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Age, Gender, and Risk-Taking: Evidence from the S&P Executives and Firm Riskiness[☆]

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Abstract

This paper examines whether the age and gender of the firm's top executives influence market-based measures of firm risk. Using data on the S&P 1500 firms, we document that firms led by older Chief Executive Officers (CEOs) and Chief Financial Officers (CFOs) are associated with less volatile stock returns and lower levels of idiosyncratic risk. This finding suggests that executives become more risk averse with age and may constrain excessive risk-taking by their firms. Furthermore, although the relationship between executive gender and firm risk is more ambiguous, our results show that firms with female CFOs are more risky after controlling for firm-specific attributes, policy choices, and managerial risk-taking incentives. We also document that female executives, on average, are younger than their male counterparts and therefore the effect of executive gender on firm risk may be confounded by age-effects. Our additional tests indicate that executive age and gender are reflected in corporate financial and investment policies. Overall, our empirical findings demonstrate that the age and gender of the firm's top executives may have important implications for corporate outcomes.

JEL classification: G01, G21, G30, G32
Keywords: Executives, CEOs, CFOs, age, gender, firm risk, risk-taking

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1. INTRODUCTION

Anecdotal experience as well as formal psychological and behavioral economics studies suggest that age and gender affect the risk preferences and tolerance of individuals. But do these age and gender-based differences in risk tolerance affect decision-making in a professional setting, and moreover, are they reflected in corporate decisions that the firm's top executives make? In this paper, we empirically address these questions by examining whether the age and gender of the firm's Chief Executive Officer (CEO) and Chief Financial Officer (CFO) influence market-based measures of firm risk.

The general underlying premise in our study is that the characteristics, attitudes, and personal preferences of the top executives may affect firm outcomes through the decisions these executives make. The upper echelons theory of Hambrick and Mason (1984) and abundant empirical evidence suggests that the characteristics of individual executives are reflected in firms' business strategies, performance, financial and investment policies, and other corporate outcomes (see e.g., Bertrand and Schoar, 2003; Malmendier and Tate, 2005; Antia, Pantzalis and Park, 2010; Chava and Purnanandam, 2010; Malmendier, Tate and Yan, 2011; Cronqvist, Makhija and Yonker, 2012; Graham, Harvey and Puri, 2013; Cline, Walkling and Yore, 2018).[1] Our motivation for investigating how executive age and gender relate to firm risk comes from the gender and age-related behavioral differences that have been extensively documented in psychology and experimental economics literature over the past few decades.

[1] Bertrand and Schoar (2003) provide a comprehensive discussion on why individual executives may matter for corporate decisions.

In brief, the prior literature on gender-based behavioral differences demonstrates that women are more risk averse than men. Levin, Snyder and Chapman (1988), Johnson and Powell (1994), Powell and Ansic (1997), Eckell and Grossman (2002), Fehr-Duda, de Gennaro and Schubert (2006), and Borghans, Golsteyn, Heckman and Meijers (2009) conduct experiments to examine gender differences in rendering financial decisions. They conclude that women try to avoid losses and are more cautious and less likely to take risks. In a meta-analysis of fifteen experimental studies, Charness and Gneezy (2012) document that women invest less and are more financially risk averse than men. It has been well documented that women exhibit less risky behavior also in real-world financial decisions. Studies by Jianakoplos and Bernasek (1998), Sunden and Surette (1998), Barber and Odean (2001), Dwyer, Gilkeson and List (2002), Agnew, Balduzzi and Sunden (2003), Watson and McNaughton (2007), and Halko, Kaustia and Alanko (2012) indicate that women hold less risky investment portfolios and follow more conservative investment styles.

The evidence on the association between age and risk tolerance is a bit more mixed. Several studies provide support for the belief that aging leads to increasing risk aversion and cautiousness (the early literature is reviewed in Okun, 1976). McInish (1982), Morin and Suarez (1983), Palsson (1996), and Hunter and Kemp (2004) document that older individuals tend to hold less risky stocks and investment portfolios. Nevertheless, experimental studies provide mixed findings about age-related differences in risky decisions, and often find no evidence that aging would be systematically associated with less risk-taking (see e.g. Mather, 2006 for a review). Mata, Josef, Samanez-Larkin and Hertwig (2011) conduct a meta-analysis of the literature and conclude that the relationship between age and risk-taking is ambiguous. They report that older individuals are less risk averse than younger individuals in decisions in which

learning from experience encourages risk averse behavior, and more risk averse in decisions in which learning results in risk-seeking behavior. Experimental study by Mather et al. (2012) indicates that older individuals exhibit a stronger preference for sure gains and a stronger avoidance of sure losses than younger individuals, which implies that age affects the weighting of uncertain outcomes.

Given the documented age and gender-based differences in risk tolerance, it is not surprising that several studies have recently focused on the potential effects of age and gender of the top executives on firm-level financial decisions and outcomes. Barua, Davidson, Rama and Thiruvadi (2010), Peni and Vahamaa (2010), and Francis, Hasan, Park and Wu (2015) report that firms led by female CEOs and CFOs are associated with more conservative and cautious financial reporting practices. Jurkus, Park and Woodard (2011) document that gender diversity in the top management may constrain agency costs, especially in firms with weak external governance mechanisms. Khan and Vieito (2013) examine whether firms led by female CEOs are associated with better performance, and find that female CEOs have a positive effect on profitability. Huang and Kisgen (2013) focus on the influence of female CEOs and CFOs on corporate financial and investment decisions. Their findings suggest that female executives are less likely to conduct acquisitions and issue debt than their male counterparts.

Most closely related to our study, Elsaid and Ursel (2011), Khan and Vieito (2013), Palvia, Vahamaa and Vahamaa (2015), and Faccio, Marchica and Mura (2016) examine the association between female CEOs and firm riskiness. Using a sample of North American firms, Elsaid and Ursel (2011) document that corporate risk decreases after appointments of new female CEOs, while Faccio et al. (2016) find that European privately-held firms run by female CEOs make less risky financing and investment decisions. The findings of Khan and Vieito

(2013) suggest that firms with female CEOs are associated with lower stock return volatility. Finally, Palvia et al. (2015) report that U.S. commercial banks with female CEOs and board chairs are associated with more conservative capital buffers and were less likely to fail during the financial crisis. Collectively, these prior studies suggest that firms led by female CEOs are less risky.

The alternative hypothesis with respect to executive gender is that the women who have broken through the glass ceiling are not that different from men in terms of risk aversion. As argued by Adams and Funk (2012) and Adams and Ragunathan (2018), women who pursue leadership positions may be very similar to men, and thereby gender differences in risk tolerance may disappear among executives and directors. Using survey data on Swedish CEOs and directors, Adams and Funk (2012) document that female executives and directors are less tradition and security oriented than men, and are also more risk-loving than their male counterparts. They conclude that having women on the boards does not necessarily lead to more risk-averse corporate decisions. Berger, Kick and Schaeck (2014) examine how executive board composition and board gender diversity affect the portfolio risk of German financial institutions, and find that a higher proportion of female board members increases bank risk. Consistent with the assertion that gender differences in risk tolerance may vanish beyond the glass ceiling, Sila, Gonzalez and Hagendorff (2016) and Adams and Ragunathan (2018) document that female representation on the board of directors does not have any meaningful effect on firm risk. Given the contrasting empirical evidence regarding the influence of female CEOs and directors on firm riskiness, more empirical work is warranted in this area.

The potential implications of age-based behavioral differences on corporate decisions have been previously examined in Davis (1979), Datta and Rajagopalan (1998), Bertrand and

Schoar (2003), Davidson, Xie, Xu and Ning (2007), Antia et al. (2010), Yim (2013), Serfling (2014), Cline and Yore (2016), and Zhang, Sabherwal, Jayaraman and Ferris (2016). While Davis (1979) finds no relationship between CEO age and firm performance, Datta and Rajagopalan (1998), Bertrand and Schoar (2003), Davidson et al. (2007), Antia et al. (2010), and Cline and Yore (2016) document systematic differences in corporate strategies, performance, financial and investment policies, and market valuation that are related to the age of the firm's top executives. Yim (2013) and Zhang et al. (2016) investigate the effects of CEO age on acquisition decisions, and find that firms led by younger CEOs are more likely to undertake acquisitions. Directly related to the analysis presented in this paper, Serfling (2014) examines the relation between CEO age and firm risk-taking. His findings indicate that firm-level riskiness is negatively associated with the age of the CEO and that older CEOs reduce firm risk through less risky investment policies.

In this paper, we attempt to contribute to the existing literature by examining whether market-based measures of firm risk are associated with the age and gender of the firm's Chief Executive Officer and Chief Financial Officer. Using data on the S&P 1500 firms from 2004 to 2014, we document that firms led by older CEOs and CFOs are associated with less volatile stock returns and lower levels of idiosyncratic risk. This evidence suggests that executives become more risk averse with age and may constrain excessive risk-taking by their firms. Although our findings with respect to executive gender are a bit more ambiguous, we find that firms with female CFOs are associated with higher total risk and idiosyncratic risk after controlling for firm-specific attributes, financial and investment policies, and managerial risk-taking incentives. Furthermore, we also document a positive association between female CEOs and idiosyncratic risk. We utilize instrumental variable regressions, propensity score matching,

and difference-in-difference tests to control for potential endogeneity, and we also conduct a number of additional tests to investigate the robustness of our results. These tests provide further evidence to conclude that executive age and gender influence firm riskiness. Our additional tests also show that executive age and gender affect corporate financial and investment policy choices. Taken as a whole, our empirical findings indicate that the age and gender of the firm's top executives may have important implications for corporate outcomes.

Our analysis extends the previous studies in a number of ways. First, in contrast to the prior studies by Elsaid and Ursel (2011), Khan and Vieito (2013), Palvia et al. (2015), Faccio et al. (2016), and Serfling (2014) that consider only one of the two demographic dimensions, we show that both age and gender of the executives influence firm-level riskiness. We further document that female executives, on average, are younger than their male counterparts, and consequently, the effect of executive gender on firm risk may be confounded by age. If females are typically more risk-averse than males, on one hand, but younger individuals are more risk-loving than older individuals on the other hand, the question of how younger female executives influence firm risk is ultimately addressed empirically.

Second, we extend Elsaid and Ursel (2011), Palvia et al. (2015), and Faccio et al. (2016) who consider accounting-based measures of risk by utilizing market-based measures of firm risk. Unlike the accounting-based risk measures which provide an ex post representation of financial decisions, the market-based measures of risk used in this study reflect the perceptions of market participants regarding the aggregate riskiness of a firm. The market-based risk measures are considered to reflect perceptions about risks related to, for instance, the firm's business strategies, financial decisions, investment decisions, and the variability of cash flows. The three

market-based risk measures used in our empirical analysis are total risk, systematic risk, and idiosyncratic risk.[2]

Furthermore, while Elsaid and Ursel (2011), Khan and Vieito (2013), Palvia et al. (2015), and Faccio et al. (2016) focus on female CEOs and Serfling (2014) on CEO age, we also examine the influence of CFO characteristics on firm risk. The extension of the analysis to CFO characteristics is important because previous studies have documented that they may play a stronger role than those of the CEOs on corporate financial policies (e.g., Bertrand and Schoar, 2003; Chava and Purnanandam, 2010; Jiang, Petroni and Wang, 2010). In contrast to the negative association between female CEOs and firm risk documented in Elsaid and Ursel (2011), Khan and Vieito (2013), Palvia et al. (2015), and Faccio et al. (2016), our empirical findings suggest that firms with female executives and especially with female CFOs exhibit greater risk. Thus, our results reveal that CFO gender is an important additional factor influencing firm risk. Consistent with Serfling (2014), we find strong evidence that CEO age is negatively associated with total risk and idiosyncratic risk. However, we also complement Serfling's (2014) analysis by documenting that CEO age is largely irrelevant with respect to systematic risk, and moreover, that firms with older CFOs in addition to older CEOs are associated with lower idiosyncratic risk. Overall, we extend Sefling (2014) by showing that CFO age may have an incremental impact on firm risk over and above the influence of CEO age.

[2] Khan and Vieito (2013) also use a measure of total risk in their empirical analysis. Their market-based risk measure is calculated as the standard deviation of monthly stock returns over the past five years, and consequently, they examine whether a female CEO in year *t* is associated with the total risk observed over the past five years from year *t*-4 to year *t*. In contrast to Khan and Vieito (2013), we measure total risk as the standard deviation of daily stock returns over the next 12 months, and thereby examine whether a female CEO in year *t-1* is associated with the level of total risk in year *t*.

The remainder of the paper proceeds as follows. Section 2 describes the data and presents the methodology used in our analysis. The empirical findings on the effects of executive age and gender on firm risk are reported in Section 3. Finally, Section 4 provides concluding remarks.

2. DATA AND METHODOLOGY

2.1. Data

The sample used in our empirical analysis consists of the S&P 1500 firms for the period 2004-2014. We collect the data from the following sources: (i) the data on the age and gender of the firms' CEOs and CFOs as well as executive compensation data are obtained from Execucomp, (ii) the stock price data used for calculating market-based measures of firm riskiness are taken from CRSP, (iii) the financial statement data used as control variables are from Compustat, and (iv) the data on institutional ownership come from the Institutional Shareholder Services and Thomson Reuters Institutional (13f) Holdings reports. We exclude banks, insurance companies, and other financial institutions (SIC codes 6000-6999) as well as individual firms with insufficient or missing data on executive characteristics and/or financial information. After these exclusions, we are left with an unbalanced panel of 1107 individual non-financial firms and 8,282 usable firm-year observations for our main regressions.[3]

[3] The number of observations varies across our empirical tests due to data availability. Data on CFO age and gender are available only from 2006 onwards, and consequently, the regression specifications in which CFO characteristics are included are based on a smaller sample of 6,286 firm-year observations.

2.2. Model specification

We utilize fixed-effects panel regressions to examine whether the age and gender of the firm's top executives are associated with firm-level riskiness. Specifically, we estimate several alternative versions of the following regression specification:

$$\begin{aligned} Firm\ risk_{j,t} = {} & \alpha + \beta_1 Age_{j,t-1} + \beta_2 Gender_{j,t-1} + \beta_3 Size_{j,t-1} + \beta_4 Leverage_{j,t-1} \\ & + \beta_5 Profitability_{j,t-1} + \beta_6 Cash\ holdings_{j,t-1} + \beta_7 Cash\ flow\ volatility_{j,t-1} \\ & + \beta_8 Growth_{j,t-1} + \beta_9 Market\text{-}to\text{-}book_{j,t-1} + \beta_{10} Ownership_{j,t-1} \\ & + \beta_{11} R\&D_{j,t-1} + \beta_{12} Firm\ age_{j,t-1} + \beta_{13} Delta_{j,t-1} + \beta_{14} Vega_{j,t-1} \\ & + \sum_{k=1}^{n-1} \alpha_k Industry_j^k + \sum_{y=2006}^{2014} \omega_y Year_j^y + \varepsilon_{j,t} \end{aligned} \quad (1)$$

where the dependent variable *Firm risk*$_{j,t}$ is one of three alternative market-based firm risk measures for firm *j* at time *t*. Our first measure of firm riskiness is *Total risk*$_{j,t}$ which is measured as the annualized standard deviation, or volatility, of the daily stock returns for firm *j* during year *t*. The second measure of firm riskiness is *Systematic risk*$_{j,t}$ which is measured as the beta coefficient for firm *j* based on the market model estimated against the S&P 500 index using daily return data for year *t*. Finally, we use *Idiosyncratic risk*$_{j,t}$, calculated as the standard deviation of the residuals of the market model regression for firm *j* at time *t*, as the third measure of firm risk. The approach of using daily stock returns over a one-year period for estimating the three risk measures is consistent with the prior literature (see e.g., Rajgopal and Shevlin, 2002; Coles, Daniel and Naveen; 2006; Low, 2009; Lord and Saito, 2012; Serfling, 2014). The stock price data for estimating the market-based measures of firm riskiness are obtained from CRSP.

The two test variables of interest in Equation (1) are *Age*$_{j,t}$ and *Gender*$_{j,t}$. Depending on the regression specification, these variables are indicators for the age and gender of either the

Chief Executive Officer or the Chief Financial Officer of the firm. In our regressions, *Age* is the age of the firm's CEO and CFO at the end of year *t*.[4] The following two executive gender dummies are used in the regressions: (i) *Female CEO* equals one for firms that have a female CEO at the end of year *t* and (ii) *Female CFO* equals one for firms that have a female CFO. The data on the age and gender of the CEOs and CFOs are collected from Execucomp.[5]

Following the prior literature, we employ several control variables in our analysis to account for the potentially confounding effects of firm-specific factors such as size, leverage, growth, and executive compensation incentives on the riskiness of the firm.[6] The control variables used in Equation (1) are defined as follows: $Size_{j,t}$ is measured as the logarithm of firm *j*'s total assets at the end of year *t*, $Leverage_{j,t}$ is the logarithm of the ratio of long-term debt to market value of equity at the end of year *t*, $Profitability_{j,t}$ is measured as the return on assets (ROA) at time *t*, $Cash\ holdings_{j,t}$ is the logarithm of cash holdings scaled by total assets, $Cash\ flow\ volatility_{j,t}$ is the logarithm of the coefficient of variation of cash flows from operations calculated as the standard deviation of operating cash flows scaled by the absolute value of the mean over the preceding five years, $Growth_{j,t}$ is the transformed logarithm of the growth rate of sales from year *t*–3 to year *t*, $Market\text{-}to\text{-}book_{j,t}$ is the logarithm of the market value of equity scaled by the book value of equity at time *t*, $Ownership_{j,t}$ is the percentage of institutional ownership of firm *j* at the end of year *t*, $R\&D_{j,t}$ is the logarithm of research and development

[4] In the univariate tests and in our robustness checks, we also use dummy variables for young and old CEOs and CFOs. These dummy variables are constructed based on the lower and upper quartiles of CEO and CFO age.

[5] Data on CFO age and gender are available only from 2006 onwards, and consequently, the regression specifications in which CFO characteristics are included are based on a shorter sample period.

[6] It is worth noting that Palvia et al. (2015) and Faccio et al. (2016) use financial leverage as a proxy for firm riskiness, while we utilize market-based measures of firm risk and use leverage as a control variable in our main analysis. In our additional tests, we also investigate the relationship between leverage and executive age and gender.

expenditures scaled by sales at time *t*, and *Firm age*$_{j,t}$ is the logarithm of the age of the firm determined by the year the firm first appears in CRSP or Compustat.

In addition to firms' financial characteristics, we also control for managerial compensation incentives by including the sensitivities of CEO and CFO wealth to stock price and stock return volatility in the regressions. Previous studies have shown that these sensitivities may affect firm risk-taking and the perceived level of riskiness (see e.g., Rajgopal and Shevlin, 2002; Coles et al., 2006; Tong, 2010; Armstrong and Vashishtha, 2012; Chen, Truong and Veeraraghavan, 2015). *Delta* is the logarithm of the sensitivity of executive wealth to changes in stock price (dollar change in wealth for a one percent change in stock price), while *Vega* is the logarithm of the sensitivity of executive wealth to changes in stock return volatility (the dollar change in executive wealth for a one percentage point change in volatility). The deltas and vegas are calculated following the approach of Core and Guay (2002) and Coles et al. (2006).

Finally, we control for potential biases related to omitted and/or unobservable variables with industry fixed-effects (*Industry*$_j$) based on the Fama & French 12 industry classification and we also account for the potential time fixed-effects with fiscal year dummy variables (*Year*$_j$). All the independent variables in Equation (1) are lagged one-period in order to alleviate endogeneity concerns and to avoid potential reverse causality from the riskiness measures to our independent variables. Moreover, we winsorize the risk measures and all the control variables at the 1st and 99th percentiles to moderate the effect of extreme outliers.

Although our main analysis is based on alternative versions of Equation (1), we also perform a number of additional tests. Specifically, we utilize two-stage instrumental variable regressions, propensity score matching, and difference-in-difference tests in Section 3.3. to mitigate potential endogeneity concerns. Furthermore, given that executive age and gender are

likely to affect firm risk through the financial and investment decisions that the executives make, we aim to identify the potential channels through which the age and gender effects occur in Section 3.4. by estimating simultaneous equations specifications in which executive age and gender can influence financial leverage, cash holdings, and research and development expenditures, and the three market-based firm risk measures are simultaneously a function of executive age and gender and the policy choice variables.

2.3. Descriptive statistics

Table 1 reports the descriptive statistics of our three alternative dependent variables (*Total risk*, *Systematic risk*, and *Idiosyncratic risk*), the four different executive age and gender variables (*CEO age*, *CFO age*, *Female CEO*, and *Female CFO*), and the control variables used in the regressions. As shown in Table 1, the average stock return volatility (*Total risk*) of the S&P 1500 firms during our sample period is about 39 percent, and both the mean and the median beta coefficients (*Systematic risk*) estimated against the S&P 500 index are slightly below one. Regarding the age and gender variables, it can be noted from Table 1 that the average CEO is 56 years old (*CEO age*), while the CFOs of the S&P 1500 firms are, on average, 51 years old (*CFO age*). The table also shows that women are largely underrepresented among the top executives of the S&P 1500 firms; only about 3 percent of the sample firms have a female CEO (*Female CEO*) and approximately 9 percent of the firms have a female as the CFO (*Female CFO*). Correspondingly low percentages of female executives have been recently reported for instance in Elkinawy and Stater (2011), Jurkus et al. (2011), and Palvia et al. (2015).

(insert Table 1 about here)

As can be seen from Table 1, the sample firms are very heterogeneous in terms of the firm-specific control variables. The median *Size* of the sample firms is about $2,03 billion with the 1st–99th percentile range between $938 million and $269 billion. Furthermore, *Profitability* and *Cash holdings* vary considerably around the mean ROA of 5.7 percent and the mean cash to total assets ratio of 11 percent, and the descriptive statistics for *R&D* demonstrate that the sample contains firms with very different research and development investment intensity.[7] The level of institutional ownership in the S&P 1500 firms (*Ownership*) is very high, with the mean institutional ownership being about 80 percent. Interestingly, Table 1 indicates that the percentage of institutional ownership ranges from 21 to 117 percent.[8] Finally, it can be noted from Table 1 that the mean CEO (CFO) delta is $659,410 ($83,920) and mean CEO (CFO) vega is $167,780 ($40,310).

Pairwise correlation coefficients (not tabulated) between the variables used in the empirical analysis demonstrate that our three market-based firm risk measures are strongly positively correlated with each other. *CEO age* and *CFO age* are significantly negatively correlated with all three risk measures, suggesting that firms with younger top executives exhibit greater risk. Inconsistent with the hypothesis that executive gender influences firm risk, our market-based risk measures appear virtually uncorrelated with *Female CEO* and *Female CFO*.

[7] Because of the large number of missing values for research and development expenditures, we set the missing values to zero in our panel regressions in order to increase panel size.

[8] Obviously, it is impossible to own more than 100 percent of a firm. The unreasonably high levels of institutional ownership in the Thomson Reuters Institutional (13f) Holdings reports for some firms can be explained by stock

CEO age and *CFO age* are significantly positively correlated, while the executive gender and age variables are strongly negatively correlated with each other. This suggests that firms with older CEOs are more likely to have older CFOs, and moreover, that female executives tend to be younger than corresponding male executives.

The correlations also indicate that older CEOs and CFOs are more common in larger and older firms that have higher leverage, lower cash holdings, and lower levels of institutional ownership. Moreover, the correlations of the executive age and gender with the compensation incentive variables demonstrate that the wealth of older executives and male executives is more sensitive to changes in stock price and volatility. Our three market-based risk measures are strongly correlated with most of our control variables. The correlations indicate that larger firms with higher profitability and lower financial leverage, cash flow volatility, cash holdings, and R&D investment intensity are less risky, and furthermore, that higher levels of institutional ownership may encourage firm risk-taking.

3. RESULTS

3.1. Univariate tests

We first perform a set of univariate tests to examine potential differences between firms led by older and younger executives and between firms led by male and female executives. For this purpose, we divide our sample into the following four pairs of two subsamples: (i) firms with young CEOs and old CEOs, (ii) firms with young CFOs and old CFOs, (iii) firms with

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lending activity; an institution that has lent the shares and the institution that borrowed the shares may both report themselves as the owners of the shares.

female CEOs and male CEOs, (iv) firms with female CFOs and male CFOs. After constructing these pairs of subsamples, we conduct two-tailed *t*-tests for the null hypothesis that there is no difference in the variable means within the different subsample pairs.

(insert Table 2 about here)

The results of the *t*-tests are presented in Table 2. Panel A provides comparisons between firms with younger (bottom age quartile) and older (top age quartile) CEOs. As can be noted from Panel A, almost all the mean differences between the two subsamples are statistically significant, thereby indicating that the age of the firm's CEO is strongly associated with firm characteristics. The *t*-tests suggest that firms with younger CEOs have more volatile stock returns and are associated with higher levels of systematic risk. The mean difference in *Idiosyncratic risk*, however, is negative. Moreover, the *t*-tests suggest that firms with younger CEOs are significantly more likely to have female CEOs and younger CFOs. Regarding our control variables, Panel A shows that *CEO age* is significantly negatively associated with *Profitability*, *Cash holdings*, *Cash flow volatility*, *Growth*, *Market-to-book*, *Ownership*, and *R&D*, while being positively related to *Size* and *Leverage*, and *CEO delta*.

Panel B presents the results of the *t*-tests for the subsamples of younger (bottom quartile) and older (top quartile) CFOs. In general, the *t*-test results in Panel B are very similar to the results reported in Panel A. Firms with younger CFOs are associated with significantly higher *Total risk* and *Systematic risk* and are more likely to have female CFOs and younger CEOs. Overall, the univariate tests reported in Panels A and B demonstrate that firms led by younger CEOs and CFOs are very different from the ones led by older executives in terms of observable

firm characteristics. Moreover, the *t*-tests also indicate that executive age and gender are closely intertwined variables; female CEOs and CFOs are significantly more common in firms led by younger executives.

Finally, in Panels C and D of Table 2, we divide the sample into subsamples of female-led and male-led firms. The univariate tests provide mixed evidence on the effects of female executives on firm riskiness. While firms with female CEOs and CFOs are associated with significantly lower *Systematic risk*, the results also suggest that *Idiosyncratic risk* is higher in female-led firms. Furthermore, the *t*-tests demonstrate that female executives are statistically significantly younger than corresponding male executives. With respect to our control variables, it can be noted from Panel C that firms led by female CEOs hold more cash and have lower growth rates and institutional ownership levels than firms with male CEOs. Moreover, consistent with the findings of Baixauli-Soler, Belda-Ruiz and Sanchez-Marin (2015), our univariate tests indicate that firms led by female CEOs have lower CEO and CFO pay-performance sensitivities, suggesting that female executives have lower incentives to increase firm risk-taking. The *t*-tests in Panel D suggest that firms led by female CFOs have higher profitability and cash holdings and lower levels of leverage and R&D investments.

3.2. Regression results

We use fixed-effects panel regressions to examine the association between executive age and gender and market-based measures of firm risk in a multivariate setting. The estimation results of nine alternative versions of Equation (1) are presented in Table 3. In Models 1-3, we use *Total risk* as the dependent variable, while in Models 4-6 and 7-9 the dependent variables are *Systematic risk* and *Idiosyncratic risk*, respectively. All of these alternative regression

specifications include the same set of control variables and account for industry fixed-effects as well as year fixed-effects. As shown in the table, the adjusted R^2s of our panel regressions range from 67 percent to 93 percent and the *F*-statistics are significant at the 1 percent level in every model specification.[9]

(insert Table 3 about here)

Regarding the test variables of interest, the estimates in Table 3 demonstrate that firm risk is negatively associated with the age of the top executives and especially with the age of the CEO. Specifically, in the regressions with *Total risk* (Models 1-3) and *Idiosyncratic risk* (Models 7-9) as the dependent variables, the coefficient estimates for *CEO age* are consistently negative and statistically highly significant. Moreover, the coefficients for *CFO age* also appear significant in Models 8 and 9. Thus, consistent with the hypothesis that older CEOs and CFOs are more risk averse, the regressions indicate that firms with older executives are associated with lower risk. This finding suggests that age-based differences in risk tolerance may be reflected in firm-level risk, and more generally, that the age of the firm's top executives may have important implications for corporate outcomes. However, the estimates in Table 5 also indicate that the level of systematic risk is unaffected by the age of the firm's CEO and CFO. In the three alternative regressions with *Systematic risk* as the dependent variable (Models 4-6), the coefficients for *CEO age* and *CFO age* are statistically insignificant.

[9] It should be noted that the high R^2s are caused by the inclusion of industry and year fixed-effects in the regressions. Without industy and year fixed-effects, the R^2s of the regressions are much lower and range from 5 percent to 31 percent.

As can be noted from Table 3, the coefficient estimates for *Female CFO* are positive and highly significant in the regressions with *Total risk* (Models 1-3) and *Idiosyncratic risk* (Models 7-9) as the dependent variables. Moreover, the coefficients for *Female CEO* are also positive and significant in the *Idiosyncratic risk* regressions (Models 7 and 9). Thus, the regression results suggest that female-led firms, and especially the firms with female CFOs, are more risky. The magnitudes of the estimated coefficients suggest that female CEOs and CFOs increase stock return volatility by approximately 3 to 5 percentage-points. The observed positive association of female executives with firm riskiness is inconsistent with the hypothesis that female executives are more risk averse as well as with the prior empirical evidence documented in Elsaid and Ursel (2011), Palvia et al. (2015), and Faccio et al. (2016). Nonetheless, it is important to note that our results cannot be directly contrasted with the prior studies which have not examined the influence of female CFOs on firm risk and have focused on accounting-based measures of risk instead of market-based risk measures. Moreover, the documented positive association between female executives and firm risk is broadly consistent with Adams and Funk (2012) and Berger et al. (2014), who document that female CEOs and directors are more risk-loving than their male counterparts and they may have a positive influence on firm risk-taking. Similar to the coefficients for *CEO age* and *CFO age*, the coefficient estimates for *Female CEO* and *Female CFO* are statistically insignificant in the regressions with *Systematic risk* as the dependent variable (Models 4-6). Thus, we conclude that the level of systematic risk appears unaffected by executive age and gender.

The coefficient estimates for most of the control variables in Table 3 are highly significant throughout the alternative model specifications, demonstrating the importance of these variables as determinants of *Total risk*, *Systematic risk*, and *Idiosyncratic risk*. The

regressions indicate that the market-based firm risk measures are positively associated with *Leverage*, *Cash holdings*, *Cash flow volatility*, and *Ownership*, while being negatively related to *Size*, *Profitability*, *Market-to-book*, and *Firm age*. The regression results in Table 3 are somewhat equivocal with respect to managerial compensation incentives. *CEO delta* is positively associated with *Total risk* and *Idiosyncratic risk*. On the other hand, *CFO delta* is negatively associated with *Idiosyncratic risk*, while the coefficient estimates for *CEO vega* are consistently negative and significant. Hence, a bit surprisingly, the estimates suggest that firms are less risky when the wealth of the top executives is more sensitive to stock return volatility.[10]

Overall, the regression results presented in Table 3 demonstrate that the age and gender of the firm's top executives are important factors for explaining the cross-sectional differences in stock return volatility and idiosyncratic risk. Specifically, the results provide strong evidence that firms led by older CEOs are less risky, and moreover, that firms with older CFOs are associated with lower idiosyncratic risk. These findings corroborate the empirical evidence recently reported in Serfling (2014) with respect to CEO age and thereby provide further support for the hypothesis that older executives are more risk averse and may constrain risk-taking by their firms. Our panel regressions further indicate that firms with female CFOs are associated with significantly more volatile stock returns and higher levels of idiosyncratic risk, and we also

[10] Similar to our results, Serfling (2014) documents negative and highly significant coefficients for CEO vegas in his regressions with total risk and idiosyncratic risk as the dependent variables. The negative relation between vegas and market-based risk measures is intriguing given that vega is an explicit measure of risk-sensitivity of executive compensation, thereby providing a direct proxy for the risk-taking incentives of the top executives. In the prior literature, higher vegas have been commonly linked to higher stock return volatility and riskier corporate policies (e.g., Coles, Daniel and Naveen, 2006; Chava and Purnanandam, 2010). Nevertheless, the less recognized alternative view is that compensation-based risk-taking incentives do not necessarily encourage risk-averse, less-diversified executives to increase firm risk and may even induce executives to adopt less risky policies (e.g., Carpenter, 2000; Meulbroek, 2001; Ross, 2004; Hayes, Lemmon and Qiu, 2012).

document a positive association between female CEOs and idiosyncratic risk. Hence, the results do not support the hypothesis that female executives are more risk averse and constrain firm-level risk. Nevertheless, it is important to acknowledge that executive age and gender are closely intertwined variables and are likely to have confounding effects on firm risk-taking because female executives, on average, tend to be younger than male executives.

3.3. Endogeneity

Potential endogeneity and reverse causality are always a concern in an empirical analysis such as ours. It is possible that certain firm characteristics or shareholder preferences simultaneously affect firm risk and the appointment of top executives of certain age or gender. Moreover, executives may self-select into firms with specific risk characteristics based on their personal risk preferences and level of risk tolerance. We aim to mitigate these endogeneity concerns by conducting three additional tests.

First, we utilize two-stage instrumental variable regressions to examine the effects of executive age and gender on firm-level riskiness. Following Serfling (2014) and Cline and Yore (2016), we use the logarithm of the consumer price index in the birth year of the executive (*CPI at birth*) as the instrumental variable for *CEO age* and *CFO age*. As argued by Serfling (2014) and Cline and Yore (2016), *CPI at birth* should be highly correlated with executive age while being uncorrelated with the current financial policies of individual firms. Consistent with Huang and Kisgen (2013) and Palvia et al. (2015), our instrument of choice for *Female CEO* and *Female CFO* is the level of the gender equality index in the firm's headquarter state (*Gender equality index*). Gender status equality is likely to be positively related to the appointment of female executives and should arguably not have any conceptual relation to the riskiness of

individual firms.

(insert Table 4 about here)

Table 4 presents the coefficient estimates of the two-stage instrumental variable regressions. Consistent with Serfling (2014) and Cline and Yore (2016), the first-stage regressions in Panel A indicate that *CPI at birth* is significantly negatively associated with executive age. The high partial R^2s and partial *F*-statistics indicate that *CPI at birth* is a strong instrument for *CEO age* and *CFO age*. The second-stage regressions with the instrumented executive age variables are broadly consistent with our main regression results in Table 3. The coefficients for the instrumented *CEO age* and *CFO age* are negative and highly significant in the regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables, while being insignificant in the regressions with *Systematic risk* as the dependent variable. Hence, the instrumental variable regressions alleviate age-related endogeneity concerns and provide additional evidence to suggest that older CEOs and CFOs constrain firm risk-taking.

The instrumental variable regressions regarding female executives are reported in Panel B of Table 4. As can be seen from the table, the coefficient estimates for *Gender equality index* in both first-stage regressions are positive and highly significant, indicating that state-level gender status equality is positively associated with the appointment of female executives. However, despite the significant coefficients for the instrumental variable, the low partial R^2s and the low partial *F*-statistics, especially in the first-stage regression with *Female CEO* as the dependent variable (*F*-stat = 5.43), suggest that the IV estimates are likely to suffer from a weak-

instrument problem.[11] As noted by Larcker and Rusticus (2010), the use of weak instruments can have large effects on the second-stage estimates and can cause serious inference problems. Thus, the IV estimates in Panel B should be interpreted cautiously. The coefficients for the instrumented *Female CEO* and the instrumented *Female CFO* in the second-stage are insignificant throughout the alternative model specifications, with the only exception being the positive and significant coefficient for the instrumented *Female CFO* in Model 4. It can be noted from the second-stage estimates that some of the coefficients on the instrumented female executive variables are unreasonably large in comparison to the female executive coefficients in Table 3, which suggests that the IV estimates are not reliable enough to replace our main regressions. Given the weak-instrument problem associated with *Gender equality index* and the lack of a more appropriate instrument, we are unable to rule out concerns about endogeneity with the instrumental variable regressions.

Our second approach for alleviating endogeneity concerns is propensity score matching. The univariate tests in Table 3 suggest that firms led by younger CEOs and CFOs are very different from the ones led by older executives, and moreover, that female-led firms differ from the male-led firms at least in terms of executive age, cash holdings, growth, institutional ownership, R&D intensity, and executive compensation incentives. Using propensity score matching, we build several matched-firm samples in which firms led by young executives are matched with essentially identical firms led by older executives and female-led firms are matched with similar male-led firms. We use the firm-specific control variables and the industry and year dummies to estimate propensity scores in order to identify firms with older executives

[11] The first-stage *F*-statistics reported in Huang and Kisgen (2013) are also low and suggest that *Gender equality index* is not a particularly strong instrument for a firm having a female executive.

that are statistically indistinguishable from the firms with young executives. Similarly, we use propensity score matching to identify male-led firms that are indistinguishable from the female-led firms in terms of the control variables. We utilize one-to-one nearest neighbor matching and require that the maximum difference between the propensity score of each treatment firm and that of its matched control firm does not exceed 0.2 standard deviations. Given that the only observable differences between the propensity score matched samples are the age and gender of the CEOs and CFOs, we should not observe any differences in *Total risk*, *Systematic risk* and *Idiosyncratic risk* unless firm-level riskiness is affected by the age and/or the gender of the firm's top executives. Thus, propensity score matching should correct for any endogenous selection on observed variables.

(insert Table 5 about here)

Table 5 reports the results of alternative versions of Equation (1) based on the propensity score matched samples. In Panel A of Table 5, we match firms led by young top executives with firms led by older executives. Given that executive age and gender are closely intertwined variables in the sample firms and may have offsetting effects firm risk, we perform the propensity score matching both with and without executive gender matching. The matching diagnostics in Panel A indicate that the matched control firms are essentially identical to the treatment firms in terms of observable firm characteristics. The mean differences between the propensity scores of the treatment and matched firms are 0.00 in all four matches and the mean percentage differences range from 0.06 to 0.08 percent. When the probit models underlying the propensity score matching is re-estimated using the matched samples, the coefficients for the

control variables appear statistically insignificant and the insignificant post-matching LR chi-square statistics suggest that all of the coefficients are simultaneously equal to zero in all four matches. This suggests that the propensity score matching effectively removes the observable differences between the firms.

Overall, the results of the regressions in Panel A provide further support for the hypothesis that older executives reduce firm riskiness. Consistent with our main regressions in Table 3, the coefficients for *CEO age* are negative and statistically significant and also the coefficients for *CFO age* are negative and significant in the regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables. When executive gender is used as an additional matching criterion in the propensity score, we observe that *CEO age* is negatively associated with *Total risk* and *Idiosyncratic risk* and also the coefficient for CFO age is negative and significant at the 5 percent level in Model 2. The coefficients for *Female CEO* and *Female CFO* are positive and appear more significant when executive gender is used as an additional matching criterion.

In Panel B of Table 5, we match each firm led by a female CEO with a similar firm led by a male CEO and each firm led by a female CFO with an identical firm led by a male CFO. Similar to Panel A, we perform the propensity score matching both with and without executive age matching because of the potentially confounding effects of age and gender on firm risk.[12] Again, the matching diagnostics indicate that the matched peer firms are sufficiently similar to the treatment firms. The mean differences between the propensity scores of the treatment and matched control firms are 0.00 in all four matches and the mean percentage differences are around 0.04 percent. Furthermore, the post-matching LR chi-square statistics of the probit

[12] Female CEOs and CFOs are statistically significantly younger than male CEOs and CFOs in the matched-firm samples when propensity score matching is performed without matching for executive age.

models are insignificant, and thereby indicate that the matching removes the observable differences between the firms.

When executive age is not used as a matching criterion, the regressions provide rather weak evidence of a positive relationship between female executives and firm risk. The coefficient estimate for *Female CFO* is positive and significant at the 10 percent level in Model 2 and the coefficient for *Female CEO* is positive and significant at the 5 percent level in Model 5. When the propensity score matching is performed with executive age as an additional matching criterion, the regressions indicate that firms led by female CFOs are associated with more volatile stock returns and higher levels of systematic and idiosyncratic risk than essentially identical male-led firms. It is noteworthy that the coefficients for *CEO age* and *CFO age* are statistically insignificant throughout the alternative regression specifications when female-led firms are matched with firms led by male executives of similar age. Taken as a whole, the matched sample regressions presented in Panel B suggest that firms with female CFOs exhibit greater risk.

Finally, we attempt to moderate endogeneity concerns by analyzing changes in firm risk after executive turnovers. Ultimately, if firm risk is affected by the age and gender of the firm's top executives, we should observe a change in the risk measures after the appointment of new executives who differ from their predecessors in terms of age and/or gender. Hence, we identify CEO and CFO turnovers in which the new executive is at least five years younger than the predecessor and also turnovers in which a male executive is replaced by a female executive. After identifying these executive turnovers, we estimate difference-in-difference regressions with changes in *Total risk*, *Systematic risk*, and *Idiosyncratic risk* from year t to t+1 as the dependent variables.

(insert Table 6 about here)

The estimates of the executive turnover regressions are reported in Table 6. In Panel A, the dependent variable is the change in *Total risk* from the year of executive turnover to the following year. The difference-in-difference estimates in Panel A suggest that CEO and CFO turnovers in which a younger executive succeeds an older executive do not affect stock return volatility. While we do not observe any significant change in *Total risk* after male-to-female CEO turnovers, the regression results indicate that *Total risk* decreases significantly after turnovers in which a male CFO is replaced by a female CFO.

Panel B of Table 8 reports the regressions with the change in *Systematic risk* as the dependent variable. As can be noted from the table, the coefficient estimates in Panel B uniformly indicate that *Systematic risk* decreases after executive turnovers regardless of whether the new executive is younger than the predecessor or whether a male executive is succeeded by a female executive. Lastly, Panel C presents the executive turnover regressions with the change in *Idiosyncratic risk* as the dependent variable. Inconsistent with the estimates in Panel B, these regressions suggest that *Idiosyncratic risk* increases after turnovers in which a younger executive succeeds an older executive and also after male-to-female turnovers. Overall, the results of the executive turnover regressions in Table 6 are inconclusive and provide ambiguous evidence regarding the effects of executive age and gender on firm riskiness. Nevertheless, when interpreting these results, it is necessary to recognize that the potential implications of new executives on firm risk may be seen with a considerable lag rather than immediately after the turnover.

3.4. Executive age and gender and the riskiness of firm financial and investment decisions

The primary objective of this paper is to examine how executive age and gender relate to market-based measures of firm risk. The market-based firm risk measures reflect perceptions about risks related to the firm's business strategies, financial and investment decisions, and the variability of cash flows. Our empirical findings above indicate that firms led by younger CEOs and CFOs as well as firms led by female CFOs are more risky after controlling for firm-specific attributes, financial and investment policies, and managerial risk-taking incentives. However, given that market-based risk measures are not managerial choice variables that the top executives, per se, could directly influence, we next aim to investigate the mechanism by which executive age and gender may affect stock return volatility and idiosyncratic risk.

Based on the prior literature, the main channels through which the characteristics and personal preferences of the top executives can influence market-based risk measures are corporate financial and investment policy decisions; more risk-averse executives can reduce firm risk by making more conservative policy choices. With respect to executive age and gender, the findings of Serfling (2014) indicate that firms with older CEOs invest less in research and development, have lower operating leverage, hold less cash, and undertake more diversifying acquisitions, while the results of Elsaid and Ursel (2011), Palvia et al. (2015) and Faccio et al. (2016) suggest that female-led firms have lower leverage, higher cash holdings, and less volatile cash flows and earnings.

Our univariate tests in Table 2 indicate that there are significant differences in observable policy choice variables between the firms led by older and younger executives and also between the firms led by male and female executives. Specifically, at least in a univariate setting, firms led by younger top executives have lower financial leverage, higher cash holdings, more volatile

cash flows, and higher research and development investments. With the exception of lower leverage, these variables are positively associated with market-based measures of firm risk.[13] Moreover, the univariate tests indicate that firms with female CFOs appear to have lower leverage, higher cash holdings, and lower R&D intensity than firms with male CFOs. This suggests that female CFOs may pursue more conservative financial and investment policies. Collectively, the univariate tests demonstrate that executive age and gender are associated with financial and investment policies that are proximal to managerial decision-making, and are the primary channels through which the top executives may influence firm risk.[14]

Given the differences in policy choice variables, we next regress *Leverage*, *Cash holdings*, *Cash flow volatility*, and *R&D* on the executive age and gender variables while controlling for firm size, managerial compensation incentives, and industry and year fixed-effects. These regressions (not tabulated) indicate that *CEO age* and *CFO age* are positively associated with *Leverage* and negatively associated with *Cash holdings*. Moreover, consistent with Serfling (2014), we find that *CEO age* is significantly negatively associated with *R&D*. The regressions further demonstrate that firms led by female CEOs and CFOs have significantly higher cash holdings. Consistent with the findings of Palvia et al. (2015) and Faccio et al. (2016)

[13] It is worth noting that although higher cash holdings may improve firm liquidity and act as a buffer to mitigate unforeseen risks, contrary to casual intuition, larger cash holdings are strongly positively associated with firm risk. Although more conservative executives may prefer higher cash holdings, several studies show that cash holdings are associated with higher firm risk, riskier cash flows, higher R&D intensity, value-destroying corporate acquisitions, and more severe agency problems (e.g., Harford, 1999; Harford, Mansi and Maxwell, 2008; Acharya, Davydenko and Strebulaev, 2012; Palazzo, 2012).

[14] Other potential channels through which executive age and gender may affect market-based risk measures include acquisition strategies and propensity (Huang and Kisgen, 2013; Yim, 2013; Serfling, 2014; Zhang et al., 2016), corporate deal-making (Jenter and Lewellen, 2015; Cline and Yore, 2016), and informational asymmetries between the executives and other stakeholders (Antia et al., 2010; Barua et al., 2010; Jurkus et al., 2011).

regarding female CEOs, our regressions indicate that *Female CFO* is negatively associated with *Leverage*. Interestingly, the coefficient estimate for *Female CEO* is positive and the coefficient for *Female CFO* is negative in the regressions with *R&D* as the dependent variable. Finally, the regressions indicate that executive age and gender have no meaningful effect on cash flow volatility.

Our main analysis in Table 3 indicates that executive age and gender have incremental impact on market-based risk measures over and above the influence of financial and investment policy variables that, in turn, are also influenced by executive age and gender. This provides an impetus to specify and estimate simultaneous equations models. Thus, we estimate six alternative simultaneous systems of four equations using seemingly unrelated regression (SUR) approach which allows residual correlation across the equations. In particular, we estimate simultaneous equations specifications in which our three policy choice variables of interest (*Leverage*, *Cash holdings*, and *R&D*) are a function of executive age and gender and industry and year fixed-effects, and our three market-based firm risk measures (*Total risk*, *Systematic risk*, and *Idiosyncratic risk*) are simultaneously a function of executive age and gender, the three policy choice variables and other firm-specific controls as well as industry and year fixed-effects.

(insert Table 7 about here)

Table 7 reports the estimates of the simultaneous equations systems. The estimation results show that firms led by older CEOs have significantly higher financial leverage and lower research and development investments and lower cash holdings. *CFO age* is unrelated to *Leverage* and *R&D*, but is strongly negatively associated with *Cash holdings*. Furthermore, the

estimates indicate that firms with female CFOs have lower leverage and R&D intensity and hold higher levels of cash. *Female CEO* is significantly positively associated with *R&D* and *Cash holdings*. Consistent with our main regressions reported in Table 3, the coefficient estimates of the risk equations demonstrate that CEO age and CFO gender influence market-based measures of firm risk. The results provide strong evidence to suggest that firms with younger CEOs and female CFOs are associated with more volatile stock returns and higher levels of idiosyncratic risk. The estimates also indicate that *Female CEO* is positively associated with *Idiosyncratic risk* and *CFO age* is positively associated with *Systematic risk*.

Overall, our results suggest that the age and gender of the top executives are important for explaining the cross-sectional differences in market-based measures of firm risk even after controlling for financial and investment policy choices that are likely to be influenced by executive preferences and incentives. Our empirical findings indicate that the negative association between executive age and market-based risk measures of firm risk can to some extent be explained by lower research and development investments and lower cash holdings. The documented positive association between female CFOs and market-based risk measures, however, is more puzzling given that firms with female CFOs have lower financial leverage and invest less in research and development. The only policy choice variable in female-led firms that is consistent with higher firm risk is the level of cash holdings.

3.5. Robustness checks

We examine the robustness of our empirical findings with a number of additional tests.[15] First, we estimate several alternative parsimonious versions of Equation (1) in order to ensure that our results are not caused by spurious correlations between the independent variables or affected by potentially redundant control variables. Specifically, we estimate models in which only *Size*, *Leverage*, *Profitability*, and *Growth* are used as the only control variables.[16] The estimates of these regressions (not tabulated) are consistent with the results reported in Table 3. Most importantly, the coefficients for *CEO age* and *CFO age* are negative and statistically significant and the coefficients for *Female CEO* and *Female CFO* are positive and significant in the regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables. Furthermore, we also estimate parsimonious models in which the age and gender variables are not included simultaneously. The estimated coefficients for *CEO age* and *CFO age* are negative and highly significant in the models without executive gender dummies and with *Total risk* and *Idiosyncratic risk* as the dependent variables, while being positive in the models with *Systematic risk* as the dependent variable. When we exclude the executive age variables from the regressions, the coefficient estimates for *Female CEO* and *Female CFO* are positive and statistically significant. Overall, these additional regressions suggest that our results are not caused by spurious correlations between the variables.

[15] For brevity, the results of the robustness checks are only described in the text. Tabulated results are available from the authors.

[16] The parsimonious set of control variables increases sample size to 10,063 firm-year observations in the regressions with CEO characteristics and to 7,625 firm-year observations in the regressions with CFO characteristics as the test variables of interest.

In order to address potential firm-size effects, we re-estimate the regressions using two subsamples from which either the largest quartile or the smallest quartile of firms are excluded.[17] The estimates based on the subsample from which the smallest firms are excluded are qualitatively similar to our main findings, and indicate that firms led by older CEOs and by male CFOs are less risky. Nevertheless, in contrast to our main results in Table 3, the coefficients for *CFO age* and *Female CEO* are insignificant throughout the alternative model specifications. Moreover, the coefficient estimate for *CEO age* is negative and significant in Model 4 and the coefficients *Female CFO* are positive and significant in Models 5 and 6 with *Systematic risk* as the dependent variable, suggesting that large firms with younger CEOs and female CFOs are associated with higher levels of systematic risk in addition to having more volatile stock returns and higher idiosyncratic risk.

When the largest firms are excluded from the sample, the coefficient estimates for *CEO age* and *CFO age* are negative and significant in the regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables with the only exception being the insignificant coefficient for *CEO age* in Model 9. However, inconsistent with our main results, the coefficients for *Female CEO* and *Female CFO* are insignificant throughout the different regression specifications. Taken as a whole, the regressions based on the size-restricted samples demonstrate that the negative association between executive age and firm riskiness is insensitive to firm-size effects, while the documented positive association between female executives and risk is more pertained to larger firms.

[17] Recall that the univariate tests reported in Table 2 suggest that larger firms are more likely to have older CEOs and CFOs.

To further examine the robustness of our results, we perform additional regressions using subsamples from which either the youngest or the oldest quartile of executives are excluded. These regressions are broadly consistent with our main analysis, but also suggest that our findings are to some extent driven by firms with younger top executives. When the firms with the oldest CEOs and CFOs are excluded, the coefficients for *CEO age* are negative and significant and the coefficients for *Female CFO* are positive and significant in the regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables. Moreover, the coefficient for *Female CFO* is positive and significant also in the regression with *Systematic risk* as the dependent variable. When the youngest executives are excluded from the sample, the coefficients for *CEO age* and *CFO age* are insignificant, while the coefficients for *Female CFO* remain positive and statistically significant. Inconsistent with our main regressions, the coefficient for *Female CEO* is negative and becomes statistically significant when the regressions are estimated using the subsample of firms without youngest CEOs.

Finally, we acknowledge that executive age and gender are closely intertwined variables which may have confounding effects on firm risk-taking. Given that female CEOs and CFOs are younger than corresponding male top executives, we further investigate the effects of executive gender on firm risk by using dummy variables for old and young female CEOs and CFOs. These dummy variables are constructed based on the median ages of female CEOs and CFOs in our sample. We re-estimate the regressions by replacing the executive age and gender variables with the young and old female executive dummies. The estimates of these additional regressions indicate that firms led by female CEOs are associated with higher levels of idiosyncratic risk regardless of the age of the CEOs. Consistent with our main regressions in Table 3, the coefficients for the young and old female CEO dummy variables are insignificant in the *Total*

risk and *Systematic risk* regressions. The coefficient estimates for the young female CFO dummy variables are positive and statistically significant at the 1 percent level in the regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables, while the coefficients for the old female CFO variables are insignificant throughout the regressions. Thus, these additional regressions indicate that the positive association between female CFOs and risk-taking is induced by firms with young female CFOs, suggesting that the effect of executive gender on firm risk is confounded by age-effects.

Collectively, the additional tests imply that our empirical findings are robust to alternative model specifications and variable definitions. The robustness checks mostly support the conclusions drawn from our main analysis, and thereby provide further evidence to suggest that firms with older CEOs and CFOs are associated with less volatile stock returns and lower idiosyncratic risk and that female-led firms exhibit higher risk. Nevertheless, it can also be concluded from our additional tests that the results with respect to female executives and especially female CEOs are less robust and are to some extent driven by firms with younger top executives.

4. CONCLUSIONS

In this paper, we examine whether market-based measures of firm risk are associated with the age and gender of the firm's Chief Executive Officer and Chief Financial Officer. The motivation for our analysis comes from the age and gender-related behavioral differences that have been extensively documented in the psychology and experimental economics literature over the past few decades. The prior literature generally suggests that aging leads to increased risk aversion, and moreover, that women tend to be more risk averse than men. If these age and

gender-based differences in risk tolerance affect decision-making in a professional setting and are reflected in corporate decisions that the firm's top executives make, we should observe that firms with older executives and female executives are less risky.

Using data on the S&P 1500 firms from 2004 to 2014, we find that the age- and gender-related behavioral differences may influence firm risk. Specifically, our empirical findings indicate that firms with older top executives are associated with less volatile stock returns and lower levels of idiosyncratic risk. This evidence suggests that executives become more risk averse with age and may constrain excessive risk-taking by their firms. While our analysis complements and confirms the findings of Serfling (2014) with respect to a strong negative association between CEO age and firm risk, we also extend the analysis by documenting that CEO age is largely irrelevant with respect to systematic risk, and moreover, that firms with older CFOs are also associated with lower levels of idiosyncratic risk. Overall, the results demonstrate that the age of the CFO has an incremental impact on firm risk over and above the influence of CEO age. Our additional tests indicate that the negative association between executive age and market-based measures of firm risk can to some extent be explained by lower research and development investments and lower cash holdings.

Our empirical findings on the influence of executive gender on firm risk are a bit more ambiguous. We document strong evidence that firms with female CFOs are associated with higher total risk and idiosyncratic risk after controlling for firm-specific attributes, financial and investment policy choices, managerial risk-taking incentives, and potential endogeneity. We also find weaker and less robust evidence to suggest that firms led by female CEOs exhibit greater risk. The positive association between female executives and firm risk is in stark contrast to Elsaid and Ursel (2011), Palvia et al. (2015), Faccio et al. (2016) who consider accounting-based

measures of risk instead of the market-based measures of firm riskiness utilized in this study. We also document that female executives, on average, are younger than their male counterparts, and furthermore, that the positive association between female executives and risk-taking is induced by firms with younger top executives. This suggests that the influence of executive gender on firm risk may be confounded by age-effects. Collectively, our results with respect to executive gender and market-based risk measures do not provide support for the hypothesis that female executives are more risk averse and would constrain risk-taking by their firms.

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Table 1. Descriptive statistics.

Variable	Mean	Median	Min	Max	Std. dev.	No. of obs.
Risk measures:						
Total risk	0.39	0.35	0.13	1.06	0.18	8364
Systematic risk	0.94	0.93	0.03	2.41	0.53	8364
Idiosyncratic risk	0.05	0.02	0.01	0.19	0.05	8364
Gender and age:						
CEO age	55.76	56.00	29.00	90.00	6.85	8364
CFO age	50.65	51.00	29.00	71.00	6.40	6395
Female CEO	0.03	0.00	0.00	1.00	0.16	8364
Female CFO	0.09	0.00	0.00	1.00	0.29	6395
Control variables:						
Size	8937.74	2031.75	93.81	269147.90	24316.14	8364
Leverage	0.28	0.14	0.00	2.34	0.41	8364
Profitability	5.68	5.76	-170.14	78.31	8.88	8364
Cash holdings	0.11	0.08	0.00	0.77	0.11	8364
Cash flow volatility	0.58	0.33	0.00	8.60	0.99	8364
Growth	4.37	4.36	3.84	4.97	0.17	8364
Market-to-book	1.69	1.35	0.08	7.16	1.23	8364
Institutional ownership	0.80	0.82	0.21	1.17	0.16	8364
R&D	0.04	0.00	0.00	3.94	0.11	8364
Firm age	28.27	21.00	0.00	86.00	20.66	8364
CEO delta	659.41	256.06	5.59	9988.90	1314.59	8364
CEO vega	167.78	75.74	0.00	1376.18	242.95	8364
CFO delta	83.92	41.99	0.90	764.72	117.74	6395
CFO vega	40.31	18.35	0.00	367.90	59.63	6395

The table reports summary statistics for the sample of S&P 1500 firms. Financial institutions (SIC codes 6000–6900) and firms with inadequate data for our regression analysis are excluded. *Total risk* is measured as the annualized standard deviation of daily stock returns, *Systematic risk* is the beta coefficient of the market model estimated against the S&P 500 index using daily return data, and *Idiosyncratic risk* is the standard deviation of the residuals of the market model regression. *CEO age* and *CFO age* denote the ages of the corresponding executives. *Female CEO* equals one if the firm's CEO is a female and *Female CFO* is assigned to if the firm has a female CFO. *Size* is measured by the firm's total assets, *Leverage* is the ratio of long-term debt to market value of equity, *Profitability* is measured as the return on assets (ROA), *Cash holdings* is cash holdings scaled by total assets, *Cash flow volatility* is the coefficient of variation of cash flows from operations over the preceding five years, *Growth* is the three-year growth rate of sales, *Market-to-book* is the market value of equity divided by the book value of equity, *Institutional ownership* is the percentage of institutional ownership, *R&D* is research and development expenditures scaled by sales, *Firm age* is the age of the firm, *CEO delta* and *CFO delta* measure the sensitivity of executive wealth to changes in stock price (dollar change in wealth for a one percent change in stock price), and *CEO vega* and *CFO vega* measure the sensitivity of executive wealth to changes in stock return volatility (dollar change in wealth for a one percentage point change in volatility). The risk measures and the control variables are winsorized at the 1st and 99th percentiles.

Table 2. Univariate tests: executive age and gender.

Panel A: Firms with young CEOs vs. firms with old CEOs

	Young CEO	No. of obs.	Old CEO	No. of obs.	Difference	t-stat
Total risk	0.404	2919	0.372	2755	0.033 ***	7.19
Systematic risk	0.912	2919	0.843	2755	0.069 ***	4.72
Idiosyncratic risk	0.050	2919	0.057	2755	-0.007 ***	-5.06
CFO age	49.639	2324	51.944	2169	-2.305 ***	-11.64
Female CEO	0.039	3058	0.009	2815	0.030 ***	7.58
Female CFO	0.086	2485	0.102	2305	-0.016 *	-1.93
Size	7.403	2813	7.706	2527	-0.303 ***	-7.20
Leverage	0.183	2777	0.211	2513	-0.028 ***	-4.21
Profitability	5.795	3048	5.404	2811	0.391 *	1.89
Cash holdings	0.116	2970	0.098	2748	0.018 ***	6.79
Cash flow volatility	0.392	2970	0.375	2748	0.017 *	1.93
Growth	4.392	3043	4.363	2811	0.029 ***	6.31
Market-to-book	0.402	2777	0.259	2513	0.143 ***	7.62
Institutional ownership	0.809	2869	0.763	2684	0.046 ***	10.04
R&D	0.043	2970	0.028	2748	0.014 ***	8.10
Firm age	2.862	2970	3.187	2748	-0.325 ***	-15.82
CEO delta	5.349	2568	5.850	2309	-0.501 ***	-12.25
CEO vega	3.846	2767	3.811	2513	0.035	0.66
CFO delta	3.709	2109	3.748	1955	-0.039	-1.01
CFO vega	2.580	2284	2.598	2131	-0.017	-0.37

Panel B: Firms with young CFOs vs. firms with old CFOs

	Young CFO	No. of obs.	Old CFO	No. of obs.	Difference	t-stat
Total risk	0.441	2220	0.384	2126	0.057 ***	10.05
Systematic risk	0.836	2220	0.716	2126	0.120 ***	7.37
Idiosyncratic risk	0.058	2220	0.068	2126	-0.010 ***	-6.82
CEO age	54.599	2276	57.282	2163	-2.683 ***	-11.91
Female CEO	0.032	2290	0.039	2171	-0.006	-1.15
Female CFO	0.096	2292	0.048	2171	0.047 ***	6.10
Size	7.392	2076	7.742	1848	-0.350 ***	-7.05
Leverage	0.207	2059	0.217	1837	-0.010	-1.20
Profitability	4.927	2288	5.424	2165	-0.497 **	-2.08
Cash holdings	0.119	2213	0.100	2100	0.019 ***	6.20
Cash flow volatility	0.392	2213	0.372	2100	0.020 *	1.92
Growth	4.370	2283	4.350	2163	0.020 ***	3.75
Market-to-book	0.284	2059	0.253	1837	0.031	1.42
Institutional ownership	0.809	2140	0.767	2015	0.042 ***	8.14
R&D	0.036	2213	0.035	2100	0.002	0.60
Firm age	2.922	2213	3.224	2100	-0.302 ***	-12.78
CEO delta	5.294	1925	5.522	1801	-0.229 ***	-5.04
CEO vega	3.667	2047	3.613	1990	0.054	0.87
CFO delta	3.385	1947	3.990	1775	-0.605 ***	-15.18
CFO vega	2.393	2111	2.578	2018	-0.185 ***	-3.70

Table 2. *Continued.*

Panel C: Firms with female CEOs vs. firms with male CEOs

	Female CEO	No. of obs.	Male CEO	No. of obs.	Difference	t-stat
Total risk	0.367	353	0.380	10926	-0.013	-1.39
Systematic risk	0.699	353	0.873	10926	-0.175 ***	-5.87
Idiosyncratic risk	0.067	353	0.053	10926	0.014 ***	5.11
CEO age	53.570	363	56.023	11149	-2.453 ***	-6.40
CFO age	51.094	319	50.924	8631	0.170	0.46
Female CFO	0.143	335	0.090	9263	0.053 ***	3.29
Size	7.755	309	7.722	10305	0.032	0.36
Leverage	0.214	303	0.210	10221	0.004	0.28
Profitability	5.629	367	5.559	11295	0.070	0.17
Cash holdings	0.114	348	0.099	11039	0.015 ***	2.92
Cash flow volatility	0.361	348	0.378	11039	-0.017	-0.97
Growth	4.344	369	4.372	11288	-0.028 ***	-3.10
Market-to-book	0.253	303	0.301	10221	-0.048	-1.21
Institutional ownership	0.768	336	0.788	10674	-0.019 **	-2.06
R&D	0.033	348	0.034	11039	-0.001	-0.23
Firm age	3.078	348	3.105	11039	-0.027	-0.62
CEO delta	5.145	303	5.557	9450	-0.413 ***	-5.05
CEO vega	3.456	342	3.876	10286	-0.420 ***	-3.97
CFO delta	3.495	256	3.784	7793	-0.288 ***	-3.64
CFO vega	2.214	306	2.626	8564	-0.412 ***	-4.41

Panel D: Firms with female CFOs vs. firms with male CFOs

	Female CFO	No. of obs.	Male CFO	No. of obs.	Difference	t-stat
Total risk	0.387	873	0.396	8475	-0.009	-1.41
Systematic risk	0.720	873	0.796	8475	-0.076 ***	-3.97
Idiosyncratic risk	0.069	873	0.060	8475	0.009 ***	5.11
CEO age	56.475	880	55.898	8645	0.577 **	2.27
CFO age	49.686	821	51.052	8134	-1.366 ***	-5.75
Female CEO	0.054	885	0.033	8713	0.021 ***	3.29
Size	7.696	773	7.744	7774	-0.048	-0.82
Leverage	0.187	771	0.221	7701	-0.034 ***	-3.51
Profitability	6.222	884	5.230	8698	0.991 ***	3.61
Cash holdings	0.112	871	0.101	8455	0.011 ***	3.13
Cash flow volatility	0.369	871	0.368	8455	0.001	0.06
Growth	4.366	886	4.361	8692	0.005	0.83
Market-to-book	0.277	771	0.264	7701	0.013	0.49
Institutional ownership	0.792	839	0.789	8205	0.003	0.47
R&D	0.028	871	0.034	8455	-0.005 **	2.11
Firm age	3.041	871	3.121	8455	-0.080 ***	2.79
CEO delta	5.569	751	5.474	7347	0.095 *	1.76
CEO vega	3.906	818	3.770	7921	0.136 *	1.89
CFO delta	3.731	743	3.778	7308	-0.047	-0.98
CFO vega	2.598	827	2.613	8045	-0.015	-0.25

The table reports the mean values for the dependent and independent variables and the results of two-tailed *t*-tests for the null hypothesis that there is no difference in the means between two subgroups. In Panels A and B, the young CEO (CFO) subgroup consists of firms with CEO (CFO) age in the bottom quartile of the sample and the old CEO (CFO) subgroup consists of firms with CEO (CFO) age in the top quartile of the sample. In Panels C and D, the sample is divided into subsamples of firms with female CEOs (CFOs) and male CEOs (CFOs). *Total risk* is measured as the annualized standard deviation of daily stock returns, *Systematic risk* is the beta coefficient of the market model estimated against the S&P 500 index using daily return data, and *Idiosyncratic risk* is the standard deviation of the residuals of the market model regression. *CEO age* and *CFO age* denote the ages of the corresponding executives. *Female CEO* equals one if the firm's CEO is a female and *Female CFO* is assigned to if the firm has a female CFO. *Size* is measured as the logarithm of the firm's total assets, *Leverage* is the ratio of long-term debt to market value of equity, *Profitability* is measured as the return on assets (ROA), *Cash holdings* is cash holdings scaled by total assets, *Cash flow volatility* is the coefficient of variation of cash flows from operations over the preceding five years, *Growth* is the transformed logarithm of the three-year growth rate of sales, *Market-to-book* is the logarithm of the market value of equity scaled by the book value of equity, *Institutional ownership* is the percentage of institutional ownership, *R&D* is the research and development expenditures scaled by sales, *Firm age* is the age of the firm, *CEO delta* and *CFO delta* are the logarithms of the sensitivities of executive wealth to changes in stock price (dollar change in wealth for a one percent change in stock price), and *CEO vega* and *CFO vega* are the logarithms of the sensitivities of executive wealth to changes in stock return volatility (dollar change in wealth for a one percentage point change in volatility). The risk measures and the control variables are winsorized at the 1st and 99th percentiles. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 3. Regression results.

	Total risk			Systematic risk			Idiosyncratic risk		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Constant	-0.783 ***	-0.640 ***	-0.506 ***	0.577 ***	0.532 ***	0.629 ***	-3.498 ***	-3.298 ***	-3.200 ***
	(-5.32)	(-4.12)	(-3.43)	(3.51)	(3.30)	(3.62)	(-21.71)	(-15.18)	(-15.08)
Age and gender:									
CEO age	-0.002 ***		-0.002 ***	0.000		0.000	-0.001 ***		-0.001 ***
	(-4.42)		(-4.21)	(0.20)		(-0.49)	(-3.28)		(-2.76)
CFO age		-0.001	-0.001		0.001	0.001		-0.001 *	-0.001 ***
		(-1.26)	(-1.26)		(1.45)	(1.16)		(-1.65)	(-4.05)
Female CEO	-0.001		-0.017	0.000		0.001	0.047 ***		0.029 ***
	(-0.03)		(-0.83)	(0.02)		(0.03)	(4.49)		(2.70)
Female CFO		0.031 ***	0.038 ***		0.020	0.023		0.027 ***	0.028 ***
		(3.94)	(4.65)		(1.29)	(1.45)		(3.63)	(3.21)
Control variables:									
Size	-0.095 ***	-0.087 ***	-0.094 ***	-0.009 **	0.006	0.007 *	-0.074 ***	-0.060 ***	-0.064 ***
	(-12.05)	(-10.41)	(-9.61)	(-2.23)	(1.42)	(1.66)	(-5.36)	(-3.77)	(-3.91)
Leverage	0.214 ***	0.233 ***	0.235 ***	0.081 ***	0.080 ***	0.067 **	0.177 ***	0.169 ***	0.171 ***
	(10.60)	(13.40)	(14.08)	(2.78)	(2.84)	(2.39)	(4.70)	(3.97)	(4.04)
Profitability	-0.004 ***	-0.004 ***	-0.004 ***	-0.004 ***	-0.005 ***	-0.005 ***	-0.003 ***	-0.003 ***	-0.003 ***
	(-6.93)	(-5.79)	(-5.70)	(-4.55)	(-5.40)	(-5.36)	(-3.32)	(-3.85)	(-3.39)
Cash holdings	0.310 ***	0.336 ***	0.328 ***	0.046	0.078	0.075	0.222 ***	0.237 ***	0.227 ***
	(5.67)	(6.05)	(5.59)	(0.81)	(1.53)	(1.45)	(4.23)	(4.13)	(4.07)
Cash flow volatility	0.196 ***	0.203 ***	0.200 ***	0.135 ***	0.075 ***	0.075 ***	0.139 ***	0.113 ***	0.114 ***
	(29.97)	(33.90)	(25.75)	(7.18)	(4.24)	(4.15)	(5.66)	(3.12)	(3.27)

Table 3. *Continued.*

	Total risk			Systematic risk			Idiosyncratic risk		
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6	Model 7	Model 8	Model 9
Growth	0.054 *	0.036	0.014	0.026	-0.004	-0.024	0.146 ***	0.159 ***	0.141 ***
	(1.74)	(1.34)	(0.52)	(0.79)	(-0.11)	(-0.67)	(4.88)	(3.79)	(3.52)
Market-to-book	-0.077 ***	-0.076 ***	-0.089 ***	-0.017	-0.020 **	-0.023 **	-0.046 **	-0.044 **	-0.055 **
	(-4.65)	(-4.30)	(-4.97)	(-1.63)	(-2.08)	(-2.36)	(-2.35)	(-2.01)	(-2.47)
Ownership	0.139 ***	0.131 ***	0.155 ***	0.084 ***	0.028	0.046	0.098 ***	0.082 **	0.092 **
	(4.25)	(4.03)	(4.16)	(2.45)	(0.87)	(1.38)	(3.54)	(2.00)	(1.99)
R&D	0.119 **	0.051	0.068	0.005	-0.154 **	-0.160 **	0.130 **	0.062	0.088 *
	(2.17)	(0.89)	(1.24)	(0.06)	(-2.27)	(-2.27)	(2.42)	(1.27)	(1.79)
Firm age	-0.039 ***	-0.048 ***	-0.041 ***	0.007	0.007	0.009	-0.044 ***	-0.048 ***	-0.042 ***
	(-7.41)	(-7.45)	(-6.88)	(0.98)	(1.02)	(1.34)	(-13.33)	(-8.17)	(-8.28)
Delta	0.019 ***	0.002		0.004	-0.007		0.008 **	-0.018 **	
	(3.63)	(0.29)		(0.95)	(-1.05)		(2.11)	(-4.60)	
Vega	-0.013 ***	-0.008		-0.015 ***	-0.003		-0.008 **	0.006	
	(-4.98)	(-1.64)		(-4.03)	(-0.63)		(-2.19)	(1.59)	
Sum of deltas			0.020 ***			0.001			0.002
			(2.68)			(0.18)			(0.35)
Sum of vegas			-0.013 ***			-0.011 ***			-0.003
			(-3.65)			(-2.75)			(-0.85)
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	8,282	6,286	5,983	8,282	6,286	5,983	8,282	6,286	5,983
Adjusted R^2	0.69	0.70	0.70	0.66	0.69	0.69	0.93	0.93	0.93
F-stat.	550.62 ***	468.79 ***	423.68 ***	495.61 ***	449.49 ***	400.62 ***	3529.68 ***	2887.25 ***	2578.52 ***

The table reports the estimates of nine alternative versions of Equation (1). The dependent variable in Models 1-3 is *Total risk* measured as the logarithm of the annualized standard deviation of daily stock returns. The dependent variable in Models 4-6 is *Systematic risk* measured as the beta coefficient of the market model estimated against the S&P 500 index using daily return data. The dependent variable in Models 7-9 *Idiosyncratic risk* measured as the logarithm of the standard deviation of the residuals of the market model estimated against the S&P 500 index using daily return data. The test variables of interest are defined as follows: *CEO age* and *CFO age* denote the ages of the corresponding executives, *Female CEO* equals one if the firm's CEO is a female, and *Female CFO* is assigned to if the firm has a female CFO. The control variables are defined as follows: *Size* is measured as the logarithm of the firm's total assets, *Leverage* is the logarithm of the ratio of long-term debt to market value of equity, *Profitability* is measured as the return on assets (ROA), *Cash holdings* is the logarithm of cash holdings scaled by total assets, *Cash flow volatility* is the logarithm of the coefficient of variation of cash flows from operations over the preceding five years, *Growth* is the transformed logarithm of the three-year growth rate of sales, *Market-to-book* is the logarithm of the market value of equity scaled by the book value of equity, *Ownership* is the percentage of institutional ownership, *R&D* is the logarithm of research and development expenditures scaled by sales, *Firm age* is the logarithm of the age of the firm, *Delta* is the logarithm of the sensitivity of executive wealth to changes in stock price (dollar change in wealth for a one percent change in stock price), and *Vega* is the logarithm of the sensitivity of executive wealth to changes in stock return volatility (dollar change in wealth for a one percentage point change in volatility). The risk measures and the control variables are winsorized at the 1^{st} and 99^{th} percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by period in Models 1-3 and 7-9 and by firm in Models 4-6. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 4. Instrumental variable regressions.

Panel A: Executive age IV regressions

	First-stage regressions		Second-stage regressions					
			Total risk		Systematic risk		Idiosyncratic risk	
Variable	CEO age	CFO age	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Instrumental variables:								
CPI at birth	-1.358 ***	-1.128 ***						
	(-69.59)	(-29.41)						
Age and gender:								
Intrumented CEO age			-0.002 ***		0.000		-0.002 ***	
			(-4.31)		(0.24)		(-3.51)	
Intrumented CFO age				-0.002 ***		0.000		-0.001 **
				(-2.88)		(0.60)		(-2.40)
Female CEO			-0.021		0.005		0.030	
			(-1.16)		(0.16)		(1.63)	
Female CFO				0.037 ***		0.024 *		0.032 ***
				(3.45)		(1.82)		(3.17)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	8,282	6,286	8,282	6,286	8,282	6,286	8,282	6,286
Shea's partial R^2	0.87	0.78						
Partial *F*-stat.	4842.96 ***	864.95 ***						
Adjusted R^2	0.89	0.80	0.67	0.68	0.66	0.69	0.93	0.93
F-stat.	577.90 ***	179.71 ***	540.63 ***	453.01 ***	515.76 ***	463.53 ***	3662.74 ***	2983.91 ***

Table 4. *Continued.*

Panel B: Female executive IV regressions

	First-stage regressions		Second-stage regressions					
			Total risk		Systematic risk		Idiosyncratic risk	
Variable	Female CEO	Female CFO	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Instrumental variables:								
Gender equality index	0.001 **	0.002 ***						
	(2.33)	(5.05)						
Age and gender:								
CEO age			-0.002		0.003		-0.003 **	
			(-1.58)		(1.44)		(-2.10)	
CFO age				-0.001		0.495 **		-0.001
				(-1.29)		(1.96)		(-1.42)
Intrumented Female CEO			0.023		1.933		-0.711	
			(0.04)		(1.62)		(-0.87)	
Intrumented Female CFO				0.193		0.002 **		0.044
				(1.00)		(2.35)		(0.24)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	8,154	6,215	8,154	6,215	8,154	6,215	8,154	6,215
Shea's partial R^2	0.001	0.003						
Partial *F*-stat.	5.43 **	25.52 ***						
Adjusted R^2	0.02	0.02	0.66	0.67	0.32	0.64	0.93	0.93
F-stat.	6.55 ***	6.36 ***	540.43 ***	455.08 ***	514.48 ***	464.73 ***	3637.19 ***	2955.30 ***

The table reports the estimates of two-stage instrumental variable regressions. In Panel A, the instrumental variable for *CEO age* and *CFO age* in the first-stage regressions is the logarithm of the consumer price index in the birth year of the executive (*CPI at birth*). In Panel B, the instrumental variable for *Female CEO* and *Female CFO* in the first-stage regressions is the level of the gender equality index in the firm's headquarter state (*Gender equality index*). In the second-stage regressions, *Total risk*, *Systematic risk*, and *Idiosyncratic risk* are regressed on the fitted values of the executive age and gender variables from the first-stage regressions and the control variables. The dependent variables are defined as follows: *Total risk* is the logarithm of the annualized standard deviation of daily stock returns, *Systematic risk* is the beta coefficient of the market model estimated against the S&P 500 index using daily return data, and *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals of the market model regression. The test variables of interest are defined as follows: *CEO age* and *CFO age* denote the ages of the corresponding executives, *Female CEO* equals one if the firm's CEO is a female, and *Female CFO* is assigned to if the firm has a female CFO. The control variables are defined as follows: *Size* is measured as the logarithm of the firm's total assets, *Leverage* is the logarithm of the ratio of long-term debt to market value of equity, *Profitability* is measured as the return on assets (ROA), *Cash holdings* is the logarithm of cash holdings scaled by total assets, *Cash flow volatility* is the logarithm of the coefficient of variation of cash flows from operations over the preceding five years, *Growth* is the transformed logarithm of the three-year growth rate of sales, *Market-to-book* is the logarithm of the market value of equity scaled by the book value of equity, *Ownership* is the percentage of institutional ownership, *R&D* is the logarithm of research and development expenditures scaled by sales, *Firm age* is the logarithm of the age of the firm, *Delta* is the logarithm of the sensitivity of executive wealth to changes in stock price (dollar change in wealth for a one percent change in stock price), and *Vega* is the logarithm of the sensitivity of executive wealth to changes in stock return volatility (dollar change in wealth for a one percentage point change in volatility). The risk measures and the control variables are winsorized at the 1^{st} and 99^{th} percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroscedasticity. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 5. Regressions with propensity score matched samples.

Panel A: Executive age

	Total risk		Systematic risk		Idiosyncratic risk	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Matching without gender:						
CEO age	-0.002 ***		0.001		-0.003 ***	
	(-3.25)		(0.90)		(-3.23)	
CFO age		-0.002 ***		0.001		-0.002 **
		(-2.74)		(0.52)		(-2.27)
Female CEO	0.009		0.020		0.068 *	
	(0.26)		(0.48)		(1.91)	
Female CFO		0.035 *		0.057 **		0.033 *
		(1.74)		(2.08)		(1.70)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1,830	1,734	1,830	1,734	1,830	1,734
Adjusted R^2	0.64	0.69	0.58	0.65	0.90	0.91
F-stat.	100.25 ***	137.93 ***	109.71 ***	147.32 ***	744.61 ***	738.92 ***
Matching with gender:						
CEO age	-0.003 ***		0.000		-0.002 ***	
	(-4.00)		(0.11)		(-3.18)	
CFO age		-0.002 **		0.000		-0.001
		(-2.42)		(-0.10)		(-1.24)
Female CEO	0.072 **		-0.027		0.123 ***	
	(2.20)		(-0.56)		(3.64)	
Female CFO		0.042 **		0.066 ***		0.042 **
		(2.21)		(2.63)		(2.16)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	1,830	1,732	1,830	1,732	1,830	1,732
Adjusted R^2	0.64	0.70	0.58	0.65	0.90	0.91
F-stat.	109.97 ***	150.14 ***	98.82 ***	144.82 ***	720.56 ***	716.30 ***

Table 5. *Continued.*

	Total risk		Systematic risk		Idiosyncratic risk	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
PSM diagnostics:	CEO age matching without gender	CFO age matching without gender	CEO age matching with gender	CFO age matching with gender		
Pre-matching pseudo R^2	0.07	0.08	0.07	0.08		
Pre-matching LR chi-square	417.57 ***	431.73 ***	417.65 ***	431.76 ***		
Post-matching pseudo R^2	0.01	0.01	0.01	0.01		
Post-matching LR chi-square	12.74	13.32	19.36	14.65		
Mean difference	0.000	0.000	0.000	0.000		
Max difference	0.015	0.014	0.015	0.015		
Mean percentage difference	0.064	0.080	0.060	0.070		
Max percentage difference	4.080	3.014	4.110	3.057		

Panel B: Executive gender

	Total risk		Systematic risk		Idiosyncratic risk	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Matching without age:						
CEO age	0.002		0.006 **		0.004 **	
	(0.93)		(2.38)		(1.99)	
CFO age		-0.004 ***		-0.002		-0.003 **
		(-3.50)		(-1.00)		(-2.44)
Female CEO	-0.008		0.002		0.050 **	
	(-0.31)		(0.05)		(2.11)	
Female CFO		0.027 *		0.002		0.020
		(1.86)		(0.12)		(1.49)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	465	1,152	465	1,152	465	1,152
Adjusted R^2	0.71	0.68	0.66	0.69	0.93	0.94
F-stat.	40.37 ***	77.89 ***	36.90 ***	116.49 ***	266.93 ***	695.99 ***

Table 5. *Continued.*

	Total risk		Systematic risk		Idiosyncratic risk	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Matching with age:						
CEO age	-0.001		0.001		0.000	
	(-0.31)		(0.29)		(-0.20)	
CFO age		-0.001		0.001		-0.001
		(-0.92)		(0.83)		(-0.98)
Female CEO	0.014		-0.032		0.039	
	(0.61)		(-1.05)		(1.53)	
Female CFO		0.048 ***		0.042 **		0.027 **
		(3.32)		(2.52)		(1.98)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	464	1,150	464	1,150	464	1,150
Adjusted R^2	0.74	0.67	0.64	0.69	0.92	0.94
F-stat.	50.25 ***	72.57 ***	38.62 ***	111.77 ***	254.32 ***	658.10 ***

PSM diagnostics:	CEO gender matching without age	CFO gender matching without age	CEO gender matching with age	CFO gender matching with age
Pre-matching pseudo R^2	0.06	0.03	0.07	0.04
Pre-matching LR chi-square	116.19 ***	146.10 ***	154.80 ***	169.38 ***
Post-matching pseudo R^2	0.02	0.01	0.03	0.01
Post-matching LR chi-square	13.25	15.47	20.42	7.97
Mean difference	0.000	0.000	0.000	0.000
Max difference	0.001	0.005	0.001	0.003
Mean percentage difference	0.039	0.034	0.040	0.035
Max percentage difference	0.525	2.131	0.491	1.068

The table reports the estimates of alternative versions of Equation (1) with propensity score matched samples. We utilize propensity score matching to build matched-firm samples in which each firm with a (i) young CEO, (ii) young CFO, (iii) female CEO, or (iv) a female CFO is matched with similar firm with an (i) older CEO, (ii) older CFO, (iii) male CEO, or (iv) a male CFO. The young CEO (CFO) subgroup consists of firms with CEO (CFO) age in the bottom quantile of the sample. The age-based propensity score matching in Panel A is performed both with and without executive gender as a matching criterion, and correspondingly, the gender-based matching in Panel B is performed both with and without executive age as a matching criterion. The dependent variables in the regressions are defined as follows: *Total risk* is the logarithm of the annualized standard deviation of daily stock returns, *Systematic risk* is the beta coefficient of the market model estimated against the S&P 500 index using daily return data, and *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals of the market model regression. The test variables of interest are defined as follows: *CEO age* and *CFO age* denote the ages of the corresponding executives, *Female CEO* equals one if the firm's CEO is a female, and *Female CFO* is assigned to if the firm has a female CFO. The control variables are defined as follows: *Size* is measured as the logarithm of the firm's total assets, *Leverage* is the logarithm of the ratio of long-term debt to market value of equity, *Profitability* is measured as the return on assets (ROA), *Cash holdings* is the logarithm of cash holdings scaled by total assets, *Cash flow volatility* is the logarithm of the coefficient of variation of cash flows from operations over the preceding five years, *Growth* is the transformed logarithm of the three-year growth rate of sales, *Market-to-book* is the logarithm of the market value of equity scaled by the book value of equity, *Ownership* is the percentage of institutional ownership, *R&D* is the logarithm of research and development expenditures scaled by sales, *Firm age* is the logarithm of the age of the firm, *Delta* is the logarithm of the sensitivity of executive wealth to changes in stock price (dollar change in wealth for a one percent change in stock price), and *Vega* is the logarithm of the sensitivity of executive wealth to changes in stock return volatility (dollar change in wealth for a one percentage point change in volatility). The risk measures and the control variables are winsorized at the 1^{st} and 99^{th} percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroscedasticity. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 6. Changes in risk after executive turnovers.

Panel A: Change in total risk

	Model 1	Model 2	Model 3	Model 4
Young CEO succeeds old CEO	0.003			
	(0.78)			
Young CFO succeeds old CFO		-0.003		
		(-0.65)		
Female CEO succeeds male CEO			-0.003	
			(-0.25)	
Female CFO succeeds male CFO				-0.043 ***
				(-3.99)
Control variables	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
No. of observations	499	459	50	109
Adjusted R^2	0.66	0.68	0.63	0.56

Panel B: Change in systematic risk

	Model 1	Model 2	Model 3	Model 4
Young CEO succeeds old CEO	-0.108 ***			
	(-6.70)			
Young CFO succeeds old CFO		-0.170 ***		
		(-10.64)		
Female CEO succeeds male CEO			-0.123 **	
			(-2.69)	
Female CFO succeeds male CFO				-0.244 ***
				(-7.62)
Control variables	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
No. of observations	499	459	50	109
Adjusted R^2	0.26	0.43	0.24	0.47

Table 6. *Continued.*

Panel C: Change in idiosyncratic risk

	Model 1	Model 2	Model 3	Model 4
Young CEO succeeds old CEO	0.007 ***			
	(12.92)			
Young CFO succeeds old CFO		0.010 ***		
		(18.30)		
Female CEO succeeds male CEO			0.015 ***	
			(9.60)	
Female CFO succeeds male CFO				0.021 ***
				(13.97)
Control variables	Yes	Yes	Yes	Yes
Year dummies	Yes	Yes	Yes	Yes
No. of observations	499	459	50	109
Adjusted R^2	0.95	0.95	0.97	0.96

The table reports the estimates of difference-in-difference regressions. The dependent variable in Panel A is the change in *Total risk* (annualized standard deviation of daily stock returns) from the year of executive turnover to the following year. The dependent variable in Panel B is the change in *Systematic risk* (the beta coefficient of the market model estimated against the S&P 500 index using daily return data) from the year of executive turnover to the following year. The dependent variable in Panel C the change in *Idiosyncratic risk* (the standard deviation of the residuals of the market model estimated against the S&P 500 index using daily return data) from the year of executive turnover to the following year. The control variables included in the regressions are the changes in *Size* (the logarithm of the firm's total assets), *Leverage* (the ratio of long-term debt to market value of equity), and *Profitability* (return on assets) from the year of executive turnover to the following year. The risk measures and the control variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on Huber-White heteroskedasticity consistent standard errors. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

Table 7. Simultaneous equations models.

	Total risk		Systematic risk		Idiosyncratic risk	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Leverage equation:						
CEO age	0.001 *		0.001 *		0.001 *	
	(1.71)		(1.72)		(1.71)	
CFO age		0.000		0.000		0.000
		(0.54)		(0.55)		(0.57)
Female CEO	-0.003		-0.003		-0.003	
	(-0.19)		(-0.19)		(-0.19)	
Female CFO		-0.021 **		-0.021 **		-0.021 **
		(-2.00)		(-1.99)		(-1.99)
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	9,320	6,805	9,320	6,805	9,320	6,805
Adjusted R^2	0.14	0.13	0.14	0.13	0.14	0.13
R&D equation:						
CEO age	-0.039 ***		-0.039 ***		-0.039 ***	
	(-4.53)		(-4.53)		(-4.53)	
CFO age		0.012		0.012		0.012
		(1.13)		(1.13)		(1.13)
Female CEO	0.733 **		0.733 **		0.733 **	
	(2.01)		(2.01)		(2.01)	
Female CFO		-0.749 ***		-0.750 ***		-0.749 ***
		(-3.07)		(-3.07)		(-3.07)
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	10,225	7,693	10,225	7,693	10,225	7,693
Adjusted R^2	0.30	0.29	0.30	0.29	0.30	0.29
Cash equation:						
CEO age	-0.001 ***		-0.001 ***		-0.001 ***	
	(-4.51)		(-4.51)		(-4.51)	
CFO age		-0.001 ***		-0.001 ***		-0.001 ***
		(-5.90)		(-5.90)		(-5.90)

Table 7. *Continued.*

	Total risk		Systematic risk		Idiosyncratic risk	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Female CEO	0.018 ***		0.018 ***		0.018 ***	
	(3.55)		(3.55)		(3.55)	
Female CFO		0.008 **		0.008 **		0.008 **
		(2.15)		(2.14)		(2.14)
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	10,225	7,693	10,225	7,693	10,225	7,693
Adjusted R^2	0.15	0.14	0.15	0.14	0.15	0.14
Risk equation:						
CEO age	-0.002 ***		0.000		-0.001 *	
	(-3.73)		(0.01)		(-1.82)	
CFO age		-0.001		0.001 *		0.000
		(-1.45)		(1.66)		(-1.03)
Female CEO	0.000		0.000		0.048 ***	
	(0.02)		(0.01)		(2.93)	
Female CFO		0.030 ***		0.021		0.026 ***
		(2.76)		(1.64)		(2.54)
Control variables	Yes	Yes	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
No. of observations	8,282	6,286	8,282	6,286	8,282	6,286
Adjusted R^2	0.69	0.70	0.66	0.69	0.93	0.93

The table reports the estimates of six alternative simultaneous equations systems using seemingly unrelated regressions framework. The simultaneous equations specifications consist of four equations in which three policy choice variables *Leverage*, *R&D*, and *Cash holdings* are used as the dependent variables with lagged *Age* and *Gender* along with industry and year fixed-effects as the independent variables and the fourth equation corresponds to Equation (1). The dependent variables in the three policy choice regressions are defined as follows: *Leverage* is the logarithm of the ratio of long-term debt to market value of equity, *R&D* is the logarithm of research and development expenditures scaled by sales, and *Cash holdings* is the logarithm of cash holdings scaled by total assets. The dependent variables in the risk regressions are defined as follows: *Total risk* is the logarithm of the annualized standard deviation of daily stock returns, *Systematic risk* is the beta coefficient of the market model estimated against the S&P 500 index using daily return data, and *Idiosyncratic risk* is the logarithm of the standard deviation of the residuals of the market model regression. The independent variables of interest in the simultaneous equation system are defined as follows: *CEO age* and *CFO age* denote the ages of the corresponding executives, *Female CEO* equals one if the firm's CEO is a female, and *Female CFO* is assigned to if the firm has a female CFO. The control variables used in the risk equations include *Leverage*, *R&D*, and *Cash holdings* and the other controls are defined as follows: *Size* is measured as the logarithm of the firm's total assets, *Profitability* is measured as the return on assets (ROA), *Cash flow volatility* is the logarithm of the coefficient of variation of cash flows from operations over the preceding five years, *Growth* is the transformed logarithm of the three-year growth rate of sales, *Market-to-book* is the logarithm of the market value

of equity scaled by the book value of equity, *Ownership* is the percentage of institutional ownership, *Firm age* is the logarithm of the age of the firm, *Delta* is the logarithm of the sensitivity of executive wealth to changes in stock price (dollar change in wealth for a one percent change in stock price), and *Vega* is the logarithm of the sensitivity of executive wealth to changes in stock return volatility (dollar change in wealth for a one percentage point change in volatility). All variables except for *Age* and *Gender* are winsorized at the 1st and 99th percentiles. ***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.