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CEO Characteristics and Risk-Taking under Economic Policy Uncertainty

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Abstract: This paper investigates the effects of such CEO characteristics as gender, age, and education on the CEOs' risk-taking behavior during periods of economic policy uncertainty. The paper utilizes Execucomp, BoardEx, and Compustat data from 2005 to 2017 in order to give a novel perspective on how CEO characteristics may provide differing risk-taking positions when faced with varying levels of uncertainty. The results offer robust evidence that older CEOs generally take less risk—regardless of the level of economic policy uncertainty. However, more educated CEOs take less risk only during economically uncertain times. The results also indicate that while female CEOs tend to be younger and have lower levels of education, gender does not provide a significant difference in risk-taking behavior during periods of economic policy uncertainty. Furthermore, we do not find any significant effect of insider status or corporate governance variables on CEO risk-taking under economic policy uncertainty once gender, age, and education are controlled for.

Keywords: CEO risk taking; economic policy uncertainty; CEO characteristics

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1. Introduction

Risk-taking is inherent in all economic activities that face uncertain prospects (Laux 2015; Vereshchagina and Hopenhayn 2009). While Bloom (2014) reviews how uncertainty can impact firms through various channels, including CEO incentives, the prior literature lacks studies testing which observable CEO characteristics significantly explain risk-taking behavior when faced with varying levels of economic policy uncertainty. In this paper, we contribute to the literature by empirically exploring how socio-demographic characteristics such as the gender, education, and age of senior executives in a firm affect risk-taking behavior under varying degrees of economic uncertainty caused by fluctuations in the policy and regulatory outcomes controlled by governments and regulators. Our first contribution lies in empirically demonstrating that, contrary to previous findings, gender is not a significant determinant of CEO risk-taking behavior when controlling for other socio-demographic factors such as age and education. A striking characteristic of the senior executives in our sample is that female CEOs, on average, are younger and less educated than their male counterparts. Female executives are also less likely to be insiders and have shorter tenure with their firms. Therefore, we argue that age, education and gender are highly co-linear, and not controlling for the aforementioned problem may have plagued earlier research.

Our results highlight age and level of education as more important determinants. Specifically, while older CEOs always take less risk, CEOs with higher levels of education take less risk only when economic policy uncertainty increases. Our results regarding the age of the CEOs are consistent with the previous studies, which argue that not only

older managers (Vroom and Pahl 1971) but also older organizations (Desai 2008) are more risk-averse. In a similar vein, our results show that older CEOs are more risk-averse during both certain and uncertain times. Our second contribution, however, lies in the fact that we can differentiate between the behavior during "certain" and "uncertain" times using the economic policy uncertainty index of Baker et al. (2016).

Our third contribution is documenting that CEO education levels significantly influence risk-taking behavior, with higher education leading to reduced risk-taking under economic uncertainty. When there are no controls for economic policy uncertainty, more educated CEOs tend to be higher risk-takers. However, under periods of economic uncertainty, CEOs with higher education levels can significantly decrease a firm's risk-taking level. When executive stock option volatility controls are added, especially, the decrease in risk-taking becomes even more significant. Finally, we do not find evidence of a link between risk-taking during economic policy uncertainty and Ivy League education. The results indicate that higher education levels are more important than the institution granting the degree. Similarly, corporate governance characteristics, like whether the CEO is an insider and the ratio of independent directors, have significant effects on the risk-taking level. However, when controlling for periods of economic policy uncertainty, the strength of corporate governance controls loses their significance on the results. Next, we find that firms' leverage and liquidity (measured by debt and current rations, respectively) seem to be positively correlated with risk-taking, and the result is statistically significant. On the contrary, larger and more profitable firms seem to take lower levels of risk.

2. Literature Review

The literature has documented that risk-taking behavior depends on several factors, including incentive systems, personal experiences, environment, biological traits, and life choices. Black et al. (2017) establish that approximately 2/3 of the variance in risk-taking in financial markets can be attributed to environmental and biological factors. Existing studies show that gender, education, and age matter in corporate practices. For instance, younger chief executive officers (CEOs) are more likely to undertake acquisitions (Yim 2013), female-led firms have lower levels of unsystematic risk (Peltomäki et al. 2021) and CEOs with more advanced degrees are awarded higher compensation (Graham et al. 2012). Orlitzky and Benjamin (2001) show that firms with a stronger focus on corporate social performance (CSP) tend to have lower financial risks. The connection between CSP and risk seems to work both ways: past CSP is linked to lower future financial risks, and prior financial risks are tied to lower subsequent CSP.

Economic policy uncertainty negatively impacts firm acquisitiveness. It extends the time it takes to complete M&A deals (Nguyen and Phan 2017), is negatively related to firm-level capital investment (Gulen and Ion 2016), and generally reduces corporate risk-taking (Wen et al. 2021). Bloom (2014) gives an extensive review of how uncertainty may affect firms through such channels as real options, risk premia, risk aversion, and through the incentives of their CEOs. While policy-related economic uncertainty is an important component of macroeconomic volatility that may induce behavioral differences in risk-taking across senior executives and firms, to the best of our knowledge, no research addresses how CEO characteristics influence risk-taking under economic policy uncertainty.

In this paper, we close this gap by testing which observable CEO characteristics play a significant role in explaining the magnitude of risk-taking behavior when confronted with varying degrees of economic policy uncertainty. Different cohorts might react to risk differently under varying levels of economic policy uncertainty. For example, the evidence about the differences in risk-taking behavior of different genders is mixed. There is some evidence around the fact that men are inclined to take more risks than women. Charness and Gneezy (2012) assemble data from 15 experiments with one simple underlying investment game and find a robust result that women are more risk averse than men. Another study by Mather and Lighthall (2012) argue that while male risk-taking increases under stress,

female risk-taking tends to decrease under stress. On the other hand, Adams and Funk (2012) find that male directors are slightly less risk-loving than female directors.

Hypothesis 1: *We expect female CEOs to take lower risks, both during certain and uncertain times.*

On the other hand, the evidence around the effect of CEO age on risk-taking behavior is pretty consistent across the literature. Older managers are found to be less risk-taking than younger managers: Serfling (2014). In their theoretical model, Prendergast and Stole (1996) predict younger CEOs to invest more aggressively and take greater risks. Similarly, Peltomäki et al. (2021) find that firms led by older CEOs tend to have lower stock return volatility. Serfling (2014) also finds that less (more) risky firms tend to hire older (younger) CEOs, while the firm's risk preferences and those of the CEO are unlikely to match.

Hypothesis 2: *We expect older CEOs to take lower risks, both during certain and uncertain times.*

Among other characteristics that might differ under economic policy uncertainty is the level of education. To begin with, Dollinger (1984) shows the link between education and an increased tolerance for ambiguity—which implies that the risk-taking behavior may change with uncertainty for educated CEOs. Martino et al. (2020) contend that a company's risk-taking significantly and negatively relates to professional education, while Bantel and Jackson (1989) document that there exists a positive relationship between the average education level of the top management team and corporate innovation. Similarly, Wiersema and Bantel (1992) using a sample of Fortune 500 companies show that higher educated management teams are associated with a higher likelihood of strategic change. Using regulated industries and R&D spending as proxies for risk propensity, Palia (2000) find that unregulated industries tend to prefer managers with higher quality educational backgrounds while Barker III and Mueller (2002) contend that CEO education does not affect the amount of R&D spending, whereas R&D spending increases significantly in firms where the CEO has advanced science training.

Additionally, King et al. (2016) find that firms led by MBAs improve their performance when compensation structures are geared towards greater risk-taking incentives and banks follow riskier or more innovative business models. They conclude that management education delivers skills enabling CEOs to manage increasingly larger and more complex banking firms and achieve successful performance outcomes. Firms seem to pay a premium to newly appointed CEOs with superior educational credentials (Falato et al. 2015), and stock markets reward the announcements of appointments of CEOs with stronger educational credentials with positive and significant abnormal returns (Bhagat et al. 2010).

Hypothesis 3: *We expect more educated CEOs to take lower risks, but only during uncertain times.*

We also contribute to the pertinent literature that has extensively analyzed the correlation between several firm-level or governance variables on the one hand, and risk-taking on the other. Coles et al. (2006) find that the structure of managerial compensation within the firm significantly affects risk appetite. Further, Green and Talmor (1985) show that the value of corporate tax liability can affect the risk-taking attitudes of firms. In a similar vein, Acharya et al. (2011) suggest that differences in the strength of creditor rights can predict risk-seeking behavior by senior executives. Other studies have shown that senior executives have a higher propensity to take risks if they hold lower inside debt (Cassell et al. 2012), if they are born into the upper class (Kish-Gephart and Campbell 2015), if they hold aircraft pilot licenses (Cain and McKeon 2016), if they have prior legal infractions (Davidson et al. 2015), or if they have no military backgrounds (Benmelech and Frydman 2015).

3. Data and Descriptive Statistics

We use data from all firms in the Execucomp and BoardEx database between 2005 and 2017. The CEO education data are collected from BoardEx and the other CEO characteristics

from the Execucomp and BoardEx databases. CEO-related qualitative variables are CEO age, CEO gender, CEO education index, CEO Ivy-league dummy, and insider CEO dummy. The frequency of the data is yearly.

To elaborate, CEO age is the age of the CEO in a given fiscal year. CEO gender is a dummy variable that takes the value of 1 if the CEO is a female and 0 otherwise. CEO education index is an index variable that increases as the CEO's terminal degree increases, starting at 1 for a bachelor's degree and increasing by one up to a doctoral degree (i.e., 1—bachelor's degree, 2—master's degree, 3—doctorate). The insider CEO dummy variable takes the value of 1 when the CEO is promoted from inside and 0 otherwise. CEO tenure is the years the CEO has served in that position as of the current fiscal year. CEO Ivy-league dummy is 1 when CEO graduates from an Ivy-league school with a bachelor's, master's, or Ph.D. degree[1]. Another variable related to board composition is an independent director ratio, namely the ratio of independent directors on the firm's board to the total number of directors. The firm-specific control variables are the following: assets (natural log of total assets of the firm), current ratio (current assets over current liability), debt ratio (total liability over total assets), and ROA (net income over total assets.

While firm-specific accounting data are collected from the Compustat database, stock return and market data are collected from CRSP. The main dependent variable for measuring the level of risk-taking is total return volatility, calculated following the methodology in Yost (2018) as the standard deviation of daily stock returns during the fiscal year. We exclude the firms that do not have the required CEO information in the Execucomp database. We also exclude the firms without all the accounting variables we use in our analysis. The final dataset includes 11,437 firm-year level observations from 1602 unique firms between 2005 and 2017.

We follow the literature to measure the economic policy uncertainty and use two indices developed by Baker et al. (2016). We call the first index the three-component index (TCI). Accordingly, TCI is the aggregate index based on three components: (i) the newspaper coverage of policy-related economic uncertainty, (ii) the number of federal tax code provisions set to expire in future years, and (iii) disagreement among economic forecasters as a proxy for uncertainty. The second one is calculated from the monthly count of predetermined uncertainty and policy-related terms in news articles published in the top ten newspapers in the United States. We dub that index NEWS. We download the indices from the database at http://www.policyuncertainty.com (accessed on 6 June 2023).[2] Baker et al. (2016) contend that their index effectively captures changes in policy uncertainty around major events that increase economic uncertainty, such as elections, debates over the debt ceiling, Gulf wars, the Federal Reserve's quantitative easing, and the US government shutdown. The index has been extensively used in the finance literature previously (Kaviani et al. 2020; Bonaime et al. 2018).

We present our descriptive statistics in Table 1. Panel A presents the summary statistics by gender, while Panel B presents the summary statistics by education. A preliminary analysis of difference-in-means tests in Panel A show that female senior executives are not only younger and less educated, on average, but also are less likely to be insiders and have shorter tenure. While the median values of education are higher for both men and women, the difference is more pronounced for women, which points to the fact that the distribution of education is more skewed to the left for female CEOs than for male CEOs. On the other hand, while CEO tenure is skewed to the right for both men and women, the difference is more pronounced for males, which implies that more males than females occupy the CEO position for a substantially longer period.

Table 1. Descriptive Statistics. This table provides descriptive statistics for the dependent variable and all control variables of interest. Total return volatility is the annualized standard deviation of firm daily returns for the respective fiscal year and it measures CEO risk-taking. Idiosyncratic volatility is a standard deviation of daily residual returns calculated for each year using a market model (parameters are estimated using 36 months of daily returns). Earnings volatility is the volatility of quarterly return on assets (ROA) seasonally adjusted, measured by standard deviation of quarterly ROA for three years from t to t + 2. Age is the age of the firm's CEO at the end of a given fiscal year. Gender is a dummy variable that takes the value of 1 if the CEO is a female and 0 otherwise. Education index is an index variable that increases as the CEO's terminal degree increases, starting at 1 for a bachelor's degree and increasing through to a doctoral degree (i.e., 1: bachelor's degree, 2: master's degree, 3: doctorate degree). The insider CEO dummy variable takes the value of 1 when the CEO is promoted from inside and 0 otherwise. The Independent director ratio is the ratio of independent directors on the firm's board. Panel A provides gender comparisons of risk-taking behavior by CEOs, while Panel B provides comparisons based on their level of education. Assets are expressed as a natural logarithm of year-end total assets. *, ** and *** represent significance at the 10%, 5%, and 1% levels, respectively.

Panel A: Differences in Risk-Taking by Gender

	Female (1)		Male (2)		Difference (1)–(2)	
	Mean	Median	Mean	Median	Mean	Median
Total return volatility	0.386	0.334	0.393	0.336	−0.01	−0.00*
Idiosyncratic volatility	0.332	0.278	0.326	0.278	0.01	−0.00
Earnings volatility	0.096	0.038	0.113	0.042	−0.02	−0.00
Age	54.397	55	56.008	56	−1.61 ***	−1.00 ***
Education index	1.575	2	1.707	2	−0.13 ***	0.00 ***
Insider CEO	0.245	0	0.315	0	−0.07 ***	0.00 ***
Independent director ratio	0.879	0.875	0.84	0.833	0.04 ***	0.04 ***
Assets	7.84	7.649	7.773	7.696	0.07	−0.05

Panel B: Differences in Risk-Taking by Level of Education

	Education index						Difference					
	Bachelor (1)		Master's (2)		Doctorate (3)		(1)–(2)		(2)–(3)		(1)–(3)	
	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median	Mean	Median
Total return volatility	0.473	0.395	0.465	0.384	0.583	0.525	0.01 *	0.01 ***	−0.12 ***	−0.14 ***	−0.11 ***	−0.13 ***
Idiosyncratic volatility	0.409	0.335	0.403	0.325	0.499	0.435	0.01	0.01 ***	−0.10 ***	−0.11 ***	−0.09 ***	−0.10 ***
Earnings volatility	0.247	0.057	0.217	0.049	0.795	0.134	0.03	0.01 ***	−0.58 ***	−0.09 ***	−0.55 ***	−0.08 ***
Age	55.606	55	55.95	56	57.409	57	−0.34 ***	−1.00 ***	−1.46 ***	−1.00 ***	−1.80 ***	−2.00 ***
Insider CEO	0.327	0	0.307	0	0.403	0	0.02 **	0.00 **	−0.10 ***	0.00 ***	−0.08 ***	0.00 ***
Independent director ratio	0.782	0.778	0.796	0.8	0.783	0.8	−0.01 ***	−0.02 ***	0.01 ***	0.00 ***	−0.00	−0.02 *
Assets	6.693	6.716	6.738	6.7	5.646	5.256	−0.05 *	0.02	1.09 ***	1.44 ***	1.05 ***	1.46 ***
Gender	0.052	0	0.031	0	0.036	0	0.02 ***	0.00 ***	−0.01	0.00	0.02 **	0.00 **

Panel B shows, consistent with the previous literature, that senior executives with a doctoral degree are, on average, more risk-taking than those with a bachelor's or master's degree. While a median CEO with a master's degree is slightly more risk-averse than a median CEO with a bachelor's degree, the difference in means is inconclusive. Unsurprisingly, the CEO's average age increases with more education obtained.

4. Results

4.1. Effects of CEO Characteristics on Risk-Taking

By following the literature, we begin our analysis with a set of regressions that do not control for the changes in economic uncertainty to establish a benchmark. We test the impact of CEO characteristics on firms' risk-taking by running panel OLS regressions. Specifically, we begin by estimating the following model:

$$\text{Risk-taking proxy}_{i,t} = \alpha_{i,t} + \beta_1 \text{CEO characteristic}_{i,t} + \zeta \text{Control variables}_{i,t} + \epsilon_{i,t} \quad (1)$$

where the risk-taking proxy is a dependent variable of total return volatility. In this model, our variables of interest are the following CEO characteristics: age, gender, education level, Ivy League dummy, insider CEO dummy, and stock options ratio. Additionally, we test one board characteristic as a control variable—the independent director ratio in the board.

The empirical results are presented in Table 2. We document a consistently significant negative effect of age on CEO risk-taking (Regressions 1–5), confirming the conventional wisdom that older CEOs generally take less risk. This result is consistent with Vroom and Pahl (1971) as well as Jianakoplos and Bernasek (2006), who show that risk-taking decreases with age. While education is not significant at the 5% cutoff, a CEO with a degree from an Ivy League institution decreases risk-taking. The baseline specification also shows, not surprisingly, that CEOs take more risk if they have more stock options or if they are insiders (i.e., former employees). Also unsurprisingly, when governance controls are stronger, i.e., when the board has more independent directors, CEOs take less risk.

Table 2. Effects of CEO Characteristics on Risk-Taking. This table uses regression results to show the effects of major CEO characteristics on CEO risk-taking without controlling for economic uncertainty or any interaction variables. The dependent variable, used as a proxy for CEO risk-taking, is the total return volatility of the firm for the respective fiscal year. Age is the age of the firm's CEO at the end of a given fiscal year. Gender is a dummy variable that takes the value of 1 if the CEO is a female and 0 otherwise. Education index is an index variable that increases as the CEO's terminal degree increases, starting at 1 for a bachelor's degree and increasing through to a doctoral degree (i.e., 1: bachelor's degree, 2: master's degree, 3: doctorate degree). The Ivy League dummy is 1 when CEO graduated from an Ivy League school at a Bachelor, Master, or/and Ph.D. level. The Insider CEO dummy variable takes the value of 1 when the CEO is promoted from inside and 0 otherwise. The Independent director ratio is the ratio of independent directors on the firm's board. The Stock option ratio is the percentage of total CEO compensation that is provided through stock options. T-statistics are provided in parentheses. * and *** represent significance at the 10% and 1% levels, respectively.

	(1)	(2)	(3)	(4)	(5)
Age	−0.003 ***	−0.003 ***	−0.003 ***	−0.003 ***	−0.003 ***
	(−12.98)	(−13.03)	(−13.08)	(−12.64)	(−10.57)
Gender	−0.011	−0.011	−0.01	−0.007	−0.015
	(−1.11)	(−1.14)	(−1.05)	(−0.69)	(−1.38)
Education index	0.005	0.008 *	0.005	0.006	0.001
	−1.61	−2.47	−1.6	−1.85	−0.3
Ivy League		−0.022 ***			
		(−5.12)			
Insider CEO			0.009 *		
			−2.33		

Table 2. *Cont.*

	(1)	(2)	(3)	(4)	(5)
Independent director ratio				−0.109 ***	
				(−12.91)	
Stock option ratio					0.063 ***
					(6.00)
N	14,147	14,147	14,147	14,147	10,887
p-value	0.000	0.000	0.000	0.000	0.000

4.2. Effects of CEO Characteristics on Risk-Taking under Economic Uncertainty

Next, we focus on answering novel questions about what type of CEO takes more (less) risk in rising economic policy uncertainty. Towards this end, we develop a model in which the variables of interest are the interaction terms between each CEO characteristic and the economic uncertainty index. Note that an annual change in the economic uncertainty index incorporates the time dimension. Specifically, we estimate the following model:

$$\begin{aligned}\text{Risk-taking proxy}_{i,t} = {} & \alpha_{i,t} + \beta_1 \text{CEO characteristic}_{i,t} + \beta_2 \text{Economic uncertainty}_{i,t} + \\ & \beta_3 \text{CEO characteristics}_{i,t} \times \text{Economic uncertainty}_{i,t} + \zeta \text{Control variables}_{i,t} + \epsilon_{i,t}\end{aligned} \quad (2)$$

where the risk-taking proxy is the dependent variable of total return volatility, and CEO characteristics are a vector of the same characteristics variables as in Formula (1). In contrast to the previous analysis, our variables of interest in this model are the interaction terms between CEO characteristics and economic uncertainty proxied by TCI. TCI is the aggregate index based on three components that are discussed in Section 2. Controls include an array of firm-level and CEO-level variables, described below. Assets is the natural log of the firm's total assets for that fiscal year. Current is the current ratio of the firm. Debt is the debt ratio of the firm as a proxy for leverage. ROA is the return on assets defined as net income over total assets. Delta to Vega is a proxy for executive stock option volatility. Delta measures stock option changes as the base security price changes, whereas Vega measures the change in the implied value of the stock option as expected underlying price changes. Other control variables are the independent director ratio, insider director ratio, and insider CEO.

Table 3 shows that more educated CEOs decrease risk-taking during economic policy uncertainty. This result is robust and survives in every specification, with various control variables, and confirms the third hypothesis. Panel A of Table 3 also shows that CEO education positively relates to risk-taking. Together, these two results indicate that more educated CEOs take more risk in general but take less risk during times with higher economic policy uncertainty. Our finding that more educated CEOs decrease risk only during high uncertainty might emanate from various channels. To begin with, more educated CEOs (who also hold large stakes in firm equity) can better hedge in times of uncertainty, for example, by using derivatives (Knopf et al. 2002), which, in turn, leads to lower exposure to risk. Next, since high economic policy uncertainty periods are normally associated with times of high investors' marginal utility of wealth, educated CEOs aim to decrease risk-taking to decrease the risk exposure of their investors during uncertain times. Another possible channel is via real options, because uncertainty can make more educated CEOs cautious about investments and hiring, which can be expensive to reverse due to adjustment costs.

Table 3. Effects of CEO Characteristics on Risk-Taking under Economic Uncertainty—Using TCI as a proxy for Economic Uncertainty. This table uses regression results to show the effects of major CEO characteristics on CEO risk-taking when controlling for periods of economic uncertainty. The dependent variable, used as a proxy for CEO risk-taking, is the total return volatility of the firm for a given fiscal year. Three-component index (TCI) is the variable that measures economic policy uncertainty. Age is the age of the firm's CEO at the end of a given fiscal year. Gender is a dummy variable that takes the value of 1 if the CEO is a female and 0 otherwise. Education index is an index variable that increases as the CEO's terminal degree increases, starting at 1 for a bachelor's degree and increasing through to a doctoral degree (i.e., 1: bachelor's degree, 2: master's degree, 3: doctorate degree). The Ivy League dummy is 1 when CEO graduated from an Ivy League school at a Bachelor, Master, or/and Ph.D. level. The Insider CEO dummy variable takes the value of 1 when the CEO is promoted from inside and 0 otherwise. The Independent director ratio is the ratio of independent directors on the firm's board. The Stock option ratio is the percentage of total CEO compensation that is provided through stock options. Assets are a control variable for the natural log of the firm's total assets for that fiscal year. Current is the current ratio of the firm. Debt is the firm's debt ratio (used as a proxy for leverage). ROA is the return on assets defined as net income over total assets. Panel A presents the results without controlling for stock option volatility. Panel B includes Delta to Vega as a proxy for executive stock option volatility. Following Coles et al. (2006), Vega is measured as the dollar change in the CEO wealth for a 0.01 change in standard deviation of returns. Delta is measured as the dollar change in the executive's wealth for a 1% change in stock price. T-statistics are provided in parentheses. *, ** and *** represent significance at the 10%, 5% and 1% levels, respectively.

Panel A: Without Controls for Stock Option Volatility

	(1)	(2)	(3)	(4)	(5)
TCI	−0.000	−0.000	−0.000	−0.000	−0.001 *
	(−0.61)	(−0.61)	(−0.86)	(−0.12)	(−2.33)
Age	−0.002 ***	−0.002 ***	−0.003 ***	−0.002 ***	−0.003 ***
	(−4.23)	(−4.23)	(−4.25)	(−4.18)	(−4.21)
Age × TCI	0.001	0.001	0.001	0.001	0.002 *
	(1.76)	(1.76)	(1.86)	(1.72)	(2.32)
Gender	0.003	0.003	0.003	0.003	−0.011
	(0.15)	(0.15)	(0.14)	(0.15)	(−0.40)
Gender × TCI	0.008	0.008	0.008	0.008	0.023
	(0.39)	(0.39)	(0.39)	(0.40)	(0.90)
Education index	0.023 **	0.023 **	0.023 **	0.023 **	0.022 *
	(3.14)	(3.07)	(3.17)	(3.14)	(2.34)
Education index × TCI	−0.017 *	−0.016 *	−0.017 *	−0.016 *	−0.017 *
	(−2.44)	(−2.34)	(−2.47)	(−2.42)	(−1.98)
Assets	−0.049 ***	−0.049 ***	−0.049 ***	−0.049 ***	−0.049 ***
	(−41.65)	(−41.90)	(−41.00)	(−40.81)	(−35.05)
Current	0.022 **	0.022 **	0.022 **	0.023 **	0.026 **
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	(3.15)	(3.15)	(3.12)	(3.19)	(3.22)
Debt	0.090 ***	0.090 ***	0.090 ***	0.091 ***	0.097 ***
	(7.33)	(7.33)	(7.31)	(7.39)	(7.65)
ROA	−0.463 ***	−0.463 ***	−0.463 ***	−0.463 ***	−0.557 ***
	(−9.15)	(−9.14)	(−9.16)	(−9.13)	(−9.70)
Ivy League		−0.001			
		(−0.06)			
Ivy League × TCI		−0.000			
		(−0.02)			
Insider CEO			−0.003		
			(−0.41)		
Insider CEO × TCI			−0.004		
			(−0.51)		

Table 3. *Cont.*

Panel A: Without Controls for Stock Option Volatility					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Independent director ratio				−0.010	
				(−0.59)	
Independent director ratio × TCI				−0.013	
				(−0.97)	
Stock option ratio					−0.028
					(−0.97)
Stock option ratio × TCI					0.027
					(0.97)
N	11,084	11,084	11,084	11,084	8283
p-value	0.000	0.000	0.000	0.000	0.000
Panel B: Controlling for Executive Stock Option Volatility					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
TCI	0.000	0.000	0.000	0.001	−0.000
	(0.56)	(0.55)	(0.63)	(1.09)	(−0.12)
Age	−0.002 *	−0.002 *	−0.002 *	−0.002 *	−0.003 **
	(−2.28)	(−2.29)	(−2.30)	(−2.28)	(−2.93)
Age × TCI	0.001	0.001	0.001	0.001	0.002 *
	(1.41)	(1.41)	(1.44)	(1.40)	(2.06)
Gender	−0.009	−0.010	−0.008	−0.009	−0.034
	(−0.21)	(−0.24)	(−0.20)	(−0.21)	(−0.72)
Gender × TCI	0.059	0.060	0.058	0.059	0.088
	(1.39)	(1.41)	(1.37)	(1.40)	(1.75)
Education index	0.024 *	0.026 *	0.023 *	0.023 *	0.029 *
	(2.10)	(2.34)	(2.09)	(2.08)	(2.25)
Education index × TCI	−0.022 *	−0.024 *	−0.022 *	−0.022 *	−0.031 *
	(−2.09)	(−2.29)	(−2.08)	(−2.06)	(−2.47)
Assets	−0.058 ***	−0.058 ***	−0.058 ***	−0.057 ***	−0.055 ***
	(−25.76)	(−25.71)	(−25.20)	(−25.51)	(−22.66)
Current	0.037 ***	0.037 ***	0.037 **	0.037 ***	0.035 **
	(3.31)	(3.34)	(3.29)	(3.31)	(3.17)
Debt	0.127 ***	0.127 ***	0.127 ***	0.127 ***	0.113 ***
	(5.09)	(5.11)	(5.10)	(5.10)	(4.46)
ROA	−0.420 ***	−0.420 ***	−0.420 ***	−0.420 ***	−0.519 ***
	(−4.93)	(−4.92)	(−4.92)	(−4.92)	(−5.94)
Delta to Vega	−0.000	−0.000	−0.000	−0.000	0.000
	(−0.10)	(−0.09)	(−0.06)	(−0.20)	(0.36)
Ivy League		−0.020			
		(−1.30)			
Ivy League × TCI		0.016			
		(1.09)			
Insider CEO			0.013		
			(0.84)		
Insider CEO × TCI			−0.013		
			(−0.91)		
Insider director ratio				0.023	
				(0.80)	
Insider director ratio × TCI				−0.038	
				(−1.40)	
Stock option ratio					0.036
					(1.03)
Stock option ratio × TCI					−0.056
					(−1.71)
N	3534	3534	3534	3534	2772
p-value	0.000	0.000	0.000	0.000	0.000

Panel B of Table 3 includes additional controls for executive stock option volatility and shows that CEO education is even more strongly correlated with risk-taking during times of uncertainty. For example, the last specification in the panel has a negative coefficient on the interaction term education index TCI of −0.031, which is almost double the magnitude of the same coefficient in Panel A. This points to the importance of the correct model specification with relevant control variables. Next, Table 3 shows that CEO gender does not change risk-taking, which rejects the second hypothesis. This may be explained by the fact that the recent literature argues that the combination of a female CEO and female directors leads to a stronger awareness of competitive actions (Kolev et al. 2021). While age has a negative impact on risk-taking, its impact does not change during uncertain times, confirming our second hypothesis. In addition to CEO-level controls, we include several firm-level control variables. Assets are the natural logarithm of firm assets with a significant negative coefficient. In other words, larger companies take less risk. We also show that firms with higher ROA have a lower total risk level. On the other hand, firms with higher levels of debt and current ratio also take more risks.

4.3. Robustness

It is worth noting that researchers often use an alternative policy uncertainty index of Baker et al. (2016) that is based on the monthly number of uncertainty-related articles published in the top 10 US newspapers. We name that index NEWS and perform robustness tests by replacing TCI with NEWS. Table 4 shows that our main result of decreasing risk with increasing CEO education is robust when using an alternative uncertainty measure. Specifically, Panel A of Table 4 shows that an interaction term of education index and NEWS is robust in four out of five specifications.

Table 4. Effects of CEO Characteristics on Risk-Taking under Economic Uncertainty—Using NEWS as a proxy for Economic Policy Uncertainty. This table uses regression results to show the effects of major CEO characteristics on CEO risk-taking when controlling for periods of economic uncertainty. The dependent variable, used as a proxy for CEO risk-taking, is the total return volatility of the firm for a given fiscal year. NEWS is the alternative measure of economic policy uncertainty. Age is the age of the firm's CEO at the end of a given fiscal year. Gender is a dummy variable that takes the value of 1 if the CEO is a female and 0 otherwise. Education index is an index variable that increases as the CEO's terminal degree increases, starting at 1 for a bachelor's degree and increasing through to a doctoral degree (i.e., 1: bachelor's degree, 2: master's degree, 3: doctorate degree). The Ivy League dummy is 1 when CEO graduated from an Ivy League school at a Bachelor, Master, or/and Ph.D. level. The Insider CEO dummy variable takes the value of 1 when the CEO is promoted from inside and 0 otherwise. The Independent director ratio is the ratio of independent directors on the firm's board. The Stock option ratio is the percentage of total CEO compensation that is provided through stock options. Assets are a control variable for the natural log of the firm's total assets for that fiscal year. Current is the current ratio of the firm. Debt is the firm's debt ratio (used as a proxy for leverage). ROA is the return on assets defined as net income over total assets. Panel A presents the results without controlling for stock option volatility. Panel B includes Delta to Vega as a proxy for executive stock option volatility. Following Coles et al. (2006), Vega is measured as the dollar change in the CEO wealth for a 0.01 change in standard deviation of returns. Delta is measured as the dollar change in the executive's wealth for a 1% change in stock price. T-statistics are provided in parentheses. *, ** and *** represent significance at the 10%, 5% and 1% levels, respectively.

Panel A: Without Controls for Stock Option Volatility					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
NEWS	0.000	0.000	−0.000	0.000	−0.001
	(0.13)	(0.13)	(−0.10)	(0.37)	(−1.46)
Age	−0.002 **	−0.002 **	−0.002 **	−0.002 **	−0.003 ***
	(−3.19)	(−3.20)	(−3.26)	(−3.19)	(−3.32)

Table 4. *Cont*.

Panel A: Without Controls for Stock Option Volatility					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Age × NEWS	0.000	0.000	0.000	0.000	0.001
	(0.82)	(0.82)	(0.97)	(0.82)	(1.63)
Gender	0.010	0.010	0.010	0.010	−0.000
	(0.42)	(0.41)	(0.41)	(0.42)	(−0.02)
Gender × NEWS	0.003	0.003	0.003	0.003	0.013
	(0.13)	(0.13)	(0.13)	(0.13)	(0.59)
Education index	0.021 **	0.021 **	0.022 **	0.021 **	0.017
	(3.05)	(3.01)	(3.09)	(3.05)	(1.81)
Education index × NEWS	−0.015 **	−0.015 *	−0.015 **	−0.015 **	−0.013
	(−2.65)	(−2.57)	(−2.69)	(−2.63)	(−1.80)
Assets	−0.049 ***	−0.049 ***	−0.049 ***	−0.049 ***	−0.049 ***
	(−41.66)	(−41.91)	(−40.99)	(−40.81)	(−34.99)
Current	0.022 **	0.022 **	0.022 **	0.023 **	0.027 **
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
	(3.16)	(3.16)	(3.12)	(3.20)	(3.22)
Debt	0.091 ***	0.091 ***	0.090 ***	0.091 ***	0.097 ***
	(7.34)	(7.33)	(7.32)	(7.40)	(7.66)
ROA	−0.464 ***	−0.464 ***	−0.464 ***	−0.463 ***	−0.558 ***
	(−9.16)	(−9.15)	(−9.17)	(−9.14)	(−9.72)
Ivy League		0.001			
		(0.09)			
Ivy League × TCI		−0.001			
		(−0.17)			
Insider CEO			−0.004		
			(−0.48)		
Insider CEO × TCI			−0.003		
			(−0.44)		
Insider director ratio				−0.010	
				(−0.61)	
Insider director ratio × TCI				−0.013	
				(−0.97)	
Stock option ratio					−0.025
					(−0.85)
Stock option ratio × TCI					0.025
					(0.85)
N	11,084	11,084	11,084	11,084	8283
p-value	0.000	0.000	0.000	0.000	0.000
Panel B: Controlling for Executive Stock Option Volatility					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
NEWS	0.000	0.000	0.000	0.001	0.000
	(0.58)	(0.56)	(0.65)	(1.11)	(0.13)
Age	−0.002 *	−0.002 *	−0.002 *	−0.002 *	−0.003 **
	(−2.48)	(−2.49)	(−2.50)	(−2.48)	(−2.83)
Age × NEWS	0.001	0.001	0.002	0.001	0.002 *
	(1.60)	(1.60)	(1.64)	(1.59)	(1.97)
Gender	−0.032	−0.034	−0.032	−0.032	−0.053
	(−0.76)	(−0.78)	(−0.75)	(−0.76)	(−1.11)
Gender × NEWS	0.081	0.082	0.081	0.082	0.106 *
	(1.79)	(1.81)	(1.78)	(1.80)	(2.05)
Education index	0.027 *	0.029 **	0.026 *	0.026 *	0.029 *
	(2.47)	(2.71)	(2.46)	(2.45)	(2.36)
Education index × NEWS	−0.025 *	−0.028 **	−0.025 *	−0.025 *	−0.031 **
	(−2.48)	(−2.67)	(−2.46)	(−2.44)	(−2.63)

Table 4. *Cont.*

Panel B: Controlling for Executive Stock Option Volatility					
	(1)	**(2)**	**(3)**	**(4)**	**(5)**
Assets	−0.058 ***	−0.058 ***	−0.058 ***	−0.057 ***	−0.055 ***
	(−25.76)	(−25.71)	(−25.20)	(−25.52)	(−22.65)
Current	0.037 ***	0.037 ***	0.037 **	0.037 ***	0.035 **
	(3.31)	(3.33)	(3.29)	(3.31)	(3.18)
Debt	0.127 ***	0.127 ***	0.127 ***	0.127 ***	0.114 ***
	(5.10)	(5.11)	(5.10)	(5.10)	(4.46)
ROA	−0.420 ***	−0.420 ***	−0.420 ***	−0.420 ***	−0.518 ***
	(−4.93)	(−4.93)	(−4.93)	(−4.92)	(−5.92)
Delta to Vega	−0.000	−0.000	−0.000	−0.000	0.000
	(−0.10)	(−0.09)	(−0.07)	(−0.20)	(0.37)
Ivy League		−0.021			
		(−1.34)			
Ivy League × TCI		0.017(1.12)			
Insider CEO			0.012		
			(0.83)		
Insider CEO × TCI			−0.013		
			(−0.90)		
Insider director ratio				0.023	
				(0.82)	
Insider director ratio × TCI				−0.038	
				(−1.42)	
Stock option ratio					0.036
					(1.03)
Stock option ratio × TCI					−0.057
					(−1.71)
N	3534	3534	3534	3534	2772
p-value	0.000	0.000	0.000	0.000	0.000

In Panel B of Table 4, the result is significant in all five specifications. This is the case even though, due to additional controls, the number of observations has reduced substantially from Panel A and decreased the power of the tests in Panel B. Note that the magnitude of the coefficients on TCI and NEWS education interaction terms are very close, which means that either one can be used in place of the other.

Similarly, other results on CEO-specific and firm-specific variables survive the robustness check. CEO age is negatively related to risk-taking, and education is positively related to risk-taking. Such firm-level variables as assets and ROA are negatively correlated with risk-taking. On the contrary, the current ratio and debt positively relate to risk-taking, and the coefficients are significant in all specifications.

5. Conclusions

In the paper, we demonstrate a negative relation between CEO education level and risk-taking in times of economic policy uncertainty in the United States. This result is robust in various specifications using various controls and alternative definitions of uncertainty, and confirms our third hypothesis. Additionally, we explore several possible channels via which more educated CEOs decrease risk-taking in times of uncertainty.

We further contribute to risk-taking-related research by exploring how the impact of other CEO characteristics changes in uncertain times. We do not find any evidence of a significant correlation between risk-taking in times of uncertainty and such CEO characteristics as gender, Ivy League education, or insider CEO status. In particular, our findings regarding gender reject our first hypothesis, suggesting that omitted variable bias may have influenced previous research in this area.

We show that while CEO age is negatively related to risk-taking, its effect does not change during uncertain times. This is consistent with our second hypothesis. Similarly,

the influence of insider director ratio on risk-taking does not depend on economic policy uncertainty. Finally, several firm-level characteristics are statistically significantly correlated with risk-taking. We show that a higher level of debt and current ratio leads to higher risk-taking by firms in our sample. However, more profitable and larger companies decrease risk-taking.

In future research, exploring the channels via which more educated CEOs take less risk will be interesting. Furthermore, estimating the relation between other CEO characteristics and risk-taking will be useful. Scholars could also test if CEO characteristics impact risk-taking changes in recessions and expansions or low and high consumer confidence periods. Future researchers could address the aforementioned questions with additional data.

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Notes

[1] While Ivy League school is an appropriate and objective proxy for quality education, we recognize that this classification omits some excellent educational institutions that are non-Ivy League. However, because the classification of non-Ivy League quality institutions would be subjective, we have not implemented it.

[2] More details on the index construction are available at http://www.policyuncertainty.com/methodology.html (accessed on 1 June 2023).

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