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Beneath the surface: The asymmetric effects of unconventional monetary policy on corporate investment

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ABSTRACT

This paper explores the asymmetric effects of unconventional monetary policy on corporate investment in the aftermath of the Great Recession. Using a comprehensive dataset of US listed firms, our research unveils a compelling insight: firms with higher investment irreversibility and market power are less responsive to fluctuations in corporate bond yields following an unconventional monetary policy announcement. These results emphasize the critical importance of taking into consideration firm-specific characteristics when formulating monetary policy, providing valuable insights for central banks aiming to enhance the effectiveness of their policies.

1. Introduction

The Federal Reserve has traditionally used the federal funds rate to achieve its dual mandate of maximum employment and stable prices. However, when the effective lower bound (ELB) was reached in 2008, conventional monetary policy based on policy-rate management became ineffective, undermining traditional transmission mechanisms of monetary policy. In this situation, the Federal Reserve was forced to draw upon two unconventional monetary policy tools in order to boost the economy and meet its policy objectives: large-scale asset purchases (also known as quantitative easing or QE) and forward guidance (FG).

Prior research has analyzed the impact of QE and FG on the economy as well as the potential costs and risks associated with the use of these unconventional monetary-policy tools (e.g., Kuttner, 2018; Bernanke, 2020). However, the specific effects that such tools have on corporate investments and the potential asymmetries at the micro level have not been fully explored. We address this gap by delving into the relationship between unconventional monetary policy and corporate investment using a panel of US listed firms. We find that decreases in bond yields that occur in a quarter when an expansionary QE or FG announcement is made are associated with higher levels of corporate investment. However, the response of corporate investment is not uniform across firms. Specifically, firms that have higher levels of investment irreversibility and market power are less affected by shifts in corporate bond yields that take place in the same quarter as an expansionary announcement.

Our work contributes to the existing literature in three significant ways. Firstly, we focus on exploring the dynamic relationship

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between unconventional monetary policy and firm-level investments. Prior research has primarily studied either the effects of unconventional monetary policy on aggregate investment (e.g., Khemraj and Yu, 2016) or the influence of conventional monetary policy on corporate investment at the micro level (e.g., de la Horra et al., 2021). Foley-Fisher et al. (2016) use a panel of US firms to examine the impact of unconventional monetary policy on the financial constraints of businesses. However, our paper differs from Foley-Fisher et al. (2016) by centering our attention on the asset side of firms' balance sheet. Secondly, we employ the panel VAR methodology developed by Holtz-Eakin et al. (1988), which, to the best of our knowledge, has not been previously utilized to scrutinize the asymmetric effects of unconventional monetary policy on corporate investment. Lastly, we leverage the insights from the real options literature to investigate how monetary policy affects firms characterized by three specific attributes: investment irreversibility, operating inflexibility, and market power (Bontempi et al., 2009; Grullon et al., 2012; Gulen and Ion, 2016).

2. Empirical analysis

2.1. Data

We draw upon two types of data. First, the monetary policy indicator is sourced from the Federal Reserve Bank of St. Louis. Second, we resort to a balanced panel of US listed firms from Refinitiv. Specifically, we have quarterly financial data from 5,048 public firms over the period 2000–2018. Following Pindado et al. (2011), financials and utilities are excluded.

2.2. Econometric model

The relationship between unconventional monetary policy announcements and corporate investment is analyzed using the following reduced-form panel-VAR model (Holtz-Eakin et al., 1988):

$$I_{i,t} = \sum_{j=1}^{p} \beta_j I_{i,t-j} + \sum_{j=1}^{p} \gamma_j Q_{i,t-j} + \sum_{j=1}^{p} \delta_j CF_{i,t-j} + \sum_{j=1}^{p} \theta_j UMP_{t-j} + \omega_i + \nu_{i,t} \quad (1)$$

where t denotes quarter, i denotes firm, and p the lag order[1]; I is investment; Q represents Tobin's q; CF is a cash-flow variable; $UMP$is an unconventional monetary policy variable; ωis a vector of firm-specific and industry-specific fixed effects; ν is the serially-uncorrelated error term; and β, γ, δ and θ are matrices of coefficients capturing the marginal effects of the lagged variables on investment.

The advantages of panel VARs are manifold (Canova and Ciccarelli, 2013). Firstly, they effectively capture the dynamic interdependencies inherent in the model with minimal constraints. Secondly, panel VARs can be leveraged to gauge the impact of an exogenous shock in one variable on the dependent variable. Thirdly, this methodology enables the control of unobservable heterogeneity that emerges when dealing with panel data. Lastly, the assumption of endogeneity for variables eliminates the need for a priori exogeneity assumptions to estimate the model, although identifying restrictions may still be imposed to assess the effects of exogenous shocks (Abrigo and Love, 2016).

The potential endogeneity of regressors is addressed using a difference GMM estimator (Arellano and Bond, 1991). This instrumental-variable technique tackles endogeneity through two key mechanisms (Roodman, 2009). First, it allows for the transformation of the data to remove the fixed effects. Second, it uses lagged values of the endogenous variables as instruments to circumvent endogeneity. To enhance the efficiency of estimated coefficients, missing values of instruments are replaced with zeros (Holtz-Eakin et al., 1988).

We measure investment as capital expenditures in the quarter of observation divided by gross fixed assets at the beginning of the quarter ($I_{i,t}$)(Carpenter and Guariglia, 2008). The lagged dependent variable (I_{it-1})captures the accelerator effect and the investment dynamics (Aivazian et al., 2005). The ratio of enterprise value in the quarter of observation to total assets proxies Tobin's q ($Q_{i,t-1}$) (Pindado et al., 2011). Financial constraints are measured using a cash-flow variable ($CF_{i,t-1}$), calculated as after-tax profits plus depreciation normalized by gross fixed assets at the beginning of the quarter (Carpenter and Guariglia, 2008). The three variables enter the models in logarithmic and first difference form.[2][3] Finally, UMP_{t-1} is the interaction between Moody's seasoned Aaa corporate bond yield (AAA_t) and a dummy that takes the value 1 when an expansionary unconventional monetary policy announcement is made, and 0 otherwise ($dummyQEFG$).[4]As a result,

[1] Our analysis assumes the absence of any simultaneous impact of explanatory variables on investment. Consequently, it requires a minimum of one quarter for changes in monetary policy, cash flow, and Tobin's q to influence investment. This is particularly pertinent to monetary policy, as its impact on investment is typically observed with a discernible delay (Bernanke and Blinder, 1992). Without loss of generality, we consider the same lag length for all variables in all models:$p = 1$. Lag-length selection is based on three criteria for GMM models proposed by Andrews and Lu (2001): the Akaike information criterion, the Bayesian information criterion, and the Hannan–Quinn information criterion. Results are available upon request.

[2] When applying the log-transformation, zero-valued observations become missing values. Nonetheless, this does not pose a problem since fewer than 0.9 % of the observations for the three transformed variables have values of zero.

[3] Observations below the 1st percentile and above the 99th percentile are removed.

[4] Expansionary QE announcements have been retrieved from https://www.yardeni.com/chronology-of-feds-quantitative-easing/. Expansionary FG announcements can be found at the Federal Reserve website (Board of Governors of the Federal Reserve System, 2019)

$$UMP_{t-1} = (AAA_t * dummyQEFG_t)_{t-1} \quad (2)$$

We choose Moody's seasoned Aaa corporate bond yield as our monetary-policy indicator for several reasons. First, our sample exclusively includes listed firms, as they are more prone to accessing bond financing. Second, there is a strong relationship between corporate bond yields and firm-level investment (Giambona et al., 2020). Third, unconventional monetary policy was effective in lowering corporate bond yields in the aftermath of the Great Recession (Kuttner, 2018). Finally, there was a substantial increase in long-term borrowings from 2010 onwards (Fig. 1), suggesting a potential relationship between unconventional monetary and the issuance of corporate bonds.

According to the real options literature (Bontempi et al., 2009; Grullon et al., 2012; Gulen and Ion, 2016), three specific characteristics may affect corporate investment in contexts of high economic uncertainty: investment irreversibility, operating inflexibility, and opportunity costs. We measure investment irreversibility as net property, plant and equipment over total assets($PPE_{i,t}$) (Gulen and Ion, 2016). The rationale is that investments in physical assets tend to: (1) require substantial upfront costs; and (2) be specific to their line of business. Operating inflexibility ($OF_{i,t}$) is calculated as fixed costs over sales (Agrawal and Hall, 2014; Jiang et al., 2006). Firms with high fixed costs will find it more difficult to expand or contract operations in response to shifts in economic conditions. Finally, opportunity costs resulting from the loss of competitive advantages are measured using the price-cost margin ($PCM_{i,t}$) (Bontempi et al., 2009; Domowitz et al., 1986). Firms with high price-cost margins (i.e., high market power) face lower opportunity costs, since their competitive position is less vulnerable to preemptive actions by rivals. Table 1 displays summary statistics for all the above variables.

In order to determine the moderating role of investment irreversibility, operating inflexibility, and market power in the relationship between unconventional monetary policy and corporate investment, we divide the sample for each moderating variable using a dummy that takes the value 1 when the observation is above the industry median in each quarter, and 0 otherwise, and estimate orthogonalized impulse–response functions to elucidate the asymmetric impact on corporate investment of lower corporate bond yields after an expansionary announcement.[5]

3. Results

Results can be found in Figs. 2–4.[6] Figs. 1 and 2 display the effects on firm-level investment of a one-standard-deviation shock on the interaction between Aaa Moody's corporate bond yield and *dummyQEFG* for firms with low (left) and high (right) levels of investment irreversibility and operating inflexibility, respectively. Fig. 2 shows that a one-standard-deviation decrease in corporate bond yields in a quarter when an expansionary announcement is made is associated with a 20.45 % increase in corporate investment by firms with lower levels of investment irreversibility (left graph), whereas it has no effect on capital-intensive firms (right graph), as shown by the fact that the confidence intervals include the zero line (Abrigo and Love, 2016).

In contrast, the response of operationally flexible firms to lower corporate bond yields is similar to that of inflexible firms. Specifically, Fig. 3 shows that firms with lower operating inflexibility (left graph) increase their investment by 4.8 %, as opposed to 4.13 % for operationally inflexible firms (right graph). Finally, Fig. 4 displays the impact on corporate investment of a one-standard-deviation shock on the interaction variable for firms with lower (left graph) and higher market power (right graph). Results indicate that firms with higher market power are less sensitive to lower corporate bond yields after an expansionary announcement than low-market-power firms. Specifically, an expansionary announcement is associated with a 14.66 % increase in corporate investment of firms with low market power, whereas the same shock has no impact on high-market-power firms.

These findings are consistent with the corporate-bond lending channel (Giambona et al., 2020). Unconventional monetary policy exerts downward pressure on corporate bond yields through portfolio balance effects, which in turn incentivizes firms to increase capital investments. However, adhering to the tenets of real option theory, this impact exhibits heterogeneity among firms. Specifically, firms characterized by higher investment irreversibility and market power are less responsive to shifts in corporate bond yields resulting from unconventional monetary-policy announcements.

4. Conclusion

In the aftermath of the Great Recession, the Federal Reserve was compelled to resort to two unconventional monetary policy tools: quantitative easing and forward guidance. In this paper, we analyze the effectiveness of these tools in stimulating investment at the firm level. We find that corporate investment is less responsive to shifts in corporate bond yields after an expansionary announcement for firms with higher levels of investment irreversibility and market power. Our results suggest that monetary authorities should incorporate these asymmetric effects when estimating the potential impact of their policies on corporate investment. Finally, our findings are not without limitations. Estimating the effects of QE and FG is an inherently difficult task since markets tend to anticipate central-bank policies (Belke et al., 2017). Consequently, relying solely on announcements may not comprehensively capture the true impact of unconventional monetary policies on corporate investment. Furthermore, our monetary-policy variable may not fully identify surprise changes in FG and QE announcements, as illustrated by Swanson (2021).[7] To address this, future research could

[5] We opt for the median as the cutoff point to highlight the asymmetric effects of the moderating variables distributions on investment.

[6] Appendix A contains the estimated models corresponding to Figs. 2–4 (Table A1). All models meet the stability condition. Stability tests can be found in the Appendix, Fig. A1.

[7] We thank an anonymous reviewer for bringing this limitation to our attention.

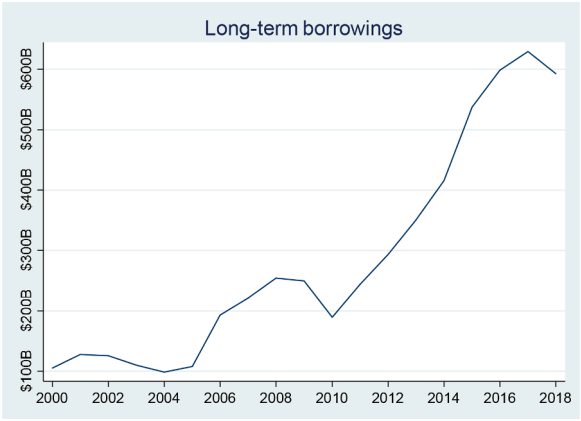

Fig. 1. Evolution of long-term borrowings in our sample over the period 2000–2018.

Table 1
Summary statistics.

Variable	Mean	Median	St. dev.	Maximum	Minimum	Observations
$I_{i,t}$	0.03	0.0171	0.0444	0.4330	0	42,151
$Q_{i,t}$	7.97	1.8	32.11	496.9	0.5481	181,707
$CF_{i,t}$	−0.5824	0.0247	2.931	1.319	−38.47	40,979
AAA_t	5.088	5.235	1.151	7.77	3.34	76
$PPE_{i,t}$	0.2515	0.153	0.2586	0.9553	0	187,100
$OF_{i,t}$	1.89	0.3053	7.72	105.6	0.0178	155,624
$PCM_{i,t}$	0.4501	0.42089	0.2997	1	−1.767	167,278

Summary statistics for investment ($I_{i,t}$), Tobin's Q ($Q_{i,t}$), cash flows ($CF_{i,t}$), and Moody's seasoned Aaa corporate bond yield (AAA_t), plant, property, and equipment over total assets ($PPE_{i,t}$), fixed costs over sales ($OF_{i,t}$), and the price-cost margin ($PCM_{i,t}$). The sample comprises 5,048 US publicly traded firms. Financials and utilities are excluded from the sample. The period covered spans 2000Q1 to 2018Q4.

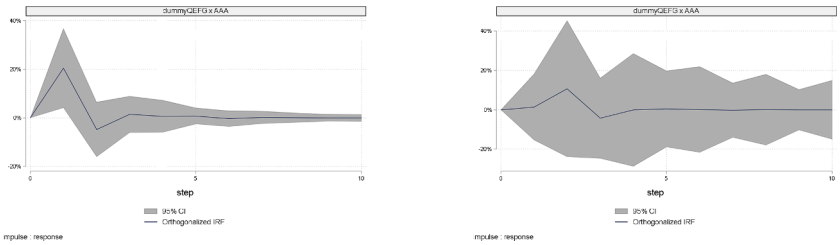

Fig. 2. Orthogonalized impulse–response functions (IRFs). Response of corporate investment to a one-standard-deviation shock to the interaction between a dummy that takes the value 1 when either an expansionary QE or FG announcement is made (*dummyQEFG*) and Moody's Aaa corporate bond yield for firms with low (left) and high (right) investment irreversibility.

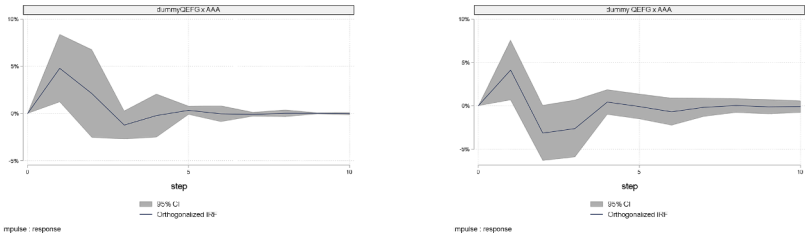

Fig. 3. Orthogonalized impulse–response functions (IRFs). Response of corporate investment to a one-standard-deviation shock to the interaction between a dummy that takes the value 1 when either an expansionary QE or FG announcement is made (*dummyQEFG*) and Moody's Aaa corporate bond yield for firms with low (left) and high (right) operating inflexibility.

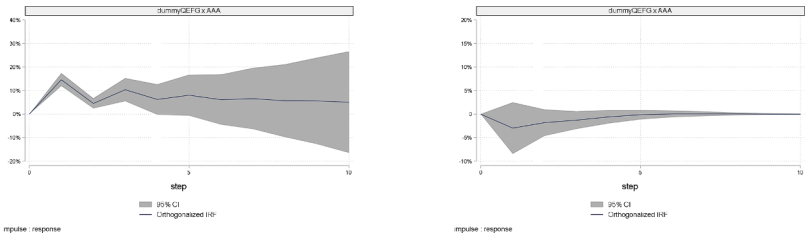

Fig. 4. Orthogonalized impulse–response functions (IRFs). Response of corporate investment to a one-standard-deviation shock to the interaction between a dummy that takes the value 1 when either an expansionary QE or FG announcement is made (*dummyQEFG*) and Moody's Aaa corporate bond yield for firms with low (left) and high (right) market power.

integrate Swanson (2021)'s unconventional monetary policy measures alongside the panel VAR methodology employed in this paper. This approach would likely provide a more nuanced understanding of the dynamics at play in the realm of unconventional monetary policy and its influence on corporate investment

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CRediT authorship contribution statement

Luis P. de la Horra: Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Javier Perote:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing. **Gabriel de la Fuente:** Conceptualization, Data curation, Formal analysis, Funding acquisition, Investigation, Methodology, Project administration, Resources, Software, Supervision, Validation, Visualization, Writing – original draft, Writing – review & editing.

Declaration of competing interest

We affirm that we have no conflicts of interest or financial affiliations that could influence the interpretation of our findings, the conduct of our research, or the presentation of our results. This paper is solely based on the objective pursuit of knowledge and the advancement of science

Data availability

The authors do not have permission to share data.

Appendix A

See Fig. A1

Table A1
Panel VAR estimations: Figs. 2–4.

	Model 1		Model 2		Model 3	
	Investment irreversibility $PPE_{i,t}$		Operating inflexibility $OF_{i,t}$		Market power $PCM_{i,t}$	
	Low	High	Low	High	Low	High
$I_{i,t-1}$	0.0927	−0.2185	0.3099***	0.1619*	0.3328***	0.4423***
	(0.1874)	(0.2452)	(0.1131)	(0.0971)	(0.0535)	(0.1146)
$Q_{i,t-1}$	2.111***	−1.091	−1.472***	−0.2095	−1.501***	−0.9349*
	(0.5837)	(1.227)	(0.5242)	(0.4774)	(0.2483)	(0.5614)
$CF_{i,t-1}$	0.3396	0.1315	0.1321**	−0.6301***	−0.2443***	−0.2731**
	(0.2199)	(0.2072)	(0.0572)	(0.0557)	(0.0214)	(0.1152)

(*continued on next page*)

Table A1 (*continued*)

	Model 1		Model 2		Model 3	
	Investment irreversibility $PPE_{i,t}$		Operating inflexibility $OF_{i,t}$		Market power $PCM_{i,t}$	
	Low	High	Low	High	Low	High
UMP_{t-1}	−0.12.51**	−0.0074	−0.0307**	−0.0215**	−0.0873***	−0.0168
	(0.0613)	(0.0446)	(0.0177)	(0.0117)	(0.0089)	(0.0158)
Hansen'sJstatistic	58.48	57.14	91.2	106.2	93.02	107.93
$p-value$	0.671	0.716	0.618	0.223	0.567	0.191
Degreesoffreedom	64	64	96	96	96	96

Investment ($I_{i,}$), measured as capital expenditures in the quarter of observation divided by gross fixed assets at the beginning of the quarter, is the dependent variable. Tobin's Q (Q_i) is the ratio of enterprise value in the quarter of observation to total assets. Cash flow (CF_i) is calculated as after-tax profits plus depreciation normalized by gross fixed assets at the beginning of the quarter. The three variables enter the models in logarithmic and first difference form. Finally, the unconventional monetary policy indicator (*UMP*) is the interaction between Moody's seasoned Aaa corporate bond yield (AAA_t) and a dummy that takes the value 1 when an expansionary unconventional monetary policy announcement is made, and 0 otherwise. We divide the sample for $PPE_{i,t}$, $OF_{i,t}$, and $PCM_{i,t}$ using a dummy that takes the value 1 if the observation is above the industry median in each quarter (high), and 0 otherwise (low). *, **, and *** indicate statistical significance at 10, 5, and 1 %, respectively. Standard errors are in parentheses. All variables in levels lagged from $t-4$ to $t-8$ (Model 1) and from $t-2$ to $t-8$ (Models 2 and 3) are used as instruments for the variables of the models in differences. Hansen's J statistic tests the null hypothesis of the joint validity of instruments (Hansen, 1982).

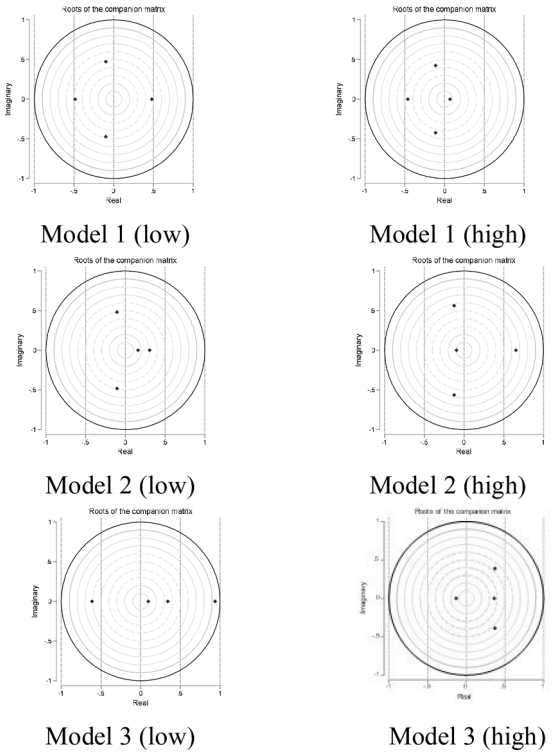

Fig. A1. Stability tests corresponding to Table A1. All the eigenvalues lie inside the unit circle. Therefore, all models satisfy the stability condition.

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