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Navigating through economic policy uncertainty: The role of corporate cash holdings

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ABSTRACT

We find that U.S. corporations increase their cash holdings in response to higher economic policy uncertainty. The increase in cash holdings is not attributed to a reduction in firm investments. This increase is more pronounced for financially constrained firms or those with larger exposure to policy uncertainty. Holding more cash in the presence of policy uncertainty alleviates the negative impact of policy uncertainty on capital investment and firm innovation outputs. Our findings demonstrate that cash holdings represent an important channel in mitigating the negative effect of policy uncertainty on firm real economic activities.

1. Introduction

Recent political conflicts and fiscal crises in the United States have spurred a growing concern on the impact of economic policy uncertainty (EPU hereafter) on corporate activities including capital investment (Bernanke, 1983; Bloom, 2009; Gulen and Ion, 2016; Julio and Yook, 2012; Leahy and Whited, 1996), merger and acquisition activities (Bonaime et al., 2018; Nguyen and Phan, 2017), innovation (Bhattacharya et al., 2017), corporate transparency (Bird et al., 2017) and equity prices and risk premia (Brogaard and Detzel, 2015; Pástor and Veronesi, 2012, 2013). Such declines in firms' real economic activity and information environment can lead to negative long-term consequences for firms, investors, and eventually the economy. Yet, there remains a paucity of research on corporate financial decisions in response to policy uncertainty. We fill this gap in the literature by investigating whether firm managers change their cash holdings policy in response to higher policy uncertainty and if they do, whether and how such changes in cash holdings help mitigate the negative effect of policy uncertainty on firms' real economic activity.

We focus on the effect of macro-level EPU on firm cash holdings for the following reasons. First, cash holdings play an important role in affecting other corporate financial policies such as alleviating refinancing risk (Harford et al., 2014) and improving firm innovation efficiency (Lyandres and Palazzo, 2016). Second, the cash balances of the U.S. firms are substantial, exceeding 1.3 trillion dollars (Hoberg et al., 2014), accounting for more than 45% of the financial assets (Duchin et al., 2017) and 23% of the total firm assets (Bates et al., 2009).[1] Third, corporate managers are more responsive to EPU in managing cash holdings than long-term oriented

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[1] A recent estimate by Moody's indicates that the U.S. non-financial companies' cash and liquid investment is $1.9 trillion which is approximately 10% of the U.S. 2017 Gross Domestic Products. For more information, refer to https://www.moodys.com/research/Moodys-US-corporate-cash-pile-to-rise-5-to-19–PR_375739.

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capital structure decisions. Furthermore, corporate cash reserves are relatively easily accessible and manageable with little scrutiny. Finally, EPU acts as an exogenous shock to all firms which is largely non-diversifiable. In contrast, firm-specific uncertainty is more endogenous and hence relatively easier for managers to predict (*e.g.*, through capital budgeting), hedge against (*e.g.*, through using derivatives) and/or diversify away (*e.g.*, through acquiring different asset classes or engaging in various projects). Thus, macro-level EPU may exert a distinct impact on corporate cash holdings as compared to those of other firm-level sources of uncertainty. It is therefore important to understand the effect of policy uncertainty on cash holdings and the channel of the effect.

We conduct our empirical analysis in two stages. In the first stage, we investigate whether firms' cash holdings change in response to higher EPU. We foresee financial constraints as an important economic channel through which EPU may affect corporate cash holdings. A growing literature asserts that EPU affects firm financial constraints by increasing financing costs (Gungoraydinoglu et al., 2017; Pástor and Veronesi, 2012, 2013) or hindering firm access to bank loan finance (Bordo et al., 2016; Gilchrist and Jae, 2014). The literature on corporate cash holdings also documents that when firms face greater friction in securing outside financing, they tend to accumulate more cash (Denis and Sibilkov, 2010; Harford et al., 2014; Opler et al., 1999). These evidences suggest that, through the "financial constraints" channel, with constraints on capital supply or increasing financing costs (due to greater EPU), firms are encouraged to hold more cash.

We use the policy uncertainty index developed in Baker et al. (2016) (henceforth, BBD) as a measure of EPU. Unlike measures of general macroeconomics uncertainty, this index captures uncertainty about what may be the upcoming monetary or fiscal policy, the tax or regulatory regime, or uncertainty over electoral outcomes that influence political leadership (Baker et al., 2016).[2] Further, while election years are also used in the literature as another measure of policy uncertainty (Bhattacharya et al., 2017; Jens, 2017; Julio and Yook, 2012), we use the BBD index because it accounts for both uncertainties during the election years and non-election years (Gulen and Ion, 2016; Nguyen and Phan, 2017). Finally, using a discrete event such as election may be artificially precise as the passing of legislation during an election does not necessarily indicate the complete resolution of uncertainty surrounding the government policy (Brogaard and Detzel, 2015).

We find a strongly positive relation between policy uncertainty and cash holdings for the U.S. firms over the period 1985–2014. In terms of economic significance, a doubling in the level of policy uncertainty leads to an increase by 3.012% in the ratio of cash to assets in the following year. The positive impact of policy uncertainty on firm cash holdings remains unchanged after we control for the effect of firm investment opportunities and other sources of general macro-economic uncertainty. We further show that all components (news, tax, inflation and government spending) of policy uncertainty have a significant and positive impact on corporate cash holdings, with the news-based component having the biggest influence. This result is not surprising as this news-based component represents the biggest fraction of 50% of the total BBD index.

One possible concern regarding the interpretation of our baseline regression result is that our EPU may capture the effects of other general macroeconomic uncertainty or weaker economies, as increases in EPU are usually correlated with increases in general economic uncertainty (Gulen and Ion, 2016). To address this confounding effect concern, we follow Çolak et al. (2017) and Jens (2017) and use gubernatorial elections as an exogenous shock to an increase in EPU. This setting offers several empirical advantages for studying managerial response. First, state-level elections could increase the uncertainty regarding who will win the election, what new policies will be implemented and how they will impact on firm corporate decisions. Second, gubernatorial election timing is largely exogenous to the firm's operations, which helps disentangle the endogenous nature of financing decisions (Çolak et al., 2017; Jens, 2017). Furthermore, the staggered nature of election cycles across states creates cross-sectional variation in policy uncertainty, yielding a set of control firms to account for macroeconomic factors and other time trends that influence firm financing decisions. We further employ the numbers of incumbents who do not run for re-election due to their term limit and the predictability of gubernatorial election outcomes as instrumental variables for EPU (Bonaime et al., 2018; Jens, 2017). These two instrumental variables satisfy the relevance condition because new incumbents and greater uncertainty about election outcomes will lead to higher EPU (Bonaime et al., 2018; Jens, 2017). These measures also satisfy the exclusion restriction as term limits and predictability of gubernatorial election outcomes are unlikely to have a direct impact on firm cash holdings except indirectly through increasing policy uncertainty. The results of these identification tests corroborate with our findings.

We next examine the cross-sectional variation in the relation between policy uncertainty and cash holdings. We argue that if firms increase their cash holdings in response to higher policy uncertainty, this effect should be stronger for those who are more exposed to policy uncertainty ex-ante. In our analysis, we classify firms as being more likely to be affected by policy uncertainty if they (i) rely more on the government for their sales (Belo et al., 2013), (ii) have governments as their major customers (Dhaliwal et al., 2016), (iii) have higher exposure to political risk (Hassan et al., 2017) or (iv) have higher return sensitivity to changes in overall EPU (Bonaime et al., 2018). We find supporting evidence of our prediction that firms' exposure to policy uncertainty amplifies the positive impact of policy uncertainty on their cash reserves.

We then investigate whether financial constraint is an economic channel through which policy uncertainty affects corporate cash holdings. We document that a higher degree of policy uncertainty encourages firms to save more cash from internally generated cash flows, using the cash-cash flow sensitivity model of Almeida et al. (2004).

We next examine how firms accumulate more cash in the periods of heightened EPU. We anticipate that if EPU increases managers' perceived cash flow risk and firm financial frictions, it would be optimal for these firms to choose conservative decisions by reducing their dividend payout and share repurchases. Our results support this conjecture.

[2] Prior studies use various measures of the overall macroeconomic uncertainty faced by firms including the dispersion in analyst forecasts or volatility of stock returns (Bali et al., 2014), input and output prices (Leahy and Whited, 1996), or total factor productivity (Bloom et al., 2018).

In the second stage of our empirical analysis, we document the strategic motives underlying managers' conservative cash holdings policy to deal with increasing policy uncertainty through the lens of (i) capital investment and (ii) innovation. We demonstrate that cash holdings alleviate the dampening effect of policy uncertainty on capital expenditure, especially for financially constrained firms. While firm innovation is negatively related to policy uncertainty (Bhattacharya et al., 2017), firms that hold more cash have more innovation output and innovation efficiency than firms with lower level of cash holdings. These findings suggest that larger cash accumulations allow constrained firms to undertake value-enhancing projects (either tangibles or intangibles) that might otherwise be bypassed (Almeida et al., 2004; Denis and Sibilkov, 2010) as a result of the increased policy uncertainty (Gulen and Ion, 2016).

Our paper contributes to the existing literature in three important dimensions. First, we demonstrate the role of firm cash holdings in mitigating the adverse effect of policy uncertainty. While prior studies document a strong negative relation between policy uncertainty and firm-level capital investment (Bloom, 2009; Gulen and Ion, 2016; Julio and Yook, 2012), M&A activities (Nguyen and Phan, 2017), and innovation activities (Bhattacharya et al., 2017), the question of what financial actions/measures firms can undertake to mitigate the adverse effect of policy uncertainty remains under-researched in the extant literature. We document that holding more cash during the times of heightened policy uncertainty attenuates the dampening effect of policy uncertainty on investment and firm innovation output.

Second, the literature attributes the dampening effect of policy uncertainty on investment to the precautionary delays due to investment irreversibility (Gulen and Ion, 2016). Our paper, on the other hand, shows that the relation between policy uncertainty and cash holdings is not a manifestation of the delays in investment, but rather a precautionary response of firms to the increase in financial constraints. Our paper, therefore, makes a fundamental contribution to the literature by not only highlighting the effect of policy uncertainty on cash holdings policy but also identifying different channels through which policy uncertainty affects corporate financing decisions.

Finally, we contribute to the corporate cash holdings literature. Prior studies explain the level and value of corporate cash holdings based on various firm- or industry-specific variables, including corporate governance (Dittmar and Mahrt-Smith, 2007; Harford et al., 2008), financial constraints (Almeida et al., 2004; Denis and Sibilkov, 2010), cash flow volatility (Opler et al., 1999), product market threats (Hoberg et al., 2014), refinancing risk (Harford et al., 2014), R&D investment (Brown and Petersen, 2011; He and Wintoki, 2016), tangible assets (Lei et al., 2018), firm diversification (Fernandes and Gonenc, 2016; Subramaniam et al., 2011) labor union-related issues (Klasa et al., 2009; Qiu, 2019), local government quality (Chen et al., 2014) or city-level political uncertainty (Xu et al., 2016). We extend these studies by highlighting the macroeconomy-level uncertainty of economic policy and regulatory outcomes as an additional determinant of corporate cash policy. Our findings are important because the aggregate policy uncertainty is largely outside the control of a firm and cannot be easily hedged through derivatives or financial contracting.

The remainder of this study proceeds as follows. Section 2 provides details of data and variable description. Section 3 interprets the main findings. Section 4 discusses economic channels. Section 5 analyzes the effects of holding more cash in the period of higher EPU. Section 6 concludes the paper.

2. Data and variable descriptions

2.1. Data

To examine the relation between policy uncertainty and corporate cash holdings, we use the BBD index of Baker et al. (2016). We use Compustat annual industrial file as the primary source of information for firm-specific characteristics for the period between 1985 and 2014.

Following prior studies on corporate cash holdings (Fernandes and Gonenc, 2016; Opler et al., 1999), we exclude financial firms (*SIC* codes: 6000 and 6999) because their operations are subject to industry-specific regulations, such as capital and liquidity requirements, which differ from non-bank financial institutions. We also exclude utility companies (*SIC* codes: 4900–4999) because their cash holdings are regulated in a number of states (Bates et al., 2009; Lei et al., 2018). Firms that are not incorporated in the United States or have negative assets or negative sales are also excluded. Following Almeida and Campello (2007), we eliminate firm-year observations with assets or sale growth greater than 100% because this sharp increase may be associated with major corporate events such as mergers and acquisitions. We further exclude firms with market-to-book ratios that are negative or greater than 10 (Almeida and Campello, 2007; Gilchrist and Himmelberg, 1995).

2.2. Economic policy uncertainty measures

The BBD index is a weighted average of three measures of (i) frequency of newspaper articles referencing EPU; (ii) the role of policy and federal tax code provisions changes; and (iii) the disagreement among forecasters on future inflation and future government spending. The BBD index significantly correlates with events ex-ante expected to generate policy-related uncertainty such as uncertainty over the stimulus package, the debt ceiling dispute, wars, financial crashes and major federal elections. This index remains a consistent measure of EPU after a wide range of robustness tests. These includes comparing the index with the Chicago Board Options Exchange Market Volatility Index (VIX); controlling for the potential for political slant to skew newspaper coverage of policy uncertainty; and using uncertainty indicators based on the Beige Book releases before each regularly scheduled meeting of the Federal Open Market Committee (Baker et al., 2016). This measure has been used in the recent literature to investigate the impact of policy uncertainty on investment (Gulen and Ion, 2016), mergers and acquisitions (Bonaime et al., 2018; Nguyen and Phan, 2017) and stock prices (Pástor and Veronesi, 2013).

Table 1
Correlation matrix and descriptive statistics.

Panel A: Correlation matrix

	CASH	*PU*	*PU_NEWS*	*PU_TAX*	*PU_GOVCPI*	*SIZE*	*MLEV*	*CF*	*NWC*	*CAPEX*	*BLEV*	*R&D*	*DIV_PAYER*	*ICFVOL*
CASH	1.000													
PU	0.027***	1.000												
PU_NEWS	0.053***	0.909***	1.000*, **											
PU_TAX	0.029***	0.904***	0.907***	1.000										
PU_GOVCPI	0.049***	0.842***	0.888***	0.840***	1.000									
SIZE	−0.206***	0.041***	0.055***	0.020***	−0.072***	1.000								
MB	0.147***	−0.097***	−0.098***	−0.075***	−0.102***	0.090***	1.000							
CF	−0.252***	−0.023***	−0.060***	−0.030***	0.025***	0.253***	0.032***	1.000						
NWC	−0.224***	−0.023***	−0.052***	−0.021***	0.063***	−0.146***	−0.169***	0.199***	1.000					
CAPEX	−0.192***	−0.047***	−0.062***	−0.047***	0.023***	0.059***	0.069***	0.152***	−0.177***	1.000				
BLEV	−0.456***	0.002***	−0.005***	−0.001***	0.051***	0.191***	−0.081***	0.034***	−0.097***	0.101***	1.000			
R&D	0.465***	−0.012***	0.016***	−0.004***	−0.046***	−0.200***	0.183***	−0.444***	−0.097***	−0.121***	−0.281***	1.000		
DIV_PAYER	−0.182***	0.025***	−0.016***	0.011***	0.063***	0.410***	0.067***	0.212***	0.051***	0.048***	0.003***	−0.197***	1.000	
ICFVOL	0.247***	0.156***	0.142***	0.092***	−0.042***	−0.015***	0.083***	−0.141***	−0.239***	−0.122***	−0.154***	0.171***	−0.149***	1.000

Panel B: Descriptive statistics

Variable	Obs.	Mean	SD	P25	Median	P75
PU	73,931	4.612	0.232	4.396	4.645	4.752
PU_NEWS	73,931	4.624	0.238	4.421	4.628	4.835
PU_TAX	73,931	4.518	0.419	4.172	4.500	4.926
PU_GOVCPI	73,931	4.495	0.387	4.167	4.608	4.791
CASH	73,931	0.162	0.195	0.023	0.082	0.231
SIZE	73,931	5.022	2.091	3.498	4.902	6.448
MB	73,931	2.200	1.662	1.049	1.721	2.832
CF	73,931	0.030	0.180	0.016	0.071	0.114
NWC	73,931	0.123	0.185	−0.006	0.110	0.246
CAPEX	73,931	0.061	0.062	0.021	0.042	0.077
BLEV	73,931	0.200	0.178	0.026	0.173	0.322
R&D	73,931	0.041	0.080	0.000	0.000	0.049
DIV_PAYER	73,931	0.282	0.450	0.000	0.000	1.000
ICFVOL	73,931	0.238	0.120	0.156	0.212	0.282

This table presents the correlation matrix (Panel A) and the descriptive statistics (Panel B) for the main variables used in the analysis. The data extends from 1985 to 2014. Panel B reports firm-year observations that do not have any missing values on all used variables. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

2.3. Correlation matrix and descriptive statistics

The correlation matrix and the descriptive statistics of all variables used in the main analysis are presented in Table 1. In Panel A, the overall index (*PU*) is highly correlated with each of its components, especially with *PU_NEWS* (0.909). We also observe that the news component is also highly correlated with the tax components, *PU_TAX*, (0.907), but less so with the other two components combined, *PU_GOVCPI*, (0.888). More importantly, we find that the overall policy uncertainty index (*PU*) is positively correlated with firm cash holdings (*CASH*). Among the three components of the policy uncertainty index, the news-based measure of policy uncertainty (*PU_NEWS*) has the highest correlation with firm cash holdings (0.053). These observations provide an early indication of a positive impact of policy uncertainty on corporate cash holdings. In Panel B, we report the mean, standard deviation, median values of all variables. The mean cash holdings (to total assets) ratio is 16.2% which is consistent with those reported in Harford et al. (2014), Lyandres and Palazzo (2016) and Harford et al. (2017).

3. Policy uncertainty and cash holdings: baseline results

In this section, we investigate the effect of policy uncertainty on firm cash holdings. We test the effect using overall and the main components of the BBD uncertainty index and control for firm-level characteristics, firm investment opportunities and the macroeconomic uncertainties that are known to affect cash holdings. We then address the issues of omitted variables and reverse causality in the policy uncertainty and cash holdings regressions. We also conduct additional cross-sectional tests to further explain the association between policy uncertainty and cash holdings.

3.1. Baseline models

We begin our empirical analysis by estimating the following baseline regression:

$$\mathrm{CASH}_{i,t+1} = \alpha_0 + \beta_1 \mathrm{PU}_t + \theta_j \mathrm{CONTROL}_{j,i,t} + \gamma_i \mathrm{Firm}_i + \epsilon_{i,t+1} \quad (1)$$

The dependent variable is $CASH_{i,t+1}$, of firm i in year $t + 1$. Control variables include *SIZE*, *MB*, *CF*, *NWC*, *CAPEX*, *BLEV*, *R&D*, *DIV_PAYER* and *ICFVOL* of firm i in year t (He and Wintoki, 2016; Lei et al., 2018; Opler et al., 1999). In the baseline regressions, we include firm-fixed effects and cluster robust standard errors at the firm level to control for time-invariant firm characteristics and within-firm serial correlations in the error term $\epsilon_{i,t+1}$. Appendix A1 provides the detailed definitions of all variables introduced.

The key explanatory variable of interest is policy uncertainty, PU_t, which is measured as the natural log of the arithmetic average of the BBD index in the 12 months of fiscal year t. Each firm i in year t is assigned the same *PU* value of year t. This means we cannot include year fixed effects (FEs) in the models where *PU* is specified because the *PU* variable is cross-sectionally invariant, hence year FEs will absorb all the explanatory power of *PU*.

Columns 1 and 2 of Panel A in Table 2 present the regressions associated with Eq. (1). Specifically, only *PU* and firm FEs are specified in Column (1), firm-level control variables are further incorporated in Column (2). The results suggest that an increase in policy uncertainty is associated with higher firm cash holdings in the following year, manifested by the positive and statistically significant of PU.

There are three main concerns in the interpretation of the above results in Columns (1) and (2). The first is the possibility that policy uncertainty is negatively correlated with investment opportunities (Bloom, 2014) and thus an increase in firm cash holdings may be driven by the effect of lower investment opportunities. To address this concern, we employ four popular variables that have been used in the prior literature as proxies for firm investment opportunities at the aggregate level (Bloom, 2014; Gulen and Ion, 2016). The first is the expected GDP growth (*EX_GDPGROWTH*) which is the percentage change between the mean one-year-ahead GDP forecasts from the Philadelphia Federal Reserve's biannual Livingstone survey and the current GDP level. The second proxy is the real GDP growth rates (*REAL_GDPGROWTH*) from the World Bank's World Development Indicator. Third, we employ the year-on-year log change in the Conference Board's monthly Leading Economic Index (*ECONOMIC_INDEX*) which is based on the ten macroeconomic indicators that have been shown to have predictive power over future GDP. The final proxy is the Michigan Consumer Confidence Index (*CONSUMER_CONFIDENCE*) from the University of Michigan to capture consumers' expectations about future economic prospects.

The second and third concerns are to separate the effects of political cycles from the business cycles as well as to measure the effects of EPU rather than macroeconomic uncertainty or weaker economies, as an increased policy uncertainty is highly correlated with an increase in general economic uncertainty (Baker and Bloom, 2013). To control for these possible contaminations, we further include the following six plausible proxies for macroeconomic uncertainty that possibly affect firm cash holdings in Eq. (1). We first follow Julio and Yook (2012) to construct an election year dummy (*ELECYEAR*) that is equal to one on the years of presidential elections. Second, we use the Livingstone survey of professional forecasters to compute a proxy for uncertainty about future economic growth (*GDPDIS*).[3] Third, to capture uncertainty about future profitability, we calculate the yearly cross-sectional standard deviation of firm-level profit growth (*SDPROFIT*). Fourth and fifth, to control for equity market-based uncertainty, we include the yearly cross-sectional standard deviation of stock returns (*SDRETURN*) and the implied volatility index (*VXO*) from the Chicago Board Options Exchange, respectively. Finally, we use another comprehensive measure of aggregate uncertainty (*JLN*), developed by Jurado et al.

[3] Biannual GDP forecasts from the Livingstone survey of the Philadelphia Federal Reserve Bank.

Table 2
Policy uncertainty and cash holdings: Main results.

Panel A: Regression results

	(1)	(2)	(3)	(4)	(5)	(6)
Variables	*CASH (t + 1)*	*CASH (t + 1)*	*CASH (t + 1)*	*CASH (t + 1)*	*CASH (t + 1)*	*CASH (t + 1)*
PU	0.022***	0.019***	0.020***			
	[0.00]	[0.00]	[0.00]			
PU_NEWS				0.023***		
				[0.00]		
PU_TAX					0.009***	
					[0.00]	
PU_GOVCPI						0.009***
						[0.00]
SIZE		−0.009***	−0.014***	−0.014***	−0.014***	−0.014***
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
MB		0.004***	0.004***	0.004***	0.004***	0.004***
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
CF		−0.014**	−0.009	−0.009	−0.009	−0.009
		[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
NWC		−0.163***	−0.156***	−0.156***	−0.155***	−0.156***
		[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
CAPEX		−0.291***	−0.281***	−0.281***	−0.280***	−0.283***
		[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
BLEV		−0.236***	−0.224***	−0.224***	−0.224***	−0.224***
		[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
R&D		−0.097***	−0.095***	−0.095***	−0.095***	−0.094***
		[0.03]	[0.03]	[0.03]	[0.03]	[0.03]
DIV_PAYER		0.000	0.002	0.002	0.002	0.002
		[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
ICFVOL		0.011	−0.032*	−0.029	−0.029	−0.032*
		[0.02]	[0.02]	[0.02]	[0.02]	[0.02]
EX_GDPGROWTH			0.002***	0.003***	0.003***	0.003***
			[0.00]	[0.00]	[0.00]	[0.00]
ECONOMIC_INDEX			0.000***	0.000***	0.000***	0.000***
			[0.00]	[0.00]	[0.00]	[0.00]
CONSUMER_CONFIDENCE			−0.000*	−0.000***	−0.000	−0.000**
			[0.00]	[0.00]	[0.00]	[0.00]
REAL_GDPGROWTH			−0.001***	−0.001***	−0.001***	−0.001***
			[0.00]	[0.00]	[0.00]	[0.00]
ELECYEAR			0.004***	0.003***	0.003***	0.003***
			[0.00]	[0.00]	[0.00]	[0.00]
GDPDIS			0.004	0.003	0.003	0.001
			[0.00]	[0.00]	[0.00]	[0.00]
SDPROFIT			−0.003***	−0.002**	−0.002**	−0.001
			[0.00]	[0.00]	[0.00]	[0.00]
VXO			0.005	−0.004	−0.003	−0.004
			[0.01]	[0.01]	[0.01]	[0.01]
SDRETURN			0.015***	0.015***	0.011***	0.012***
			[0.00]	[0.00]	[0.00]	[0.00]
JLN			−0.005	0.004	0.005	0.006
			[0.01]	[0.01]	[0.01]	[0.01]
Obs.	85,216	80,197	73,931	73,931	73,931	73,931
Adj. R-squared	0.702	0.736	0.742	0.742	0.742	0.742
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes
Firm Cluster	Yes	Yes	Yes	Yes	Yes	Yes

Panel B: Normalized all variables (Column 3)

Variables	Coefficients	Robust standard errors
PU	0.025***	[0.01]
SIZE	−0.159***	[0.02]
MB	0.035***	[0.00]
CF	−0.011	[0.01]
NWC	−0.153***	[0.01]
CAPEX	−0.094***	[0.00]
BLEV	−0.217***	[0.01]
R&D	−0.044***	[0.01]

(*continued on next page*)

Table 2 (*continued*)

Panel B: Normalized all variables (Column 3)

Variables	Coefficients	Robust standard errors
DIV_PAYER	0.005	[0.00]
ICFVOL	−0.022*	[0.01]
EX_GDPGROWTH	0.020***	[0.01]
ECONOMIC_INDEX	0.036***	[0.01]
CONSUMER_CONFIDENCE	−0.011*	[0.01]
REAL_GDPGROWTH	−0.018***	[0.00]
ELECYEAR	0.008***	[0.00]
GDPDIS	0.009	[0.01]
SDPROFIT	−0.013***	[0.00]
VXO	0.009	[0.01]
SDRETURN	0.014***	[0.00]
JLN	−0.010	[0.01]

In Panel A of this table, we regress firm cash holdings (cash-to-assets ratio, *CASH*) on policy uncertainty (log of BBD index) in Column (1) and include firm-level controls such as size (*SIZE*), market-to-book ratio (*MB*), cash flow (*CF*), net working capital (*NWC*), capital expenditure (*CAPEX*), book leverage (*BLEV*), R&D expense (*R&D*), dividend paying dummy (*DIV_PAYER*), industry cash flow volatility (*ICFVOL*) in Column (2). In Column (3), we add four proxies for firm investment opportunities, including expected GDP growth (*EX_GDPGROWTH*), leading economic index (*ECONOMIC_INDEX*), consumer confidence (*CONSUMER_CONFIDENCE)* and real GDP growth (*REAL_GDPGROWTH*) and six proxies for general economic uncertainty, including election year dummy (*ELECYEAR*), GDP forecast dispersion (*GDPDIS*), standard deviation of cross-sectional profit growth (*SDPROFIT*), implied volatility *(VXO*), standard deviation of cross-sectional real returns (*SDRETURN*), and Jurado et al. (2015)'s index (*JLN*). In Columns (4) through (6), we replace the overall policy uncertainty measure by each of its three components (news (*PU_NEWS*), tax (*PU_TAX*), and government spending combined with inflation (*PU_GOVCPI*)). All continuous variables are winsorized at 1% levels and defined in Appendix A1. In all regressions, we include firm fixed effects and firm clustering effects. Robust firm clustered standard errors are reported in the brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively. Panel B reports the economic significance of each of the independent variable in Column (3) of Panel A.

(2015), which is based on the co-movement in the unpredictable component of 132 macroeconomic data series and 147 financial markets data series. We take natural logarithms of all of these economic uncertainty measures except for the election year dummy.

We then augment our baseline specifications by adding the four investment opportunities and six macroeconomic uncertainty variables to the regression model in Eq. (1) and present the results in Column (3) of Panel A in Table 2. The results show that the positive effect of *PU* on corporate cash holdings holds after controlling for aggregate investment opportunities and macroeconomic uncertainty and the economic magnitude of the effect slightly increases.

To facilitate the comparison of economic magnitudes across covariables, all variables in Column (3) of Table 2 have been normalized by their sample standard deviations following Gulen and Ion (2016). Therefore, each coefficient can be interpreted as the change in the dependent variable (as a proportion of its standard deviation) associated with a one-standard-deviation increase in the independent variable. Given that we use log of policy uncertainty measures and firm fixed effect, the coefficient estimate for the policy uncertainty variable can be interpreted as the number of standard deviation changes in cash holdings in response to a 100% increase in policy uncertainty. We present the regression results of all normalized variables in Panel B of Table 2. The coefficient of *PU* of 0.025 indicates that when policy uncertainty (*i.e.*, BBD index) increases by 100%, firms, on average, increase their ratio of cash to assets by 0.025 standard deviations. This implies a 48.8 basis points (0.195 * 0.025) increase, which is equivalent to 3.012% (= 48.8 bps/0.162) increase in the average cash holdings in the sample.

Columns (4) through (6) of Table 2 report the regression results when each of three components of policy uncertainty including news (*PU_NEWS*), tax (*PU_TAX*), inflation and government spending combined (*PU_GOVCPI*) is used, respectively. We obtain each component by taking a natural log of the corresponding component BBD index. The results show that all of those uncertainty sources can independently and upwardly drive firm cash holdings in the following year, $CASH_{i,t+1}$ after controlling for firm-control variables as in Column (2) as well as the four investment opportunities and six macroeconomic uncertainty variables as in Column (3). However, the coefficient estimates or the impacts on cash holdings differ across these components with the news-based index being the strongest factor. This result is expected because BBD employs the news-based technique to capture the volatility in all types of economic policies, including those related to tax code, government spending and inflation. The news-based component also represents the biggest fraction of 50% of the overall index, which makes it the main driver of the positive effect of the aggregate policy uncertainty on cash holdings. For this reason, we use only the news-based PU measure for all the remaining regressions.[4] Another reason is to alleviate any possible confusion about which components of the BBD index contribute to our results.

We then average our dependent variable $CASH_{t+1}$ by year and plot the time series evolution of the association between policy uncertainty and corporate cash holdings over time in Fig. 1. It also plots the index of policy uncertainty together with recessionary and expansionary periods within our sample period 1985–2014. To determine the periods of expansion and recession, we use the US Business Cycle Expansions and Contractions provided by the National Bureau of Economic Research (NBER).[5] According to the NBER

[4] This approach is also employed by Gulen and Ion (2016).

[5] Among multiple sources of definitions of recessionary/expansionary periods, we choose to follow those developed by NBER because these have

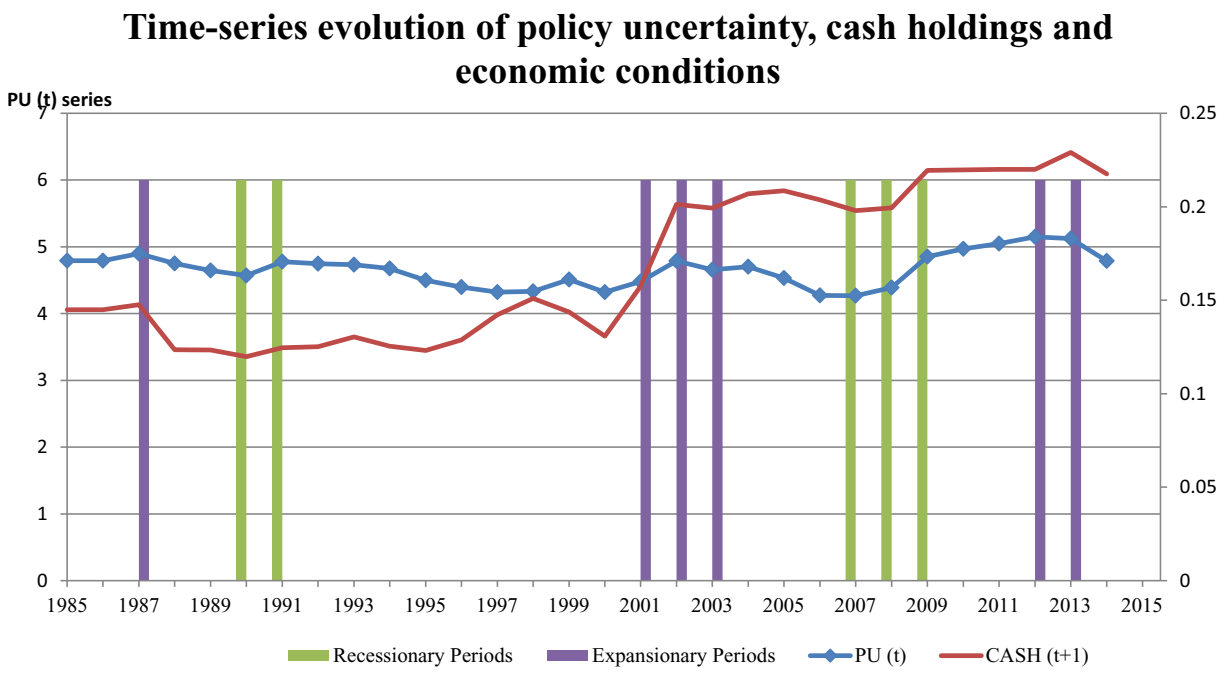

Figure 1. This figure plots the time series evolution of the association between policy uncertainty,corporate cash holdings and economic conditions over 1985–2014.

business cycles, the following periods are identified as the recessionary periods: July 1990 to March 1991, March 2001 to November 2001 and December 2007 to June 2009 and expansionary periods are the remaining periods. We observe the following noticeable patterns. First, consistent with the evidence presented by Baker et al. (2016), the BBD index increases around events which are ex-ante expected to increase policy-related uncertainty, such as recessions, financial crises, and wars. Second, EPU can increase in both the recessionary (for example, those in 1990, 1991, 2007, 2008 and 2009 in green bars) and the economic expansionary periods (for example, those in 1987, 2001, 2002, 2003, 2012 and 2013 in purple bars). The plot also reveals a positive correlation between policy uncertainty and corporate cash holdings in both recessionary and expansionary periods. For example, during recessions (*i.e.* 1990–1991 and 2007–2009), the BBD index rises and cash holdings also increase. During the expansionary periods (2001 – 2003), cash holdings rise as the BBD index rises. Similarly, in 2012–2013 expansionary environment, cash holdings decline following a decrease in the BBD index.

3.2. Identifying the effects of EPU on corporate cash holdings

To further isolate the effect of policy uncertainty with general economic condition and to establish the causal link between EPU and corporate cash holdings, we employ the following two identification strategies. First, we use gubernatorial elections as an exogenous shock to EPU because they increase the uncertainty regarding who will win the election, what policies a newly elected governor would implement (*i.e.* state taxes, government spending and contracts) and how the new policies would impact on firm corporate decisions. The gubernatorial elections are also exogenous as firms cannot influence over the years in which an election is held. Although firms can make strategic decisions concerning their state of headquarters, the motivation is likely to be, for example, avoiding state income taxes (*e.g.*, Jens (2017)). To be problematic for this estimation, firms would need to re-locate their headquarters to different states every time election is held, which is unlikely. Thus, there is no self-selection bias given the election cycle of a state in which a firm is headquartered (Çolak et al., 2017; Jens, 2017). Furthermore, unlike presidential elections, which could coincidentally line up with the business cycles, gubernatorial elections are staggered, with at least two elections occurring in each year. The exogenous nature of elections allows us to estimate the following difference-in-differences (DD) model:

$$\mathrm{CASH}_{i,t+1} = \alpha_0 + \beta_1 \mathrm{GUBER\_ELECT}_{s,i,t} + \theta_j \mathrm{CONTROL}_{j,i,t} + \delta_k \mathrm{EU}_{k,t} + \mu_m \mathrm{IO}_{m,t+} \gamma_i \mathrm{Firm}_i. + \epsilon_{i,t+1} \quad (2)$$

In Eq. (2), all the variables are the same as those in Column 3 of Table 2 except for $GUBER\_ELECT_{s,i,t}$ which equals to 1 if fiscal year t is a gubernatorial election year in state s where firm i is headquartered and 0 otherwise. $EU_{i,t}$ and $IO_{i,t}$ are vectors of the six proxies

(*footnote continued*)
been popularly adopted by researchers as well as policy makers (Claessens and Kose, 2018; Jens, 2017; Morley and Piger, 2012). The data can be retrieved from https://www.nber.org/cycles.html.

Table 3
Addressing endogeneity in cash holdings regressions.

	(1)	(2)	(3)
Variables	*CASH (t + 1)*	*CASH (t + 1)*	*CASH (t + 1)*
GUBER_ELECT	**0.002*** **		
	[0.00]		
FPU_NOINCUM		**0.021*** **	
		[0.00]	
FPU_5%MARGIN			**0.011*** **
			[0.00]
SIZE	−0.014***	−0.015***	−0.015***
	[0.00]	[0.00]	[0.00]
MB	0.004***	0.003***	0.003***
	[0.00]	[0.00]	[0.00]
CF	−0.011*	−0.012*	−0.012*
	[0.01]	[0.01]	[0.01]
NWC	−0.157***	−0.155***	−0.155***
	[0.01]	[0.01]	[0.01]
CAPEX	−0.281***	−0.276***	−0.276***
	[0.01]	[0.01]	[0.01]
BLEV	−0.224***	−0.219***	−0.218***
	[0.01]	[0.01]	[0.01]
R&D	−0.100***	−0.094***	−0.095***
	[0.03]	[0.03]	[0.03]
DIV_PAYER	0.002**	0.002	0.002
	[0.00]	[0.00]	[0.00]
ICFVOL	−0.037*	−0.053***	−0.049***
	[0.02]	[0.02]	[0.02]
Obs.	72,777	70,359	70,359
Adj. R-squared	0.742	0.746	0.746
Firm FE	Yes	Yes	Yes
Year FE	No	No	No
Firm Cluster	Yes	Yes	Yes
Macro Variables	Yes	Yes	Yes
Investment Opp.	Yes	Yes	Yes
F-statistics from the 1st stage	–	30.77	40.67

The bold figures are the our variables of the analysis which are discussed in details in our writing
This table reports the difference-in-difference estimation between gubernatorial election and firm cash holdings in Column (1). The second-stage regression of firm cash holdings (*CASH*) over the fitted values of news-based policy uncertainty measure (*PU_NEWS*), and firm-level control variables are presented in Columns (2) and (3). The fitted values are obtained from running first-stage monthly time-series regressions of original news-based policy uncertainty on political uncertainty generated by gubernatorial election data in the presence of the four firm investment opportunities and the six macro-economic uncertainty measures. The first instrument variable is *PU_NOINCUM* which is the proportion of assets owned by firms headquartered in state-year with gubernatorial elections where the incumbent does not run for re-election due to their term limits to total assets of all firms in all states in a given year. The second is *PU_5%MARGIN* which is the proportion of assets owned by firms headquartered in states with gubernatorial election where the election is won by a margin of 5% or less to total assets of all firms in all states in a given year. All continuous variables are winsorized at 1% levels and defined in Appendix A1. In all regressions, we include firm fixed effects and firm clustering effects. Robust firm clustered standard errors are reported in the brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

for economic uncertainty and the four proxies for firm investment opportunities as described earlier, respectively. The results associated with this regression equation are presented in Table 3 below.[6,7]

The results in Column (1) of Table 3 show that the coefficient on our variable of interest, *GUBER_ELECT*, is significantly positive suggesting firms hold more cash during gubernatorial elections years. This is consistent with our primary result of the positive association between EPU and corporate cash holdings.

We further address endogeneity concerns by employing two instrumental variables that measure the political uncertainty using gubernatorial election data from the Congressional Quarterly Press Electronic Library. These include *PU_NOINCUM* which is the proportion of assets owned by firms headquartered in state-years with gubernatorial elections where the incumbent does not run for re-election due to term limit to total assets owned by all firms in all states in the corresponding year; and *PU_5%MARGIN* which is defined as the proportion of assets owned by firms headquartered in state-years with gubernatorial election where the election is won

[6] The results remain robust if we exclude the four firm investment opportunity and the six macroeconomic uncertainty measures and replace them with year fixed effects.

[7] Following Jens and Page (2018), we run quarterly regressions to estimate the effects of gubernatorial elections on firm cash holdings. Our results of Table IA1 in the Internet Appendix are quite consistent with Jens and Page (2018) when we use a similar set of control variables and model specifications. Specifically, we find that in the quarters before the election, firms increase their cash holding. During the election quarter (Quarter 4), U.S. firms reduce their cash holdings.

by a margin of 5% or less to total assets of all firms in all states in a given year (Bonaime et al., 2018; Jens, 2017). For *PU_NOINCUM* and *PU_5%MARGIN* to be considered valid instrumental variables, they must satisfy both the relevance and exclusion conditions (Roberts and Whited, 2013).

The first relevance condition requires that each of the two instrumental variables *PU_NOINCUM* and *PU_5%MARGIN* is positively related to *PU_NEWS* after netting out the effects of other exogenous variables. Theoretically, new incumbents and greater uncertainty about election outcomes will lead to higher uncertainty about future economic policy (Jens, 2017). To test this relevance condition, we investigate the impact of *PU_NOINCUM* and *PU_5%MARGIN* on *PU_NEWS* in the presence of the six macroeconomic and the four firm investment opportunity variables. We find that *PU_NOINCUM* and *PU_5%MARGIN* are significantly related to EPU. Specifically, the F-statistics are 30.77 and 40.67 and the adjusted R^2 of the regressions are 51.7% and 58.8%, respectively, alleviating concerns that the instruments may be weak.[8]

The exclusion condition requires that *PU_NOINCUM* and *PU_5%MARGIN* can only affect firm cash holdings through EPU. As there is no empirical test for the exclusion condition, determining whether *PU_NOINCUM* and *PU_5%MARGIN* satisfy the exclusion condition requires an understanding of the relation between EPU and these instrumental variables. Essentially, *PU_NOINCUM* is calculated based on the numbers of incumbents who do not run for re-election due to their term limit. The term limit laws are specified in state constitutions to limit the number of terms an officeholder may serve in a particular elected office. Its purpose is to curb the potential for monopoly and protect a democracy. It is unlikely that firms would be able to change these laws to serve their interests (*i.e.* to have optimal cash holding policy). Rather, these term limit laws will increase EPU and which in turn influences firm cash holding policy. Similarly, *PU_5%MARGIN* captures the margin of election victory (*i.e.*, the difference between the fraction of votes won by the victor and that garnered by the runner-up) with smaller margin indicates greater uncertainty in election outcome (Jens, 2017). The actual vote counts from the elections and the fact that the elections are won by a very small margin are only defined from election results and are less likely to be manipulated by firms. Thus, this small margin of election victory can impact on individual firm financing policy if it increases uncertainty about election outcome and hence EPU. Collectively, these measures arguably satisfy the exclusion restriction as *PU_NOINCUM* and *PU_5%MARGIN* are unlikely to have a direct impact on a firm cash holding except indirectly through increasing EPU.

We first regress the policy uncertainty index, *PU_NEWS*, on the instrumental variables and the six macroeconomic variables using the following regression model.

$$\mathrm{PU\_NEWS}_t = \alpha_0 + \beta_1 \mathrm{PU\_NEWS\_IV}_t + \theta_k \mathrm{EU}_{k,t} + \mu_k \mathrm{IO}_{k,t} + \epsilon_t \quad (3)$$

Eq. (3) is a monthly time-series regression where *PU_NEWS_IV* is one of the two alternative instrumental variables including *PU_NOINCUM* and *PU_5%MARGIN* as defined above. PU_NEWS_t, EU_t and IO_t denote the news-based measure of policy uncertainty, six other direct proxies for general economic uncertainty and four firm investment opportunities, respectively.[9]

From Eq. (3), the fitted values of *PU* are aggregated to yearly level to be the key variable of interest, $FPU_{i,t}$, in Eq. (4).

$$\mathrm{CASH}_{i,t+1} = \alpha_0 + \beta_1 \mathrm{FPU}_t + \theta_j \mathrm{CONTROL}_{j,i,t} + \delta_k \mathrm{EU}_{k,t} + \mu_k \mathrm{IO}_{k,t} + \gamma_i \mathrm{Firm}_i + \epsilon_{i,t+1} \quad (4)$$

The specification of Eq. (4) is the same with Eq. (1), except that the original news-based *PU* is replaced by the *FPU*. *FPU* is either *FPU_NOINCUM* or *FPU_5%MARGIN* estimated from Eq. (3) using *PU_NOINCUM* or *PU_5%MARGIN* as the instrumental variables, respectively. Firm-level controls, six general economic uncertainty variables, four firm investment opportunities, firm FEs and firm cluster effects are included in Eq. (4) as in Column (3) of Table 2. The regression results using Eq. (4) are documented in Columns (2) and (3) of Table 3. The significantly positive coefficients of the *FPU* confirm the baseline findings that policy uncertainty upwardly drives cash holdings.

3.3. Variations in the relation between policy uncertainty and cash holdings

We conduct four additional analyses to show the cross-sectional variations in the relation between policy uncertainty and corporate cash holdings. These include firms with high government dependence, governments as their major customer, high exposure to political risk or high return sensitivity to changes in overall EPU. The following sections will discuss these analyses in detail.

3.3.1. Firms' dependence on government spending

We examine whether policy uncertainty affects cash holdings more for firms that rely more on government spending. Intuitively, if higher policy uncertainty causes firms to hold more cash, then the influence should be stronger for those firms that are more exposed to government demand. To test this prediction, we follow Belo et al. (2013) to first measure the magnitude of a firm's dependence on government spending by using data from the Benchmark Input-Output Accounts, available from the Bureau of Economic Analysis (BEA) website. The detailed instruction on how to measure this variable is provided in our Internet Appendix Section 2.

Due to a highly industry-concentrated attribute of this government spending measure Belo et al. (2013), we construct a dummy variable, *HIGHGOVSP*, which is equal to one if government spending is greater than the sample median value, and zero otherwise. This empirical design allows us to specify the *HIGHGOVSP* dummy independently and interact it with *PU* in the same model. Similar

[8] These regressions' results are available upon request.

[9] For brevity, we do not display the results of Eq. (3). The results are available upon request.

to our baseline regression, we control for firm characteristics, the four firm investment opportunities and the six macroeconomic uncertainty variables and exclude year-fixed effects in the model as the explanatory power of *PU_NEWS* is subsumed by the year-fixed effects.[10] The variable of interest is the interaction term *PU_NEWS*HIGHGOVSP* which captures the impact of the degree of government contractual relations on the association between policy uncertainty and firm cash holdings. Column (1) of Table 4 presents regression results of this impact. The results suggest that the dependence on government spending serves as a mechanism through which policy uncertainty reinforces its positive impact on firm cash holdings, as indicated by the positive and statistically significant coefficient of the interaction term *PU_NEWS*HIGHGOVSP*. In short, the evidence supports the prediction that higher exposure to government spending makes cash holding decisions more sensitive to aggregate policy uncertainty.

3.3.2. Firms with government as major customers

We also use another proxy for firms' dependence on the government. We argue that firms are more dependent on the government if they have the government as one of their major customers. Similar to Dhaliwal et al. (2016), we use Compustat customer segment data to identify whether firms have their government as their major customer. *GOV_CUS* is a dummy variable that equals to one for firms that have government as their major customer and zero otherwise. We interact *GOV_CUS* with *PU_NEWS* to investigate if firms with government as their major customer will hold more cash when policy uncertainty increases. The positive and statistically significant coefficient on the interaction term *PU_NEWS*GOV_CUS* in Column (2) of Table 4 suggests that firms indeed hold more cash if they maintain a closer customer-supplier relationship with the government.

3.3.3. Firm-level political risk

We next examine whether the association between policy uncertainty and cash holdings is stronger for firms with high exposure to political risk. Hassan et al. (2019) use textual analysis of quarterly earnings conference-call transcripts to construct a firm-level measure of the extent and type of political risk faced by individual firms listed in the United States. We expect that firms with higher political risk (*PRISK*) have stronger precautionary motive to hold more cash when overall EPU increases. Result for this test presented in Column (3) of Table 4 supports this prediction, manifested by the positive and statistically significant coefficient of the interaction term *PU_NEWS*PRISK*.

3.3.4. Firms with return sensitivity to policy uncertainty changes

In the next cross-sectional analysis, we investigate whether the effect of policy uncertainty on cash holdings is more pronounced for stocks with higher PU-return sensitivity. We follow Brogaard and Detzel (2015) and Bonaime et al. (2018) to construct our measure of the PU-stock return sensitivity (*BETA*). Specifically, the PU-stock return sensitivity (*BETA*) is computed by estimating coefficient of *PU_NEWS* in regressions of each Fama-French 48 industry's value weighted monthly excess stock returns on *PU_NEWS,* market excess return, SMB, HML over the 60 months prior to the beginning of the firm's fiscal year.[11] We interact *BETA* with *PU_NEWS* to capture the effect of *PU_NEWS* on firm cash holdings and whether this impact is more pronounced for firms whose returns are more sensitive to *PU_NEWS* changes. The results as presented in Column (4) of Table 4 show that *PU_NEWS*BETA* is positively related to corporate cash holdings suggesting that firms with greater return sensitivity to changes in policy uncertainty hold more cash than those with low return sensitivity.

4. Economic channel: firm financial constraints

Pástor and Veronesi (2012, 2013) theoretically and empirically show that stock investors require a risk premia for uncertain government policy leading to stock price decline, which implies higher firm costs of equity capital. Bordo et al. (2016) further document that policy uncertainty hinders bank credit growth at both aggregate- and bank- specific levels suggesting an increase in firm difficulties in accessing debt markets.[12] If that is the case, firms may face difficulty in accessing the external financial markets when policy uncertainty increases; therefore, they tend to have more precautionary incentives to reserve cash (Bates et al., 2009; Harford et al., 2014; Opler et al., 1999). Financially constrained firms are forced to rely more on internally generated resources for investment relative to unconstrained counterparts (Almeida et al., 2004; Chen et al., 2012). Thus, we should observe that firms hold back more cash from cash flows when policy decision making is more unstable. To test this conjecture, we augment the cash-cash flow sensitivity model of Almeida et al. (2004) as follows:

$$\Delta CASH_{i,t} = \alpha_0 + \beta_1 PU\_NEWS_t + \beta_2 CF_{i,t} + \beta_3 PU\_NEWS_t * CF_{i,t} + \beta_3 SIZE_{i,t} + \beta_4 TOBINQ_{i,t} + \delta_k EU_{k,t} + \mu_m IO_{m,t+} \gamma_i Firm_i + \epsilon_{i,t} \quad (5)$$

Here, $\Delta CASH_{i,t}$ is the yearly change in the level of cash deflated by total assets of firm *i* in year *t*. *PU_NEWS, CF, SIZE*, and *TOBINQ*

[10] As a robustness check, we exclude *PU_NEWS*, four firm investment opportunities and the six macroeconomic variables and include year-fixed effects to control for any general economic conditions (including those captured by *PU_NEWS*) that may affect the dependent variable. The results are qualitatively unchanged.

[11] These data are sourced from http://mba.tuck.dartmouth.edu/pages/faculty/ken.french/data_library.html from Kenneth French's Data Library.

[12] In the spirit of Bordo et al. (2016), we further examine whether aggregate bank credit conditions are tightened due to heightened policy uncertainty and find that commercial and industrial loans become costlier when policy uncertainty is stronger. The result is presented in Table IA3 of the Internet Appendix.

Table 4
Cross-sectional analysis.

	(1)	(2)	(3)	(4)
Variables	*CASH (t + 1)*	*CASH (t + 1)*	*CASH (t + 1)*	*CASH (t + 1)*
PU_NEWS	0.009	0.010***	0.076***	0.012***
	[0.01]	[0.00]	[0.02]	[0.00]
PU_NEWS*HIGHGOVSP	**0.020*** **			
	[0.00]			
HIGHGOVSP	−0.097***			
	[0.02]			
PU_NEWS*GOV_CUS		**0.002*** **		
		[0.01]		
GOV_CUS		−0.005		
		[0.05]		
PU_NEWS*PRISK			**0.001*** **	
			[0.00]	
PRISK			0.000*	
			[0.00]	
PU_NEWS*BETA				**0.014** **
				[0.00]
BETA				0.026*
				[0.02]
Obs.	34,149	73,931	10,955	72,744
Adj. R-squared	0.806	0.742	0.814	0.743
Firm FE	Yes	Yes	Yes	Yes
Year FE	No	No	No	No
Firm Cluster	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
Macro Variables	Yes	Yes	Yes	Yes
Investment Opp.	Yes	Yes	Yes	Yes

In this table, we conduct additional analyses to further show the cross-sectional variations of the relation between policy uncertainty and firm cash holdings. We regress firm cash holdings (*CASH*) on a dummy variable (*HIGHGOVSP*) indicating if a firm's industry-based government spending dependence is greater than the sample median value and the interaction term *PU_NEWS*HIGHGOVSP* in Column (1), on firms with government as their major customer (*GOV_CUS*) and the interaction term *PU_NEWS*GOV_CUS* in Column (2), on firm-level political risk *PRISK* and its interaction term *PU_NEWS* PRISK* in Column (3) and on PU-stock return sensitivity (*BETA*) and its interaction term *PU_NEWS*BETA* in Column (4). All continuous variables are winsorized at 1% levels and defined in Appendix A1. In all regressions, we include firm fixed effects and firm clustering effects. Robust firm clustered standard errors are reported in the brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

are a news-based policy uncertainty, operating cash flows deflated by total assets, natural log of total assets, and ratio of market-to-book, respectively. We include six other direct proxies for general economic uncertainty and four firm investment opportunities. The variable of interest is the interaction term, *PU_NEWS*CF*, which captures the effect of policy uncertainty on the sensitivity of cash reserves to cash flows. If firms hold back more cash from cash flows when policy uncertainty heightens, we will observe a significant and positive coefficient on the interaction term.

The regression results for these tests are provided in Table 5. Column (1) documents the regression results using Eq. (5). In Column (2) we include three additional control variables: capital expenditure (*CAPEX*); change in net working capital (*ΔNWC*); and change in book leverage (*ΔBLEV*) following the literature (Chen et al., 2012). As expected, the coefficient on the interaction term (*PU_NEWS*CF*) is positive and statistically significant at 1% level, indicating that firms save more cash from cash flows when policy uncertainty increases.

5. Sources of firm cash holdings in the presence of policy uncertainty

Our analysis thus far documents a strong and plausibly causal effect of EPU on corporate cash holdings with financial constraints as an economic channel. Prior literature shows that increases in political uncertainty lead to lower initial public offering activities (Çolak et al., 2017) and higher bank loans costs (Ashraf and Shen, 2019). In this section, we investigate how firms accumulate more cash in the periods of heightened EPU. We anticipate that if EPU increases firm financial frictions and managers' negative perception of future earnings stability, they may retain a greater portion of their earnings by decreasing their dividends and share repurchase to alleviate these frictions. This expectation draws on early evidence of Lintner (1956), Hoberg and Prabhala (2009) and Chay and Suh (2009) who suggest that it is optimal for firms to choose conservative payout decisions to reduce the probability of tapping external equity markets. In order to test this prediction, we use the following regression models to estimate the impact of policy uncertainty on the corporate payout decisions:

$$\mathrm{PAYOUT}_{i,t} = \alpha_0 + \beta_1 \mathrm{PU\_NEWS}_t + \theta_j \mathrm{CONTROL}_{j,i,t} + \delta_k \mathrm{EU}_{k,t} + \mu_m \mathrm{IO}_{m,t+} \gamma_i \mathrm{Firm}_i + \epsilon_{i,t} \quad (6)$$

Table 5
Policy uncertainty, and cash-cash flow sensitivity.

	(1)	(2)
Variables	Δ*CASH (t)*	Δ*CASH (t)*
PU_NEWS	−0.034***	−0.034***
	[0.01]	[0.01]
PU_NEWS*CF	**0.182*** **	**0.171*** **
	[0.05]	**[0.05]**
CF	−0.527**	−0.406*
	[0.21]	[0.21]
MB	0.018***	0.013***
	[0.00]	[0.00]
SIZE	0.004***	0.005***
	[0.00]	[0.00]
CAPEX		−0.413***
		[0.02]
Δ*NWC*		−0.369***
		[0.01]
Δ*BLEV*		−0.076***
		[0.01]
Obs.	75,859	72,855
Adj. R-squared	0.25	0.309
Firm FE	Yes	Yes
Year FE	No	No
Firm Cluster	Yes	Yes
Macro Variables	Yes	Yes
Investment Opp.	Yes	Yes

The dependent variable is the change in cash holdings (Δ*CASH*), defined as the change in cash holdings for firm *i* from year *t-1* to *t*, scaled by total assets. The key variable of interest is the interaction term, *PU_NEWS*CF*, which captures the effect of the news-based policy uncertainty measure on the cash-cash flow sensitivity. In Column (1) we control for firm size (*SIZE*) and market-to-book ratio (*MB*). In Column (2) we further include capital expenditure (*CAPEX*), change in net working capital ($\Delta NWC_{i,t} = NWC_{i,t} - NWC_{i,t-1}$), and change in book leverage ($\Delta BLEV_{i,t} = BLEV_{i,t} - BLEV_{i,t-1}$). All continuous variables are winsorized at 1% levels and defined in Appendix A1. In all regressions, we include firm fixed effects and firm clustering effects. Robust firm clustered standard errors are reported in the brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

In Eq. (6), *PAYOUT* is the firm total payout ratio measured by the sum of dividends and repurchases scaled by total assets. Following Adhikari and Agrawal (2018), we normalize the total amount of firm payout by book assets, rather than by market capitalization and earnings, to ensure that the results are not influenced by stock price variations or affected by firms with negative earnings. Similar to *DIV_PAYER* (dividend payment dummy) in the baseline regression, we replace all missing values of *PAYOUT* with 0. We further employ the following firm-specific control variables including Tobin's q (*TOBINQ*), firm size (*SIZE*), firm life cycle (*LIFE_CYCLE*), return on assets (*ROA*), cash holdings (*CASH*) and stock return volatility (*SDRETURN*). We also include the four firm investment opportunities, the six macro-economic control variables, firm-level fixed effects and cluster robust standard errors at the firm level to control for within-firm serial correlations in the error term.

The results associated with Eq. (6) are reported in Column (1) of Table 6. We find that an increase in EPU is associated with a reduction in total firm payout ratios, manifested by the negative and statistically significant coefficient of *PU_NEWS* in Column (1). To address any potential endogeneity issue between EPU and corporate payout, we employ gubernatorial elections (*GUBER_ELECT)* as an exogenous shock to policy uncertainty as well as the two instrumental variables: *PU_NOINCUM* and *PU_5%MARGIN*. The result of the difference-in-differences model using gubernatorial elections is presented in Column (2) while the results associated with the two instrumental variables are outlined Columns (3) and (4). These results confirm our primary findings of the negative association between EPU and corporate payouts, suggesting that firms reduce their total payout in the period of heightened EPU.[13]

6. The role of cash holdings in the presence of policy uncertainty

In this section, we examine the role of cash holdings in the presence higher policy uncertainty in two distinct areas of a firm's activities: (i) capital investment and (ii) innovation outputs. We investigate whether firms strategically utilize cash reserves to mitigate the reduction in capital expenditure and innovation outputs in the presence of higher policy uncertainty.

[13] We also find evidence in Table IA2 of the Internet Appendix that firms are less likely to pay dividends and reduce the amount of stock repurchase during periods of higher EPU.

Table 6
Policy uncertainty and corporate payouts.

	(1)	(2)	(3)	(4)
Variables	*PAYOUT*	*PAYOUT*	*PAYOUT*	*PAYOUT*
PU_NEWS	**−0.009*** **			
	[0.00]			
GUBER_ELECT		**−0.001*** **		
		[0.00]		
FPU_NOINCUM			**−0.006*** **	
			[0.00]	
FPU_5%MARGIN				**−0.010*** **
				[0.00]
TOBINQ	−0.002***	−0.002***	−0.002***	−0.002***
	[0.00]	[0.00]	[0.00]	[0.00]
SIZE	−0.001***	−0.002***	−0.002***	−0.001***
	[0.00]	[0.00]	[0.00]	[0.00]
LIFE_CYCLE	−0.000* **	−0.000	−0.000	−0.000
	[0.00]	[0.00]	[0.00]	[0.00]
CASH	0.010***	0.010***	0.010***	0.010***
	[0.00]	[0.00]	[0.00]	[0.00]
ROA	0.009***	0.010***	0.009***	0.009***
	[0.00]	[0.00]	[0.00]	[0.00]
SDRETURN	−0.008***	−0.009***	−0.008***	−0.008***
	[0.00]	[0.00]	[0.00]	[0.00]
Obs.	86,295	86,295	82,935	82,935
Adj. R-squared	0.020	0.019	0.020	0.021
Firm FE	Yes	Yes	Yes	Yes
Year FE	No	No	No	No
Firm Cluster	Yes	Yes	Yes	Yes
Macro Variables	Yes	Yes	Yes	Yes
Investment Opp.	Yes	Yes	Yes	Yes

We employ the firm fixed effect regression to examine the effect of EPU on total payout (dividend and share repurchase) ratio in Columns (1). The difference-in-difference model using gubernatorial elections as an exogenous shock to *PU* are presented in Column (2) while the results of the two instrumental variables: *FPU_NOINCUM* and *FPU_5%MARGIN* are presented in Columns (3) and (4). In all models, we control for firm characteristics, the four firm investment opportunities and the six macro-economic control variables. All continuous variables are winsorized at 1% levels and defined in Appendix A1. Robust firm clustered standard errors are reported in the brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

6.1. Mitigating investment reduction

Recent evidence has established a negative effect of policy uncertainty on firm capital investment (Baker et al., 2016; Gulen and Ion, 2016). In this section, we examine whether cash holdings serve as a moderating channel to alleviate such a dampening effect of policy uncertainty. Specifically, we argue that when financial constraints increase as a result of higher policy uncertainty, larger cash holdings would allow firms to mitigate underinvestment and reduced growth (Denis and Sibilkov, 2010). In other words, the more financially constrained a firm is, the more it is motivated to reserve cash (Bates et al., 2009; Opler et al., 1999). Hence, this moderating role of cash holdings on the relation between policy uncertainty and investment is expected to be stronger for more financially constrained firms. If this is the case, the evidence will document one more benefit of holding more cash when policy uncertainty is higher.

To test this hypothesis, we estimate the following model:

$$\mathrm{CAPEX}_{i,t+1} = \alpha_0 + \beta_1 \mathrm{CASH}_{i,t} + \beta_2 \mathrm{PU\_NEWS}_t * \mathrm{CASH}_{i,t} + \theta_j \mathrm{CONTROL}_{j,i,t} + \delta_k \mathrm{EU}_{k,t} + \mu_m \mathrm{IO}_{m,t} + \gamma_i \mathrm{Firm}_i + \epsilon_{i,t+1} \quad (7)$$

In Eq. (7), $CAPEX_{i,t+1}$ is a proxy for capital investment that is calculated by capital expenditure deflated by total assets of firm i in year $t + 1$. PU_NEWS_t and $CASH_{i,t}$ are news-based policy uncertainty and cash holdings measures of firm i in year t. $CONTROL_{j,i,t}$ comprise variables that are well documented to affect investment including firm-level size (*SIZE*), market-to-book ratio (*MB*), book leverage (*BLEV*), cash flows (*CF*), and sales growth ($\Delta SALE$) (Gulen and Ion, 2016). The variable of interest is the interaction term, *PU_NEWS*CASH*, which captures the impact of cash holdings on the association between policy uncertainty and capital investment. If cash holdings mitigate the detrimental impact of policy uncertainty on capital investment, the coefficient of the interaction term should be positive.

To test whether the moderating role of cash holdings is more pronounced for more financially constrained firms, we follow Almeida et al. (2004) and Denis and Sibilkov (2010) to partition our sample into two groups: financially constrained (*FC*) and unconstrained (*UC*). Since there is no agreement on the best approach to classify financially constrained and unconstrained firms in prior studies, we rely on the following three well-documented categorization schemes. In the first scheme, each year we rank firms based on their asset size and assign to the financially constrained (unconstrained) group as those firms in the bottom (top) fifty

percentile of the annual size distribution. In the second scheme, we use the Hoberg and Maksimovic (2014)'s text-based measure of financial constraints (*TEXT_CONSTRAINT*) to measure the extent to which firms are constrained.[14] Similar to firm size, we assign the financially constrained (unconstrained) group those firms in the top (bottom) fifty percentile of the annual *TEXT_CONSTRAINT* distribution. In the final scheme, firms are classified as financially unconstrained if they have their short-term rated by S&P's and their debt is not in default. Firms are defined as financially constrained if they have positive short-term debt but are not rated by S&P's.[15]

In these schemes, financially constrained firms are typically small and have liquidity issues, and, hence, more vulnerable to capital market frictions (Almeida et al., 2004; Hadlock and Pierce, 2010; Hoberg and Maksimovic, 2014). In addition, having paper ratings is an indicator of good market evaluation of a firm's short-term credit quality, hence allowing the firm to relatively more easily tap into the capital markets (Gilchrist and Himmelberg, 1995; Kashyap et al., 1994; Whited, 1992).

We re-estimate Eq. (7) separately on the two groups for each classification scheme. We display regression results for these tests in Table 7. In particular, in Column (1) we replicate the baseline model of explaining investment as in Gulen and Ion (2016). Specifically, we add the *ELECYEAR* indicator and ΔGDP variable as macro control variables. The significantly negative coefficient on *PU_NEWS* confirms the finding of Gulen and Ion (2016) that policy uncertainty is negatively associated with firm capital investment. In Column (2), we further include *PU_NEWS* and *PU_NEWS*CASH* variables independently and the four firm investment opportunities and the six macroeconomic variables as per Column (3) of Table 2. The result in Column (2) of Table 7 suggests that the coefficient of the interaction term, *PU_NEWS*CASH*, is positive and statistically significant as expected. Overall, the evidence points to the mitigating role of cash holdings on the negative impact of policy uncertainty on capital investment.

Columns (3) through (8) of Table 7 present regression results on subgroups of constrained (*FC*) and unconstrained (*UC*) firms using the three aforementioned classification schemes. We find that the positive coefficients of the interaction term, *PU_NEWS*CASH*, are evident both for the *FC* and *UC* subsamples from Columns (3) to (6) when we use asset size and the Hoberg and Maksimovic (2014)'s text-based measure of financial constraints (*TEXT_CONSTRAINT*) to classify financially constrained and unconstrained firms. The Chi^2 tests indicate that the mitigating role of corporate cash holding is stronger for constrained firms. When we use short-term debt rating to classify financially constrained and unconstrained firms, the results in Columns (7) and (8) show that the interaction term *PU_NEWS*CASH* is positive and statistically significant only for the *FC* sample. Overall, these results indicate that the increase in cash reserves help financially constrained firms to avoid underinvestment caused by higher policy uncertainty. The results support our hypothesis that cash holdings serve as a mechanism to mitigate the negative association between policy uncertainty and capital investment, and more so for financially constrained firms.[16]

6.2. Improving corporate innovation outputs

Bhattacharya et al. (2017) show that policy uncertainty reduces innovation outputs. We extend their analysis by examining whether cash holdings help alleviate the influence of policy uncertainty on firm innovation. Existing literature has suggested at least four main reasons why policy-uncertainty-induced-cash-rich firms have more innovation outputs than those with lower level of cash holdings. First, firms with more innovation outputs are particularly vulnerable to the potential inability to access external capital markets especially at the investment stage of their business cycle (Lyandres and Palazzo, 2016). Since cash helps reduce the likelihood of seeking external financing (Lyandres and Palazzo, 2016), cash-rich firms are more likely to invest in innovation than those with smaller cash holdings. Second, cash helps absorb the adverse shocks from outside and sustain the daily operations smoothly (Gamba and Triantis, 2008). Therefore, the firm manager will have less career concerns and are more likely to produce more innovation outputs when they hold more cash. Third, by using internal cash flows for their investments, firms can avoid frequent scrutiny from outside public investors who are in general myopic and impatient to temporary failures (Gamba and Triantis, 2008). In the absence of public pressure, firm managers are more able to concentrate on innovative activities and produce more innovation outputs. Finally, relying less on funds from public markets, cash rich firms do not need to release proprietary information of their innovation projects to the public, thereby reducing the risks of revealing valuable information to their competitors and securing their innovation success (Bhattacharya and Ritter, 1983). Thus, based on the above arguments, we anticipate that firms with higher level of cash holdings are more likely produce more innovation outputs than firms with lower level of cash holdings in the period of higher policy uncertainty.

To investigate this conjecture, we use the following regression model:

$$\text{INNOVATION}_{i,t+2} = \alpha_0 + \beta_1 \text{CASH}_{i,t} + \beta_2 \text{PU\_NEWS}_t * \text{CASH}_{i,t} + \theta_j \text{CONTROL}_{j,i,t} + \delta_k \text{EU}_{k,t} + \mu_m \text{IO}_{m,t} + \gamma_i \text{Firm}_i + \epsilon_{i,t+2} \quad (8)$$

where, *INNOVATION* is firm innovation output which is measured by the following four proxies: Total numbers of firm patents each year (*PATENT*), citations per patent (*PAT_CITE)* (Julian, 2013), economic value of patent (*PAT_ECO)* (Kogan et al., 2017) and firm innovation efficiency (*INO_EFF)* (Chu et al., 2019; Hirshleifer et al., 2013). The details of these variable constructions are provided in Section 5 of Internet Appendix.

[14] The data can be retrieved from: http://faculty.marshall.usc.edu/Gerard-Hoberg/MaxDataSite/index.html.

[15] In an untabulated result, we also classify those firms that have their debt rated by Standard & Poor's (S&P Long-term Senior Debt rating) and their debt not in default (rating of "D") as financially unconstrained. Firms that do not have their debt rated but report positive long-term debt are defined as financially constrained. The results remain qualitatively consistent and are available from the corresponding author upon request.

[16] In an untabulated result, we find that financially constrained firms that hold more cash in both the recessionary and expansionary periods can alleviate the negative impact of *PU* on firm investment more than non-constrained firms.

Table 7
Policy uncertainty, cash holdings and capital investment.

Variables	*CAPEX (t + 1)*							
	Full	*Full*	*SIZE*		*TEXT_CONSTRAINT*		*PAPER_RATING*	
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
			FC	UC	FC	UC	FC	UC
PU_NEWS	**−0.006*** **	**−0.021*** **	−0.014***	−0.025***	−0.032***	−0.024***	−0.019***	−0.028***
	[0.00]	**[0.00]**	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
CASH		−0.101*, ***	−0.097***	−0.084***	−0.148***	−0.058**	−0.101***	−0.152
		[0.02]	[0.02]	[0.02]	[0.03]	[0.03]	[0.02]	[0.11]
PU_NEWS*CASH		**0.021*** **	**0.021*** **	**0.016*** **	**0.035*** **	**0.013** **	**0.021*** **	**0.028**
		[0.00]	**[0.01]**	**[0.00]**	**[0.01]**	**[0.01]**	**[0.00]**	**[0.02]**
SIZE	−0.007***	−0.001	0.002**	−0.003***	0.001	−0.003***	−0.001	−0.007***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
MB	0.004***	0.005***	0.004***	0.005***	0.005***	0.004***	0.005***	0.004***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
BLEV	−0.033***	−0.044***	−0.042***	−0.048***	−0.050***	−0.048***	−0.044***	−0.036***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.01]	[0.00]	[0.00]	[0.01]
CF	0.035***	0.030***	0.023***	0.044***	0.020***	0.020***	0.029***	0.086***
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.03]
ΔSALE	0.000**	0.000**	−0.000	0.000***	0.000***	0.000***	0.000**	0.000***
	[0.00]	−0.021***	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
ELECYEAR	−0.002***							
	[0.00]							
ΔGDP	0.150***							
	[0.01]							
Chi^2			14.76		11.97		14.25	
Prob > Chi^2			0.0001		0.0005		0.0002	
Obs.	74,354	69,920	31,511	37,821	14,842	17,436	64,476	5333
Adj. R-squared	0.597	0.602	0.538	0.683	0.700	0.666	0.596	0.743
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Year FE	No	No	No	No	No	No	No	No
Firm Cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro Variables	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Investment Opp.	No	Yes	Yes	Yes	Yes	Yes	Yes	Yes

In this table, we regress firm capital investment (*CAPEX*) on the news-based policy uncertainty measure (*PU_NEWS*), cash holdings (*CASH*), the interaction term (*PU_NEWS*CASH*), and other controls. Firm-level controls include size (*SIZE*), market-to-book ratio (*MB*), book leverage (*BLEV*), cash flows (*CF*), sales growth *(ΔSALEit = (SALEi,t-1) - SALEi,t-1)/SALEi,t-1*). Country-level controls include election year dummy (*ELECYEAR*), and GDP growth *(ΔGDPt = (GDPt-1) - GDPt-1)/GDPt-1*). Column (1) reports regression result without *CASH* included. Columns (2) reports the results for the whole sample, where all the four firm investment opportunities and the six proxies for general economic uncertainty similar to Table 3 Column 4 are included. In Columns (3) through (8), we rerun the model in Column (2) on subsamples of financially constrained (*FC*) and unconstrained (*UC*) firms using three classification schemes, including firm size, text-based measures of financial constraints and paper rating. All continuous variables are winsorized at 1% levels and defined in Appendix A1. Robust firm clustered standard errors are reported in the brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

PU_NEWS_t and $CASH_{i,t}$ are news-based policy uncertainty and cash holdings measures of firm *i* in year *t*. $CONTROL_{j,i,t}$ comprise variables that are well documented to affect firm innovation (Chemmanur et al., 2014) including firm size (*SIZE*), return on asset (*ROA*), R&D expenses over total assets (*R&D*), asset tangibility (*PPE*), total debts over total assets (*BLEV*), firm financial constraints using KZ index (Edwards et al., 2015), capital expenditure over total assets (*CAPEX*), market value of assets over book value of assets (*TOBINQ*), Herfindaln-Hirschman Index which is the sum of squares of the market shares of the firms' sales within an industry (*HHI*).

The variable of interest is the interaction term, *PU_NEWS*CASH*, which captures the impact of cash holdings on the association between policy uncertainty and firm innovation. Table 8 presents the result of this analysis.[17] In Columns (2), (4), (6) and (8), we add all four investment opportunities variables and the six proxies for general economic uncertainty as per Column 3 of Table 2. In particular, the signs of the coefficients of the interaction terms of *PU_NEWS*CASH* in all models (except Column (2)) are positive and statistically significant, which are cconsistent with our predictions. These indicate that while firm innovation is negatively related to policy uncertainty, firms that hold more cash tend to have more patent citations, higher economic value of patent and more innovation efficiency than firms with lower level of cash holdings. This suggests that cash holding acts as a moderating channel for the negative association between policy uncertainty and innovation.

[17] The results are qualitatively similar if we lead innovation outputs by 3 years ahead.

Table 8
Policy uncertainty, cash holdings and firm innovation.

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
VARIABLES	*PATENT*	*PATENT*	*PAT_CITE*	*PAT_CITE*	*PAT_ECO*	*PAT_ECO*	*INO_EFF*	*INO_EFF*
	(t + 2)	*(t + 2)*	*(t + 2)*	*(t + 2)*	*(t + 2)*	*(t + 2)*	*(t + 2)*	*(t + 2)*
PU_NEWS	0.052**	0.052**	−0.012	0.611***	−0.516***	−0.444***	−0.110	−0.196***
	[0.02]	[0.03]	[0.04]	[0.04]	[0.03]	[0.04]	[0.11]	[0.04]
CASH	0.332	0.369	−3.216***	−2.743***	−5.403***	−5.437***	−2.725*	−1.904***
	[0.27]	[0.27]	[0.63]	[0.56]	[0.49]	[0.50]	[1.46]	[0.44]
PU_NEWS*CASH	**0.043***	**0.053**	**0.799*****	**0.665*****	**1.141*****	**1.145*****	**0.566***	**0.397*****
	[0.06]	**[0.06]**	**[0.13]**	**[0.12]**	**[0.10]**	**[0.11]**	**[0.31]**	**[0.09]**
SIZE	0.076***	0.119***	−0.597***	−0.360***	0.358***	0.378***	0.141***	0.115***
	[0.01]	[0.01]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]	[0.02]
ROA	0.069**	0.069**	0.291***	0.249***	0.165***	0.173***	−0.064**	−0.094***
	[0.03]	[0.03]	[0.09]	[0.07]	[0.06]	[0.06]	[0.03]	[0.02]
R&D	0.210**	0.315***	−1.124***	−0.459**	0.959***	1.047***		
	[0.09]	[0.09]	[0.25]	[0.21]	[0.18]	[0.18]		
PPE	0.669***	0.483***	2.151***	1.076***	−0.111	−0.231	0.179	0.213
	[0.10]	[0.09]	[0.19]	[0.16]	[0.14]	[0.14]	[0.17]	[0.15]
BLEV	−0.087	−0.086	0.395***	0.176*	−0.596***	−0.626***	−0.089	−0.011
	[0.05]	[0.06]	[0.12]	[0.10]	[0.09]	[0.09]	[0.09]	[0.06]
KZ	0.001**	0.001**	0.000	−0.000	0.000	0.000	−0.001*	−0.000
	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]	[0.00]
CAPEX	2.188	3.088*	2.726	8.797*	3.720	4.156	2.415	1.728
	[1.54]	[1.59]	[5.27]	[5.08]	[4.45]	[4.82]	[1.99]	[1.07]
TOBINQ	−0.002	−0.004	0.097***	0.058***	0.243***	0.236***	0.012	0.013**
	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]	[0.01]
HHI	−0.081	0.042	−0.292*	−0.004	−0.149	−0.134	0.191*	0.120
	[0.08]	[0.08]	[0.16]	[0.13]	[0.10]	[0.11]	[0.11]	[0.10]
Obs.	18,239	17,105	16,037	15,751	15,362	15,087	33,646	32,001
Adj. R-squared	0.662	0.696	0.529	0.615	0.849	0.849	0.740	0.753
Firm FE	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Firm Cluster	Yes	Yes	Yes	Yes	Yes	Yes	Yes	Yes
Macro Variables	No	Yes	No	Yes	No	Yes	No	Yes
Investment Opp.	No	Yes	No	Yes	No	Yes	No	Yes

The bold figures are the our variables of the analysis which are discussed in details in our writing
In this table, we regress firm innovation output (*PATENT, PAT_CITE, PAT_ECO* and *INO_EFF*) on the news-based policy uncertainty measure (*PU_NEWS*), cash holdings (*CASH*), the interaction term (*PU_NEWS*CASH*), and other controls including firm size (*SIZE*), return on asset (*ROA*), R&D expenditure (*R&D*), asset tangibility (*PPE*), leverage (*BLEV*), KZ index (*KZ*), capital expenditure (*CAPEX*), TobinQ (*TOBINQ*) and Herfindahl-Hirschman Index (*HHI*). In Columns (2), (4), (6) and (8), we add six proxies for general economic uncertainty and four firm investment opportunities variables. All continuous variables are winsorized at 1% levels and defined in Appendix A1. Robust firm clustered standard errors are reported in the brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

7. Further analysis and robustness checks

7.1. Alternative explanation: reductions in investment

We have so far established that an increase in firm cash holding during the period of heightened EPU is due to increased firm financial constraints. Since policy uncertainty adversely affects firm investment (Julio and Yook, 2012), one may raise a concern that an increase in firm cash holdings during the period of economic uncertainty may be attributed to a reduction in firm investment rather than their external financial constraints. We conduct two additional sets of analyses to address this concern.[18] First, we regress the sum of change of cash and change of investment ($\Delta CASH + \Delta CAPEX$) on *PU*. If an increase in cash is mainly due to a reduction in investment, then this sum of change of cash and change of investment will be approximately equal to zero. The impact of *PU*, therefore, should not be statistically significant. Second, we perform our baseline regression models on the subset of firms that have not reduced their investment in response to increase in the economic policy uncertainty. If our results are mainly driven by reductions in investment (*CAPEX*) when policy uncertainty heightens, we should not observe any significant relation between policy uncertainty and cash holdings in this subsample. We present the results for these two sets of analyses in Table 9. The coefficients of *PU* and its components remain positive and statistically significant suggesting that policy uncertainty increases cash holdings regardless of the change in investment.[19]

[18] We are grateful to the anonymous referee for suggesting this additional analysis.

[19] Gulen and Ion (2016) find that firms whose investments are harder to reverse are more likely to delay investments when policy uncertainty rises. Thus, one may expect an increase in cash holdings during the time of heightened policy uncertainty to be more pronounced for firms with

Table 9
Alternative explanations: Reductions in investments.

Panel A: Sum of change in CASH and CAPEX

	(1)	(2)	(3)	(4)
Variables	$\Delta CASH + \Delta CAPEX$	$\Delta CASH + \Delta CAPEX$	$\Delta CASH + \Delta CAPEX$	$\Delta CASH + \Delta CAPEX$
PU	0.013***			
	[0.01]			
PU_NEWS		0.017***		
		[0.00]		
PU_TAX			0.007***	
			[0.00]	
PU_GOVCPI				0.002***
				[0.00]
Obs.	73,718	73,718	73,718	73,718*
Adj. R-squared	0.0865	0.0867	0.0866	0.0864
Firm FE	Yes	Yes	Yes	Yes
Year FE	No	No	No	No
Firm Cluster	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
Macro Variables	Yes	Yes	Yes	Yes
Investment Opp.	Yes	Yes	Yes	Yes

Panel B: Subsample of firms with no reduction in CAPEX when PU increases

	(1)	(2)	(3)	(4)
Variables	*CASH (t + 1)*	*CASH (t + 1)*	*CASH (t + 1)*	*CASH (t + 1)*
PU	0.043***			
	[0.02]			
PU_NEWS		0.033***		
		[0.01]		
PU_TAX			0.021***	
			[0.00]	
PU_GOVCPI				0.016**
				[0.01]
Obs.	13,866	13,866	13,866	13,866
Adj. R-squared	0.734	0.734	0.734	0.733
Firm FE	Yes	Yes	Yes	Yes
Year FE	No	No	No	No
Firm Cluster	Yes	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes	Yes
Macro Variables	Yes	Yes	Yes	Yes
Investment Opp.	Yes	Yes	Yes	Yes

The bold figures are the our variables of the analysis which are discussed in details in our writing
In this table, in Panel A, we regress the sum of change of cash ($CASH_{t+1}$ - $CASH_t$) and change of investment ($CAPEX_{t+1}$ - $CAPEX_t$) on policy uncertainty (*PU*) or its components (news (*PU_NEWS*), tax (*PU_TAX*), and government spending combined with inflation (*PU_GOVCPI*)). In Panel B, we regress firm cash holdings (cash-to-assets ratio, *CASH*) on policy uncertainty (*PU*) or its components (*PU_NEWS*, *PU_TAX*, *PU_GOVCPI*) using the sample of firms that have not reduced their investment in response to increases in the EPU. Across all models, we include firm-level controls including size (*SIZE*), market-to-book ratio (*MB*), cash flow (*CF*), net working capital (*NWC*), capital expenditure (*CAPEX*), book leverage (*BLEV*), R&D expense (*R&D*), dividend paying dummy (*DIV_PAYER*), industry cash flow volatility (*ICFVOL*), four proxies for firm investment opportunities and six proxies for general economic uncertainty. All continuous variables are winsorized at 1% levels and defined in Appendix A1. In all regressions, we include firm fixed effects and firm clustering effects. Robust firm clustered standard errors are reported in the brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

7.2. Firm business cycle

To further disentangle the effect of EPU from the business cycle, we divide our sample into two sub-samples: the expansionary and recessionary periods and run the baseline regression on these two subsamples to examine whether the impact of EPU on corporate

(*footnote continued*)
higher investment irreversibility or those with riskier investment. Using various measures of investment irreversibility and riskiness, we do not find support for this conjecture, further illustrating that our main finding is not a manifestation of reductions in investment. We present the results for this analysis in Table IA4 in the Internet Appendix.

Table 10
Policy uncertainty, cash holdings and business cycle.

	(1)	(2)	(3)
	Recessionary periods	Expansionary periods	Full sample
PU_NEWS	**0.032*** **	**0.014** **	**0.016*** **
	[0.01]	**[0.00]**	**[0.00]**
*EXPANSION *PU_NEWS*			−0.001***
			[0.00]
EXPANSION			−0.003*
			[0.02]
Obs.	14,777	57,210	73,931
Adj. R-squared	0.836	0.771	0.741
Firm FE	Yes	Yes	Yes
Firm Cluster	Yes	Yes	Yes
Firm Controls	Yes	Yes	Yes
Macro Variables	Yes	Yes	Yes
Investment Opp.	Yes	Yes	Yes

The bold figures are the our variables of the analysis which are discussed in details in our writing
In this table, we regress firm cash holdings (cash-to-assets ratio, *CASH*) on policy uncertainty (log of BBD index) during the recessionary and expansionary periods. We further regress firm cash holdings on the interaction term between a dummy variable for expansionary period and policy uncertainty. We include firm-level controls including size (*SIZE*), market-to-book ratio (*MB*), cash flow (*CF*), net working capital (*NWC*), capital expenditure (*CAPEX*), book leverage (*BLEV*), R&D expense (*R&D*), dividend paying dummy (*DIV_PAYER*), industry cash flow volatility (*ICFVOL*), the four firm investment opportunities and the six macroeconomic uncertainty. All continuous variables are winsorized at 1% levels and defined in Appendix A1. In all regressions, we include firm fixed effects, firm clustering effects. Robust firm clustered standard errors are reported in the brackets. *, **, and *** indicate statistical significance at the 10%, 5%, and 1% level, respectively.

cash holdings changes with the underlying economic conditions. To determine the periods of expansion and recession, as stated earlier, we use the US Business Cycle Expansions and Contractions provided by the NBER. According to the NBER business cycles, the following periods are identified as the recessionary periods: July 1990 to March 1991, March 2001 to November 2001 and December 2007 and June 2009 and expansionary periods are other periods. A firm-year observation is defined as in the NBER recessionary periods if the firm's fiscal year end falls within the recessionary periods or at least 6 months in the fiscal year falling into NBER recessionary periods. Across all models, we include the four investment opportunities and six macroeconomic uncertainty variables as per Column (3) of Table 2. We present these results in Columns (1) and (2) of Table 10 for the recessionary periods and expansionary periods, respectively. The coefficients of policy uncertainty remain positive and statistically significant, indicating the impact of *PU_NEWS* on cash remains unchanged in both expansionary and recessionary periods.

To further unravel the effect of EPU from the business cycle, we include the interaction term between the expansionary period and EPU (*EXPANSION*PU_NEWS*) in the baseline regression to examine whether the impact of EPU on corporate cash holdings changes with the underlying economic conditions. We still observe a positive association between policy uncertainty and cash holdings. The coefficients of the interaction term (*EXPANSION*PU_NEWS*) is negative and statistically significant, indicating that the impact of policy uncertainty on cash is more pronounced in the recessionary periods than in the expansionary environments.

7.3. Other robustness tests

We conduct additional tests to ensure the robustness of the results. We first re-estimate all models in Table 2 with standard errors being clustered by both firm and year to control for the possibility that standard errors are correlated across firms and over time (Bates et al., 2009; Cameron et al., 2011). We then control for dividend tax cut reform in 2003 as this policy has significantly increased the U.S. firm dividend payout ratio which has effectively impacted on the firm internal cash holdings (Chetty and Saez, 2005). We also rerun the baseline regression using an alternative measure of macroeconomic uncertainty developed by Bali et al. (2014) and perform change regressions following (Bates et al., 2009) to control for the possibly omitted control variables. To address the endogeneity issue on firm investment and innovation regressions reported earlier in Tables 7 and 8, we further augment our Eqs. (7) and (8) by replacing the original measure of policy uncertainty with its fitted value, *FPU*. We also provide analysis of the impact of state ideology on the relation between policy uncertainty and cash holdings.

The test results are provided in our Online Appendix Table IA5-IA11 show that overall and component measures of policy uncertainty remain statistically significant and positive in determining the level of cash holdings. We also find that firms in state whose incumbent's ideology is different from the president's ideology hold more cash than their counterparts. Overall, these robustness tests further strengthen our findings of the positive association between policy uncertainty and cash holdings.

8. Conclusion

We find a strongly positive association between policy uncertainty and corporate cash holdings for the U.S. firms during the 1985–2014 period. This result is robust to controlling for measures of firm investment opportunities, and macroeconomic

uncertainty. We also find consistent results when we use gubernatorial elections an exogenous shock to EPU, as well as instrumental variable analysis with the numbers of incumbents who do not run for re-election due to their term limit and the predictability of gubernatorial election outcomes as two alternative instrumental variables for EPU. Our cross-sectional tests further show that the relation between policy uncertainty and corporate cash holdings is more pronounced for firms with high government dependence, with governments as their major customers, with high exposure to political risk, and with high return sensitivity to changes in overall EPU.

We then examine financial constraint as an economic channel underlying the policy uncertainty-cash holdings relation and find that firms save more cash from their cash flows when policy uncertainty increases. We further find that managers pursue conservative payout decisions such as reducing the total payout (dividend payment and share repurchase) in order to generate more cash in the period of EPU. We also analyze the role of increasing cash holdings to better understand the motivations of this firm decision. In particular, we show the role of cash holdings in mitigating the negative impact of policy uncertainty on capital investment and firm innovation output. Finally, our analysis shows the relation between policy uncertainty and cash holding is not a manifestation of the delays in investment but rather due to the exacerbation of external financing conditions during uncertain times. By documenting these findings, our research extends the current understanding on the impact of higher policy uncertainty on corporate financial constraints and behaviours, as well as contributing to the literature on the role of corporate cash holdings in alleviating the adverse effect of EPU on firm real economic activities.

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Appendix A1: Variable Codes, Names and Definitions

Code	Name	Definition
Panel A: Firm-level characteristics		
CASH	Cash Holdings	Cash and marketable securities deflated by total assets.
ΔCASH	Change in Cash Holdings	Cash and marketable securities at time t + 1 minus cash and marketable securities at time t, deflated by total assets.
SIZE	Firm Size	Logarithm transformation of the total assets.
MB	Market-to-Book Ratio	Ratio of market-to-book value of equity.
CF	Cash Flows	Earnings after interest, dividends, and taxes, but before depreciation, deflated by total assets.
TOBINQ	Tobin Q	Ratio of market-to-book value of firm assets.
NWC	Net Working Capital	Working capital net of liquid assets, deflated by total assets.
ΔNWC	Change in Net Working Capital	Yearly change in net working capital, deflated by total assets.
CAPEX	Capital Expenditure	Capital investment, deflated by total assets.
ΔCAPEX	Change in Capital Expenditure	Capital investment at time t + 1 minus capital investment at time t, deflated by total assets.
BLEV	Book Leverage	Ratio of total debt (long-term and short-term debt), deflated by total assets.
ΔBLEV	Change in Book Leverage	Yearly change in total debt, deflated by total assets.
R&D	Research and Development (over Sales)	R&D expense, deflated by net sales. Missing observations are replaced by zero.
DIV_PAYER	Dividend Dummy	Dummy variable indicating if a firm pays dividend in a particular year. Missing observations are replaced by zero.
ΔSALE	Sale growth	The ratio of firm sale at time t minus firm sale at time t-1, deflated by firm sale at time t.
PPE	Property, Plants and Equipment	Ratio of net PPE-to-total assets.
TEXT_CONSTRAINT	Text-based measure of financial constraints	Disclosures in the Management's Discussion and Analysis section on liquidity and capital sources of the 10-K as measure of financial constraints.
KZ	Financial Constraints	The Kaplan and Zingales (1997)'s financial constraint index.
HHI	Market Concentration Measure	The sum of squares of the market shares of the firms' sales within an industry.
LIFE_CYCLE	Firm Life Cycle	The retained earnings-to-total equity ratio
PAYOUT	Total Payout Ratio	The sum of dividends and repurchases scaled by total assets
ROA	Return on Assets	The return on assets: operating income divided by total assets
PATENT	Total Numbers of Firm Patents	Natural logarithm of one plus the number of patents for each firm-year divided by the mean number of patents for the same year.
PAT_CITE	Citations Per Patent	Natural logarithm of one plus the number of patent citations divided by the average of patent citations in the same cohort (year-and-technology class) in which the patent belongs.
PAT_ECO	Economic Value of Patent	The economic value of new innovations is based on stock market reactions to patent grants. *PAT_ECO* is equal to one plus the economic value of innovation.
INO_EFF	Firm Innovation Efficiency	An innovation efficiency measure, which captures innovation output per unit of input, in which the innovation input is measured by R&D capital accumulated over the previous five years.

GOV_CUS	Government as Major Customer	A dummy variable that equals to one for firms that have government as their major customer and zero otherwise.
PRISK	Firm-level Political Risk	The share of firm quarterly earnings conference calls that firm devotes to political risks.
BETA	PU-stock Return Sensitivity	The estimated coefficient of *PU_NEWS* in regressions of each Fama-French 48 industry's value weighted monthly excess stock returns on *PU_NEWS,* market excess return, SMB, HML over the 60 months prior to the beginning of the firm's fiscal year.
Panel B: Industry-level characteristics		
ICFVOL	Industry Cash Flow Volatility	The average industry standard deviation of cash flow at the two-digit *SIC* level on a 10-year rolling basis.
GOVSP	Government Spending	Government-related sales over total sales of a particular industry.
HIGHGOVSP	High Government Spending	A dummy variable which is equal to one if government spending is greater than the sample median value, and zero otherwise
Panel C: Country-level characteristics		
PU	Policy Uncertainty (Overall)	Log transformation of BBD Index (Overall).
PU_NEWS	Policy Uncertainty (News)	Log transformation of BBD Index (News).
PU_TAX	Policy Uncertainty (Tax Codes)	Log transformation of BBD Index (Tax Codes).
PU_GOVCPI	Policy Uncertainty (Government Spending and Inflation combined)	Average of Log transformation of BBD Index (Government Spending) and of BBD Index (consumer price index).
GUBER_ELECT	Gubernatorial Election	A dummy variable which equals to 1 if year t is a gubernatorial election year for a given firm i's state and 0 otherwise.
FPU_NOINCUM	Fitted Value of *PU_NEWS*	A fitted value which is obtained from running first-stage monthly time-series regressions of original news-based policy uncertainty on *PU_NOINCUM* which is the proportion of assets owned by firms headquartered in state-year with gubernatorial elections where the incumbent does not run for re-election due to their term limits to total assets of all firms in all states in a given year.
FPU_5%MARGIN	Fitted value of *PU_NEWS*	A fitted value which is obtained from running first-stage monthly time-series regressions of original news-based policy uncertainty on *PU_5%MARGIN* which is the proportion of assets owned by firms headquartered in states with gubernatorial election where the election is won by a margin of 5% or less to total assets of all firms in all states in a given year.
EX_GDPGROWTH	Expected GDP Growth	The percentage change between the annual mean one-year-ahead GDP forecasts from the Philadelphia Federal Reserve's biannual Livingstone survey.
ECONOMIC_INDEX	Leading Economic Index	The Conference Board's monthly Leading Economic Index, which is based on ten macroeconomic indicators.
CONSUMER_CONFIDENCE	Consumer Confidence	The Michigan Consumer Confidence Index from the University of Michigan.
REAL_GDPGROWTH	Real GDP Growth Rates	The real GDP growth rates from the World Bank's World Development Indicator.
ELECYEAR	Election Year Dummy	Dummy variable indicating the presidential election years.
GDPDIS	GDP Dispersion	Log transformation of GDP Dispersion.
SDPROFIT	Profit Volatility	Log transformation of profit growth.
VXO	Implied Volatility	Log transformation of VXO index.
SDRETURN	Return Volatility	The yearly historical stock return volatility, *i.e.*, the standard deviation of monthly stock returns in previous twelve months.
JLN	Jurado et al. (2015)'s Index	Log transformation of JLN aggregate uncertainty index.
ΔGDP	GDP Growth	Yearly change in GDP, divided by lagged GDP.
EXPANSION	Expansionary periods	A dummy variable which equals to 1 for NBER expansionary periods and 0 otherwise.

Appendix A. Supplementary data

Supplementary data to this article can be found online at https://doi.org/10.1016/j.jcorpfin.2020.101607.

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