WHY ARE SO FEW FEMALES PROMOTED INTO CEO AND VICE PRESIDENT POSITIONS? DANISH EMPIRICAL EVIDENCE, 1997–2007

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The authors estimate the probability of promotion into VP and CEO positions using employer-employee data from all Danish companies observed during the period 1997 to 2007. After controlling for a large number of firm and family-related variables, including take-up history of maternity and paternity leave and proxies for female-friendly companies, a considerable gap still occurs in the promotion probabilities for CEO positions. Part of the gap is due to gender differences in the area of specialization as top executive. Women tend to cluster in VP positions in HR, R&D, and IT areas in which the chances of a CEO promotion are lower than for positions as CFOs and VPs in Sales or Production areas.

Women constitute a very small proportion of CEOs in most Organisation for Economic Co-operation and Development (OECD) countries, despite the fact that women in many countries are as educated as their male peers and have been active labor market participants during recent decades. In Denmark, only 7% of the CEOs in companies with more than 50 employees are women, and for the other Scandinavian countries the picture is about the same. Restricting our view to larger companies, the proportion of women among CEOs is even smaller. Danish women, along with other Nordic women, were among the first in the western world to enter the labor market during the 1960s and 1970s when family-friendly policies were expanding rapidly in the Nordic welfare states (see OECD 2001 and Jaumotte 2003). In 1960, the female labor force participation rate for Danish women aged 15 to 64 was 44% (compared to 43% in the United States). Ten years later, the same figures had increased to 58% in Denmark and 49% in

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the United States.[1] Therefore, the low percentage of women among top executives may at first glance seem surprisingly low. Furthermore, the fact that women are increasingly improving on educational attainment, for example, and males are increasingly taking part in care for children and household work in general would suggest that the promotion chances of women should have caught up with the promotion chances of men. Also, there has been an increasing focus in the management literature on the advantages of diversity management, which might have induced firms to increase the share of women in the executive teams and on the boards in general.

A few years ago, Denmark and other Scandinavian countries were nominated as forerunners with respect to equal opportunities and family-friendly policies in a number of OECD country studies published under the title Babies and Bosses, Reconciling Work and Family Life (OECD 2002, 2003, 2004, 2005). The Scandinavian countries were praised by OECD for having been able to maintain a fairly stable fertility rate during the recent decades when Scandinavian women entered the labor market and became full-time workers. Denmark is ranked as number 7 (of 135 countries) on the overall Gender Gap Index, according to the World Economic Forum (2011). When it comes to the representation of women in top positions in the labor market, however, the Scandinavian countries are not forerunners. Denmark is ranked as low as number 78 with respect to the gender gap for representation among legislators, senior officials, and managers. The same tendency is found in Albrecht, Bjorklund, and Vroman (2003) and Gupta, Oaxaca, and Smith (2006) who report that the gender pay gap in Sweden and Denmark has been increasing significantly during the latest decades at the upper end of the skill distribution.

In this article we analyze why so few women succeed in being promoted into top executive positions as CEOs or Vice Presidents in a Nordic country, specifically Denmark. Are there still discriminatory forces working against women, either through classical discriminatory mechanisms or by more subtle mechanisms such as imperfect information and statistical discrimination, giving rise to the same outcomes as classical discrimination but working through different channels and for different reasons? Alternatively, can the observed and apparent glass ceiling be partly explained by observed and unobserved differences with respect to career decisions, preferences, characteristics, and risk behavior of male and female managers? In particular, we investigate whether observed gender differences in behavior with respect to timing of childbirths, periods out of the labor market, and choice of partner and spouse can explain the gender gap and whether these potential effects vary across the career ladder, being strongest at the top.

We test two recent dynamic models of statistical discrimination in promotion, originally proposed by Fryer (2007) and Bjerk (2008). The model by Fryer predicts that women may face statistical discrimination and higher hiring standards at a lower level on the career ladder, but if they succeed in

[1]OECD, Annual Labour Force Statistics, http://www.oecd.org.

becoming promoted into high-level executive positions, "belief flipping" may happen, that is, women may face "inverse discrimination" because employers know that these women were selected from the top of the ability distribution. Contrary to Fryer, Bjerk's model predicts that there is no gender gap in promotions at the highest levels in the organization. We focus explicitly on the upper levels: promotion from a (high) executive position into a vice president position (VP) and promotion from VP to Chief Executive Officer (CEO). The model is estimated on a Danish employer-employees sample of top executives and potential top executives observed during the period 1996 to 2007. The probability models are estimated by panel probit models.

The novelty of this article is that we apply a model of statistical discrimination on the narrow top positions of VP and CEO and estimate the model on a large panel sample that covers all Danish companies with more than 50 employees in the private sector. The large sample allows us to dig more deeply into the relation between the promotion of female top executives and childbirths, maternal leave periods out of the labor market, the careers of spouses, and the gender composition of the management board and board of directors. We present new empirical evidence on the paradox of a considerable still-existing gender gap or glass ceiling at the top of the Danish labor market despite that more than half a century has passed since Danish women entered the labor market, despite several decades with family-friendly policies, and despite that women are now more educated than men and constitute a majority at universities.

Earlier Studies and Empirical Evidence

One of the first economic models on the gender gap in promotion is presented in Lazear and Rosen (1990). Their model predicts a glass ceiling in promotion rates for women without assuming any taste-based discrimination among employers and assuming similar job ability distributions for men and women. The driving assumption is that women are superior to men in the ability of non-market work, for example, housework and care for children, and therefore have a higher probability of leaving the job as the value of the non-market alternative is likely to exceed the wage offer. The model predicts that women must have higher abilities than men to become promoted and therefore, on average, are less likely to be promoted. Booth, Francesconi, and Frank (2003) use the concept of "sticky floors" as an alternative explanation of the few women observed at the top of the hierarchy. "Sticky floors" refers to a process in which women are promoted to the same extent as their male colleagues but experience a slower subsequent compensation growth upon promotion. If female executives are less flexible compared with men (because of obligations at home, they may not be able to commute long distances, or the family may be less willing to move because of new job opportunities of the mother, and so forth), they may have less favorable outside opportunities; that is, they are not able to be promoted

by getting a better job in another company to the same extent as their male colleagues. Their current employer may be aware of this fact and may even exploit it by offering lower wages to female executives.

A few recent papers aim at explaining the existence of a glass ceiling as an equilibrium outcome in a dynamic model, see Fryer (2007) and Bjerk (2008). These models build on the assumption that women either have a higher turnover rate (due to childbirth-related career interruptions) or they are less able to signal their skills for varying reasons compared with their male peers—the models are basically variants of the statistical discrimination theory originally proposed by Phelps (1972). Bjerk's model may be considered a synthesis of glass ceiling and sticky floor models in the sense that both effects can coexist. Statistical discrimination against women is explained by the fact that the majority of those making promotion decisions are men, and this fact "explains" why women have more difficulties in signaling their productivity as effectively and/or as frequently as their male counterparts. According to the model in Bjerk (2008), female executives face statistical discrimination at lower levels, but for those women who succeed in getting into a career track there is no statistical discrimination. In the model by Fryer (2007), female executives even face belief flipping, implying that they have higher promotion rates to higher level positions than their male peers.

In the sociological and management literature, a parallel theory to the economic statistical discrimination models and "belief theories" has been the "gender stereotyping models." One hypothesis is Think Manager-Think Male, which portrays a tight relationship between sex role stereotypes and the characteristics that are necessary to become a successful manager (Schein 1973). Basically, employers, colleagues, and even the potential top executives themselves, whether males or females, tend to have gender stereotype views on what it takes to hold a position as a CEO. This may give rise to the (statistical) discrimination effects described above, or it may keep women away from applying for top executive positions because they find them more unattractive and more difficult to combine with other areas of their lives than comparable men do. Women may feel that they have to give up a "normal life" to fill the role as a CEO.

Another explanation for the low proportion of female top executives is that women do not want to take the risk and responsibilities related to top executive jobs; see, for example, Booth and Nolen (2009) and Niederle and Vesterlund (2007). Or, many women do not want to allocate the same amount of time and resources to a job after they become parents as their male peers do; see, for example, Bertrand, Goldin, and Katz (2010). Niederle and Vesterlund show that women are more reluctant to engage in a competitive tournament incentive scheme than their male counterparts, even though female ability and performance equal male ability and performance. Women may dislike competition more than men, or they may be less self-confident than men with respect to their own abilities. According to the experiments in Niederle and Vesterlund, the latter effect is what mainly

explains why women shy away from competition. If men and women possess differing behaviors with respect to applying for top executive positions, these differences may increase the observed gender gap in promotion probabilities at lower levels in the hierarchy as predicted in the models by Fryer and Bjerk. But they may reverse the predictions concerning the gender gap at top level promotions if women are more reluctant to apply for positions at the highest level, such as CEO positions, because of differing preferences or less confidence in their own abilities.

The empirical results concerning gender differences in promotion rates (defined more broadly without being restricted to CEO positions) are mixed, see, for instance, Blau and DeVaro (2006). When controlling for other observed factors, some studies find that women are less likely to be promoted in private firms (McCue 1996; Cobb-Clark 2001; Blau and DeVaro 2006; and Frederiksen and Kato 2011); however, other studies do not confirm this pattern. Booth et al. (2003) find that women are promoted to about the same extent as men, but they do not attain as high wage growth after promotion as men do (the sticky floor result). The influence of personal traits is investigated empirically by Fietze, Holst, and Tobsch (2009) who find that German men seem to be more willing to take risks as compared with women, but according to this study these personal traits cannot explain much of the gender gap with respect to occupational positions in Germany. Bell (2005) finds that promotion chances of female executives are significantly higher in women-led firms in the United States, that is, a positive effect from female CEOs or female board chairmen is observed on the salaries and promotion rates of female managers at lower levels in the firm.

Blau and DeVaro (2006) include the gender of the supervisor when studying promotion into higher ranking positions, and they do not find any effect from the gender of the supervisor. As they note, this does not rule out the possibility of gender discrimination against females in executive positions if female supervisors also have prejudices against women subordinates—sometimes denoted the Queen Bee Syndrome. This hypothesis is actually confirmed by Neergaard et al. (2008) who find that Danish managers have a fairly stereotyped perception of what it takes to become a successful manager. The most surprising finding in their study is that it is mainly female managers who have such gender-stereotype views, while male managers are much more gender-neutral in Denmark.

There are very few empirical studies on the gender gap in promotion rates at the highest level, that of CEO, in the company, but a few empirical studies have analyzed the compensation gap among CEOs. In the seminal study by Bertrand and Hallock (2001) on the earnings of U.S. CEOs, the raw compensation gap between male and female top executives was estimated to be 44%, but when controlling for differences in observed characteristics, most of the gender compensation gap disappeared, meaning it was explained by observed factors. To our knowledge, the only other paper analyzing the gender gap in promotion of CEOs is one by Matsa and Miller

(2011). They find that the female share of board of directors has a significantly positive effect on the female share of top management (top 5 positions) in U.S. S&P companies during the period 1997 to 2009.

Theoretical Framework

The promotion model estimated in this study builds mainly on the theoretical model in Bjerk (2008) and the model by Fryer (2007). Both Bjerk and Fryer analyze the promotion in a regime with three states: 0, 1, and 2. We assume that in a career track for top executives there are three states. A potential top executive may be promoted from the Pool of Potentials (POP) into the position as a Vice President (VP), and further into the CEO position. There may be more than one VP in a given company. CEOs are selected among the VPs in the firm concerned or recruited among VPs outside the firm.

There are two types of workers in the POP group: *h*-workers who are high-skilled and *l*-workers who are low-skilled. By "skill" we understand unobservable personal traits as ambitions, effort, and productivity in general. Those who are high-skilled never fail in the tasks they perform during their career, while type-*l* workers sometimes fail when they are recruited into positions as VPs or CEOs. Employers believe—and we assume they are right in their belief—that the proportion of men who are of the *h*-type is larger than the proportion of women: $\alpha_m > \alpha_f$ where α_j is the proportion of type h in group j, $j = m, f$. Within the two skill groups, *h*- and *l*-workers, there are no gender differences in skills and productivity, and employers are not assumed to have discriminating preferences.

To become promoted, POP workers have to send a number of positive signals to the leaders or supervisors who are responsible for their promotion. The signals help the supervisors determine whether potential top executives who have not yet been in a position in which they undertake top management decisions and management tasks are *h*-workers or *l*-workers. Such signals help the supervisors recognize and promote the most productive members in the POP group. Signals may appear when POPs socialize and communicate with their leaders, either at work or in social activities related to the job. Bjerk (2008) assumes that these signals, positive or negative, are more easily understood by supervisors who come from the same group, that is, men are better at understanding and decoding the signals from men, and women better understand signals from other women. The reason may be gender differences in communication styles or psychological mechanisms. The probability that an *l*-worker reveals himself through signals as an *l*-worker is denoted λ_j. Note that *h*-workers always send positive signals. If we assume that most leaders who make promotion decisions are men, and that men are better at decoding signals from male POPs compared with female POPs, we have that $\lambda_m > \lambda_f$. An alternative interpretation of λ might be that formal or informal mentoring processes within the firm are mainly taking place within same-sex relations (Athey, Avery, and Zemsky 2000).

Men and women are assumed to differ with respect to their ability to send signals, for instance, because women experience more career interruptions than their male peers. Another reason may be that female potential top executives socialize less with male superiors because they are not members of the same networks, or because they are not invited or do not accept invitations to the same extent as their male peers to, for example, sports events. If women have less experience and tenure due to family responsibilities or participate less in social networks and social activities, they are assumed to send signals with a lower intensity, θ_j, that is, $\theta_m > \theta_f$. The lower female signaling frequency may of course also reflect that women have less preferences for top positions compared with their male peers, either because of taste differences, or less self-confidence in their own abilities, as indicated by recent experimental studies such as Niederle and Vesterlund (2007).

Based on these three main assumptions, we apply the results in Bjerk (2008) which show that a unique Bayesian Nash Equilibrium exists for which the hiring standards (measured by the expected number of signals that a member of the POP group shall send until promotion into a VP position) are higher for women than for men. More specifically, it can be shown that if $\lambda_m > \lambda_f$ or $\alpha_m > \alpha_f$, the probability of promotion from POP to VP will be larger for males than for females for a given number of signals (n), $p_m(n) > p_f(n)$.

Given the assumptions concerning employers' beliefs or their ability to decode signals, the number of signals that female POPs have to send before they are promoted into a VP position will be greater than the number males send (Smith, Smith, and Verner 2011). Further, if women tend to have a lower signaling intensity, the model implies that female members of the POP group tend to be older when they are promoted into a VP position.

After being promoted into a VP position, an individual is assumed to take on important management decisions, and the principals (now the owner of the company or the board of directors) no longer have to rely on signals. Instead, they observe the number of successful tasks undertaken by the VP. In the model by Fryer (2007), the employer uses the information that individuals from the minority group (women) are a more positively selected group than male VPs. Thus, the Fryer model predicts that in the next promotion step women will benefit from this knowledge and will face belief flipping, facing "inverse statistical discrimination" and having higher promotion probabilities than their male peers. Contrary to Fryer, Bjerk (2008) assumes that employers apply the information that individuals in VP positions have fulfilled the same conditions for becoming a VP. This means that in the Bjerk context there is no statistical discrimination taking place when promoting into CEO positions. There may still be lower observed promotion rates for women from VP to CEO if female VPs do not complete as many successful tasks as their male peers, for instance because of absence from the job during maternity leave periods.

When focusing on promotion into the top level position of CEO, the results in the Fryer and Bjerk models may not be fully applicable because the

decision on whom to hire for the CEO position in the company may be different from other top executive positions at lower levels in the company. Often the "decision-making agent" for the CEO position is the board of directors or the chairman of the board of directors, and they often make decisions assisted by professional headhunters or consultants (for large firms this may of course also happen for VP positions). The decision process in a given company may function more like a tournament with a number of contestants and only the winner gets the CEO position. The board chooses among the contestants who have performed best and supplied the highest level of effort.

This may change the implication of the model with respect to a potential gender gap in promotion chances into CEO positions. 1) If the board of directors is (more) risk-averse when it comes to the CEO decision compared with the VP positions, they may be more reluctant to employ individuals from the minority group. Another mechanism may be that the board of directors or the chairman of the board may be more external to the company and to a smaller extent rely on actual information on successful tasks and to a larger extent rely on gender-stereotype attitudes and biased evaluations as compared with the promotion process at lower levels where the hiring agent is internal in the company and more directly observes performance. 2) The concept of "successful task" may not be an objective concept. If male supervisors or headhunters (unconsciously) suffer from old-fashioned beliefs on female productivity, effort, and behavior, there may be statistical discrimination forces taking place at this step in the evaluation of what is a successful task. Further, if there are gender differences in VP positions with respect to the type of tasks and areas within the company, this may imply that typically female tasks such as human resource management are seen as less valuable for the company than, for instance, financial tasks in CFO positions (Bertrand et al. 2010). 3) Female VPs may find it less attractive to apply and compete for CEO positions and to be in the contestant pool if they have less preferences for the responsibilities associated with the job as a CEO, are less self-confident with respect to their own abilities, or who shy away from competition (Niederle and Vesterlund 2007). This may induce a gender gap with respect to who are candidates for CEO positions, which does not exist (to the same extent) for lower positions.

Empirical Model

The empirical model is a reduced form model from which we estimate the gender gap in the probabilities of promotion from POP to VP and from VP to CEO, that is, the probability of becoming a CEO is conditional on being in a VP position. The probability models are estimated on the employer-employee data set that allows us to control for both observed firm-specific factors (x_{jt}) in the recruiting firms, individual-specific factors (x_{it}), and unobserved heterogeneity captured by the time-invariant firm-specific and individual-specific terms, μ_j and μ_i. The key variable F is an indicator variable

that takes the value of 1 for women, and 0 otherwise. If the latent variable for promotion $k = VP, CEO$ of individual i in firm j at time t is denoted y^k_{ijt} the model is given by

$$y^k_{ijt} = \delta^k F_i + x'_{it}\beta^k + x'_{jt}\gamma^k + \mu^k_i + \mu^k_j + \upsilon^k_{ijt}, \quad (1)$$

where $i = 1, \ldots, M$, $j = 1, \ldots, N$, $t = 1, \ldots, T$, $k = VP, CEO$ and v^k_{ijt} is a random error term.

The empirical hypotheses to be tested are:

Hypothesis 1: $\delta^{VP} < 0$, reflecting $\alpha_f < \alpha_m$ and/or $\lambda_m > \lambda_f$, and/or $\theta_f < \theta_m$.
Hypothesis 2: $\delta^{CEO} > 0$ if belief flipping (Fryer),
$\delta^{CEO} = 0$ if gender-neutral promotion within the career track (Bjerk), or
$\delta^{CEO} < 0$ if CEO promotions are described by competition in tournament processes.

Further, we test how the estimates of δ^{VP} and δ^{CEO} are affected by including additional explanatory variables to the model in Equation (1), which are supposed to proxy the gender-specific parameters determining the probabilities of promotion:

Hypothesis 3a: We test whether δ^{VP} and δ^{CEO} become insignificant when controlling for (gender-specific) effects of tenure and children, age at first childbirth, time spent on parental leave, and the career of the spouse. We expect that the number of children and the time spent on maternity leave have negative effects on promotion chances of female executives. We also expect that age at first childbirth has a positive effect on the career for women (but not necessarily for men) because having completed an education and having established a career before childbirth may improve the chances that women are able to come back onto the career track after childbirth. Being married to a spouse who is a CEO is expected to have a negative effect on the promotion chances for women when the occupation of the spouse is taken as a proxy for division of work within the household.

Hypothesis 3b: Firm-specific factors may proxy the parameters, λ_j and α_j. We test whether δ^{VP} and δ^{CEO} become insignificant when controlling for (gender-specific) effects of a female-led recruiting company (i.e., led by a female CEO or chairman of the board of directors).

Hypothesis 3c: The type of activities and tasks undertaken in a given VP position is important for the chance of being promoted into CEO positions. For instance, VPs who work with human resource management tasks are less likely to be promoted. We test whether the gender gap in CEO promotions disappears when controlling for type of activities of the VPs.

The empirical strategy is to add a large number of control variables from the extremely rich data set available, which includes historical information on spouses, childbirths, leave periods, and so forth, and in this way be able

to control for most of the relevant heterogeneity for the promotion process. However, it is obvious that one has to be careful in the interpretation of the parameter estimates that cannot be considered causal effects since more of the variables may be endogenous to the promotion probabilities. For instance, if a potential executive does not succeed in becoming promoted, he or she may choose to have more children ceteris paribus, and the timing decisions with respect to having children may be endogenous to career aspirations, see for instance Miller (2011). Also unobserved variables may affect both the promotion probabilities and some of the right-hand side variables, such as preferences for career or family values. Thus career expectations earlier in life may have driven both human capital accumulation decisions (choice of education, labor supply, and type of specialization as executive) and fertility decisions; see, for instance, the lifetime utility maximization models in Polachek (1981) and Adda, Dustmann, and Stevens (2011). The Polachek model illustrates how women with preferences for family life and children later in life may select into educations with a low atrophy rate due to periods out of the labor market. Thus, it should be kept in mind that our results are conditional on having already reached positions as potential top executives. Part of the endogeneity problems due to unobservables may be captured by the panel estimator if the unobserved variables are time-invariant. But some of the important unobservables, such as career aspirations, may change over the life cycle.

The model is estimated by pooled probit estimations and a panel probit random effects estimator where we treat either μ_i^k or μ_j^k as random effects capturing time-invariant heterogeneity among individuals or firms.[2] Modeling both types of heterogeneity simultaneously is not possible. The RE probit model requires that μ_i^k and μ_j^k are independent of the included explanatory variables and are normally distributed, see, for instance, Wooldridge (2002). If μ_i^k is correlated with F, for instance if women in general are more risk-averse than men or have less preferences for power and leadership, this may bias the estimate of δ^{VP} and δ^{CEO} downward (more negative estimate).

Therefore, we prefer an estimator proposed by Wooldridge (2002: 487–88), which is used in all estimations in Tables 5, 7, 8, and 9 and which controls for the potential endogeneity of the key variable F and other included explanatory variables by including additional firm-specific mean values of F and the firm-specific mean of other explanatory variables x which are added to the right-hand side of the expression in relation (1). Using the individual-specific RE estimations is not possible since F (and other individual-specific family variables) are time-invariant for individuals but not for firms.

[2]We do not apply a probit (or logit) FE estimator, which is fairly complicated and requires estimation of the unobserved or fixed effects along with the structural parameters (contrary to linear models where the FE estimator is much simpler). Further, the panel probit FE estimator suffers from the incidental parameter problem which implies inconsistent estimation of the structural coefficients when the number of groups is large relative to the time series dimension (as is the case in our data), and the maximum likelihood estimator will in general result in inconsistent estimates.

To evaluate the robustness of the preferred estimator, Table 2 shows the estimated gender gap for alternative estimators.[3]

Data

The data set is a merged employer-employee panel sample of all Danish companies observed during the period 1996 to 2007. The companies are privately owned or listed firms. Information from administrative registers is supplemented with information from a private Danish data account register, Experian. We restrict the sample to executives who are either in a CEO or VP position, and executives who are at a hierarchical level just below CEOs and VPs, denoted the pool of potentials, or POPs. The definition of a CEO and a VP is restricted to individuals who are top executives in medium-sized or larger companies with at least 50 employees. Since there are many small firms in Denmark and since a relatively large proportion of women start their careers in smaller companies, we also consider a jump from a CEO or VP position in a small company with less than 50 employees into a position as VP or CEO in a medium or large company as a promotion. This means that the top executive in a company with less than 50 employees is included in the POP group. Given our definition, there is only one CEO in a firm, while there may be one or more VPs.[4] In total, there were 3,053 companies and 57,632 executives in 2007, see Table 1.

Figure 1 shows the female proportion in the three executive categories for the sample period, 1996 to 2007. Times are changing in the sense that more women have entered top executive positions during this time frame. In 1996, 4% of the CEOs were women. Ten years later, this figure had almost doubled to 7.5%. At the lower levels, the female proportion also increased. Figure 2 shows the gender-specific promotion rates from 1997 to 2007. There is a clear cyclical pattern in the promotion rates with more promotions taking place before the cyclical downturn in 2001. In general, the promotion rates are higher for male executives than for female executives, especially for CEO promotions.

The included explanatory variables in the estimations represent individual (x_{it}) as well as firm-specific (x_{jt}) characteristics:

x_{it}: Age, age squared, employment experience, experience squared, tenure, and educational level. Employment experience (and tenure) is measured as the accumulated number of years spent in employment (in the

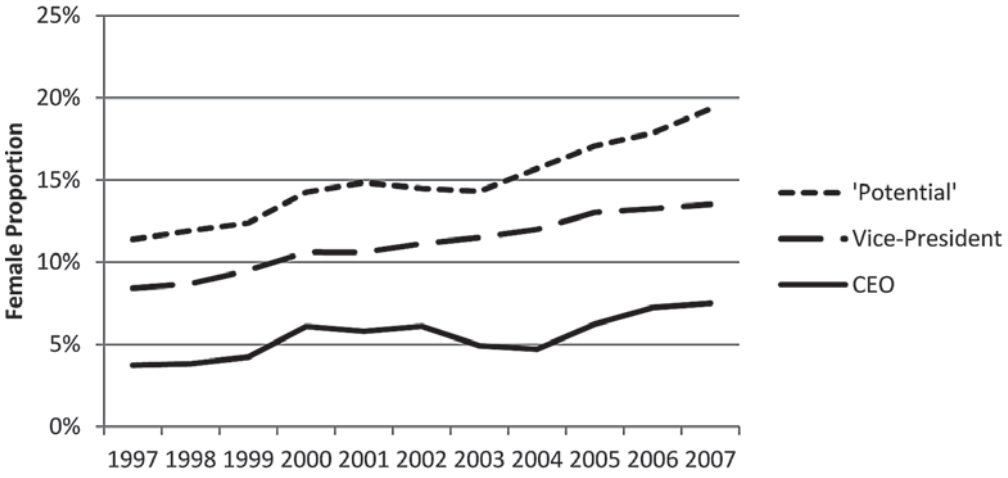
[3]The models are estimated by the STATA procedure "xtprobit," which is a conditional MLE procedure using quadrature optimizing (Gauss-Hermite with 12 evaluation points).

[4]The exact definition using Statistics Denmark's "DISCO-codes" is: CEO = Executive director (RAS-DISCO code 121, 1210). VP = Vice President (DISCO 122, 123, 1221–1239). Pool of potentials = Potential executives (CEO or VP). (First digit of DISCO code is 1 but not included in the groups of top or vice directors.) The registration of the DISCO codes in the administrative registers has been improved during the observation period. To remove outliers or errors in the DISCO codes, we restrict the CEO group to individuals who are observed with annual earnings in the top 10 of the firm. The VP group is restricted to individuals who are observed among the top 25.

Table 1. Number of Individuals and Promotion Rates by Gender and Occupational Position, 2007

Variable	*POP*	*VP*	*CEO*
Number of observations in 2007			
Males	34,765	9,934	2,824
Females	8,328	1,552	229
Males and Females	43,093	11,486	3,053
Female proportion among POPs, VPs, and CEOs	0.193	0.135	0.075
Promotions between 2006–2007 into VP and CEO (promotion rates in parentheses)			
Males	1,269 (0.036)		422 (0.044)
Females	229 (0.030)		39 (0.027)
Males and Females	1,498 (0.035)		461 (0.042)

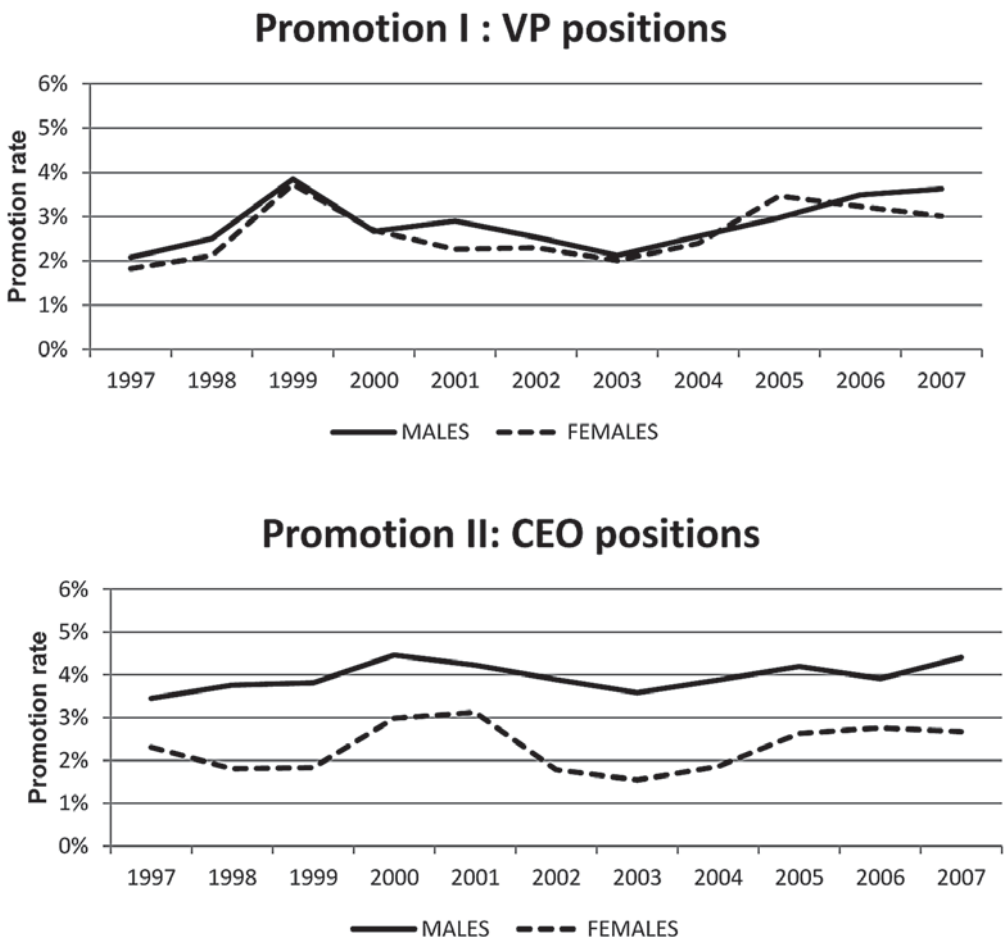
Figure 1. Female Share of POPs, VPs, and CEOs



company). Periods in part-time employment are counted as half of full-time employment. We are not able to measure overtime work or individuals holding more than one job since the employment variables are based on pension payments to a compulsory pension scheme (ATP). In some of the estimations we add information on tenure in various positions, that is, number of years spent as POP or VP in order to get proxies for the number of signals or successful tasks the executive has been able to undertake. Education level is measured by a number of indicators allowing for nonlinear effects of education. Excluded category is no education beyond compulsory school. Child variables are indicators for number of children (1, 2, and 3+). Excluded category is "no children." In some of the estimations we also include information on the spouse or cohabitant of the executive. These variables are an indicator for being married or cohabiting with a spouse who is a CEO and an indicator for being married or cohabiting with a spouse who is not a CEO. Excluded category is "single."

To test whether the timing of childbirth matters for the career as is found in many other studies, we include in some of the estimations the variable

Figure 2. Promotion Rates into VP and CEO Positions



age at first childbirth (age when becoming a parent for the first time), the number of years since last childbirth (i.e., age of youngest child), and alternative measures on time spent out of the labor market on parental leave. From the social registers we have information on the number of days spent each year on maternity, paternity, and parental leave for all individuals, including information on the spouses whom the individuals were living with at the time of childbirth. Based on this information, we calculate the accumulated number of days spent in child-related leave arrangements during the career, and the same for the spouse (if the individual was not single after childbirth). These variables reflect time spent out of the labor market but may also proxy division of household responsibilities.

In some of the estimations of the probability of a CEO promotion, we include additional information on the type of VP position the executive had before being promoted. Based on the 4-digit DISCO codes, we split VP positions into the following categories: Vice CEO, CFO (financial tasks), HR (human resource), Sales (sales and marketing), IT and R&D, and Production-related tasks.

x_{jt}: Firm size is measured by the number of employees (represented by four categories to allow for nonlinearities: CEO or VP in a company with less than 50 employees, 50 to 100 employees, 100 to 500 employees, and more than 500 employees). Other firm variables are: An indicator for being listed on the stock exchange, firm profits ROE (Return On Equities), industry indicators (Energy, Building and construction, Hotel and restaurants, Transportations and telecommunications, and Finance; excluded category is Manufacturing), and female proportion of employees. In some of the estimations we include variables reflecting whether the firm is women-led: indicators for being promoted into a firm with a female on the board, a female CEO, or at least one woman among the group of VPs in the firm. All firm variables are lagged one year. For the variables "firm size" and "firm performance," we include separate variables for both recruiting firm and origin firm.

Sample means for the main variables in the basic model are shown in Appendix Table A.1.

Estimation Results

The Gender Gap in Promotion Probabilities

The estimated marginal effects from the female indicator (F) are reported in Table 2 for different specifications of the random effects (RE) probit models. The upper part of Table 2 refers to promotion from POP to VP positions and the lower part refers to promotion from VP to CEO. In column 1, only the female indicator and time indicators are included while in column 2 the basic individual human capital and firm variables are included. In general, all estimates of the parameter δ are significantly negative, and controlling for individual human capital and firm variables does not affect the size of the estimated coefficient. Thus, we cannot reject Hypothesis 1 that δ is negative, that is, there seems to be a gender gap in the hiring probabilities into VP and CEO positions in Danish companies.

The estimated marginal effect of being a woman in the pooled probit estimations is about –0.005 for promotion I and more negative, –0.016, for promotion II. When controlling for individual-specific time-invariant unobservables, the numerical size is reduced to about –0.001 and –0.010 for VP and CEO promotions, respectively. For VP promotions, the firm-specific RE estimate of δ is close to the individual-specific RE estimate but for CEO promotions, the δ-estimate turns more negative, –0.017, almost the same estimate as in the pooled probit. Finally, we show the results from our preferred estimator (–0.002 and –0.021 for VP and CEO promotions, respectively) in which we control for potential endogeneity of the F-variable by including the firm-specific means value of F in the regression.

In 2007, the raw gender gap for POP to VP promotions was 0.006 (=0.030–0.036), see Table 1. By including observable individual and firm characteristics and time-invariant unobservable firm characteristics, we are able to

Table 2. Estimated Marginal Effect on Promotion: Probability of Being "Female"[a]

Alternative estimators	*Only time indicators*	*Basic model: Time indicators + HC and Firm Variables*
Promotion I, VP positions Raw Gap 2007: 0.030–0.036 = –0.006		
Pooled probit	–0.003	–0.005
Individual specific RE	–0.001	–0.001
Firm specific RE	–0.001	–0.002
Firm specific RE including firm means[b]	–0.001	–0.002
Promotion II, CEO positions Raw Gap 2007: 0.027–0.044 = –0.017		
Pooled probit	–0.017	–0.016
Individual specific RE	–0.010	–0.010
Firm specific RE	–0.018	–0.017
Firm specific RE including firm means[b]	–0.018	–0.021

[a]All marginal effects are significant at the 0.1% level. HC variables are experience, experience squared, tenure, age, age squared, and education. Firm variables are firm size indicators, performance, listed on stock exchange, and female share of employees. Firm size and performance are included for recruiting and originating firm, while other firm variables refer to recruiting firm. All firm variables are lagged one year. Number of observations in the estimation are 432,685 (promotion I) and 113,302 (promotion II).
[b]The preferred estimator proposed by Wooldridge, see description in the section on Empirical Model.

reduce this gap to 0.001 to 0.002, meaning we can explain most of the gap, though the estimated gap is still significant in Table 2. For promotions into CEO positions, the observed gap was 0.017. In the preferred estimation, controlling for observables and firm-specific time-invariant heterogeneity, the gender gap increased from 0.017 to 0.021. First, these results indicate that observable firm and individual characteristics in the basic model do not explain the observed gender gap. Second, we cannot confirm Hypothesis 2 that the estimated effect δ from statistical discrimination is numerically larger at lower levels of the firm hierarchy compared with the gender gap for promotions into CEO positions. This must reflect either that the theoretical model for CEO promotions is more in line with a tournament process, or that belief flipping or a gender-neutral promotion process as in the models by Fryer and Bjerk is not dominating. Alternatively, the explanation could be that we do not add enough control variables to capture gender differences in the parameters of these models.

Tenure in Different Positions

As a first step to explain the unexplained gender gap in Table 2, we split the experience variable into variables reflecting the time spent in different positions and allow both experience variables to have gender-specific effects on

Table 3. Sample Means, 1997–2007: Years of Experience in Varying Positions and Tenure (in company) When Promoted, Conditional on Promotion[a]

Variable	*Age at promotion*	*Total experience at promotion*	*Experience as POP when promoted into VP position*	*Experience as VP when promoted into CEO position*	*Tenure in company when promoted*
POP to VP (if same year)					
Males	41.5	18.5	*2.2*	—	*3.9*
Females	39.7	16.4	*2.2*	—	*4.1*
VP to CEO					
Males	42.7	*18.9*	—	*2.5*	*4.7*
Females	41.0	*17.8*	—	*2.3*	*4.5*

[a]Satterthwaites test for equality between males and females shows that all variable means are significantly different for men and women, except for values in italics. Individuals who already possess a position as POP, VP, or CEO when entering the data set are excluded from this table.

the promotion probabilities. In Table 3, the conditional sample means of the variables age, experience, and tenure are shown for the year when a promotion occurs. Contrary to a priori expectations, men are on average more than two years older than women when they are promoted into VP positions (41.5 years for men and 39.7 for women). The same picture holds for CEO promotions (average age at promotion for men is 42.7 years and 41.0 for women). Women also tend to have less total experience when promoted into VP and CEO positions though the difference is not significant for the latter group. Finally in columns 3 to 5, the position-specific experience as POP and VP is shown for those who are promoted into VP and CEO positions. According to the theoretical model, one might expect that women had to have longer experience in lower positions before they were promoted because they were not able to signal as intensively, or because their signals were more unclear. However, there are no significant differences between men and women with respect to the average number of years they spend as POP and VP until they are promoted into a higher level, conditional on being promoted.[5] When we add occupation-specific experience and tenure into the preferred basic model estimated in Table 2 (and allow for gender-specific effects of these variables by interacting with gender), it does not reduce the estimated gender gap in promotion into VP and CEO positions. Instead, the opposite happens; that is, numerical estimate of δ tends to increase since the female interactions terms with tenure and experience tend to be positive.

Children and Husbands

As the next step to explain the unexplained gender gap, δ, we include the number of children and the position of the spouse as additional explanatory variables. The impact of children may run through a number of channels.

[5]Part of the reason women are promoted at a relatively young age may be compositional effects due to the fact that very few older women are in the group of executives while the proportion of women is growing in the younger cohorts.

Table 4. Sample Means for Child Variables and Spouse Occupation by Gender and Occupation,[a] 2007

	POP		*VP*		*CEO*	
Variable	*Males*	*Females*	*Males*	*Females*	*Males*	*Females*
0 children	0.32	0.31	0.11	0.25	0.08	0.25
1 child	0.14	0.18	0.15	0.19	0.13	0.16
2 children	0.36	0.39	0.50	0.45	0.49	0.46
3+ children	0.18	0.12	0.24	0.11	0.30	0.13
Spouse CEO or VP	0.03	0.11	0.03	0.12	0.05	0.15
Single	0.26	0.26	0.11	0.25	0.08	0.24
Number of observations	34,765	8,328	9,934	1,552	2,824	229

[a]Satterthwaites test for equality between males and females shows that all variable means are significantly different for men and women, except for values in italics.

The more children in the family, the more income is needed to sustain a given level of living standards. Usually, this income effect of children is stressed as an explanation of the positive impact that children tend to have on fathers' careers. For mothers, the child effect may be split into a number of different factors, assuming that mothers are the main caregivers for children during their childhood. Applying the structure of the theoretical model, children are assumed to affect the signaling intensity of the mothers, θ, and the number of successful tasks that mothers can perform during their early career. There may also be an effect on the effort that women supply in the job, for example, in practice being *h*- or *l*-workers may change over the life cycle: having children may change the status from being an *h*-worker to being an *l*-worker. Further, the occupation of the spouse (whether spouse of the woman is a CEO or has a lower position than a CEO position, excluded category is "single") is assumed to proxy distribution of housework within the family. We expect that being married to a spouse who is a CEO will reduce the effort and chances of becoming promoted.

Table 4 shows the sample values of these variables in 2007. In general, women in VP and CEO positions have only slightly fewer children compared with their male peers. This is probably attributable to the large coverage of publicly provided high-quality childcare services for children in Denmark (Gupta, Smith, and Verner 2008), making reconciliation of work possible. Of the female CEOs, 13% have three children or more (for men, 30%). We also find that more female CEOs are single, either unmarried or divorced (24% compared with 8% of the male CEOs). Of the female CEOs, 15% are married to a CEO while the same figure for male CEOs is only 5%.

The question is whether these gender differences in proxy variables for household responsibilities explain the gender gap in promotion probabilities? In Table 5, the estimates of δ are shown after adding child and spouse variables and gender interaction terms to the model; based on these estimates, the answer is no. The estimate of δ is reduced, especially for VP promotions, but still significant. Since we include an interaction term for being a woman, the estimate of δ only captures part of the female effect. We

Table 5. Marginal Effects on Promotion Probability: Child Variables and Spouse Occupation Interacted by Gender, 1997–2007[a]

	Promotion I (VP)		*Promotion II (CEO)*	
Variable	*Main effect*	*Interaction effect woman*	*Main effect*	*Interaction effect woman*
Woman dummy (0/1)	–0.0012***	—	–0.0193***	—
1 child (0/1)	0.0009***	–0.0011***	0.0039*	–0.0130***
2 children (0/1)	0.0011**	–0.0012***	0.0044**	–0.0096**
3+ children (0/1)	0.0001***	–0.0019***	0.0046**	–0.0090
Spouse_CEO (0/1)	0.0001	0.0000	0.0126**	–0.0015
Spouse_not_CEO (0/1)	0.0012***	–0.0011***	0.0048***	–0.0056
Total female effect [b]	–0.0016***	—	–0.0121***	—
Other explanatory variables[c]	Yes		Yes	
Number of observations	432,685		113,302	

[a]Firm specific RE including firm means (Wooldridge estimator), see Table 2.
[b]The total female effect is calculated as the sum of female interaction coefficients (including woman dummy) x female means for the variables, which are interacted with the woman dummy. Since the estimated model also includes tenure and experience variables that are interacted with woman dummy, these interaction variables are also included in total female effect. Significance of the effect is calculated by the STATA procedure "nlcom," which calculates approximative standard errors of combinations of parameter estimates using the delta method.
[c]See note [a] to Table 2.
*significant at 10%, **significant at 5%, ***significant at 1%.

therefore calculate the average total female effect, which includes the coefficient of the woman dummy plus the woman interaction effects evaluated at the mean female values (the total female effect includes an interaction term for family variables, i.e., children and husband, along with experience and tenure variables, which are also included in the models in Table 5). The total average effect of being a woman is significantly negative, –0.16 percentage points for VP promotions and –1.21 percentage points for promotion into CEO positions. Thus, despite the negative estimates of the female interaction effects for children in the CEO relation, the total estimated effect of being a woman is numerically smaller when including the interaction terms because the female tenure and experience interaction terms are positive.

The sign and size of the coefficients of the child and spouse variables are interesting, albeit caution is needed with causal interpretations of these variables. The main effects of the spouse and child indicators are significantly positive while the interaction terms are negative and significant in most cases. This is in line with the a priori expectations that married men who are fathers tend to have higher promotion rates into VP and CEO positions than single men and childless men. For women, this pattern is not observed. For women who have not reached VP or CEO positions, the overall effect of children is that the more children, the lower probability of promotion into a VP position. Surprisingly, the numerical size of the negative child effect on female CEO promotion rates is not increasing with number of children. The indicator for having three or more children even becomes insignificant

for promotions of women into CEO positions. Being married, even to a CEO, does not reduce the promotion probability into CEO positions for women, conditionally on having already reached a VP position.

Timing of Childbirths and Maternity Leave

To explore further the influence of children, we use the sample information on the timing of childbirths and the maternity and paternity leave periods spent out of the labor force in the past. Since the late 1970s, Danish mothers have had the right to maternity leave with partial or full compensation, and the duration of the maternity leave period has been extended gradually. In the first part of the observed period, up to 2002, women were entitled to 14 weeks of maternity leave, fathers had 2 weeks, and there was a parental leave period of 10 weeks that either of the parents could take (Gupta et al. 2008). Furthermore, childcare leave was available for most parents. In 2002, the benefits were changed and the childcare leave was converted into a formal parental leave of 26 weeks on top of the 10 weeks. Thus, since 2002 the maternity and parental leave period added up to 12 months per child. In total, about 6% of the days spent in maternity and parental leave are picked up by fathers (population figures for Denmark), and this proportion has been quite stable since 1990. Virtually all families, including high-income families in top executive positions, take the full leave period; see Gupta et al. (2008) for a more detailed description of the Danish leave arrangements.

This picture is confirmed by the sample means in Table 6. In the full sample, including executives with no children, the proportion who have ever taken maternity leave for more than two weeks is almost the same across occupational positions, 18 to 27% for males and 59 to 65% for females. When conditioning on being parents, however, some differences appear across the three groups of executives. The higher up in the hierarchy, the fewer days spent in paternity leave for male executives. But for females this pattern is not observed, which may partly reflect that female CEOs on average are older than women in lower positions and for this reason tend to have more kids, ceteris paribus (see Table 4). On average, female (male) POPs have taken 396 (17) days of maternal/parental leave during their career. For VPs, these sample means are 347 and 14 days, for females and males, respectively; and for CEOs 355 and 11 days.[6] As demonstrated in Table 6, women are on average about one year younger (27 years old) than men (28 years) when they become parents for the first time with no notable

[6]Since data do not include information on maternity leave before 1984, we restrict the sample to women who had their first child after 1984. In the estimations we include all individuals but employ a dummy variable assuming the value of 1 for those individuals who were observed to give birth to their first child before 1984. Spouse information on leave periods is available after 1992. Thus, the variable "proportion of leave days" is defined only for individuals having their first child after 1992. Again, we include all observations but add a dummy variable assuming the value of 1 for individuals who had children before 1992.

Table 6. Sample Means of Leave Period Variables by Gender, 1997–2007[a]

	POP		*VP*		*CEO*	
Variable	*Male*	*Female*	*Male*	*Female*	*Male*	*Female*
Ever on maternity or parental leave (0/1)	0.195	0.588	0.267	0.654	0.182	0.630
	Sample means conditional of giving birth to a child/being a parent					
Age at first childbirth	27.8	26.5	28.3	27.3	28.1	26.9
Years since last childbirth	15.8	15.0	*14.8*	*14.7*	17.0	15.5
Accumulated number of leave days	17.22	395.67	14.21	346.96	10.53	355.45
Proportion of total leave days in the household	0.084	0.911	0.055	0.900	0.045	0.875
Number of observations						
All individuals	421,066	72,660	105,137	13,162	29,755	1,740
Parents only	264,488	49,985	92,445	9,746	27,323	1,269

[a]All sample means differ significantly (at 1%) between men and women, except for values in italics (Satterthwaites test for equality). Italics indicate that sample means are not different for males and females.

difference between POPs, VPs, and CEOs. On average, the youngest child is aged between 15 and 17 years for the three groups. Fertility and career outcomes may of course interact in a complex way that we do not aim to model in this article (see Miller 2011).

Table 7 shows the results from re-estimating the model in Table 5 with additional variables reflecting alternative measures of take-up of leave periods due to childbirth. The leave period variables are added to the model in Table 5, one at a time; five alternative models are estimated for each promotion rate. The results reveal there is still a significant estimate of δ in all models. Thus, in general we are not able to confirm Hypothesis 3a, that is, that the estimated gender gap in promotion probabilities is reduced when including variables reflecting timing and duration of leave periods.

In most cases, there are significant gender differences with respect to the coefficient of leave variables (Models *i* – *iii*). In general, the estimate of the parameter of take-up of leave benefits (main effect) is significantly negative, as found in many other studies (see, for instance, Bertrand et al. 2010). But the marginal female interaction effect tends to be positive and of about the same numerical size as the negative main effect. Thus, men who take up parental leave benefits tend to have lower promotion chances, but for women there is no observed relation between take-up of parental leave and promotion chances. These results fit into the general statistical discrimination explanation and signaling theory: If all women, including potential top executives, are expected to take up most of the leave periods they are eligible to, the individual woman is not "punished" when actually taking her maternal/parental leave, while the very few fathers who take part of the parental leave period (i.e., more than two weeks, which is about the average take-up for Danish fathers) send a very negative signal to the employer, see Albrecht, Edin, Sundstrøm, and Vroman (1999). According to Table 7, the "total female effect" turns insignificant in the CEO model, when including the gender specific effect of accumulated number of leave days.

Table 7. Marginal Effects on Promotion Probability of Alternative Child-Related Variables, 1997–2007[a]

	Promotion I (VP)		*Promotion II (CEO)*	
Model	*Main effect*	*Interaction effect*	*Main effect*	*Interaction effect*
Model i				
Woman dummy (0/1)	–0.0012***	—	–0.0203***	—
Ever on maternity or parental leave (0/1)	–0.0001	0.0004	–0.0021	0.0108
Total female effect	–0.0015***		–0.0115***	
Model ii				
Woman dummy (0/1)	–0.0012***	—	–0.0198***	—
Accumulated number of leave days/100	–0.0007**	0.0007**	–0.0202***	0.0196***
Total female effect	–0.0006***		0.0121	
Model iii				
Woman dummy (0/1)	–0.0012***	—	–0.0192***	—
Proportion of total leave days in the household	–0.0015**	0.0016**	–0.0053	0.0037
Total female effect	–0.0013***		–0.0147***	
Model iv				
Woman dummy (0/1)	–0.0009**	—	–0.0156***	—
Age at first childbirth/100	0.0059***	–0.0024	0.0151	–0.0600**
Total female effect	–0.0017***		–0.0191***	
Model v				
Woman dummy (0/1)	–0.0010***	—	–0.0185***	—
Years since last childbirth/100	–0.0076***	0.0020	–0.0148	0.0143
Total female effect	–0.0015***		–0.0157***	
Other explanatory variables in each model *See Table 5*	Yes		Yes	
Number of observations	432,685		113,302	

[a]See notes a–c in Table 5. Each of the models (*i*) to (*v*) also includes all the explanatory variables included in Table 5.
*significant at 10%, **significant at 5%, ***significant at 1%.

The estimated marginal effect of age at first childbirth is significantly positive for promotion from POP to VP, meaning the probability of being promoted into a VP position increases with age when being a parent for the first time. For CEO positions, however, the picture seems to differ. The main effect of "age at first childbirth" is insignificant, but the estimated interaction effect is numerically large and significantly negative.[7] Thus, the

[7]The variables "age at first childbirth" and "years since last childbirth" assume the value of 0 for childless individuals, and we include a dummy for childless individuals in order to secure that these observations do not affect the estimate of the two variables. "Age at first childbirth" is a time-constant variable, that is, by definition it does not vary over time for an individual. Therefore, the dummy for childless individuals is not identical with the dummy for having no children in a given year, meaning we are able to identify the child indicators. We have experimented with many different specifications in order to test the robustness of the numerically large coefficient of the interaction term in Model *iv*, but the result seems to be extremely stable. One hypothesis might be that the variable "age at first childbirth" catches differences in female birth cohorts where old cohorts tended to have their children earlier. However, this is not the case. First, we control for age in the model. Second, more detailed descriptions of the variable "age at first childbirth" do not reveal any systematic differences between age groups or between the three groups of POPs, VPs, and CEOs.

estimations in Table 7 indicate that conditional on having reached a VP position, having the first baby at an early age improves the chances of promotions into CEO positions. One explanation for this may be that women who have their first child very early in their career and succeed in reaching a position in the group of VPs, have more success in their signaling as POPs or in doing successful tasks as VPs. Though we do not claim that these estimates represent causal effects, there may be more reasons for this observation: Either mothers become more effective during their career when they have children early, or the fact that they have children early and still pursue a career is taken as a positive indication of being an *h*-worker.

Female-Friendly or Female-Led Firms and Promotion

In the search for observed variables that may explain the estimated "unexplained gender gap," $\hat{\delta}$, we now look to variables on the company side that may explain the promotion gap. If the firm has a female CEO, this may affect the promotion chances of females into VP positions because these more female-led firms may have different information on female applicants or less prejudices against women, or they may be better in decoding the signals from female applicants. In Model *i*, we also test whether a male CEO who is married to a female CEO or VP may have changed his view of (modern) potential female executives more than other males.[8] In Model *ii*, we test whether the promotion chances are related to the proportion of women in the management board, that is, other female VPs (as in Bell 2005). If there are one or more females in the management board, this may affect both the decoding chances of signals of potential top executives and the evaluation of tasks performed by women contrary to the assumption in Bjerk (2008). We also test for the potential effect of having a large group of potential female top executives, which may affect the "belief" of the proportion of females who are *h*-workers (Model *iii*). We expect that a higher proportion of females in the POP group of the hiring firm will increase the chances for women to become promoted from POP to VP (but not from VP to CEO). In Model *iv*, we test whether there is a relationship between the gender of the chairman of the board of directors and the gender of those who are promoted into CEO positions. In Models *v* and *vi*, we include proxies for "hierarchical distance" between VP and CEO positions. In Model *vi*, we add the variable "Annual CEO compensation minus average annual VP compensation," and in Model *vii*, we add the variable "Number of VPs in company." Our expectation is that including these two variables in Models *v* to *vi* may reduce the estimated gender gap in promotion rates into CEO positions if women tend to have larger difficulties in reaching the top position when

[8]For CEO promotion, the interpretation of the results in Models i–ii is complex because there is only one CEO in the company. If a CEO promotion is observed, this means that the previous CEO has left the position. Thus, the coefficient of gender of the previous CEO partly reflects gender differences in CEO turnover. The estimations (not shown here) actually indicate that female CEOs have higher turnover than male CEOs.

Table 8. Marginal Effects on Promotion Probability of Alternative Models ("Female-Led" and "Male-Led" Variables), 1997–2007[a]

	Promotion I (VP)		*Promotion II (CEO)*	
Variable	*Main effect*	*Interaction effect*	*Main effect*	*Interaction effect*
Model i[b]				
Woman dummy (0/1)	–0.0011***	—	–0.0120***	—
Male CEO with CEO/VP partner (0/1)	0.0005	–0.0007	–0.0068	–0.0036
Male CEO with no partner (0/1)	0.0003	–0.0006	–0.0026	0.0053
Female CEO (0/1)	0.0005	0.0009	–0.0132***	0.0072
Total female effect	–0.0016***		–0.0155***	
Model ii				
Woman dummy (0/1)	–0.0010***	—	–0.0148***	—
Female share of VPs and CEOs	0.0023***	–0.0021**	0.0177**	–0.0264**
Total female effect	–0.0016***		–0.0187***	
Model iii				
Woman dummy (0/1)	–0.0010	—	–0.0191***	—
Female share of POPs	–0.0035***	–0.0008	–0.0168***	–0.0039
Total female effect	–0.0017***		–0.0157***	
Model iv				
Woman dummy (0/1)	–0.0012***	—	–0.0192***	—
Female Chairman of Board of Directors (0/1)	–0.0009**	0.0021	0.0049	–0.0040
Total female effect	–0.0016***		–0.0156***	
Model v				
Woman dummy (0/1)	0.0002	—	–0.0186***	—
Total number of VP	–0.00005***	–0.0002***	–0.0030***	0.0003
Total female effect	–0.0015***		–0.0139***	
Other explanatory variables[b]	Yes		Yes	
Number of observations	432,685		113,302	

[a]See notes a–c in Table 5. Each of the Models (*i*)–(*v*) also includes all the explanatory variables included in Table 5.
[b]Excluded category is companies with male CEO married to a partner who is not CEO or VP.
*significant at 10%, **significant at 5%, ***significant at 1%.

the hierarchical distance between CEO and VP positions is large, that is, reflecting that competition for the CEO position is larger (a more tough tournament). We include estimates for these models also for VP promotions though we do not expect these variables to affect VP promotions.

The size and significance of the estimates of δ and the "total female effect" in Table 8 indicate that including these alternative variables reflecting "female-led" or "female-friendly male leader" have a marginal effect on the estimates of δ in some of the models on VP promotions but not on the models on CEO promotions. Thus, we are partly able to confirm Hypothesis 3b that part of the gender gap in promotion chances for POPs into VP positions is explained by variables proxying female-friendly preferences in the hiring companies. However, we are still left with a significant unexplained gender gap in promotion probabilities into CEO positions. In general, we find insignificant or even negative estimates of the marginal effect from the

Table 9. Marginal Effects on Promotion Probabilities: "Overall" Model, 1997–2007[a]

	Promotion I (VP)		*Promotion II (CEO)*		*Promotion II (CEO)*	
Variable	*Main effect*	*Interaction effect woman*	*Main effect*	*Interaction effect woman*	*Main effect*	*Interaction effect woman*
Woman dummy (0/1)	–0.0007	—	–0.0112*	—	–0.0074	—
1 child (0/1)	0.0005	–0.0007*	0.0001	–0.0031	0.0003	–0.0018
2 children (0/1)	0.0009***	–0.0008**	0.0018	–0.0003	0.0015	0.0004
3+ children (0/1)	0.0008**	–0.0016***	0.0029	–0.0006	0.0023	–0.0022
Spouse_CEO (0/1)	0.0006	0.0000	0.0123**	–0.0015	0.0064	–0.0029
Spouse_not_CEO (0/1)	0.0012***	–0.0010***	0.0048***	–0.0054	0.0031*	–0.0038
Acc.# of leave days/100	–0.0008***	0.0008**	–0.0206***	0.0204***	–0.0157***	0.0155***
Age at first childbirth/100	0.0061***	–0.0023	0.0224*	–0.0561**	0.0173	–0.0536**
F-share of VPs and CEOs	0.0026***	–0.0018*	0.0180**	–0.0266**	0.0167**	–0.0244***
F chairman (0/1)	–0.0009**	0.0023	0.0050	–0.0042	0.0059	–0.0087
F-share of POPs	–0.0036***	–0.0006	–0.0171***	–0.0024	–0.0134***	–0.0013
Type of VP						
Vice CEO (0/1)	—	—	—	—	0.0794***	–0.0004
CFO (0/1)	—	—	—	—	0.0018	0.0028
HR (0/1)	—	—	—	—	–0.0056*	–0.0002
Sales (0/1)	—	—	—	—	0.0009	–0.0030
IT, R&D (0/1)	—	—	—	—	–0.0090***	0.0025
Total female effect	–0.0011*		–0.0014		–0.0015	
Other explanatory variables[a]	Yes		Yes		Yes	
Number of observations	432,685		113,302		113,302	

[a]See notes a–c in Table 5. Each of the Models (*i*)–(*v*) also includes all the explanatory variables included in Table 5.
*significant at 10%, **significant at 5%, ***significant at 1%.

interaction term between having a female chairman of the board of directors or a female CEO of the firm and being a female applicant to a VP position.

What Explains the Gender Gap in VP and CEO Promotions? A Full Model

Until now, we have not been able to "explain" the gender gap in promotions into VP and CEO positions by controlling for additional firm- and individual-specific variables successively. In Table 9, we show the results from a full model in which we include most of the family and firm variables entered one at a time in the estimations above in order to test simultaneously the impact of the individual- and firm-related factors on promotion rates. A few variables are not included, either because their impact in the previous estimations were minor or because they are by definition highly correlated with other included variables.

As demonstrated in Table 9, the estimate of the gender gap, δ, turns out to be insignificant for VP positions when controlling for the additional individual- and firm-specific variables simultaneously. However, the average "total female effect," which includes all female interaction terms, is still

significantly negative (–0.11 percentage points). For CEO promotions, the estimate of δ is significant and amounts to 1.1 percentage points (columns 3). Most of the family-related variables tend to be much more significant in explaining VP promotions compared with CEO promotions. Most notable is the difference with respect to child coefficients for which the results indicate that potential male top executives (POPs) benefit in their career prospects by having children, but for female POPs this positive effect is not observed (adding main effect and interaction effect, the total effect of children is slightly negative, though not significant in all cases). The significant effect of children disappears for CEO promotions. Compared with the results in Table 5, according to alternative estimations (not shown here), the variable "age at first childbirth" affects the size of the child coefficients in the CEO relation. When controlling for age at first childbirth, the number of children in itself does not have any significant effect on promotion chances into CEO positions, compared to having no children, as found in previous results (see Table 5). As in Table 7, we find a highly significant and negative effect of taking paternity leave for the promotion chances of male executives, but not for women.

The larger the proportion of women on the executive board (VPs and CEOs), the larger the promotion chances are for men (main effect) but not for women (interaction effect). The interpretation of the main effect is that female VPs and CEOs have a higher turnover. The exit rates for female VPs and CEOs are considerably higher than for male VPs and CEOs in the data set. We do not find that a higher proportion of women in the management board increases the chances for female applicants, and for CEO positions the opposite is found—the higher the proportion of women in the management board, the lower the chances for female applicants. This result is different from what is found in Bell (2005) for U.S. firms. We find a negative—though insignificant—effect on female promotion chances for CEO positions from having a female chairman on the board of directors. This may reflect that female chairmen are at least as gender-stereotypical as their male peers, a surprising result which is also found in another recent Danish study by Neergaard et al. (2008). Alternatively, the result may reflect a tokenism effect: if there is already one woman on the board, no more women are hired.

As a last attempt to explain the insignificant estimate of δ in the CEO model, we add a number of indicator variables reflecting the type of activities and tasks the executive undertakes in the VP position. We add 5 indicators to the model (Vice CEO, CFO, HR, Sales, and IT/R&D with excluded category "Production"). The VP executives in Vice CEO positions have a significantly higher chance of becoming promoted into a CEO position, a result which is not very surprising since this category reflects being "number 2" in the company. VPs who are working in HR, IT, and R&D areas have significantly lower chances of becoming promoted into CEO positions, which is remarkable as HR is the VP area with the highest share of females (Table 10). Turning to the estimate of δ, the results in Table 9 show that controlling

Table 10. Frequency Table for Vice Presidents, Divided into Subcategories by Gender, 2007

Subcategory	*Men*	*Women*	*All % (Total number)*
Vice CEO	1,312	133	12.6 (1,445)
CFO	890	274	10.1 (1,164)
HR	243	132	3.3 (375)
Sales	1,890	310	19.2 (2,200)
IT, R&D	2,591	391	26.0 (2,982)
Production	3,008	312	28.9 (3,320)
All	9,934	1,552	100 (11,486)

for type of VP, the coefficient becomes numerically smaller and becomes insignificant.

The differing impact on promotion chances from being, for instance, a VP with a HR or R&D background compared with being a CFO or Vice CEO may reflect that the board of directors or the headhunters consider the HR and R&D tasks as being less demanding or less valuable competences for filling a CEO position. Thus, this result does not rule out that women may also face (statistical) discrimination mechanisms when applying for CEO positions since the different remuneration to the VP indicators may reflect (statistical) discrimination mechanisms. However, these indicator variables may also capture selection effects: Women who already at the start of their career (or education) had career aspirations and preferences for reaching top executive positions have made other choices with respect to human capital accumulation and occupational choices. Thus, we cannot rule out that part of the gender gap in CEO promotions that end up being explained by the VP indicators may reflect a gender gap in preferences for top executive positions.

Conclusion and Discussion

This article analyzes the gender gap in promotion into top corporate jobs based on employer-employee data on all Danish companies. The raw VP- and CEO-promotion rates in the data set show a fairly constant distance between males and females during the period 1997 to 2007. In 2007, 3.6% of the males and 3.0% of the females in the group of potential top executives were promoted into a VP position, while for promotions from VP positions into CEO positions, the same figures were 4.4% and 2.7%, respectively; that is, there was a gender gap of 0.6 percentage points for VP positions and 1.7 percentage points for CEO positions.

First, we test whether these gender gaps are explained by gender differences in observed characteristics or unobserved time-invariant characteristics of firms or individuals. They are not! We cannot explain the gender gap by women's lack of formal observed or unobserved time-invariant competences or, probably more surprisingly, by some firms being consistently more

reluctant to hire or promote women into top executive positions. Especially, the last step from a VP position to a CEO position seems to be a difficult hurdle for women, also when controlling for a number of background characteristics of the executives and companies. These results are not in line with models proposed by Fryer (2007) and Bjerk (2008).

Second, we dig deeper into the explanations behind the gender gap in promotion probabilities by focusing on a number of factors that may have different effects on male and female careers at the top level. We analyze the gender-specific role of children, childbirth, and household responsibilities. We have historical information on maternity, paternity and parental leave periods for the individuals (and for their spouses) included in the sample. Our results indicate that time out of the labor market and child-related decisions are important factors when explaining the gender gap in promotion into top executive positions. Children seem to benefit the promotion rates of fathers but have no effect on mothers' promotion chances, ceteris paribus. If the fathers take parental leave, however, they are strongly punished on career prospects and promotions while the individual woman is not.

For the small group of women promoted from a VP position into a CEO position, age at first childbirth is strongly negatively correlated with promotion chances, meaning that women who give birth at a relatively young age seem to have higher promotion chances. For this group, the number of children has no significant effect on women's CEO-promotion probabilities. Our interpretation is that women who had their children at a relatively young age (not as teenagers, but at the age of around 21 to 24) and who succeeded in climbing the career ladder into a position as VP, are able to signal that they are highly productive workers in a more convincing way than women who have their children later in life. We also search for explanations on the firms' side. We test a number of hypotheses about the recruiting firm. One hypothesis is that the barriers for women are minor in female-led companies. We conclude that female-led firms are either not different from other firms or in some cases hire fewer women into top positions, compared with other companies, contrary to results found for U.S. firms by Bell (2005). The fact that we do not find positive effects for Danish female-led firms fits with other empirical evidence for Denmark saying that female managers may have more gender-stereotyped beliefs than male managers have on female competences and the requirements for management positions.

Our results show that an important determinant of the chances to become CEO is the area of specialization as a top executive. VPs who are responsible for HR, R&D, and IT areas have significantly lower chances of becoming promoted into CEO positions than, for instance, CFOs and VPs in Sales or Production areas. Women in top management and VP positions tend to cluster in HR positions, and this is an important factor behind the lower CEO-promotion rates for women.

Appendix

Table A.1. Sample Means for Selected Variables by Gender and Occupational Position,[a] 2007

	POP		*VP*		*CEO*	
Variable	*Males*	*Females*	*Males*	*Females*	*Males*	*Females*
Individual characteristics						
Short further education (0/1)	0.07 (0.25)	0.09 (0.29)	0.08 (0.28)	0.11 (0.31)	*0.05 (0.23)*	*0.06 (0.24)*
Medium further education (0/1)	*0.16 (0.37)*	*0.15 (0.36)*	0.26 (0.44)	0.20 (0.40)	0.28 (0.45)	0.21 (0.41)
Long further education (0/1)	0.11 (0.31)	0.15 (0.36)	0.20 (0.40)	0.23 (0.42)	*0.21 (0.41)*	*0.24 (0.43)*
Work experience, years	18.90 (12.02)	17.23 (10.40)	23.41 (9.79)	20.70 (9.41)	24.35 (10.05)	19.70 (9.08)
Tenure, years	4.76 (6.89)	4.34 (6.12)	6.64 (7.22)	6.12 (7.04)	8.23 (7.91)	5.66 (6.78)
Age, years	41.36 (13.00)	40.60 (10.91)	46.35 (8.64)	43.80 (8.44)	49.17 (8.85)	44.14 (9.30)
Firm characteristics[b]						
Less than 50 employees (0/1)	0.42 (0.49)	0.34 (0.47)	—	—	—	—
50–100 employees (0/1)	0.03 (0.17)	0.05 (0.21)	0.32 (0.47)	0.41 (0.49)	*0.50 (0.50)*	*0.53 (0.50)*
101–500 employees (0/1)	0.11 (0.31)	0.16 (0.37)	*0.47 (0.50)*	*0.45 (0.50)*	*0.41 (0.49)*	*0.41 (0.49)*
More than 500 employees (0/1)	*0.44 (0.50)*	*0.45 (0.50)*	0.21 (0.41)	0.13 (0.34)	0.09 (0.28)	0.05 (0.22)
Listed on stock exchange (0/1)	0.03 (0.18)	0.05 (0.22)	*0.06 (0.23)*	*0.05 (0.21)*	0.03 (0.17)	0.01 (0.11)
Lagged performance (ROE)	1.19 (115.37)	–0.09 (25.72)	*0.22 (4.73)*	*0.28 (3.23)*	*0.16 (4.32)*	*0.05 (4.01)*
Female share of employees	0.29 (0.20)	0.47 (0.23)	0.33 (0.18)	0.49 (0.22)	0.32 (0.21)	0.50 (0.26)
Number of observations	34,765	8,328	9,934	1,552	2,824	229

[a]Satterthwaites test for equality between males and females shows that all variable means are significantly different for men and women, except for values in italics.

[b]Firm size variables refer to origin company in cases where executives change company. In the estimation we include lagged values for both recruiting and origin company.

References

Adda, Jérôme, Christian Dustmann, and Katrien Stevens. 2011. The career costs of children. CEPR Discussion Paper no. DP8697.

Albrecht, James W., Per-Anders Edin, Marianne Sundstrøm, and Susan B. Vroman. 1999. Career interruptions and subsequent earnings: A reexamination using Swedish data. *Journal of Human Resources* 34(1): 294–311.

Albrecht, James, Anders Bjorklund, and Susan Vroman. 2003. Is there a glass-ceiling in Sweden? *Journal of Labor Economics* 21(1): 145–77.

Athey, Susan, Christopher Avery, and Peter Zemsky. 2000. Mentoring and diversity. *American Economic Review* 90(4): 765–86.

Bell, Linda. 2005. Women-led firms and the gender wage gap in top executive jobs. IZA Discussion Paper no. 1689.

Bertrand, Marianne, and Kevin F. Hallock. 2001. The gender gap in top corporate jobs. *Industrial and Labor Relations Review* 55(1): 3–21.

Bertrand, Marianne, Claudia Goldin, and Lawrence F. Katz. 2010. Dynamics of the gender

gap for young professionals in the corporate and financial sectors. *American Economic Journal: Applied Economics* 2(3): 228–55.
Bjerk, David. 2008. Glass ceiling or sticky floors? Statistical discrimination in a dynamic model of hiring and promotion. *Economic Journal* 118(530): 961–82.
Blau, Francine D., and Jed DeVaro. 2006. New evidence on gender differences in promotion rates: An empirical analysis of a sample of new hires. NBER Working Paper no. 12321.
Booth, Alison L., Marco Francesconi, and Jeff Frank. 2003. A sticky floors model of promotion, pay, and gender. *European Economic Review* 47(2): 295–322.
Booth, Alison L., and Patrick Nolen. 2009. Gender differences in risk behaviour: Does nurture matter? CEPR Discussion Paper no. 7198.
Cobb-Clark, Deborah. 2001. Getting ahead: The determinants of and payoffs to internal promotion for young US men and women. Centre for Economic Policy Research, Australian National University, Discussion Paper no. 430.
Fietze, Simon, Elke Holst, and Verena Tobsch. 2009. Personality and career: She's got what it takes. DIW Discussion Paper, no. 955, Berlin.
Frederiksen, Anders, and Takao Kato. 2011. Human capital and career success: Evidence from linked employer-employee data. IZA Discussion Paper no. 5764.
Fryer, Roland G. 2007. Belief flipping in a dynamic model of statistical discrimination. *Journal of Public Economics* 91(5–6): 1151–66.
Gupta, Nabanita Datta, Ronald L. Oaxaca, and Nina Smith. 2006. Swimming upstream, floating downstream: Comparing women's relative wage progress in the United States and Denmark. *Industrial and Labor Relations* 59(2): 243–66.
Gupta, Nabanita Datta, Nina Smith, and Mette Verner. 2008. The impact of Nordic countries' family-friendly policies on employment, wages, and children. *Review of Economics of the Household* 6(1): 65–89.
Jaumotte, Florence. 2003. Labour force participation of women: Empirical evidence on the role of policy and other determinants in the OECD countries. *OECD Economic Studies* 37(2): 51–108.
Lazear, Edward P., and Sherwin Rosen. 1990. Male-female wage differentials in job ladders. *Journal of Labor Economics* 8(1): S106–S123.
Matsa, David A., and Amalia R. Miller. 2011. Chipping away at the glass ceiling: Gender spillovers in corporate leadership. *American Economic Review* 101(3): 635–39.
McCue, Kristin. 1996. Promotions and wage growth. *Journal of Labor Economics* 14(2): 175–209.
Miller, Amalia R. 2011. The effects of motherhood timing on career path. *Journal of Population Economics* 24(3): 1071–1100.
Neergaard, Helle, Mette Hersby, Henning Madsen, John Parm Ulhøi, and Mona T. Madsen. 2008. Revisiting the think manager-think male syndrome in an egalitarian culture. Proceedings of the Academy of Management Conference, Anaheim, California, USA.
Niederle, Muriel, and Lisa Vesterlund. 2007. Do women shy away from competition? Do men compete too much? *Quarterly Journal of Economics* 122(3): 1067–1101.
[OECD] Organisation for Economic Co-operation and Development. 2001. *Employment Outlook.* Paris, OECD.
OECD. 2002, 2003, 2004, 2005. *Babies and Bosses, Reconciling Work and Family Life.* Paris, OECD.
Phelps, Edmund S. 1972. The statistical theory of racism and sexism. *American Economic Review* 62(4): 659–61.
Polachek, Solomon W. 1981. Occupational self-selection: A human capital approach to sex differences in occupational structure. *Review of Economics and Statistics* 63(1): 60–69.
Schein, Virginia E. 1973. The relationship between sex role stereotypes and requisite management characteristics. *Journal of Applied Psychology* 57(2): 95–100.
Smith, Nina, Valdemar Smith, and Mette Verner. 2011. Why are so few females promoted into CEO and Vice-President positions? Danish empirical evidence 1997–2007. IZA-DP 5961, Bonn, IZA.
Wooldridge, Jeffrey M. 2002. *Econometric Analysis of Cross Section and Panel Data.* Cambridge, MA: MIT Press.
World Economic Forum. 2011. *The Global Gender Gap Report.* Geneva, World Economic Forum.