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1. October 2013

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by

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Abstract

This paper examines the effect of economic policy uncertainty and its components on firm-level investment. It is found that economic policy uncertainty in interaction with firm-level uncertainty depresses firms' investment decisions. When firms are in doubt about costs of doing business due to possible changes in regulation, cost of health care and taxes, they become more guarded with investment plans. The effect of economic policy uncertainty on firm-level investment is greater for firms with higher firm-level uncertainty and during a recession. News-based policy shock has a significantly negative long-term effect on firms' investment. Federal expenditure forecast interquartile range shock has a significant negative effect in the short- and long-run. Policy uncertainty does not seem to influence the investment decisions of the very largest firms (about 20% of listed firms).

JEL classification: E22, E61, G31
Key words: Policy uncertainty, Firm investment, Stock price volatility

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Lee is grateful for the financial support of Kyung Hee University during his sabbatical leave to University of Missouri- Columbia.

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1. Introduction

In a recent paper Baker et al. (2013) examine whether economic policy uncertainty has intensified the 2007-2009 recession and weakened the recovery. This work is part of a growing literature on the real effects of policy uncertainty that builds on earlier work relating uncertainty to firm-level investment and employment decisions when there are adjustment costs. If firms decide to lower investment by realizing the option value of waiting for new information to arrive, an economic slowdown is likely to occur. Early work in this area includes contributions by Bernanke (1983), Romer (1990), Bertola and Caballero (1994), Dixit and Pindyck (1994), Abel and Eberly (1996), among others.

With regard to the literature on economic policy uncertainty, Rodrick (1991) notes that reform in developing countries can result in investment being delayed until uncertainty regarding the success of the reform is eliminated. Hassett and Metcalf (1999) and Fernandez-Villaverde et al. (2011) find the uncertainty works through a fiscal policy channel. They show the certainty of tax credits and budget adjustment acts as an implicit subsidy to encourage firms' investment, whereas the fiscal volatility shocks have significantly adverse effects on economic activity. Byrne and Davis (2004) provide evidence that uncertainty may affect U.S. nonresidential fixed investment through a monetary policy channel in which the temporary component of inflation uncertainty has a greater negative effect on investment than the permanent component. Recent papers by Gilchrist et al. (2010) and Pastor and Veronesi (2012) find that policy uncertainty drives up the cost of finance, lowering investment and intensifying economic contraction.[1]

[1] The view that uncertainty about economic policy may not have major effects has also been advanced. For instance, Bachmann and Bayer (2011) note that fast monetary policy reaction may dampen the aggregate fluctuations arising

In a related literature on the effect of uncertainty on firm-level decisions, Leahy and Whited (1996), Bloom et al. (2007), Baum et al. (2008), Bloom (2009) and Panousi and Papanikolaou (2012) argue that uncertainty faced by the individual firm can be represented by its own stock price volatility. Bloom et al. (2007) present a model in which uncertainty reduces firms' irreversible investment in response to shocks to sales. They argue that firms become more cautious during times of heightened volatility of a firm's daily stock returns over the year (interpreted as demand shocks). Leahy and Whited (1996) find for U.S. manufacturing firms over the period of 1981 to 1987, a negative relationship between investment and the volatility of a firm's daily stock returns over the year. Baum et al. (2008) and Bloom et al. (2007) report similar results for U.S. manufacturing firms during 1984 to 2003 and for UK firms from 1972 to 1991, respectively.

The relationship between firm-level investment and measures of firm-level uncertainty obtained from survey data have been examined by researchers. Guiso and Parigi (1999) obtain the conditional mean and variance of projected future demand and find that uncertainty weakens the response of investment by Italian firms to demand. Bontempi et al. (2010) and Bianco et al. (2013) measure demand uncertainty facing Italian firms by the min–max range of the expected growth rate of demand. Bianco et al. (2013) finds that investment by family firms is significantly more sensitive to uncertainty than is investment by nonfamily firms. Bontempi et al. (2010) find that firms' investment plans (obtained at the same time as subjective uncertainty about demand) are negatively impacted by uncertainty. Driver et al. (2004) find that an uncertainty variable

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from uncertainty shocks. Born and Pfeifer (2011) in a general equilibrium model find aggregate uncertainty about labor and capital tax rates, monetary policy, and government spending has only minor effects on the business cycle.

based on the cross-sectional dispersion of beliefs across firms in an industry with regard to optimism for the industry has a negative effect on investment.[2]

The literature also addresses the issue of the effects of macro and micro uncertainty on investment. Panousi and Papanikolaou (2012) show that firm-level idiosyncratic risk (volatility in stock price not explained by market and industry sector stock price) is negatively associated with investment by U.S. firms over 1970-2005.[3] Temple et al. (2001) distinguish between the effects of macro and micro sources of uncertainty on investment by firms in the United Kingdom. Panel data on firm-level survey response regarding expectations that uncertainty about demand might limit future investment enable comparison of the two levels of uncertainty. It is found that both sources of uncertainty have a negative impact on investment (other than in highly concentrated industries in which neither effect is important). Baum et al. (2010) distinguish between own uncertainty, based on a firms' stock returns, market uncertainty, derived from stock index returns, and a measure of covariance between the two. An increase in market uncertainty inhibits firm-level investment, and the sign of the effect of the other measures of uncertainty on firm-level investment depend on interaction with cash flow.

The new finding in this paper is that firm-level investment is influenced by the interplay between the firm-level uncertainty (i.e., micro uncertainty) and the aggregate economic policy uncertainty (i.e., macro uncertainty). Specifically, we find that economic policy uncertainty depresses firms' investment decisions, and the effect of economic policy uncertainty on firm-level investment is greater for firms with higher firm-level uncertainty. It is the uncertainty

[2] The papers by Guiso and Parigi (1999), Bontempi et al. (2010) and Bianco et al. (2013) utilize measures of demand uncertainty based on the Survey on Investment in Manufacturing by the Bank of Italy. Driver et al. (2004) use the Confederation of British Industry's Industrial Trends Survey.

[3] Chen et al. (2011) and Bhagat and Obreja (2013) provide reviews of the literature relating uncertainty to investment. Chen et al. (2011) argue that cross-industry dispersion of stock returns stand-in for permanent shocks that drive structural unemployment. Bhagat and Obreja (2013) relate investment to cash flow uncertainty. Bloom et al. (2012) argue that volatility in shocks to total factor productivity are strongly connected with firm stock price volatility and drive plant, firm, industry and aggregate output and productivity.

generated by the economic policy uncertainty shock in interaction with firm-level uncertainty (stock price volatility) that influences the firm investment decision significantly. We caveat our results by noting that stock price uncertainty shall contain an element driven by idiosyncratic and/or market uncertainty.

Overall economic policy uncertainty and its components, news-based policy uncertainty, tax legislation expiration, federal expenditures forecast interquartile range and CPI forecasters interquartile range are defined in Baker et al. (2013). An error correction model of capital stock adjustment is used to investigate the effect of economic policy uncertainty on firm-level investment over 2,700 publicly traded U.S. manufacturing firms between 1985 and 2010. News-based policy shock has a significantly negative effect on the investment of firms in the long run. Federal expenditure policy shock has a significantly negative effect on the investment of firms in both the short- and long-run. The tax policy and inflation shocks have no significant effect on firm-level investment. Policy uncertainty does not seem to influence the investment decisions of largest manufacturing firms (about 20% of listed manufacturing firms). The depressing effect of policy shocks on firm-level investment is greater during recessions. Bloom et al. (2007) suggest that an increase in firm's stock price volatility reduces the link between sales growth and investment. We find evidence that greater federal expenditure policy uncertainty further weakens the link between sales growth and firm-level investment for a given level of firm uncertainty. Empirical results also show the effect is quantitatively amplified during the period 2007-2010.

The paper proceeds as follows. The empirical model is presented in the next section. Data and variables are specified in Section 3. Econometric issues and empirical results are discussed in Section 4. Section 5 offers concluding remarks.

2. The model

The empirical work in the literature builds on the solid micro-foundations of theoretical work on investment by Abel and Eberly (1996) and many others. Under uncertainty, when investment is irreversible, investment has an opportunity cost that increases with uncertainty.[4] The typical model of investment under uncertainty predicts that investment only occurs when a firm's marginal revenue product of capital (m) is above the user cost of capital $(c(u))$, that rises with uncertainty (u). The user cost of capital has been defined to properly reflect irreversibility and uncertainty. Following Abel and Eberly (1996), let $m = a(K / y)^{-1/\gamma}$ evaluated at the current level of the stock of capital (K), the level of demand (y), a constant (a) and a parameter $(0 < \gamma < 1)$. The firm's optimal level of capital stock is $K^* = y(c(u) / a)^{-\gamma}$ and investment decision becomes $I = K^* - K > 0$ if $m > c(u)$ or $K < y(c(u) / a)^{-\gamma}$, and $I = 0$ if $m < c(u)$. In the empirical work that follows we assume (as in Guiso and Parigi (1999) and other papers) that $m > c(u)$ and that increased uncertainty reduces the reaction of investment to demand.

The inclusion of uncertainty in the empirical model is founded in micro theory of the behavior of the firm under uncertainty. In this paper we are interested in the effect of economic policy uncertainty on firm-level investment. Economic policy changes can transform the economic environment confronting the firm. Uncertainty about future government policy and about the effect of future policy has the potential to influence firm decision making about investment. To capture the key feature that under the irreversibility condition, uncertainty weakens the response of investment to demand shocks, we examine the impacts on firm-level investment of firm-level uncertainty (stock price volatility), σ_{it}^{s} (for firm i in year t), economic

[4] Discussion of the circumstances under which uncertainty will either raise or decrease investment and review of the literature on this subject are provided in Bontempi et al. (2010) and Bianco et al. (2013).

policy shock, σ_t^p, and the interaction of firm-level uncertainty with economic policy shock, $U_{it} \equiv \sigma_t^p \times \sigma_{it}^s$.

The empirical analysis builds on an error correction model (ECM) specified by Bloom et al. (2007) with the inclusion of firm-level and economic policy uncertainty shocks and their interaction.[5] We specify the following model for the investment rate:

$$\begin{aligned}\frac{I_{it}}{K_{i,t-1}} = \beta_1 \frac{I_{i,t-1}}{K_{i,t-2}} + \beta_2 \Delta y_{it} + \beta_3 \frac{c_{it}}{K_{i,t-1}} + \beta_4 \frac{c_{i,t-1}}{K_{i,t-2}} + \beta_5 (y-k)_{i,t-1} + \beta_6 (\Delta y_{it})^2 \\ + \beta_7 \Delta\sigma_{it}^s + \beta_8 \sigma_{i,t-1}^s + \beta_9 \sigma_{it}^s \Delta y_{it} + \beta_{10} \Delta\sigma_t^p + \beta_{11} \sigma_{t-1}^p + \beta_{12} \Delta U_{it} + \beta_{13} U_{i,t-1} \\ + \beta_{14} \sigma_t^p \Delta y_{it} + \beta_{15} U_{it} \Delta y_{it} + A_i + \delta_i + B_t + \varepsilon_{it}.\end{aligned} \tag{1}$$

where i denotes individual firm, t denotes year, and Δ is the first difference operator. In equation (1) I_{it} is gross investment of firm i in period t, K_{it} is the actual capital stock, c_{it} denotes the log of cash flow, y_{it} denotes the log of real sales, k_{it} is the log of capital stock, Δy_{it} is the first-difference of log of real sales used to control firms' demand shocks, A_i and B_t are unobserved firm and time fixed effects, δ_i is the firm-specific depreciation rate, and ε_{it} is the serially uncorrelated error term.

The effects of the interaction between firm-level uncertainty and firm sales growth is captured by $\sigma_{it}^s \Delta y_{it}$. A statistically significant negative coefficient estimate of β_9 is taken by Bloom et al. (2007) to indicate that an increase in firm uncertainty reduces the effect of sales growth on firm-level investment. The square of the growth rate of real sales $(\Delta y_{it})^2$ captures a potential non-linear effect of sales growth on investment. The terms σ_{it}^s and $\Delta\sigma_{it}^s$ appear to capture possible difference in long-run and short-run effects of uncertainty on firm-level uncertainty.

[5] The ECM specification is motivated and derived in Bloom (2000).

The model (1) incorporates multifaceted influences of economic policy uncertainty on firm investment. Direct effects of economic policy uncertainty are captured by the first-difference and the lag of economic policy shock variables, $\Delta\sigma_t^p$ and σ_{t-1}^p. The effects of the interaction between economic policy shock and firm stock price volatility on firm investment are captured by the variables, ΔU_{it} and U_{it-1}. The effect of the interaction between economic policy shock and firm sales growth is captured by $\sigma_t^p \Delta y_{it}$ and the effect of the interaction between U_{it} and firm sales growth is captured by $U_{it}\Delta y_{it}$. The acceptance of the hypothesis, $\beta_{10} = \beta_{11} = ... = \beta_{15} = 0$, eliminates the effects of economic policy uncertainty from the model.

The ECM in equation (1) includes current and lagged cash flow variables as additional controls. Cash flow variables are usually included in estimation of investment equations with firm-level data. The cash flow variables are statistically significant. In our empirical analysis this specification including cash flow terms is not rejected by the test of over-identifying restrictions. The reason for inclusion of cash flow variables may not be primarily due to the presence of financial constraint. It may be due, as Bond et al. (2004) argue, to expectations of future sales growth or profitability.

We first estimate a model in which economic policy uncertainty does not appear and then a model in which it does appear. The firm-level uncertainty measured by firm stock price volatility appears in both models. This procedure allows the results to be directly compared to those in the literature on the effects of firm stock price volatility on firm investment, and to assess the effects of economic policy uncertainty.

3. Data and variable specification

The main regressions are based directly upon annual data, with annual measures of uncertainty constructed from higher frequency data. The sample data come from three sources.

The dependent variable in the analysis is annual firm-level investment (net capital expenditure) scaled by the capital stock (at t-1). The annual book value and other accounting data come from Standard and Poor's Industrial Annual COMPUSTAT database. The sample consists of an unbalanced panel of publicly traded manufacturing firms (SIC code 2000-3999) between 1985 and 2010. The monthly economic policy uncertainty index and its components come from Baker et al. (2013). The daily stock returns, including dividends, are from CRSP Daily Stock Combine File. Table A1 in the appendix presents all variables used for data screening and model estimation.

3.1. Economic policy uncertainty and components

Baker et al.'s (2013) overall index of economic policy uncertainty is a weighted average [6] of four uncertainty components: news-based policy uncertainty, CPI forecast interquartile range, tax legislation expiration, and federal expenditure forecast interquartile range (denoted by news uncertainty, CPI disagreement, taxation expiration, and expenditure dispersion, respectively). The news uncertainty reflects newspaper coverage of economic policy uncertainty, constructed by month-by-month searches of 10 large newspapers [7] for articles containing three words relating to uncertainty, economic/economy and (monetary and fiscal) policies.[8] The number of articles that discuss both U.S. economy and policy uncertainty each month quantifies the news uncertainty in that month.[9] The CPI disagreement and expenditure dispersion are measured by the forecasters' disagreement (the interquartile range of forecast) over future outcomes about

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[6] Baker et al. (2013) set the weights to 1/2 on the news-based uncertainty and 1/6 on each of taxation expiration, CPI disagreement, and expenditure dispersion components.

[7] The newspapers are USA Today, the Miami Herald, the Chicago Tribune, the Washington Post, the Los Angeles Times, the Boston Globe, the San Francisco Chronicle, the Dallas Morning News, the New York Times, and the Wall Street Journal.

[8] The three words are 'uncertainty' or 'uncertain', 'economic' or 'economy' and one or more of the following: 'congress', 'legislation', 'white house', 'regulation', 'federal reserve', or 'deficit'.

[9] The raw counts about the news uncertainty are normalized by the number of news articles that contain the term 'today' in order to mitigate the volume accumulation and high-frequency noise problems.

inflation rates and federal government purchases, respectively.[10] The taxation expiration is a transitory measure constructed by the number of temporary federal tax code provisions set to expire in the contemporaneous calendar year and future ten years and reported by the Joint Committee on Taxation.[11]

We first construct monthly economic policy shock (σ_m^p) as $\sigma_m^p = u_m / h_m^u$, where u_m denotes the rate of change of economic policy uncertainty index in month *m*, and h_m^u is the conditional standard deviation of u_m generated by its GARCH(1,1) model.[12] The policy shock (σ_m^p) is expected to reflect how big a given uncertainty change relative to the recent historical level (h_m^u). The intuition is that the normalization of uncertainty change by its conditional standard deviation can reflect the belief that people may get used to the past level of uncertainty quickly, such that once a high level of uncertainty that caused an adjustment in investment may lose its significance if the high level of uncertainty continues for a while.[13] A monthly policy shock measure is also constructed in the same way for each of the four components, news uncertainty, CPI disagreement, taxation expiration, and expenditure dispersion. We adopt a parsimonious $GARCH(1,1)$ representation to obtain the conditional variance of the rate of change in policy uncertainty by setting 6 autoregressive lags in the regression.[14] The annual policy shock is the average of monthly shocks within a year and is given by:

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[10] The quarterly raw data of the forecast about inflation rates and federal government purchases are drawn from the survey of professional forecasters of Federal Reserve Bank of Philadelphia. The index value of monthly CPI disagreement and expenditure dispersion is held constant for each quarter.

[11] The index value of taxation uncertainty is obtained for each January and kept constant for 12 months in the year.

[12] Pagan (1984) notes a potential problem of making inferences in models with generated regressors. We note that the problem of generated regressors in equation (1) is mitigated since the dependent variable I_t (and K_t) are usually known more than a year before.

[13] See Lee et al. (1995) that uses the same transformation for real oil price shocks.

[14] Bollerslev et al. (1992) argue in favor of lower-order autoregressive terms in GARCH(1,1) modeling. We find the results are robust to different autoregressive lag lengths.

$$\sigma_t^p = \sum_{m=1}^{12} \sigma_m^p / 12. \tag{2}$$

3.2. Firm-level data and uncertainty

We utilize daily stock returns to compute monthly stock volatilities (σ_{im}^s) for firm i in month m via the methodology developed by Baum et al. (2008).[15] The method first computes the ratio of the first difference of a firm i's daily returns (Δr_{id}) to the square root of the number of days intervening $\sqrt{\Delta\varphi_d}$. If the data were generated on every calendar day, $\Delta\varphi_d = 1$. The square of the ratio, denoted by the daily stock volatility, represents the daily contribution to the monthly volatility, $\xi_{id} = (\Delta r_{id} / \sqrt{\Delta\varphi_d})^2$. The monthly stock volatility of firm i is then defined as the square root of the sum of the daily contributions, $\sigma_{im}^s = \sqrt{\sum_d \xi_{id}}$, within a given month m. The annual stock volatility is the mean of monthly volatility within a year t, and is given by:[16]

$$\sigma_{it}^s = \sum_{m=1}^{12} \sigma_{im}^s / 12. \tag{3}$$

The interaction variable $U_{it} \equiv \sigma_t^p \times \sigma_{it}^s$ denoting the interaction between economic policy shocks and the firm-level uncertainty will play a key role in our empirical analysis. Figure 1 shows the monthly plot of the interaction variable $U_m = \sigma_m^p \times \sigma_m^s$ for an average case, where $\sigma_m^s = \frac{1}{N}\sum_{i=1}^{N} \sigma_{im}^s$ and N is the total number of firms. U_m is the product of monthly policy shocks and the average of monthly stock volatilities of all firms from January 1985 to December 2010. The shaded area represents the economic recessions, 1990.7 - 1991.3, 2001.3 - 2001.11, and

[15] Our measure of annual stock volatility, based on Merton's (1980) methodology that assumes the stock returns are generated by a diffusion process, differs slightly from that in Baum et al. (2008) in that their measure is the square root of the sum of the daily contributions to the volatility over a year.
[16] The results that the stock volatility has negative effects on firm-level investment are qualitatively similar.

2007.12 - 2009.6. The timing of the outbreak of ten major historical events is marked in the figure.

It can be seen that all ten dates of well-known events are followed by rises in U_m. Following the Gulf War, Clinton/Bush Election, and Terrorist Attack, there were huge increases in the uncertainty. After Iraq War, Stimulus Debate, Obama Election, and Leman Brother/Banking Crisis, there were significant increases in the uncertainty. These spikes in the uncertainty are likely due to the large increase in both the economic policy shock and stock price volatility following the major events in U.S. history.[17] It shows that the early Budget Balance Act and recent Euro Crisis were only modestly associated with a rise in the uncertainty. Moreover, it can be seen that the significant rise in the uncertainty is related with economic downturns during 1985.01 - 2010.12. The uncertainty spikes are closely associated with each of the recent three economic recessions during the sample period identified by NBER. For instance, the largest uncertainty spike of 2001.9 occurred during the 2001.3 - 2001.11 recession, followed by the uncertainty spike of 1990.8 during the 1990.7 - 1991.3 recession. During the 2007.12 - 2009.6 recession, there are four uncertainty spikes. The figure shows that the economic policy shock×stock price volatility uncertainty may qualify as a good proxy for major historical events that contributed significantly to the downturn of economic activity. In this paper, we refer it as the uncertainty channel of transmission of economic policy shocks.

4. Empirical result

Before conducting the empirical analysis, we discuss several econometric issues that arise in estimating the firm-level investment model. The main empirical concerns are about the treatment of fixed effects and about possible endogeneity problems as obstacles to obtaining

[17] Both policy shocks and stock price volatility follow a pattern similar to that showed in Figure 1.

consistent estimators. To deal with the firm-specific depreciation rate (δ_i), Bloom et al. (2007) suggest the use of the approximation $\Delta \log K_{it} \approx (I_{it} / K_{i,t-1}) - \delta_i$ as the dependent variable. We find the result is not significantly affected when the dependent variable is $I_{it} / K_{i,t-1}$ and the individual effect only includes the firm-specific dummy variable. A standard within group estimator can eliminate the individual effect, but this can create a correlation between the transformed dependent variable and transformed error. To avoid this bias we use orthogonal deviation transformation, the preferred method in estimating unbalanced panel data models (Roodman, 2009).

GMM is used to estimate the parameters in equation (1) taking into account the possibility of the presence of unmeasured errors or the potential endogeneity of explanatory variables. The system GMM estimator was developed by Arellano and Bover (1995) and Blundell and Bond (1998). It combines a system of equations in first differences using lagged levels of endogenous variables as instruments with equations in levels for which lagged differences of endogenous variables are used as instruments. Following Bloom et al. (2007), such variables as sales, cash flows, economic policy shocks, stock price volatilities, and policy shocks×stock price volatilities are considered as endogenous. To allow for potentially long delays in the transmission of the effects of economic policy shock into the real economy, a set of instruments with lags from the third on back in the first-difference equation and with lag 2 in the level equation is used. The validity of instruments is tested using Sargan–Hansen test of over-identifying restrictions. [18] The squared correlation coefficient between actual and predicted levels of the dependent variable is used as the measure of the goodness-of-fit, whereas the Lagrange

[18] Sargan-Hansen statistics are equal to the value of the GMM objective function at the estimated parameter value, which under the null hypothesis of instruments orthogonal to the error term is asymptotically distributed as Chi-square with degrees of freedom equal to the difference in the number of instruments and regressors.

multiplier test examines the presence of serial correlation in the error term. We utilize the system GMM estimation module in STATA, *xtabond2* written by Roodman (2009), for econometric estimation.

4.1. Effect of overall economic policy shock on firm-level investment

Table 1 reports the results of GMM estimation when the aggregate overall economic policy shock is introduced in the investment model. The lagged investment rate I_{it-1} / K_{it-2}, sales growth Δy_{it}, lagged cash flow C_{it-1}/K_{it-2}, and the cointegrating term $(y-k)_{it-1}$ all have intuitively correct signs and are highly significant, with the smallest t-value being 3.74. For all six models, the Lagrange multiplier tests for the presence of the second-order serial correlation in the error term cannot reject the null hypothesis of no serial correlation, while Sargan-Hansen tests do not reject the validity of over-identifying restrictions. The goodness-of-fit statistics measured by the squared correlation coefficient between actual and predicted levels of the dependent variable suggest that all six models have pretty good explanatory power.

Column (1) of Table 1 contains the estimation results of equation (1) with the restriction that $\beta_{10} = \beta_{11} = ... = \beta_{15} = 0$. This result obtained with the data on U.S. manufacturing firms can be compared with the result on Bloom et al. (2007, Table 5) obtained with the data on U.K. manufacturing firms (for 1972-1991). The effect of the firm-specific uncertainty-demand growth interaction variable, $\Delta\sigma_{it}^{s}\Delta y_{it}$, is negative and significant (similar to that in Bloom et al. (2007)). The linear terms included in the model ensure that the significant coefficient estimate of an interaction term is not due to omitted variables. The finding indicates that an increase in firm-level uncertainty reduces the link between sales growth and investment (Bloom et al. (2007), p. 408).

Columns (2) and (3) of Table 1 report the results from estimating versions of equation (1) when the model includes the economic policy shock variables $\Delta\sigma_t^p$ and σ_{t-1}^p. The firm stock price volatility is excluded in column (2) but included in column (3).[19] In column (3) the coefficient estimates of the change in the policy shock and the lag of the policy shock are negative but not statistically significant. Note that the interaction between economic policy shock and sales growth $\sigma_t^p \Delta y_{it}$ is included in both columns (2) and (3). This term has a negative coefficient and is not statistically significant. The results suggest that the exclusion of the change in the policy shock, the lag of the policy shock, and the interaction term does not alter the significance of other coefficient estimates in columns (2) and (3).

The effects of the uncertainty driven by economic policy shock×stock price volatility interaction on the firm-level investment are investigated in columns (4)-(6) of Table 1. Column (4) contains all variables in the model. In column (5), both the policy shock variables and firm stock price volatility variables are excluded, and in column (6), the policy shock variables are excluded. All the coefficient estimates of the change and the lag of the economic policy shock×stock price volatility interaction variables, ΔU_{it} and U_{it-1}, are negative in all three regression equations, indicating their negative effects on firms' short- and long-run investment decisions. The statistical significances of ΔU_{it} and U_{it-1} are at the 5% level in column (6). In column (4), when the model contains all variables, the potential multicollinearity between the change and lag of economic policy shock variables, $\Delta\sigma_t^p$ and σ_{t-1}^p, and the year dummies seems

[19] To mitigate the multicollinearity issue between policy uncertainty shock variables $\Delta\sigma_t^p$ and σ_t^p and the year dummy, we also estimated columns (2) and (3) omitting the year dummy. The coefficients of the two variables become negative but still remain insignificant.

to make the change and lag of the economic policy shock×stock price volatility interaction variables ΔU_{it} and $\mathrm{U}_{i,t-1}$ lose their statistical significance.[20]

In column (6) of Table 1, the statistical significance of the short- and long-run effects of the policy shock×stock price volatility interaction is bolstered by the presence of stock price volatility variables. Additionally, the coefficient estimates of the change in and the lag of stock price volatility are negative and intuitive. We adopt the model in column (6) as our preferred model. The model is given by:

$$\frac{I_{it}}{K_{i,t-1}} = \beta_1 \frac{I_{i,t-1}}{K_{i,t-2}} + \beta_2 \Delta y_{it} + \beta_3 \frac{c_{it}}{K_{i,t-1}} + \beta_4 \frac{c_{i,t-1}}{K_{i,t-2}} + \beta_5 (y-k)_{i,t-1} + \beta_6 (\Delta y_{it})^2 + \beta_7 \Delta\sigma_{it}^s + \beta_8 \sigma_{i,t-1}^s + \beta_9 \sigma_{it}^s \Delta y_{it} + \beta_{12} \Delta U_{it} + \beta_{13} U_{i,t-1} + \beta_{15} U_{it} \Delta y_{it} + A_i + \delta_i + B_t + \varepsilon_{it}. \quad (4)$$

The conclusion of this section is that firm-level investment is affected by the interaction between extrinsic economic policy shocks and intrinsic individual firm uncertainty (i.e., stock price volatility) rather than by policy shocks alone. These results provide supporting evidence on the theory of real options in capital budgeting decisions that predicts uncertainty causes firms to delay production and investment. Firms facing higher intrinsic uncertainty are more vulnerable to negative extrinsic economic policy shocks.

4.2. Transmission channel of economic policy uncertainty

We now turn to the issue of searching the channel through which economic policy shocks depress the firm investment decisions. Utilizing the model in equation (4), Table 2 reports the estimates of the effects of four policy shock components on the firm-level investment in columns (1), (2), (3) and (4), respectively. For the four models, the coefficient estimates of the interaction

[20] When a multicollinearity test is conducted using all variables in the model as in column (4) in which the year dummy variable B_t is omitted, all coefficients of error-correction term, stock price volatility, and economic policy shock×sales growth interaction change their signs erratically and become not intuitive.

terms of the change in and the lag of the economic policy shock×stock price volatility, ΔU_{it} and $U_{i,t-1}$, are uniformly negative which implies that for more uncertain firms, the higher the economic policy uncertainty the lower the firm's investment in both the short- and long-run.[21]

In column (1) of Table 2, the uncertainty U_{it} represents the interaction of news-based policy shock×stock price volatility. The result shows that the parameter estimate of the lag of the news policy shock×stock price volatility interaction uncertainty U_{it-1} is negative and statistically significant, but the estimate of the change in uncertainty ΔU_{it} is not significant. This indicates that firm's investment decisions are affected more by the long-run uncertainty U_{it-1} than by the short-run uncertainty ΔU_{it}. The uncertainty U_{it} in column (2) refers to the monetary policy shock×stock price volatility interaction. The coefficient estimates of ΔU_{it} and U_{it-1} are not statistically significant. Two explanations may fit here. First, it is likely due to the fact that the monetary policy shock is mostly associated with the temporary uncertainty (Byrne and Davis, 2004). Second, the CPI forecast disagreement might not be a useful proxy for the monetary policy uncertainty (Rich and Tracy, 2010). In column (3), the tax policy shock×stock volatility uncertainty U_{it} reflects how the temporary federal tax code provisions affect the investment decision. The coefficient estimates of the change in and the lag of the uncertainty, ΔU_{it} and U_{it-1}, are not statistically significant. It is partially due to the fact that as Baker et al. (2013) recognized, their tax policy uncertainty was a temporary measure subject to the future search.

The shock effect of the fourth component, the forecast dispersion of federal government purchases, on the firm-level investment is reported in column (4). The coefficient estimates of

[21] The $U_{i,t-1}$ term in column (4) is also negative when we increase the instrument lags from third to sixth or more in first-differenced equations.

the change in and the lag of the expenditure policy shock×stock price volatility, ΔU_{it} and U_{it-1}, are negative and statistically significant, with t-values 2.64 and 3.24, respectively. Two notable findings should be mentioned. First, the literature on the relationship between the disagreement among forecasters over future outcomes (e.g., inflation forecast disagreement) and other measures of uncertainty (e.g., real GDP growth uncertainty) has grown quite large in recent years but with contradicting findings over the strength and the interpretation of the link.[22] The statistical significance of the change in and the lag of uncertainty, ΔU_{it} and U_{it-1}, in column (4) of Table 2 suggests that the disagreement among forecasters seems to be a good proxy for the federal expenditure policy uncertainty in the firm-level investment model. The fiscal policy shock driven by the forecast dispersion of federal government purchases has a significantly negative effect on the firm-level investment, in interaction with firm stock price volatility, in both the short-run (ΔU_{it}) and long-run (U_{it-1}) in column (4) of Table 2.

4.3. Firm size effect

In this subsection we take advantage of having firm-level data and investigate the potential difference in the effects of uncertainty on investment arising from different firm sizes. The finding that uncertainty has a negative effect on investment could be attributable to unidentified risk factors of individual firm (e.g., information asymmetries associated with firm sizes by Kumar et al. (1999) and Love (2003)). Columns (5) and (6) in Table 2 reports the effects of federal expenditure policy shocks on small and large firms, respectively. Firms with real total assets below the sample mean value (13.49 hundred million dollars) in each year are considered

[22] For example, Giordani and Soderlind (2003), Boero, et al. (2008), among others, find significant correlations between inflation forecast disagreement and GDP growth uncertainty, whereas Rich and Tracy (2010) find inflation forecast disagreement is not a useful proxy for uncertainty.

small firms.[23] The sample split on mean real assets yields about 650 large firms and 2,370 small firms. In column (5) for small firms, the coefficient estimates of the interaction terms of the change in and the lag of each economic policy shock×stock price volatility, ΔU_{it} and $U_{i,t-1}$, are negative and significant (at the 5% and 1% levels, respectively), indicating that expenditure policy shocks depress investment of small firms. In column (6) for large firms, all coefficient estimates of the change in and the lag of economic policy shock×stock price volatility are not significant. Thus, policy uncertainty does not seem to influence investment decisions of very large firms (top 20% in terms of size). With regard to small firms (in results not shown) the negative coefficient estimate of the lag of the news-based policy shock×stock price volatility is statistically significant at the 10% level. The empirical results reinforce the finding that it is the news-based and the federal expenditure policy shocks that depress firms' investment, and do so differentially by depressing investment more for more uncertain small firms.

5. Conclusion

This paper finds that economic policy uncertainty affects firm's investment via the economic policy shock×stock price volatility interaction channel. We obtain the results by estimating an error correction model of capital stock adjustment using firm-level data of more than 2,700 U.S. manufacturing firms for 1985-2010. The four different economic policy uncertainty shocks affect the firm-level investment differently. The news-based policy shock has a significantly negative effect on investment in interaction with firm stock price volatility in the long run, and the federal expenditure policy shock has significant and negative effects in both the short- and long-run. On the other hand, the depressing effects of tax policy and inflation shocks are found to be statistically insignificant. We find that the statistical significance of the effect of

[23] The result is qualitatively similar for small firms defined by the real total assets below the sample median value in each year. Love (2003) and Babenko et al. (2011) identify small firms as having real assets below the mean.

the economic policy shock×stock price volatility interaction variable on the firm-level investment is dependent upon the phase of the business cycle. For the significance of the federal expenditure policy shock, the particular magnitude of economic contraction may not be as important as the fact that there is an economic contraction. For the significance of the news-based policy shock, however, the intensity of economic contraction does matter. Policy uncertainty does not influence the firm-level investment of very large manufacturing firms.

This paper makes contributions to two strands of the literature. First, it contributes to the investment literature by estimating an error correction model of capital stock adjustment and providing supporting evidence on the theory of real options in capital budgeting decisions that predicts uncertainty causes firms to delay investment. Second, this paper contributes to the growing body of macroeconomic literature by showing that the depressing effect of uncertainty on investment is associated with the business cycle. Economic policy uncertainty (extrinsic uncertainty) in interaction with firm-level uncertainty (intrinsic uncertainty) works through the channels of news-based policy and federal expenditure policy shocks.

Appendix

A.1. Table A1 presents all variables used for data screening and model estimation.

A.2. Business cycle explanation

Baker et al. (2013) investigate whether policy-related economic uncertainty deepens recession and slows economic recovery of the economy. To test the potential role of economic policy uncertainty in driving business cycles we introduce a cyclical variable into the model. A triple interaction term of cyclical variable and economic policy shock $\times$ stock price volatility, UC_{it}, is added to the regression equation.[24] The cyclical variable is measured in two ways. First, in Table A2 in columns (C) the business cycle variable is set to equal to the real GDP growth rate if the growth rate is negative, otherwise set to zero, in periods of 1985 – 2010 and 2007 – 2010, respectively. Second, in columns $(C)^{01}$ the business cycle variable is set to equal to 1 if the growth rate is negative, otherwise set to zero, in periods of 1985 – 2010 and 2007 – 2010, respectively. Column (1C) in Table A2 shows that the change in and the lag of the triple interaction terms ΔUC_{it} and $UC_{i,t-1}$ have statistically significant coefficients for 1985 – 2010, whereas these interaction terms are not significant in column $(1C)^{01}$, indicating that the extent of the decline in real GDP matters but not just the fact that real GDP is declining. The addition of UC_{it} in columns (1C) and $(1C)^{01}$ of A2 does not significantly affect the coefficient estimates of the interaction of news-based policy shocks $\times$ stock price volatility, U_{it}, in column (1) of Table 2. When the interaction terms, ΔU_{it} and $U_{i,t-1}$, are taken out, the coefficient estimate of the lag of the triple interaction term ΔUC_{it} remains significant at the 5% level in column (1C) for 2007 – 2010. The empirical result indicates that higher levels of news-based policy shocks are

[24] Potentially a degree of circularity can arise in the argument that uncertainty impacts on investment to a greater extent during a recession. Investment is a large component of economic activity, so a downturn in investment shall be associated with a recession, which may or may not be associated with greater uncertainty.

associated with economic contraction periods. Second, the news-based policy shocks deepen the economic contraction, and do so depending on the intensity of the economic contraction.

The depressing effect of federal expenditure policy shock shows different pattern on the firm-level investment, in association with the business cycle. In columns (2C) and $(2C)^{01}$ in Table A2, the coefficient estimates of the change in and the lag of the triple interaction term ΔUC_{it} and $UC_{i,t-1}$ lose statistical significance. Instead, the quadruple interaction, $UC_{it} * \Delta y_{it}$, of federal expenditure policy shock $\times$ stock price volatility, business cycle, and sales growth, has a negative coefficient that is statistically significant in columns $(2C)^{01}$ for 1985 – 2010 and $(2C)^{01}$ for 2007 – 2010. These empirical results reinforce the finding in Table 2 that the fiscal expenditure policy shocks work through the additional channel in interaction with firm stock price volatility and with sales growth, and do so depending on the presence, not the intensity of the economic contraction.

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Table 1. Econometric estimates for overall economic policy shock

Dependent variable ($I_{it} / K_{i,t-1}$)	(1)	(2)	(3)	(4)	(5)	(6)
Lagged investment rate ($I_{i,t-1} / K_{i,t-2}$)	0.282 ***	0.310 ***	0.296 ***	0.285 ***	0.291 ***	0.277 ***
	(13.98)	(16.36)	(16.56)	(16.65)	(14.51)	(14.60)
Sales growth (Δy_{it})	0.306 ***	0.203 ***	0.312 ***	0.304 ***	0.199 ***	0.326 ***
	(5.88)	(9.88)	(6.27)	(6.65)	(9.80)	(6.93)
Cash flow ($C_{it} / K_{i,t-1}$)	-0.014	-0.019 **	-0.016 *	-0.017 *	-0.016	-0.017 *
	(1.32)	(2.06)	(1.66)	(1.90)	(1.54)	(1.71)
Lagged cash flow ($C_{i,t-1} / K_{i,t-2}$)	0.031 ***	0.029 ***	0.029 ***	0.029 ***	0.033 ***	0.031 ***
	(4.01)	(3.74)	(3.88)	(4.07)	(4.04)	(4.12)
Error correction term $(y\text{-}k)_{i,t-1}$	0.104 ***	0.100 ***	0.107 ***	0.107 ***	0.097 ***	0.102 ***
	(9.43)	(9.95)	(10.76)	(11.75)	(9.09)	(10.13)
Sales growth squared $(\Delta y_{it})^2$	0.006	0.005	0.007	0.009	0.005	0.006
	(0.53)	(0.47)	(0.66)	(0.94)	(0.46)	(0.67)
Change in policy shock ($\Delta\sigma^p_t$)		-0.040	-0.054	-0.018		
		(0.59)	(0.83)	(0.26)		
Lagged policy shock (σ^p_{t-1})		0.031	-0.013	0.024		
		(0.26)	(0.12)	(0.21)		
Change in stock volatility ($\Delta\sigma^s_{it}$)	-0.028		-0.054	-0.085		-0.073
	(0.31)		(0.58)	(1.02)		(0.83)
Lagged stock volatility ($\sigma^s_{i,t-1}$)	0.048		0.093	0.004		-0.005
	(0.84)		(1.61)	(0.11)		(0.10)
Change in uncertainty (ΔU_{it})				-0.077	-0.149	-0.240 **
				(0.71)	(1.15)	(2.04)
Lagged uncertainty ($U_{i,t-1}$)				-0.163	-0.251	-0.463 **
				(0.89)	(1.20)	(2.42)
Policy shock * sales growth ($\sigma^p_t{*}\Delta y_{it}$)		-0.064	-0.005	0.164		
		(0.63)	(0.05)	(0.80)		
Stock volatility * sales growth ($\sigma^s_{it}{*}\Delta y_{it}$)	-0.397 *		-0.432 **	-0.428 **		-0.503 **
	(1.80)		(2.04)	(2.23)		(2.56)
Uncertainty * sales growth ($U_{it}{*}\Delta y_{it}$)				-0.552	-0.313	-0.181
				(0.73)	(0.83)	(0.56)
No. of observations	23771	23771	23771	23771	23771	23771
No. of firms	2759	2759	2759	2759	2759	2759
Average years	8.62	8.62	8.62	8.62	8.62	8.62
Firm effect	yes	yes	yes	yes	yes	yes
Year effect	yes	yes	yes	yes	yes	yes
Serial correlation *(p-value)*	0.066	0.168	0.098	0.054	0.091	0.037
Sargan-Hansen *(p-value)*	0.123	0.344	0.156	0.311	0.208	0.201
Goodness of fit	0.299	0.304	0.298	0.297	0.302	0.298

Notes: In column (1), σ^s_{it} is firm i's stock price volatility in the year t computed using Baum et al.'s (2008) approach that is described in Table A1. In columns (2)-(3), the economic policy shock σ^p_t is the rate of the change in the index of economic policy uncertainty, multiplied by 100 and then divided by its GARCH(1, 1) conditional standard deviation, from Baker et al. (2013). In columns (4)-(6), the uncertainty that firm i is facing, U_{it}, which is set equal to $U_{it} = \sigma^p_t * \sigma^s_{it}$. The estimates are obtained by applying Arellano-Bond two-step system GMM method that produces heteroscedasticity robust standard errors. Sales, cash flows, stock-volatilities, and policy uncertainty growth are considered as endogenous, with the instruments in the first-differenced equations that are similar to Bloom et al. (2007): $I_{i,t-1}/K_{i,t-2}$, $C_{it}/K_{i,t-1}$, $C_{it-1}/K_{i,t-2}$, Δy_{it}, $(y\text{-}k)_{i,t-1}$, σ^p_{t-1}, U_{it-1} and σ^s_{it-1} with lags from the third on back to allow for a long shock delay, and in the level equations: $\Delta(I_{it}/K_{i,t-1})$, $\Delta\Delta y_{it}$, $\Delta\Delta C_{it}/K_{i,t-1}$, $\Delta\Delta(y\text{-}k)_{i,t}$, $\Delta\Delta\,\sigma^p_t$, $\Delta\Delta\,\sigma^s_{it}$, $\Delta\Delta U_{it}$ with lag 2 in the models in the full model (6). The corresponding instrumental variables are not used when the endogenous variables do not appear in the models (1)-(6). A full set of year dummies is included in the specifications (1)-(6). Second-order serial correlation in the first-differenced residuals is tested using a Lagrange multiplier test (Arellano and Bond, 1991). Instrument validity is tested using a Sargan-Hansen test of the over-identifying restrictions. The goodness of fit measure is the squared correlation coefficient between actual and predicted levels of the dependent variable (Windmeijer, 1995). ***, **, * denote the significant levels at 1%, 5%, and 10%, respectively. The absolute t-values in parentheses are robust to autocorrelation and heteroscedasticity.

Table 2. Econometric estimates for four policy shock component s and for small/large firm investment

Dependent variable $(I_{it} / K_{i,t-1})$	News Uncertainty	CPI Disagreement	Taxation Exp.	Expenditure Disp.	Expenditure Dispersion	
					Small firm	Large Firms
	(1)	(2)	(3)	(4)	(5)	(6)
Lagged investment rate $(I_{i,t-1} / K_{i,t-2})$	0.322 ***	0.331 ***	0.337 ***	0.327 ***	0.336 ***	0.436 ***
	(14.48)	(14.60)	(15.06)	(14.04)	(13.07)	(9.84)
Sales growth (Δy_{it})	0.408 ***	0.374 ***	0.372 ***	0.399 ***	0.439 ***	0.068
	(5.89)	(6.00)	(5.05)	(5.44)	(4.28)	(0.80)
Cash flow $(C_{it} / K_{i,t-1})$	-0.018 *	-0.023 **	-0.015	-0.018	-0.037 ***	0.102 ***
	(1.82)	(2.04)	(1.38)	(1.61)	(2.91)	(4.07)
Lagged cash flow $(C_{i,t-1} / K_{i,t-2})$	0.040 ***	0.041 ***	0.036 ***	0.036 ***	0.042 ***	-0.006
	(4.58)	4.43	(3.73)	(3.68)	(4.11)	(0.23)
Error correction term $(y\text{-}k)_{i,t-1}$	0.072 ***	0.067 ***	0.067 ***	0.065 ***	0.063 ***	0.018 *
	(6.51)	6.15	(5.97)	(5.74)	(5.02)	(1.68)
Sales growth squared $(\Delta y_{it})^2$	-0.011	-0.016	-0.017	-0.017	-0.020	-0.073
	(0.68)	(1.01)	(0.96)	(1.05)	(1.09)	(1.57)
Change in stock volatility $(\Delta\sigma^s_{it})$	-0.177	-0.225 *	-0.189	-0.203 *	-0.150	0.255
	(1.58)	(1.93)	(1.54)	(1.78)	(1.00)	(1.38)
Lagged stock volatility $(\sigma^s_{i,t-1})$	0.018	-0.003	-0.020	-0.017	0.052	0.152
	(0.37)	(0.06)	(0.37)	(0.37)	(0.95)	(1.42)
Change in uncertainty (ΔU_{it})	-0.082	-0.103	-0.072	-0.291 ***	-0.363 **	0.191
	(0.75)	(0.91)	(1.34)	(2.64)	(2.49)	(0.81)
Lagged uncertainty $(U_{i,t-1})$	-0.415 ***	-0.087	0.047	-0.610 ***	-0.667 ***	0.125
	(2.89)	(0.42)	(0.42)	(3.24)	(2.77)	(0.32)
Stock volatility * sales growth $(\sigma^s_{it}*\Delta y_{it})$	-0.712 ***	-0.576 **	-0.575 *	-0.741 **	-0.874 **	0.630
	(2.58)	(2.42)	(1.87)	(2.54)	(2.27)	(1.17)
Uncertainty * sales growth $(U_{it}*\Delta y_{it})$	0.149	0.392	-0.204 *	-0.717 *	-0.354	-0.950
	(0.30)	(1.26)	(1.83)	(1.74)	(0.62)	(1.40)
No. of observations	23771	23771	23771	23771	18290	5481
No. of firms	2759	2759	2759	2759	2371	654
Average years	8.62	8.62	8.62	8.62	7.71	8.38
Firm effect	yes	yes	yes	yes	yes	yes
Year effect	yes	yes	yes	yes	yes	yes
Serial correlation *(p-value)*	0.259	0.324	0.343	0.202	0.329	0.717
Sargan-Hansen *(p-value)*	0.249	0.034	0.124	0.138	0.142	0.419
Goodness of fit	0.308	0.308	0.311	0.554	0.299	0.207

Notes: The σ^s_{it} is firm i's stock price volatility in the year t computed using Baum et al.'s (2008) approach that is described in Table A1. The economic policy shock σ^p_t is the rate of the change in the index of each economic policy uncertainty component (i.e., news-based policy uncertainty, tax legislation expiration, federal expenditures forecast interquartile range, and CPI forecasters interquartile range), divided by its GARCH(1, 1) conditional standard deviation, from Baker et al. (2013). Small firms have real total assets below the sample mean and large firms have real total assets are above the sample mean. The uncertainty that firm i is facing, U_{it}, which is set equal to $U_{it} = \sigma^p_t * \sigma^s_{it}$. The estimates are obtained by applying Arellano-Bond two-step system GMM method that produces heteroscedasticity robust standard errors. Sales, cash flows, stock-volatilities, and policy uncertainty growth are considered as endogenous, with the instruments in the first-differenced equations that are similar to Bloom et al. (2007): $I_{i,t-1}/K_{i,t-2}$, $C_{it}/K_{i,t-1}$, $C_{it-1}/K_{i,t-2}$, Δy_{it}, $(y\text{-}k)_{i,t-1}$, U_{it-1} and σ^s_{it-1} with lags from the third to the fifth, and in the level equations: $\Delta(I_{it}/K_{i,t-1})$, $\Delta\Delta y_{it}$, $\Delta\Delta C_{it}/K_{i,t-1}$, $\Delta\Delta(y\text{-}k)_{i,t}$, $\Delta\Delta U_{it}$, $\Delta\Delta\ \sigma^s_{it}$ with lag 2 in the models. A full set of year dummies is included in all specifications. Second-order serial correlation in the first-differenced residuals is tested using a Lagrange multiplier test (Arellano and Bond, 1991). Instrument validity is tested using a Sargan-Hansen test of the over-identifying restrictions. The goodness of fit measure is the squared correlation coefficient between actual and predicted levels of the dependent variable (Windmeijer, 1995). ***, **, * denote the significant levels at 1%, 5%, and 10%, respectively. The absolute t-values in parentheses are robust to autocorrelation and heteroscedasticity.

Table A1. Variable definitions

Variable	Acronym	Definition
		From COMPUSTAT (1985 – 2010) (MM$ = million U.S. dollars)
Total assets	TA	Total assets at the beginning of the period (MM$)
Capital stock	K	Net property, plant and equipment (MM$)
Sale	S	Net sales at the end of period t (MM$)
Investment	I/K	Net capital expenditure scaled by capital at period (t-1)
Net sales	S/K	Net sales at the end of period t scaled by capital at period (t-1)
Cash flow	CF/K	Income before extraordinary items + depreciation and amortization, scaled by capital at period (t-1)
Tobin's Q	TQ	Market value + book value of assets - common equity and deferred taxes, scaled by the book value of assets
		From CRSP (January 1, 1985 - December 31, 2010)
Return	r_d	The daily stock returns including dividends
Volatility (monthly)	σ^s_{im}	The square root of the sum of daily volatility over past month
Volatility (annual)	σ^s_{it}	The mean of monthly stock volatility within a year
		From Baker et al. (2013) (January 1985 - December 2010)
Policy shock (monthly)	σ^p_m	The rate of change in each economic policy uncertainty divided by its GARCH(1, 1) conditional standard deviation each month.
Policy shock (annual)	σ^p_t	The mean of monthly policy uncertainty shock within a year
Uncertainty	U_{it}	The product of the annual stock volatility and the annual policy shock, $\sigma^s_{it}*\sigma^p_t$

Notes: The sample is an unbalanced panel on individual manufacturing firms (*SIC 2000-3999*) from 1985 to 2010. Firm-level data is eliminated if a firm has three or less years of coverage, if there are missing values for investment, capital stock, sales, and cash flow, and if there are observations with negative values for assets, sales, or capital stock. In addition, we follow Gilchrist and Himmelberg (1998) and Love (2003) to exclude observations with I/K > 2.5, S/K > 20, and outliers in the top and bottom 1% of the accounting data from COMPUSTAT database. We also eliminate firms with missing or inconsistent data and exclude firms with less than 12 months of past return data from CRSP database. Stocks in the top and bottom 1% of the variable values are also excluded. The final data set contains 28131 firm-years pertaining to 2759 firms with complete data for all variables used in the analysis.

Table A2. Economic policy shock during economic recession

Dependent variable $(I_{it} / K_{i,t-1})$	(1) News Uncertainty			(2) Expenditure Dispersion		
	1985 - 2010		2007-2010	1985 - 2010		2007-2010
	(1C)	$(1C)^{01}$	(1C)	(2C)	$(2C)^{01}$	$(2C)^{01}$
Lagged investment rate $(I_{i,t-1} / K_{i,t-2})$	0.319 ***	0.321 ***	0.337 ***	0.322 ***	0.327 ***	0.340 ***
	(14.49)	(14.52)	(14.97)	(14.19)	(14.22)	(15.01)
Sales growth (Δy_{it})	0.434 ***	0.417 ***	0.390 ***	0.397 ***	0.390 ***	0.379 ***
	(5.98)	(5.91)	(4.73)	(5.24)	(5.22)	(4.78)
Cash flow $(C_{it} / K_{i,t-1})$	-0.018 *	-0.017 *	-0.014	-0.017	-0.016	-0.012
	(1.76)	(1.75)	(1.20)	(1.48)	(1.39)	(1.10)
Lagged cash flow $(C_{i,t-1} / K_{i,t-2})$	0.039 ***	0.040 ***	0.036 ***	0.037 ***	0.036 ***	0.035 ***
	(4.38)	(4.60)	(3.38)	(3.47)	(3.58)	(3.45)
Error correction term $(y-k)_{i,t-1}$	0.073 ***	0.073 ***	0.064 ***	0.063 ***	0.062 ***	0.066 ***
	(6.84)	(6.59)	(5.67)	(5.55)	(5.50)	(5.83)
Sales growth squared $(\Delta y_{it})^2$	-0.014	-0.010	-0.020	-0.018	-0.014	-0.017
	(0.86)	(0.62)	(1.02)	(1.07)	(0.91)	(0.88)
Change in stock volatility $(\Delta\sigma^s_{it})$	-0.132	-0.185	-0.214	-0.208 *	-0.210 *	-0.232 *
	(1.09)	(1.55)	(1.56)	(1.76)	(1.82)	(1.79)
Lagged stock volatility $(\sigma^s_{i,t-1})$	0.018	0.014	0.016	-0.022	-0.022	0.014
	(0.36)	(0.28)	(0.25)	(0.48)	(0.49)	(0.22)
Change in uncertainty (ΔU_{it})	-0.116	-0.095		-0.288 ***	-0.296 ***	
	(0.99)	(0.81)		(2.58)	(2.65)	
Lagged uncertainty $(U_{i,t-1})$	-0.531 ***	-0.499 ***		-0.634 ***	-0.664 ***	
	(3.39)	(3.07)		(3.31)	(3.32)	
Change in uncertainty*cycle (ΔUC_{it})	-0.391 **	-0.131	-0.300	0.024	0.087	0.295
	(2.03)	(0.27)	(1.36)	(0.10)	(0.18)	(0.55)
Lagged uncertainty*cycle $(UC_{i,t-1})$	-1.044 ***	0.260	-0.995 **	-0.079	0.254	0.354
	(2.78)	(0.85)	(2.23)	(0.29)	(0.41)	(0.42)
Stock volatility * sales growth $(\sigma^s_{it}*\Delta y_{it})$	-0.773 ***	-0.751 ***	-0.607 *	-0.689 **	-0.672 **	-0.534
	(2.58)	(2.63)	(1.74)	(2.21)	(2.21)	(1.57)
Uncertainty * sales growth $(U_{it}*\Delta y_{it})$	0.030	0.288		-0.386	0.123	
	(0.05)	(0.47)		(0.75)	(0.19)	
Uncertainty * cycle * sales growth $(UC_{it}*\Delta y_{it})$	-0.205	-0.814	-0.306	0.907	-1.756 *	-1.985 ***
	(0.46)	(0.73)	(0.75)	(1.54)	(1.82)	(2.67)
No. of observations	23771	23771	23771	23771	23771	23771
No. of firms	2759	2759	2759	2759	2759	2759
Average years	8.62	8.62	8.62	8.62	8.62	8.62
Firm Effect	yes	yes	yes	yes	yes	Yes
Year Effect	yes	yes	yes	yes	yes	Yes
Serial correlation *(p-value)*	0.224	0.262	0.359	0.208	0.226	0.413
Sargan-Hansen *(p-value)*	0.469	0.317	0.173	0.156	0.172	0.132
Goodness of fit	0.305	0.307	0.307	0.306	0.307	0.309

Notes: In columns (C) the business cycle variable is set to equal to the real GDP growth rate if the growth rate is negative, otherwise set to zero. In columns $(C)^{01}$ the business cycle variable is set to equal to 1 if the growth rate is negative, otherwise set to zero. σ^s_{it} is firm i's stock price volatility in the accounting year t computed using Baum et al.'s (2008) approach that is described in Table A1. The economic policy shock σ^p_t is the rate of the change in the index of economic policy uncertainty, multiplied by 100 and then divided by its GARCH(1, 1) conditional standard deviation, from Baker et al. (2013). The uncertainty that firm i is facing, U_{it}, which is set equal to $U_{it} = \sigma^p_t * \sigma^s_{it}$. The estimates are obtained by applying Arellano-Bond two-step system GMM method that produces heteroscedasticity robust standard errors. Sales, cash flows, stock-volatilities, and policy uncertainty growth are considered as endogenous, with the instruments in the first-differenced equations that are similar to Bloom et al. (2007): $I_{i,t-1}/K_{i,t-2}$, $C_{it}/K_{i,t-1}$, $C_{it-1}/K_{i,t-2}$, Δy_{it}, $(y-k)_{i,t-1}$, U_{it-1}, UC_{it-1} and σ^s_{it-1} with lags from the third to the fifth, and in the level equations: $\Delta(I_{it}/K_{i,t-1})$, $\Delta\Delta y_{it}$, $\Delta\Delta C_{it}/K_{i,t-1}$, $\Delta\Delta(y-k)_{i,t}$, $\Delta\Delta\, \sigma^s_{it}$, $\Delta\Delta U_{it}$, $\Delta\Delta UC_{it}$ with lag 2 in the models in the full models (1C) and (2C). The corresponding instrumental variables are not used when the endogenous variables do not appear in the models. A full set of year dummies is included in all specifications. Second-order serial correlation in the first-differenced residuals is tested using a Lagrange multiplier test (Arellano and Bond, 1991). Instrument validity is tested using a Sargan-Hansen test of the over-identifying restrictions. The goodness of fit measure is the squared correlation coefficient between actual and predicted levels of the dependent variable (Windmeijer, 1995). ***, **, * denote the significant levels at 1%, 5%, and 10%, respectively. The absolute t-values in parentheses are robust to autocorrelation and heteroscedasticity.

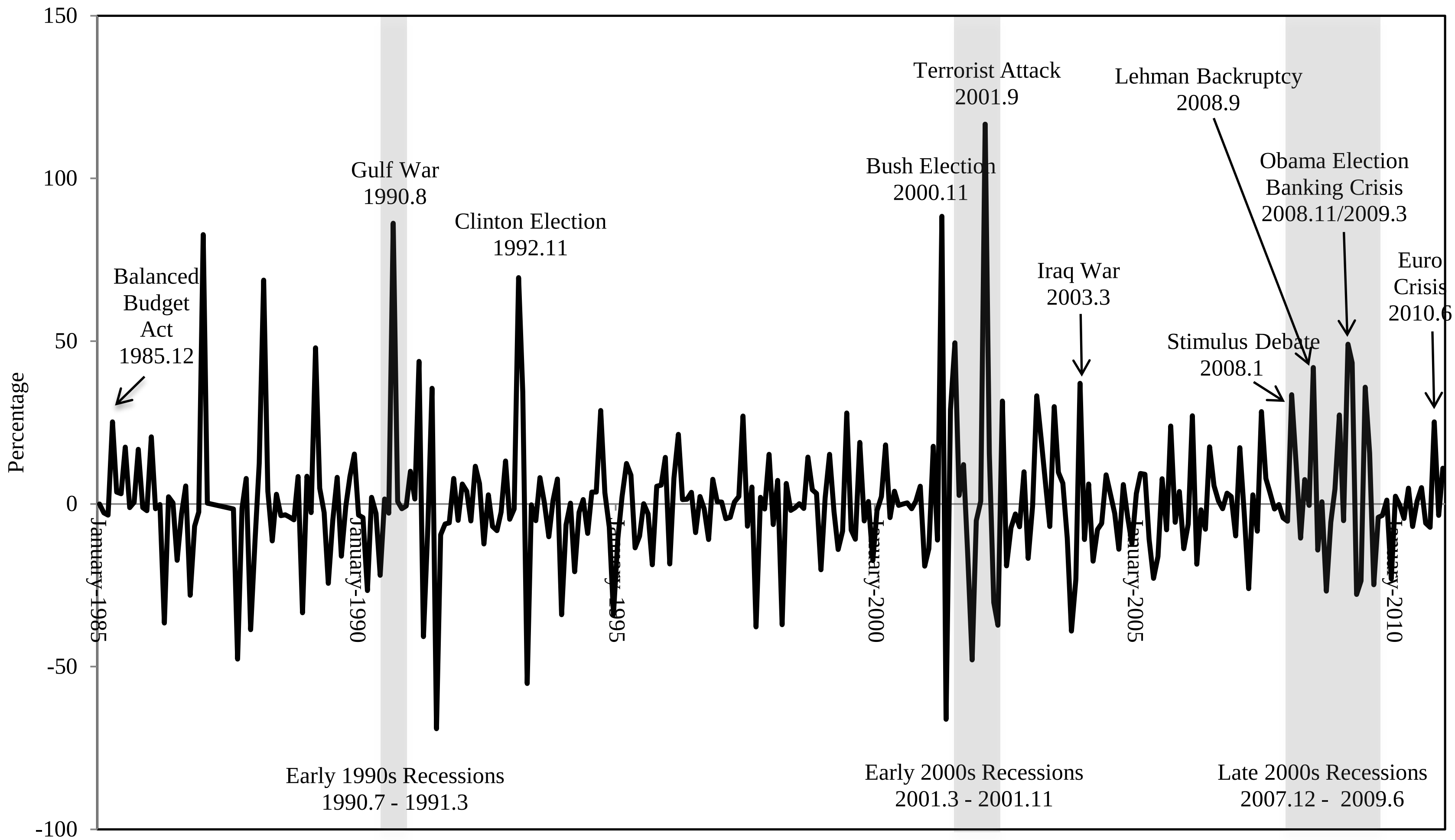

Figure 1. The time-series of monthly interation variable U_m = economic policy shock×stock price volatility, $\sigma^p_m \times \sigma^s_m$.

Notes: the monthly economic policy shock×stock price volatility is equal to the product of the mean of monthly standard deviation of stock prices for all firms and monthly overall economic policy shock from January 1985 to December 2010. The shaded area represents the economic recessions during 1990.7 - 1991.3, 2001.3 - 2001.11 and 2007.12 - 2009.6.