Bulletin of Monetary Economics and Banking

Volume 27 | Number 2 Article 4

5-31-2024

Endogenous Uncertainty: Does Investment Inefficiency Contributes to Uncertainty?

Rita Juliana
Universitas Pelita Harapan, Indonesia, ritaj0710@gmail.com

Irwan Adi Ekaputra
Universitas Indonesia, Indonesia, irwan.adi@ui.ac.id

Zaäfri Ananto Husodo
Universitas Indonesia, Indonesia, z.husodo@ui.ac.id

Sung suk Kim
Universitas Pelita Harapan, Indonesia, sungsuk.kim@uph.edu

Recommended Citation

Juliana, Rita; Ekaputra, Irwan Adi; Husodo, Zaäfri Ananto; and Kim, Sung suk (2024) "Endogenous Uncertainty: Does Investment Inefficiency Contributes to Uncertainty?," *Bulletin of Monetary Economics and Banking*: Vol. 27: No. 2, Article 4.
DOI: https://doi.org/10.59091/2460-9196.2275
Available at: https://bulletin.bmeb-bi.org/bmeb/vol27/iss2/4

Bulletin of Monetary Economics and Banking, Vol. 27 No. 2, 2024, pp. 265 - 298
p-ISSN: 1410 8046, e-ISSN: 2460 9196

ENDOGENOUS UNCERTAINTY: DOES INVESTMENT INEFFICIENCY CONTRIBUTES TO UNCERTAINTY?

Rita Juliana*, Irwan Adi Ekaputra**, Zaäfri Ananto Husodo***, and Sung Suk Kim****

*Corresponding author. Faculty of Economics and Business, Universitas Pelita Harapan, Indonesia. Email: ritaj0710@gmail.com
**Faculty of Economics and Business, Universitas Indonesia, Indonesia. Email: irwan.adi@ui.ac.id
***Faculty of Economics and Business, Universitas Indonesia, Indonesia. Email: z.husodo@ui.ac.id
****Faculty of Economics and Business, Universitas Pelita Harapan, Indonesia. Email: sungsuk.kim@uph.edu

ABSTRACT

We investigate the endogenous relationship between firm-level investments and macro-level uncertainty for U.S publicly listed firms from 1996 Q1 to 2019 Q4. Based on the Vector AutoRegressive analysis, we learn that underinvestment tends to increase news-based Economic Policy Uncertainty (EPU); overinvestment increases macroeconomic uncertainty; and both under- and over-investment lead to increasing financial uncertainty. Furthermore, the information flow explanation is closely linked to a positive relationship between underinvestment and EPU. Meanwhile, the positive relationship between overinvestment and macroeconomic uncertainty is related to the excessive growth speculation explanation. The small (large) firm subsample analysis also reiterates the explanation of the information flow (excessive growth speculation).

Keywords: Economic policy uncertainty; Financial uncertainty; Macroeconomic uncertainty; Overinvestment; Underinvestment; VAR.
JEL Classifications: D8; E32; E44.

Article history:
Received : October 5, 2021
Revised : June 29, 2022
Accepted : May 1, 2024
Available Online : May 31, 2024

https://doi.org/10.59091/2460-9196.2275

I. INTRODUCTION

Since the global financial crisis, the number of macroeconomic studies that interact with financial fields has been increasing (Glandon *et al*., 2022). These studies include efforts to understand how corporate finance can affect the macroeconomy through various channels. Some of these channels are financial frictions (Brunnermeier and Sannikov, 2014) and financial distress (Inekwe *et al*., 2018). As suggested by Fajgelbaum *et al*. (2017), Claessens and Kose (2018), and Benhabib *et al*. (2019), corporate investments seem to be the main factor in explaining the linkages between finance and macroeconomic outcomes. This paper explores whether corporate investment can serve as a channel for corporate finance to contribute to macroeconomic phenomena such as uncertainty.

Uncertainty emerges when agents in the economy cannot receive complete and accurate information about economic fundamentals. The topic of "uncertainty" has gained serious interest from academics and policymakers because it seems to be one of the reasons for the slow economic recovery from the global financial crisis (Benhabib *et al*., 2019; Gulen and Ion, 2016; Ozturk and Sheng, 2018). Extant studies investigate the impact of uncertainties on managers' decisions for firms' future survivability. The decisions include leverage and debt maturity (Pan *et al*., 2019; Schwarz and Dalmácio, 2020), dividend policy (Buchanan *et al*., 2017), trade credit policy (Jory *et al*., 2020), and cash holding (Phan *et al*., 2019). Additionally, a mounting body of knowledge has investigated the uncertainty effect on corporate investments (Agliardi *et al*., 2016; Chen *et al*., 2020; Gulen and Ion, 2016; Kim and Kung, 2017; Neamtiu *et al*., 2014; Nishimura and Ozaki, 2007; Suh and Yang, 2021). They suggest that uncertainty decreases the value of investment opportunities and causes managers to disinvest or omit their investment opportunities. Overall, these empirical studies imply that uncertainty has a significant one-way role (exogenous) effect that will cause managers to adjust their corporate finance and investment policies.

Another strand of studies analyzes uncertainty-corporate investment relation and proposes potential endogenous associations between corporate investment activity and macro-level uncertainty (Benhabib *et al*., 2019; Fajgelbaum *et al*., 2017). In brief, this endogenous uncertainty hypothesis argues that a feedback loop between macroeconomic uncertainty and corporate investment can lead to self-fulfilling uncertainty traps.[1] Benhabib *et al*. (2019) and Fajgelbaum *et al*. (2017) demonstrate how the endogenous uncertainty mechanism may provide a complete understanding of the uncertainty in the severity of an economic downturn. Failure to notice endogenous uncertainty may cause misestimation of the effect of uncertainty on the economy. However, there is still no theoretical consensus on whether uncertainty has an endogenous or exogenous impact on corporate investment (Ludvigson *et al*., 2021). Thus, this paper aims to address this gap and contribute to the endogenous impact of the uncertainty literature strand.

[1] Other papers study endogenous uncertainty in a different context. Kurz and Motolese (2001), for instance, use the disagreement level between pessimistic and optimistic investors as endogenous uncertainty to explain the equity premium puzzle. In addition, Plante *et al*. (2018) use the stochastic volatility setup to calculate endogenous uncertainty to testwhether endogenous uncertainty caused a stronger negative correlation between GDP growth and uncertainty in the Zero Lower Bound (ZLB) Fed rate period.

https://bulletin.bmeb-bi.org/bmeb/vol27/iss2/4
DOI: 10.59091/2460-9196.2275

This study utilizes corporate-level investment inefficiencies to investigate whether firm-level investment endogenously causes uncertainties. Based on previous studies, there are relevant hypotheses to our study. First, according to the social learning hypothesis (Fajgelbaum *et al*., 2017), a firm learns and acquires essential information such as productivity, market demand, and regulations based on other firms' investments. An ambiguous information environment causes investment delay (underinvestment) during a high uncertainty period. Investment corrections may not occur due to less precise market information (Benhabib *et al*., 2019) and more expensive investment adjustment costs (Bloom *et al*., 2007). Low investment activity leads to low market information flow, which exacerbates macroeconomic uncertainty. Moreover, Baker *et al*. (2016) argue that there is a possible causal relationship between policy uncertainty and investment because policy may respond to economic conditions. For instance, the IMF records that governments in several countries adjusted policies to overcome massive corporate investment cuts due to the COVID-19 crisis.[2] Thus, policymakers may react to the underinvestment crisis and make policy changes. Ludvigson *et al*. (2021) find that policy uncertainty reacts to negative productivity shocks. We hypothesize that underinvestment may also lead to higher economic policy uncertainty.

Second, Benhabib *et al*. (2019) also argue the importance of firms' information to the financial market. They argue that there is mutual learning between the financial market and the real economy. The financial market and firms tend to make decisions based on information they acquire from each other. Thus, when firms underinvest and produce little information, financial market agents face difficulties making precise valuations and decisions. Henceforth, we hypothesize that underinvestment will also increase financial market uncertainty.

Third, overinvestment may affect uncertainty through asset misallocation problems. Overconfident managers tend to overinvest during a high uncertainty period (Wang *et al*., 2016). Overinvestment aims to signal good long-run performance (Bebchuk and Stole, 1993). Yoon and Ratti (2011) show that increasing investment may not fully lead to increasing total sales in a high uncertainty period. Moreover, when firms produce more than the economy can absorb, they suffer from overcapacity (Kotz, 2013). Hence, overinvestments during a period of high uncertainty are inefficient for producing income. Firms will face uncertain growth outcomes that may lead to inaccurate financial market valuations that exacerbate uncertainties (Caballero *et al*., 2006). Therefore, we hypothesize that overinvestment will drive higher financial market uncertainty. Overall, based on the three hypotheses, we conjecture that macroeconomic uncertainty (Jurado *et al*., 2015), economic policy uncertainty (Baker *et al*., 2016), and financial uncertainty (Ludvigson *et al*., 2021) would react endogenously to investment inefficiencies shocks.

To test our hypothesis, we estimate macro-level investment inefficiency using the information generated from firm-level observations. We follow Inekwe *et al*. (2018) to define investment inefficiency at the macro-level as the proportion of inefficient firms in a particular quarterly period. We calculate firm-level investment inefficiency using the expected investment model (Biddle *et al*., 2009; Chen and

[2] https://www.imf.org/en/Topics/imf-and-covid19/Policy-Responses-to-COVID-19.

Chen, 2011; Jiang *et al*., 2018). The expected investment model states that the firm's growth opportunity determines the optimal investment. Thus, the deviation from the firm's expected investment level is investment inefficiency.

Moreover, we also follow Megaritis *et al*. (2021) in utilizing two different macroeconomic uncertainty measures: Jurado Ludvigson Ng (JLN) macroeconomic uncertainty (Jurado *et al*., 2015) and Economic Policy Uncertainty (EPU) (Baker *et al*., 2016). These uncertainties are different based on how they are constructed. The JLN macroeconomic uncertainty is more unobservable, quantitative, and data-driven, while the EPU is an observable, qualitative, and subjective uncertainty measure (Megaritis *et al*., 2021; Suh and Yang, 2021). Our analysis also adds financial uncertainty (Ludvigson *et al*., 2021). Benhabib *et al*. (2019) suggest that firms and the financial market tend to acquire information from each other to make decisions. Thus, low activity (underinvestment) can cause uncertainty in the financial market. Additionally, Caballero *et al*. (2006) also suggest that overinvestment can trigger extreme valuations in the financial market.

Based on Vector AutoRegressive (VAR) analysis, we find that under- and over-investment contribute to different uncertainty measures. Underinvestment affects EPU and financial uncertainties, while overinvestment drives JLN macroeconomic and financial uncertainties. The positive association between underinvestment and EPU may relate to the information channel hypothesis (Fajgelbaum *et al*., 2017; van Nieuwerburgh and Veldkamp, 2006); firms' low investment activity can disturb information flows and amplify uncertainty.

On the other hand, overinvestment relates to the JLN uncertainty measure, which captures unexpected changes in macroeconomic variables (Jurado *et al*., 2015). We also find that overinvestment shocks show a more prominent and long-lasting positive effect on financial uncertainty. The findings are closely linked to the excessive growth speculation explanation. High financial market speculation can cause a persistent credit boom and an unexpected economic downturn (Caballero *et al*., 2006; Pintus and Wen, 2013; Terrones and Mendoza, 2008).

We separate our samples into large and small firms and construct macro-level investment inefficiency from both subsamples to gain further insight. Compared to large firms, we learn that small firms' underinvestment leads to higher EPU. On the other hand, large firms' overinvestment leads to higher JLN macroeconomic uncertainty. In line with the information channel hypothesis, small firms face serious information asymmetry problems (Faulkender and Petersen, 2006); thus, small firms' underinvestment may trigger more severe economic information flow disruption. On the contrary, large firms' overinvestment may generate more significant shocks that can affect the economy (Gabaix, 2011). Hence, their overinvestment can cause excessive growth speculation and a credit boom that amplifies macroeconomic uncertainty.

Our study makes two contributions. First, this paper contributes to the endogenous uncertainty-investment literature by providing empirical evidence of the endogenous investment-uncertainty relationship. Prior studies focus on the exogenous impact of uncertainty on a firm's investment decision (Agliardi *et al*., 2016; Chen *et al*., 2020; Gulen and Ion, 2016; Kim and Kung, 2017; Neamtiu *et al*., 2014; Nishimura and Ozaki, 2007; Suh and Yang, 2021) without considering the feedback loop of investment to uncertainty (Benhabib *et al*., 2019; Fajgelbaum *et al*., 2017). Similarly, Carriero *et al*. (2018) provide empirical evidence on endogenous uncertainty. In contrast to our study, theirs focuses on analyzing the endogenous reaction of financial and macroeconomic uncertainty to macroeconomic variables shock. The previous study found that financial uncertainty is endogenous but not macroeconomic uncertainty. On the other hand, our study aims to observe the endogenous relations between investment inefficiencies and uncertainties. Second, we also contribute to constructing a measurement of macro-level investment inefficiency by utilizing firm-level information.

The rest of the paper is organized as follows. Section II presents the methodology and data in the study. Section III discusses descriptive statistics. Section IV presents the results, and Section V concludes the paper.

II. DATA AND METHODOLOGY

A. Data

The study utilizes firm-level data to calculate investment inefficiency. We select the U.S. publicly listed firms in NYSE, AMEX, and NASDAQ as our sample. All financial report data is collected from the S&P Capital I.Q. database. For data completeness, we use data from the period 1996Q1 to 2019Q4. Firms in financial, utility, and government entities are excluded because their investment behaviors differ from those in other industries. The final sample to calculate investment inefficiency has 202,257 firm-quarter observations. Table A1 in the appendix provides a detailed operationalization of the variables used in this study. We use 3-month forwardlooking macroeconomic and financial uncertainty (Jurado et al., 2015; Ludvigson *et al*., 2021).[3],[4] We utilize Baker *et al*. (2016) as the Economic Policy Uncertainty (EPU) measure.[5]

B. Investment Inefficiency: Intuition and Measurement

Macro-level investment inefficiency measure is generated from firm-level observations. We adopt Inekwe *et al*. (2018) method by defining macro-level investment inefficiency as the proportion of inefficient firms in each quarterly period. We need to determine which firms are categorized as inefficient by calculating each firm's investment inefficiency. To measure firm-level investment inefficiency, we follow Biddle *et al*. (2009) to estimate firms' investment as a function of growth opportunities and use the residuals as the inefficiency measure. According to Chung and Charoenwong (1991) and Myers (1977), firms decide their future investments based on their investment opportunities. Intuitively, an investment that is more (less) than the investment opportunities is an over (under) investment. The model is presented in Eq. (1).

---

[3] According to Ludvigson *et al*. (2021), the correlation between their financial market uncertainty measurement and the VIX index is 0.85, which is quite high. Thus, we chose Ludvigson *et al*. (2021) financial market uncertainty because they include 147 financial series covering the stock market and other financial market securities variables (ex: bonds). Meanwhile, VIX is covering only the S&P 500 stock volatility.

[4] Taken from Sydney Ludvigson website (https://www.sydneyludvigson.com/).

[5] Taken from www.policyuncertainty.com

$$Inv_{i,t} = \alpha_0 + \beta_1 SGR_{i,t-1} + \varepsilon_{i,t} \tag{1}$$

Where *i* represents firms and *t* represents quarters (1996Q1-2019Q4). *Inv* represents the actual firm investment that we measure in three different ways: (1) capital expenditure scaled by the lag of total assets (Inv_1); (2) capital expenditure scaled by the lag of net PPE (Inv_2); and (3) the sum of capital expenditure, research, and development cost, and cash acquisition less sale of property, plant, and equipment, scaled by lagged total assets (Inv_3).

To measure investment opportunities, we follow Biddle *et al*. (2009) in using the quarterly Sales Growth Rate (*SGR*). Eq. (1) is estimated using the robust standard error with firms' fixed effect. All variables are stationary (see Appendix, Table A3). Eq. (1) residual is the abnormal unexpected investment (Inv^{ε}_{t}), which measures a firm's investment inefficiency. We classify firms into overinvesting and underinvesting categories by quarterly sorting based on the Inv^{ε}_{t}. Firms with residuals in the bottom 30% are classified as underinvesting. In contrast, firms in the upper 30% are classified as overinvesting. The classification is described in Eq.

$$investment\ inefficiency = \begin{cases} overinvest & if \quad Inv^{\varepsilon}{}_{i,t} \geq 70\%\, Inv^{\varepsilon}{}_{t} \\ neutral & if \quad 30\%\, Inv^{\varepsilon}{}_{t} < Inv^{\varepsilon}{}_{i,t} < 70\%\, Inv^{\varepsilon}{}_{t} \\ underinvest & if \quad Inv^{\varepsilon}{}_{i,t} \leq 30\%\, Inv^{\varepsilon}{}_{t} \end{cases} \tag{2}$$

(2).

After each firm classification, we generate a macro-level investment inefficiency measure by calculating the proportion of firms categorized as inefficient (under- or over-invest) for each quarter. Thus, the investment inefficiency at the macro-

$$InvIneff_t = \sum_{i=1}^{N_t} Invineff_{it} / N_t \tag{3}$$

level at time *t* is:

Where N_t is the total number of firms in quarter-*t*. $Invineff_{it}$ is a dummy variable equal to one if firm-*i* in quarter-*t* is in the under- or over-invest category based on Eq. (2). Hence, $InvIneff_t$ is the (macro-level) proportion of firms that are under- or over-invest in quarter-*t*.

C. VAR Model

To investigate the endogenous uncertainty-investment relationship, we use the VAR model. VAR is useful for establishing causal relationships (in the Granger sense) between variables. Thus, we estimate a multivariate VAR with four variables: investment inefficiency (overall inefficiency, underinvestment, and overinvestment), financial uncertainty, macroeconomic uncertainty, and EPU. The

$$Y_t = A_0 + A_1 Y_{t-1} + \cdots + A_k Y_{t-k} + u_t \quad (5)$$

reduced-form VAR model is:
Where Y_t is the vector of endogenous variables, A_0 is a vector of intercepts, A_1 to A_k are coefficient matrices, and u_t represents the vector of disturbances (u_t~$N(0,\Sigma)$). The lag length (k) for the VAR model is set to two lags (k=2) based on the Schwarz (SBIC) optimal lag length information criterion. The order of our 4-factor VAR

$$Y_t = [\, INVeff_t, FinU_t, MacU_t, EPU_t \,] \quad (6)$$

model is:
Where $INVeff_t$, $FinU_t$, $MacU_t$, and EPU_t are the VAR model's quarterly (3-month) endogenous variables. One of the challenges of the VAR model is that one needs to determine the order of variables when estimating the effects of variables shocks based on the recursive structure. According to Ludvigson *et al*. (2021), there is still no consensus on the theoretical reason why uncertainty is ordered ahead of or after the real activity. In this study, we follow the intuition developed from Ludvigson *et al*. (2021) and Claessens and Kose (2018), that is, by assuming that financial uncertainty (*FinU*) is ordered first, while macroeconomic uncertainty (*MacU*) and Economic Policy Uncertainty (*EPU*) put as the third and last variables in the order. Ludvigson *et al*. (2021) find that financial uncertainty causes a sharp and persistent decline in real economic activity. On the other hand, they find little evidence that negative shocks in real activity and macroeconomic uncertainty affect financial uncertainty, suggesting financial market uncertainty leads to other variables. Moreover, they also find that real activity can affect macroeconomic uncertainty, which explains investment inefficiency in the second place in the VAR order.

Additionally, Claessens and Kose (2018) show that equity price leads to output growth by a few quarters, and they believe investment serves as the channel. So, we apply the structure based on these results. Using the Cholesky identification method, we base our analysis on estimated Orthogonalized Impulse Response Functions (OIRFs).

III. EMPIRICAL FINDINGS

A. Descriptive Statistics

In Appendix (Table A2), we present descriptive statistics of underinvesting and overinvesting firms. As we can see, underinvesting firms tend to exhibit smaller size, higher leverage, lower cash holdings, lower earnings, and lower market value. Overall, the economic impact of underinvesting and overinvesting may differ. Figure 1 panel A shows the series variation of overinvesting, underinvesting, macroeconomic, and financial uncertainty. At the same time, Figure 1 panel B shows the series of investment inefficiencies and economic policy uncertainty. We can observe from Figure 1 that overinvestment tends to reach its peak before the crisis (2000 tech boom and the 2007-2008 financial crisis). Plausibly, overinvestment can serve as an early warning of a crisis. Excessive investments trigger speculative valuations in the financial market, generating a significant and long-lasting boom-bust cycle (Caballero *et al*., 2006; Pintus and Wen, 2013). On the other hand, underinvestment tends to be more stable, reaching its highest level in 2017Q1-Q2

Table 1.
Correlation Matrix

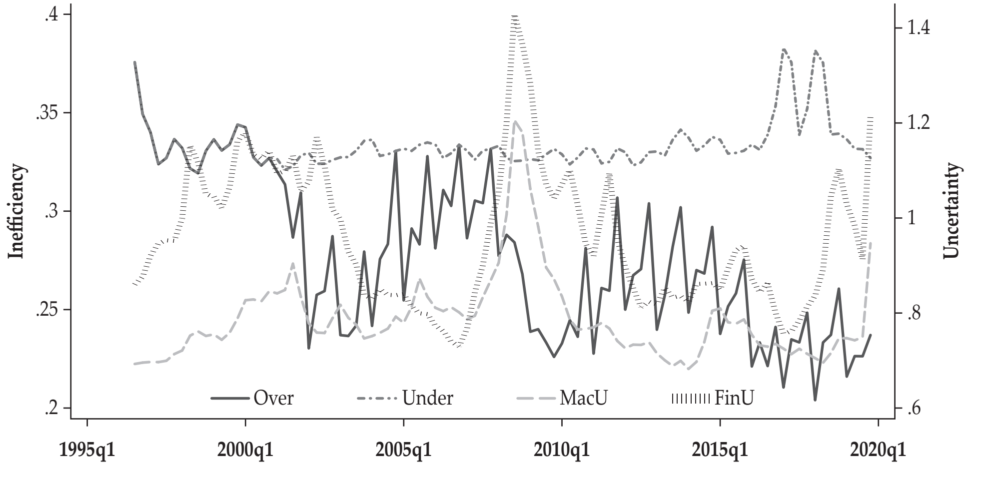
The table contains the correlation matrix. MacU is (h3) the next three-month macroeconomic uncertainty (Jurado *et al*., 2015); FinU is (h3) the next three-month financial uncertainty (Ludvigson *et al*., 2021); EPU is the 3-month average economic policy uncertainty (Baker *et al*., 2016)

Variables	MacU	FinU	EPU
MacU	1.000		
FinU	0.639	1.000	
EPU	0.116	0.257	1.000

Figure 1.
Overinvest, Underinvest, Macroeconomic, Financial and Economic Policy Uncertainty

This figure plots the quarterly data on the overinvestment, underinvestment, macroeconomic, financial uncertainty, and EPU. The sample covers the period from 1996Q1 to 2019 Q4. Overinvestment (underinvestment) is the proportion of firms overinvesting (underinvesting) as discussed in Section 2.2. Macroeconomic and financial uncertainty data is from www.sydneyludvigson.com, and EPU data is from www.policyuncertainty.com.

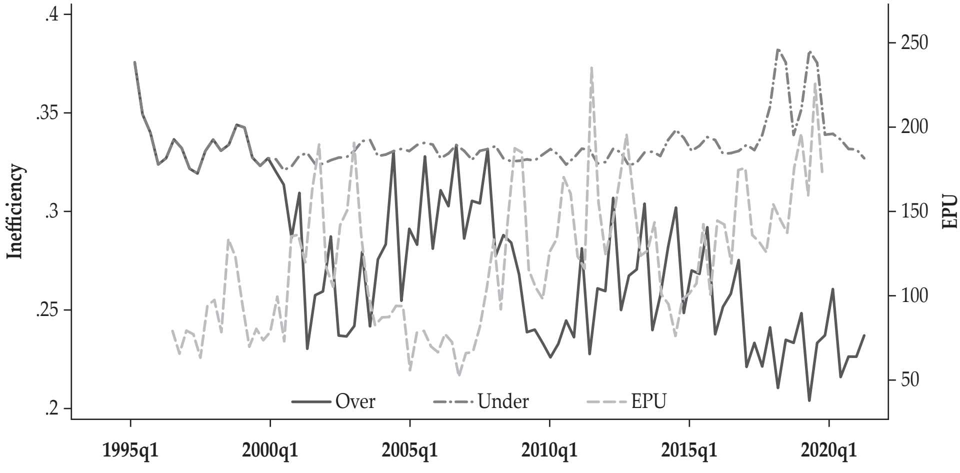
Panel A. Overinvestment, Underinvestment, Macroeconomic and Financial uncertainty



https://bulletin.bmeb-bi.org/bmeb/vol27/iss2/4
DOI: 10.59091/2460-9196.2275

Figure 1.
Overinvest, Underinvest, Macroeconomic, Financial and Economic Policy Uncertainty (Continued)

Panel B. Overinvestment, Underinvestment, and EPU



and 2018Q1-Q2 during the early US-China trade war.

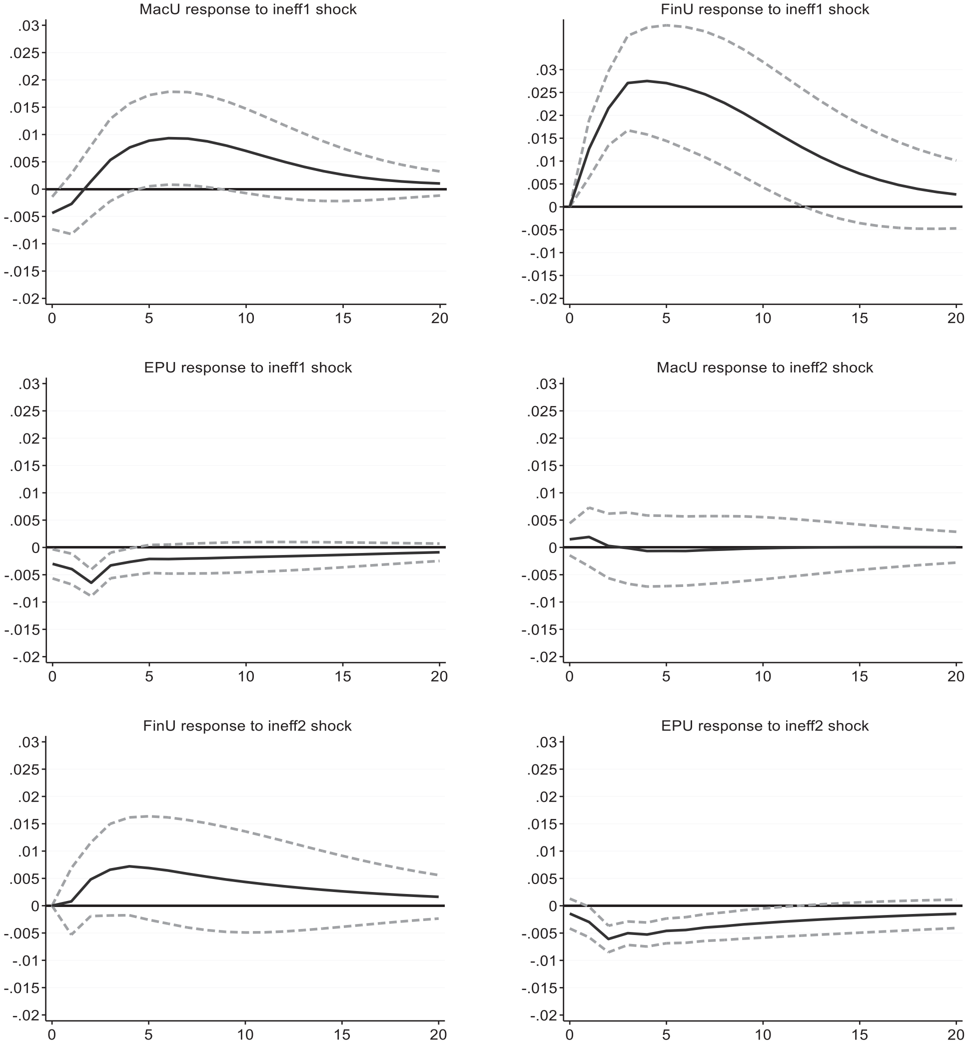
Moreover, from Figure 1 panel A, we can see that macroeconomic and financial uncertainty increased during the global financial crisis (2007-2008). Interestingly, Figure 1 panel B shows that *EPU* had a more dramatic increase during the US-China trade war period (2017-2019) than JLN Macroeconomic and Financial uncertainty. Additionally, Table 1 reports low correlations between macroeconomic uncertainty, financial uncertainty, and *EPU*. The low correlation between measurements suggests that the three uncertainty measurements capture different information contents.

B. VAR Results: Responses of Uncertainty to Investment Inefficiency Shocks

Previous studies (Benhabib *et al*., 2019; Fajgelbaum *et al*., 2017) suggest a potential endogenous relationship between investment and uncertainty. With that consideration, we proceed with our analysis with the 4-factor variable VAR model. The stationarity tests (shown in Appendix, Table A3) show that all the variables are stationary. We also conduct an autocorrelation and stability test to examine whether our model is valid. Overall, the test result indicates that our models satisfy the stability conditions and have no autocorrelation problem. The OIRFs

Figure 2.
Orthogonalized Impulse Response Functions of Uncertainty Measurements to Investment Inefficiency Shocks

The first row of the figure is investment inefficiency calculated with investment defined as Inv_1 = capital expenditure scaled by total assets. The second row of the figure is investment inefficiency calculated with investment defined as Inv_2 = capital expenditure scaled by net Plant, Property, and Equipment (PPE). The third row of the figure is investment inefficiency calculated with investment defined as Inv_3 = Total investment (sum of R&D, capital expenditure, and cash acquisitions less sale of PPE) scaled by total assets. The solid line represents the OIRFs while dashed bands are ± two standard errors.



DOI: 10.59091/2460-9196.2275

Figure 2.
Orthogonalized Impulse Response Functions of Uncertainty Measurements to Investment Inefficiency Shocks (Continued)

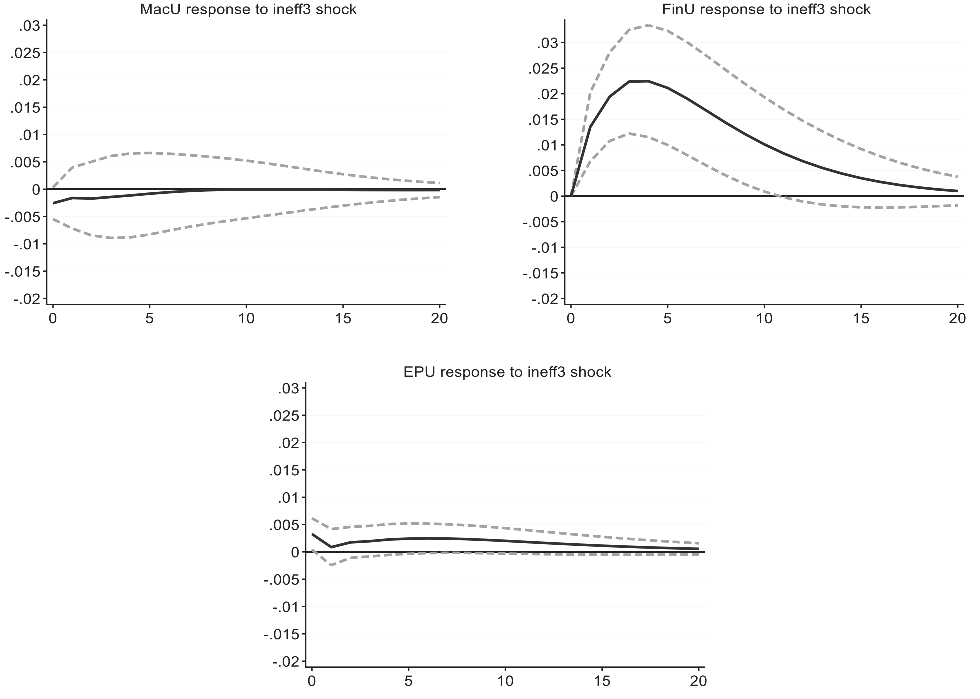


Figure 3.
Orthogonalized Impulse Response Functions of Uncertainty Measurements to Underinvestment Shocks

The first row of the figure is investment inefficiency calculated with investment defined as Inv_1 = capital expenditure scaled by total assets. The second row of the figure is investment inefficiency calculated with investment defined as Inv_2 = capital expenditure scaled by net Plant, Property, and Equipment (PPE). The third row of the figure is investment inefficiency calculated with investment defined as Inv_3 = Total investment (sum of R&D, capital expenditure, and cash acquisitions less sale of PPE) scaled by total assets. The solid line represents the OIRFs while dashed bands are ± two standard errors.

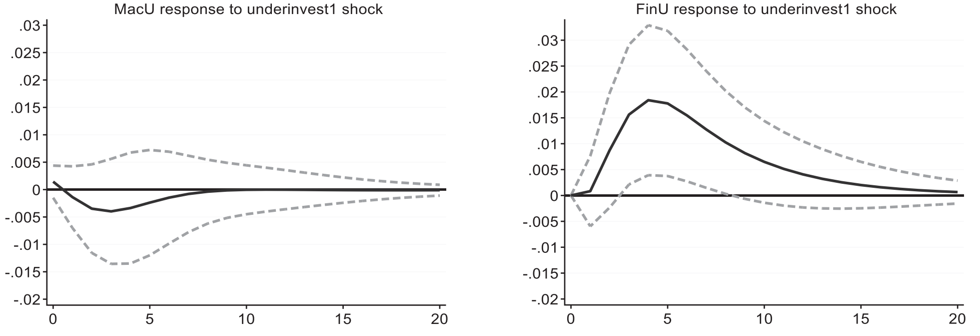
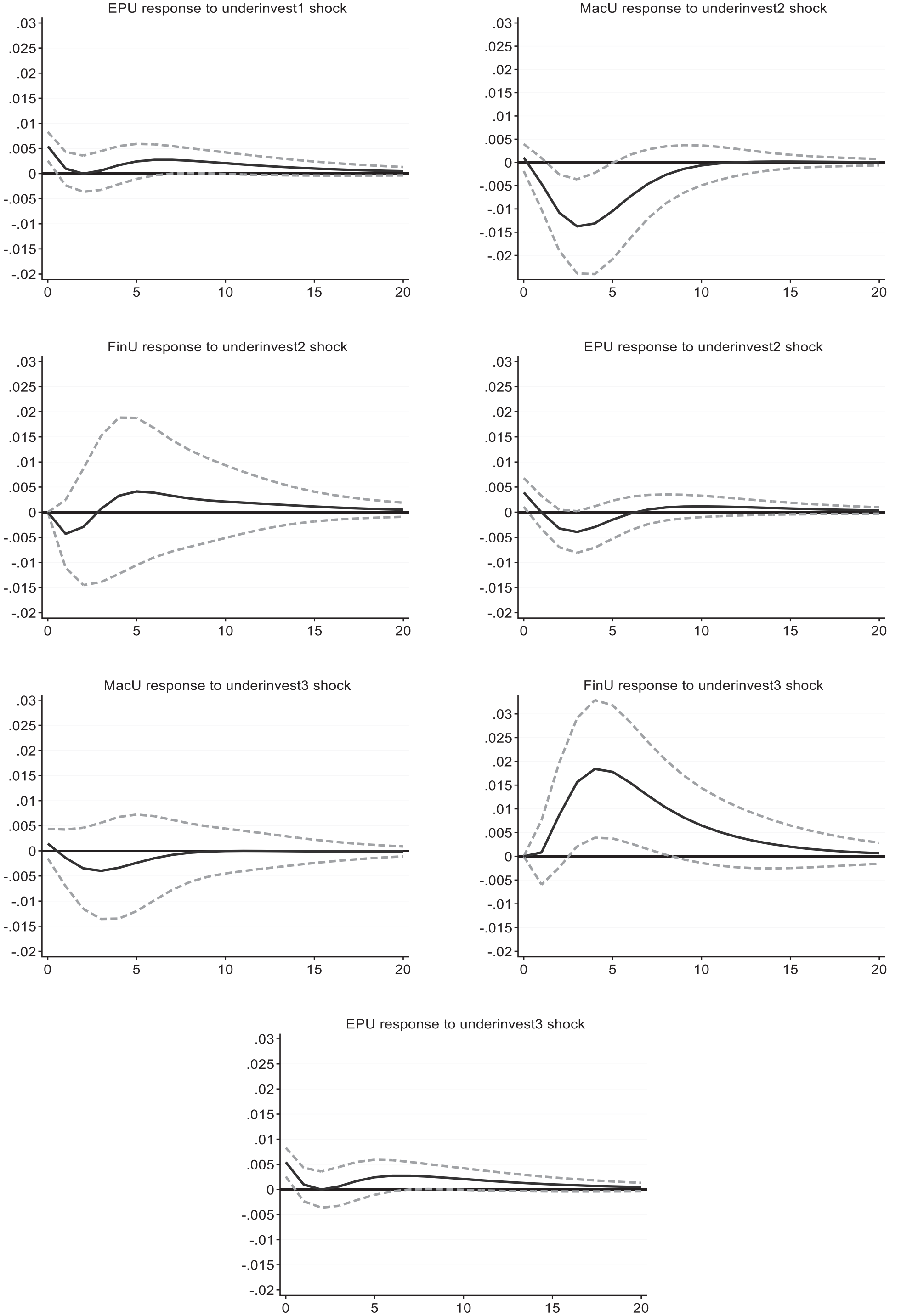


Figure 3.
Orthogonalized Impulse Response Functions of Uncertainty Measurements to Underinvestment Shocks (Continued)



from estimating the VAR model are reported in Figure 2 to Figure 4.

Figure 2 shows the effect of investment inefficiency (underinvest plus overinvest) shocks on uncertainty. We find that investment inefficiency shock increases *FinU*, while *MacU* and EPU are more inconclusive across different investment measurements. The effects of underinvesting and overinvesting are possibly different and should be analyzed separately. Figure 3 and Figure 4 clarify the effect of underinvestment and overinvestment on uncertainty. The effects of underinvestment and overinvestment shocks on uncertainty are consistent across investment measurements. Underinvestment shocks lead to an immediate increase in *EPU*. Meanwhile, overinvestment shocks cause a positive effect on *MacU*. A possible explanation is that EPU, JLN macroeconomic, and financial uncertainty capture different types of uncertainties. According to Megaritis *et al*. (2021), JLN uncertainty measurement reflects the unobservable uncertainty because it is constructed based on unforecastable (by economic agents) variations of macroeconomic indicators.

In contrast, they consider *EPU* as a more observable uncertainty measurement. Suh and Yang (2021) also differentiate *EPU* and JLN uncertainties based on the information used to construct the measurements. *EPU* is a newspaper-based uncertainty that reflects the frequency of uncertainty-related words and terms that appear in the newspaper. Thus, it is considered a more qualitative and subjective uncertainty proxy. On the other hand, Suh and Yang (2021) consider JLN's uncertainty to be a more quantitative and data-driven proxy because it is constructed from thousands of numerical macroeconomic and financial variables. We hypothesize that underinvestment caused information scarcity problems in the economy. The information scarcity problem might be more related to *EPU*, a qualitative, news-based, and subjective uncertainty measurement. By contrast, overinvestment is more unexpected since it can result in a good or bad investment boom. Overinvestment should be more related to JLN uncertainty measurement,

Figure 4.
Orthogonalized Impulse Response Functions of Uncertainty Measurements to Overinvestment Shocks

The first row of the figure is investment inefficiency calculated with investment defined as Inv_1 = capital expenditure scaled by total assets. The second row of the figure is investment inefficiency calculated with investment defined as Inv_2 = capital expenditure scaled by net Plant, Property, and Equipment (PPE). The third row of the figure is investment inefficiency calculated with investment defined as Inv_3 = Total investment (sum of R&D, capital expenditure, and cash acquisitions less sale of PPE) scaled by total assets. The solid line represents the OIRFs while dashed bands are ± two standard errors.

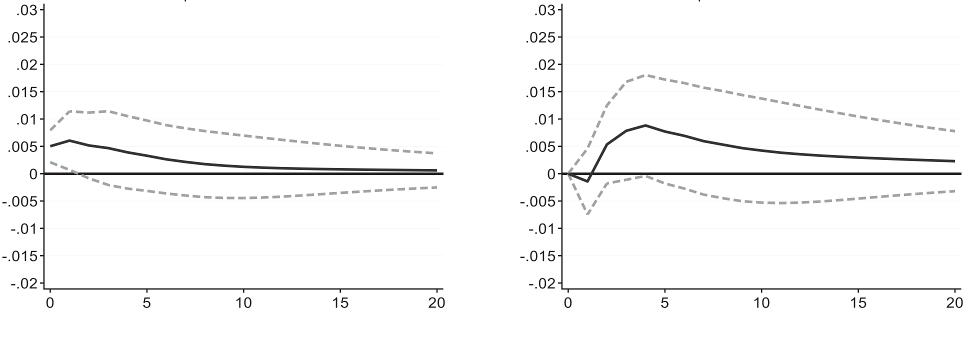
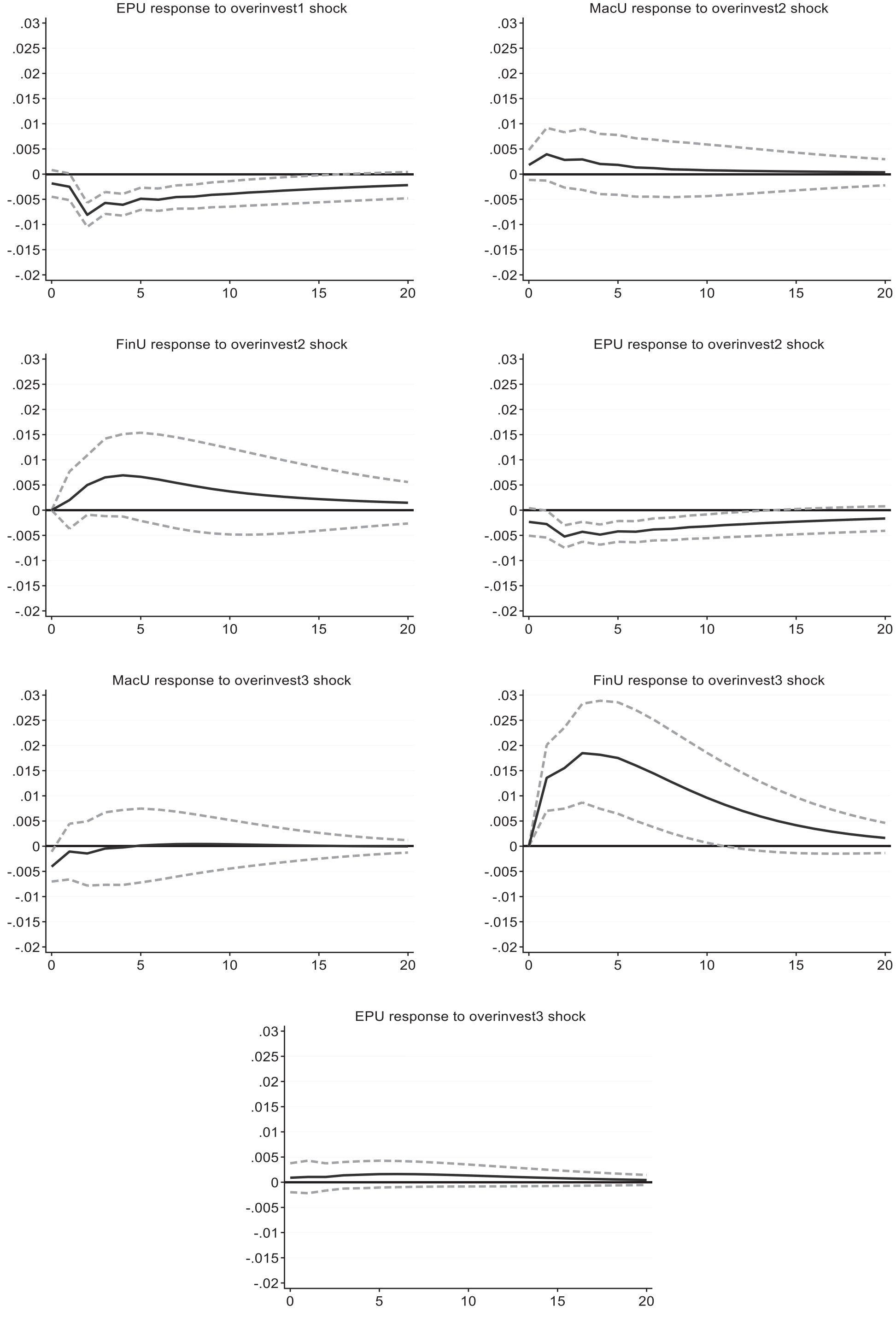


Figure 4.
Orthogonalized Impulse Response Functions of Uncertainty Measurements to Overinvestment Shocks (Continued)



which captures unobservable ("surprise") uncertainty.

Figure 3 and Figure 4 (column 2) show that financial uncertainty positively responds to underinvestment and overinvestment shocks. Benhabib *et al*. (2019) hypothesize the informational interdependence between firms and the financial market. Firms and financial market agents learn from the information generated by each other to make investment decisions. The results suggest that when the proportion of underinvesting firms increases in the economy, the information needed for valuation also becomes scarce, resulting in high financial uncertainty.

Moreover, overinvestment shocks also have a significant impact on financial uncertainty. Compared to the underinvestment shocks, the impact remains positive and persists for five years after the shocks. These results support Kotz (2013) that overinvestment causes a prolonged global financial crisis. Overinvestment leads to higher losses and later results in a further collapse in investment, followed by a large overhang of unused production capacity. The condition can last longer and cause prolonged uncertainty. Moreover, the results also confirm the speculative growth hypothesis, which argues overinvestment can cause speculation on growth outcomes (Caballero et al., 2006; Mendoza and Terrones, 2008; Pintus and Wen, 2013). When the financial market captures this information, it induces a credit boom, leading to further asset misallocation and financial uncertainty.

To conclude, our findings show the importance of firm investments in information flow in the economy. The underinvestment result shows that firm investment activity will increase the information flow to encourage the economy's overall activity. Less activity means less information flow. This condition will cause a longer period of low activity and generate a long-lasting recession. The overinvestment results show that overproduction will cause firms to suffer from investment overhangs. Investment overhangs take longer to recover. Moreover, overinvestment also creates higher speculation based on inaccurate information that can exacerbate economic uncertainty.

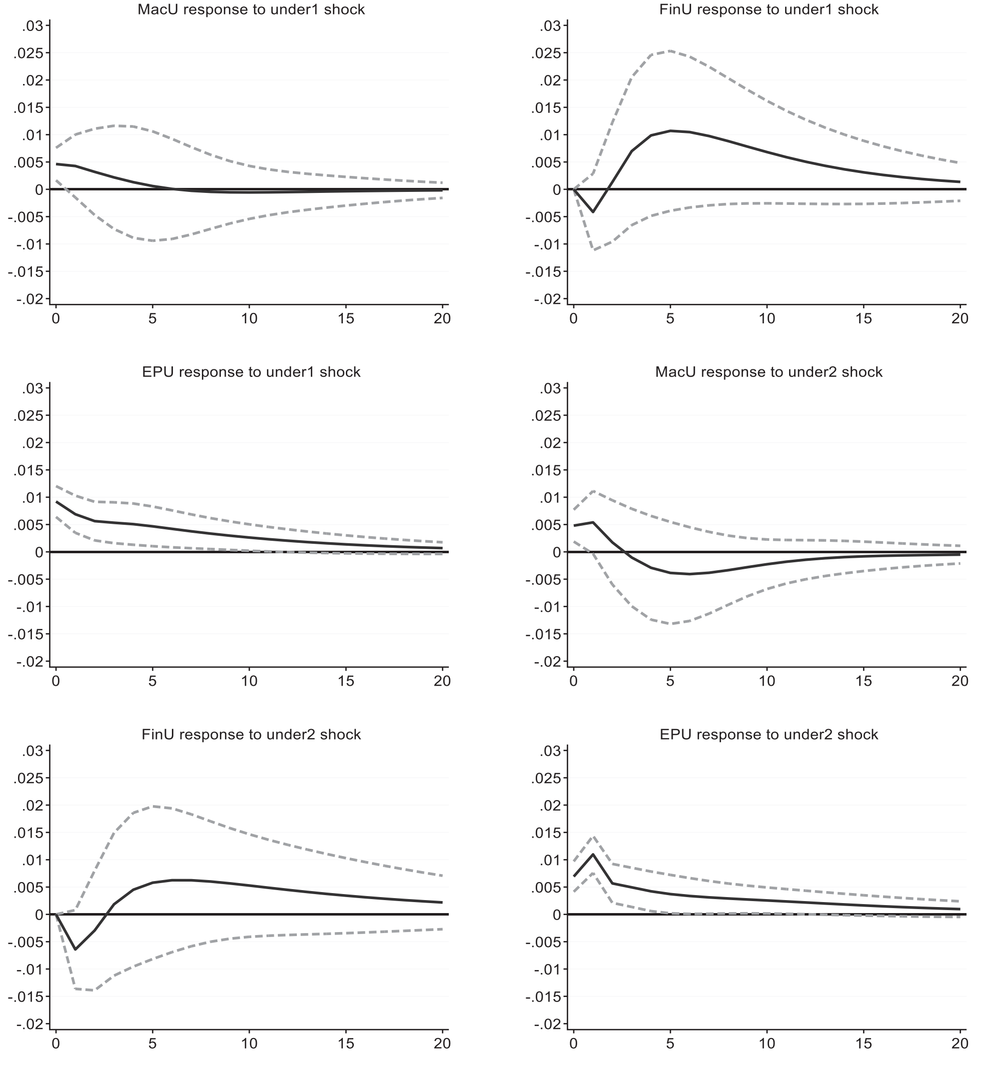
IV. ROBUSTNESS CHECKS

A. Large vs Small Firm Sample

In Figure 5 to Figure 8, we repeat the baseline VAR models on large and small firm subsamples. The samples are grouped based on the median of total assets. Large (small) firms are those with total assets higher (lower) than the median of overall samples.

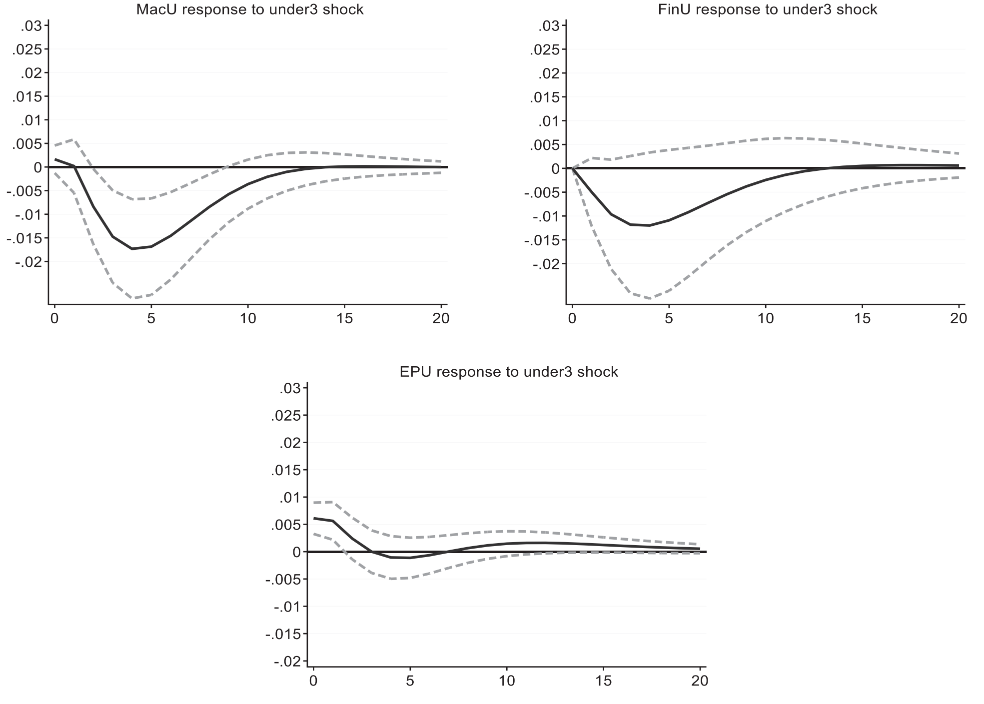
Figure 5.
Orthogonalized Impulse Response Functions of Uncertainty Measurements to Small Firms' Underinvestment Shocks

The first row of the figure is investment inefficiency calculated with investment defined as Inv_1 = capital expenditure scaled by total assets. The second row of the figure is investment inefficiency calculated with investment defined as Inv_2 = capital expenditure scaled by net Plant, Property, and Equipment (PPE). The third row of the figure is investment inefficiency calculated with investment defined as Inv_3 = Total investment (sum of R&D, capital expenditure, and cash acquisitions less sale of PPE) scaled by total assets. The solid line represents the OIRFs while dashed bands are ± two standard errors.



DOI: 10.59091/2460-9196.2275

Figure 5.
Orthogonalized Impulse Response Functions of Uncertainty Measurements to Small Firms' Underinvestment Shocks (Continued)



The results suggest that a higher proportion of small firms underinvesting will increase EPU. In comparison, a higher proportion of large firms that overinvest leads to higher JLN *MacU* and *FinU*. More importantly, we can only observe the positive response of *EPU* from small firms' underinvestment shocks. This result supports our baseline that an underinvestment shock drives EPU uncertainty through the information channel. Small firms tend to suffer high information asymmetry problems because they are usually young, less experienced, have lower assets, and have limited external financing access (Faulkender and Petersen, 2006). In order to give information to their investors, small firms should take their growth opportunities to assets in place. Hence, without investment activity, they will suffer more information asymmetry problems that lead to worsening overall uncertainty, especially the *EPU* news-based uncertainty.

Figure 6.
Orthogonalized Impulse Response Functions of Uncertainty Measurements To Small Firms' Overinvestment Shocks

The first row of the figure is investment inefficiency calculated with investment defined as Inv_1 = capital expenditure scaled by total assets. The second row of the figure is investment inefficiency calculated with investment defined as Inv_2 = capital expenditure scaled by net Plant, Property, and Equipment (PPE). The third row of the figure is investment inefficiency calculated with investment defined as Inv_3 = Total investment (sum of R&D, capital expenditure, and cash acquisitions less sale of PPE) scaled by total assets. The solid line represents the OIRFs while dashed bands are ± two standard errors.

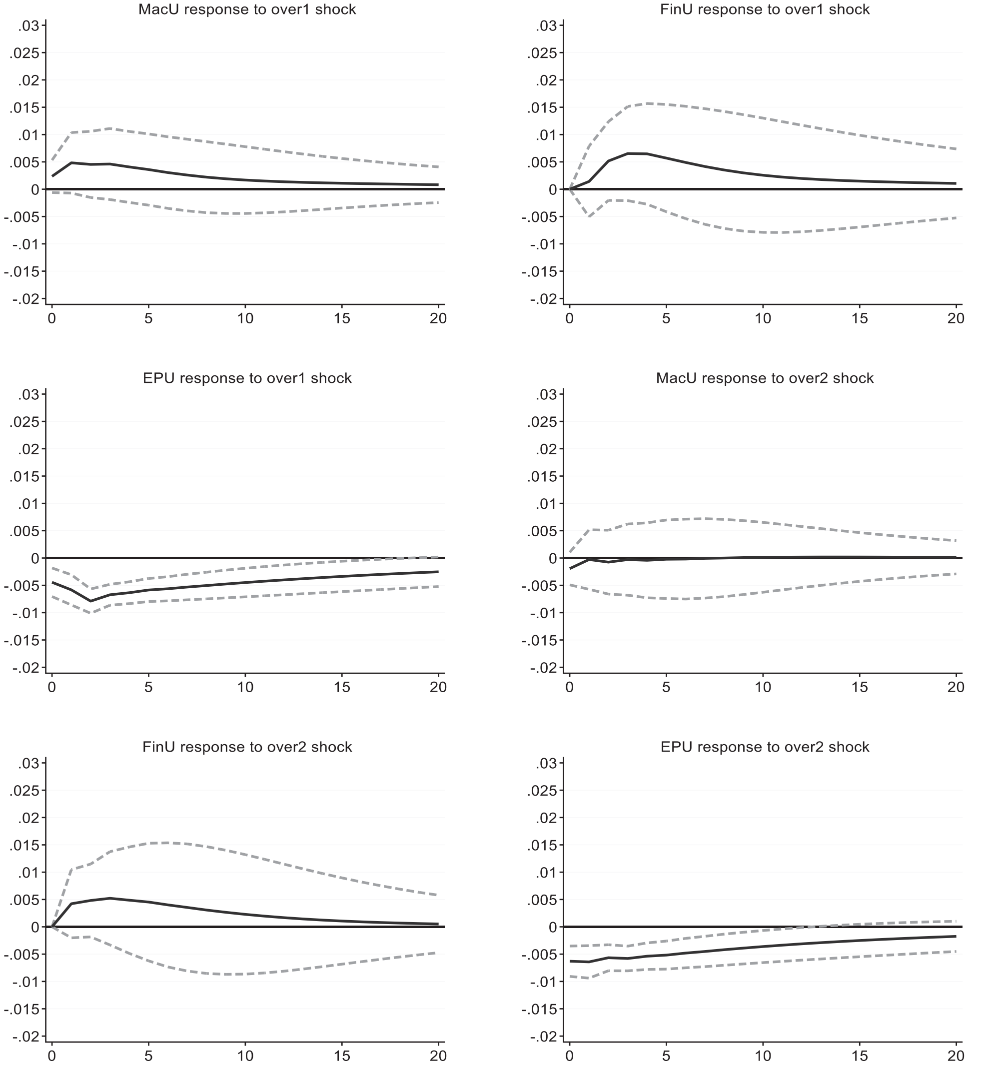


Figure 6.
Orthogonalized Impulse Response Functions of Uncertainty Measurements To Small Firms' Overinvestment Shocks (Continued)

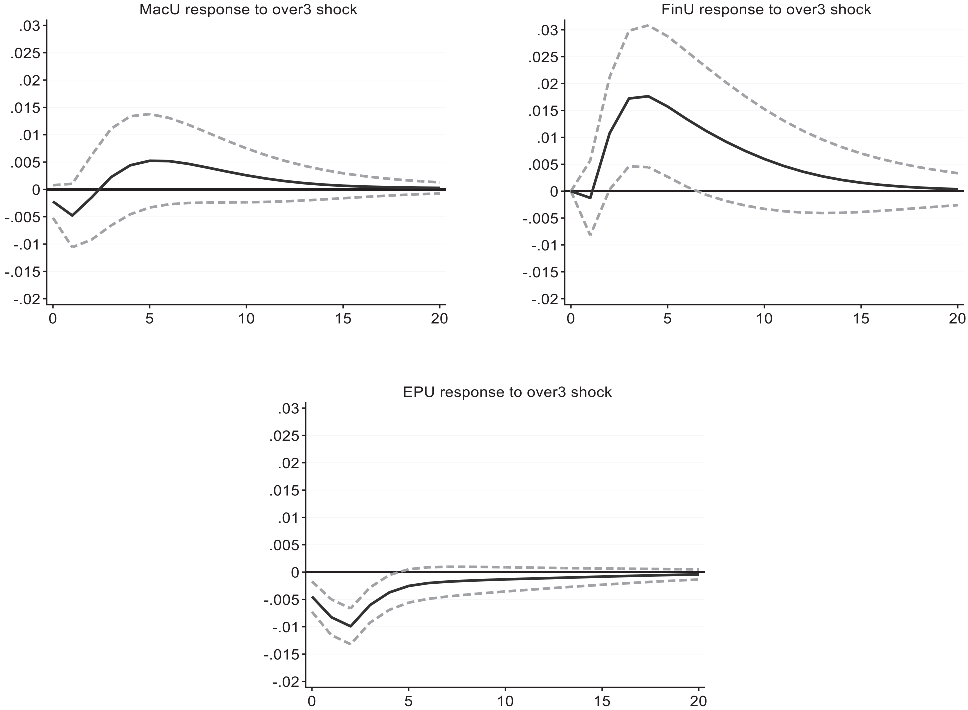


Figure 7.
Orthogonalized Impulse Response Functions of Uncertainty Measurements to Large Firms' Underinvestment Shocks

The first row of the figure is investment inefficiency calculated with investment defined as Inv_1 = capital expenditure scaled by total assets. The second row of the figure is investment inefficiency calculated with investment defined as Inv_2 = capital expenditure scaled by net Plant, Property, and Equipment (PPE). The third row of the figure is investment inefficiency calculated with investment defined as Inv_3 = Total investment (sum of R&D, capital expenditure, and cash acquisitions less sale of PPE) scaled by total assets. The solid line represents the OIRFs while dashed bands are ± two standard errors.

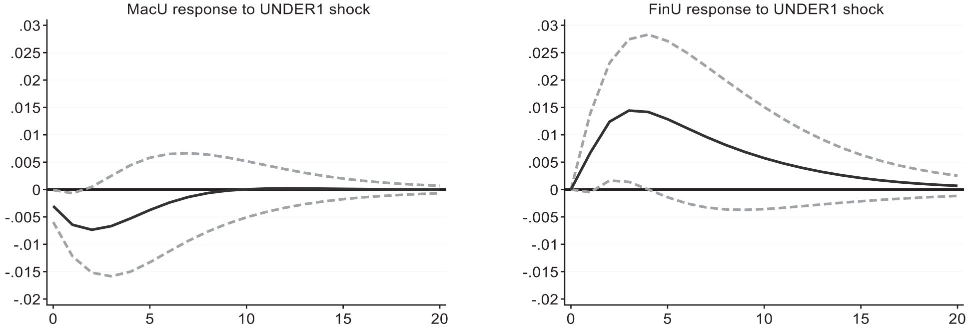


Figure 7.
Orthogonalized Impulse Response Functions of Uncertainty Measurements to Large Firms' Underinvestment Shocks (Continued)

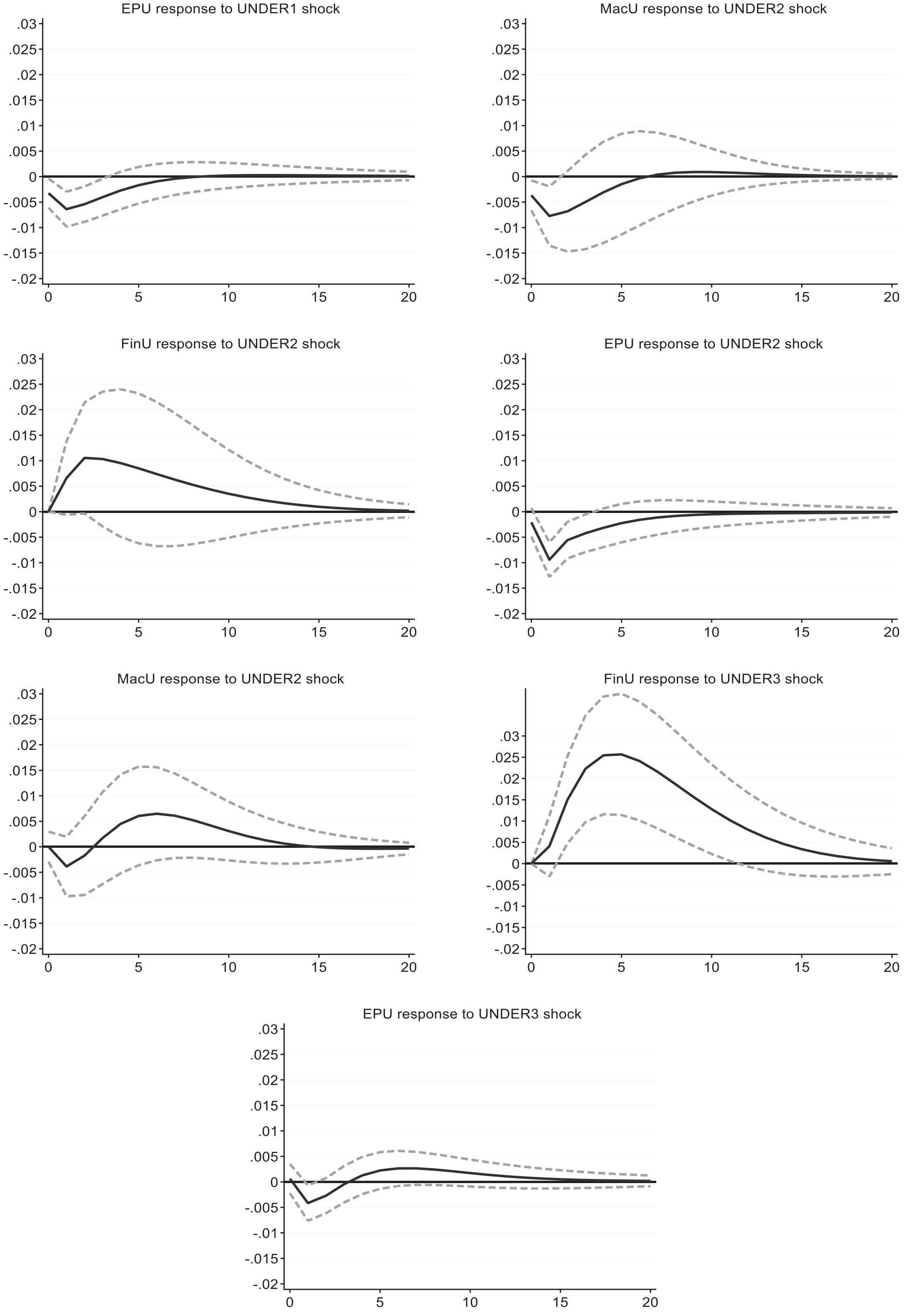


Figure 7 shows that the underinvestment shocks of large firms positively impact *FinU*. Additionally, from Figure 8, we observe that overinvesting in large firms increases both JLN macroeconomic and financial uncertainties. Although overinvesting in small firms also positively affects macroeconomic and financial uncertainties, the effect is more potent in large firms. Consistent with our result, Gabaix (2011) argues that large firms dominate the economy, and thus their idiosyncratic shocks can affect the aggregate macroeconomic level variables. When large firms overinvest, financial markets absorb that information and cause speculative growth valuation episodes (Pintus and Wen, 2013). When large firms underinvest, the financial market will also lose confidence based on the information, resulting in further financial market uncertainty. According to Crouzet and Mehrotra (2020), 75% of total sales and 85% of the total investment in their United States samples were contributed by their top 1% of the largest firm's samples. Financial market agents may rely on these large firms' information since their activity most likely reflects the market information.

Figure 8.
Orthogonalized Impulse Response Functions of Uncertainty Measurements to Large Firms' Overinvestment Shocks

The first row of the figure is investment inefficiency calculated with investment defined as Inv_1 = capital expenditure scaled by total assets. The second row of the figure is investment inefficiency calculated with investment defined as Inv_2 = capital expenditure scaled by net Plant, Property, and Equipment (PPE). The third row of the figure is investment inefficiency calculated with investment defined as Inv_3 = Total investment (sum of R&D, capital expenditure, and cash acquisitions less sale of PPE) scaled by total assets. The solid line represents the OIRFs while dashed bands are ± two standard errors.

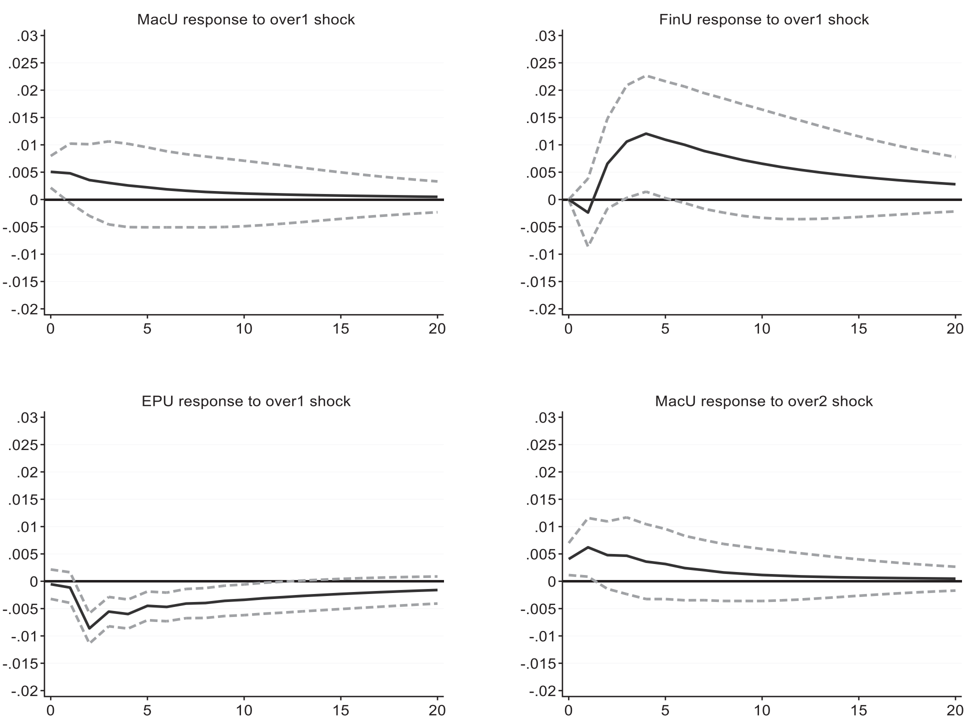
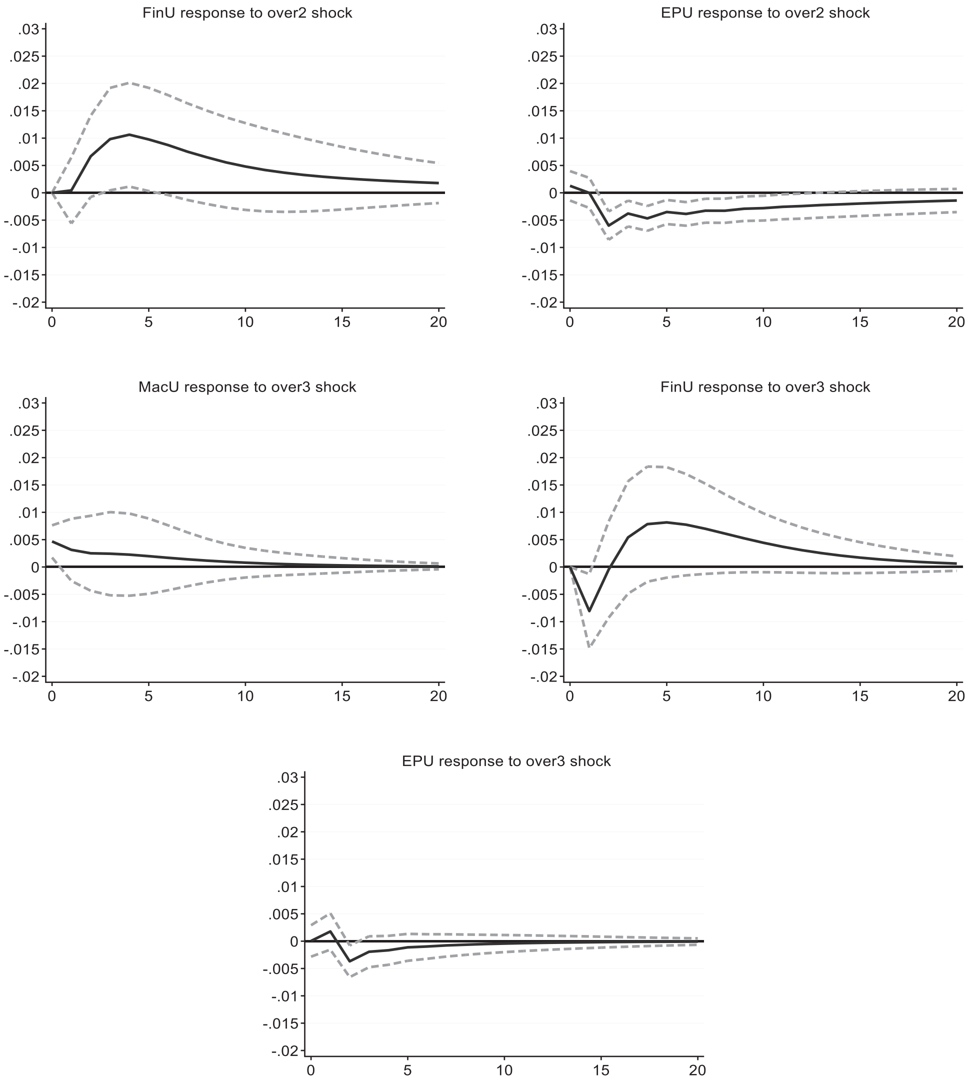


Figure 8.
Orthogonalized Impulse Response Functions of Uncertainty Measurements to Large Firms' Overinvestment Shocks (Continued)



B. Other Measurements of Investment Inefficiency

We use alternative investment inefficiency measurement (Huang, 2020) to ensure our study's robustness. The investment inefficiency is taken from Equation (7) below:

$$INV_{i,t} = \beta_0 + \beta_1 MTB_{i,t-1} + \beta_2 SGR_{i,t-1} + \beta_1 FCF_{i,t} + \beta_1 LEV_{i,t-1} + \beta_5 SIZE_{t-1} + \varepsilon_t \quad (7)$$

https://bulletin.bmeb-bi.org/bmeb/vol27/iss2/4
DOI: 10.59091/2460-9196.2275

The logic of this equation is that firms decide their investment level based on their investment opportunities and internal and external funding. Where *INV* is a firm investment as the dependent variable and the independent variables of the model include sales growth (*SGR*), market to book ratio (*MTB*), net free cash flow (*FCF*), leverage (*LEV*), and firm size (*SIZE*). All variables are stationary (see Appendix, Table A3).

The results of the estimated OIRFs using the alternative investment inefficiency measurement (Equation (7)) is shown in Appendix (Figure A4). Underinvestment shocks contribute significantly to heightening *EPU*. Meanwhile, overinvestment shocks contribute to increasing JLN macroeconomic and financial uncertainties. Hence, we can conclude that our results are robust to the alternative investment inefficiency measurements.

C. Sectoral Analysis

For additional analysis, we extend our study by observing the impact of investment inefficiency at the sector level. We use the North American Industry Classification System (NAICS) to classify our samples and calculate the investment inefficiency at the sector level. The OIRFs of VAR results[6] are presented on Appendix (Figure A5). The results show that suboptimal (under and over) investments drive up EPU, *MacU*, and *FinU*. Our finding is similar to Morikawa (2016), showing that manufacturing firms tend to have higher business uncertainty than non-manufacturing firms.

V. CONCLUSIONS AND POLICY IMPLICATIONS

We investigate the impact of investment inefficiencies (under- and over-investment) on macro-level uncertainty. Our study contributes to the endogenous uncertainty-investment relations literature based on the VAR model. We also introduce the investment inefficiency measurement at the macro-level, developed from firm-level data.

Our VAR results show that investment inefficiency shocks cause macro-level uncertainty to increase. We discover that underinvestment and overinvestment lead to different uncertainties. Underinvestment increases *EPU*, while overinvestment elevates JLN *MacU*. Based on the information channel explanation, underinvestment causes informational problems in the economy. Hence, it is more related to news based EPU.

In comparison, overinvestments cause unexpected shocks (ex-post surprise) to the economy. The shocks will be more related to the unobservable JLN uncertainty. More importantly, both underinvestment and overinvestment shocks drive up *FinU*. Both under- and over-investment results imply that the financial market is sensitive and relies on the information produced by firms. Low information causes difficulties for financial market agents to do valuations, while overinvestment increases speculative valuations that exacerbate financial market uncertainty.

---

[6] We only report information and the manufacturing industry for brevity because most of our samples are classified in these industries. Other industry results are available upon request.

Our robustness checks find that small firms' underinvestment contributes to higher *EPU*. Meanwhile, large firms' overinvestments lead to higher *MacU* and *FinU*. We argue that small firms tend to have information asymmetry problems. Their underinvestments can drive a higher news-based *EPU*. On the other hand, large firm overinvestments can trigger excessive speculative valuation episodes in the financial market, which explains their higher effect on *FinU*.

Our research shows that firms' investment activities contribute to the severity of uncertainty in the economy, resulting in a prolonged recession. Consequently, we also believe that to resolve uncertainty, policymakers, as an essential part of the economy, could pay more attention to firms' activity, particularly investment activity. Such effort from policymakers minimizes information asymmetry as a significant contributor to uncertainty.

REFERENCES

Agliardi, E., Agliardi, R., & Spanjers, W. (2016). Corporate Financing Decisions Under Ambiguity: Pecking Order and Liquidity Policy Implications. *Journal of Business Research*, 69, 6012–6020. https://doi.org/10.1016/j.jbusres.2016.05.016

Baker, S. R., Bloom, N., & Davis, S. J. (2016). Measuring Economic Policy Uncertainty. *The Quarterly Journal of Economics*, 131, 1593–1636. https://doi.org/10.1093/qje/qjw024

Bebchuk, L. A., & Stole, L. A. (1993). Do Short-term Objectives Lead to Under- or Overinvestment in Long-term Projects? *The Journal of Finance*, 48, 719–730. https://doi.org/10.1111/j.1540-6261.1993.tb04735.x

Benhabib, J., Liu, X., & Wang, P. (2019). Financial Markets, the Real Economy, and Self-Fulfilling Uncertainties. *Journal of Finance*, 74, 1503–1557. https://doi.org/10.1111/jofi.12764

Biddle, G. C., Hilary, G., & Verdi, R. S. (2009). How Does Financial Reporting Quality Relate to Investment Efficiency? *Journal of Accounting and Economics*, 48, 112–131. https://doi.org/10.1016/j.jacceco.2009.09.001

Bloom, N., Bond, S., & van Reenen, J. (2007). Uncertainty and Investment Dynamics. *Review of Economic Studies*, 74, 391–415. https://doi.org/10.1111/j.1467-937X.2007.00426.x

Brunnermeier, M. K., & Sannikov, Y. (2014). A Macroeconomic Model with a Financial Sector. *American Economic Review*, 104, 379–421. https://doi.org/10.1257/aer.104.2.379

Buchanan, B. G., Cao, C. X., Liljeblom, E., & Weihrich, S. (2017). Uncertainty and Firm Dividend Policy—A Natural Experiment. *Journal of Corporate Finance*, 42, 179–197. https://doi.org/10.1016/j.jcorpfin.2016.11.008

Caballero, R. J., Farhi, E., & Hammour, M. L. (2006). Speculative Growth: Hints from the U.S. Economy. *American Economic Review*, 96, 1159–1192. https://doi.org/10.1257/AER.96.4.1159

Carriero, A., Clark, T. E., & Marcellino, M. (2018). Endogenous Uncertainty. *Working Papers*, W.P. 18-05. https://doi.org/10.26509/FRBC-WP-201805

Chen, S. S., & Chen, I. J. (2011). Inefficient Investment and the Diversification Discount: Evidence from Corporate Asset Purchases. *Journal of Business Finance and Accounting*, 38, 887–914. https://doi.org/10.1111/j.1468-5957.2011.02251.x

Chen, X., Le, C. H. A., Shan, Y., & Taylor, S. (2020). Australian Policy Uncertainty and Corporate Investment. *Pacific Basin Finance Journal*, 61, 101341. https://doi.org/10.1016/j.pacfin.2020.101341

Chung, K. H., & Charoenwong, C. (1991). Investment Options, Assets in Place, and the Risk of Stocks. *Financial Management*, 20, 21. https://doi.org/10.2307/3665748

Claessens, S., & Kose, M. A. (2018). Frontiers of Macrofinancial Linkages. *BIS Papers*, 95.

Crouzet, N., & Mehrotra, N. R. (2020). Small and Large Firms Over the Business Cycle. *American Economic Review*, 110, 3549–3601. https://doi.org/10.1257/AER.20181499

Fajgelbaum, P. D., Schaal, E., & Taschereau-Dumouchel, M. (2017). Uncertainty Traps. *Quarterly Journal of Economics*, 132, 1641–1692. https://doi.org/10.1093/qje/qjx021

Faulkender, M., & Petersen, M. A. (2006). Does the Source of Capital Affect Capital Structure? *Review of Financial Studies*, 19, 45–79. https://doi.org/10.1093/rfs/hhj003

Gabaix, X. (2011). The Granular Origins of Aggregate Fluctuations. *Econometrica*, 79, 733–772. https://doi.org/10.3982/ecta8769

Glandon, P. J., Kuttner, K., Mazumder, S., & Stroup, C. (2022). Macroeconomic Research, Present and Past. *Working Paper* 29628. http://www.nber.org/papers/w29628

Gulen, H., & Ion, M. (2016). Policy Uncertainty and Corporate Investment. *Review of Financial Studies*, 29, 523–564. https://doi.org/10.1093/rfs/hhv050

Huang, K. (2020). Management Forecast Errors and Corporate Investment Efficiency. *Journal of Contemporary Accounting and Economics*, 16, 100208. https://doi.org/10.1016/j.jcae.2020.100208

Inekwe, J. N., Jin, Y., & Valenzuela, M. R. (2018). The Effects of Financial Distress: Evidence from US GDP Growth. *Economic Modelling*, 72, 8–21. https://doi.org/10.1016/j.econmod.2018.01.001

Jiang, F., Cai, W., Wang, X., & Zhu, B. (2018). Multiple Large Shareholders and Corporate Investment: Evidence from China. *Journal of Corporate Finance*, 50, 66–83. https://doi.org/10.1016/j.jcorpfin.2018.02.001

Jory, S. R., Khieu, H. D., Ngo, T. N., & Phan, H. V. (2020). The Influence of Economic Policy Uncertainty on Corporate Trade Credit and Firm Value. *Journal of Corporate Finance*, 64, 101671. https://doi.org/10.1016/j.jcorpfin.2020.101671

Jurado, K., Ludvigson, S. C., & Ng, S. (2015). Measuring Uncertainty. American Economic Review, 105, 1177–1216. https://doi.org/10.1257/aer.20131193

Kim, H., & Kung, H. (2017). The Asset Redeployability Channel: How Uncertainty Affects Corporate Investment. *Review of Financial Studies*, 30, 245–280. https://doi.org/10.1093/rfs/hhv076

Kotz, D. M. (2013). The Current Economic Crisis in the United States: A Crisis of Over-investment. *Review of Radical Political Economics*, 45, 284–294. https://doi.org/10.1177/0486613413487160

Kurz, M., & Motolese, M. (2001). Endogenous Uncertainty and Market Volatility. *Economic Theory*, 17, 497–544. https://doi.org/10.1017/S0266466601173019

Ludvigson, S. C., Ma, S., & Ng, S. (2021). Uncertainty and Business Cycles: Exogenous Impulse or Endogenous Response? *American Economic Journal: Macroeconomics*, 13, 369–410. https://doi.org/10.3386/w21803

Megaritis, A., Vlastakis, N., & Triantafyllou, A. (2021). Stock Market Volatility and Jumps in Times of uncertainty. *Journal of International Money and Finance*, 113, 1–24. https://doi.org/10.1016/j.jimonfin.2021.102355

Mendoza, E., & Terrones, M. (2008). An Anatomy of Credit Booms: Evidence from Macro Aggregates and Micro Data. *NBER Working Paper* 14049. https://doi.org/10.3386/w14049

Morikawa, M. (2016). Business Uncertainty and Investment: Evidence from Japanese Companies. *Journal of Macroeconomics*, 49, 224–236. https://doi.org/10.1016/j.jmacro.2016.08.001

Myers, C. (1977). Determinants of Corporate Borrowing. *Journal of Financial Economics*, 5, 147–175.

Neamtiu, M., Shroff, N., White, H. D., & Williams, C. D. (2014). The Impact of Ambiguity on Managerial Investment and Cash Holdings. *Journal of Business Finance and Accounting*, 41, 1071–1099. https://doi.org/10.1111/jbfa.12079

Nishimura, K. G., & Ozaki, H. (2007). Irreversible Investment and Knightian Uncertainty. *Journal of Economic Theory*, 136, 668–694. https://doi.org/10.1016/j.jet.2006.10.011

Ozturk, E. O., & Sheng, X. S. (2018). Measuring Global and Country-specific Uncertainty. *Journal of International Money and Finance*, 88, 276–295. https://doi.org/10.1016/j.jimonfin.2017.07.014

Pan, W. F., Wang, X., & Yang, S. (2019). Debt Maturity, Leverage, and Political Uncertainty. *North American Journal of Economics and Finance*. https://doi.org/10.1016/j.najef.2019.04.024

Phan, H. V., Nguyen, N. H., Nguyen, H. T., & Hegde, S. (2019). Policy Uncertainty and Firm Cash Holdings. *Journal of Business Research*, 95, 71–82. https://doi.org/10.1016/j.jbusres.2018.10.001

Pintus, P. A., & Wen, Y. (2013). Leveraged Borrowing and Boom-bust Cycles. *Review of Economic Dynamics*, 16, 617–633. https://doi.org/10.1016/j.red.2012.09.006

Plante, M., Richter, A. W., & Throckmorton, N. A. (2018). The Zero Lower Bound and Endogenous Uncertainty. *The Economic Journal*, 128, 1730–1757. https://doi.org/10.1111/ecoj.12445

Schwarz, L. A. D., & Dalmácio, F. Z. (2020). The Relationship Between Economic Policy Uncertainty and Corporate Leverage: Evidence from Brazil. *Finance Research Letters*, 40, 101676. https://doi.org/10.1016/j.frl.2020.101676

Suh, H., & Yang, J. Y. (2021). Global Uncertainty and Global Economic Policy Uncertainty: Different Implications for Firm Investment. *Economics Letters*, 200, 109767. https://doi.org/10.1016/j.econlet.2021.109767

Terrones, M., & Mendoza, E. G. (2008). An Anatomy of Credit Booms: Evidence from Macro Aggregates and Micro Data. *IMF Working Papers*. https://doi.org/10.5089/9781451870848.001

van Nieuwerburgh, S., & Veldkamp, L. (2006). Learning Asymmetries in Real Business Cycles. *Journal of Monetary Economics*, 53, 753–772. https://doi.org/10.1016/j.jmoneco.2005.02.003

Wang, Y., Chen, C. R., Chen, L., & Huang, Y. S. (2016). Overinvestment, Inflation Uncertainty, and Managerial Overconfidence: Firm Level Analysis of Chinese Corporations. *North American Journal of Economics and Finance*, 38, 54–69. https://doi.org/10.1016/j.najef.2016.07.001

Yoon, K. H., & Ratti, R. A. (2011). Energy Price Uncertainty, Energy Intensity and Firm Investment. *Energy Economics*, 33, 67–78. https://doi.org/10.1016/j.eneco.2010.04.011

APPENDIX

Table A1.
Operationalization of Variables

This table provides detail variable definitions considered in this study.

Variable	Variable Names	Definitions
SGR	Sales Growth	$\frac{Sales_t - Sales_{t-1}}{Sales_{t-1}}$
Inv 1	CAPEX/TA	$\frac{CAPEX_t}{Total\ assets_{t-1}}$
Inv 2	CAPEX/PPE	$\frac{CAPEX_t}{PPE_{t-1}}$
Inv 3	Total Investment	$\frac{CAPEX_t + R\&D_t + CASH\ ACQUISITION_t - Sale\ PPE_t}{Total\ Asset_{t-1}}$
Size	Firm size	Log(total sales)
MTB	Market to book ratio	$\frac{total\ assets - BV\ equity + MV\ equity_t}{total\ assets_{t-1}}$
LEV	Leverage	$\frac{Long\ term\ debt_t}{Long\ term\ debt_t + MV\ equity_t}$
FCF	Free Cash Flow	$\frac{cash\ flow\ from\ operating\ activities - depr\ and\ amort + R\&D_t}{Total\ assets_{t-1}}$
MacU	Macroeconomic Uncertainty	Macroeconomic uncertainty developed by (Jurado *et al.*, 2015) taken from https://www.sydneyludvigson.com/
EPU	Economic Policy Uncertainty	The average value of three monthly (Baker *et al.*, 2016) EPU, taken from https://www.policyuncertainty.com/
FinU	Financial Uncertainty	Financial uncertainty (Ludvigson *et al.*, 2021) taken from https://www.sydneyludvigson.com/

Table A2.
Summary Statistics Comparing Overinvest and Underinvest Firms

This table reports the summary statistics of the main variables. The variables are presented for both overinvested (Over) and underinvested (Under) firms. Size refers to firm size, while Leverage measures the extent of debt financing. ROA represents profitability, and Cash indicates the level of cash holdings. MTB reflects firm's Market to Book ratio, while Tang denotes asset tangibility. Investment signifies the level of capital expenditure, and Dividend represents dividend payments. The mean and Standard Deviation (SD) values for both overinvested and underinvested firms are provided, along with the mean differences. *, **, and *** represent significance at the 1%, 5%, and 10% levels, respectively.

Variable	Over Mean	Over SD	Under Mean	Under SD	Mean Diff.
Panel A: Investment Definition: Inv1: Capex/TA					
Size	8.647	1.059	7.995	1.246	0.652***
Leverage	0.494	0.727	0.768	1.630	-0.274***
ROA	-0.019	0.145	-0.085	0.247	0.066***
Cash	0.119	0.149	0.192	0.225	-0.073***
MTB	2.705	5.040	2.095	5.161	0.610***
Tang	0.400	0.244	0.129	0.173	0.272***
Investment	0.035	0.027	0.002	0.002	0.034***
Dividend	0.358	0.479	0.196	0.397	0.162***
Panel B: Investment Definition: Inv2: Capex/PPE					
Size	8.323	1.001	8.244	1.246	0.079***
Leverage	0.469	0.748	0.712	1.380	-0.243***
ROA	-0.036	0.165	-0.065	0.221	0.029*
Cash	0.196	0.204	0.139	0.187	0.056***
MTB	3.193	5.718	1.883	4.742	1.309***
Tang	0.166	0.196	0.292	0.243	-0.126***
Investment	0.215	0.207	0.015	0.011	0.200***
Dividend	0.197	0.398	0.306	0.461	-0.109***
Panel C: Investment Definition: Inv3: Total Investment/TA					
Size	8.230	1.073	8.288	1.264	-0.058***
Leverage	0.548	1.038	0.742	1.483	-0.194***
ROA	-0.068	0.208	-0.052	0.214	-0.015***
Cash	0.205	0.214	0.135	0.188	0.070***
MTB	3.147	6.057	1.901	4.636	1.246***
Tang	0.248	0.246	0.192	0.208	0.056***
Investment	0.097	0.088	0.003	0.005	0.094***
Dividend	0.198	0.398	0.311	0.463	-0.113***

Table A3.
Results of Unit Root Test

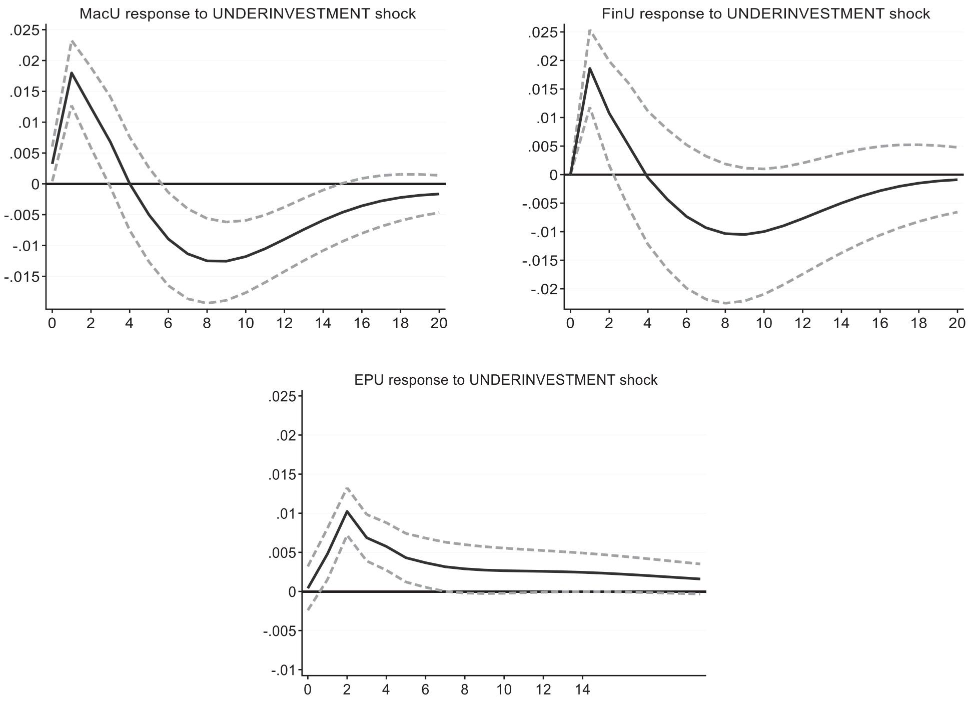
This table presents the results of the stationarity analysis for the variables under consideration. The stationarity of each variable is assessed using Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests. In the investment inefficiencies model, Investment1, Investment2, and Investment3 represent different proxies for firm-level investment inefficiencies. while Inefficient1, Inefficient2, and Inefficient3 denote firm-level investment inefficiencies under different investment proxies. Additionally, Overinvest1, Overinvest2, Overinvest3, Underinvest1, Underinvest2, and Underinvest3 represent overinvestment and underinvestment level under different investment proxies. Leverage measures the firm-level leverage, while Size refers to firm size, FCF refers to firm's free cash flow, and SGR denotes firm's annual sales growth rate. *, **, and *** denote rejection of the null hypothesis at 10%, 5%, and 1% significance levels, respectively.

Variables Included in the Estimation of the Investment Inefficiencies Model (Eq. (1) And Eq. (7))		
Variable	**Augmented Dickey-Fuller**	**Result**
Investment1	226.567 (0.000)	Stationary
Investment2	236.466 (0.000)	Stationary
Investment3	358.328 (0.000)	Stationary
leverage	38.602 (0.000)	Stationary
size	101.739 (0.000)	Stationary
Free cash flow (FCF)	295.527 (0.000)	Stationary
Sales Growth (SGR)	709.669 (0.000)	Stationary
Variables Included in VAR		
Variables	**Augmented Dicky Fuller**	**Phillips-Perron**
Macroeconomic uncertainty	-3.054**	-3.589***
Financial uncertainty	-3.925***	-3.782***
EPU	-5.852***	-5.911***
$Inefficient_1$	-3.826***	-3.565***
$Inefficient_2$	-4.037***	-3.863***
$Inefficient_3$	-7.871***	-8.009***
$Overinvest_1$	-4.099***	-3.679***
$Overinvest_2$	-3.831***	-3.513***
$Overinvest_3$	-6.447***	-6.568***
$Underinvest_1$	-4.866***	-4.866***
$Underinvest_2$	-4.733***	-4.817***
$Underinvest_3$	-4.866***	-4.866***

Figure A4.
Orthogonalized Impulse Response Functions

Orthogonalized Impulse Response Functions of uncertainty measurements to (a) Underinvestment and (b) Overinvestment shock. Underinvestment and overinvestment are calculated with the expected investment model suggested by (Huang, 2020). The solid line represents the OIRFs while dashed bands are ± two standard errors.

(a). Underinvestment



(b). Overinvestment

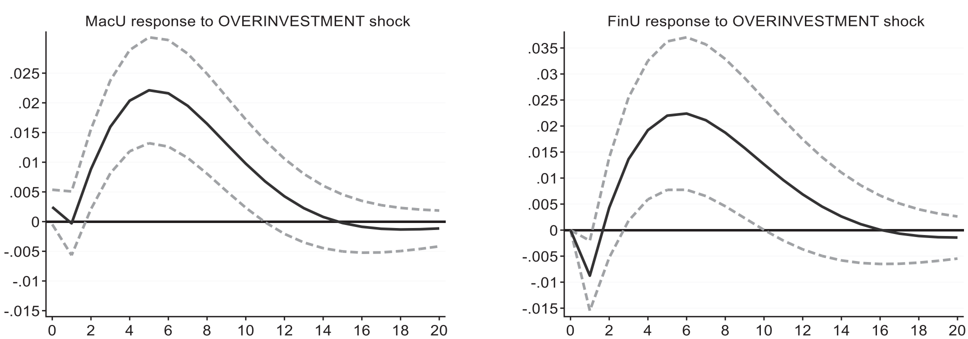


Figure A4.
Orthogonalized Impulse Response Functions (Continued)

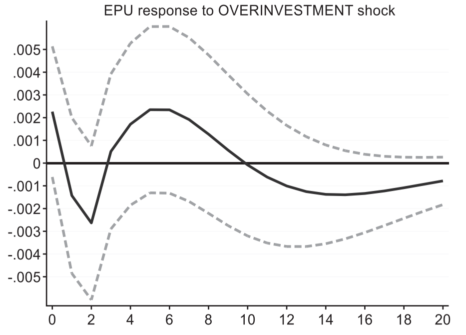
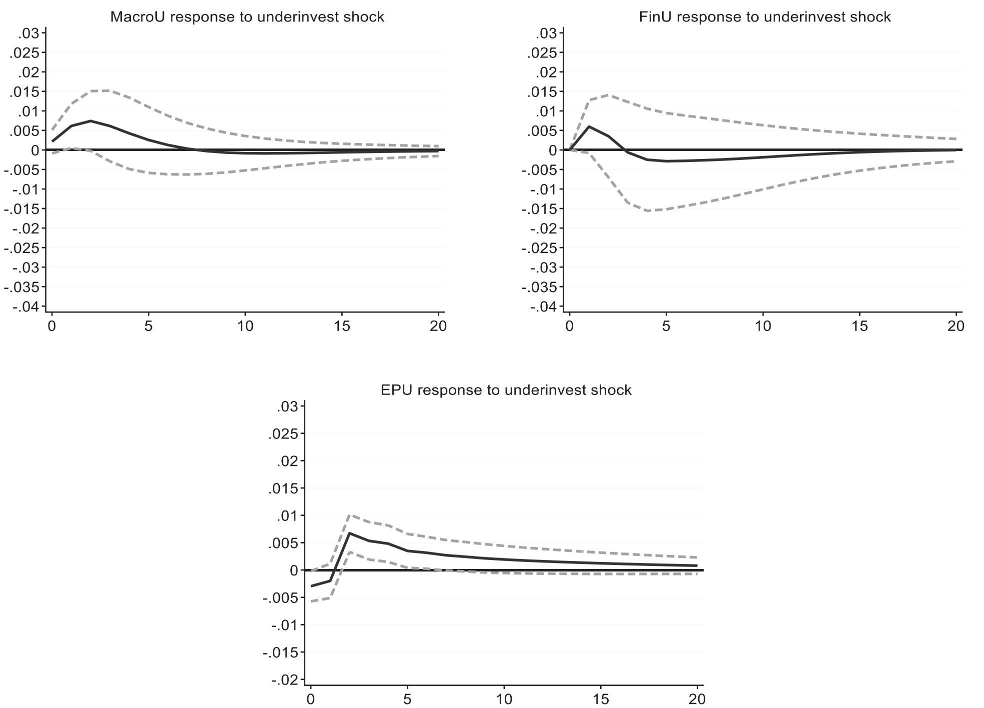


Figure A5.
Sectoral Analysis

The figure illustrates Orthogonalized Impulse Response Functions (OIRFs) depicting the impact of uncertainty measurements on (i) Underinvestment and (ii) Overinvestment shocks within the Manufacturing and Information sectors. Solid lines represent OIRFs, while dashed bands denote ± two standard errors.

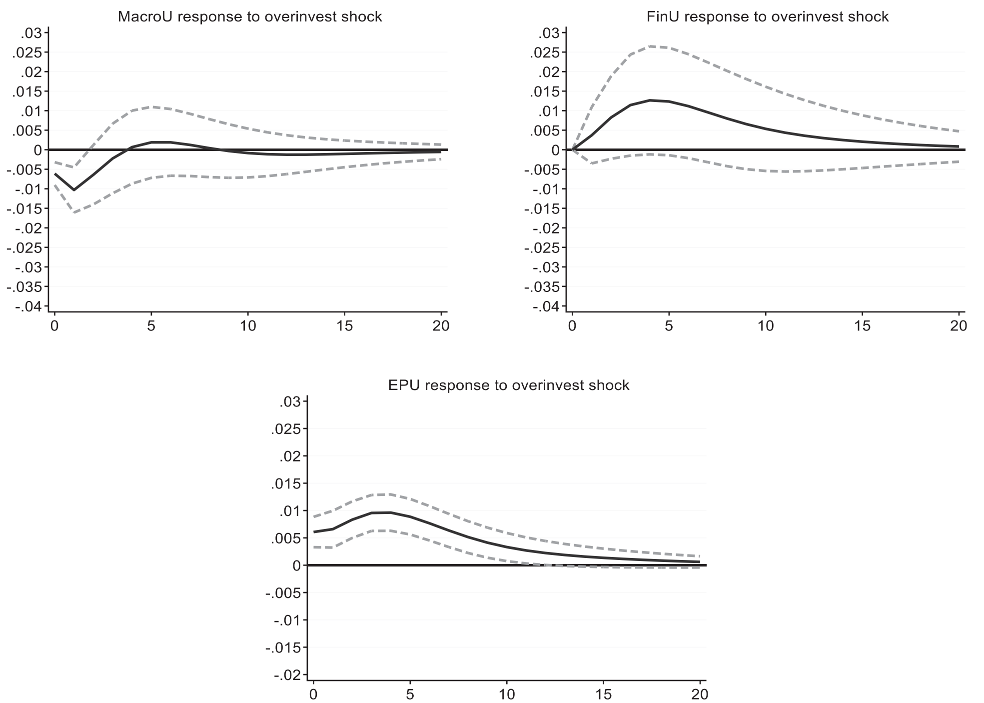
A. Manufacturing Sector
i. Underinvestment



https://bulletin.bmeb-bi.org/bmeb/vol27/iss2/4
DOI: 10.59091/2460-9196.2275

Figure A5.
Sectoral Analysis (Continued)

ii. Overinvestment



B. Information Sector
i. Underinvestment

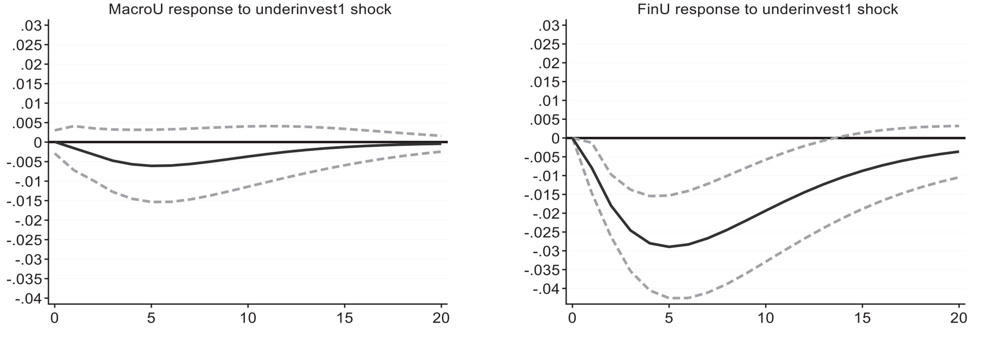
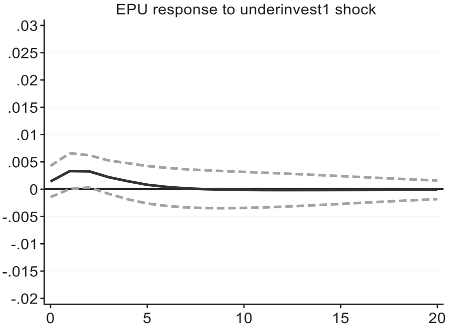
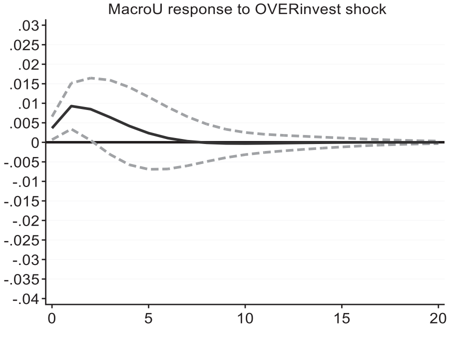
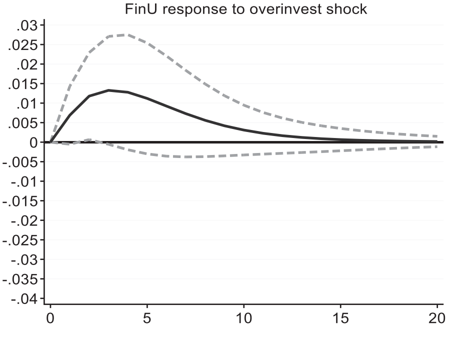


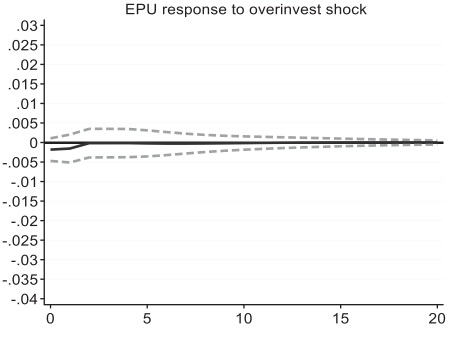
Figure A5.
Sectoral Analysis (Continued)



ii. Overinvestment







https://bulletin.bmeb-bi.org/bmeb/vol27/iss2/4
DOI: 10.59091/2460-9196.2275