive firms. To assess whether this holds in the data, we estimate the impact of stronger product market competition on firms' profits in different parts of the within-industry productivity distribution. The results are shown in the remaining columns in Table 5. Regardless of the specification considered, we indeed find a stronger negative impact on profits for firms in the lower part of the productivity distribution for their respective industries. The asymmetry in impact appears also to be strongest in the tails of the productivity distribution (see columns (7) and (8)), lending support to the skilled-biased competition effect.

Table 5

As a further check, the final two columns in Table 5 include the share of female managers and its interaction with competition. Our theory is ambiguous on the impact of female managers on firm profits. On the one hand, female managers are associated with a higher hurdle cost, which reduces these firms' profits; on the other hand, the glass ceiling effect in Proposition 1 suggests that female managers—on average—should have a higher skill level, which should increase profits for firms with a higher share of female managers. From the last two columns in Table 5, we find that firms with a higher share of female managers have lower profits if they are in the lowest quantile of the productivity distribution. For firms in the highest quantile of the productivity distribution, we find no statistically significant relationship between the share of female managers and profits. Proposition 2 suggests that if the female career hurdle is sufficiently high, firms with female managers should—on average—handle competition better than firms with male managers. We find some indicative evidence for this prediction from the positive and significant effect of the interaction between the share of female managers and competition for the lower quantile in the productivity distribution.

Let us now turn to our main regressions and examine how female and male managers' wages are affected by the intensity of product market competition.

4.2. Product market competition and the wage of female workers

Proposition 2(i) posits that if discrimination is sufficiently severe, female managers should, on average, experience an increase in their wages if competition increases (i.e., $\frac{d\mathbb{E}[w_j^*|\theta\in\mathcal{F})]}{dC} > 0$ in Equation 3.13). We can test this prediction by estimating the following regression on female workers' wages that explicitly controls for characteristics that are common to the worker and the firm:

$$\log w_{ijt}(i \in \mathcal{F}) = \alpha + \beta_{\mathcal{F}}\hat{C}_{rt} + \varsigma_{ij} + \varsigma_t + \gamma Experience_{it}^2 + \mathbf{X}'_{jt}\boldsymbol{\lambda} + \varepsilon_{ijt}, \tag{4.3}$$

where $\log w_{ijt}(i \in \mathcal{F})$ is the log monthly wage of a female worker i in firm j in year t. ς_{ij} is a "spell" fixed effect for each unique firm-individual combination, which implies that we are following a female worker employed at the same firm over time. The spell fixed effect is a time-invariant unobservable component of each unique employer-employee combination. This approach allows us to control for both unobserved individual- and firm-specific factors. ς_t is a time-specific effect. Note that we are interested in how an increase in competition, as measured by the estimated Boone elasticity, $\hat{C}_{rt}$, affects the wage through the estimated coefficient β. Equation (4.3) also includes a vector, $\mathbf{X}_{jt}$, of time-varying firm characteristics as controls, such as firm size, capital intensity, and the share of skilled workers. Finally, we also control for (squared) worker experience.[27]

4.3. Product market competition and the wage of male workers

As male workers do not face a hurdle, Proposition 2(ii) shows that the impact of competition on male managers' wages is ambiguous (i.e., $\frac{d\mathbb{E}[w_j^*|\theta\in\mathcal{M})]}{dC} \gtreqless 0$ in Equation 3.13). However, Proposition 2(iii) posits that when females face a sufficiently high hurdle, female managers' wages should increase relative to those of male managers (i.e., $\frac{d\left(\mathbb{E}[w_j^*|\theta\in\mathcal{F})]-\mathbb{E}[w_j^*|\theta\in\mathcal{M})]\right)}{dC} > 0$ in Equation 3.15).

To test these hypotheses, we also estimate the corresponding wage equation for male workers:

$$\log w_{ijt}(i \in \mathcal{M}) = \alpha + \beta_{\mathcal{M}}\hat{C}_{rt} + \varsigma_{ij} + \varsigma_t + \hat{\gamma} Experience_{it}^2 + \mathbf{X}'_{jt}\boldsymbol{\lambda} + \varepsilon_{ijt}. \tag{4.4}$$

Due to the glass ceiling effect, female managers need greater inherent talent to invest in firm-specific skills and take up a manager position. Since only the top managers will be able to reap the benefit from stronger competition in terms of a higher salary from the skill-biased competition effect, we would expect that $\beta_{\mathcal{F}} = \frac{d\mathbb{E}[w_j^*|\theta\in\mathcal{F})]}{dC} > 0$ and $\beta_{\mathcal{F}} > \beta_{\mathcal{M}} = \frac{d\mathbb{E}[w_j^*|\theta\in\mathcal{M})]}{dC}$ if a high female career hurdle is present.

[27] Note that education is essentially time invariant and is therefore subsumed in the worker-firm fixed effects. Experience is constructed as age minus the number of years of schooling minus seven. Because the years of schooling rarely change in the sample, when both spell and year fixed effects are included, experience varies directly with the year fixed effects, that is, the impact of experience on wages is captured by the year fixed effects. Therefore, experience is excluded from the regression equation.

4.4. Product market competition and the hiring of female managers

If female managers see their wages increase in competition, $\beta_{\mathcal{F}} > 0$, this should also encourage more female workers to invest in firm-specific skills to pursue a career as a manager. Indeed, this is predicted by Proposition 3, which we will test by estimating the following firm-level regression:

$$share_{jt} = \nu_{\mathcal{M}} + \nu_{\mathcal{M}}\hat{C}_{rt} + \varsigma_j + \varsigma_t + \mathbf{X}'_{jt}\boldsymbol{\gamma} + \varepsilon_{jt}, \tag{4.5}$$

where $share_{jt}$ is the share of female managers in firm j in year t. The main explanatory variable of interest is product market competition (C_{rt}), where we expect $\nu_{\mathcal{M}} > 0$ when the female career hurdle is sufficiently large. We also include a vector, $\mathbf{X}_{jt}$, of time-varying firm characteristics (identical to that used above). All of the estimations also include firm fixed effects, ς_j, to control for unobserved firm heterogeneity and year fixed effects, ς_t, that control for common macro-level shocks. Finally, ε_{jt}, is the error term.

4.5. Results

4.5.1. The intensive margin: wages

Table 6 shows the results from separately estimating (4.3) and (4.4). The two first columns report the estimates using all individuals in the data, irrespective of occupation. These regressions are based on over 8 million individual-year observations, consisting of over 2 million individual-firm pairs ("spells"). From these specifications, we find that the Boone elasticity, measuring the level of competition, is statistically insignificant. This is the case for both men and women. This is also what is to be expected. For the vast majority of individuals, the level of competition in the industry in which they are employed should have no effect on their wage since their wages are determined in a nation-wide competitive labor market. This is further validated in columns three and four, which report the results for individuals who are not managers.

Table 6

Columns (5)–(10) present the results for employees holding different management positions. Here, we find interesting gender differences. Columns five and six are estimated on all types of managerial positions, comparing men and women. The results reveal a clear difference in the impact of stronger competition on wages for male and female managers. When product market competition increases through an increase in the Boone elasticity, this leads to a statistically significant increase in the wage of female managers, $\hat{\beta}_{\mathcal{F}} > 0$, whereas we cannot reject the null hypothesis of no effect of competition on male managers' wages, $\hat{\beta}_{\mathcal{M}} = 0$.

These estimates give strong support to the predictions of Proposition 2: Due to the glass ceiling effect, female workers need greater innate talent than male workers to invest in firm-specific skills and take a job as a manager. Since only top managers will be able to reap the benefits from stronger competition through the skill-biased competition effect, female managers are then more likely to

see their wages increase when competition increases, which is confirmed in the estimates. Further support for the asymmetry between male and female managers is given in columns seven and eight, which repeat the estimation for managers below the CEO level, while columns nine and ten depict the results for CEOs. Interestingly, the impact of competition on female managers' wages is the strongest for the highest positions in the firm. The size of the estimated effect is twice as large for CEOs as for lower managerial positions.

In Table 7, we re-estimate Equations (4.3) and (4.4) for different size classes of firms. This does not qualitatively change the results. We do however find that it is primarily at the CEO level that the differences persist. Again, this is consistent with our proposed model, which stresses that the selection or glass ceiling effect may be stronger for women in top positions.

Table 7

In Table 8, we use an alternative measure of competition, namely European Union (EU) import tariffs. One potential critique of the Boone measure of competition is endogeneity. There may be other factors that change over time and are correlated with the Boone measure but have little to do with competition. While our estimates are solidly grounded in theory, such concomitant changes jeopardize the causal interpretation of the estimates. One may then argue that lower import tariffs should lead to increased competition and, therefore, that the variation in import tariffs could serve the same role as the Boone elasticity while offering the advantage of appearing to be less associated with endogeneity problems. The main advantage of using tariffs is that they can be considered exogenous after 1995, when Sweden joined the European Union. It is unlikely that a small country such as Sweden has a substantial impact on the level of tariffs set by the EU. In addition, tariffs set at the EU level are not affected by conditions in Swedish industries. We aggregate the six-digit HS tariff data from the UNCTAD TRAINS database up to the three-digit level of SNI (the Swedish Industrial Classification) using trade shares as weights.[28] Specifically, to construct the industry-level import tariffs, the shares of Swedish imports in 1996 (the first year in the sample) are used as weights. We note that import tariffs were reduced over the sample period and that tariff reductions vary across industries. The tariff data are only available for the manufacturing sector.

Starting with regressions on all employees, independent of occupation, (columns 1–2) and on all non-managers (columns 3–4), we find no effect of competition and no gender differences. These results are in accordance with the results in Table 5. Similar results are found for employees with lower-level management positions and in estimations in which we pool all managers (columns 5–8). These results differ from those of the corresponding specifications in Table 6.

Continuing with the impact on CEOs, columns 9–10 reveal that the asymmetry between males and females remains for CEOs, where higher import tariffs (worsening competition) lead to a reduction in the wages of female CEOs. Again, for male CEOs, there is no statistically significant effect of import tariffs on their wages.

[28] SNI roughly corresponds to Standard Industrial Classification (SIC).

Table 8

4.5.2. The extensive margin: hiring

The results thus far are in accordance with female employees in top positions in firms facing a career hurdle. This discrimination is identified by the fact that the variation in product market competition differently affects female and male managers: The expected wage of a female manager increases in competition, whereas the expected wage of a male manager is not affected by competition. Our theoretical framework explains this differential impact of competition through the glass ceiling effect, which implies that a gender-specific hurdle cost only allows the most talented women to become managers, and the skill-biased competition effect, which posits that it is only the most talented managers who are able to take advantage of increased product market competition (extracting a surplus from increased competition).

If the combination of the glass ceiling effect and the skill-biased competition effect generates higher wages for female managers when competition increases, then the comparative statics results in Proposition 3 suggest that increased competition may also lead to an increasing share of firms with female managers and CEOs. We argue above that we can test this by estimating Equation 4.5. The results are presented in Table 9.

Table 9

The results in column 1 of Table 9 show that there is no effect on the overall share of women in a firm, although there seems to be a positive and significant effect on the share of women, excluding managers, as seen in column two. However, as shown in column 7, where we control for the share of women at the industry level, this result seems to be partly driven by industries having inherent differences in the share of women.

Regarding the results on the share of female managers, the share of non-CEO managers or whether the firm has a female CEO, we obtain consistent evidence that an increase in product market competition is associated with a greater presence of female executives, as predicted by our theoretical analysis. Similar to our results above on individual wages, the results are strongest for CEOs (columns 5 and 10).

5. Extension to the benchmark model

Our wage regressions show that female managers' wages, on average, increase when product market competition increases, whereas male managers' wages, on average, are unaffected by product market competition. This asymmetry can be explained by female managers facing a higher career hurdle. This *glass ceiling effect* forces female managers to possess significantly higher firm-specific skills than male managers. However, female managers are then also more likely to reap the benefits from the *skill-biased competition effect*, which states that only the most skilled managers benefit from

competition in the form of an increased wage. In this section, we show that these results remain valid in a number of extensions of the benchmark model: generalized bargaining, preference-based discrimination, a skill-dependent gender-specific career hurdle (where women are restricted from making the most of their skills by working fewer hours), competition over talent between firms, competition between talent within firms, allowing for different ability distributions between men and women, and modelling female managers working fewer hours. These exercises also give raise to new theoretical results.

5.1. Generalized bargaining

The benchmark model assumes that women and men are *equally able* in wage negotiations. Card et al. (2016), however, show that women are less likely to work in high-paying jobs and that women receive a lower share of the surplus generated at the firm level. This suggests that women may—for some reason— have weaker bargaining power.

To examine how weaker bargaining power for women would affect our results, let the firm have bargaining power, $\eta > 0$. If there is a female talent in firm j in (3.2) then she has $\psi > 0$ in bargaining power. Correspondingly, if firm j has a male talent, he has $\delta > 0$. In solving the model for the generalized Nash-bargaining solution, it is straightforward to show that the critical abilities needed to fulfill the investment conditions in (3.7) now become:

$$\begin{cases} S_j(\theta^{\mathcal{F}}) = \frac{\psi+\eta}{\psi} \times I + \psi D, \\ S_j(\theta^{\mathcal{M}}) = \frac{\delta+\eta}{\delta} \times I. \end{cases} \tag{5.1}$$

where under generalized bargaining it is convenient to redefine the surplus in (3.3) as $S_j(\theta) = \pi_j(\theta) - \pi_j(0)$.

Equation 5.1 yet again reveals how the hurdle cost D forces women to have a higher ability than men to become managers. Interestingly, if females are worse at wage bargaining than males, $\psi < \delta$, this will *strengthen* the glass ceiling effect—if women receive a lower share of the generated surplus than men, then an even higher surplus, $S_j(\theta)$, and, hence, an even higher ability, θ, is needed to make career investment worthwhile.

Turning to the skilled-biased competition effect, Lemma 2 still holds—the change in the surplus in competition, $S'_{j,C}(\theta)$ is U-shaped in ability θ. It then follows that the prediction in Proposition 2 on how competition can affect male and female managers' average wages differently also applies when $D = 0$, that is, when there is neither an additional disutility for women from taking up a position as manager nor an extra cost for firms to hire women as managers. Why? If women have a sufficiently strong disadvantage in bargaining, $\psi < \delta$, Equation (5.1) reveals that the glass ceiling effect arises from women needing a higher ability, θ, to cover the investment cost I. Adding the skilled-biased competition effect and again assuming a sufficiently strong disadvantage, it follows that the average wage for female managers will be increasing in competition, while the impact of competition on the average wage for male managers will be ambiguous.

Thus, the asymmetric impact of stronger competition on female and male CEOs' wages is also

compatible with women having lower bargaining power than men. Interestingly, and in contrast to the benchmark model that predicts a fixed gender pay gap (derived from the fixed cost, D), if women also have weaker bargaining power than men, then it can be shown that the *gender wage gap will be an increasing function of ability or firm-specific skill, θ.* Hence, that the gender pay gap will be highest "at the top".

5.2. Preference-based discrimination

We have assumed that the hurdle females face when working as managers stems from the job being inflexible and that this comes at a higher cost for females. An alternative explanation for the hurdle, based on preferences, can be found in the literature on the "glass ceiling"—a barrier of prejudice and discrimination that excludes women from higher level leadership positions.[29] The general presence of the glass ceiling has been explained based on attitudes within the workplace suggesting that workers prefer male to female supervisors and managers (Simon and Landis (1989)).[30] An easy way to capture pure discrimination in the benchmark model in Section 3 is to assume that the full cost D falls on the firm (i.e., assume that $\alpha = 1$). Some papers in the literature have also suggested that weaker bargaining power for women can capture presence of discrimination *(*see Eckstein and Wolpin, 1999 and Bartolucci, 2013*).* It then directly follows from the above analysis that our results will also hold under pure discrimination.

5.3. Competition for managers

A strong assumption in our benchmark model is that investments in a career as a manager only produce firm-specific skills. This implies that the only outside option for a potential manager, if the wage negotiation with the firm breaks down, is regular work at the outside wage, $w(0)$. How would the results change if we allowed for transfers of managerial skills across firms?

Applying a framework similar to that of Anton and Yao (1994), suppose that in the bargaining game in Stage 2, the talent first negotiates with firm j, and then—if no agreement is made—he or she can proceed to negotiate with a rival firm $k \neq j$. Furthermore, assume that a breakdown of negotiations with firm k gives no further opportunity for managerial work. The latter wage negotiations will then give rise to the wages given in (3.4), or (3.5), merely replacing firm-subscripts, i.e., $w_k^*(\theta \in \mathcal{M})$ or $w_k^*(\theta \in \mathcal{F})$. Using (the out-of-equilibrium) wage paid by firm k as the outside option in the negotiation with firm j, it can be shown that critical abilities needed to fulfill the

[29] See, for instance, Federal Glass Ceiling Commission, 1995; Morrison et. al. (1987). Eagly and Karau. (2002) identify two forms of prejudice: (a) perceiving women less favorably than men as potential occupants of leadership roles and (b) evaluating behavior that fulfills the prescriptions of a leader role.

[30] Discrimination is often identity specific and, therefore, occupation specific. For instance, a male security guard might not want to work with a female security guard but might not have a problem working around a better paid female teacher (Akerlof and Kranton, 2000).

investment conditions in (3.7) now become:

$$\begin{cases} S_j(\theta^{\mathcal{F}}) + \frac{\eta}{\psi+\eta} \times S_k(\theta^{\mathcal{F}}) = \frac{\psi+\eta}{\psi} \times I + \frac{\psi+2\eta}{\psi+\eta} \times D, \\ S_j(\theta^{\mathcal{M}}) + \frac{\eta}{\delta+\eta} \times S_k(\theta^{\mathcal{F}}) = \frac{\delta+\eta}{\delta} \times I. \end{cases} \tag{5.2}$$

where the surplus created when the potential manager works for firm k is $S_k(\theta) = \pi_k(\theta) - \pi_k(0)$. Note also that the surplus generated when the potential manager works for firm j is now $S_j(\theta) = \pi_j(\theta, 0) - \pi_j(0, \theta)$, with $\frac{d\pi_j(\theta,0)}{d\theta} > 0 > \frac{d\pi_j(0,\theta)}{d\theta}$. The former inequality again reflects the strategic advantage of employing a new skilled manager, while the latter inequality reflects the strategic disadvantage of seeing the skilled manager go to a rival firm. Note, finally, that Lemma 2 will apply to both $S_j(\theta)$ and $S_k(\theta)$—so that the right-hand side (RHS) in (5.2), will again be U-shaped in competition, given a sufficiently high θ.

From the RHS of (5.2), we then note that if women and men can extract surplus in the same way, i.e., if $\delta = \psi$, the disutility cost for women D again gives rise to the glass-ceiling effect, $\theta^{\mathcal{F}} > \theta^{\mathcal{M}}$. However, if women extract less surplus than men in wage bargaining, i.e., if $\psi < \delta$, even more talent is needed for women to make a career worthwhile, strengthening the glass ceiling effect. However, from the left-hand side (LHS) of (5.2), we also note that the outside option of working for firm k can weaken the glass ceiling effect: if women have lower bargaining power than men, they will have a lower disagreement wage in firm k (i.e., a smaller outside option), which—ceteris paribus—gives women a larger net surplus from an agreement with firm j. The empirical results where female managers, on average, experience an increase in their wage from increasing competition, while male managers, on average, see their wage unaffected by competition, suggest that this latter effect is limited.

5.4. Competition between trainees

In the benchmark model, only one trainee is assigned to each firm. Yet another interesting extension is then to allow for competition between a male and a female trainee within the firm. Is such a setting also compatible with our empirical results?

Consider the benchmark model with investment in firm-specific skills. Suppose that firm j now has two talented workers—a male and a female. Both individuals can invest in a career as a manager but need to take the other's decision to invest into account. For simplicity, consider pure Nash equilibria in career investments. Then, there exists no equilibrium where both invest if both have the same innate talent, θ—if both would invest, the firm would then play them against each other, and the wage would be bid down to the outside wage, $w(0)$. All other possible equilibria can occur depending on the drawn talent pair: only the female trainee invests when she has talent $\theta \geq \theta^{\mathcal{F}}$ and the male trainee has talent $\theta < \theta^{\mathcal{M}}$; only the male trainee invests when he has talent $\theta \geq \theta^{\mathcal{M}}$ and she has talent $\theta < \theta^{\mathcal{F}}$; and neither invests when $\theta < \theta^{\mathcal{M}}$. When both have a talent $\theta \geq \theta^{\mathcal{F}}$, there is an asymmetric equilibrium, but we cannot predict who will invest without further assumptions.

However, if we again apply the sequential framework in Anton and Yao (1994), the firm would

first bargain with the trainee that it wants to hire, using the other trainee as its outside option. The firm would then select the trainee that creates the highest net surplus. The two trainees would see through this procedure and—in equilibrium—only one of the trainees would invest. Since the female trainee is subject to a higher hurdle, she would need to have a significantly higher ability to create the necessary surplus to be chosen, and hence the glass ceiling effect would again be present. The reasoning in the benchmark model would apply, and the glass ceiling effect and the skilled-biased competition effect would yet again produce a pattern where female managers see their wages increase in competition while male managers do not.

5.5. Different ability distributions

In the benchmark model, we assumed that men and women have identical talent distributions—how would results change if we allowed the distribution of talent to differ between men and women?

Suppose that the talent distribution of women is $f(\theta)$ and the talent distribution of men is $m(\theta) \neq f(\theta)$. While assuming different distribution for males and females will have an impact on the gender pay gap in (3.10) and (3.11) as well as the change in the expected wage when competition increases as given in (3.14) and (3.13), Proposition 2 is still valid: in particular, if the female talent distribution, $f(\theta)$, has support over the full range $\theta \in [0, \theta^{\max}]$, the average wage for female managers will always increase in competition, if women face a sufficiently high hurdle.

5.6. Female managers working fewer hours

To simplify, we have modeled the gender-specific career hurdle as a fixed cost, D, where a share α falls on the firm and a share $1 - \alpha$ falls on the female manager. This extra cost of hiring a female manager D—which captures the inherent inflexibility in the job as manager—is assumed to be independent of the skill level, or talent, of the individual, θ, as well as the level of the intensity of product market competition, C.

This may be a reasonable assumption concerning the cost falling directly on the female manager. The loss in utility from lower flexibility—or less participation in family life—may not depend on an individual's talents and skills. However, if a female manager is frequently absent from work, the productivity loss for the firm may be variable and increase with her skill level. This raises the issue whether our derived glass ceiling effect and skill-biased competition effect would still be operational in a setting where the gender-specific career hurdle is variable and type dependent.

To see that our analysis is still valid, depart from the *benchmark case* without a loss for the firm from hiring a female manager. The hurdle cost falls solely on the woman, i.e., suppose that $\alpha = 0$. Suppose further that the hurdle cost is so high that $\theta^{\mathcal{F}} = \theta^{S}$, that is, $D = \tilde{D}$. We thus

have[31]

$$\begin{cases} S_j(\theta^{\mathcal{F}}) = I + \frac{\tilde{D}}{2}, \\ S'_{j,C}\left(\theta^{\mathcal{F}}\right) = 0. \end{cases} . \tag{5.3}$$

From Lemma 2, the wage for female managers must then unambiguously increase in competition, i.e., $S'_{j,C}(\theta) > 0$ whenever $\theta > \theta^{\mathcal{F}}$.

Now we introduce a variable loss for the firm from hiring a female manager. To this end, assume that the combination of family concerns and an inflexible workplace implies that a female manager can only use a share $\beta \in (0,1)$ of her firm-specific skills, θ. It is useful to think of β as the share of the full work day of a male manager that the female manager will be available. The surplus from hiring a female manager is then $S_j(\beta\theta)$. It then follows that (5.3) becomes

$$\begin{cases} S_j(\beta\tilde{\theta}^{\mathcal{F}}) = I + \frac{\tilde{D}}{2}, \\ S'_{j,C}\left(\beta\tilde{\theta}^{\mathcal{F}}\right) = 0. \end{cases} \tag{5.4}$$

Compare the LHS in (5.3) and (5.4). From these expressions, it follows that we must have $\theta^S = \theta^{\mathcal{F}} = \beta\tilde{\theta}^{\mathcal{F}}$, and hence, $\tilde{\theta}^{\mathcal{F}} = \frac{\theta^{\mathcal{F}}}{\beta} > \theta^{\mathcal{F}}$. Thus—ceteris paribus—women need an even greater innate talent to invest into a career as manager, $\tilde{\theta}^{\mathcal{F}} > \theta^{\mathcal{F}}$. However, given this higher innate talent, female managers' wages will still increase in competition, since the surplus must increase in competition, i.e., $S'_{j,C}(\beta\theta) > 0$ for $\theta \in (\tilde{\theta}^{\mathcal{F}}, \theta^{\max}]$. Now, note that we have made no change in assumptions for male managers. Hence, it follows that this extended model—where the gender-specific career hurdle is variable and type dependent— is still compatible with male managers' wages, on average, being unaffected by competition—while female managers' wages, on average, increase in competition.

We then have the following corollary:

Corollary 1. *Suppose that the hurdle cost D solely represents the disutility a female talent associates with choosing a managerial career, i.e., $\alpha = 0$. Assume that the gender-specific career hurdle is variable and type dependent such that the female manager can only use a share $\beta \in (0,1)$ of her firm-specific talent or skill, θ. Then, if β is not too low, Proposition 2 still applies.*

This extended model with the gender-specific career hurdle being variable and type dependent also carries additional predictions. If women can only use a share $\beta \in (0,1)$ of their firm-specific talent or skill, θ, i.e., women are less productive, the gender-pay gap will be increasing in ability, since the increase in surplus from higher ability will be smaller with a female manager, i.e., $S'_j(\theta) > \beta \cdot S'_j(\beta\theta)$.[32]

[31] For simplicity, we retain the assumption that the fixed hurdle cost is shared by the firm and the female manager. However, since the investment decision in (3.7) is independent of how the fixed hurdle cost is split, the results do no hinge on how the fixed cost is split.

[32] As with the extension of weaker bargaining power for women in Section 5.1, this implies that the gender wage gap will be highest at the top. Azmat and Ferrer (2017) examine estimated gender coefficients from quantile regressions at different points in the distribution and find that for client revenue, there is some evidence that the gender gap indeed is largest at the top of the distribution.

6. Evidence of the skill-biased glass ceiling effect

The empirical findings in Section 4 provide evidence consistent with the *skill-biased competition effect* derived in Proposition 2 showing that female managers—on average—see their wages increase in competition, while male managers—on average—are unaffected by competition. Can we also find direct evidence of the skill-biased glass ceiling effect derived in Proposition 1? If women face a higher hurdle than men do when investing in a career as manager, the least skilled or talented women will abstain from investing in a managerial career. This positive selection among women should imply that the lower part of the observed distribution of female managers will be more skilled or able than the corresponding lower part of the observed distribution of male managers. This gives rise to the following predictions:

Predictions: *Suppose that females face a gender-specific career hurdle; then,*

1. *The observed wage distribution for female managers should be more skewed to the right than the observed wage distribution for male managers.*

2. *The gender wage gap should increase as we move up the observed wage distributions for female and male managers*

3. *The distribution of estimated individual-firm fixed effects for females should be more skewed to the right than the distribution of individual-firm fixed effects for male managers.*

We explore these predictions for top managers, i.e., CEOs. Using (4.3) and (4.4), we can decompose individual CEOs' wages into a part predicted from observables and a part consisting of the CEO-firm spell fixed effect and an error term:

$$\log w_{ijt}(i \in \mathcal{F}) = \underbrace{\left[\hat{\alpha}_{\mathcal{F}} + \hat{\beta}_{\mathcal{F}}\hat{C}_{rt} + \hat{\varsigma}_{t\mathcal{F}} + \hat{\gamma}_{\mathcal{F}}Experiance_{it}^2 + \mathbf{X}'_{jt}\hat{\boldsymbol{\lambda}}_{\mathcal{F}}\right]}_{\text{Predicted wage from observables, } \breve{w}_{ijt}(i\in\mathcal{F})} + \underbrace{\hat{\varsigma}_{ij}(i \in \mathcal{F})}_{\text{CEO-firm fixed effect}} + \underbrace{\varepsilon_{ijt}(i \in \mathcal{F})}_{\text{Error term}}, \tag{6.1}$$

$$\log w_{ijt}(i \in \mathcal{M}) = \underbrace{\left[\hat{\alpha}_{\mathcal{M}} + \hat{\beta}_{\mathcal{M}}\hat{C}_{rt} + \hat{\varsigma}_{t\mathcal{M}} + \hat{\gamma}_{\mathcal{M}}Experiance_{it}^2 + \mathbf{X}_{jt}\hat{\boldsymbol{\lambda}}_{\mathcal{M}}\right]}_{\text{Predicted wage from observables, } \breve{w}_{ijt}(i\in\mathcal{M})} + \underbrace{\hat{\varsigma}_{ij}(i \in \mathcal{M})}_{\text{CEO-firm fixed effect}} + \underbrace{\varepsilon_{ijt}(i \in \mathcal{M})}_{\text{Error term}}. \tag{6.2}$$

where a "hat" indicates estimates.

Figure 6.1 depicts kernel density plots for the wage distributions for male CEOs, $\log w_{ijt}(i \in \mathcal{F})$, and the raw wage distributions for female CEOs, $(\log w_{ijt}(i \in \mathcal{M}))$, where we are using data from the two last specifications of Table 6, and where we have collapsed the data by taking the mean over each spell (i.e., each CEO in a specific firm). The female wage distribution is single-peaked and

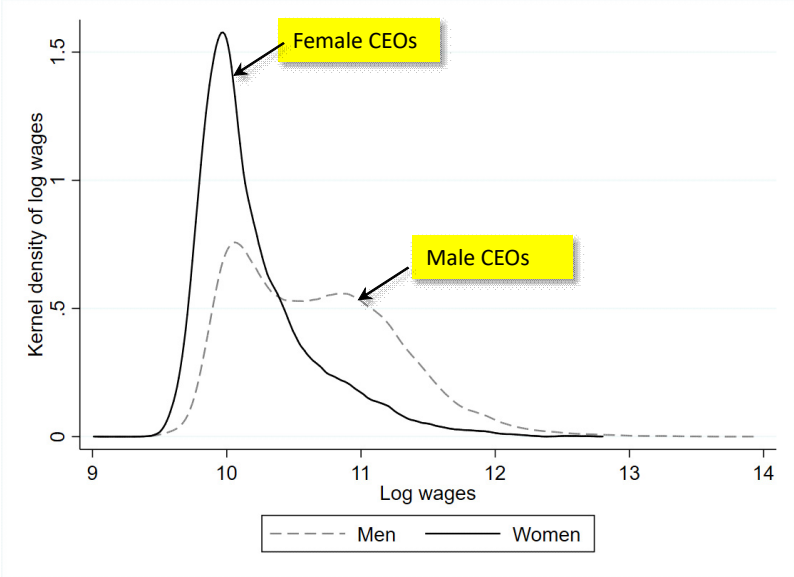


Figure 6.1: The distribution of log monthly wages for male- and female CEOs, $\log w_{ijt}(i \in \mathcal{M})$ and $\log w_{ijt}(i \in \mathcal{F})$.

heavily skewed to the right, with very little mass on its lower left tail. The male wage distribution is double-peaked, and more stretched towards its right tail.

Table 10 presents detailed results from our decomposition, showing estimates by mean CEO-firm spells (i.e., each CEO-firm combination). The results are presented for different parts of the wage distribution and also for the overall mean.

Table 10

We first note that the Shapiro Wilks tests in Table 10 reject normality for both distributions depicted in Figure 6.1. Moreover, the skewness of the female distribution is more than twice the skewness of the male distribution (1.38 versus 0.63), and kurtosis in the female distribution is almost twice as high as that in the male distribution (5.13 versus 3.27). Taken together with the visual image of the distributions in Figure 6.1, the difference in skewness and kurtosis is consistent with Prediction 1 above.

Further explorations of Table 10 also give support for Prediction 2 above. The gender wage gap for CEOs is much lower at the bottom end of the distributions than at the top ends—it is approximately 15% when we compare the bottom ten percentiles of male and female CEOs, reaching approximately 40% at the median, and then further increasing at higher percentiles.[33] We can relate these findings to previous research (i.e., Goldin, 2014) that has stressed how the gender wage gap at the top can emerge when marginal hours are very valuable for the firm, and males are

[33] This pattern is even more pronounced when we look at predicted wages from observables, $\breve{w}_{ijt}(i \in \mathcal{F})$ and $\breve{w}_{ijt}(i \in \mathcal{M})$.

able to work more hours than females. While this mechanism is also present in the extension to our theoretical benchmark model in Section 5.6, our theory also highlights a counteracting mechanism where females need to possess higher skills than their male counterparts to become CEOs. The positive selection of women implies a smaller gender wage gap, in particular, at the bottom of the wage distribution.

How can we then further trace the positive selection of female managers? As noted above, the estimated CEO-firm spell fixed effects can be viewed as a proxy for the CEOs' firm-specific skills (labelled θ in our theoretical model). These estimated CEO-firm spell-fixed effects show how much CEOs—male and female—differ from the mean wage of their gender. In the upper panel of Figure 6.2, we depict kernel density plots of the distribution of estimated CEO-firm spell fixed effects for female CEOs, $\hat{\varsigma}_{ij}(i \in \mathcal{F})$, and male CEOs, $\hat{\varsigma}_{ij}(i \in \mathcal{M})$, respectively. The visual pattern in the upper panel in Figure 5 reveals strong support for Prediction 3 above. While the male distribution is relatively symmetric around its mean (indicated as zero), the female distribution is heavily skewed to the right with little mass on its left tail. The detailed information in Table 10 reveals that skewness is about four times higher in the female distribution according to conventional measures. Moreover, the female distribution has a lower standard deviation, a higher mean and higher kurtosis. Shapiro-Wilk tests also reject normality for both distributions of CEO-firm spell-fixed effects.

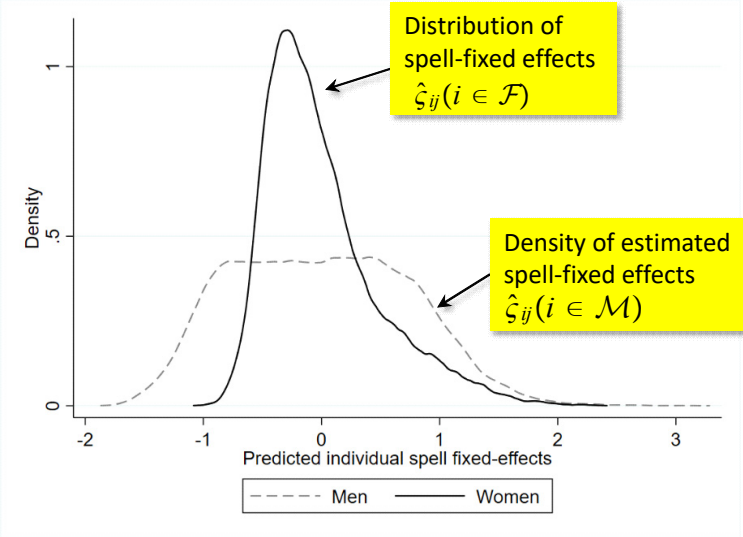
To formally test if the distributions of estimated CEO-firm spell-fixed effects for male and female CEOs are statistically different, we use the Goldman-Kaplan equality of distribution test.[34] This test is depicted in the lower panel in Figure 6.2. The top panel again shows the density of estimated CEO-firm spell fixed effects for males and females, respectively, and the lower panel shows the output of the testing procedure. In the lower panel, the two CDFs of estimated CEO-firm spell-fixed effects for male and female CEOs are plotted, and the range of values for which the test rejects the equality of distribution are displayed as horizontal lines. In line with the top panel and with Prediction 3 above, equality of the two distributions is rejected at low- and middle values of proxied ability. Overall, the Goldman and Kaplan test rejects equality of the distributions at the 0.001 level.

If we use the mean wages for male and female CEOs in Table 10 and add the estimated CEO-firm spell fixed effects for the different percentiles, we can also provide a rough quantification of the skilled-biased glass ceiling effect measured in wages. The last column in Table 10 shows that when taking into account the CEO-firm spell-fixed effects, female CEOs earn higher wages than male CEOs in the first ten percentiles.[35] This relationship is reversed at higher percentiles, consistent with the extended model in Section 5.6, which predicts that if female CEOs are constrained in their

[34] The Goldman-Kaplan approach is a generalization of the Kolgomorov-Smirnov test, which tests a single hypothesis of equality of the distributions as their maximum difference. The Goldman-Kaplan test examines the equality of the distribution functions at each possible value. See Goldman and Kaplan (2018).

[35] We can also use the time dummies, the intercept and the estimates spell-fixed effects to display the evolution over time. This shows an upward trend in the male premium over the time period. Since the spell-fixed effects are time-invariant, this translates into a negative male premium at the lowest percentiles in the early years of the period and a slightly positive gender gap during the end of the period.

(ii) Distribution of estimated spell-fixed effects for male and female CEOs



(ii) CDFs of estimated spell-fixed effects for male and female CEOs

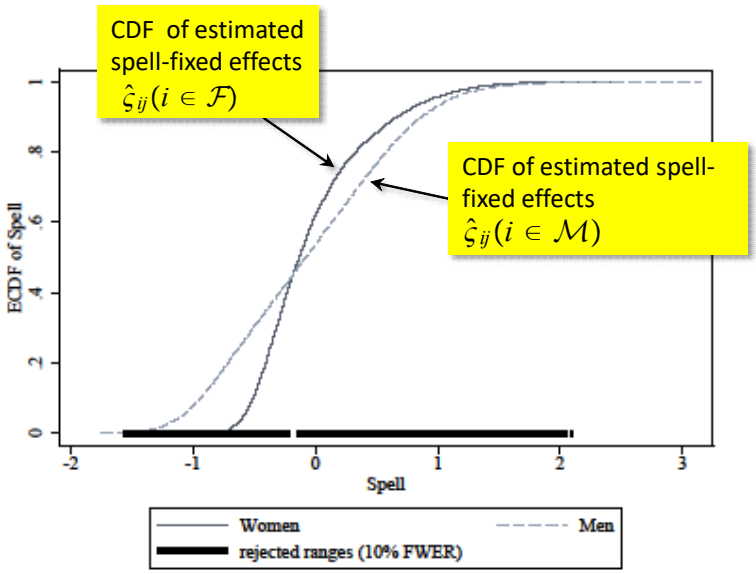


Figure 6.2: Panel (i) shows the distributions of estimated spell fixed effects for male- and female CEOs. Panel (ii) depicts the CDFs for estimated spell-fixed effects for male CEOs, $\hat{\varsigma}_{ij}(i \in \mathcal{M})$, and female CEOs, $\hat{\varsigma}_{ij}(i \in \mathcal{F})$. Also depicted are the regions over which equality of the CDFs is rejected, based on the null hypothesis $H_{0_{\hat{\varsigma}}} : \Xi(\hat{\varsigma}_{ij}(i \in \mathcal{F})) = \Gamma(\hat{\varsigma}_{ij}(i \in \mathcal{M}))$ for all $\hat{\varsigma}$, where $\Xi(\hat{\varsigma}_{ij}(i \in \mathcal{F}))$ is the female CDF and $\Gamma(\hat{\varsigma}_{ij}(i \in \mathcal{M}))$ is the male CDF and $\hat{\varsigma}$ are the estimated spell fixed effects. The indicated FWER is the probabality of rejecting any true $H_{0_{\hat{\varsigma}}}$ which is controls for type I error for multiple testing. Goldman and Kaplan apply a strong control for FWER. The stated 10 % level can be interpreted as false positives will be absent 90 % of the time (see Kaplan, 2019).

labor supply, they will on average be more skilled than their male peers—but less productive. The dampening impact on wage remuneration of lower productivity arising from not being able to put in the extra hours is then much stronger for high-skilled female CEOs than for less skilled female CEOs.

We have also examined estimated individual-firm spell-fixed effects for managers other than CEOs and non-managers. Broadly, we then find that the difference in skewness between the female and male distributions is less accentuated, consistent with weaker bargaining power or, lacking evidence for that, competition affecting wages for groups other than managers, and in particular CEOs.

7. Conclusions

In this paper, we have investigated how product market competition and gender-specific management career hurdles affect the gender wage gap for managers. We develop a model in which (i) oligopolistic firms hire managers that can be female or male, (ii) females' and males' management skills are drawn from the same skill distribution, and (iii) the inflexibility associated with management jobs is more costly for females. Since the inflexibility associated with management jobs is more costly for females, a female manager with the same skill level as a male will receive a lower wage. Under plausible assumptions regarding how profits depend on a managers' skills and product market competition, we then show that increased product market competition can reduce the gender wage gap for managers. Since women face a higher career hurdle, only the most talented females will find it worthwhile to pursue a career as a manager. This positive selection implies that female managers must, on average, be more skilled than male managers and, therefore, that female managers will, on average, be able to respond better to more intense product market competition. Hiring and wages will then increase more for female managers when the intensity of product market competition increases. Using Swedish matched employer-employee data, we find strong empirical evidence for these predictions for managers and, in particular, for CEOs.

We also provide direct evidence for the positive selection of female managers by comparing estimated individual-firm fixed effects (serving as a proxies for individual firm-specific managerial skills) for female CEOs and male CEOs in our Swedish data. We then find that while the male distribution is more symmetric, the female distribution is heavily skewed to the right, consistent with the presence of a female career hurdle that forces females with lower talent to abstain from a managerial career. Statistical tests also reject the equality of the two distributions.

Our findings suggest that increased product market competition can work as a (imperfect) substitute for other policies intended to remove discriminatory hurdles. One advantage of increased product market competition is that it both mitigates discriminatory behavior and induces the most talented individuals from the group being discriminated against to pursue investments in their careers. A potential problem with, for example, quotas is that they benefit all members of the group that is subject to discrimination, both the talented and the less talented, and might thus entail inefficiencies.

An implication from our theory is that policies reducing the hurdles impeding women from pursuing top manager positions will not only benefit women—they also indirectly improve firm performance and therefore, ultimately, are likely to benefit consumers. When more able female managers replace male managers, the firm is likely to invest in better projects and to organize production and market its products in a better way. The reduction of hurdles also comes at a cost if the organization has to adjust to female managers' demand for workplace flexibility. However, these costs are more likely to be in the form of fixed costs, whereas better management capabilities will likely reduce variable costs or lead to new products. These features imply that a large share of the benefits of better management will accrue to consumers in the form of lower prices and new products and services. Thus, there are likely to be positive externalities associated with reducing the female management hurdle. Extending the theoretical exercise to a welfare analysis of different policies seems like a fruitful avenue for future research. Such an analysis could also endogenize time allocation within the family.

The theory and the empirical evidence presented here is consistent with females having to overcome a career hurdle to pursue a career as a top manager. However, which factors affect the magnitude of this hurdle? For instance, how do recent advancements in new technologies and different policy changes affect the hurdle? An interesting avenue for future research would be to study the effects on gender wage gaps and gender skill distribution gaps for managers when firms implement new technologies and policies that make jobs more flexible. Another interesting issue to explore is how different family policies influence the specific gender wage gaps for managers. Yet another avenue for research would be to examine how gender composition in corporate boards affects gender wage gaps and gender skill distribution gaps for managers.

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Tables and additional Figures

Tables

Table 1: O*Net characteristics. Means (normalized) by occupational group. Table 2 in Goldin (2014) but with additional information on managers and on chief executives and legislators.

O*Net characteristics	Technology and Science	Business	Health	Law	Managers	Chief executives and legislators
Time pressure	-.571	.055	.107	1.510	.640	.833
Contact with other	-.888	-.079	.788	.483	.429	.520
Establishing and maintaining interpersonal relationships	-.699	.574	.216	.781	.454	1.426
Structured vs. Unstructured work	-.610	.089	.419	1.220	.491	.979
Freedom to make decisions	.523	-.209	.743	.764	.290	1.108
Number of occupations	29	18	14	1	16	1

Notes: This table shows O*Net characteristics for the original four occupational groups presented in Table 2 in Goldin (2014), but where we separate out managerial occupations and chief executives and legislators.

Table 2: O*Net characteristics differences between managers and non-managers.

O*Net characteristics	Time pressure	Contact with other	Establishing and maintaining interpersonal relationships	Structured vs. Unstructured work	Freedom to make decisions
Manager	0.77***	0.52***	0.55**	0.59**	0.35*
	(0.23)	(0.17)	(0.27)	(0.23)	(0.18)
Observations (occupations)	94	94	94	94	94
R^2	0.09	0.04	0.04	0.05	0.02

Notes: This table shows estimated coefficients from regressions by O*Net characteristics. Each specification has an O*Net characteristics (normalized) as dependent variable and Manager is an indicator variable equal to one if the occupation is a manager occupation. Robust standard errors, where ***, **, * show significance at the 1%, 5%, and 10% levels, respectively.

Table 3. Descriptive statistics

Source	Variable	All years (1996–2013)		1996–2002		2003–2009	
		Mean	SD	Mean	SD	Mean	SD
A. Firms Position	Share of women	0.33	0.23	0.32	0.23	0.34	0.24
	Share high-edu.: women	0.36	0.29	0.32	-0.29	0.38	0.29
	Share medium-edu.: women	0.33	0.25	0.33	0.24	0.34	0.25
	Share low-edu.: women	0.33	0.3	0.34	0.3	0.33	0.31
	Share female managers	0.19	0.25	0.16	0.23	0.21	0.26
	Share female CEOs	0.12	0.28	0.09	0.25	0.13	0.29
	Competition	4.24	1.41	4.28	1.45	4.19	1.38
	Number of employees	326	1161	342	1260	312	1071
	Capital intensity	0.98	0.43	1	4.31	0.97	4.37
	Share high-skilled	0.25	0.23	0.22	0.21	0.28	0.24
	Age	40.78	5.19	40.26	5.1	41.22	5.23
	Number of observations	41,183		18,852		22,331	
B. Individual level	Wage (in logs)	9.94	0.33	9.87	0.31	10.02	0.33
	Wage (in logs): women	9.85	0.29	9.77	0.26	9.93	0.29
	Wage (in logs): men	10	0.34	9.92	0.32	10.07	0.34
	Work experience	22.56	12.58	22.47	12.44	22.64	12.71
	Number of observations	1,298,218		6,216,633		6,765,556	

Notes: Share high-edu.: women is share of women with least three years of university studies, Share medium-edu.: women is share of women with at least upper secondary school and Share low-edu.: women is share of women with at least compulsory school. Competition is based on Boone measure (see Section 3 for details), Capital intensity is Capital stock/Number of employees, Firm size is number of employees and Share skill high is share of the labor force with at least 3 years of post-secondary education. Firm level statistics on workers education stem from aggregated plant level data on education. Data on individual workers' education stem from individual register data on education. Wages at the worker level are gross real monthly full-time-equivalent wages (in 1995 SEK).

Table 4a. Gender differences in wages, 1996-2009 (all employees)

	1	2	3	4	5	6
=1 if female	-0.147***	-0.156***	-0.144***	-0.105***	-0.092***	-0.094***
	(0.006)	(0.005)	(0.005)	(0.005)	(0.004)	(0.004)
=1 if finished 9 years of primary school		0.013***	0.041***	0.015***	0.017***	0.016***
		(0.004)	(0.005)	(0.003)	(0.003)	(0.002)
=1 if 2 years of secondary school		0.058***	0.075***	0.028***	0.031***	0.027***
		(0.007)	(0.010)	(0.004)	(0.004)	(0.003)
=1 if 3 years of secondary school		0.110***	0.218***	0.092***	0.093***	0.087***
		(0.012)	(0.012)	(0.005)	(0.004)	(0.004)
=1 if 4 years of secondary school		0.227***	0.281***	0.103***	0.115***	0.097***
		(0.013)	(0.011)	(0.007)	(0.005)	(0.005)
=1 if college degree		0.430***	0.518***	0.241***	0.248***	0.229***
		(0.015)	(0.014)	(0.009)	(0.007)	(0.007)
=1 if doctoral degree		0.683***	0.767***	0.436***	0.431***	0.407***
		(0.026)	(0.025)	(0.022)	(0.015)	(0.016)
Experience			0.026***	0.018***	0.017***	0.017***
			(0.001)	(0.001)	(0.001)	(0.001)
Experience/100^2			-0.040***	-0.028***	-0.026***	-0.026***
			(0.002)	(0.001)	(0.001)	(0.001)
Capital intensity						0.001
						(0.001)
Log firm size						0.003
						(0.002)
Share skill high						0.191***
						(0.030)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Occupation fixed effects	No	No	No	Yes	Yes	Yes
Industry fixed effects	No	No	No	No	Yes	Yes
R^2	0.12	0.30	0.40	0.56	0.59	0.60
No. of obs.	12,982,189	12,901,343	12,901,343	12,604,820	12,558,919	12,558,918

Notes: Dependent variable is log full-time equivalent wages. Capital intensity is Capital stock/Number of employees, Firm size is number of employees, Share skill high is share of the labor force with at least 3 years of post-secondary education. Standard errors are clustered at the individual level. ***, **, * show significance at the 1%, 5%, and 10% level, respectively.

Table 4b. Gender differences in wages, 1996-2009 (executive positions)

	Type of position					
	All managerial		Managerial below CEO		CEOs only	
=1 if female	-0.167***	-0.148***	-0.125***	-0.127***	-0.454***	-0.219***
	(0.002)	(0.002)	(0.002)	(0.002)	(0.007)	(0.005)
=1 if finished 9 years of primary school		0.050***		0.041***		0.058***
		(0.005)		(0.005)		(0.015)
=1 if 2 years of secondary school		0.078***		0.065***		0.094***
		(0.004)		(0.004)		(0.014)
=1 if 3 years of secondary school		0.239***		0.211***		0.300***
		(0.004)		(0.004)		(0.015)
=1 if 4 years of secondary school		0.296***		0.259***		0.353***
		(0.005)		(0.005)		(0.017)
=1 if college degree		0.555***		0.486***		0.665***
		(0.005)		(0.004)		(0.016)
=1 if doctoral degree		0.678***		0.612***		0.795***
		(0.009)		(0.008)		(0.028)
Experience		0.043***		0.039***		0.048***
		(0.000)		(0.000)		(0.001)
Experience/100^2		-0.064***		-0.059***		-0.069***
		(0.001)		(0.001)		(0.002)
Capital intensity		0.005***		0.005***		0.001*
		(0.000)		(0.000)		(0.001)
Log firm size		-0.008***		-0.002***		-0.007***
		(0.000)		(0.000)		(0.002)
Share skill high		0.383***		0.381***		0.478***
		(0.006)		(0.006)		(0.019)
Year fixed effects	Yes	Yes	Yes	Yes	Yes	Yes
Occupation fixed effects	No	Yes	No	Yes	No	Yes
Industry fixed effects	No	Yes	No	Yes	No	Yes
No. of obs.	794,298	794,298	692,707	692,707	101,591	101,591
R^2	0.13	0.47	0.17	0.49	0.12	0.54

Notes: Dependent variable is log full-time equivalent wages. Capital intensity is Capital stock/Number of employees, Firm size is number of employees, Share skill high is share of the labor force with at least 3 years of post-secondary education. Standard errors are clustered at the individual level. ***, **, * show significance at the 1%, 5%, and 10% level, respectively.

Table 5. Product market competition (Boone), share of female managers and profits: Firm-level estimates 1996-2009 on different parts of the productivity distribution

	Part of the productivity distribution									
	All obs	All obs	Below median	Above median	Below median	Above median	Below p(25)	Above p(75)	Below p(25)	Above p(75)
Competition	-7.607***	-2.452*	-4.889**	-2.354	-5.006**	-3.362**	-8.322*	-1.950	-11.660**	-1.238
	(2.227)	(1.235)	(2.250)	(1.568)	(2.235)	(1.551)	(4.172)	(2.094)	(4.475)	(2.483)
Share female managers									-1.086***	-0.059
									(0.387)	(0.248)
Comp.*Share fem. managers									17.686**	-2.933
									(7.997)	(5.481)
Capital intensity		0.074***			0.033	-0.002	0.067	-0.036	0.015	-0.017
		(0.018)			(0.028)	(0.023)	(0.045)	(0.028)	(0.050)	(0.029)
Log firm size		0.592***			0.812***	0.611***	0.829***	0.580***	0.748***	0.610***
		(0.035)			(0.059)	(0.052)	(0.113)	(0.097)	(0.142)	(0.089)
Share skill high		0.405*			0.328	-0.151	0.971	0.380	0.735	0.277
		(0.241)			(0.439)	(0.268)	(0.794)	(0.386)	(1.025)	(0.344)
R^2	0.003	0.060	0.038	0.048	0.070	0.080	0.066	0.087	0.066	0.087
No. of obs.	30,505	30,085	12,583	17,547	12,359	17,367	4,725	8,721	4,725	8,721

Notes: Dependent variable is log profits. Competition is based on Boone measure (see Section 3 for details). Capital intensity is Capital stock/Number of employees, Firm size is number of employees, Share skill high is share of the labor force with at least 3 years of post-secondary education. Productivity is measured as value added per employee. Grouping of firms are based on the within-industry productivity distribution. Standard errors are clustered by industry. ***, **, * show significance at the 1%, 5%, and 10% level, respectively.

Table 6. Product market competition (Boone) and relative wages: Individual-level estimates by gender 1996-2009

	Type of position									
	All		Non-managerial		All managerial		Managerial below CEO		CEOs only	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Competition	0.148	0.159	0.159	0.157	0.147	0.499**	0.099	0.342*	0.302	0.707***
	(0.155)	(0.179)	(0.151)	(0.191)	(0.110)	(0.222)	(0.111)	(0.198)	(0.274)	(0.241)
Experience/100^2	-0.035***	-0.031***	-0.033***	-0.029***	-0.064***	-0.046***	-0.064***	-0.049***	-0.047***	-0.026***
	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capital intensity	0.001	0.001	0.001	0.001	0.000	0.000	0.000	0.000	0.000	0.001
	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Log firm size	0.005	-0.000	0.005	-0.001	0.002	0.004***	0.001	0.005***	0.017	0.012**
	(0.006)	(0.003)	(0.006)	(0.003)	(0.004)	(0.001)	(0.004)	(0.001)	(0.010)	(0.005)
Share skill high	0.117**	0.111***	0.091*	0.091***	0.060**	0.066**	0.048**	0.085***	0.223***	0.046
	(0.055)	(0.036)	(0.049)	(0.033)	(0.023)	(0.031)	(0.022)	(0.031)	(0.042)	(0.064)
R^2	0.40	0.43	0.37	0.42	0.49	0.47	0.51	0.49	0.29	0.28
No. spells	2,275,488	1,451,939	2,111,681	1,388,023	201,468	59,595	180,077	51,881	31,469	11,256
No. obs.	8,258,078	4,596,236	7,434,113	4,329,862	632,687	161,574	556,838	135,835	75,849	25,739

Notes: Dependent variable is log full-time equivalent wages. Competition is based on Boone measure (see Section 3 for details). Capital intensity is Capital stock/Number of employees, Firm size is number of employees, Share skill high is share of the labor force with at least 3 years of post-secondary education. Standard errors are clustered by industry. ***, **, * show significance at the 1%, 5%, and 10% level, respectively.

Table 7. Product market competition (Boone) and relative wages: Individual-level estimates by gender and firm size 1996-2009

	Type of position and firm size group																	
	All managerial, 50+		All managerial, 100+		All managerial, 250+		Managerial below CEO, 50+		Managerial below CEO, 100+		Managerial below CEO, 250+		CEOs only, 50+		CEOs only, 100+		CEOs only, 250+	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Competition	0.150	0.498**	0.140	0.504**	0.148	0.542**	0.099	0.348*	0.084	0.343	0.076	0.353	0.308	0.689***	0.277	0.657**	0.295	0.727**
	(0.112)	(0.228)	(0.119)	(0.237)	(0.135)	(0.267)	(0.113)	(0.203)	(0.120)	(0.208)	(0.136)	(0.239)	(0.293)	(0.245)	(0.289)	(0.269)	(0.333)	(0.291)
Experience/	-0.064***	-0.046***	-0.065***	-0.046***	-0.066***	-0.047***	-0.064***	-0.049***	-0.065***	-0.049***	-0.066***	-0.050***	-0.049***	-0.026***	-0.048***	-0.026***	-0.046***	-0.027***
100^2	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capital int.	0.000	0.000	0.001	0.001	0.001	0.001	0.000	0.000	0.001	0.000	0.001	0.000	0.001	0.002	0.003	0.003	0.002	0.001
	(0.001)	(0.001)	(0.002)	(0.002)	(0.002)	(0.002)	(0.001)	(0.001)	(0.002)	(0.002)	(0.003)	(0.002)	(0.001)	(0.003)	(0.002)	(0.003)	(0.002)	(0.003)
Log firm size	0.001	0.004***	0.005	0.003	0.002	0.003	0.000	0.005***	0.003	0.006	0.000	0.004	0.013	0.011***	0.027	0.011	0.017	0.009
	(0.004)	(0.001)	(0.012)	(0.006)	(0.014)	(0.006)	(0.004)	(0.001)	(0.013)	(0.005)	(0.014)	(0.006)	(0.009)	(0.004)	(0.019)	(0.011)	(0.021)	(0.011)
Share skill	0.076***	0.081**	0.074**	0.103**	0.069*	0.128***	0.060**	0.099***	0.057*	0.113**	0.048	0.117**	0.303***	0.075	0.367***	0.097	0.408***	0.157**
high	(0.027)	(0.035)	(0.035)	(0.042)	(0.040)	(0.042)	(0.025)	(0.035)	(0.030)	(0.043)	(0.035)	(0.044)	(0.052)	(0.065)	(0.061)	(0.087)	(0.077)	(0.069)
R^2	0.496	0.469	0.504	0.470	0.513	0.475	0.515	0.487	0.521	0.487	0.530	0.491	0.299	0.284	0.306	0.283	0.310	0.287
No. spells	191,006	56,802	173,805	52,116	148,827	45,091	172,199	49,572	157,662	45,500	135,389	39,415	28,358	10,623	24,895	9,823	21,149	8,401
No. obs.	608,729	155,560	561,052	144,072	490,081	126,977	539,204	130,984	499,484	121,052	437,460	106,686	69,525	24,576	61,568	23,020	52,621	20,291

Notes: Dependent variable is log full-time equivalent wages. Competition is based on Boone measure (see Section 3 for details). Capital intensity is Capital stock/Number of employees, Firm size is number of employees, Share skill high is share of the labor force with at least 3 years of post-secondary education. Standard errors are clustered by industry. ***, **, * show significance at the 1%, 5%, and 10% level, respectively.

Table 8. Product market competition (import tariffs) and relative wages: Individual-level estimates by gender 1996-2009

	Type of position									
	All		Non-managerial		All managerial		Managerial below CEO		CEOs only	
	Men	Women	Men	Women	Men	Women	Men	Women	Men	Women
Competition	-0.001	0.002	0.005	0.006	-0.002	-0.005	0.001	0.001	-0.005	-0.111**
	(0.018)	(0.011)	(0.015)	(0.009)	(0.009)	(0.012)	(0.008)	(0.011)	(0.019)	(0.051)
Experience/	-0.029***	-0.029***	-0.027***	-0.026***	-0.061***	-0.052***	-0.059***	-0.051***	-0.067***	-0.070***
100^2	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)	(0.000)
Capital	0.004***	0.004***	0.004***	0.004***	0.005***	0.003***	0.005***	0.003***	0.003*	0.003
intensity	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.001)	(0.002)
Log firm size	0.032***	0.022***	0.032***	0.021***	0.013*	0.008	0.015**	0.009*	0.013	0.025
	(0.007)	(0.004)	(0.008)	(0.004)	(0.008)	(0.005)	(0.007)	(0.005)	(0.018)	(0.025)
Share skill	0.164*	0.160***	0.119*	0.122***	0.034	0.040	0.033	0.040	0.125*	0.141
high	(0.084)	(0.056)	(0.069)	(0.035)	(0.024)	(0.037)	(0.023)	(0.032)	(0.061)	(0.169)
R^2	0.41	0.47	0.39	0.46	0.50	0.52	0.52	0.53	0.34	0.37
No. spells	990,316	393,662	911,852	372,479	90,739	16,271	82,028	14,837	13,018	2,154
No. obs.	4,232,266	1,502,356	3,799,480	1,404,535	307,125	46,820	274,652	42,211	32,473	4,609

Notes: Dependent variable is log full-time equivalent wages. Competition is based on import tariffs (see Section 3 for details). Capital intensity is Capital stock/Number of employees, Firm size is number of employees, Share skill high is share of the labor force with at least 3 years of post-secondary education. Standard errors are clustered by industry. ***, **, * show significance at the 1%, 5%, and 10% level, respectively.

Table 9. Product market competition (Boone) and share of female employees. All employees: firm level estimates 1996-2009

	Type of position									
	All	Non-managerial	All managerial	Managerial below CEO	CEOs only	All	Non-managerial	All managerial	Managerial below CEO	CEOs only
Competition	0.034	0.157**	0.359**	0.281*	0.748***	-0.007	0.124*	0.323*	0.257*	0.719***
	(0.043)	(0.072)	(0.168)	(0.155)	(0.195)	(0.040)	(0.070)	(0.169)	(0.152)	(0.194)
Log firm size	0.002	-0.001	0.005	0.003	0.017**	0.002	-0.001	0.005	0.002	0.016**
	(0.002)	(0.002)	(0.003)	(0.004)	(0.007)	(0.002)	(0.002)	(0.003)	(0.004)	(0.007)
Capital intensity	-0.000	0.000	0.000	-0.001	0.000	-0.000	0.000	0.000	-0.001	0.000
	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)	(0.001)	(0.001)	(0.000)	(0.001)	(0.001)
Share skill high	0.010	0.019	0.043	0.079*	-0.024	0.009	0.015	0.039	0.076	-0.030
	(0.019)	(0.023)	(0.039)	(0.046)	(0.047)	(0.019)	(0.023)	(0.040)	(0.046)	(0.049)
Share skill high (industry level)						0.078***	0.111***	0.117**	0.081*	0.164**
						(0.009)	(0.020)	(0.048)	(0.046)	(0.065)
No. of obs.	191,502	40,983	35,806	33,022	23,578	191,502	40,983	35,806	33,022	23,578
R^2	0.005	0.007	0.034	0.030	0.012	0.007	0.013	0.035	0.031	0.012

Notes: Dependent variable is share of females. Competition is based on Boone measure (see Section 3 for details). Capital intensity is Capital stock/Number of employees, Firm size is number of employees, Share skill high is share of the labor force with at least 3 years of post-secondary education. Standard errors are clustered by industry. ***, **, * show significance at the 1%, 5%, and 10% level, respectively.

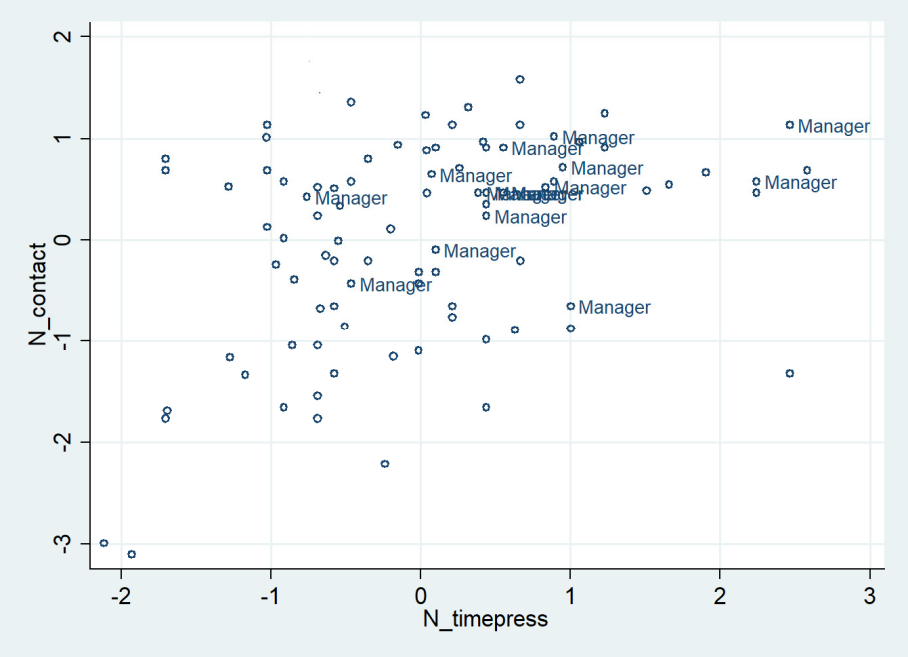
Table 10. Decomposition of CEO wages, 1996-2009

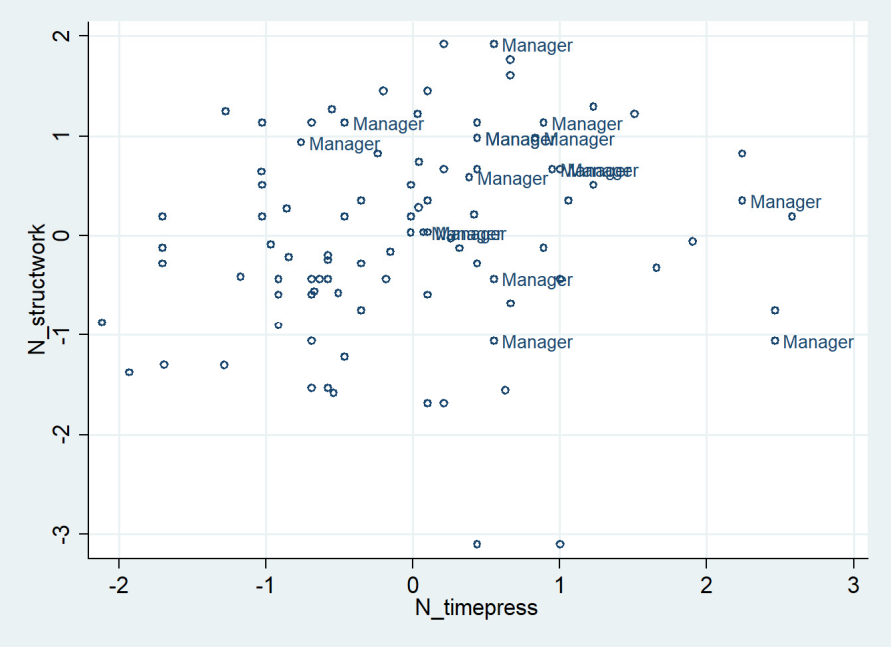
	Log wage			Predicted wage from observables			CEO-firm fixed effects (spell fixed effects)		
	Female	Male	Gender gap (%)	Female	Male	Gender gap (%)	Female	Male	Gender Gap* (%)
99%	9,61	9,73	12,7	9,66	9,83	18,5	-0,71	-1,36	-20,5
95%	9,73	9,88	16,2	9,84	10,07	25,9	-0,59	-1,09	-7,7
90%	9,79	9,96	18,5	9,93	10,2	31,0	-0,51	-0,94	-1,00
75%	9,9	10,16	29,7	10,09	10,44	41,9	-0,36	-0,61	18,5
50%	10,07	10,58	66,5	10,25	10,71	58,4	-0,13	-0,08	60,0
25%	10,41	11,02	84,0	10,39	10,96	76,8	0,21	0,46	95,4
10%	10,83	11,38	73,3	10,48	11,15	95,4	0,67	0,87	85,9
5%	11,08	11,62	71,6	10,53	11,23	101,4	0,95	1,1	76,8
1%	11,63	12,15	68,2	10,58	11,34	113,8	1,42	1,59	80,4
Mean	10,21	10,63	52,2	10,23	10,69	58,4	-0,02	-0,05	47,7
Std Dev.	0,43	0,56		0,21	0,36		0,48	0,7	
Variance	0,19	0,32		0,04	0,13		0,23	0,49	
Skewness	1,38	0,63		-0,6	-0,31		1,15	0,27	
Kurtosis	5,13	3,27		3,03	2,58		4,33	2,59	
	Shapiro Wilk test for normality								
W	0.97	0.89		0.97	0.99		0.92	0.99	
V	16.64	610,88		157.10	161,07		449.11	170.38	
z	16.64	17.23		13.58	13.97		16.40	14.13	
Prob > z	0.000	0.000		0.000	0.000		0.000	0.000	
No. of spells (CEO-firm)	31,469	11,256		11,256	31,469		11,256	31,469	

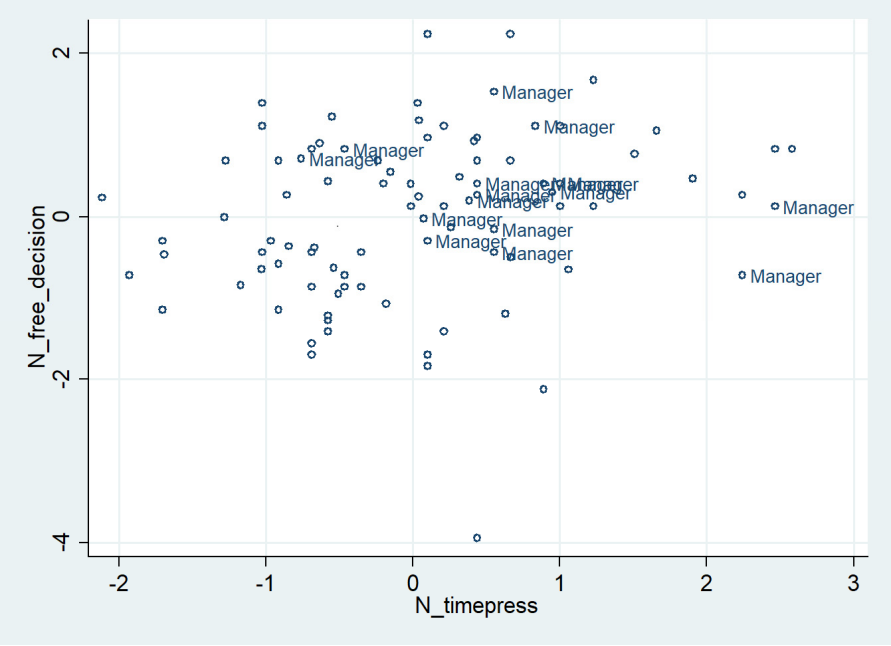
Note: Numbers in this table are based on the specifications for CEOs in Table 6. *Calculated from gender-specific means. For example, the implied gender-wage gap from estimated CEO-firm fixed effects at the 99 % percentile is given as $100 \times \frac{e^{10.63-1.36} - e^{10.21-0.71}}{e^{10.21-0.71}}$ = -20.5%.

Appendix: Figures

Figure A1

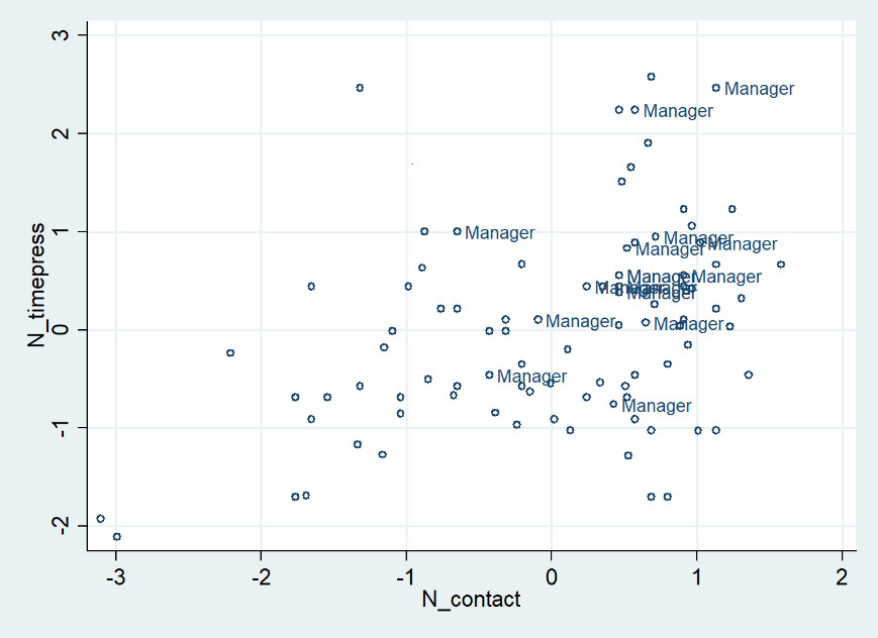


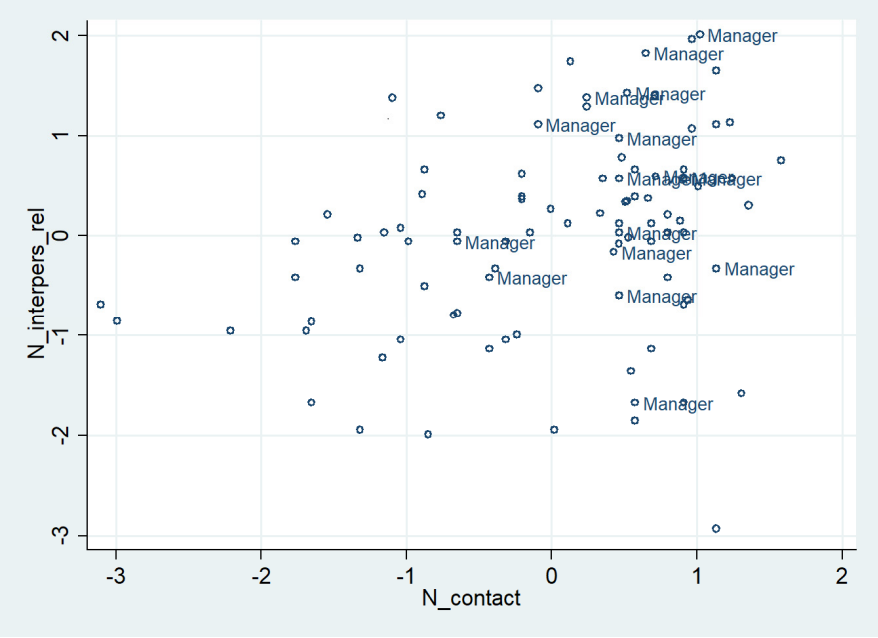


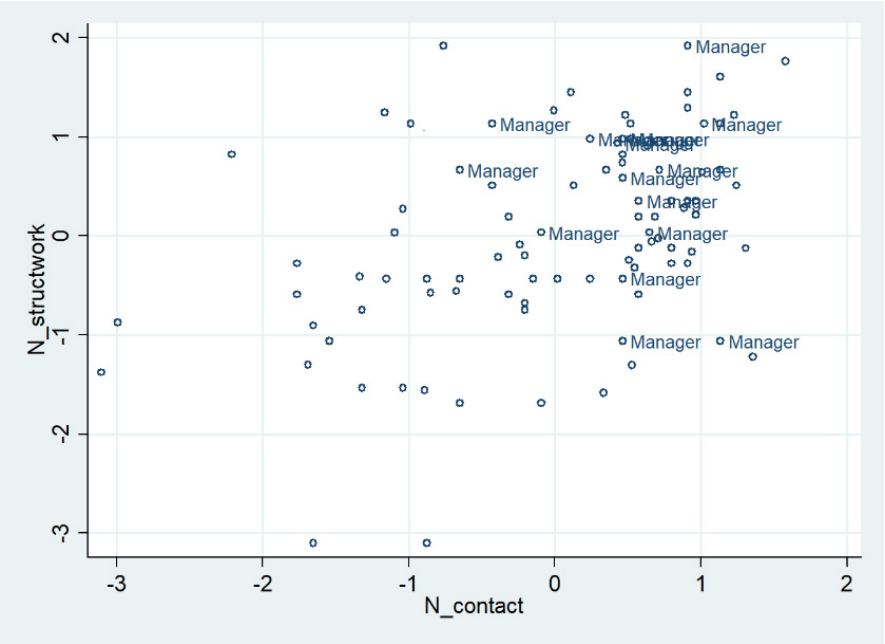


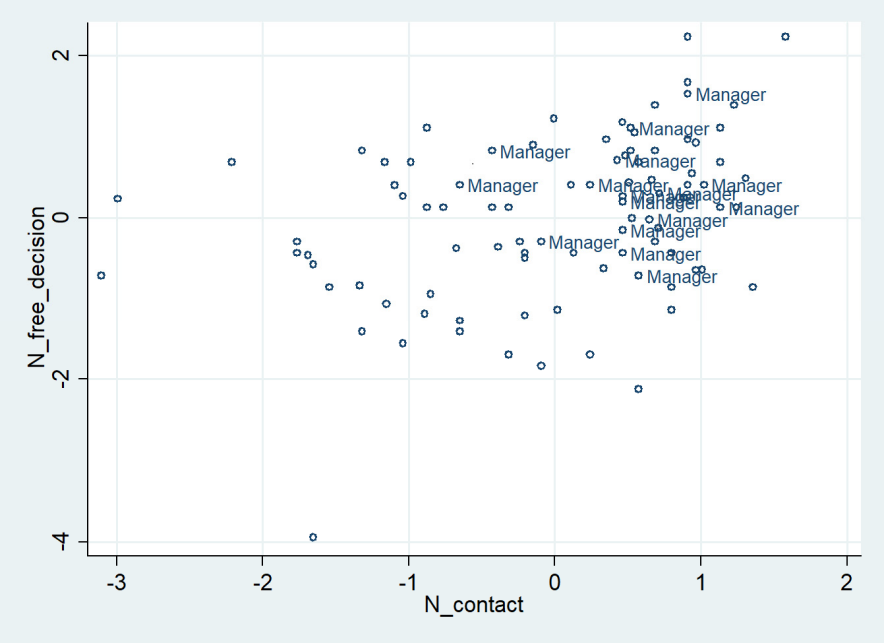
Notes: Figure A1 plots "Time pressure" at the horizontal axis against "Contact with other", "Establishing and maintaining interpersonal relationships", "Structured vs. Unstructured work" and "Freedom to make decisions. The figure is based on the same 94 occupations as in Goldin (2014).

Figure A2


N_timepress
N_contact
Manager


N_interpers_rel
N_contact
Manager





Notes: Figure A2 plots "Contact with other" at the horizontal axis against "Time pressure", "Establishing and maintaining interpersonal relationships", "Structured vs. Unstructured work" and "Freedom to make decisions. The figure is based on the same 94 occupations as in Goldin (2014).