

**Why Are There So Few Women Top Managers?**

**A Large-Sample Empirical Study**

**of Female Participation in Top Management**

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Research suggests that entry by women into top management should create a positive social dynamic making entry by subsequent women easier. However, we theorize that the presence of a woman on a top management team may reduce the probability that another top management position in the same firm is occupied by a woman due to the enactment of gender-related social norms by men and avoidance behavior by women. Using twenty years of panel data on the S&P 1,500 firms and a novel econometric design, we find robust evidence for such negative spillovers, implying that women are “overdispersed” in top management. An analysis of the spillovers from different management positions suggests that the enactment of social norms by men is the primary mechanism underlying our results.

## 1. INTRODUCTION

Inspired by women's significant educational, social, and economic advancements over the past decades, a provocative book declares that we are witnessing "The End of Men" as the dominant sex (Rosin, 2012). Indeed, in 2011, women accounted for 47% of the labor force and 38% of all managerial positions (BLS, 2011), and have made slow but steady progress in some levels of corporate leadership, with 16% of board seats of Fortune 500 companies being held by women – a 40% increase over 2000 (Catalyst, 2005, 2012). Yet, women continue to be significantly underrepresented in the top management of U.S. corporations, despite evidence that the "pipeline to the top" is well supplied (BLS, 2011; Helfat *et al.*, 2006), that women exhibit managerial skills and styles associated with organizational success in the contemporary business environment (Dezso & Ross, 2012; Eagly, 2007), and that they benefit from the presence of female board members (Bilimoria, 2006; Catalyst, 2007; Matsa & Miller, 2011). In fact, the overall percentage of women in top management positions remains under 9%, and their percentage has actually declined in the important category of line officer positions, which have profit and loss responsibility, from a peak of 6.5% in 2009 to 6.1% in 2011.

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Insert Figure 1 about here

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Why have women failed to make better progress in top management despite making so much progress in lower managerial levels and corporate boards and with accumulating theory and empirical evidence suggesting that women greatly benefit the organizations for which they work (Hillman *et al.*, 2007)? While a number of specific mechanisms have been advanced, a general perspective, which is associated with the tokenism theory of Kanter (1977), holds that women's small numbers make them symbols of their category rather than individuals and subject them to social and professional stresses. If

more women were hired to similar positions, women would lose their token status, leading to a positive social dynamic that made it easier to recruit, train, and motivate additional women. An increase in the number of women senior managers should also attenuate other barriers to women's managerial advancement, including failure to accommodate women's desire to bear children (Bertrand *et al.*, 2010; Miller, 2011), statistical discrimination due to uncertainty about women's suitability for leadership positions on the part of other managers (Aigner & Cain, 1977; Bielby & Baron, 1986; Phelps, 1972) or investors (Lee & James, 2007), gendered behaviors in screening job applicants whereby men and women are sorted into different types of work whether due to differential commitments to the labor market or social closure (Fernandez-Mateo & King, 2011), or the dearth of role models and mentors for women at lower levels of the managerial hierarchy (Ely, 1994; Ibarra, 1992, 1993; Tsui *et al.*, 1992; Tsui & O'Reilly, 1989; Williams & O'Reilly, 1998). More women among senior management could also lead to changes in organizational culture and human resources policies, in the attitudes of male managers, and increase women-to-women interaction in the workplace. This perspective implies it should get progressively easier for women to ascend the corporate career ladder as more women do so, eventually eliminating gender inequity in corporate life.

And yet, if this perspective were the whole story, one might expect female participation rates in top management to be steadily growing – even at a progressively higher rate – until approaching equality; in fact, the growth of female participation rates is virtually flat and, for some kinds of positions, has turned negative. In this paper, we draw on the literature on majority-minority relations and gender in management to theorize two possible reasons for why it may in fact be progressively harder for women to ascend the corporate career ladder as more and more women do so: (1) the enactment of gender-related social norms by men, whose efforts to recruit, train, and promote women may slacken and perhaps even reverse their orientation after limited progress in achieving the goal of hiring women to top management; and (2) avoidance behavior by women, who may actively undermine each other's advancement or prefer not to

work with or for each other. Such negative spillovers would imply that attention to human resources practices designed to improve women's access to the upper echelons of management should be *strengthened* rather than weakened after the appointment of a woman to a senior position.

The question of whether the presence of women in top management tends to facilitate or impede the ascension of other women is thus of both theoretical and practical importance. It is therefore surprising that, to our knowledge, no study specifically addresses this question using large sample methods. One possible reason for this lacuna is that it is impossible to draw legitimate statistical inferences from standard regression approaches to studying this question. As we explain in detail, estimation difficulties include unobservable heterogeneity, simultaneity bias, mechanical bias in the potential independent variables of interest, and persistence in that top managers have multi-year tenures on their top management teams, yet also switch positions on the same team. To overcome this problem, we develop a novel estimation technique, which we believe could be readily adapted to other questions in strategic management.<sup>1</sup>

We apply our estimation technique using longitudinal data on top management teams in U.S. public companies over a 20-year period. The basic idea is to simulate as rigorously as possible what the gender composition of these top management teams would be in the absence of gender-related spillovers, conditioning on both observable and unobservable factors associated with firms, individual positions, and time that influence the propensity for women to work in senior management. If there are positive gender-related spillovers, we would expect the actual data to exhibit a higher degree of clustering than the simulated data, whereas if there are negative gender-related spillovers, we would expect the actual data to be "overdispersed," that is, to have more isolated women than the simulated data and fewer teams with no women at all. We find strong evidence of overdispersion.

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<sup>1</sup> While we are not aware of another study in the social sciences using a similar methodology, the fact that our methodology is intuitive and based on foundational principles of probability theory suggests that it is certainly possible another study on a different topic was conducted along similar lines.

We further analyze the spillovers by conditioning on a top management team having a woman in one particular type of position and then calculating the average number of women the team has in that and various other types of position. The percentage differences between these conditional averages in the actual and simulated data are the marginal effects of the negative spillovers *from* having a woman in one particular type of position *on* the probability of having a woman in another particular type of position. We find particularly strong negative spillovers associated with professional positions. Since professional positions are generally more supporting in nature and less powerful than positions that confer profit-and-loss responsibility (e.g., CEO or head of a subsidiary), we argue that firms' male managers have greater latitude to use professional positions to enact gender-related social norms. In addition, the negative spillover from a woman chief executive officer (CEO) is somewhat weaker than from women in other positions, as if the woman CEO's own actions partially mitigated the negative spillover otherwise arising from her presence. Taken together, these results suggest that the enactment of gender-related social norms by men is the primary mechanism underlying the negative spillovers we observe.

## **2. THEORETICAL BACKGROUND**

### **2.1 Women in Top Management Positions: Reasons for a Positive Spillover**

While the tokenism theory proposed by (Kanter, 1977) suggests the possibility of both positive and negative spillovers, i.e., that having a woman in a top management position may make it more or less likely that another position in the same firm will be filled by a woman, the theory generally holds that women in management may find safety in numbers. Indeed, a wide range of theoretical and empirical research lends support to the general proposition that women's entry into traditionally male-dominated realms like the upper echelons of corporate management should resemble the S-curve of adoption; the first woman would face the highest barriers, the next woman slightly fewer and so on, so that the number of women entering

top management would accelerate progressively until eventually leveling off at something approaching equality. An identical argument could be applied to the *concurrent* advancement of multiple women.

The reasons for this are manifold. From a cognitive perspective, social similarity enhances communication and the development of trust and acts as a mechanism for reducing uncertainty, leading to similarity attraction (Byrne, 1971; Kanter, 1977), and thus a propensity for women to seek to work with other women. In addition, social identity theory (Tajfel, 1974) argues that social categorization is driven not only by cognitive considerations but also by “values, perception, and social representations” (Tajfel & Forgas, 1981: 114) and that membership in a social category plays a significant role in an individual’s social identity and self-image. As a result, gender-based social categorization may prompt women to positively discriminate in favor of other women (Baron & Pfeffer, 1994; see Brewer & Kramer, 1985; and Powell & Butterfield, 2002 for extensive reviews). A woman may also serve as a model for social comparison, mentor, or sponsor for women at lower levels and may, simply by her presence, encourage men and women in the organization to enact fewer masculine behaviors and more feminine behaviors, thereby making the work environment more hospitable to women (Ely, 1994; Ibarra, 1993). A woman on the top management team may thus serve as a catalyst for change that increases the possibility of additional women joining her on the top management team, and women who rise together would be expected to enhance each other’s chances of success within the organization.

Moreover, as the number of women in senior positions rises, there could be greater impetus to accommodate maternity leave, flexible work schedules, and alternative career paths, which are differentially important to women (Bertrand *et al.*, 2010; Miller, 2011). These changes would mitigate barriers to advancement by women. Likewise, to the extent that male managers consciously or subconsciously use gender as a proxy for ability, a woman on the top management team could, through her demonstrations of competent leadership, engender a more positive attitude toward the competency of women in general; this would lessen statistical discrimination against women due to uncertainty about their

skills (Aigner & Cain, 1977; Bielby & Baron, 1986; Phelps, 1972), again lowering the barriers to advancement by other women in the same organization, whether at the same level or below.

Finally, from an econometric perspective, one might also suspect that the presence of even a single woman on a top management team would be positively associated with important but largely unobservable aspects of the firm's culture and human resources policies that made the environment more favorable to women than during periods when there were no women on the top management team. That is, there could be a sort of reverse causality whereby the presence of a woman on the top management team serves as a proxy for the very mechanisms discussed above. It is thus intuitive to expect that women would tend to come in bunches, as it were, in top management. Formally, we have:

*Hypothesis 1A: The presence of a woman in a given top management position in a firm will be positively associated with the presence of a woman in another top management position in that firm.*

## **2.2 Women in Top Management Positions: Reasons for a Negative Spillover**

Despite the arguments advanced in the preceding section, there are two distinct social mechanisms that may, in fact, make it *harder* for women to advance to the upper levels of the corporate hierarchy when women are already present in top management or women peers are ascending the corporate hierarchy concomitantly.

**Enactment of gender-related social norms by men:** We theorize that men may enact gender-related social norms in a way that sometimes help women advance to senior management and is sometimes detrimental to their chances. First, firms clearly face pressure to recruit, train, and promote women managers, and many managers, the overwhelming majority of whom are male, may subscribe to an aspirational norm of gender equity in senior management. Organizations like Catalyst lobby for greater female representation at senior corporate levels. Large investment companies like CalPERS, CalSTRS, and Pax World Funds have overtly promoted gender equity at senior corporate levels across their



investment portfolio and in specific funds (Dezso & Ross, 2012). In general, firms require legitimacy in the eyes of internal and external constituents to secure needed resources and trading partners (Meyer & Rowan, 1977), thus making a public demonstration of progress toward gender equity in senior management important for firm prosperity. In addition, direct pressure from sex discrimination lawsuits and negative press in an industry (see Skaggs, 2008, for an example from the supermarket industry) can exert coercive pressure for hiring women into highly visible positions, leading to isomorphism in top management teams (DiMaggio & Powell, 1983).

While equal numbers of women and men on the top management team may be normative in an aspirational sense, even a single member of a minority can act as a symbol (Blalock, 1967), and the paucity of women in top management means that firms with only a single female top manager are likely to be perceived as progressive. Thus, a single woman can act as a female representative of the firm to the media and other external constituencies by making credible representations about the firm's proactive approach to assisting the advancement by women up the hierarchy. This suggests that from the standpoint of organizational legitimacy, the marginal value of the first woman on a firm's top management team would be considerably higher than the marginal value of any additional women. Senior managers who subscribe to the aspirational norm of gender equity could also be expected to feel less immediate urgency with respect to recruiting, training, and promoting a woman to the top management team if a woman is already (or soon will be) on the top management team simply because these managers feel their organizations are closer than peer firms to the ideal, or at least further away from negative public scrutiny. Indeed, Kanter (1977) describes many male managers as being ready to relax at any sign of progress. The general shift in organizational focus away from women's advancement would be expected to reduce the possibility of another woman overcoming any barriers that may exist to her advancement to the top management team.

Indeed, the shift in organizational focus may go beyond neutrality to an active resistance by a firm's male majority to the ascension of additional women to the top management team. In general, majority

resistance to a minority is increasing in the degree to which the majority perceives the minority to be a threat to its power and resources; this threat is usually an increasing function of the minority's relative size (Blalock, 1967). In studies of discrimination in voting, for example, a strong positive relationship has been observed between the size of a racial minority in a given state and proxies for both minority disenfranchisement and white racial solidarity in voting. Giles (1977) likewise finds a positive association between the degree of racial hostility in white (American) Southerners' attitudes toward blacks and the proportion of the local population accounted for by blacks, and Reed (1972) documents a similar relationship with lynchings in Mississippi. The degree of majority resistance often appears to increase at a convex rate from as little as 20-25% (Blalock, 1967), i.e., roughly the percentage accounted for by a token woman on a typical five-person top management team.

With regard to gender, Kanter (1977) herself notes that if more than one woman manager was present in a corporate setting, then male managers adopted a number of behavioral strategies, whether consciously or not, to set the women against each other. These findings are corroborated by South et al. (1982), who find that the proportion of workgroups accounted for by women is negatively related to the social support and encouragement for promotion women receive from men. South et al. (1982) also find that as the proportion of women increases, they interact less with the male majority, potentially depriving women of important sources of support and mentoring.

**Avoidance behavior by women:** Though controversial, some evidence suggests that women may be resistant to subordinate or supervisory relationships with other women. Where organizations are subject to pressure to create opportunities for disadvantaged groups, the first admitted member of the minority often benefits from minority status and may be given access to important resources (Blalock, 1967). Token women in particular may benefit from being different in an environment where success is associated with being known (Kanter, 1977). A token woman in a top management position may in effect occupy an ecological niche made possible by her organization's need to conform to the aspirational norm of gender

equity. Another woman on the top management team would represent a threat to be actively resisted (Staines *et al.*, 1974).

In addition, members of a disadvantaged minority may adopt the identification strategy of affiliating psychologically with the ideology of the advantaged majority, particularly if the advantaged majority also occupies a higher status position in a different categorical dimension such as an elite profession (Chattopadhyay *et al.*, 2004). This strategy may be especially useful in the context of a corporation's top management, given its predominately male discourse and scarcity of female role models. Indeed, a requirement for a woman to tacitly accept token status may be a credible ongoing demonstration of acceptance of the male majority's norms (Nieva & Gutek, 1981). Moreover, after achieving a top management position, women might perceive the value of their membership in such a high status group to be threatened if they exhibit favoritism towards other women or if other women either bring higher qualifications or reinforce negative stereotypes about women's lack of qualification (Duguid *et al.*, 2012). As a result, women who have succeeded in male-dominated environments are sometimes accused of being "more male than men" in the popular jargon (Mavin, 2006), and relationships among women may be more competitive than supportive in such environments (Ely, 1994). These postulated behaviors by senior women suggest that the presence of a woman on a top management team would reduce the probability that another position on that team would be filled by a woman.

The foregoing would also suggest that women at lower management levels might seek to avoid working for more senior women. The popular business press echoes these ideas, with some women reporting particularly abusive behavior from their female superiors (Mooney & D'Argy Smith, 2005; Platell, 2004). In addition, scholars argue that because females are discouraged from aggressive behavior, their aggression may be channeled towards other women (Warning & Buchanan, 2009). Some women also internalize gendered norms, including that female supervisors should be nurturing; these women may resist working for a female supervisor either in reaction to, or anticipation of, the supervisor's failure to comply

with these norms (O'Leary & Ryan, 1994). Echoing these ideas, some research has found that women believe that other women are good managers but do not want to work for them (Warning & Buchanan, 2009). Women who avoid subordinate positions that would lead to contact with a woman on a firm's top management team would simultaneously reduce their exposure to the entire top management team and thereby diminish their chances for promotion. Taken together, these arguments lead to the following countervailing hypothesis:

*Hypothesis 1B: The presence of a woman in a given top management position in a firm will be negatively associated with the presence of a woman in another top management position in that firm.*

In what follows, we seek to investigate the extent to which the enactment of gender-related social norms by men and avoidance behavior by women play a role in explaining female participation in top management. To do so, we examine the differential gender-related spillovers from, and on, different job categories represented in top management teams.

**The CEO position and avoidance behavior by women:** The CEO position is clearly the most powerful position in most firms. Therefore, the few women who occupy the CEO position possess greater ability than other top managers to influence the composition of the executive team, and women averse to working for other women would presumably be especially leery of joining a top management team headed by a woman. Thus, if negative spillovers arise due to avoidance behavior by women, we would expect these spillovers to be especially pronounced from a woman CEO on other top management positions in the same firm. Formally, we have:

*Hypothesis 2A: The presence of a woman chief executive officer in a firm will have a particularly strong negative association with the presence of a woman in another top management position in that firm.*

Senior women line managers represent a more credible replacement to a woman CEO than women in other top management positions. Of the over 6,400 CEOs who held their first CEO position in our data, about 47% were line officers in their previous job versus only 4% who were professionals (and these figures are, respectively, 53% and 5% after 2000, in which years we have fewer missing job titles – see below for more information on how we coded management positions). Indeed, women’s relatively lower representation in line positions (see Figure 1) is frequently identified as a significant barrier to women’s managerial advancement (e.g., Morrison & Vonglinow, 1990). In addition, a woman CEO may be particularly sensitive to the repercussions of placing a woman in a line position, since poor performance in such a position could reinforce negative stereotypes about women as managers (Duguid *et al.*, 2012). Thus, if negative spillovers arise due to avoidance behavior by women, the particularly large negative spillover from a woman CEO on other top management positions in the same firm should be especially large on line officer positions:

*Hypothesis 2B: The negative association between the presence of a woman chief executive officer in a firm and the presence of a woman in another top management position will be especially strong for line positions.*

**Professional positions and the enactment of social norms:** Line positions like the chief operating officer or the head of a subsidiary generally have profit and loss responsibility and in many cases act like CEOs for the parts of the firms they run. In contrast, professional positions like chief accounting officer or head of human resources, while undoubtedly important, have more of an ancillary, supporting role. Placing a woman manager in a senior line position to comply with the aspirational norm of gender equity in top management could accordingly be – or be perceived by male managers to be – more disruptive to the operations of the firm than placing a woman in a senior professional position. As noted above, line positions are a more frequent stepping stone to the CEO position than are professional positions and would therefore be of higher status to ambitious male managers as individuals and in the collective enforcement of the male

majority's dominant social position. Thus, male managers could be expected to be more willing to tolerate the presence of women in professional positions than in line positions for the purpose of enacting gender-related norms in top management, whereas the presence of women in line positions is more likely to be the result of merit-based promotions. These arguments suggest that if the enactment of gender-related social norms by men is an important mechanism in the generation of negative spillovers, we would see particularly strong negative spillovers associated with professional positions.

As a result, we expect that if there is a woman in a senior professional position, it would be especially likely that she was promoted to that position because there would otherwise not have been another woman (or enough other women) in other positions on the firm's top management team. In other words, the presence of a woman in a senior professional position may imply the absence of a woman in another top management position. Formally, we have:

*Hypothesis 3A: The presence of a woman in a senior professional position in a firm will have a particularly strong negative association with the presence of a woman in another top management position in that firm.*

Likewise, if a firm has a woman in any given senior position, then there would be less need to place another woman on the top management team to comply with the aspirational norm of gender equity in senior management. The resulting shift in organizational focus away from hiring a woman for this motivation would disproportionately affect professional positions vis-à-vis line positions and the CEO position, given the greater latitude firms have to place women in professional positions for the purpose of complying with gender norms. We thus have:

*Hypothesis 3B: The presence of a woman in a top management position in a firm will have a particularly strong negative association with the presence of a woman in a senior professional position in that firm.*

### 3. EMPIRICAL ANALYSIS

#### Data

In general, U.S. public companies are required to report information on the CEO and four other most highly-paid managers. We use Standard & Poor's ExecuComp, which provides data on these executives for the S&P 1,500 firms, a widely used index of public companies designed to reflect the broad U.S. equity market (Standard & Poor's, 2010). Following previous research (c.f. Dezso & Ross, 2012), we take the managers reported in ExecuComp to be a firm's top management team. The size of the top management teams reported in ExecuComp is in line with studies in the upper echelons literature, which typically report the "inner circle" of top management to number between three and seven people (Carpenter & Sanders, 2002). The sample period is 1992 to 2011, inclusive.

ExecuComp contains, inter alia, the gender and job title of the executives in our sample, but job title is missing for 67% of the managers in the ExecuComp database in one or more years, or for about 22% of the total number of observations. We accordingly supplemented ExecuComp using BoardEx, which provides detailed career histories for board members of U.S. public companies, many of which are executives in other firms. To obtain accurate matches between the two datasets, we first identified companies in both datasets using three common identifiers, Central Index Key, CUSIP, and ticker symbol. We then matched individuals within each firm by full name (including suffixes such as Jr. and Sr.) and year of birth where available. Due to differences in spelling, inconsistent use of middle names and nicknames (e.g., Bob, Bill, Ben, etc.), we conducted a second round of matching on last name and first name initials only. These matches were then manually validated by comparing years of entry and exit into each firm and with extensive web queries. After the matching procedure, the number of managers with any missing titles for any year was reduced to 43%.

ExecuComp contains a field indicating whether a given executive is male or female. However, inspection of the data revealed that approximately 100 women managers were improperly coded as male

because the managers in question had the female honorific “Ms.” and obviously female first names. (The number of men improperly coded as female appeared to be much lower.) We accordingly coded a manager as a woman if either ExecuComp coded the manager as a woman or the manager had the honorific “Ms”. (Our results do not qualitatively change if we use ExecuComp’s gender coding as is.)

We used S&P’s CompuStat database as our source of financial information about the firms in our sample. CompuStat collects financial information from firms’ public filings. We use the Center for Research in Securities Prices (CRSP) as our source of firms’ initial public trading date. CRSP provides stock trading information for firms whose shares trade on the NYSE, AMEX, and NASDAQ exchanges.

### **Variable Definitions**

Throughout we use the subscript  $t-1$  to refer to lagged values and the Greek letter  $\Delta$  to refer to the change in a variable from year  $t-1$  to year  $t$ .

**Dependent variable:** We define the dummy variable *Female*, which takes the value 1 if a given top management position in a given firm in a given year is occupied by a woman (with gender determined as described above). This variable serves as the equivalent of a dependent variable in our estimation methodology, as described below.

**Job categories:** We classify top management team positions into categories by extending the taxonomy of Helfat *et al.* (2006) and defining dummy variables representing category membership as follows. *Chief executive officer*, the highest ranking position in a firm, is coded using the CEO flag field in ExecuComp. For over 99% of the firm-years in our sample, ExecuComp identifies one and only one CEO. *Line officer* includes senior managers with responsibility for running revenue generating operations; these include a second in command after the CEO like the President or COO (Hambrick & Cannella, 2004) and the head of a division or subsidiary. *Professional* denotes a manager with responsibility for a support area; examples include the chief accounting officer, chief administrative officer, chief compliance officer, chief financial officer, chief marketing officer, chief technology officer, and general counsel, as well as the head of human



resources or research and development. *Ex CEO* is a small category for managers who served as CEO and subsequently shifted to an advisory capacity. All other managers are classified as *Miscellaneous* (the omitted category in all statistical analyses); these managers' titles are either missing or do not indicate the nature of the manager's job (e.g., EVP). Some managers have multiple titles that span categories; the most common example is a CEO who is also COO or President, which would mean that the CEO is not only responsible for strategy formulation and representation of the firm to external constituencies but is also responsible for strategy implementation and oversight of operations. To resolve these instances, we establish a hierarchy of *Chief executive officer* > *Line officer* > *Professional*, and code a manager as belonging to the highest category for which that manager has an appropriate title.<sup>2</sup> It is obvious that *Chief executive officer* outranks other categories. We rank *Line officer* above *Professional* because, as noted above, line officers have profit and loss responsibility and are more apt to become CEO. Further justification for this hierarchy is reflected in compensation data; if we rank each manager in terms of salary and bonus from lowest to highest, the mean ranks are 1.32, 3.36, and 3.89 for *Chief executive officer*, *Line officer*, and *Professional*, respectively. (*Ex CEO* has a mean rank of 2.96.)

**Female representation in other positions:** One natural but econometrically problematic way to test for gender spillovers among top management team positions is as follows: In respect of each top management position in a given firm in a given year, define a measure of the count or frequency of women managers in the rest of that top management team. Then, include this variable as the independent variable of interest in a regression with *Female* as the dependent variable. To illustrate why this approach is problematic, we present regressions with such a measure later. Specifically, for each observation of a given top management position in a given firm in a given year, we define the dummy variable, *Other woman*, which

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<sup>2</sup> About 71% of *Chief executive officer*-years in our data have titles that would otherwise have resulted in the CEO being classified as *Line officer* or *Professional*, and about 28% of the *Line officer*-years in our data have titles that would otherwise have resulted in the manager being classified as *Professional*.

takes the value 1 (0) if any (none) of the other managers reported in ExecuComp for the same firm in the same year is also a woman.<sup>3</sup>

**Other control variables:** We use a number of control variables, many of which have been linked theoretically in the literature to female representation in top management. *Advertising intensity*<sub>*t-1*</sub>, a log transform of the ratio of advertising expense to assets, encodes firms' orientation towards B2C (Business to Customer) sales; a number of authors have argued that women managers are particularly important if a firm is focused on selling to consumers since women understand women consumers better (See, for example, Hillman *et al.*, 2007: 944, and the references therein). Research dating at least back to Stinchcombe (1965, ch.10) argues that societal norms at the time of a firm's founding persist over time and affect organizational characteristics. We proxy for the impact of this process with *Firm age*, a log transform of the firm's age in years measured as the difference between the current year and the earlier of the firm's first year in CompuStat or CRSP. *Leverage*<sub>*t-1*</sub>, the ratio of debt to the market value of a firm's assets, captures the possibility that women's lower average preference for risk (Carman & Langeard, 1980) may affect a firm's propensity to hire women to senior positions. The *Number of executives* reported by the firm in ExecuComp controls for the possibility that the number of managers a firm chooses to report in its public filings is endogenously related to the gender composition of its top management team. *Number of women*<sub>*t-1*</sub>, i.e., the subset of *Number of executives*<sub>*t-1*</sub> who are female, dynamically controls for persistence in female representation in a firm across time. Dezsó & Ross (2012) find that innovation intensity makes female participation in top management more valuable. Thus, we control for the ratio of R&D expense to assets with the variable *R&D intensity*<sub>*t-1*</sub>. *Tobin's q*<sub>*t-1*</sub>, a log transform of the ratio of the market value of a firm's assets to their replacement value, controls for a possible relationship between firm performance and the presence of women in the top management team. To wit, the scarcity of senior women managers may

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<sup>3</sup> Other reasonable definitions of *Other woman* produce qualitatively similar results and are econometrically problematic for the same reasons, as we explain below.

allow them to self-select into more successful firms (Farrell & Hersch, 2005), and more successful firms may be more prone to respond to institutional pressure to hire women (Meyer & Rowan, 1977).  $Size - assets_{t-1}$ , a log transform of the book value of a firm's assets, and  $Size - employees_{t-1}$ , a log transform of the size of a firm's workforce, provide two proxies for the possibility that women may be less interested in workplace environments characterized by steep promotion tournaments (Matsa & Miller, 2011; Niederle & Vesterlund, 2007). We also include (untabulated) year fixed effects to control for the time trends in Figure 1. We consider  $\Delta Number\ of\ women$  as a possible dependent variable, as described below. Table 1 reports summary statistics and correlations.<sup>4</sup>

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Insert Table 1 about here

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### Estimation Challenges

We face a number of econometric challenges in testing the paper's research question. First, we have explicitly theorized the existence of simultaneity in the sense that the probability that a given top management team position in a given firm in a given year is filled by a woman is affected by whether another top management team position in that same firm is filled by a woman, and vice-versa. Second, our data are not a proper panel because the jobs comprising a firm's top management team change from year to year. Third, some managers change job categories from year to year, both in reality and because their job title description changes in precision, allowing us to code them precisely in some years but only as *Miscellaneous* in other years. Fourth, we have persistence in the sense that having a woman on a top management team in a given year makes it more likely she will be on that team in subsequent years, although not necessarily in the same position. Fifth, it is almost certainly true that unobservable

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<sup>4</sup> If R&D expense or advertising expense is not material, a firm is not required to disclose it as a separate line item. Accordingly, if one of these items is not separately disclosed, we impute the value of zero to it in the calculation of *Advertising intensity* and *R&D intensity*.

heterogeneity at the firm-level influences the propensity for top management positions to be filled by a woman. Sixth, female representation on a top management team is bounded both at the individual level (*Female* is either 0 or 1) and at the team level, since a firm cannot have fewer than 0 women on its top management team or more women than there are members. Seventh, *Other woman* (or any similar measure) is mechanically related to *Female* by construction. To our knowledge, there is no existing methodology that successfully addresses all these issues. We now discuss how some of these challenges create problems if we use standard estimation methodologies.

**Regression analysis at the position level:** Consider a standard OLS regression with *Female* as the dependent variable and *Other woman* as the independent variable of interest, as depicted in Table 2, Model 1. (Table 2 uses linear regression to make interpretation easier; discrete choice models yield qualitatively the same results.) The positive coefficient on *Other woman* seems to indicate that the probability of having a woman in a given top management position is positively affected by having a woman in another top management team position in the same firm in the same year. But this inference is unwarranted because of unobservable firm-level heterogeneity, which would make some firms more likely to have woman managers, both as a result of internal factors like culture and human resources policies and external factors that affected the supply of women managers. Absent a control for these factors, *Other woman* may act as a proxy for them, thereby serving as a measure of the probability that the top management team has a woman in any position in a given year, which would be positively correlated with *Female*. Under this scenario, the coefficient on *Other woman* suffers from a positive omitted variable bias.

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Insert Table 2 about here

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Two straightforward ways of controlling for this are to include *Number of women*<sub>*t*-1</sub>, which controls for the propensity of a firm to have a woman senior manager in a dynamic sense, and firm fixed effects,

which control for the time invariant propensity of a firm to have a woman senior manager. Models 2, 3, and 4 add *Number of women*<sub>*t-1*</sub>, firm fixed effects, or both, respectively. In each regression, *Other woman* is negative and highly statistically significant, as if to indicate that the probability of having a woman in a given top management position is negatively affected by having a woman in another top management team position in the same firm in the same year. However, this inference, although consistent with the results we report later, is not warranted, because of the relationship between *Other woman* (or any similar measure) and the group mean of *Female*, which induces a mechanical negative bias akin to mean reversion in a standard regression model when a lagged value of the dependent variable is included as an independent variable. The bias disappears as the number of observations used to calculate the mean of the dependent variable grows large with respect to each group of observations. In Model 1, the group is effectively the entire dataset, so the negative bias is vanishingly small. In the fixed effects regressions, each group of observations corresponds to a firm, so the negative bias is potentially much larger. The lagged value of the dependent variable, or a function of it like *Number of women*<sub>*t-1*</sub>, has a similar effect. To see why, consider a firm for which *Number of women*<sub>*t-1*</sub> equals 1. Because of persistence, i.e., because managers tend to have multi-year tenures on their top management teams, there is likely to be only one woman in year *t*, too, making the combination of *Number of women*<sub>*t-1*</sub> and *Other woman* a negative determinant of *Female* in year *t* without any actual gender-related spillovers among top management positions.

In addition, because for a given observation, *Other woman* is a contemporaneous function of the dependent variable *Female* in other observations, all the regressions in Table 2 suffer from a simultaneity bias of unknown magnitude and direction that does not disappear asymptotically.

**Analysis of changes at team level:** Another potential regression approach would be to use changes at the team level. For instance, we could run the ordinal logit regression in Table 2, Model 5, where the dependent variable is  $\Delta$  *Number of women*, and we focus on the sign and significance of *Number of women*<sub>*t-1*</sub>. If there are positive spillovers, having a woman on the top management team should make

further increases in *Number of women* more likely, whereas negative spillovers should make further increases less likely. The negative and highly statistically significant coefficient on *Number of Women*<sub>*t-1*</sub> suggests a strong negative influence of this variable on further increases; we confirm this by examining the (untabulated) marginal effects of *Number of women*<sub>*t-1*</sub>, which are -0.066 vis-à-vis the outcome +1 woman and 0.046 vis-à-vis the outcome -1 woman, in each case highly statistically significant. These values are consistent with negative spillovers. Again, however, making such an inference is unwarranted because the coefficient on *Number of women*<sub>*t-1*</sub> is biased downward. To see why, imagine that a 5-person top management team has no woman in year *t-1*. The only changes possible are positive and could be as large as +5 in principle. Conversely, if that top management team has exactly one woman in year *t-1*, it is now possible to have a negative change and positive changes are limited to +4. The downward bias is a mechanical function of the implicit bound on the size of each firm's top management team.

### **Our Approach**

There is, to our knowledge, no existing regression technique that addresses these issues, including newer techniques from the field of spatial autoregression, which can address simultaneity bias but not many of the other challenges listed above, most notably the mechanical bias in using a measure like *Other woman* as an independent variable. One option would be to attempt to design a bespoke regression estimator. Even if possible, this would likely require making many potentially debatable identifying assumptions. So, we have adopted an alternative approach, which we believe is intuitive and would be straightforward to adapt to other similar research questions. While it is certainly possible that other studies in the social sciences have adopted a similar approach, we have not found another instance in the literature.

The basic idea is as follows. We know what percentage of top management positions are filled by women in our data. We could randomly assign this number of women to top management positions and then compare the resulting simulated top management teams to the top management teams we actually observe with regard to gender distribution. If the gender distributions of the simulated top management

teams matched the actual teams we observe, we would conclude that women are randomly distributed in reality. If women were more dispersed among firms in the simulated data than in the actual data, we would conclude that there is something drawing women together in reality; and if the women were more clustered in the simulated data than in the actual data, we would conclude that there is something pushing women apart in reality. Our actual procedure builds on this idea but exploits the richness of the data by first conditioning on the large number of empirical determinants, both observable and unobservable, that a given top management position in a given firm in a given year is filled by a woman. We can thereby generate much better predictions than random assignment.

Roughly 43% of our observations are accounted for by firms that never have a woman on their top management teams in the sample period. For these firms, we impute a value of zero to the probability of having a woman occupy any given position. Note that this biases our results against finding negative spillovers, because, in reality, the *ex ante* probability that a woman would have occupied a senior management position in one of these firms in any given year is perforce larger than zero. For the remaining observations, we proceed as follows.

The first step is to run the following conditional logit regression:

$$\begin{aligned}
 y_{ijt}^* &= \alpha + \beta_C C_{ijt} + \beta_X X_{jt} + \varphi_t + \xi_j + \varepsilon_{ijt} \\
 Female_{ijt} &= \begin{cases} 1 & y_{ijt}^* > 0 \\ 0 & \text{otherwise} \end{cases} \quad (1)
 \end{aligned}$$

where  $y_{ijt}^*$  is a latent variable representing the underlying propensity for top management position  $i$  in firm  $j$  in year  $t$  to be filled by a woman,  $\alpha$  is a constant,  $C_{ijt}$  is a vector of job category indicator variables,  $X_{jt}$  is a vector of firm level controls,  $\varphi_t$  is a year fixed effect,  $\xi_j$  is a firm fixed effect, and  $\varepsilon_{ijt}$  has the standard logistic distribution. Because we have far too many firms to estimate the firm fixed effects directly, we condition on the sum of *Female* across each firm to generate estimates of  $\alpha, \beta_C, \beta_X, \varphi_t$ .

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Insert Table 3 about here

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The first column of Table 3 reports the estimated coefficients and the second column reports marginal effects (which, following a standard protocol, are unconditioned on the group effects). The results closely match those in Table 2. Women are more likely to be in professional positions and less likely to be line positions. Women are especially unlikely to be CEO, and even less likely to be a former CEO kept on the top management team in an advisory capacity. *Number of executives* is not significant, suggesting that firms do not increase the size of their reported top management teams simply to create the impression of greater gender equity. *Number of women<sub>t-1</sub>* is positive and highly significant, reflecting the fact that individual managers tend to spend several consecutive years on a firm's top management team. *Size – employees<sub>t-1</sub>* is negative and significant; the size of a firm's workforce may proxy for the number of layers of bureaucracy, which may itself be associated with a competitive tournament atmosphere or other social processes to which women are differentially averse. *Firm age* is negative and significant, perhaps reflecting organizational imprinting of social norms from an era when women were not as active in the professional workforce. Firm performance, as measured by *Tobin's q<sub>t-1</sub>*, is positive and significant, consistent with the twin propositions that female representation in top management both engenders and is engendered by good organizational performance. None of the other variables are significant, including *Advertising intensity<sub>t-1</sub>* and *R&D intensity<sub>t-1</sub>*, intriguing non-findings given that these two variables proxy for what are viewed in the literature as potentially important benefits of female representation in top management.

The next step is to use the estimated coefficients in Table 3 to calculate an offset with respect to each individual observation equal to the unconditional linear prediction for that observation. We then run separate logit regressions for each group where *Female* is again the dependent variable and the



independent variables are the offset, whose coefficient is set to 1, and a constant, which identifies the firm fixed effect. Formally, we have the following where “ $\hat{\cdot}$ ” represents an estimated value.

$$\text{logit} \left\{ \Pr \left( Female_{ijt} = 1 \mid C_{ijt}, X_{jt}, \varphi_t, \xi_j \right) \right\} = \underbrace{\hat{\alpha} + \hat{\beta}_C C_{ijt} + \hat{\beta}_X X_{jt} + \hat{\varphi}_t}_{\text{offset}_{ijt}} + \xi_j \quad (2)$$

We use the predicted probabilities from these group-by-group regressions in our 100 simulations. In each simulation, we draw a random number from a uniform distribution on [0,1] in respect of each observation. If the random number is less than the predicted probability that *Female* equals 1 for that observation, we impute a value of 1 to *Female* for that observation. In this way, we generate 100 simulated populations of senior managers across the sample.

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Insert Figure 2 about here

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The results of these simulations are depicted graphically in Figure 2, which is a bar chart showing the distribution of women by firm-year. The dark bars represent the actual data, and the clear bars represent the median of the simulations. The small black rectangles on top of the clear bars represent min-max ranges from the simulations. The main result of the paper is apparent from this figure: The actual data has too many singletons and not enough zeroes or multiple women vis-à-vis the simulations. Women are “overdispersed” in the actual data. More formally, controlling for a host of observable and unobservable factors, the presence of a woman on a top management team lowers the probability of another top management position in the same firm in the same year being occupied by a woman. Thus, Hypothesis 1A is rejected and Hypothesis 1B is supported. This impression is confirmed by comparing the first and second moments of the actual and predicted distribution of women by firm-year in Table 4. The mean number of women per firm-year is 0.35 in the actual data, and the simulations match this almost exactly in every

iteration. However, the variance of the number of women per firm-year is only 0.42 in the actual data, versus a range of 0.60 to 0.64 in the simulated data.

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Insert Table 4 about here

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In regression analyses, one is primarily focused on the size and significance of the marginal effects (which are the same as the coefficients in a linear regression). We can calculate an equivalent to a marginal effect here by comparing the expected average number of women on a top management team in the actual and simulated data, conditional on the team having at least one woman. We subtract one from these averages, because a woman manager cannot have a spillover effect on herself. Thus, we are calculating the number of *additional* women a top management team has, conditional on having a woman. As shown in the upper part of Table 5, if there is at least one woman on a top management team, there are 0.277 additional women on average in the actual data and 0.570 additional women on average using the medians in Figure 2, implying a marginal effect from negative spillovers of  $0.277/0.570 - 1$  or over -51%. (The max and min of these figures are very close, as is obvious from Figure 2.)

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Insert Table 5 about here

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To test Hypotheses 2A-3B, we extend this analysis of conditional averages to the category level in the bottom panels of Table 5. The small absolute size of the within-category conditional means reflects the fact that the remaining positions on a top management team are less likely to be in the same category as the focal position; for example, the 0.117 figure in the bottom right of the top part of the table represents the *additional* number of women professionals we would expect to see, conditional on a firm having at least one woman professional, and we have, by construction, excluded one professional position from the

consideration set because it is the position on which we are conditioning. The relatively high expectations conditional on having a woman CEO reflect the intuitive fact that women CEOs are more often found in companies that, for observable and unobservable reasons, tend to have more women in general. However, our interest is in the marginal effects derived from taking the ratio of the actual and predicted values.

We see that the greatest marginal effects are all associated with the professional position: (a) having a woman in any given particular job category has a greater negative marginal effect on the probability that a woman will serve in a professional position than on any other job category; and (b) having a woman professional has a greater negative marginal effect on having a woman in each of the three job categories than does having a woman line officer or CEO. These results appear quite robust. As shown in the bottom two panels of Table 5, the professional position is associated with the greatest marginal effects in every simulation except for one where the line officer position has the greatest negative marginal effect on the CEO position. Thus, Hypotheses 3A and 3B are strongly supported.

Conversely, Hypotheses 2A and 2B are not supported at all. In fact, the relative magnitudes of the marginal effects are precisely the opposite of what these hypotheses would suggest. Woman CEOs have the smallest negative spillover on each of the other two job categories and a smaller negative spillover on women line officers than on professionals. These results are not only consistent with an absence of avoidance behavior by women but are also consistent with women's behavior toward each other creating a positive spillover, albeit one that is not strong enough to fully overcome the negative spillover generated by the enactment of gender-related social norms by men.

## **5. DISCUSSION**

The foregoing results indicate that the probability a given position in a given top management team in a given year is filled by a woman is lower if another position in the same firm in the same year is filled by a woman. An implication is that women are overdispersed across top management teams, relative to what a

random allocation would produce, once other observable and unobservable factors influencing the propensity of a woman to occupy a given top management position are controlled for. We also found that the greatest negative spillovers are associated with professional positions and the weakest with the CEO position. We believe these results are consistent with the enactment of social norms by men, who may be particularly willing to use relatively low-status professional positions to achieve a token level of female representation in top management. Conversely, we believe these results are not at all consistent with avoidance behavior by women. If this were an important mechanism driving our results, we would expect to see particularly large negative spillovers from the CEO position, because a woman CEO would have the greatest power to frustrate the ambitions of other women to ascend the managerial hierarchy in her firm and a particular incentive to do so in respect of senior line positions. In fact, we observe the smallest negative spillovers from the CEO position, and they are at their very smallest with respect to line positions. Thus, there is a possibility that women may, on balance, tend to help each other but not quite enough to overcome the negative spillover generated by the enactment of gender-related social norms by men.

As we explained above, conventional regression methodologies for addressing our research question are seriously flawed. In response, we developed a simulation technique whereby we used a discrete choice model to predict the probability that a given top management team position in a given firm in a given year would be filled by a woman. This model included a large number of controls for persistence, observable factors related to firm performance and strategy, and unobservable factors related to firms and years. We used the predicted probabilities derived from this model to simulate what the gender distribution of women managers across top management teams would look like in the absence of gender-related spillovers. We compared our simulations with the actual data using standard sample statistics and generated the equivalent of marginal effects using conditional expectations. While we are not prepared to assert that a similar approach has never been used in any other study, we have not come across another

instance. It would not be difficult to adapt our approach to study other important strategic questions. We accordingly believe that our estimation approach is an important contribution of this paper.

It is interesting to contrast the results we obtain with other work that suggests that women are able to help each other in a corporate setting. For instance, female managers have been related to other gender-related organizational outcomes such as wages. Based on a small sample of Swedish employees Hultin and Szulkin (1999) find that in 1991, women who worked in establishments with more female managers received higher wages. Cardoso and Winter-Ebmer (2010) investigate the effect of female CEOs on the wage policies of all Portuguese private firms over the period 1987-2000. They find that female CEOs pay their female employees higher wages than do male CEOs, and that the gender wage gap is 1.5% lower in female-led firms. Similarly, some large-sample studies find that women with influence over the hiring process may reduce workplace gender segregation at non-managerial levels (Huffman *et al.*, 2010), or increase participation by women at lower levels (Kalev *et al.*, 2006). It is possible that the effects we observe in our data are largely confined to the same or nearby levels within a managerial hierarchy. It is also possible that the spillover effects of female participation in management may depend on the level in the managerial hierarchy. For instance, Cohen *et al.* (1998) use data from the California savings and loan industry and find that the proportion of women at a focal level in a firm is positively associated with the probability that a hire is a woman at that level. There are some important differences between that study and this one, notably their focus on hires rather than on the ongoing presence of women, which includes the effects of departures. Perhaps, the most important difference is that their results appear to be primarily driven by mid-level hires and promotions, whereas our study, by design, focused solely on firms' top management teams. Men's willingness to work towards – or at least not interfere with – the betterment of women within their organizations may be lower in the upper managerial echelons, where each job is so valuable both to the individual who holds it and to the dominant male coalition inside the organization.

Closer in spirit to our investigation, Bilimoria (2006) and Matsa and Miller (2011) find that, in the largest U.S. corporations, the share of female board members is positively associated with the share of female senior managers. It is notable, however, that for boards of directors, which are mostly outsider dominated, some of the mechanisms posited in this study work in the opposite direction: board members have little reason to feel their position threatened by the appointment of female top managers and, being representatives of various stakeholders, might regard it as part of their remit to push the organization to fulfill societal norms related to female representation in management. Hence, male board members would not be expected to resist efforts by their female colleagues to advance women's interests within the firm with the same vigor as, perhaps, senior male executives might resist the efforts of their female colleagues.

We also think that the marginal effects of the control variables in our simulation regression are interesting (Table 3). For example, the positive marginal effect of the lagged value of Tobin's  $q$  is consistent with arguments that firm performance and female representation in top management are positively reinforcing. Dezsó and Ross (2012) find that innovation intensity as measured by R&D expenditures makes female participation in top management more valuable, but this variable does not predict that a woman will occupy a given top management position. A number of authors have argued that women managers are particularly important if a firm is focused on selling to consumers, because women understand women consumers better; our measure of advertising intensity proxies for the importance of consumers to a firm's business, but has no explanatory power. The lack of explanatory power of these various variables may be a result of the fact that we control rigorously for firm-level heterogeneity. Older firms are less likely to have top women managers, suggesting that firms are to some degree imprinted, as it were, with the gender norms of their founding eras. Firms with larger workforces are less likely to have top women managers, reflecting some of the social mechanisms that act as barriers to women; for example, many layers of bureaucracy create more of a competitive tournament atmosphere, to which women may be differentially averse. It is also interesting that the job category in which women are most rarely found is not CEO – as

one might expect – but that of a former CEO retained in an advisory capacity. Further work on this phenomenon is warranted.

We believe that our results offer many opportunities for future research. Some research suggests that at least part of the reason that women have not made larger inroads into top management stems from different preferences. For instance, relative to men, women may have an aversion to competing for promotions (Niederle & Vesterlund, 2007) or be less interested in achievement and power (Adams & Funk, 2012). These differential preferences, however, could be related to, and even caused by, the enactment of gender-related social norms by men. In addition, we note that our research design does not allow us to observe the behavior of the managers we study or directly measure their attitudes. We thus view our work as complementary to the large body of anthropological and social psychology work that studies gender issues in management.

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**Table 1 – Descriptive statistics and correlations**

	Mean	Std. Dev.	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15
1. <i>Advertising intensity<sub>t-1</sub></i>	0.00	0.01															
2. <i>Chief executive officer</i>	0.16	0.37	0.00														
3. $\Delta$ <i>Number of Women</i>	0.03	0.37	0.01	-0.02													
4. <i>Ex CEO</i>	0.02	0.13	0.01	-0.06	0.00												
5. <i>Female</i>	0.06	0.24	0.01	-0.08	0.13	-0.03											
6. <i>Firm Age</i>	2.72	0.98	-0.01	0.00	0.01	0.01	-0.03										
7. <i>Leverage<sub>t-1</sub></i>	0.16	0.15	-0.04	0.00	0.00	0.00	-0.02	0.13									
8. <i>Line officer</i>	0.28	0.45	0.01	-0.27	-0.01	-0.08	-0.03	0.02	0.00								
9. <i>Other woman</i>	0.25	0.43	0.01	0.02	0.29	0.01	0.08	-0.04	-0.02	0.00							
10. <i>Number of executives</i>	6.26	1.42	-0.01	-0.08	0.16	0.03	0.00	0.11	0.05	0.01	0.13						
11. <i>Number of women<sub>t-1</sub></i>	0.34	0.65	0.01	0.00	-0.22	0.00	0.38	-0.05	-0.03	0.00	0.70	0.06					
12. <i>Professional</i>	0.34	0.47	0.00	-0.32	0.00	-0.10	0.10	-0.03	0.00	-0.45	0.02	-0.07	0.05				
13. <i>R&amp;D intensity<sub>t-1</sub></i>	0.00	0.02	0.10	0.00	0.01	0.00	0.00	-0.03	-0.10	0.00	0.00	-0.01	-0.01	0.01			
14. <i>Size – assets<sub>t-1</sub></i>	0.99	2.59	0.26	0.01	0.01	0.00	0.00	0.03	0.03	0.01	-0.01	-0.03	-0.01	0.01	0.32		
15. <i>Size – employees<sub>t-1</sub></i>	1.93	1.28	0.03	0.00	0.01	0.02	0.00	0.31	0.12	0.05	0.01	0.16	0.01	-0.05	-0.08	0.04	
16. <i>Tobin's q<sub>t-1</sub></i>	1.00	0.37	0.05	0.00	0.02	0.00	0.01	-0.19	-0.50	0.00	0.02	-0.02	0.01	0.00	0.14	-0.04	-0.12

**Table 2 – Preliminary analysis of gender spillovers among top management positions**

Dependent Variable	Linear Probability				Ordinal Logit
	Female				$\Delta$ Number of women
	1	2	3	4	5
<i>Other woman</i>	3.74*** (0.47)	-20.31*** (0.58)	-15.50*** (0.62)	-27.70*** (0.64)	
<i>Chief executive officer</i>	-4.93*** (0.31)	-4.41*** (0.26)	-4.45*** (0.28)	-4.25*** (0.26)	
<i>Ex CEO</i>	-6.22*** (0.15)	-5.18*** (0.33)	-5.77*** (0.38)	-5.30*** (0.37)	
<i>Line officer</i>	-2.16*** (0.27)	-2.03*** (0.21)	-2.01*** (0.24)	-2.00*** (0.22)	
<i>Professional</i>	2.36*** (0.30)	1.65*** (0.25)	1.86*** (0.28)	1.42*** (0.25)	
<i>Advertising intensity<sub>t-1</sub></i>	11.34** (5.03)	8.41 (5.32)	-1.99 (4.71)	5.75 (5.87)	3.20*** (1.06)
<i>Firm age</i>	-0.62*** (0.87)	-0.17* (0.09)	-0.43* (0.23)	-0.34* (0.20)	-0.09*** (0.03)
<i>Leverage<sub>t-1</sub></i>	-1.87** (0.90)	-0.15 (0.53)	-2.79* (1.48)	-1.18 (1.13)	-0.23 (0.15)
<i>Number of executives</i>	0.12* (0.07)	0.28*** (0.07)	0.93*** (0.09)	1.06*** (0.08)	0.41*** (0.02)
<i>Number of women<sub>t-1</sub></i>		23.34*** (0.50)		19.95*** (0.44)	-1.31*** (0.52)
<i>R&amp;D intensity<sub>t-1</sub></i>	-4.09 (2.82)	0.48 (2.58)	0.35 (3.90)	1.60 (3.15)	0.00 (0.78)
<i>Size – assets<sub>t-1</sub></i>	-0.04* (0.02)	0.03 (0.02)	0.00 (0.03)	0.02 (0.03)	0.01 (0.01)
<i>Size – employees<sub>t-1</sub></i>	0.19 (0.11)	0.04 (0.06)	-1.29*** (0.37)	-0.74*** (0.24)	-0.02 (0.02)
<i>Tobin's q<sub>t-1</sub></i>	0.33 (0.38)	0.63*** (0.23)	-0.05 (0.51)	0.99** (0.39)	0.10 (0.06)
Firm Fixed Effects	N	N	Y	Y	N
Year Fixed Effects	Y	Y	Y	Y	Y
Observations	196,124	196,124	196,124	196,124	32,942

Standard errors are in parentheses and are clustered at the firm level. The subscript *t-1* refers to the prior year.  $\Delta$  indicates a change in value from *t-1* to *t*.

Coefficients and standard errors in Models 1-4 are expressed in percentage terms. \*, \*\*, \*\*\* Denote significance at the 10%, 5%, and 1%, levels, respectively.

**Table 3 – Simulation regression**

Dependent Variable	Conditional Logit	
	Female	
	Coefficients	Marginal Effects
Chief executive officer	-1.63*** (0.05)	-30.45*** (1.38)
Ex CEO	-2.34*** (0.18)	-43.71*** (3.68)
Line officer	-0.58*** (0.04)	-10.78*** (0.77)
Professional	0.20*** (0.03)	3.67*** (0.58)
Advertising intensity <sub>t-1</sub>	0.53 (0.89)	9.90 (16.58)
Firm age	-0.06** (0.03)	-1.04** (0.49)
Leverage <sub>t-1</sub>	-0.20 (0.15)	-3.73 (2.91)
Number of executives	0.01 (0.01)	0.12 (0.18)
Number of women <sub>t-1</sub>	0.91*** (0.02)	16.92*** (0.64)
R&D intensity <sub>t-1</sub>	0.15 (0.47)	2.77 (8.75)
Size – assets <sub>t-1</sub>	0.00 (0.00)	0.05 (0.09)
Size – employees <sub>t-1</sub>	-0.07** (0.03)	-1.40** (0.57)
Tobin's q <sub>t-1</sub>	0.14*** (0.05)	2.60*** (0.94)
Firm Fixed Effects	Y	Y
Year Fixed Effects	Y	Y
Observations	196,124	196,124

Standard errors are in parentheses. The subscript *t-1* refers to the prior year. Figures are expressed in percentage terms. Marginal effects are unconditional on the firm fixed effects. Marginal effects and their standard errors are expressed in percentage terms. 111,474 observations were used to fit model because 84,650 observations are accounted for by firms that never have a top women manager. \*, \*\*, \*\*\* Denote significance at the 10%, 5%, and 1%, levels, respectively.

**Table 4 – Distribution of women among top management teams:  
Sample statistics by firm year**

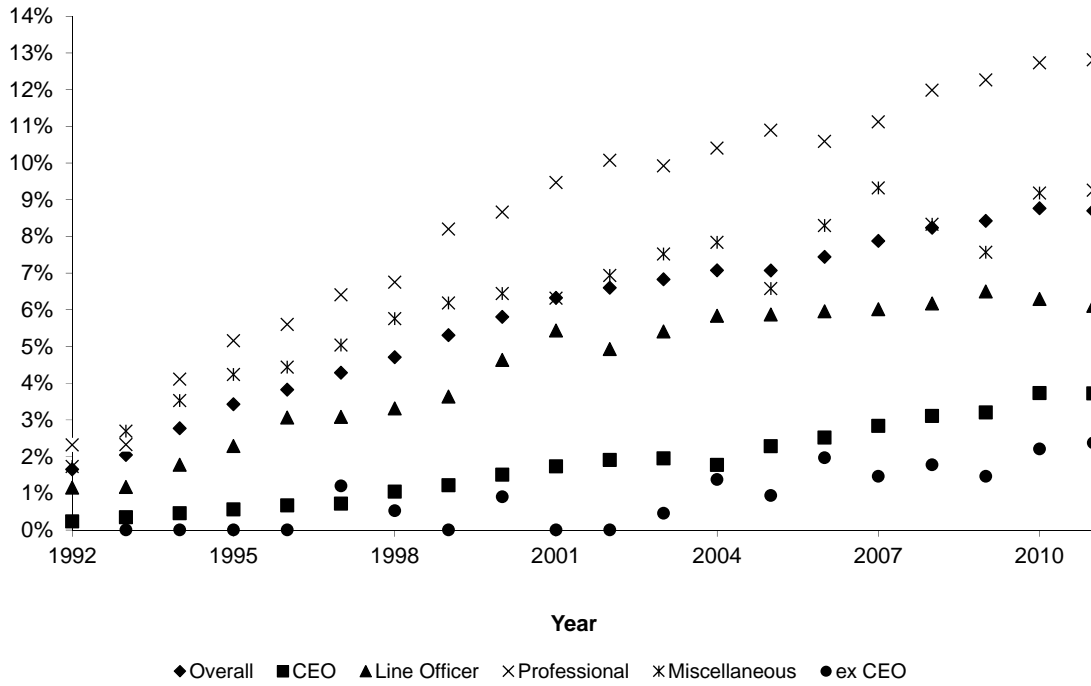
	<i>Actual</i>	<i>Predicted</i>		
		<i>Min</i>	<i>Median</i>	<i>Max</i>
Mean	0.35	0.35	0.35	0.36
Variance	0.42	0.60	0.62	0.64

**Table 5 – Conditional average of number of women on top management team**

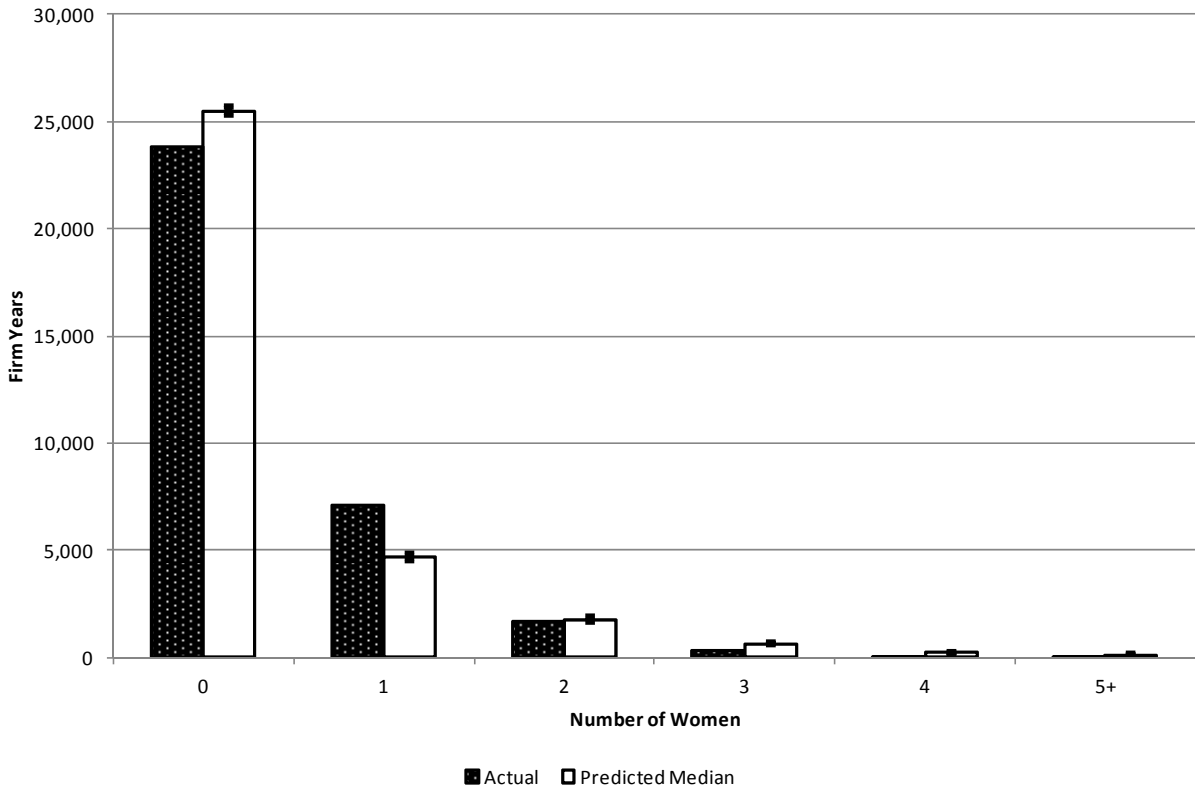
		<i>Expected number of additional women overall</i>		
Actual		0.277		
Predicted median		0.570		
% difference: Actual from predicted median		-51.37%		
<b>Focal woman's job category</b>	<i>Expected number of additional women by category</i>			
	Chief executive officer	Line officer	Professional	
		<i>Actual</i>		
Chief executive officer	–	0.251	0.439	
Line officer	0.056	0.088	0.287	
Professional	0.039	0.109	0.117	
		<i>Predicted median</i>		
Chief executive officer	–	0.374	0.816	
Line officer	0.079	0.148	0.604	
Professional	0.066	0.234	0.288	
		<i>% difference: Actual from predicted median</i>		
Chief executive officer	–	-32.82%	-46.17%	
Line officer	-28.68%	-40.38%	-52.52%	
Professional	-41.31%	-53.32%	-59.35%	
		<i>Prediction difference rankings: Row minimum (cases)</i>		
Chief executive officer	–	0	100	
Line officer	0	0	100	
Professional	0	0	100	
		<i>Prediction difference rankings: Column minimum (cases)</i>		
Chief executive officer	–	0	0	
Line officer	1	0	0	
Professional	99	100	100	



**Figure 1 – Female Participation Rates in Top Management across Time, by Job Category**



**Figure 2 – Actual and predicted distribution of women among top management teams**



Range of minimum and maximum predicted values represented by black error bars.