CEO Gender and Corporate Risk-Taking

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Abstract

We complement the literature on how managerial traits relate to corporate choices by documenting that firms run by female CEOs have lower leverage, less volatile earnings, and a higher chance of survival than otherwise similar firms run by male CEOs. Additionally, transitions from male to female CEOs (or vice-versa) are associated with economically and statistically significant reductions (increases) in corporate risk-taking. The results are robust to controlling for the endogenous matching between firms and CEOs using a variety of econometric techniques. We also discuss some theoretical mechanisms that might explain our results.

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I. Introduction

Among the *Fortune 500* companies, the number of female CEOs reached its historic high in mid-2014.[1] Despite that, with a headcount of only 24 (or 4.8% of the Fortune 500 firms), female CEOs remain an exception rather than a rule in corporate America. This "gender gap" in corporate leadership is not specific to large U.S. firms. In fact, according to a recent *Wall Street Journal* article, only 3% of the largest 145 Scandinavian companies have a female CEO.[2] Are the women who climb to the top of the corporate ladder close substitutes for male executives? Or are there any systematic differences among the firms with male CEOs and female CEOs? Furthermore, are there differences in the decisions that female CEOs make after taking the corporate reins?

In this paper, we investigate the relation between CEO gender and corporate risk-taking choices. Using a large sample of privately-held and publicly-traded European companies from the *Amadeus Top 250,000* database, 9.6% of which are run by female CEOs, we document that female CEOs tend to associate with less risky firms. In the cross-section, firms run by female CEOs are less leveraged, have less volatile earnings, and are more likely to remain in operation than firms run by male CEOs. Additionally, in the time-series, transitions from male to female CEOs (or vice-versa) are associated with an economically and statistically significant decline (increase) in corporate risk-taking.

These findings are based on evidence from three different samples that are specifically selected to mitigate different selection concerns. First, we compare firms run by female CEOs to a (propensity score) matched sample of peers run by male CEOs that are virtually

[1] http://fortune.com/2014/06/03/number-of-fortune-500-women-ceos-reaches-historic-high/
[2] Wall Street Journal, May 21, 2014, "Even Scandinavia Has a CEO Gender Gap."

indistinguishable in terms of observable characteristics. More specifically, peers are selected from the same country, industry, year, and public/private status, and then matched on a number of firm- and CEO-level characteristics. The basic propensity score results show that firms run by female CEOs take significantly less risk than otherwise similar firms run by male CEOs. Second, we employ a sample of firms experiencing a transition from male to female CEOs or vice-versa (henceforth referred to as "transition firms"). Focusing on transition firms allows us to compare the risk-taking of the same firms, as run by CEOs of different genders. Those tests indicate that CEO transitions are associated with changes in corporate risk-taking. In particular, transitions from male to female CEOs are associated with a reduction in corporate risk-taking. As the timing of CEO transitions is unlikely to be random, we supplement our analyses with a third sample. This consists of a propensity score matched sample of transition firms. In this analysis, we compare the change in risk-taking observed around transitions from male to female CEOs with the change in risk-taking of otherwise similar firms that are run by male CEOs during the entire sample period. The propensity score matching analysis of transition firms confirm a significant change in corporate risk-taking around CEO transitions, over and beyond what is observed (during the same period) among otherwise identical peers.

Three potential channels are consistent with the documented association between CEO gender and corporate risk-taking. First, low risk firms and/or firms that are already experiencing a reduction in risk-taking might also happen to hire a relatively high fraction of female CEOs. Similarly, women might disproportionately self-select into firms that have low risk and/or firms that are experiencing a decline in risk-taking. In the second potential channel, firm owners who wish to avoid high risk projects or reduce their risk-taking hire a female CEO to achieve this goal. In this scenario, CEOs who are willing or better able to manage in a low risk fashion are

matched with firms for which less risk-taking is preferable.[3] Third, while gender might not be a selection criterion in the appointment of CEOs, CEO gender may causally affect corporate risk-taking decisions and outcomes. (The observed differences in the corporate risk-taking choices of female vs. male CEOs may be the result of biological and/or environment-driven differences in personality traits or psychological attributes, such as preferences or overconfidence.)

To investigate the merit of the first channel, we study the determinants of CEO selection. More specifically, we investigate whether the level and/or the trend in risk-taking observed prior to a CEO hire predicts the likelihood that a woman will be selected as the new CEO. Consistent with the idea that women are more prone to self-select into "low risk" firms, we find that firms with low leverage are more likely to hire a female CEO. Thus, self-selection explains at least part of the cross-sectional association between gender and risk-taking. However, we find little support for the notion that firms undergoing a decline in risk-taking prior to a CEO transition are disproportionately more likely to hire a female CEO. Thus, these results make it difficult to attribute the *changes* in risk-taking observed after CEO transitions to pre-CEO-transition trends in risk-taking.

To investigate the merit of the second channel, we employ a variation of the Heckman two-step approach: the treatment effects model. This model specifically allows us to test whether CEO gender plays a role in financial and investment policies after we explicitly control for self-selection due to unobservables. Our choice of an exogenous determinant of the propensity to select a female CEO is based on the *familiarity* of a firm's male directors with female CEOs. More specifically, our first stage instrumental variable is the fraction of firms with a female CEO and above-average risk-taking among *all other firms* in which the firm's male directors also

[3] An implicit assumption of this scenario is that a firm can more easily or effectively achieve the desired level of risk-taking by replacing the CEO.

serve as directors. We argue that it is unlikely that this familiarity, combined with *above-average* risk-taking (in other firms), will be correlated with outcomes (in particular, risk-avoidance) *except* through its effect on CEO gender. The results of the treatment effects model provide little support for the notion that the differences in corporate risk-taking observed between firms run by female and male CEOs are due to self-selection.

Given the impossibility of randomly assigning CEOs to firms, it is difficult to test the merit of the third channel directly. However, the robustness of our results to a variety of endogeneity tests (firm fixed effects, CEO transitions, propensity score matching, and treatment effects models) suggests that a causal effect of CEO gender on corporate risk-taking is not implausible.

This paper contributes to the literature investigating managerial traits and experiences that influence corporate decision making. Those studies include Bertrand and Schoar (2003), Malmendier and Tate (2005, 2008), Malmendier, Tate, and Yan (2011), Benmelech and Frydman (2014), Cronqvist, Makhija, and Yonker (2012), and Cain and McKeon (2014). We add to this literature by showing that CEO gender is also an important trait associated with differences in corporate choices.

Our paper also relates to earlier studies investigating how gender diversity correlates with differences in corporate decisions or outcomes. For example, Weber and Zulehner (2010) document that start-ups with female first hires display a higher likelihood of survival. Adams and Ferreira (2009) provide evidence that CEO turnover correlates more strongly with poor performance when the *board of directors* is more gender-diverse. Ahern and Dittmar (2012) document that the introduction of mandatory board member gender quotas led to an increase in

acquisitions and performance deterioration in Norwegian publicly-traded firms.[4] More recent studies by Adams and Ragunathan (2013) and Berger, Kick, and Shaeck (2014) document that banks with more women on their boards appear to take more risk (or at least not less risk) than banks with fewer female board members.

However, there is little evidence investigating the relation between the gender of *top* corporate *insiders* and corporate choices. One exception is Huang and Kisgen (2013), who document that the propensity to make acquisitions is lower in companies with female CFOs. Their sample includes 19 female CEOs and 97 female CFOs. A second exception is a study of privately-owned (U.S.) firms by Cole (2013), who reports cross sectional evidence that female-owned firms have lower leverage than male-owned firms. We add to this literature by documenting significant differences in the risk-taking profile of firms run by male and female CEOs.

The rest of the paper is organized as follows. Section II describes the data. Section III presents the regression results. Section IV discusses the endogenous matching between firms and CEOs. Section V discusses the possible theoretical channels that could explain our results. Section VI concludes.

II. Data

The primary data source used in the paper is *Amadeus Top 250,000 (Amadeus)*, a *Bureau Van Dijk* database. From this database we gather the name of the CEO, ownership data, and accounting data for every European privately-held and publicly-traded company that satisfies a

[4] Other work focusing on gender diversity in corporate boards includes Matsa and Miller (2013) and Levi, Li, and Zhang (2010 and 2014).

minimum size threshold.[5] Disclosure requirements in Europe require private companies to publish accounting information annually. Consequently, we are able to gather accounting, ownership, and gender information for a very large set of firms. The quality of the data in *Amadeus* is discussed in detail in Faccio, Marchica, and Mura (2011). We gather the data from the annual *Amadeus* DVDs.[6] Our sample period starts in 1999 (the first year in which *Amadeus* started reporting shareholder identifiers) and ends in 2009 (the most recent year for which accounting and ownership data are available).

II.A. CEO Gender

We identify the gender of a CEO based primarily on his/her first name. Beginning in 2007, the *Amadeus* DVDs indicate the gender of the CEO. We begin by using this information to classify CEOs from 2007 forward. We also use this information to classify those same individuals in the prior years. Prior to 2007, *Amadeus* does not indicate the gender of the CEO. However, at least in some instances, the database reports a salutation. We use the salutation when it indisputably allows identifying the gender of the CEO.[7] If these methods do not conclusively identify the CEO's gender, we employ country-specific internet-based sources to classify gender based on each individual's first name.[8] Using country-specific sources is important to avoid misclassification. For example, Simone is used for women in France but for

[5] For France, Germany, Italy, Spain, and the United Kingdom, the database includes all companies that meet at least one of the following criteria: (1) revenues of at least €15m, (2) total assets of at least €30m, (3) at least 200 employees. For the other countries, the database includes all companies that meet at least one of the following criteria: (1) revenues of at least €10m, (2) total assets of at least €20m, (3) at least 150 employees.

[6] *Amadeus* removes firms from the database five years after they stop reporting financial data. These drawbacks are also discussed in Klapper, Leaven, and Rajan (2006) and Popov and Roosenboom (2009). In order to avoid potential survivorship bias, we collect data starting with the 2011 DVD and progressively move backward in time. By doing so, we drop no firms from the sample.

[7] For instance, "Mr." versus "Ms./Mrs./Miss" or "Dr." versus "Dr.ª" (more commonly used in Portugal).

[8] For instance, www.babynology.com, www.nordicnames.de, babynamesworld.parentsconnect.com, www.namepedia.org/en/firstname.

men in Italy. Finally, when we cannot identify the gender from the names lists found on the web, we use *OneSource*, *LinkedIn*, *Google,* and *Facebook* to further research the CEO and determine whether a specific name is male or female.

When we are unable to classify the gender of an individual, we drop the observation. Across all countries and all years, this procedure allows us to identify the gender of the CEO in 152,933 firms (or 394,835 firm-year observations). As shown in Table 1, 9.6% of the CEOs (or 38,003 firm-year observations) in the sample are women. By contrast, Huang and Kisgen (2013) document that only 2% of the CEOs of large publicly traded U.S. companies are women. The higher number (as well as percentage) of female executives in our sample is, at least in part, due to the inclusion of a large number of private firms in our sample. Consistent with this, our data show that the percentage of female CEOs is higher among privately-held firms (9.93%) than among publicly-traded firms (7.03%).

[Insert Table 1 here]

II.B. Risk-Taking

We consider three measures of risk-taking. The first measure, *Leverage*, is a measure of the riskiness of corporate financing choices. The intuition is simple: given a (negative) shock to a firm's underlying business conditions, the higher the leverage, the greater the (negative) impact of the shock on the firm's net profitability (including a higher probability of default).

Leverage is defined as the ratio of financial debt divided by the sum of financial debt plus equity. Financial debt is the sum of long-term debt (excluding "other non-current liabilities") and short-term loans. Across the firms in our sample, the average *Leverage* ratio is 36.3%. This ratio

is 32.2% for firms with a female CEO and 36.8% for firms with a male CEO (the p-value of the difference between the two is less than 0.001).

The other two risk-taking variables are measures of the riskiness of outcomes. The second measure, $\sigma(ROA)$, is the volatility of the firm's operating return on assets (where return on assets is defined as the ratio of earnings before interest and taxes to total assets). Volatility of returns is a standard proxy for risk in the financial economics literature. This variable captures the riskiness of investment decisions. We focus on the volatility of accounting returns (as opposed to stock market returns), as the vast majority of firms in our sample are privately-held. We calculate the standard deviation of the returns over five-year overlapping windows (1999-2003, 2000-2004, 2001-2005, 2002-2006, 2003-2007, 2004-2008 and 2005-2009).

Across all firms in the sample, the average volatility of ROA, $\sigma(ROA)$, is 4.9%. As with *Leverage*, there is a significant difference in this variable (p-value < 0.001) between firms run by female CEOs (2.9%) and firms run by male CEOs (5.1%).

The third measure, *Likelihood of survival*, exploits the notion that riskier firms are less likely to survive and focuses on the likelihood of surviving over a five-year period. For a firm to enter this analysis, we require only that CEO gender, ownership, and accounting data be available for at least one year during 1999-2005. Since firms that enter our sample in 2005 or earlier could have up to five years or more of data, we focus on these observations to assess the likelihood of survival. This specification has two main advantages. First, there is no survivorship bias, as both surviving and non-surviving companies are included in the analysis. Second, this measure of risk-taking is unaffected by accounting manipulation.

We find that 50.2% of the firms in the sample survive for at least five years. The likelihood of survival is 60.0% for firms with a female CEO and 49.0% for firms with a male CEO. The difference between female and male CEOs is once again statistically significant with a p-value of less than 0.001.

II.C. Control Variables

The models employed in our analyses include a number of firm-level control variables. *ROA* is defined as the ratio of earnings before interest and taxes to total assets. We include firm profitability to control for differences in management quality. *Sales Growth* is calculated as the annual rate of growth of sales. Since most of the firms in the sample are private, we use sales growth (rather than the market-to-book ratio) as a control variable. *Ln (Size)* is the natural log of total assets (in thousands US$), expressed in 2000 prices. ("Total assets" is the sum of fixed assets (tangible and intangible fixed assets and other fixed assets) and current assets (inventory, receivables, and other current assets).) *Ln (1+Age)* is the natural logarithm of (1 + the number of years since incorporation). This variable controls for differences in the life cycle of a firm. *Tangibility* is calculated as the ratio of fixed to total assets. *Private firm* is an indicator denoting firms that are not publicly traded. We use this variable as a proxy for capital constraints. *Cash flow rights* is the ownership rights of the largest ultimate shareholder.[9] The higher the ownership of a large shareholder, the greater the incentive to monitor the CEO. This would in turn mitigate agency conflicts. *CEO Ownership* is calculated as the cash flow rights of the CEO on the firm's earnings. Since a high level of ownership aligns the CEO's incentives with those of minority shareholders, we use CEO ownership to control for agency conflicts.

[9] To identify the largest ultimate shareholder, for each company that has available ownership data in *Amadeus*, we identify its owners, the owners of its owners, and so on.

In some of the models we also control for CEO age and CEO wealth. However, the availability of data on these additional CEO characteristics is limited. Adding these controls thus considerably reduces the sample size. For this reason, these controls are not included in all the tests. The inclusion of these controls is motivated by earlier evidence suggesting that younger CEOs (Taylor, 1975, Kovalchik, Camerer, Grether, Plott, and Allman, 2005, Forbes, 2005) and wealthier CEOs (Arrow, 1984, Paravisini, Rappoport, and Ravina, 2013, Calvet and Sodini, 2014) are more prone to take risks. Data in *Amadeus* allow us to construct a proxy for the equity wealth for a subsample of CEOs. To determine the equity wealth for each CEO, we first calculate the dollar value of the investment in each firm in which he/she appears as a shareholder. This is computed by multiplying the individual's ownership in the firm by the firm's book value of equity. (We use book values because most of the firms in the sample are privately-held). Next, we sum the value of all equity investments to obtain each CEO's total equity wealth.

To reduce the impact of outliers, we winsorize the accounting variables (other than sales growth, $\sigma(ROA)$, and leverage) at the top and bottom 1% of the distribution. Since sales growth, $\sigma(ROA)$, and leverage exhibit large positive skewness, these three variables are winsorized at the bottom 1% and at the top 5% of the distribution.

Summary information for all the variables is reported in Table 1. A comparison of the sample means for firms run by female and male CEOs reveals important differences in the characteristics of both firms and CEOs. Firms run by female CEOs tend to be older and more profitable. In contrast, firms run by male CEOs tend to be larger and grow at faster rates. The fraction of private firms is higher among those run by a female CEO. With respect to CEO characteristics, we notice that female CEOs tend to own a larger share of the equity of the firms

that they run. At the same time, these firms have a more dispersed ownership structure. Male CEOs tend to be, on average, marginally wealthier and older than female CEOs.

III. CEO Gender and Risk-Taking

To investigate the relation between CEO gender and corporate risk-taking, we start by regressing our measures of risk-taking on CEO gender and other determinants of risk-taking that, if excluded, could induce spurious correlations. The results are reported in Table 2. *Leverage* is the dependent variable in Regression (1). Regression (1) is a panel ordinary least squares (OLS) regression with standard errors clustered at the firm level. The results of Regression (1) indicate that firms run by female CEOs use significantly less leverage and therefore take less financial risk than firms run by male CEOs. The coefficient of *Female CEO* indicates that after controlling for several other determinants of capital structure choices, the leverage of firms run by female CEOs is 0.030 lower on average than the leverage of firms run by male CEOs. This appears to be a sizeable difference, given an average value of *Leverage* of 0.363 for the entire sample. The coefficient on the gender variable has a p-value of less than 0.001.

The volatility of firm-level profitability ($\sigma(ROA)$) is the dependent variable in Regression (2). We again employ a panel OLS specification with standard errors clustered at the firm level. In this Model (as well as in Regression (3)), all independent variables are measured at the first year-end of the five-year sample period over which the volatility of earnings (or the likelihood of survival) is measured. The results show that the volatility of a firm's ROA is significantly lower when the firm is run by a female CEO (p-values ≤ 0.001). As with *Leverage*, the difference in the volatility of firm-level profitability between firms run by female and male CEOs is sizeable (1.845/100=0.018) relative to the sample mean (0.049).

Regression (3) is a cross-sectional probit regression of the *Likelihood of survival*, in which the outcome is 1 if a company survives for at least five years and 0 otherwise. The results in Table 2 indicate significantly higher survival rates for companies run by female CEOs. To the extent that firms that take more risk are less likely to survive through time, this result is consistent with the notion that companies managed by women tend to engage in less risky projects.

Thus, in the cross-section, both corporate choices (such as leverage) and corporate outcomes (volatility of profitability and the likelihood of survival) vary significantly depending on the gender of the CEO.

However, the comparison of the firm and CEO characteristics tabulated in Table 1 makes the issue of non-random selection immediately apparent. To mitigate sample selection concerns in the comparison of firms run by female and male CEOs, in the remainder of Section III we analyze three different samples: (1) a propensity score matched sample; (2) a sample of firms experiencing a transition from male to female CEOs or vice-versa; and (3) a propensity score matched sample of firms undergoing a CEO transition.

III.A. Propensity Score Matched Samples

We begin our analysis of the differences in corporate risk-taking between female and male CEOs by employing a propensity score matching procedure (Rosenbaum and Rubin, 1983). This methodology allows us to identify a control sample of firms that are run by male CEOs and that exhibit no *observable* differences in characteristics relative to the firms run by female CEOs. Thus, each pair of matched firms is virtually indistinguishable from one another except for one key characteristic: the gender of the CEO. Matching on observable firm- and CEO-characteristics mitigates (but does not eliminate) concerns related to non-random selection.

To implement this methodology, we first calculate the probability (i.e., the propensity score) that a firm with given characteristics is run by a female CEO. We start by calculating this probability as a function of firm-level characteristics. More specifically, in Panel A of Table 3, the propensity score is estimated within a country-industry-year-public/private status category, as a function of ROA, sales growth, the natural log of total assets, the natural log of firm age, asset tangibility, the ownership of the CEO, and the ownership of the largest ultimate shareholder. To ensure that the firms in the control sample are sufficiently similar to the firms run by a female CEO, we require that the maximum difference between the propensity score of the firm run by a female CEO and that of its matching (male CEO run) peer does not exceed 0.1% in absolute value.

[Insert Table 3 here]

A comparison of *Leverage*, σ*(ROA),* and *Likelihood of survival* between the matched samples reveals that, firms with female CEOs tend to take less risk than firms with male CEOs even when several other observable characteristics between the firm pairs are virtually identical. As the results in Panel A of Table 3 show, the average leverage of firms run by female CEOs is 34.2%, compared with 37.4% for otherwise similar firms run by male CEOs. The average volatility of ROA is 2.44% for firms run by female CEOs and 3.97% for firms run by male CEOs. The likelihood of survival over a five-year period is 68.7% for firms run by female CEOs and 56.0% for firms run by male CEOs. All differences in risk-taking between the two groups are statistically significant with p-values of less than 0.001. Importantly, these results suggest that the gender-related differences in risk-taking observed in the univariate analysis are not due to *observable* differences in firm characteristics.

In Panel B of Table 3 we match firms within a country-industry-year-public/private status category, as a function of firm-level *and* CEO-level characteristics (namely, CEO wealth and CEO age) that are available on a more limited basis. Even with this very restrictive matching, our conclusions remain unchanged.

III.B. Transition Firms

A limitation of the propensity score matching results is that the documented correlation between CEO gender and corporate risk-taking may simply reflect *unobservable* characteristics that influence both CEO gender choice and corporate risk-taking choices. The omission of these controls might lead us to incorrectly attribute the differences in risk-taking to differences in CEO gender.

In this section, we exploit the panel dimension of our dataset to control for *time-invariant* firm-specific characteristics that may be correlated with omitted explanatory variables. For this purpose, we run (panel) regressions with firm fixed effects. The inclusion of firm fixed effects in the regression models removes any purely cross-sectional correlation between gender and risk-taking, reducing the risk of spurious correlation. In particular, in firm fixed effects regressions, we compare CEOs of different genders operating the same firm.

In this analysis, we include only firms that experience a change from a male CEO to a female CEO or vice versa, as only those firms contribute to the identification. *Leverage* is the dependent variable in Regression (1) of Table 4. Regression (1) is a panel regression with firm fixed effects and standard errors clustered at the firm level. The results indicate that firms run by female CEOs use significantly less leverage and therefore take less financial risk than firms run by male CEOs. The coefficient of *Female CEO* indicates that after controlling for several other determinants of capital structure choices, a firm's leverage is 0.024 lower, on average, when the

firm is run by a female CEO vs. when the same firm is run by a male CEO. This appears to be a sizeable difference, given an average value of *Leverage* of 0.363 for the full sample. The coefficient on the gender variable has a p-value of less than 0.001.

[Insert Table 4 here]

The volatility of firm-level profitability ($\sigma(ROA)$) is the dependent variable in Regression (2). We again employ a panel specification with firm fixed effects and standard errors clustered at the firm level. In this Model (as well as in Regression (4)), all independent variables are measured at the first year-end of the five-year sample period over which the volatility of earnings (or the likelihood of survival) is measured. The results show that the volatility of a firm's ROA is significantly lower when the firm is run by a female CEO (p-values ≤ 0.001). As with *Leverage*, the difference in the volatility of firm-level profitability between firms run by female and male CEOs is sizeable (1.587/100=0.016) relative to the sample mean (0.049).

A possible concern with the analysis of CEO transitions is that they are likely to be accompanied by changes in CEO characteristics other than gender. To the extent that these characteristics affect risk-taking and have been omitted from the previous analyses, we could have incorrectly attributed the change in risk-taking observed at the time of a transition to gender. We note that for non-gender-related CEO (or any) characteristics to explain the gender results, changes in these characteristics must (1) occur around the time of the transition (as in the firm fixed-effects specifications identification comes from time series changes); (2) be different for the subsample of firms (initially) run by male CEOs and female CEOs; and (3) credibly affect risk-taking choices.

To address this concern, we add controls for two CEO-level characteristics (CEO age and CEO wealth) that we are able to observe at least for some of the firms in our sample. Importantly, the regression results in the last two columns of Table 4 continue to show differences in risk-taking across genders after controlling for these additional CEO characteristics.[10] This mitigates the possibility that our results might be due to time-varying, CEO-specific omitted variables. Admittedly, we recognize that we cannot control for other potentially relevant CEO characteristics that might change around the time of transitions. Therefore, with this test we cannot rule out the omitted variable issue completely.

III.C. Propensity Score Matching Analysis of Transition Firms

One specific concern with the transition sample is that transitions occur at "special" times. The inclusion of firm fixed effects in the regression models is not sufficient to address this selection concern. To better address this concern, in Table 5 we present a propensity score analysis of the firms experiencing a transition from male to female CEOs.[11] To minimize the possible impact of confounding events, those firms are matched with a control group of firms that are run by male CEOs during the entire sample period. In this analysis, we match firms within a country-industry-year-public/private status category as a function of firm-level characteristics.

[Insert Table 5 here]

[10] Recall that the tests in Table 4 are built around a sample of transitions from male to female CEOs (and vice versa) rather than around shocks to CEO wealth or CEO age. As such, those tests are meant only to assess the impact of gender after controlling for these other CEO characteristics that *might* change around CEO transitions, as opposed to assessing the role of CEO wealth or age *per se*.

[11] For the subset of firms experiencing a transition from *female* to *male* CEOs, we find a significant *increase* in risk-taking after the transition. However, we do not have enough control firms (i.e., firms always run by female CEOs) from the same country-industry-year and public/private status category to undertake a propensity score analysis using the matching algorithm described above.

We find that transition firms on average experience a reduction in *Leverage* from an average of 0.403 (under a male CEO) to an average of 0.380 (under a female CEO). This change is statistically significant with a p-value of less than 0.001. By contrast, the leverage of otherwise similar firms that were always run by a male CEO does not change significantly during the same time periods. The difference between the change in leverage of the transition firms and that of the control group is statistically significant with a p-value of less than 0.001. Similar conclusions obtain when we look at the change in the volatility of firm level profitability, $\sigma(ROA)$. While we again acknowledge that CEO gender might not be randomly assigned, this result provides additional evidence of changes in corporate risk-taking around CEO transitions.

IV. Endogenous Matching Between Firms and CEOs

Our results thus far document an economically and statistically significant association between CEO gender and corporate risk-taking. The propensity score approach and the analysis of CEO transitions help mitigate omitted variables concerns. However, as we have discussed, those methodologies are not free of limitations. Importantly, the differences in risk-taking observed between firms run by male and female CEOs are not purely cross-sectional, as our time-series analysis of CEO transitions shows that transitions are associated with *changes* in corporate risk-taking. Therefore, any proposed mechanism behind the observed association between CEO gender and corporate risk-taking needs to be able to explain why risk-taking changes around CEO transitions.

CEO transitions may be associated with changes in corporate risk-taking through three channels. In the first potential channel, firms that are already undergoing a reduction in corporate risk-taking also happen to hire a relatively higher fraction of female CEOs for reasons that we

are unable to explicitly identify in our models. Similarly, women might disproportionately self-select into firms that are experiencing a decline in risk. In both cases, a correlation between CEO gender and corporate risk-taking is expected.

In the second potential channel, firms that desire a reduction in risk-taking may hire a female CEO for this purpose. In other words, CEOs who are willing to take on less risk and/or those who are better able to manage low risk projects are matched with firms for which a reduction in risk-taking is more efficient. An implicit assumption with this type of matching is that replacing the CEO enables the firm to adjust its risk-taking to the desired level more easily or effectively.

Third, gender might not be a selection criterion in the appointment of CEOs. However, gender affects CEOs' decisions due to biological or environment-driven differences in personality traits or psychological attributes (such as risk-taking preferences or overconfidence). This channel is consistent with a causal relation between CEO gender and corporate risk-taking choices.

To assess the merit of the first channel, we exploit the time series nature of our data to investigate the extent to which the trend in (or level of) corporate risk-taking prior to a CEO transition predicts the CEO selection choice. In particular, we investigate the determinants of CEO selection. We model this decision as a function of our previous control variables as well as the *level* and the *trend* in corporate risk-taking prior to the transition.[12] Because the incoming CEO cannot have affected either the level or the trend in risk-taking prior to his/her appointment, this investigation allows us to assess the extent to which the level or the trend in corporate risk-taking predicts whether a firm will hire a female CEO.

[12] In this section, transitions also include changes from one male (female) to another male (female) CEO.

For this purpose, we run probit models of CEO hiring decisions. The results are reported in Table 6. Consistent with the univariate statistics in Table 1, we find that highly profitable firms, older firms, and private firms are more likely to hire a female CEO.

[Insert Table 6 here]

More importantly for our argument, Model (1) shows that firms with relatively high pre-transition leverage are, at the margin, less likely to hire a female CEO. This result is consistent with female CEOs self-selecting into low risk firms and/or low risk firms being more likely to hire a female CEO. At the same time, we fail to find any significant association between the change in leverage prior to the CEO replacement decision and the likelihood that a woman is appointed as the new CEO. If anything, it appears that firms experiencing an *increase* in leverage prior to the CEO replacement decision are more likely (although not significantly so) to hire a female CEO.

In Model (2) we undertake a similar analysis using the volatility of firm-level profitability as a measure of risk-taking. As with model (1), we find high risk firms to be less likely to appoint a female CEO. The results, however, lack statistical significance at conventional levels. We also find that an increase in the volatility of firm-level profitability is associated with a higher likelihood that a woman is appointed as the CEO (although insignificantly so).

Overall, we do find some evidence that low leverage firms tend to be more likely to appoint a female CEO at the time of a CEO transition. Thus, we do find only some evidence that is consistent with endogenous matching explaining, at least in part, the *cross-sectional* association between CEO gender and risk-taking choices. At the same time, we find no evidence that our earlier results could be explained by self-selection of women into companies that are undergoing a decline in risk-taking and/or firms with declining risk being more likely to hire a

female CEO. Thus, it does not appear that the *changes* in risk-taking observed after CEO transitions are driven by pre-transition trends in risk-taking.

To investigate the second channel, i.e. that self-selection related to firms hiring a male or a female CEO might explain risk-taking choices), we employ a variation of the Heckman two-step approach: the treatment effects model. The first stage of this model is a binary outcome equation (specifically, a probit equation) which models the choice of hiring a male or female CEO. In the second step, we include the inverse Mills ratio (derived from the first stage) alongside an indicator variable characterizing CEO gender and our prior controls.

To facilitate identification, in the first stage we use an exogenous determinant of the likelihood that the board might appoint a female CEO. In prior work, Grinblatt and Keloharju (2001), Huberman (2001), and Seasholes and Zhu (2010), among others, document that *familiarity* appears to be important to investors in an investment setting. We borrow from these studies and build on the notion of familiarity to develop an instrument.

To proxy for familiarity, we suggest that male board members who serve on other boards with female CEOs are more familiar with working with women in executive roles. To the extent that their participation in these boards reflects an appreciation and familiarity with female executives, they might be more inclined to propose a woman for the position of CEO. With this in mind, we focus on the fraction of firms with a female CEO among all other firms in which the firm's male directors also serve as directors. More specifically, among all other firms in which the firm's male directors also serve as directors, we compute the fraction of firms with (1) a female CEO, (2) above-average leverage, (3) above-average volatility of ROA in the subsequent five years, and (4) lack of survival during the following five years. A benefit of using this fractional measure is that it does not vary based on the *number* of boards on which a director sits.

This mitigates any concern that the variable might correlate with connections through networks, which would likely not satisfy the exclusion restriction.

We recognize that this strategy is not without caveats. Thus, the evidence from these tests can only be interpreted as suggestive. However, or an omitted variable to explain our results, this variable would need to explain (1) CEO gender selection, (2) board selection, (3) *below*-average risk-taking for the firm in question and (curiously), at the same time, (4) *above*-average risk-taking among the other firms in which the firm's male directors serve (we focus on this scenario, by choice, in the construction of our instrument). Any omitted variable responsible for our main results would need to explain all of these (often opposing) outcomes, which certainly stands in contrast to a basic "law of simplicity."

In line with our prediction, we find that our proxy for familiarity is correlated with CEO gender (see Panel A of Table 7). Further, while the inverse Mills ratio is marginally significant in the second stage *Leverage* regression, it is not statistically significant in the other two second stage models in Panel B of Table 7. Importantly, in each and every second stage model, CEO gender remains statistically significant after controlling for self-selection due to unobserved firm or CEO characteristics; if anything, the magnitude of the CEO gender coefficient estimates becomes greater after controlling for self-selection.

[Insert Table 7 here]

Despite all the tests employed to address the issue of endogeneity (firm fixed effects, CEO transitions, propensity score matching, and treatment effects models), we find little evidence that the endogenous matching between firms and CEOs explains the documented association between CEO gender and corporate risk-taking. While causality represents a possible explanation for the changes in risk-taking observed *following* CEO transitions, explicitly testing

for causality remains a challenge (given the impossibility of randomly assigning CEOs to firms). However, our results suggest, at the very least, a strong *association* between female CEOs and a decline in firm risk-taking.

V. Interpretation

In this section, we discuss the role of various possible underlying mechanisms that could explain why CEO gender matters for corporate risk-taking choices. Possible economic reasons for why CEO gender could causally impact risk-taking and/or why women would match with firms experiencing a decline in risk-taking include (but are not limited to) more pronounced risk-aversion in female CEOs (compared to male peers), less overconfidence, differences in incentives structures, differences in unemployment risk, and social norms. These specific mechanisms are discussed below.

To the extent that female executives tend to be more risk-averse on average than their male peers, gender-related differences in risk aversion could explain the self-selection of female (male) CEOs into low (high) risk firms and/or firms that have experienced a decline (an increase) in risk. This idea is consistent with the theoretical model of Bandiera, Guiso, Prat and Sadun (2014), which predicts a manager's attitude toward risk to be a key driver in firm-manager matching.

Women might also choose to reduce corporate risk-taking to a level that fits their preferences once they have become CEOs. Indeed, the experimental economics and psychology literature have documented gender-related differences in preferences and risk tolerance (see

Croson and Gneezy (2009) and Bertrand (2011) for surveys).[13] However, we recognize that while it is well documented women are less risk tolerant than men *in general* (Hudgens and Fatkin (1985), Bruce and Johnson (1994), Johnson and Powell (1994), Sundén and Surette (1998) and Bernasek and Shwiff (2001)), there may not necessarily be a difference between males and females among *top executives*, given the specific and rare combination of skills needed to ascend to a high management position (Adams and Funk, 2012, Adams and Ragunathan, 2013).[14]

Our results could also be the outcome of a higher likelihood of *less overconfident* agents becoming the CEOs of low risk firms and/or firms that have experienced a decline in risk. The results are also consistent with the possibility that less overconfident agents *reduce* risk after they become CEOs. The specific notion of overconfidence employed in this context is that overconfident agents systematically underestimate risks. As a consequence, more overconfident CEOs are more likely to match with high risk firms relative to less overconfident peers. They do so not because they are seeking higher risk, but rather because their underestimate the firm's true riskiness. In the behavioral literature, women are typically found to be less overconfident than men, at least (on average) in the population. For example, Lundeberg, Fox and Punćochaŕ (1994) show that young boys tend to be more overconfident (when wrong) than young girls. Barber and Odean (2001) document that men on average trade more than women and perform worse. Huang and Kisgen (2013) document that female executives are less likely to engage in acquisitions and less likely to issue debt that male executives. They further document, that the investment and

[13] These differences could have biological roots (e.g., Bröder and Hohmann, 2003; Maestripieri, Sapienza, and Zingales (2009) could be the outcome of environmental influences (e.g., Booth and Nolen, 2012), or both (e.g., Edwards and O'Neal, 2009).

[14] The empirical evidence on this point is mixed. While Bandiera *et al.* (2014) provide survey-based evidence that Italian female managers are on average less risk tolerant than their male peers, Adams and Funk (2012) find Swedish female directors to be on average less risk-averse than male directors.

financing decisions of firms run by male executives are followed by lower announcement returns than those of firms run by female executives. They conclude that male executives appear to be more overconfident than female executives.

Differences in the structure of compensation and incentives may also explain the documented association between gender and risk-taking. In particular, low risk firms may be more likely to offer fixed pay contracts and may be more likely to attract female executives. Consistent with this type of matching, in Bandiera *et al.*'s (2014) model more risk-averse and less talented managers match with firms offering low-powered incentives -- a prediction that they confirm empirically using survey data on Italian managers combined with longitudinal data from administrative records. Using survey data from the *British Workplace Employees Relations Survey*, Manning and Saidi (2010) report fewer women in establishments that use variable (as opposed to fixed) pay.

Additionally, unemployment risk differences faced by different sets of agents may also influence their matching choice or help explaining any causal impact of gender on corporate choices. More specifically, if corporate risk-taking is positively correlated with the likelihood that a CEO loses his/her job, and if finding a new job is more difficult for women than men, women might choose to self-select into low risk firms or to reduce firm risk once they have become a CEO. Indeed, across the countries and over the time period included in our study, the average unemployment rate among women who previously held a managerial position is 3.9%. By comparison, this rate is 2.7% for men.[15] Earlier studies further document that women tend to remain unemployed for longer periods than men after losing a managerial job (Phelps & Mason, 1991).

[15] These statistics are computed using data from the *European Labour Force Survey*.

Finally, expectations by society about what is appropriate for women to do (see, for example, Altonji and Blank (1999), Akerlof and Kranton (2000), and Guiso, Monte, Sapienza, and Zingales (2008)) may affect not only a woman's decision to work, but also the sorting of men and women across occupations, industries and firms. These societal expectations might also affect the choices that women make in specific occupations (such as CEO). In a seminal study by Akerlof and Kranton (2000), deviating from the behavior that is expected by society decreases the agent's utility. To the extent that a society expects women to stay at home, the model predicts a lower participation of women to the workforce. Their model also explains occupational segregation by gender, which is further validated by Goldin (1990), Altonji and Blank (1999), and Bertrand, Goldin and Katz (2010). To the extent that managing high risk firms involves longer working hours and less flexible schedules, women might disproportionately self-select into low risk firms to be better able to accommodate the child rearing and household tasks that they often disproportionately carry (Goldin and Katz (2010)). Women might also reduce corporate risk-taking to a level that is compatible with their personal constraints after they become CEOs.

VI. Conclusions

We investigate how CEO gender relates to corporate risk-taking choices. We document that firms run by female CEOs tend to make financing and investment choices that are less risky than those of otherwise similar firms run by male CEOs. Further, an analysis of changes in risk-taking around CEO transitions indicates that the risk-taking of a given firm tends to decrease (increase) around the transition from a male to a female CEO (or vice-versa). The documented

change in risk-taking around CEO transitions is over and beyond what is observed around a matched sample of peers that are always run by male CEOs.

Overall, at least in our sample, it appears that women who climbed the corporate ladder are different from their male peers. These differences are reflected either in the types of firms that female CEOs match with and/or in the type of risk-taking choices we observe once they become CEOs.

We find little evidence consistent with endogenous matching explaining, at least in part, the cross-sectional association between CEO gender and corporate risk-taking. In particular, an investigation of the determinants of female CEO hiring decisions shows that firms with low leverage are more likely to hire a female CEO.

At the same time, the changes in corporate risk-taking observed *following* CEO transitions do not appear to be driven by self-selection of female CEOs into firms that are already experiencing a decline in risk-taking. The results do not also appear to be driven by unobserved CEO or firm traits that could give rise to non-random self-selection. While causality represents one possible alternative explanation for the changes in risk-taking observed following CEO transitions, testing causality directly remains a formidable challenge (given the impossibility to randomly assign CEOs to firms). Regardless, in our large sample of female CEOs, we document that gender-related differences in risk-taking documented in experimental economics and psychology studies extend to top corporate executives.

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Table 1. Univariate statistics

Female CEO is an indicator variable that takes the value of 1 if the CEO is a woman and 0 otherwise. *Leverage* is defined as the ratio of financial debt divided by the sum of financial debt plus equity. Financial debt is the sum of long-term debt (excluding "other non-current liabilities") plus short-term loans. *σ(ROA*) is the volatility of the firm's operating return on assets (ROA), defined as the ratio of earnings before interest and taxes to total assets. *Likelihood of survival* is an indicator variable that takes the value of 1 if the firm survives at least five years and 0 otherwise. *Sales Growth* is calculated as the annual rate of growth of sales. *Ln (Size)* is the natural log of total assets (in thousands US$), expressed in 2000 prices. (Total assets is the sum of total fixed assets (tangible and intangible fixed assets and other fixed assets) and current assets (inventory, receivables, and other current assets).) *Ln (1+Age)* is the natural logarithm of (1 + the number of years since incorporation). *Tangibility* is calculated as the ratio of fixed to total assets. *Private firm* is an indicator denoting firms that are not publicly traded. *Cash flow rights* is the ownership rights of the largest ultimate shareholder. *CEO ownership* is the CEO's cash flow rights on the firm's earnings. *Ln (CEO wealth)* is the natural logarithm of the CEO's equity wealth. To determine equity wealth for each CEO, we approximate the dollar value of the investment in each firm in which he/she appears as a shareholder by multiplying the individual's ownership in the firm by the firm's book value of equity. We then sum the value of all equity investments across firms to obtain the CEO's total equity wealth. *Ln (CEO age)* is the natural logarithm of the CEO's age. With the exception of *Likelihood of survival*, all statistics are computed for the panel of observations. *Likelihood of survival* can be computed only cross-sectionally.

	Full sample			Female	Male	p-value
Full sample	Mean	Median	Stnd. dev.	CEOs	CEOs	of diff.
Female CEO	0.096	0.000	0.295			
Leverage	0.363	0.310	0.326	0.322	0.368	0.000
σ(ROA)	0.049	0.031	0.057	0.029	0.051	0.000
Likelihood of survival	0.502	1.000	0.500	0.600	0.490	0.000
ROA	0.061	0.051	0.110	0.067	0.061	0.000
Sales growth	0.233	0.055	0.862	0.200	0.236	0.000
Ln (Size)	10.225	10.072	1.445	10.072	10.241	0.000
Ln (1+Age)	2.876	2.890	0.806	2.901	2.873	0.000
Tangibility	0.227	0.146	0.238	0.225	0.227	0.383
Private firm	0.951	1.000	0.215	0.965	0.950	0.000
Cash flow rights	0.638	0.680	0.357	0.586	0.644	0.000
CEO ownership	0.083	0.000	0.221	0.092	0.082	0.000
Ln (CEO wealth)	7.710	7.753	1.882	7.641	7.718	0.043
Ln (CEO age)	3.944	3.951	0.207	3.925	3.947	0.000

Table 2. Female CEOs and corporate risk-taking

In regression (1), the dependent variable is *Leverage*, defined as the ratio of financial debt divided by the sum of financial debt plus equity; in regression (2), the dependent variable is the volatility of the firm's operating return on assets *σ(ROA)* x 100, where ROA is defined as the ratio of earnings before interest and taxes to total assets; in regression (3), the dependent variable is an indicator denoting whether the firm survived over a five-year period. Regressions (1) and (2) are run for the panel of observations. Regression (3) can be run only cross-sectionally. *Female CEO* is an indicator variable that takes the value of 1 if the CEO is a woman and 0 otherwise. Control variables are defined in Table 1. P-values, adjusted for heteroskedasticity and clustering at the firm level (in the panel regressions), are reported in brackets below the coefficients.

	(1)	(2)	(3)
	Leverage	σ(ROA) x 100	Likelihood of survival
Female CEO	-0.030***	-1.845***	0.232***
	[0.000]	[0.000]	[0.000]
ROA	-0.607***	-3.418***	0.904***
	[0.000]	[0.000]	[0.000]
Sales growth	0.009***	-0.054***	-0.012***
	[0.000]	[0.003]	[0.002]
Ln (Size)	0.016***	-0.173***	0.163***
	[0.000]	[0.000]	[0.000]
Ln (1+Age)	-0.042***	-0.381***	0.086***
	[0.000]	[0.000]	[0.000]
Tangibility	0.150***	-1.055***	0.158***
	[0.000]	[0.000]	[0.000]
Private firm	0.088***	-0.911***	-0.386***
	[0.000]	[0.000]	[0.000]
Cash flow rights	0.004*	0.593***	0.019
	[0.098]	[0.000]	[0.298]
CEO ownership	0.089***	-0.978***	-0.043*
	[0.000]	[0.000]	[0.072]
Intercept	0.313***	10.083***	-2.652***
	[0.000]	[0.000]	[0.000]
Country fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
R-squared	0.190	0.100	0.156
No. of observations	394,835	124,350	72,012
No. of firms	152,933	53,064	72,012

Table 3. Propensity score matching estimators

In this table, we identify control samples of firms that are run by male CEOs by employing a propensity score matching procedure. In Panel A, the propensity score is estimated within a country-industry-year-public/private status category, as a function of ROA, sales growth, the natural log of total assets, the natural log of firm age, asset tangibility, the ownership of the largest ultimate shareholder, and the ownership of the CEO. In Panel B we match firms within a country-industry-year-public/private status category, as a function of the variables listed above as well as CEO wealth and CEO age. We require that the difference between the propensity score of the firm run by a female CEO and its matching peer does not exceed 0.1% in absolute value. *Leverage* is defined as the ratio of financial debt divided by the sum of financial debt plus equity. Financial debt is the sum of long-term debt (excluding "other non-current liabilities") plus short-term loans; the volatility of the firm's operating return on assets is *σ(ROA*) x 100, where ROA is defined as the ratio of earnings before interest and taxes to total assets; the *Likelihood of survival* is an indicator denoting whether the firm survived over a five-year period.

Panel A: The propensity score is estimated within a country-industry-year-public/private status category using available firm-level observables.

	No. of observations	Mean	Difference (Female CEOs - Male CEOs)	P-value of diff.
Leverage (Female CEOs)	14,710	0.342	-0.032	0.000
Leverage (Male CEOs)		0.374		
σ(ROA) x 100 (Female CEOs)	4,375	2.439	-1.529	0.000
σ(ROA) x 100 (Male CEOs)		3.969		
Likelihood of survival (Female CEOs)	967	0.687	0.127	0.000
Likelihood of survival (Male CEOs)		0.560		

Panel B: The propensity score is estimated within a country-industry-year-public/private status category using available firm-level observables as well as CEO wealth and CEO age.

	No. of observations	Mean	Difference (Female CEOs - Male CEOs)	P-value of diff.
Leverage (Female CEOs)	1,758	0.433	-0.037	0.000
Leverage (Male CEOs)		0.470		
σ(ROA) x 100 (Female CEOs)	554	2.134	-0.883	0.000
σ(ROA) x 100 (Male CEOs)		3.017		
Likelihood of survival (Female CEOs)	133	0.601	0.105	0.075
Likelihood of survival (Male CEOs)		0.496		

Table 4. Female CEOs and corporate risk-taking: Firm fixed effects specifications

This table reports panel regression results with firm fixed effects. In regressions (1) and (3), the dependent variable is *Leverage*, defined as the ratio of financial debt divided by the sum of financial debt plus equity. In regressions (2) and (4), the dependent variable is the volatility of the firm's operating return on assets *σ(ROA)* x 100, where ROA is defined as the ratio of earnings before interest and taxes to total assets. *Female CEO* is an indicator variable that takes the value of 1 if the CEO is a woman and 0 otherwise. Control variables are defined in Table 1. P-values, adjusted for heteroskedasticity and clustering at the firm level, are reported in brackets below the coefficients.

	(1) Leverage	(2) σ(ROA) x 100	(3) Leverage	(4) σ(ROA) x 100
Female CEO	-0.024***	-1.587***	-0.020*	-0.918***
	[0.000]	[0.000]	[0.082]	[0.008]
ROA	-0.378***	-3.828***	-0.518***	-5.784
	[0.000]	[0.008]	[0.000]	[0.274]
Sales growth	0.005***	0.061	0.011*	-0.175
	[0.001]	[0.268]	[0.061]	[0.616]
Ln (Size)	0.033***	-0.354	0.112***	-0.905
	[0.000]	[0.168]	[0.000]	[0.534]
Ln (1+Age)	-0.049***	1.279	0.067	3.534
	[0.001]	[0.134]	[0.284]	[0.395]
Tangibility	0.113***	-2.609**	0.142**	-1.753
	[0.000]	[0.015]	[0.032]	[0.425]
Private firm	0.01	0.629	0.054	4.052
	[0.360]	[0.569]	[0.428]	[0.307]
Cash flow rights	0.009	-0.297	0.022	0.648
	[0.132]	[0.459]	[0.721]	[0.662]
CEO ownership	-0.006	0.331	0.134**	-0.944
	[0.542]	[0.412]	[0.028]	[0.548]
Ln (CEO wealth)			-0.048***	-0.040
			[0.000]	[0.837]
Ln (CEO age)			0.066	0.110
			[0.172]	[0.933]
Intercept	0.121**	5.587	-0.955***	-0.331
	[0.035]	[0.136]	[0.007]	[0.988]
Firm fixed effects	Yes	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes	Yes
R-squared	0.718	0.423	0.831	0.554
No. of observations	52,918	23,822	2,983	1,480
No. of firms	11,749	8,568	1,145	627

Table 5. Propensity score matching estimators for transition firms

In this table, we identify control samples of firms that are always run by male CEOs by employing a propensity score matching procedure. The propensity score is estimated within a country-industry-year-public/private status category, as a function of ROA, sales growth, the natural log of total assets, the natural log of firm age, asset tangibility, the ownership of the largest ultimate shareholder, and the ownership of the CEO. The treatment group in this Table includes firms experiencing a transition from male to female CEOs. We require that the difference between the propensity score of the firm run by a female CEO and its matching peer does not exceed 0.1% in absolute value. *Leverage* is defined as the ratio of financial debt divided by the sum of financial debt plus equity. Financial debt is the sum of long-term debt (excluding "other non-current liabilities") plus short-term loans; the volatility of the firm's operating return on assets is *σ(ROA*) x 100, where ROA is defined as the ratio of earnings before interest and taxes to total assets.

	No. of observations	Mean	Difference (Post – Pre Transition)	P-value of diff.
Treatment Group				
Pre-Transition Leverage (Male CEOs)	5,375	0.403	-0.023***	0.000
Post-Transition Leverage (Female CEOs)		0.380		
Control Group				
Pre-Transition Leverage (Male CEOs)	5,375	0.405	-0.007	0.331
Post-Transition Leverage (Male CEOs)		0.398		
		Diff.-in-Diff.	-0.016***	0.000

	No. of observations	Mean	Difference (Post – Pre Transition)	P-value of diff.
Treatment Group				
Pre-Transition σ(ROA) x 100 (Male CEOs)	869	3.648	-1.175***	0.000
Post-Transition σ(ROA) x 100 (Female CEOs)		2.473		
Control Group				
Pre-Transition σ(ROA) x 100 (Male CEOs)	869	3.588	0.098	0.541
Post-Transition σ(ROA) x 100 (Male CEOs)		3.686		
		Diff.-in-Diff.	-1.273***	0.000

Table 6. The CEO selection choice

This table reports probit models of the likelihood that a woman is appointed as the CEO following a CEO transition. *Pre-transition leverage* is a company's leverage at the year-end prior to the year of the CEO transition. *Pre-transition change in leverage* is the difference between a company's leverage in the year-end prior to the year of the CEO transition and the company's leverage two years prior to the transition. *Leverage* is defined as the ratio of financial debt divided by the sum of financial debt plus equity. *Pre-transition σ(ROA) x 100* is the volatility of a company's ROA during the five years prior to the CEO transition (e.g., during years -5 through -1, where year 0 is the year of the transition). *Pre-transition change in σ(ROA) x 100* is the difference between the volatility of ROA during (-5,-1) and the volatility of ROA during (-6,-2). *Departing Female CEO* is an indicator variable that takes the value of 1 if the departing CEO is a woman and 0 otherwise. Control variables are defined in Table 1. P-values adjusted for heteroskedasticity are reported in brackets below the coefficients.

	(1)	(2)
Pre-transition leverage	-0.077*	
	[0.080]	
Pre-transition change in leverage	0.082	
	[0.181]	
Pre-transition σ(ROA) x 100		-0.575
		[0.258]
Pre-transition change in σ(ROA) x 100		0.329
		[0.641]
Departing Female CEO	-1.452***	-1.325***
	[0.000]	[0.000]
ROA	0.550***	0.705***
	[0.000]	[0.000]
Sales growth	-0.012	-0.079*
	[0.650]	[0.094]
Ln (Size)	-0.014	-0.031*
	[0.157]	[0.051]
Ln (1+Age)	0.057***	0.073**
	[0.002]	[0.023]
Tangibility	0.042	-0.035
	[0.500]	[0.750]
Private firm	0.306***	0.459***
	[0.000]	[0.000]
Cash flow rights	-0.323***	-0.504***
	[0.000]	[0.000]
CEO ownership	-0.034	0.129
	[0.668]	[0.334]
Intercept	-0.216	-0.357
	[0.223]	[0.235]
Country fixed effects	Yes	Yes
Industry fixed effects	Yes	Yes
Year fixed effects	Yes	Yes
R-squared	0.191	0.188
No. of observations	16,521	5,984

Table 7. Treatment effects

Across all *first stage* regressions, we use the fraction, among all other firms in which the firm's male directors also serve as directors, of firms with (1) a female CEO, (2) above-average leverage, (3) above-average volatility of ROA in the subsequent five years and (4) lack of survival during the following five years as an exogenous determinant of the CEO gender selection choice. In the *second stage regressions*, in regression (1) the dependent variable is *Leverage*, defined as the ratio of financial debt divided by the sum of financial debt plus equity; in regression (2) the dependent variable is the volatility of the firm's operating return on assets *σ(ROA)* x100, where ROA is defined as the ratio of earnings before interests and taxes to total assets; in regression (3) the dependent variable is an indicator denoting whether the firm survived over a five-year period. Control variables are defined in Table 1. The *Inverse Mills ratio* is calculated from the predicted values of the first stage probit regressions. P-values, adjusted for heteroskedasticity and clustering at the firm level, are reported in brackets below the coefficients.

Panel A: First stage probit models

	(1)	(2)	(3)
Dependent variable:		Female CEO	
Fraction of firms with a female CEO and high risk-taking among other firms in which male directors serve	1.516***	1.458***	1.322***
	[0.000]	[0.000]	[0.000]
ROA	0.206***	0.202***	0.368***
	[0.000]	[0.005]	[0.000]
Sales growth	-0.035***	-0.052***	-0.040***
	[0.000]	[0.000]	[0.000]
Ln (Size)	0.004	0.045***	0.028***
	[0.204]	[0.000]	[0.001]
Ln (1+Age)	0.058***	0.042***	0.091***
	[0.000]	[0.000]	[0.000]
Tangibility	-0.040**	-0.099***	-0.251***
	[0.045]	[0.004]	[0.000]
Private firm	0.144***	0.123***	0.111**
	[0.000]	[0.000]	[0.013]
Cash flow rights	-0.279***	-0.080***	-0.078**
	[0.000]	[0.001]	[0.015]
CEO ownership	-0.132***	-0.212***	-0.083
	[0.000]	[0.000]	[0.131]
Intercept	-1.611***	-2.057***	-2.911***
	[0.001]	[0.000]	[0.000]
Country fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
No. of observations	242,204	80,521	44,289
No. of firms	101,751	36,603	44,289

Panel B: Second stage regressions

	(1)	(2)	(3)
Dependent variable:	Leverage	σ(ROA) x100	Likelihood of survival
Female CEO	-0.065***	-2.476***	0.448***
	[0.001]	[0.001]	[0.001]
ROA	-0.420***	-4.072***	0.817***
	[0.000]	[0.000]	[0.000]
Sales growth	0.006***	0.030	-0.013***
	[0.000]	[0.403]	[0.009]
Ln (Size)	0.035***	-0.270	0.143***
	[0.000]	[0.104]	[0.000]
Ln (1+Age)	-0.046***	1.186**	0.102***
	[0.000]	[0.032]	[0.000]
Tangibility	0.137***	-1.781***	0.164***
	[0.000]	[0.010]	[0.000]
Private firm	0.009	1.516**	-0.404***
	[0.107]	[0.018]	[0.000]
Inverse Mills ratio	0.018*	0.317	-0.060
	[0.054]	[0.358]	[0.384]
Cash flow rights	0.013***	-0.170	0.051**
	[0.000]	[0.504]	[0.028]
CEO ownership	-0.015**	0.258	-0.012
	[0.017]	[0.391]	[0.740]
Intercept	0.091***	4.717*	-1.977***
	[0.007]	[0.060]	[0.000]
Country fixed effects	Yes	Yes	Yes
Industry fixed effects	Yes	Yes	Yes
Year fixed effects	Yes	Yes	Yes
No. of observations	242,204	80,521	44,289
No. of firms	101,751	36,603	44,289