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ARTICLE

Age, gender, and risk-taking: Evidence from the S&P 1500 executives and market-based measures of firm risk

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Abstract

This paper contributes to the literature by examining 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 chief executive officer (CEO) and chief financial officer (CFO) age and gender have a direct effect on market-based firm risk measures in addition to the indirect influence they may have through corporate policy choices. Specifically, we find that firms led by older CEOs and CFOs have less volatile stock returns and lower idiosyncratic risk. Although the relationship between executive gender and firm risk is more equivocal, our results suggest that female-led firms are associated with lower levels of total and idiosyncratic risks after controlling for firm-specific attributes, policy choices, and managerial risk-taking incentives. We also document that CEO and CFO age and gender do not influence the level of systematic risk. Overall, our empirical findings demonstrate that the age and gender of the firm's top executives may have important implications for firm riskiness.

KEYWORDS
age, CEOs, CFOs, executives, firm risk, gender, risk-taking

JEL CLASSIFICATION
G01, G21, G30, G32

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 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, personalities, and experiences of individual CEOs and CFOs are reflected in firms' business strategies, performance, financial and investment policies, and other corporate outcomes (see e.g., Bertrand & Schoar, 2003; Cline et al., 2018; Graham et al., 2013; Hrazdil et al., 2020; Hu et al., 2020; Malmendier & Tate, 2005; Malmendier et al., 2011).[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.

In brief, the prior literature on gender-based behavioral differences demonstrates that women are more risk-averse than men. Levin et al. (1988), Johnson and Powell (1994), Powell and Ansic (1997), Eckell and Grossman (2002), Fehr-Duda et al. (2006), and Borghans et al. (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. 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 et al. (2002), Agnew et al. (2003), Watson and McNaughton (2007), and Halko et al. (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 more mixed. Several studies provide support for the belief that aging leads to increased risk aversion and cautiousness (the early literature is reviewed in Morin & Suarez, 1983; Okun, 1976). McInish (1982), Palsson (1996), and Hunter and Kemp (2004) document that older individuals tend to hold less risky stocks and investment portfolios. Nevertheless, experimental psychological 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 et al. (2011) conduct a meta-analysis of the literature and conclude that the linkage between age and risk-taking is complex and context-dependent. 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.

Given the documented age and gender-based differences in risk tolerance, it is not surprising that several studies have focused on the potential effects of age and gender of the top executives on firm-level financial decisions and outcomes. With respect to executive gender, previous studies have documented that firms led by female CEOs and CFOs are associated with more conservative financial reporting practices, have higher cash holdings, and are less likely to issue debt and conduct acquisitions than male-led firms (see e.g., Barua et al., 2010; Francis et al., 2015; Huang & Kisgen, 2013; Peni & Vähämaa, 2010; Xu et al., 2019). Furthermore, female CEOs and gender diversity in the top management team may improve the firm's financial performance, constrain agency costs, and lead to the adoption of less risky and litigation-prone corporate policies (e.g., Adhikaria et al., 2019; Jurkus et al., 2011; Khan & Vieito, 2013;

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

Palvia et al., 2020).[2] In a recent study, Hrazdil et al. (2020) utilize machine learning to assess CEO and CFO personality traits for a large sample of US firms. Their findings suggest that female executives are less risk-tolerant than their male counterparts.

Most closely related to our study, Elsaid and Ursel (2011), Palvia et al. (2015), and Faccio et al. (2016) examine the association between female CEOs and firm risk. Using a sample of North American firms, Elsaid and Ursel (2011) document that corporate cash holding increase and cash flow volatility decreases after appointments of new female CEOs, while Faccio et al. (2016) find that European privately held firms run by female CEOs have lower leverage and less volatile earnings. Palvia et al. (2015) report that US commercial banks with female CEOs and board chairs are associated with more conservative capital ratios and were less likely to fail during the financial crisis. Collectively, these prior studies suggest that firms led by female CEOs are associated with less risky financial policies.

The alternative hypothesis with respect to executive gender is that 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), Adams (2016), and Adams and Ragunathan (2018), women who pursue leadership positions may act similarly to men, and thereby gender differences in risk tolerance may disappear or even reverse among top executives and directors. Using data on Swedish firms, 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.[3] They conclude that female leadership does not necessarily imply more risk-averse corporate decisions. Berger et al. (2014) examine how board gender diversity affects the portfolio risk of German financial institutions and find that a higher proportion of females on the executive board increases bank risk-taking. Consistent with the assertion that gender differences in risk tolerance may vanish beyond the glass ceiling, Sila et al. (2016) and Adams and Ragunathan (2018) document that board gender diversity does not have any meaningful effect on firm risk.

A vast body of research offers evidence that executive age may influence a range of corporate decisions and outcomes. While the early work of Davis (1979) finds no relationship between CEO age and firm performance, more recent studies by Datta and Rajagopalan (1998), Bertrand and Schoar (2003), Davidson et al. (2007), Antia et al. (2010), Yim (2013), Cline and Yore (2016), Zhang et al. (2016), and Croci et al. (2017) 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. Directly related to our study, Serfling (2014) examines the relation between CEO age and firm risk-taking. Using data on US firms for the years 1992 to 2010, Serfling (2014) finds that CEO age is negatively associated with stock return volatility and idiosyncratic risk. His findings also indicate that firms led by older CEOs have lower operating leverage, invest less in research and development (R&D), and undertake more diversifying acquisitions. With respect to age-based differences in risk tolerance, Hrazdil et al. (2020) provide evidence that older CEOs and CFOs exhibit more risk-averse personality traits.

In this paper, we contribute to the existing literature by examining 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 from 2006 to 2018, we document that firms led by older CEOs as well as older CFOs have less volatile stock returns and lower idiosyncratic risk. This evidence suggests that top executives may become more risk-averse with age, and thereby constrain risk-taking by their firms. Furthermore, although our findings with respect to executive gender are more equivocal, we find that female-led firms are associated with lower levels of total and idiosyncratic risks after controlling for firm-specific attributes, financial and investment policies, and managerial risk-taking incentives. We utilize instrumental variable regressions and propensity score matching to alleviate endogeneity concerns, and we also conduct a number of additional tests to investigate the robustness of our results. These tests provide further evidence to conclude that older executives and female executives constrain firm risk. Nonetheless, our additional tests also indicate that the

[2] A related stream of literature investigates the effects of board gender diversity on firms' financial performance, market valuation, financial and investment policies, governance mechanisms, and the functioning and monitoring strength of the board of directors (see e.g., Adams & Ferreira, 2009; Ahern & Dittmar, 2012; Atif et al., 2019; Baselga-Pascual et al., 2018; Bear et al., 2010; Bernile et al., 2018; Campbell & Minguez-Vera, 2008; Carter et al., 2003; Erhardt et al., 2003; Gyapong et al., 2016; Nekhili et al., 2020; Yang et al., 2019).

[3] Contradictory evidence appears in Hrazdil et al. (2020) who document that female CEOs and CFOs are less risk-tolerant than male CEOs and CFOs.

negative association between female executives and firm risk is to some extent induced by the oldest female executives and is more pertained to smaller firms.

Given that market-based firm risk measures are not managerial choice variables that the top executives, per se, could directly influence, we further examine whether the reduced riskiness of firms led by older executives and female executives can be traced to specific corporate policy decisions. For this purpose, we estimate policy choice regressions as well as simultaneous equations systems in which firm risk is affected by financial and investment policies that, in turn, are endogenously influenced by executive age and gender. Although these additional tests indicate that firms led by older top executives and female executives have lower financial leverage and higher cash holdings, the negative relation of executive age and female executives with the market-based risk measures cannot be fully reconciled by differences in financial and investment policies. Taken as a whole, our empirical findings provide strong evidence that CEO and CFO age and gender have a direct incremental effect on firm risk over and above the potential indirect influence they may have through corporate policy choices. This suggests that executive age and gender are likely to influence market-based risk measures through managerial idiosyncrasies and less easily observable mechanisms such as differences in managerial leadership styles (e.g., Eagly & Carli, 2003; Matsa & Miller, 2013), communication skills and tones (Baginski et al., 2018; Davis et al., 2015; Mayew & Venkatachalam, 2012), informational asymmetries (Antia et al., 2010; Inci et al., 2017), or the perceptions, attitudes, and reactions of different stakeholders (e.g., Bigelow et al., 2014; Lee & James, 2007).

Our paper contributes to the literature on executive gender and firm risk in three main respects. First, with respect to CEO gender, we extend the existing literature by examining the effects of female CEOs on the firm's total, systematic, and idiosyncratic risks. In general, these market-based risk measures can be considered to reflect the perceptions of stock market participants regarding the overall riskiness of a firm. These measures capture market beliefs and sentiment about the risks inherent in the firm's management, strategic decisions, financial and investment policies, other firm-specific attributes, and the perceived level of risk related to systematic market developments and uncertainty. While the existing empirical evidence documented in Elsaid and Ursel (2011), Palvia et al. (2015), and Faccio et al. (2016) suggests that firms led by female CEOs are associated with less risky financial policies, we contribute to the literature by showing that female CEOs have a direct negative influence on the firm's market-based total risk in addition to the indirect effect they may have through the firm's policy choices.

Second, to the best of our knowledge, this paper is the first to examine the association between CFO gender and firm risk. Given that previous studies have documented that CFO characteristics and incentives may play a stronger role than those of the CEO's on corporate policy decisions (e.g., Bertrand & Schoar, 2003; Chava & Purnanandam, 2010; J. Jiang et al., 2010; Peni & Vähämaa, 2010), it is of interest to examine whether CFO gender also influences market-based measures of firm risk. We contribute to the prior executive gender literature and also extend the literature on the role of CFO characteristics in influencing firm-level outcomes by documenting that firms with female CFOs are associated with less volatile stock returns and lower levels of idiosyncratic risk. Third, with respect to corporate financial policies, our additional tests extend Elsaid and Ursel (2011), Palvia et al. (2015), and Faccio et al. (2016) by demonstrating that leverage and cash holdings are influenced by CFO gender in addition to CEO gender. Moreover, our empirical analysis based on the S&P 1500 firms also complements Elsaid and Ursel (2011), Palvia et al. (2015), and Faccio et al. (2016) by utilizing a more recent sample period during which the glass ceiling has started to gradually crack and the amount of female executives has been steadily increasing.[4] Collectively, our results with respect to CEO and CFO gender and market-based risk measures provide additional support for the hypothesis that female leadership leads to less risky firms.

Our paper also contributes to the literature on executive age and firm risk in a number of ways. First, and most importantly, we are the first to examine the relation between CFO age and market-based firm risk measures. We contribute to the prior executive age literature by documenting that firms with older CFOs are associated with lower levels of total and idiosyncratic risks. Second, our paper complements and extends the work of Serfling (2014) with

[4] Elsaid and Ursel (2011) use a sample of 650 North American firms over the period 1992–2005, Palvia et al. (2015) use data on U.S. commercial banks over the period 2007-2010, and Faccio et al. (2016) use data on European firms over the period 1999-2009.

respect to CEO age. The results of our study, which are based on a more recent sample period and a slightly different empirical approach, provide further evidence that firms led by older CEOs have less volatile stock returns and lower idiosyncratic risk. We also extend Serfling (2014) by documenting that CEO age is largely irrelevant with respect to systematic risk, and more importantly, by showing that CFO age has a nontrivial incremental impact on total and idiosyncratic risks over and above the influence of CEO age. Taken as a whole, our empirical findings contribute to the existing literature by demonstrating that CEO as well as CFO age and gender are important factors for explaining differences in market-based measures of firm risk.

2 | DATA AND METHODOLOGY

2.1 | Data

The sample used in our empirical analysis consists of the S&P 1500 firms for the period 2006 to 2018.[5] 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 risk are taken from Center for Research in Security Prices (CRSP), and (iii) the financial statement data used as control variables are from Compustat. We exclude banks, insurance companies, other financial institutions (SIC codes 6000–6999), and individual firms with insufficient or missing data on executive characteristics and/or financial information. After further excluding penny stocks and firms with non-positive total assets, sales, and book values of equity, we obtain an unbalanced panel of 1709 individual non-financial firms that have been included among the S&P 1500 firms during the sample period and 13,691 usable firm-year observations for our main regressions.[6]

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 risk. Specifically, in our main analysis, we estimate alternative versions of the following regression specification:

$$\begin{aligned}\text{Firm risk}_{j,t} = {} & \alpha + \beta_1 \text{CEO age}_{j,t} + \beta_2 \text{CFO age}_{j,t} + \beta_3 \text{Female CEO}_{j,t} \\ & + \beta_4 \text{Female CFO}_{j,t} + \gamma(\text{Firm-specific controls})_{j,t} \\ & + \omega(\text{Firm fixed-effects})_{j,t} + \varphi(\text{Year fixed-effects})_{j,t} + \varepsilon_{j,t} \end{aligned} \quad (1)$$

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 risk 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 risk is *Systematic risk*$_{j,t}$, which is measured as the beta coefficient for firm *j* estimated against daily excess returns on the CRSP value-weighted market portfolio and by applying the nonsynchronous trading adjustment of Scholes and Williams (1977). Finally, we use *Idiosyncratic risk*$_{j,t}$, calculated as the annualized standard deviation of the residuals of the Scholes–Williams estimator for firm *j* at time *t*, as the third measure of firm risk. The stock price data for estimating the market-based measures of firm risk are obtained from CRSP.

[5] The sample period begins in 2006 because the data on CFO age and gender are available only from 2006 onward.

[6] We also estimate regressions with a more parsimonious set of control variables. These regressions are based on an unbalanced panel of 15,692 firm-year observations.

The test variables of interest in equation (1) are *CEO age*$_{j,t}$, *CFO age*$_{j,t}$, *Female CEO*$_{j,t}$, and *Female CFO*$_{j,t}$. The executive age variables denote the ages of the firm's CEO and the CFO in years at the end of year *t*.[7] *Female CEO* and *Female CFO* are dummy variables for executive gender; *Female CEO* equals 1 for firms that have a female CEO, and *Female CFO* equals 1 for firms that have a female CFO at the end of year *t*. The data on the age and gender of the CEOs and CFOs are collected from ExecuComp.

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.[8] The set of controls 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 one plus 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 at time *t*; *Cash holdings*$_{j,t}$ is the logarithm of one plus 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 5 years; *Growth*$_{j,t}$ is the transformed logarithm of the growth rate of sales from year *t*−3 to year *t; Market-to-book*$_{j,t}$ is the logarithm of the market value of equity scaled by the book value of equity at time *t; R&D*$_{j,t}$ is the logarithm of one plus R&D expenditures[9] scaled by sales at time *t*; and *Firm age*$_{j,t}$ is the logarithm of the age of the firm determined as the greater of the number of years from the firm's initial public offering or the number of years from the firm's first appearance in 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. *Delta* is the logarithm of the sensitivity of executive wealth to changes in stock price (dollar change in wealth for a 1% 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 1% point change in volatility). The deltas and vegas are calculated following the approach of Core and Guay (2002) and Coles et al. (2006).

Finally, in our main regressions, we control for potential biases related to time-invariant omitted and/or unobservable variables with firm fixed-effects (*Firm*$_j$), and we account for systematic variation in firm risk over time by including year fixed-effects (*Year*$_j$). The inclusion of firm fixed-effects mitigates endogeneity concerns and implies that the estimates reflect within-firm changes in executive age and gender.[10] All the independent variables in equation (1) are lagged by 1 year in order to alleviate endogeneity concerns and to avoid potential reverse causality from the risk measures to our independent variables. Moreover, we winsorize the risk measures and all the control variables annually at the 1st and 99th percentiles to moderate the effect of extreme outliers. Throughout the alternative estimations of equation (1), we use robust standard errors that are adjusted for heteroskedasticity and clustered by firm.

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 and propensity score matching in Section 3.3. to address 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 age and gender affect risk in Section 3.4. by estimating three-stage models in which executive age and gender endogenously influence financial leverage, cash holdings, and R&D expenditures, and the three market-based firm risk measures are simultaneously a function of the policy choice variables.

[7] We follow Yim (2013), Cline and Yore (2016), Zhang et al. (2016), and Croci et al. (2017) and use the ages of the CEOs and CFOs in years because the ages of these executives are fairly symmetrically distributed. In our robustness checks discussed in Section 3.5., following Serfling (2014), we estimate regressions in which the logarithms of CEO and CFO age are used as the executive age variables.

[8] It is worth noting that Elsaid and Ursel (2011), Palvia et al. (2015) and Faccio et al. (2016) use financial leverage as a proxy for firm risk, while we utilize market-based measures of firm risk and use leverage as a control variable in our main analysis. Nevertheless, we also investigate the relationship between leverage and executive age and gender in our additional tests discussed in Section 3.4.

[9] Because of the large number of missing values for R&D expenditures, we set the missing values to 0 in our panel regressions in order to increase the number of observations.

[10] Fixed-effects estimators can be used to obtain an unbiased coefficient estimates even when exogeneity assumption is violated.

TABLE 1 Descriptive statistics

Variable	Mean	Median	Min	Max	Std. dev.	No. of obs.
Risk measures:						
Total risk	0.39	0.35	0.11	1.88	0.19	14,839
Systematic risk	1.21	1.14	−0.09	4.00	0.55	14,839
Idiosyncratic risk	0.32	0.29	0.09	1.69	0.17	14,839
Gender and age:						
Chief executive officer (CEO) age	56.26	56.00	28.00	89.00	6.98	14,839
Chief financial officer (CFO) age	51.30	51.00	26.00	75.00	6.52	14,839
Female CEO	0.04	0.00	0.00	1.00	0.19	14,839
Female CFO	0.10	0.00	0.00	1.00	0.30	14,839
Control variables:						
Size	9630.81	2094.16	48.58	373,396.10	26,243.03	14,839
Leverage	0.20	0.19	0.00	0.86	0.16	14,839
Profitability	0.05	0.05	−0.83	0.31	0.10	14,839
Cash holdings	0.12	0.08	0.00	0.64	0.11	14,839
Cash flow volatility	0.57	0.32	0.01	10.58	0.89	14,839
Sales growth	0.09	0.07	−0.30	1.05	0.14	14,839
Market-to-book	3.51	2.34	0.14	114.02	4.90	14,839
R&D	0.05	0.00	0.00	2.15	0.12	14,839
Firm age	29.32	24.00	2.00	69.00	18.39	14,839
CEO delta	570.87	199.39	0.00	11,712.35	1184.21	14,839
CEO vega	125.12	43.10	0.00	1332.83	206.33	14,839
CFO delta	79.39	36.63	0.00	1075.51	120.74	14,839
CFO vega	31.18	11.24	0.00	357.63	52.22	14,839

Note: 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 estimated against daily excess returns on the CRSP value-weighted market portfolio, and *Idiosyncratic risk* is the annualized standard deviation of the residuals from the beta regression. *CEO age* and *CFO age* denote the ages of the corresponding executives. *Female CEO* equals 1 if the firm's CEO is a female, and *Female CFO* is assigned if the firm has a female CFO. *Size* is measured by the firm's total assets, *Leverage* is the ratio of the 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 5 years, *Growth* is the 3-year growth rate of sales, *Market-to-book* is the market value of equity divided by the book value of equity, *R&D* is research and development (R&D) 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 1% 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 1% point change in volatility). The risk measures and the control variables are winsorized at the 1st and 99th percentiles.

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.[11] As shown in Table 1, the average stock return volatility (*Total*

[11] Although we use logarithmic values of most of the variables in our regressions, the descriptive statistics reported in Table 1 are for the actual values of the variables before taking logarithms.

risk) of the S&P 1500 firms during our sample period is about 39%, and both the mean and the median beta coefficients (*Systematic risk*) estimated against excess return on the CRSP market portfolio are slightly above 1. It can be noted from Table 1 that the average CEO is 56 years old, while the CFOs of the S&P 1500 firms are, on average, 51 years old. The table also shows that women are largely underrepresented among the top executives of the S&P 1500 firms; only 4% of the sample firms have a female CEO and 10% of the firms have a female as the CFO.[12] Finally, the descriptive statistics indicate that the sample firms are very heterogeneous in terms of the firm-specific control variables.

Pairwise correlation coefficients (not tabulated) between the variables used in the analysis demonstrate that our three market-based firm risk measures are strongly positively correlated with each other. *CEO age* and *CFO age* are negatively correlated with all three risk measures, indicating that firms with younger top executives exhibit greater risk. The correlations also suggest that female-led firms are less risky as our three market-based risk measures are negatively correlated with *Female CEO* and *Female CFO*.

CEO age and *CFO age* are strongly positively correlated ($r = 0.17$), while the executive gender and age variables are negatively correlated with each other ($r_{CEO\ age,\ Female\ CEO} = -0.03$; $r_{CFO\ age,\ Female\ CFO} = -0.05$). This suggests that firms with older CEOs are more likely to have older CFOs and 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 lower cash holdings and sales growth. Moreover, the correlations of the executive age and gender with the compensation incentive variables demonstrate that the wealth of older 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 and older firms with higher profitability and lower financial leverage, cash flow volatility, cash holdings, and R&D investment intensity are less risky.

3 | RESULTS

3.1 | Univariate tests

We first examine the relationships between executive age and gender and market-based measures of firm risk by performing a set of univariate tests. Table 2 reports the mean values for the executive age and gender variables in different *Total risk*, *Systematic risk*, and *Idiosyncratic risk* quartiles and the results of two-tailed *t*-tests for the null hypothesis that there is no difference in the mean executive age and gender between the bottom and the top risk quartiles. As can be noted from Table 2, *CEO age* and *CFO age* decrease monotonically with increasing *Total risk*, *Systematic risk*, and *Idiosyncratic risk*, suggesting that high-risk firms are more likely to have younger CEOs and CFOs. The *t*-tests indicate that the differences in executive age between the bottom and the top risk quartiles are statistically significant.

Furthermore, the univariate tests in Table 2 suggest that female-led firms are less risky. Firms in the bottom *Total risk*, *Systematic risk*, and *Idiosyncratic risk* quartiles are more likely to have female CEOs and CFOs than firms in the top risk quartiles. The percentage of female CEOs decreases monotonically across the quartiles with the increasing level of risk, while the corresponding pattern for female CFOs is not strictly monotonic. The *t*-tests indicate that the observed differences in the prevalence of female executives between the bottom and the top risk quartiles are highly significant.

3.2 | Main results

We use fixed-effects panel regressions to examine the associations between executive age and gender and market-based measures of firm risk. The estimation results of six alternative versions of equation (1) are presented in Table 3.

[12] The amount of female executives has increased during our sample period. About 3% of the sample firms had a female CEO and 8% a female CFO in 2006, whereas in 2018, almost 9% of the firms had a female CEO, and 13% of the firms had a female CFO.

TABLE 2 Univariate tests

	Bottom quartile	Second quartile	Third quartile	Top quartile	Difference (q1–q4)	*t*-stat
Total risk:						
CEO age	57.380	56.707	55.993	55.154	2.225***	14.92
CFO age	52.355	51.278	51.030	50.283	2.073***	15.11
Female CEO	0.053	0.035	0.037	0.033	0.020***	4.71
Female CFO	0.105	0.121	0.103	0.082	0.023***	3.83
Systematic risk:						
CEO age	56.521	56.448	56.317	55.875	0.646***	4.30
CFO age	51.335	51.371	51.330	50.845	0.490***	3.45
Female CEO	0.056	0.037	0.035	0.031	0.025***	6.04
Female CFO	0.105	0.107	0.116	0.082	0.022***	3.67
Idiosyncratic risk:						
CEO age	57.351	56.753	56.169	54.979	2.372***	15.96
CFO age	52.386	51.331	50.944	50.282	2.104***	15.23
Female CEO	0.050	0.034	0.037	0.037	0.013***	3.14
Female CFO	0.100	0.117	0.107	0.087	0.013**	2.13

Note: The table reports the mean values for CEO and CFO age and gender in different total risk, systematic risk, and idiosyncratic risk quartiles. The table also reports the results of two-tailed *t*-tests for the null hypothesis that there is no difference in the mean executive age and gender between the bottom and the top risk quartiles. *Total risk* is measured as the annualized standard deviation of daily stock returns, *Systematic risk* is the beta coefficient estimated against daily excess returns on the CRSP value-weighted market portfolio, and *Idiosyncratic risk* is the annualized standard deviation of the residuals from the beta regression. *CEO age* and *CFO age* denote the ages of the corresponding executives. *Female CEO* equals 1 if the firm's CEO is a female, and *Female CFO* is assigned if the firm has a female CFO.
***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

We use Total risk as the dependent variable in Models 1 and 2, Systematic risk as the dependent variable in Models 3 and 4, and Idiosyncratic risk as the dependent variable in Models 5 and 6. Furthermore, models 1, 3, and 5 are baseline regressions with a constrained set of control variables, while models 2, 4, and 6 include the full set of controls.[13] All model specifications include firm as well as year fixed-effects to account for unobserved heterogeneity across firms and any systematic variation in market-based risk measures over time. As shown in the table, the adjusted R^2s of our regressions range from 50% to 82%, and the *F*-statistics are significant at the 1% level in every model specification.[14]

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. Specifically, in the regressions with *Total risk* (models 1 and 2) and *Idiosyncratic risk* (models 5 and 6) as the dependent variables, the coefficient estimates for *CEO age* are consistently negative and statistically significant at the 1% level. The magnitudes of the estimated coefficients suggest that a one standard deviation increase in *CEO age* would decrease the firm's stock return volatility and idiosyncratic risk by about 2% to

[13] We estimate the baseline regressions with a constrained set of control variables (models 1, 3, and 5) to ensure that our results are not caused by spurious correlations between the variables or affected by potentially redundant independent variables. The variance inflation factors for the independent variables in our regressions are below 3.

[14] It should be noted that the relatively high R^2s are caused by the inclusion of firm and year fixed-effects in the regressions. When the influence of fixed-effects is excluded, the R^2s of the regressions are much lower and range from 3% to 22%.

TABLE 3 Main regressions

	Total risk		Systematic risk		Idiosyncratic risk	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Age and gender:						
CEO age	−0.005***	−0.003***	−0.002	−0.002	−0.005***	−0.003***
	(−5.45)	(−3.27)	(−1.62)	(−1.39)	(−5.30)	(−3.36)
CFO age	−0.006***	−0.002***	0.000	−0.001	−0.004***	−0.002*
	(−6.24)	(−2.74)	(−0.11)	(−0.57)	(−5.40)	(−1.91)
Female CEO	−0.143***	−0.069	*−0.059	−0.052	−0.105***	−0.051
	(−3.76)	(−1.90)	(−1.31)	(−1.19)	(−3.00)	(−1.50)
Female CFO	−0.061***	−0.042**	−0.003	−0.004	−0.046	−0.032*
	(−3.01)	(−2.20)	(−0.11)	(−0.18)	(−2.47)	(−1.70)
Control variables:						
Size	−0.216***	−0.114***	0.025**	0.001	−0.186***	−0.111***
	(−18.76)	(−8.34)	(1.97)	(0.05)	(−16.46)	(−7.99)
Leverage	0.238***	0.394***	0.409***	0.456***	0.319***	0.443***
	(4.09)	(6.89)	(5.95)	(6.05)	(5.65)	(7.51)
Profitability	−0.586***	−0.424***	−0.714***	−0.642***	−0.602***	−0.426***
	(−12.78)	(−9.05)	(−9.74)	(−8.09)	(−13.72)	(−9.35)
Cash holdings		−0.431***		−0.167**		−0.486***
		(−7.26)		(−2.05)		(−8.09)
Cash flow volatility		0.118***		0.106***		0.120***
		(6.46)		(4.14)		(6.58)
Sales growth		0.024		−0.206***		0.049
		(0.51)		(−3.41)		(1.04)
Market-to-book		−0.107***		−0.048***		−0.099***
		(−10.38)		(−3.55)		(−9.34)
R&D		−0.396***		−0.689***		−0.338***
		(−3.51)		(−5.47)		(−3.10)
Firm age		−0.509***		0.010		−0.397***
		(−18.68)		(0.31)		(−14.89)
Sum of deltas		−0.003		−0.006		−0.002
		(−0.90)		(−1.40)		(−0.69)
Sum of vegas		0.000		−0.002		−0.006***
		(−0.13)		(−0.70)		(−2.75)
Constant	5.803***	7.687***	1.059***	1.342***	5.276***	6.807***
	(64.22)	(56.91)	(9.85)	(8.49)	(60.24)	(52.54)
	Total risk		Systematic risk		Idiosyncratic risk	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Firm fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes
Year fixed-effects	Yes	Yes	Yes	Yes	Yes	Yes

(Continues)

TABLE 3 (Continued)

	Total risk		Systematic risk		Idiosyncratic risk	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
No. of observations	15,692	13,691	15,692	13,691	15,692	13,691
Adjusted R^2	0.81	0.82	0.50	0.52	0.76	0.77
Adjusted R^2 excl. fixed-effects	0.11	0.22	0.03	0.05	0.09	0.17
F-stat.	118.99***	116.21***	25.45***	16.18***	105.37***	95.54***

Note: The table reports the estimates of six alternative versions of equation (1). The dependent variables are defined as follows: *Total risk* is measured as the annualized standard deviation of daily stock returns, *Systematic risk* is the beta coefficient estimated against daily excess returns on the CRSP value-weighted market portfolio, and *Idiosyncratic risk* is the annualized standard deviation of the residuals from the beta 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 1 if the firm's CEO is a female, and *Female CFO* is assigned 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 one plus the ratio of the long-term debt-to-market value of equity, *Profitability* is measured as the ROA, *Cash holdings* is the logarithm of one plus 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 5 years, *Growth* is the transformed logarithm of the 3-year growth rate of sales, *Market-to-book* is the logarithm of the market value of equity scaled by the book value of equity, *R&D* is the logarithm of one plus R&D expenditures scaled by sales, *Firm age* is the logarithm of the age of the firm, *Sum of deltas* is the logarithm of one plus the sum of sensitivities of CEO and CFO wealth to changes in stock price, and *Vega* is the logarithm of the sum of sensitivities of CEO and CFO wealth to changes in stock return volatility. The risk measures and the control variables are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors, which are adjusted for heteroskedasticity and are clustered by firm.
***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

3.5%.[15] Moreover, the coefficients for *CFO age* are also negative and significant in the regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables and indicate that a standard deviation increase in *CFO age* would decrease volatility and idiosyncratic risk by about 1.3% to 3.9%.[16] Thus, consistent with the hypothesis that older CEOs and CFOs are more risk-averse, our regressions indicate that firms led by older top executives are less risky after controlling for various firm-specific attributes, financial and investment policies, and managerial risk-taking incentives. This suggests that age-based differences in executives' risk tolerance are reflected in firm-level risk. However, albeit being negative, the coefficients for *CEO age* and *CFO age* are statistically insignificant in the two regressions with *Systematic risk* as the dependent variable.

Turning to gender effects in Table 3, the coefficient estimates for *Female CEO* are negative and statistically significant in models 1, 2, and 5, and the coefficients for *Female CFO* are consistently negative and significant throughout the alternative regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables. Thus, the regression results provide considerable evidence to suggest that female-led firms are less risky. The coefficient estimates of model 2 suggest that a female CEO would decrease the firm's total risk by about 7%, while firms with female CFOs are associated with about a 4% decrease in stock return volatility and over 3% decrease in idiosyncratic risk. The observed negative association of female executives with market-based measures of firm risk is consistent with the hypothesis that female executives are more risk-averse as well as with the prior empirical evidence with respect to the effects of female CEOs on corporate financial and investment policy decisions (Elsaid & Ursel, 2011; Faccio et al., 2016; Palvia et al., 2015). Similar to the coefficients for *CEO age* and *CFO age*, the coefficient estimates for *Female CEO* and *Female CFO*

[15] Models 1 and 5 suggest that that a one standard deviation increase in *CEO age* would decrease *Total risk* and *Idiosyncratic risk* by 3.5% (−0.005 × 6.98 = −0.035), while models 2 and 6 suggest a decrease of 2.1% (−0.003 × 6.98 = −0.021)

[16] The estimates of models 1 and 2 suggest that that a one standard deviation increase in *CFO age* decreases *Total risk* by 3.9% (−0.006 × 6.52 = −0.039) and 1.3% (−0.002 × 6.52 = −0.013), respectively. Models 5 and 6 indicate that a one standard deviation increase in *CFO age* decreases *Idiosyncratic risk* by 2.6% (−0.004 × 6.52 = −0.026) and 1.3% (−0.002 × 6.52 = −0.013), respectively.

are statistically insignificant in the regressions with *Systematic risk* as the dependent variable (models 3 and 4). Thus, we can conclude from Table 3 that executive age and gender do not have any direct incremental effect on systematic risk. Given that systematic risk measures the sensitivity of the firm to aggregate market fluctuations and economy-wide developments, it is inherently less likely to be influenced by managerial idiosyncrasies than the firm's total and idiosyncratic risks. As already documented in the early studies by Beaver et al. (1970) and Bowman (1979), the level of systematic risk is directly related to variables such as financial leverage, earnings volatility, growth, and firm size. Thus, although CEO and CFO age and gender may indirectly influence systematic risk through corporate policy choices, this effect may be fully captured by the covariates included in our regressions.

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 negatively associated with *Size*, *Profitability*, *Cash holdings*, *Market-to-book*, *R&D*, and *Firm age* while being positively related to *Leverage* and *Cash flow volatility*.

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 even after controlling for differences in corporate policy choices and managerial risk-taking incentives that, in turn, are also influenced by executive age and gender (see e.g., Baixauli-Soler et al., 2015; Elsaid & Ursel, 2011; Faccio et al., 2016; Palvia et al., 2015; Serfling, 2014). Specifically, our results provide strong evidence that firms led by older CEOs and CFOs are less risky. These findings complement the empirical evidence recently reported in Serfling (2014) with respect to CEO age and extend his work by showing that CFO age has a nontrivial impact on firm risk over and above the influence of CEO age. Therefore, our empirical findings 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 female-led firms are associated with lower total and idiosyncratic risks, and thereby support the hypothesis that female leadership leads to less risky firms. These results contribute to the literature by demonstrating that female CEOs and CFOs have a direct negative effect on market-based measures of firm risk in addition to the indirect influence they may have through financial and investment policy choices.

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 a 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. In our main regressions, we attempt to alleviate endogeneity concerns related to omitted variables and reverse causality by using firm fixed-effects and by lagging all the independent variables by 1 year. In the following, we further mitigate endogeneity concerns by conducting two additional tests.

First, we utilize two-stage instrumental variable (IV) regressions to examine the effects of executive age and gender on firm risk. Following Serfling (2014) and Cline and Yore (2016), we use the logarithm of the consumer price index (CPI) 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 riskiness of individual firms. Our instrument of choice for *Female CEO* and *Female CFO* is the level of the gender equality index constructed by Di Noia (2002) 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. A state-level gender equality index has previously been used as an instrument for female executives, for example, in Huang and Kisgen (2013) and Palvia et al. (2015, 2020).

Panel A of Table 4 presents the coefficient estimates of the two-stage instrumental variable regressions for CEO age and gender. The first-stage regressions indicate that *CPI at birth* is significantly negatively associated with *CEO age*, and the high partial R^2s and partial *F*-statistics indicate that *CPI at birth* is a strong instrument. Moreover, the coefficient for *Gender equality index* in the first-stage regression is positive and highly significant, indicating that state-level gender equality is positively associated with the appointment of female CEOs. Even though the partial *F*-statistic of the first-stage female CEO regression is relatively low, it exceeds the critical value of 4.58 suggested by Stock et al. (2002) and Stock and Yogo (2005).[17]

The second-stage regressions with the instrumented CEO age and gender variables are broadly consistent with our main regression results in Table 3. The coefficients for the instrumented *CEO age* and *Female CEO* are negative and highly significant in the regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables, while also being negative and significant at the 10% level in the regressions with *Systematic risk* as the dependent variable. Nevertheless, it can be noted from the second-stage estimates that the coefficients on the instrumented *Female CEO* are unreasonably large in comparison to the coefficients in Table 3, suggesting that the estimated magnitude of the effect is presumably larger than the true effect. As noted by W. Jiang (2017), this may indicate a violation of the exclusion criteria for the instrument used. Given the potential violation of the exclusion criteria and the lack of a more appropriate instrument, our IV estimates with respect to CEO gender should be interpreted cautiously.[18]

The instrumental variable regressions for CFO age and gender are reported in panel B of Table 4. Similar to panel A, the first-stage regressions indicate that *CPI at birth* is negatively associated with *CFO age*, and *Gender equality index* is strongly positively associated with *Female CFO*. Again, the partial *F*-statistics are well above the critical value suggested by Stock et al. (2002) and Stock and Yogo (2005). Consistent with our main regressions in Table 3, the coefficient estimates for the instrumented *Female CFO* are negative and significant at the 5% level in the second-stage regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables. This suggests that firms with female CFOs are less risky even after addressing potential biases related to endogeneity. It can be further noted from panel B that the coefficient estimate for the instrumented *CFO age* is negative and statistically significant in the second-stage regression with *Idiosyncratic risk* as the dependent variable while being insignificant in the *Total risk* and *Systematic risk* regressions. Overall, the instrumental variable regressions alleviate endogeneity concerns to some extent and provide additional evidence to suggest that the age and gender of the top executives influence market-based measures of firm risk.

Our second approach for alleviating endogeneity concerns is propensity score matching. Pairwise correlations as well as the first-stage estimates for the control variables in our IV regressions indicate that firms led by younger CEOs and CFOs are very different from the ones led by older executives and that female-led firms differ from the male-led firms at least in terms of leverage, cash holdings, firm age, 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 together with industry and year dummies to estimate propensity scores in order to identify firms with older executives that are statistically as similar as possible to the firms with young executives.[19] 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 a 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 0.1 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

[17] The critical values for weak instrument tests developed in Stock et al. (2002) and Stock and Yogo (2005) are provided in table 2 of Stock and Yogo (2005). The critical value for the first-stage *F*-statistic in a two-stage instrumental variable (IV) model with two endogenous regressors and two instrumental variables is 4.58.

[18] Similar to our IV estimates, the coefficients on the instrumented female executive variables reported in Huang and Kisgen (2013) and Palvia et al. (2015) are also unreasonably large relative to their main estimates, suggesting that state-level gender equality is not a particularly good instrument. Given that gender is a dichotomous variable and the occurrence of female executives is very low, it is challenging to find a suitable instrument for the female executive dummies.

[19] The industry dummies are based on the Fama and French 12 industry classification.

TABLE 4 Instrumental variable regressions

Panel A: CEO age and gender					
	First-stage regressions		Second-stage regressions		
			Total risk	Systematic risk	Idiosyncratic risk
Variable	CEO age	Female CEO	Model 1	Model 3	Model 5
Instrumental variables:					
CPI at birth	−1.216***	0.001***			
	(−36.38)	(5.99)			
Gender equality index	0.000	0.001***			
	(−0.06)	(2.87)			
Age and gender:					
Instrumented CEO age			−0.003***	−0.003*	−0.003***
			(−3.04)	(−1.94)	(−2.94)
Instrumented female CEO			−1.507**	−1.812*	−1.554**
			(−2.06)	(−1.67)	(−1.99)
Control variables	Yes	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes
No. of observations	13,050	13,050	13,050	13,050	13,050
Shea's partial R^2	0.269	0.001			
Partial *F*-stat.	665.26***	19.52***			
Adjusted R^2	0.84	0.02			
F-stat./χ^2	397.30***	7.77***	12,138.38***	3191.34***	10,545.65***
Panel B: CFO age and gender					
	First-stage regressions		Second-stage regressions		
			Total risk	Systematic risk	Idiosyncratic risk
Variable	CFO age	Female CFO	Model 1	Model 3	Model 5
Instrumental variables:					
CPI at birth	−0.789***	0.001**			
	(−38.05)	(2.06)			
Gender equality index	−0.022***	0.003***			
	(−3.27)	(6.87)			
Age and gender:					
Intrumented CFO age			−0.001	0.001	−0.001*
			(−1.23)	(0.80)	(−1.91)
Intrumented female CFO			−0.390**	−0.292	−0.426**
			(−2.54)	(−1.14)	(−2.53)

(Continues)

TABLE 4 (Continued)

	First-stage regressions		Second-stage regressions		
			Total risk	Systematic risk	Idiosyncratic risk
Variable	CFO age	Female CFO	Model 1	Model 3	Model 5
Control variables	Yes	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes	Yes
No. of observations	12,884	12,884	12,884	12,884	12,884
Shea's partial R^2	0.586	0.003			
Partial *F*-stat.	733.76***	26.70***			
Adjusted R^2	0.69	0.02			
F-stat./ χ^2	200.42***	10.11***	20,819.93***	4350.29***	17,335.23***

Note: The table reports the estimates of two-stage instrumental variable regressions. The instrumental variables in the first-stage regressions are the logarithm of the consumer price index (CPI) in the birth year of the executive (*CPI at birth*) and 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 estimated against daily excess returns on the CRSP value-weighted market portfolio, and *Idiosyncratic risk* is the annualized standard deviation of the residuals from the beta 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 1 if the firm's CEO is a female, and *Female CFO* is assigned 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 one plus the ratio of the long-term debt-to-market value of equity, *Profitability* is measured as the ROA, *Cash holdings* is the logarithm of one plus 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 5 years, *Growth* is the transformed logarithm of the 3-year growth rate of sales, *Market-to-book* is the logarithm of the market value of equity scaled by the book value of equity, *R&D* is the logarithm of one plus R&D expenditures scaled by sales, *Firm age* is the logarithm of the age of the firm, *Delta* is the logarithm of one plus the sensitivity of executive wealth to changes in stock price, and *Vega* is the logarithm of the sensitivity of executive wealth to changes in stock return volatility. The risk measures and the control variables are winsorized at the 1st and 99th 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.

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.

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. 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. When the probit models underlying the propensity score matching are re-estimated using the matched samples, the coefficients for the control variables appear statistically insignificant and the insignificant post-matching Likelihood Ratio (LR) chi-square statistics suggest that all of the coefficients are simultaneously equal to 0 both in the CEO age and the CFO age 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 risk. Consistent with our main regressions in Table 3, the coefficient estimates for *CEO age* and *CFO age* are negative and highly significant in the regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables, and the coefficient for *CEO age* is negative and significant at the 10% level also in the regression with *Systematic risk* as the dependent variable. The coefficients for *Female CEO* and *Female CFO* appear statistically insignificant in the

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
Age and gender:						
CEO age	−0.003***		−0.002		−0.003***	
	(−4.29)		(−1.94)		(−4.19)	
CFO age		−0.001		0.001		−0.002***
		(−2.12)		(0.53)		(−2.67)
Female CEO	−0.007		−0.104		0.026	
	(−0.25)		(−2.13)		(0.80)	
Female CFO		−0.003		−0.015		0.005
		(−0.16)		(−0.56)		(0.30)
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	2694	3239	2694	3239	2694	3239
Adjusted R^2	0.62	0.67	0.22	0.29	0.57	0.61
F-stat.	140.17***	191.82***	20.12***	36.97***	116.88***	153.08***
PSM diagnostics:	CEO age	CFO age				
Pre-matching pseudo R^2	0.07	0.05				
Pre-matching LR chi-square	882.00***	675.78***				
Post-matching pseudo R^2	0.01	0.01				
Post-matching LR chi-square	38.75	29.34				
Mean difference	0.000	0.000				
Max difference	0.006	0.004				
Mean percentage difference	0.015	0.010				
Max percentage difference	1.117	0.894				
Panel B: Executive gender						
	Total risk		Systematic risk		Idiosyncratic risk	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Age and gender:						
CEO age	−0.002*		0.000		−0.003	
	(−1.76)		(−0.21)		(−1.94)	
CFO age		−0.003***		0.002		−0.003***
		(−2.87)		(0.98)		(−3.19)

(Continues)

TABLE 5 (Continued)

	Total risk		Systematic risk		Idiosyncratic risk	
	Model 1	Model 2	Model 3	Model 4	Model 5	Model 6
Female CEO	−0.029*		−0.101***		−0.011	
	(−1.82)		(−3.47)		(−0.61)	
Female CFO		−0.007		−0.022		−0.004
		(−0.73)		(−1.21)		(−0.32)
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	1164	2722	1164	2722	1164	2722
Adjusted R^2	0.68	0.63	0.31	0.24	0.64	0.57
F-stat.	77.14***	150.08***	17.46***	25.00***	64.71***	124.63***
PSM diagnostics:	CEO gender	CFO gender				
Pre-matching pseudo R^2	0.04	0.03				
Pre-matching LR chi-square	265.35***	352.32***				
Post-matching pseudo R^2	0.01	0.00				
Post-matching LR chi-square	16.44	21.69				
Mean difference	0.000	0.000				
Max difference	0.001	0.002				
Mean percentage difference	0.012	0.009				
Max percentage difference	0.572	1.289				

Note: 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 a 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 quintile of the sample. 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 estimated against daily excess returns on the CRSP value-weighted market portfolio, and *Idiosyncratic risk* is the annualized standard deviation of the residuals from the beta 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 1 if the firm's CEO is a female, and *Female CFO* is assigned if the firm has a female CFO. The firm-specific control variables are defined as follows: *Size* is measured as the logarithm of the firm's total assets, *Leverage* is the logarithm of one plus the ratio of the long-term debt-to-market value of equity, *Profitability* is measured as the ROA, *Cash holdings* is the logarithm of one plus 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 5 years, *Growth* is the transformed logarithm of the 3-year growth rate of sales, *Market-to-book* is the logarithm of the market value of equity scaled by the book value of equity, *R&D* is the logarithm of one plus R&D expenditures scaled by sales, and *Firm age* is the logarithm of the age of the firm. The risk measures and the control variables are winsorized at the 1st and 99th 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.

matched-firms samples, with the only exception being the significant negative coefficients for *Female CEO* in model 3 with *Systematic risk* as the dependent variable.

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. Again, the matching diagnostics indicate that the matched peer firms are sufficiently similar to the treatment firms. The post-matching LR chi-square statistics of the probit models are insignificant, and thereby indicate that the matching removes the observable differences between the firms.

The regressions based on gender-matched samples provide only weak evidence of a negative relationship between female executives and firm risk. Although the coefficients for *Female CEO* and *Female CFO* are negative throughout the different regression specifications, the coefficient estimates for *Female CEO* are statistically significant only in models 1 and 3. These results suggest that firms led by female CEOs are associated with less volatile stock returns and lower levels of systematic risk than essentially identical male-led firms. Consistent with panel A and our main regressions in Table 3, the coefficients for *CEO age* and *CFO age* are negative and statistically significant in the regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables. Taken as a whole, the regression based on the propensity score-matched samples in Table 5 provide strong evidence that firms led by older CEOs and CFOs are less risky even after controlling for any endogenous selection on observed firm characteristics. However, given that the coefficients for female CEOs and CFOs are mostly insignificant in the matched sample regressions, we are unable to fully rule out endogeneity concerns with respect to executive gender.

3.4 | Executive age and gender and the firm's policy 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 older executives as well as female executives are less 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 CEO age, the findings of Serfling (2014) indicate that firms with older CEOs invest less in R&D, have lower operating leverage, and undertake more diversifying acquisitions, while the results of Elsaid and Ursel (2011), Palvia et al. (2015) and Faccio et al. (2016) suggest that firms led by female CEOs have lower leverage, higher cash holdings, and less volatile cash flows and earnings. Moreover, Xu et al. (2019) report that firms with female CFOs hold more cash.

To investigate whether executive age and gender are associated with policies that are proximal to managerial decision-making, we regress *Leverage*, *Cash holdings*, *Cash flow volatility*, and *R&D* on *CEO age*, *CFO age*, *Female CEO*, and *Female CFO* while controlling for other firm characteristics, managerial compensation incentives, and industry and year fixed-effects. The estimates of these policy choice regressions are reported in Table 6. As can be noted from the table, the coefficient estimates indicate that *CFO age*, *Female CEO*, and *Female CFO* are negatively associated with *Leverage*. The regression results further demonstrate that firms with younger CFOs and female CFOs have significantly higher cash holdings. Moreover, the estimates in Table 6 suggest that *CEO age* is negatively and *CFO age* is positively related to *R&D*.

Our main regressions in Table 3 indicate that executive age and gender influence market-based measures of firm risk after controlling for the effects of financial and investment policy variables that, in turn, are also influenced by executive age and gender. Given concerns related to endogeneity as well as simultaneity in this setting, we next specify and estimate six alternative systems of simultaneous equations with endogenous explanatory variables. In particular, we utilize a three-stage least squares approach to estimate systems of four structural equations in which three different policy choice variables *Leverage*, *Cash holdings*, and *R&D* are used as the dependent variables, and the fourth equation in each system corresponds to the risk equation in which *Total risk*, *Systematic risk*, or *Idiosyncratic risk* is used as the dependent variable. In these simultaneous equations systems, *CEO age*, *CFO age*, *Female CEO*, and *Female CFO* are treated as endogenous explanatory variables in the three policy choice equations. Similar to the two-stage

TABLE 6 Policy choice regressions

	Leverage	Cash holdings	Cash flow volatility	R&D
CEO age	0.000	0.000	0.000	−0.039**
	(−0.12)	(0.03)	(−0.69)	(−2.07)
CFO age	−0.001**	−0.001**	0.001	0.070***
	(−2.01)	(−2.24)	(1.10)	(3.28)
Female CEO	−0.024***	0.005	−0.016	−0.426
	(−2.82)	(0.78)	(−0.64)	(−0.93)
Female CFO	−0.016***	0.008*	−0.023	−0.255
	(−2.77)	(1.81)	(−1.63)	(−0.63)
Control variables	Yes	Yes	Yes	Yes
Industry fixed-effects	Yes	Yes	Yes	Yes
Period fixed-effects	Yes	Yes	Yes	Yes
No. of observations	14,879	14,879	14,879	14,879
Adjusted R^2	0.37	0.37	0.23	0.40
F-stat.	69.09***	54.58***	28.47***	22.28***

Note: The table reports the estimates of policy choice regressions. The dependent variables are defined as follows: *Leverage* is the logarithm of the ratio of the long-term debt-to-market value of equity, *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 5 years, and *R&D* is the logarithm of R&D expenditures scaled by sales multiplied by 100. The test variables of interest are defined as follows: *CEO age* and *CFO age* denote the ages of the corresponding executives, *Female CEO* equals 1 if the firm's CEO is a female, and *Female CFO* is assigned 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, *Profitability* is measured as the ROA, *Growth* is the transformed logarithm of the 3-year growth rate of sales, *Market-to-book* is the logarithm of the market value of equity scaled by the book value of equity, *Firm age* is the logarithm of the age of the firm, *Delta* is the logarithm of one plus the sensitivity of executive wealth to changes in stock price, and *Vega* is the logarithm of one plus the sensitivity of executive wealth to changes in stock return volatility. All variables except for *Age* and *Gender* are winsorized at the 1st and 99th percentiles. The *t*-statistics (in parentheses) are based on robust standard errors which are adjusted for heteroskedasticity and are clustered by firm.
***, **, and * denote significance at the 0.01, 0.05, and 0.10 levels, respectively.

instrumental variable regressions reported in Table 4, we use *CPI at birth* as the instrument for *CEO age* and *CFO age* and the *Gender equality index* of Di Noia (2002) as the instrument for *Female CEO* and *Female CFO*.

Table 7 reports the three-stage least squares estimates of six alternative simultaneous equations systems. With respect to the policy choice variables, the estimation results in panel A indicate that firms led by older and female executives are associated with more conservative financial policy decisions after controlling for potential endogeneity.[20] The estimated coefficients for the instrumented *CEO age*, *CFO age*, *Female CEO*, and *Female CFO* are negative and statistically highly significant in the equations with *Leverage* as the dependent variable and positive and significant in the *Cash holdings* equations. While these results are broadly consistent with Elsaid and Ursel (2011), Serfling (2014), Palvia et al. (2015), and Faccio et al. (2016), our findings also extend the previous studies by demonstrating that leverage and cash holdings are strongly influenced by CFO age and gender in addition to CEO characteristics. Interestingly, the coefficient estimates for the instrumented *Female CEO*, *CFO age*, and *Female CFO* are positive in the equations with *R&D* as the dependent variable, suggesting that firms led by female executives and older CFOs invest more in R&D.

[20] For brevity, we only report the estimates of the policy choice equations for the systems in which *Total risk* is used as the dependent variable in the risk equation. The coefficient estimates of the policy choice equations remain virtually unchanged and have the same significance levels in the systems in which *Systematic risk* and *Idiosyncratic risk* are used as the dependent variables in the risk equation.

TABLE 7 Simultaneous equations models

Panel A: policy choice equations						
	Leverage		Cash holdings		R&D	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Instrumented CEO age	−0.012***		0.005***		0.000	
	(−3.28)		(3.13)		(0.58)	
Instrumented CFO age		−0.005***		0.002**		0.002***
		(−2.85)		(2.27)		(6.50)
Instrumented female CEO	−10.315***		4.918***		0.457***	
	(−5.46)		(5.44)		(4.16)	
Instrumented female CFO		−2.957***		1.840***		0.406***
		(−8.86)		(8.83)		(7.71)
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	12,445	12,430	12,445	12,430	12,445	12,430
χ^2	46.62**	154.84***	65.28***	172.09***	2441.76***	1556.89***
Panel B: risk equations						
	Total risk		Systematic risk		Idiosyncratic risk	
	Model 1	Model 2	Model 1	Model 2	Model 1	Model 2
Leverage	0.292***	0.292***	0.221***	0.221***	0.257***	0.258***
	(13.22)	(13.22)	(12.88)	(12.89)	(10.23)	(10.26)
Cash holdings	0.260***	0.261***	0.076***	0.074***	0.289***	0.291***
	(8.50)	(8.51)	(3.19)	(3.12)	(8.30)	(8.36)
R&D	−0.033	−0.039	−0.052**	−0.045*	0.009	−0.004
	(−0.95)	(−1.13)	(−1.96)	(−1.70)	(0.22)	(−0.10)
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	12,445	12,430	12,445	12,430	12,445	12,430
χ^2	25,354.21***	25,339.06***	5293.78***	5279.64***	19,624.57***	19,593.15***

Note: The table reports the three-stage least squares estimates of six alternative simultaneous equations systems. Each system of simultaneous equations consists of four equations in which three policy choice variables *Leverage*, *Cash holdings*, and *R&D* are used as the dependent variables, and the fourth equation in each system is the risk equation in which *Total risk*, *Systematic risk*, or *Idiosyncratic risk* is used as the dependent variable. *CEO age*, *CFO age*, *Female CEO*, and *Female CFO* are treated as endogenous explanatory variables in the policy choice equations. The logarithm of the CPI in the birth year of the executive (*CPI at birth*) and the gender equality index in the firm's headquarter state (*Gender equality index*) are used as the instrumental variables for executive age and gender. The dependent variables are defined as follows: *Leverage* is the logarithm of one plus the ratio of the long-term debt-to-market value of equity, *Cash holdings* is the logarithm of one plus cash holdings scaled by total assets, *R&D* is the logarithm of one plus R&D expenditures scaled by sales, *Total risk* is the logarithm of the annualized standard deviation of daily stock returns, *Systematic risk* is the beta coefficient estimated against daily excess returns on the CRSP value-weighted market portfolio, and *Idiosyncratic risk* is the annualized standard deviation of the residuals from the beta regression. The control variables are defined as follows: *Size* is measured as the logarithm of the firm's total assets, *Profitability* is measured as the ROA, *Cash flow volatility* is the logarithm of the coefficient of variation of cash flows from operations over

(Continues)

TABLE 7 (Continued)

the preceding 5 years, *Growth* is the transformed logarithm of the 3-year growth rate of sales, *Market-to-book* is the logarithm of the market value of equity scaled by the book value of equity, *Firm age* is the logarithm of the age of the firm, *Delta* is the logarithm of one plus the sensitivity of executive wealth to changes in stock price, and *Vega* is the logarithm of one plus the sensitivity of executive wealth to changes in stock return 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.

The estimates of the risk equations in panel B of Table 7 demonstrate that *Total risk*, *Systematic risk*, and *Idiosyncratic risk* are strongly positively associated with *Leverage* and *Cash holdings*, indicating that firm risk increases with increasing financial leverage and cash holdings. It can be further noted from the simultaneous equations estimates that R&D investments are negatively associated with *Systematic risk* while having no significant effect on *Total risk* and *Idiosyncratic risk*. Our main analysis suggests that firms led by older and female executives are associated with less volatile stock returns and lower levels of idiosyncratic risk. The three-stage simultaneous equations estimates in Table 7 indicate that firms led by older top and female executives have lower financial leverage and higher cash holdings and that firms with older CFOs and female CEOs and CFOs invest more in R&D. Given that leverage and cash holdings have opposite effects on *Total risk* and *Idiosyncratic risk* in the simultaneous equations estimates, we conclude that the negative relation of executive age and female executives with the market-based risk measures can be best reconciled by differences in financial leverage.[21] Nevertheless, we acknowledge that the simultaneous equations estimates do not provide an unequivocal explanation for the observed differences in market-based measures of firm risk.

It is worthwhile to emphasize that we have only focused on the most common corporate policy decisions as the potential channels through which executive age and gender may influence market-based measures of firm risk. These financial and investment policy choices are only one potential mechanism in a complex system that determines firm riskiness. Other potential channels through which executive age and gender may affect market-based risk measures include differences in managerial leadership styles (e.g., Eagly & Carli, 2003; Matsa & Miller, 2013), communication skills and tones (Baginski et al., 2018; A. Davis et al., 2015; Mayew & Venkatachalam, 2012), acquisition strategies and propensity (Huang and Kisgen, 2013; Serfling, 2014; Yim, 2013; Zhang et al., 2016), hedging strategies (Croci et al., 2017), corporate deal-making (Cline & Yore, 2016; Jenter & Lewellen, 2015), stakeholder attitudes, perceptions, and reactions (Bigelow et al., 2014; Lee & James, 2007), and informational asymmetries between the executives and other stakeholders of the firm (Antia et al., 2010; Inci et al., 2017; Jurkus et al., 2011). While a comprehensive investigation of alternative channels through which executive age and gender may affect firm risk would be interesting, it is beyond the scope of this paper.

3.5 | Robustness checks

We examine the robustness of our empirical findings with a number of additional tests.[22] First, given that younger and female executives are more common in smaller firms, we investigate the sensitivity of our results to potential firm-size effects. Specifically, we re-estimate the regressions using two subsamples from which either the largest quartile or the smallest quartile of firms are excluded. 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 CFOs, as well as female CEOs, are associated with significantly lower *Total risk*. Nevertheless, in contrast to our main results

[21] 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 often found to be 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., Acharya et al., 2012; Harford, 1999; Harford et al., 2008; Palazzo, 2012).

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

in Table 3, the coefficients for *Female CFO* are insignificant throughout the alternative model specifications, and also the coefficient for *CFO age* is insignificant in the regression with *Idiosyncratic risk* as the dependent variable. When the largest firms are excluded from the sample, the coefficient estimates for *CEO age*, *CFO age*, and *Female CFO* are negative and statistically significant in the regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables, while the coefficients for *Female CEO* are insignificant throughout the different model specifications. Taken as a whole, the regressions based on the size-restricted samples demonstrate that the negative relationships between CEO and CFO age and firm risk are insensitive to firm-size effects, while the negative association between female CFOs and market-based measures of firm risk pertains mainly to smaller firms.

Second, we estimate 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 with respect to female CEOs and CFOs are to some extent driven by firms with older top executives. When the firms with the oldest CEOs and CFOs are excluded, the coefficients for *CEO age* and *CFO age* are consistently negative and significant in the regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables. In these regressions, the coefficient estimates for *Female CEO* and *Female CFO* are insignificant. When the youngest CEOs are excluded from the sample, the coefficients for *CEO age*, *Female CEO*, and *Female CFO* are negative and significant, while the coefficients for *CFO age* appear insignificant throughout the alternative model specifications. The estimates based on subsample without the youngest CFOs are very similar to our main regressions and indicate that *Total risk* and *Idiosyncratic risk* are lower for firms that are led by older and female executives. Interestingly, the coefficients for *Female CEO* and *Female CFO* are somewhat larger in magnitude than in Table 3 and suggest that female CEOs and CFOs would decrease the firm's total risk by about 9% and 6%, respectively.

Third, in our main regressions, we follow Cline and Yore (2016) and use the ages of the CEOs and CFOs in years because the ages of these executives are fairly symmetrically distributed around 56 and 51 years. Nevertheless, we acknowledge that Serfling (2014) uses the natural logarithm of CEO age as the primary variable of interest. In order to ascertain the robustness of our empirical findings, we re-estimate the regressions by using the logarithms of CEO and CFO age as the executive age variables. The estimates of these additional regressions are nearly identical to our main results reported in Table 3. Most importantly, the coefficients for *CEO age* and *CFO age* are negative and statistically significant in the regressions with *Total risk* and *Idiosyncratic risk* as the dependent variables, while being insignificant in the *Systematic risk* regressions. Thus, we conclude that our results are robust to alternative variable definitions.

Fourth, to further examine the robustness of our results, we replace the continuous *CEO age* and *CFO age* variables with dummy variables that identify firms led by old top executives. These dummy variables are constructed based on the median CEO and CFO ages in our sample. The regression results based on old CEO and CFO dummies are consistent with our main analysis and indicate that older and female executives have a constraining effect on market-based measures of firm risk. Specifically, the coefficient estimates for *Old CEO* and *Old CFO* are negative and statistically significant, and the magnitudes of these coefficients suggest that total and idiosyncratic risks are about 2%–3% lower in firms with above-median age CEOs and CFOs.

Finally, we perform three additional tests to examine the potential effects of the global financial crisis on our results. Specifically, we first estimate regressions in which a financial crisis dummy for years 2008 to 2009 is used as an additional control variable. In these additional regressions, the coefficients for *CEO age* and *CFO age* are negative and statistically significant when *Total risk* and *Idiosyncratic risk* are used as the dependent variables, but the coefficients for *Female CEO* and *Female CFO* are negative and significant only in the *Total risk* regressions when the full set of control variables is used.

Next, we estimate regressions in which we interact the executive age and gender variables with the financial crisis dummy. Consistent with our main regressions, the coefficient estimates for *CEO age*, *CFO age*, and *Female CFO* are negative and statistically significant in the *Total risk* and *Idiosyncratic risk* regressions, and the coefficient for *Female CEO* is negative and significant with *Total risk* as the dependent variable. The coefficients for the interaction variable *CEO age* × *Crisis* are positive and significant throughout the alternative regression specifications, and also the coefficient for *CFO age* × *Crisis* is positive and significant in the *Total risk* regression. The positive coefficients for the interaction terms

are similar or larger in magnitude than the negative coefficients for the executive age variables, indicating that the overall effect of CEO and CFO age on *Total risk* amidst the crisis was positive or nonexistent. The estimated coefficients for the interaction variables *Female CEO* × *Crisis* and *Female CFO* × *Crisis* appear insignificant, and thereby suggest that the financial crisis did not significantly influence the relationship between female executives and market-based measures of firm risk.

As the final test related to the financial crisis, we estimate cross-sectional regressions with changes in *Total risk*, *Systematic risk*, and *Idiosyncratic risk* from 2007 to 2008 as the dependent variables. Ultimately, if older and female executives constrain firm risk-taking, we should observe that firms led by older and female CEOs and CFOs experience a lesser increase in market-based risk measures during the severe financial market turmoil of 2008. Contrary to our presumption, the regression results indicate that *CEO age* is significantly positively associated with the change in *Total risk* and *Idiosyncratic risk*. The coefficients for *CFO age*, *Female CEO*, and *Female CFO* are insignificant throughout the regressions, suggesting that the changes in risk measures amidst the financial crisis are unrelated to CFO age and the gender of the top executives.

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 lower risk. Nevertheless, it can also be concluded from our additional tests that the results with respect to female CEOs and CFOs are less robust and are to some extent driven by the oldest female executives and mainly pertain to smaller firms.

4 | CONCLUSION

In this paper, we examine whether market-based measures of firm risk are associated with the age and gender of the firm's CEO and CFO. 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 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 and female executives are less risky.

Using data on the S&P 1500 firms from 2006 to 2018, we find that the age- and gender-related behavioral differences influence market-based measures of firm risk. Specifically, our empirical findings indicate that firms with older CEOs and CFOs are associated with less volatile stock returns and lower levels of idiosyncratic risk. This evidence suggests that executives may become more risk-averse with age and thereby constrain risk-taking by their firms. While our analysis complements and corroborates the findings of Serfling (2014) with respect to a strong negative linkage between CEO age and firm risk, we extend his work by documenting that CEO age is largely irrelevant with respect to systematic risk, and more importantly, by showing that firms with older CFOs exhibit less risk. Thus, our results contribute to the literature by demonstrating that the age of the CFO has a nontrivial incremental impact on firm risk over and above the influence of CEO age. We perform several additional tests to alleviate endogeneity concerns and to examine the robustness of our empirical findings to alternative model specifications and different variable definitions. Overall, these tests provide further support for the hypothesis that older CEOs and CFOs constrain firm risk-taking.

Our empirical findings on the influence of executive gender on firm risk are a bit more equivocal. We find strong evidence that firms with female CFOs are associated with lower total and idiosyncratic risks after controlling for firm-specific attributes, financial and investment policy choices, managerial risk-taking incentives, and potential endogeneity. We also document less conclusive evidence to suggest that firms led by female CEOs are less risky. Our findings contribute to the prior literature (Elsaid & Ursel, 2011; Faccio et al., 2016; Palvia et al., 2015) by demonstrating that female CEOs and CFOs have a direct negative effect on market-based measures of firm risk in addition to the indirect

influence they have through the firm's financial and investment policy choices. Our additional tests indicate that the negative association between female executives and firm risk is to some extent induced by the oldest female executives and is more pertained to smaller firms. Collectively, our results with respect to executive gender and market-based risk measures provide additional support for the hypothesis that female leadership leads to less risky firms.

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