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Research Paper

Stock market responses to monetary policy shocks: Firm-level evidence[☆]

K. Peren Arin [a,b], Samuel Kaplan [c,d], Efstathios Polyzos [a,b], Nicola Spagnolo [b,e,f,*]

[a] *Zayed University, United Arab Emirates*
[b] *Centre for Applied Macroeconomic Analysis (CAMA), Australia*
[c] *National University of Cordoba, Argentina*
[d] *Universidad de San Andres, Argentina*
[e] *Department of Economics and Finance, Brunel University of London, UK*
[f] *Dipartimento di Economia, Università degli Studi della Campania "Luigi Vanvitelli", Italy*

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ABSTRACT

Using a firm-level data set for the U.S., we investigate the stock price responses to unanticipated and unconventional monetary policy shocks. Our results show that indebtedness/leverage is more important than size or age in explaining the cross-firm variation in responses to monetary policy. We also show that the magnitude of the indebtedness is important while the debt structure is not, and the third quartile of firms drives our results. We assess the robustness of our empirical findings across several dimensions.

1. Introduction

Since the financial and economic crises of 1997–1999 and 2007–2009, academics and policymakers alike have been interested in the effects of monetary policy on asset prices and whether expansionary monetary policy can fuel financial market bubbles. Bernanke and Gertler (1999) argue that "*in a world of efficient capital markets and without regulatory distortions, movements in asset prices simply reflect changes in underlying economic fundamentals*" and, therefore, there does not seem to be enough reason for policymakers to be concerned about the financial market volatility. The market efficiency argument, however, does not hold if non-fundamental factors, like poor regulatory practices or irrational behavior by investors, guide asset price volatility. Gilchrist and Leahy (2002) affirm that monetary policy influences financial markets by modifying future growth expectations and changing firms' ability to borrow and raise capital. Christiano et al. (2008) show that news shocks can create a boom-bust cycle in a monetized version of a real business cycle model, which contains sticky wages and a Taylor-rule based monetary policy.[1]

Recently, several studies utilized micro-level data sets to investigate the effects of macroeconomic policy shocks on major macroeconomic variables of interest like consumption, investment, and employment (Cloyne and Surico, 2016; Anderson et al.,

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* Corresponding author at: Department of Economics and Finance, Brunel University of London, UK.
E-mail address: nicola.spagnolo@brunel.ac.uk (N. Spagnolo).

[1] Caines and Winkler (2021) argue that the central banks should include even the subjective asset price beliefs in their policy-making processes. They suggest that the policy-relevant interest rate should increase with subjective asset price beliefs. The optimal monetary policy raises interest rates when expected capital gains are high but does not eliminate deviations of asset prices from their fundamental value.

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2016; Adnan et al., 2022; Holm et al., 2021; Cloyne et al., 2019). The ubiquitous use of microdata enabled researchers to control for individual or firm-level characteristics and, therefore, reconcile the cross-country variation in monetary and/or fiscal multipliers. To investigate the micro-level responses of firms to policy rate changes, one needs a panel data set that spans several years and includes many firms of varying characteristics, including detailed information about firm balance sheets. Recent studies show that it is essential to use granular data to assess the relative importance of monetary policy transmission channels. Choi et al. (2024) show that changes in monetary policy tend to have a bigger impact on industries where it is harder to use assets as collateral or where there are lots of small businesses, which is consistent with the credit channel. Industries making durable goods also see significant effects, which aligns with the interest rate channel. Finally, during economic downturns and in countries with less developed financial systems, the influence of the credit channel is even more pronounced. This fits with the idea of a financial accelerator, where financial conditions amplify the impact of economic changes.

Under this prism, this paper uses a thorough dataset, including data for all publicly listed, non-financial firms in the US. This allows us to investigate the heterogeneous effects of monetary policy innovations on different "groups" of firms and, therefore, can reconcile the prior mixed evidence provided by the literature to a certain extent. Therefore, our data set, considering all listed US firms, excludes the possibility of a sample selection bias.

Our results show that, among the three firm-level variables considered, indebtedness/leverage is the most important underlying factor that would help us understand the cross-firm variation in the stock price responses to monetary policy shocks. While the share prices of firms with a high debt/asset ratio react strongly to monetary shocks, firms with lower debt levels do not show a large response, both in terms of magnitude and significance. Further analysis shows that these results are driven by the third quartile of firms (in terms of their indebtedness), and the sheer size of the debt (rather than its structure).

The layout of the paper is the following: Section 2 provides a review of the relevant literature and the hypotheses tested; Section 3 describes the data; Section 4 outlines the methodology whereas the empirical results, including robustness checks, are discussed in Section 5; Section 6 offers some concluding remarks

2. Literature review

We are not the first to empirically investigate whether monetary policy shocks can affect financial markets. Rigobon and Sack (2004) show that an increase in short-term interest rates results in a decline in stock prices and in an upward shift in the yield curve that becomes smaller at longer maturities, which is consistent with Thorbecke (1997) who documents that an expansionary monetary policy shock increases both ex-ante and ex-post stock returns. Similarly, Ioannidis and Kontonikas (2008) investigate the impact of monetary policy on stock returns in 13 OECD countries over 1972–2002 and contend that monetary policy shifts significantly affect stock returns, even after controlling for alternative measures of stock returns, non-normality, and co-movement among international stock markets. Li et al. (2010) document some cross-country variation in the response of composite stock market indices to monetary policy shocks. They found that financial market openness drives the differences in dynamic responses to monetary policy shocks. Bjornland and Leitemo (2009) argue that there is mutual causality between monetary shocks and stock prices; real stock prices fall by seven to nine percent due to a monetary policy shock that raises the federal funds rate by 100 basis points while a one percent increase in stock prices leads to an increase in the interest rate of 4 basis points. On the contrary, Bouakez et al. (2013) uses a structural vector auto-regression that relaxes the commonly imposed restrictions and argues that the interaction between monetary policy and stock returns is much weaker than suggested by the earlier literature. Sleibi et al. (2023) uncover a transmission mechanism between unconventional monetary policy and credit in the Euro area while other studies examine the response of asset prices in general to monetary policy and find mixed results (Dwyer et al., 2023; Herwartz and Roestel, 2022; Marmora, 2022).

The mixed evidence provided by the studies mentioned above shows there is no consensus on the transmission mechanisms of monetary policy into the financial markets. One should also note that the mixed evidence provided so far has been based on macro-level data, often plagued by aggregation problems. Only recently, the ever-increasing availability of granular data helped researchers to explain the cross-country variation in responses to macroeconomic shocks in different countries. The so-called "micro-data revolution" can help us understand how different economic agents react differently to macroeconomic shocks, based on several individual factors such as income or financial constraints. Cloyne et al. (2019), for instance, show that households with mortgages drive the aggregate consumption response to interest rate changes. Similarly, Cloyne and Surico (2016) show that households with mortgage debt exhibit large and significant consumption responses to tax changes. Conversely, homeowners without a mortgage do not exhibit a significant response. Anderson et al. (2016) points out that consumption responses to a positive government shock are consistent with Real Business Cycle (RBC) models for wealthy consumers and Non-Ricardian/Keynesian models for poor consumers. On the firm side, Gertler and Gilchrist (1994) in their seminal paper, show that firms are similar to consumers because small firms respond to monetary policy innovations more than larger firms. Ehrmann and Fratzscher (2004) is among the first studies that show the heterogeneous response of individual stocks to monetary policy shocks may be due to financial constraints. In a similar vein, Choi et al. (2024) demonstrate that monetary policy shocks tend to exert a greater influence on industries characterized by difficulties in using assets as collateral or a prevalence of small businesses, as well as sectors producing durable goods. Kim and Rescigno (2017) document that expansionary shocks particularly benefit distressed firms and increase market values for firms requiring external financing. Chava and Hsu (2019) show that not only the magnitude but also the timing of stock price responses may change with financial constraints. They show that differential return response between constrained and unconstrained firms appears after a delay of 3 to 4 days. Benchimol et al. (2023) provides another plausible explanation for the above-mentioned mixed results at the macro level by documenting that the magnitude of stock prices is larger during higher policy uncertainty. The authors also show that uncertainty has an asymmetric effect: the magnifying impact of uncertainty is more pronounced for positive shocks than negative shocks. Benchimol and Ivashchenko (2021) also show that during crises like the global financial crisis, uncertainty about economic conditions can greatly affect how economies are connected.

In this paper, we focus on the effect of monetary policy on firms' stock returns and the potential variations in the individual responses of the underlying firm population. Based on the previous literature, *a priori* we can expect older firms to be less responsive to monetary policy shocks. Cloyne et al. (2023) argue that younger firms that do not pay dividends exhibit the largest and most significant response to monetary policy shocks,[2]. In addition, Crouzet and Mehrotra (2020) argue that large firms (the top 1 percent by size) are less cyclically sensitive than the rest, yet financial constraints do not explain cyclical differences. We thus expect larger firms to be less responsive to monetary policy shocks. Finally, based on Bernanke and Gertler (1999) leverage should increase the magnitude of the stock price response to monetary policy surprises. As the authors contend, the most critical connections between the financial markets and the real economy are transmitted through the balance sheet channel, as credit markets are not frictionless and it is less costly for firms with strong financial positions to be extended credit. To the best of our knowledge, no research has examined all these characteristics at the same time on a sample of US firms. We aim to fill this gap.

3. Data description

3.1. Dependent variable

The relevant variables in our work are firms' stock returns and excess returns.[3] We built our returns series from the monthly share prices of public firms within the Compustat database, while excess returns for the shares of each company were computed as the monthly difference between the return for each firm and that of the S&P 500 index (which is considered as representative of the market portfolio):

$$ER_t = R_t - R(S\&500)_t \tag{1}$$

Data on the S&P 500 was also extracted from Compustat. The sample size for returns of each company depends on the number of months, starting in January 1990, that each firm has been public, meaning that the company's stock was traded in a public exchange like the New York Stock Exchange or Nasdaq. The analyzed period extends between January 1990 and December 2020, coinciding with the available time frame for the monetary policy shocks series. The total number of firms included in the sample is 15,510, and each company is considered only in the periods when it was public. Following standard practice (Loughran and Ritter, 1997; Black et al., 2006; Strebulaev and Yang, 2013), we exclude financial firms,[4] since their asset and debt structures are different from non-financial firms, thus hindering comparability (Chodorow-Reich, 2014).[5]

We choose excess returns over returns since the former would better proxy firm-level responses. Total stock returns will include market reactions to monetary policy shocks and may mask (or obfuscate) the actual underlying response of each firm. This approach is apposite when firm-level responses are examined (Patelis, 1997; Bredin et al., 2007; Li and Palomino, 2014).

3.2. Independent variables

We consider two different measures for monetary policy innovations. The first monetary policy measure that we use is by Bu et al. (2021), which we label BRW from here on. To construct their monetary policy shocks series, the authors follow a Fama-MacBeth two-step procedure. In the first stage, they estimate the impact of the unobserved policy shock on the full maturity structure of Treasury bonds. They use the 2-year treasury yield as an instrument for the unobserved monetary surprise because it not only captures crucial aspects of the Fed's monetary policy, but it also captures the possibility of reducing the Fed's information effect (information about central bank forecasts of economic fundamentals) as it is a short term rate. The first stage of regression is then:

$$\Delta R_{i,t} = \theta_i + \beta_i \Delta R_{2,t} + \xi_i \tag{2}$$

where $R_{i,t}$ stands for the change in the zero coupon yield with maturity i, and ξ_i is an error term that includes factors related to the Fed's information effect and is correlated to $R_{2,t}$ (the 2-year yield). All series are built using data for yields in a 1-day window around FOMC announcements, starting in 1994.

Finally, to recover the unobserved shock, the authors run the following regression using the β_i coefficients estimated previously as regressors:

$$\Delta R_{i,t} = \alpha_i + e_t \beta_i + \upsilon_i \tag{3}$$

[2] Thus, we expect small/young firms to be more sensitive to monetary shocks.

[3] Excess returns, as used in this paper, do not include dividends. This is a particularly important consideration when analyzing firms by age and size, as older and larger firms are more likely to distribute dividends, which could affect their overall return performance.

[4] Following Strebulaev and Yang (2013) we consider financial firms to be those with Standard Industrial Classification (SIC) codes in the region 6000–6999.

[5] Chodorow-Reich (2014) argues that high-frequency event studies show that the introduction of unconventional monetary policy in the winter of 2008–09 had a strong, beneficial impact on banks and, especially, on life insurance companies, thus leading to a markedly different impact of monetary policy shocks on financial firms concerning non-financial firms.

The series of estimated e_t are the policy shocks, that we use in our exercise, and they are meant to proxy "unconventional" monetary policy innovations, same as Bu et al. (2021) which identify monetary policy changes at the zero lower bound.[6] This is also consistent with Ippolito et al. (2018) who show that firms with greater unhedged bank debt, particularly constrained ones, exhibit a stronger response to monetary policy, with this effect primarily driven by outstanding bank loans rather than new ones, and notably diminishing in significance at the zero-lower bound. The series span from January 1994 to December 2020.

The other monetary policy shock measure used in our analysis uses the dynamic VAR framework proposed by Gertler and Karadi (2015). This measure is based on the seminal work of Kuttner (2001) and uses high-frequency changes in the federal funds rate around FOMC announcements to identify policy shocks. In particular, the proposed measure is:

$$(E_t i_{t+j})^u = f_{t+j} - f_{t+j-1} \tag{4}$$

where $(E_t i_{t+j})^u$ is the surprise in the Fed funds futures rates, while f_{t+j} represents the j months forward federal funds futures rate after any FOMC announcement, with $j = 0$ corresponding to the current month federal funds rate, and f_{t+j-1} being the monthly rate before the announcement. The monetary policy surprise is measured in a 30-minute window around the FOMC announcement. We follow the methodology used in Gertler and Karadi (2015), and resort to the 3-month forward federal funds futures rate, labeling it (following the authors) as FF4. One can think of this measure as a proxy for "unanticipated" monetary policy shocks as Gertler and Karadi (2015) isolates unexpected variations in monetary policy by using high-frequency interest rate surprises.

Both measures consider a positive monetary policy shock to represent an unexpected increase in interest rates. This is the approach considered in our analysis.

3.3. Binning variables

We use three firm-level variables as binning variables to better gauge the impact of monetary policy surprises on excess returns: Age, Leverage, and Size. All three variables were extracted and/or computed from the Compustat database. We built the age series for each firm as the number of months since the first time the company appeared in the data set, regardless of whether the firm was public or not. For leverage, we use the ratio of total debt over assets,[7] while we measure company size using firm total assets (expressed in USD millions) at each data point. The average number of months for all firms in our sample is 188 (15 years and eight months), with an average of total assets across firms worth USD 834.3mn and mean debt to assets equal to 55%.

3.4. Control variables

We consider several control variables to isolate the impact of monetary policy shocks. First, to account for the effect of financial market uncertainty on stock returns, we used the VIX series as a proxy for US stock market volatility. The series is monthly and was extracted from the Chicago Board of Exchange (CBOE). Simultaneously, to control for the impact of inflation on asset prices, we used the monthly series of CPI and PPI, both of which were extracted from the Bureau of Labor Service (BLS) database. We also used the economic policy uncertainty index (EPU) for the US ((Baker et al., 2016) - available at www.policyuncertainty.com) to control the impact of policy measures on firms' valuation. De Pooter et al. (2021) shows that policy uncertainty plays an important role in the transmission mechanisms for monetary shocks. The series is monthly and starts in January 1985. Thus we employed this control variable for the whole sample period.

4. Methodology: Impulse responses by local projection

We use the local projection methodology introduced by Jordà (2005) to construct impulse response functions to monetary shocks. This involves running separate regressions for each period, following the shock, throughout the impulse response horizon. We calculate impulse responses for eight months following an unanticipated or unconventional monetary policy innovation. The baseline specification is as follows:

$$\Delta y_{i,t+k} = \alpha_k + X_{i,t-1}\beta_k + NS_t\gamma_k + \epsilon_{i,t+k} \tag{5}$$

where $\Delta y_{i,t+k}$ is the stock returns per firm i and k are periods after a reference period t. All results are based on clustered standard errors by time, as firms are expected to respond contemporaneously to any confounding shocks in the same period. The explanatory variable of interest is NS_t, or monetary policy shocks. We consider two alternative measures of monetary shocks from Bu et al. (2021), Gertler and Karadi (2015), as mentioned earlier. The matrix $X_{i,t-1}$ includes various firm-specific control variables, such as age, size, and debt, along with VIX, as a proxy for global financial markets uncertainty, inflation rate, and seasonal fixed effects.

We also control for asymmetric effects, such as firm size, age, debt level, in turn. For instance, letting $s \in \{small, large\}$ denote firm size class – divided at the median of total asset value[8] – we consider the following specification:

$$\Delta y_{i,t+k} = \alpha_{s,k} + X_{s,i,t-1}\beta_{s,k} + NS_t\gamma_{s,k} + \epsilon_{s,i,t+k} \tag{6}$$

[6] Many recent studies use BRW as a benchmark measure for identifying unconventional monetary policy innovations. Please see Iwanicz-Drozdowska and Rogowicz (2022), Di Giovanni and Hale (2022), Iwanicz-Drozdowska and Rogowicz (2022).

[7] The terms leverage, debt, and indebtedness are used interchangeably throughout the text to signify leverage as defined by total debt over assets.

[8] This approach has been used by several other recent papers, like Eskandari and Zamanian (2020), Arin et al. (2023).

Table 1
Summary statistics.

Variables	Mean	Std. Dev.	Stationary
Dependent			
Stock Returns	−0.004	0.177	Yes
Excess Stock Returns	0.027	2.411	Yes
Monetary Policy			
BRW	−0.002	0.034	Yes
FF4	−0.014	0.049	Yes
Control			
VIX	19.52	7.68	Yes
EPU	122.8	59.9	Yes
Inflation (CPI, % yoy)	0.024	0.013	Yes
Inflation (PPI, % yoy)	0.019	0.048	Yes
Binning			
Age (Months)	187.7	145.5	–
Debt (Leverage)	0.55	0.99	–
Size (USD mn)	834.3	4,361.8	–
Size (USD mn - ln)	4.5	2.1	–

Notes: Monthly data for 15,510 U.S. publicly listed firms from January 1990 to December 2020. Stationarity has been tested utilizing Augmented Dickey–Fuller and Maddala-Wu panel tests.

which allows for unrestricted asymmetric responses to monetary innovations by firm size classes. The same approach is used for firms' age and indebtedness.

The impulse response function results show responses of stock returns (excess returns) to a monetary policy shock at time $t = 0$. All impulse responses are changes in an outcome variable compared to time zero. The impulse responses that we calculate are average responses across all firms. Firms enter and leave the sample at different times; therefore, we restricted our sample to firms that were present through the entire impulse response horizon. As a robustness check, we considered replacing missing entries with zeros.[9] These two approaches eliminate the problem of firm selection into and out of the sample in response to monetary shocks. We note here that it is reasonable to expect monetary policy shocks to affect the survival probabilities of the underlying firm population, with the effect expected to be stronger for high-debt firms. However, should a firm exit the sample (for instance, due to bankruptcy or delisting), the impact on the firm (excess) returns will normally be recorded before the firm's exit. In other words, first, we would note the (negative) impact on the share price (and thus returns), and then the firm would be delisted and exit the sample. Consequently, we argue that our approach captures the impact of monetary policy shocks on firms prior to their exit from the sample.

5. Empirical analysis

5.1. Data description

As already mentioned, we use monthly data for 15,510 publicly listed U.S. firms, from January 1990 to December 2020. Summary descriptive statistics for all variables are presented in Table 1. As a precondition for running the local projection estimation, variables are expected to be stationary. All series have been tested for the presence of a unit root by means of the Augmented Dickey–Fuller (ADF) test (Cheung and Lai, 1995), for the control variables, and Maddala-Wu panel unit root test (Maddala and Wu, 1999) for firms' excess stock returns. Results indicate that all series are stationary at the 5% significance level.

5.2. Main results

We now present the impulse response function results based on firms' characteristics. We use the Bu et al. (2021) measure (BRW) of monetary policy as the main indicator of monetary policy shocks to account for ''unconventional'' monetary policy shocks. Given the Taylor rule, we consider only uni-directional effects from monetary policy surprises to stock market excess returns. When setting the Federal Funds rate, the Taylor rule takes into account deviations from inflation and output targets, therefore ignoring any input from the stock market. On that ground, any shock from stock markets onto monetary policy can be expected to be negligible (Orphanides, 2003). We test the validity of our findings using FF4 as an alternative monetary policy measure (Gertler and Karadi, 2015).

In this section, we report the responses of firms to monetary policy shocks grouped by each of our binning variables (age, size and debt) by using impulse response functions, demonstrating the impact the shock to firm excess return in the eight months following the monetary policy shock. If the responses are not statistically significant (i.e., a zero response is included in the 95% confidence

[9] In this case, we include all firms, including those who were not listed during the impulse response horizon. Once a firm disappears, we set its investment to zero for subsequent periods.

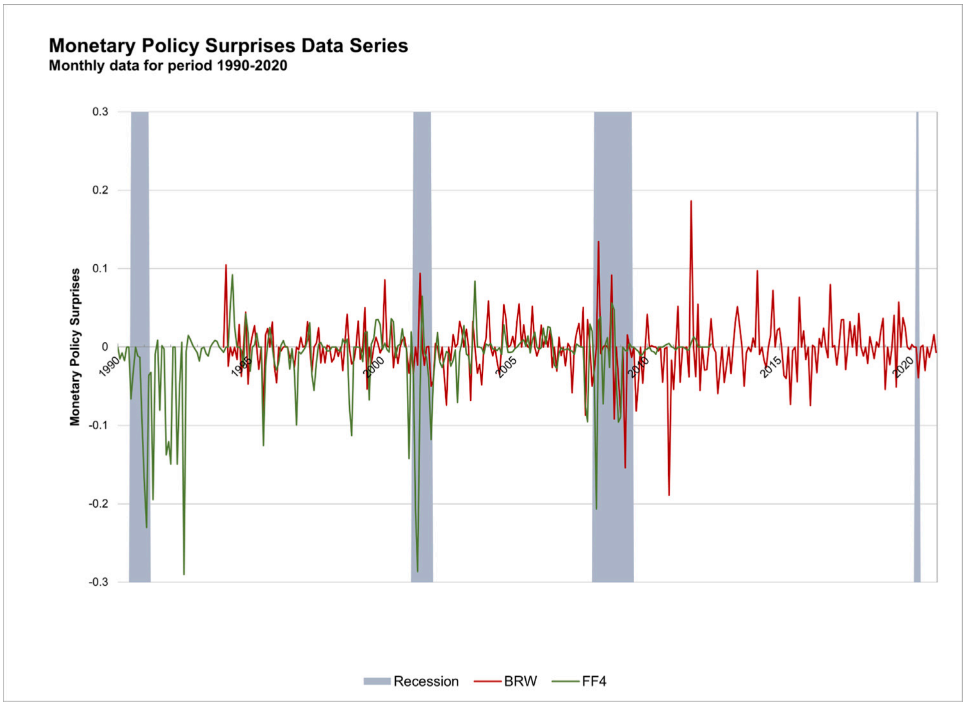
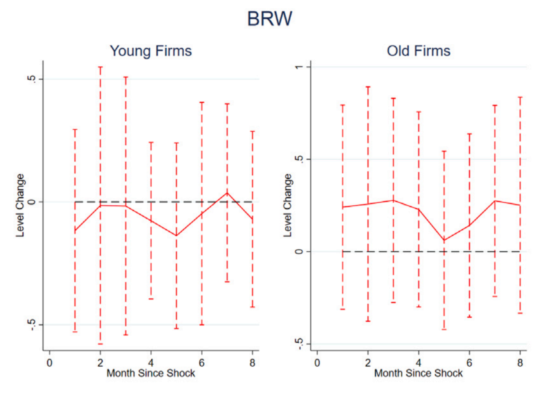
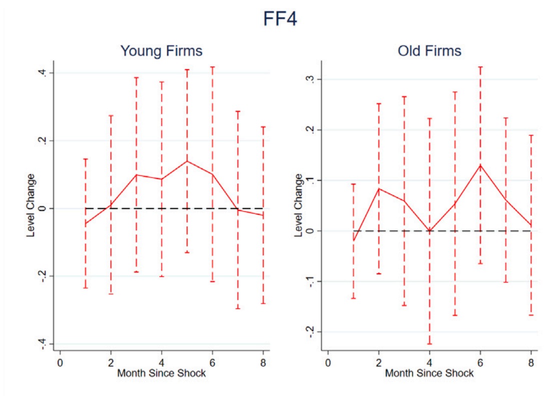


Fig. 1. Monetary Policy Surprises Data Series (BRW and FF4).
Notes: This figure shows the monetary policy surprises data series for the BRW (red line) and FF4 (green line) measures. The shaded areas highlight recession periods. (For interpretation of the references to color in this figure legend, the reader is referred to the web version of this article.)



(a) Using the BRW measure of Monetary Policy Shocks

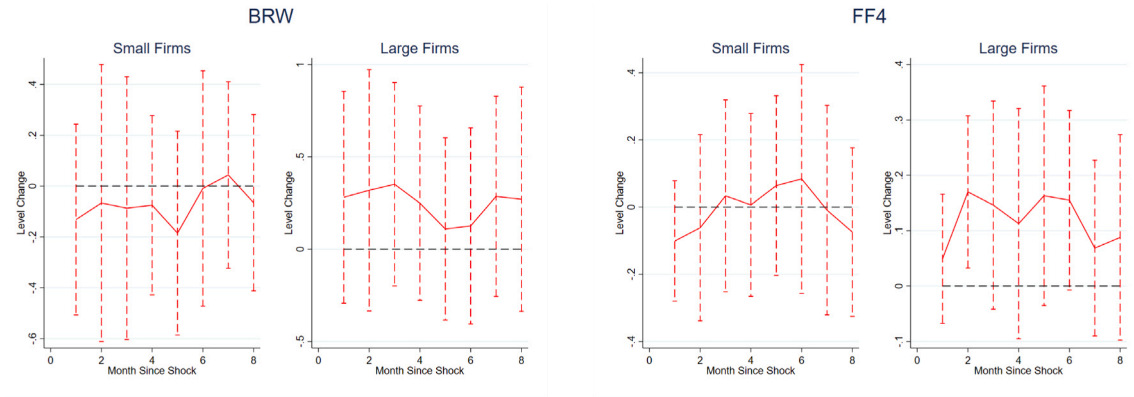


(b) Using the FF4 measure of Monetary Policy Shocks

Fig. 2. Impulse Responses of Excess Returns by Age.
Notes: This figure shows the impulse responses (using local projections) of excess returns to monetary policy shocks for firms grouped by age. Panel (a) shows the responses to the BRW measure while Panel (b) shows the responses to the FF4 measure. The solid line represents the baseline response for each group, while the dashed lines demonstrate the 95% confidence interval at each time period.

interval), then the binning variable cannot be considered to be as a potential explanatory factor for the cross-firm variation in the response to monetary policy shocks. On the other hand, if there is a significant response within one of the groups, this would suggest that that particular factor plays a vital role in explaining how monetary policy shocks impact different firms in an asymmetric manner. The same would be true if significant responses exist in both sub-samples, but are different in timing, magnitude, or direction.

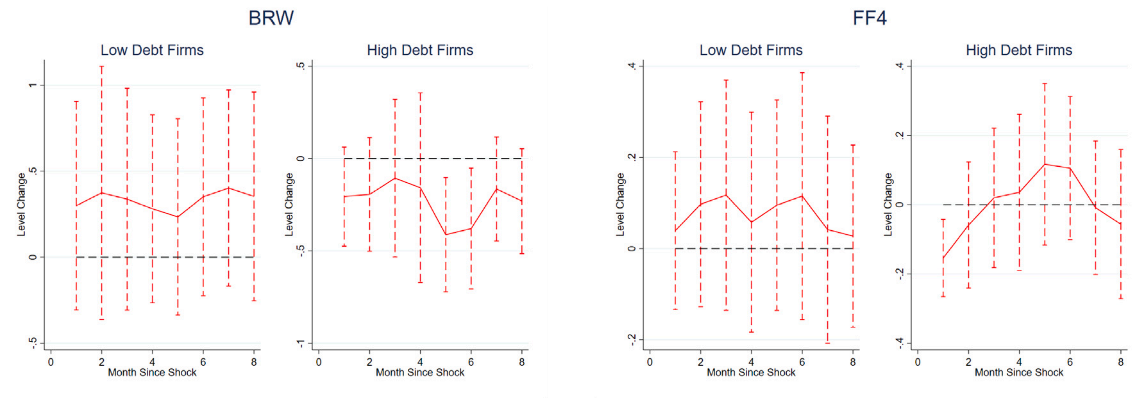
Fig. 2 shows the impulse responses for firms clustered by age, as suggested by Cloyne et al. (2023). We can see that significant responses to monetary policy shocks are noted for any of the sub-samples, regardless of the monetary policy shock measure (BRW



(a) Using the BRW measure of Monetary Policy Shocks

(b) Using the FF4 measure of Monetary Policy Shocks

Fig. 3. Impulse Responses of Excess Returns by Size (Total Assets).
Notes: This figure shows the impulse responses (using local projections) of excess returns to monetary policy shocks for firms grouped by size, using the natural logarithm of total assets as the binning variable. Panel (a) shows the responses to the BRW measure while Panel (b) shows the responses to the FF4 measure. The solid line represents the baseline response for each group, while the dashed lines demonstrate the 95% confidence interval at each time period.



(a) Using the BRW measure of Monetary Policy Shocks

(b) Using the FF4 measure of Monetary Policy Shocks

Fig. 4. Impulse Responses of Excess Returns by Debt (Debt to Assets ratio).
Notes: This figure shows the impulse responses (using local projections) of excess returns to monetary policy shocks for firms grouped by their debt-to-assets ratio. Panel (a) shows the responses to the BRW measure while Panel (b) shows the responses to the FF4 measure. The solid line represents the baseline response for each group, while the dashed lines demonstrate the 95% confidence interval at each time period.

or FF4). This suggests that firm age does not appear to play a significant role in explaining the cross-firm variation in financial responses to unanticipated and unconventional monetary policy shocks.

We now consider firm size, as suggested by Gertler and Gilchrist (1994), Crouzet and Mehrotra (2020), as a potential variable of interest in explaining cross-firm variation in responses. Firms are now clustered by size, meaning that we use the natural logarithm of total assets as the binning variable and the results are demonstrated in Fig. 3. Similarly to age, the impact of monetary policy shocks on excess returns is not statistically significant, regardless of the measure used. We note that when the FF4 measure is used, there appears to be a positive effect two months after the shock, but this finding is not confirmed when the BRW series is used. This mixed result may signal either a spurious outcome or the presence of some latent cyclical effect to which the monetary policy shock responded. However, since this outcome is not confirmed by both measures and is also not confirmed by our analysis of combined effects (see Fig. 5 below), we believe that it can be disregarded as spurious. The absence of a significant impact indicates that size does not seem to play any role when it comes to monetary policy effectiveness and the way that monetary policy shocks affect firms.

Finally, Fig. 4 shows the results of the local projections when firms are clustered by the level of indebtedness, proxied by the Debt-To-Assets ratio. We observe that while low-debt firms do not appear to be affected by monetary policy shocks, high-debt firms' excess returns respond negatively within five to six months (using the BRW measure) or within one month (using the FF4 measure) after the shock originated. The difference in the timing of the impact among the two measures can be explained by the information used in these measure. The BRW measure records changes in the spot interest rate, while FF4 is based on the three-months-ahead Federal funds' futures, suggesting that FF4 may record a monetary policy shock later than BRW. This difference in the timing of the shock among the two measures is also evident in Fig. 1.

The results here confirm that monetary policy affects firms asymmetrically and the factor that explains the asymmetry is the level of debt. Our findings suggest the monetary policy shocks leave low-debt firms relatively unscathed while reducing the excess returns of highly indebted firms within the first six months after the shock. Consequently, the transmission of the shock from monetary policy to firm performance (i.e. a reduction in excess returns) is through the debt channel. We believe that two mechanisms may be at work here, namely investor expectations and credit constraints, but a closer look into the results reveals that only one of these two channels is valid. We reiterate here that a positive monetary policy shock represents an unexpected increase in interest rates, which, in principle, should typically signal to markets that the economy is entering into a contractionary phase, thus resulting in investors anticipating a period of reduced asset prices. However, if this was the transmission mechanism, we would note a reduction in the excess returns of all firms in the sample, not only in those of high-debt firms. On other hand, the increase in interest rates leads to higher financial costs and (possibly) more hardship in securing external financing. This is more relevant to high-debt firms as they use more external financing in their capital structure and, most likely, this is achieved at a higher cost. This would suggest that the previously mentioned adverse effects cause a negative reaction to their excess returns, as they may have been forced to use expensive external financing or resort to internal financing, thus squeezing net income or reducing revenue. In addition, the impact of the change in interest rates on firms' overall cost of capital is higher for firms that use external financing. This, in turn, affects investment valuation decisions, since as the cost of capital increases, the net present value of potential investment decreases, resulting in a reduction in capital expenditure. This can affect both profitability (net income) and sales (revenue). Both elements can harm firm returns, which would be higher for high-debt firms *vis-à-vis* the rest of the market; hence the negative impact on excess returns.

On a side note, however, it can also be argued that investor reactions to a change towards a contractionary monetary policy may be asymmetrically more pronounced towards high-debt firms when compared to low-debt firms. This could be due to the perceived higher risk of high-debt firms, which is exacerbated during recessionary periods. The increase in perceived risk also affects the cost of capital (through an increase in the CAPM[10]-based cost of equity) and adds to the negative outcomes in capital expenditure mentioned above and thus excess returns.

Further to pointing to indebtedness as a potential determining factor on the effects of monetary policy, the time of such a response is key. A change towards a restrictive monetary policy is expected to affect firms with these characteristics after six months. This is an important element that needs to be considered by policymakers while devising monetary policies; the effect is expected to materialize after approximately two quarters.

We perform two additional sets of local projections for robustness purposes. First, we examine whether the combined effect of two criteria determines firm-level responses. As shown earlier, higher levels of indebtedness make firms more responsive to monetary policy surprises. However, it can be argued that such an effect could be driven by a combination of debt and other unobserved factors (in an approach similar to interaction terms in traditional regression). Hence, we cluster firms into three sets of four sub-groups by combining our binary classification criteria in pairs, as reported in Fig. 5. There is clear evidence of the important role still played by the level of debt, whereas the combination of age and size (Panel 5(a)) does not seem to produce any significant responses. By using debt, on the contrary, we show that a combination of older and high-debt firms provide a significant impulse response to monetary shocks (Panel 5(b)). The same is true for all high-debt firms, regardless of their size (Panel 5(c)). In addition, the pattern of responses (a negative response in excess returns approximately five to six months after the shock) is similar to the pattern observed by using debt as the discriminating variable. Consequently, we conclude that debt is a potential driver also when combined with other factors. In contrast, age and size would only significantly impact when combined with the level of indebtedness.

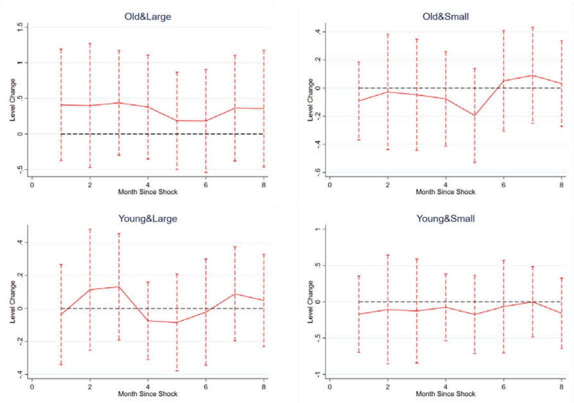
In the next step, we use the level of short-term debt as the discriminating variable; results (using the BRW measure) are shown in Fig. 6. The value of short-term debt over the total debt was employed as the selection variable. We split the sample into sub-groups by selecting: (a) companies whose ratio value was above/below the median and (b) companies whose ratio value was above/below 50%.[11] Therefore, we are in the position to investigate both the relative importance of short-term debt (*vis-à-vis* the companies in the sample) and the absolute importance (i.e. whether short-term debt makes up more than half of total debt). We can see that neither of the short-term debt variables helps explain cross-firm variation in responses. This leads us firmly to conclude that it is the total level of debt is the determining factor and that the composition of debt (short- or long-term) does not help identify the firm-level responses.

5.3. Quartile analysis

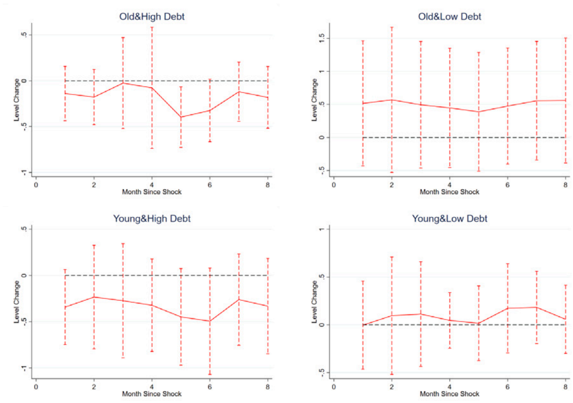
So far, our analysis has shown that indebtedness/leverage is the main culprit in explaining the cross-firm variation in the response of firms' stock price excess returns to monetary policy shocks. However, we have only clustered our sample into two groups: below and above the median level of indebtedness. We now take our analysis one step further and re-run our local projections by dividing firms into quartiles concerning their level of debt, as we did before.

[10] CAPM: Capital Asset Pricing Model.

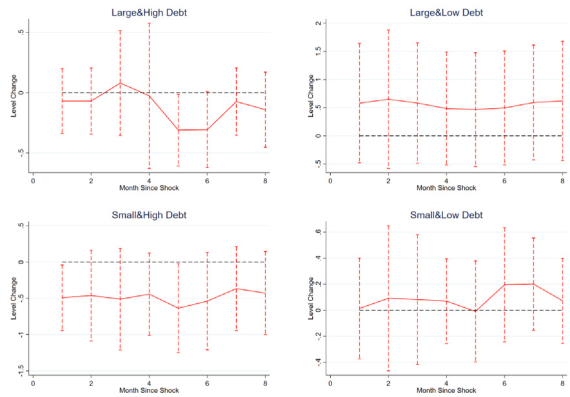
[11] By examining short-term debt, we also control for the level of long-term debt, since $ShortTermDebt + LongTermDebt = TotalDebt$ and thus $\frac{ShortTermDebt}{TotalDebt} + \frac{LongTermDebt}{TotalDebt} = 1$.



(a) Age and Size

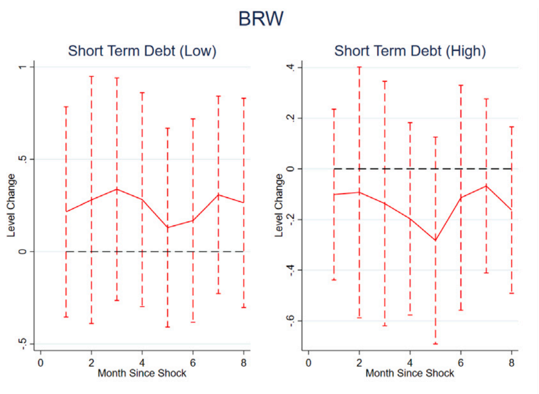


(b) Age and Debt



(c) Size and Debt

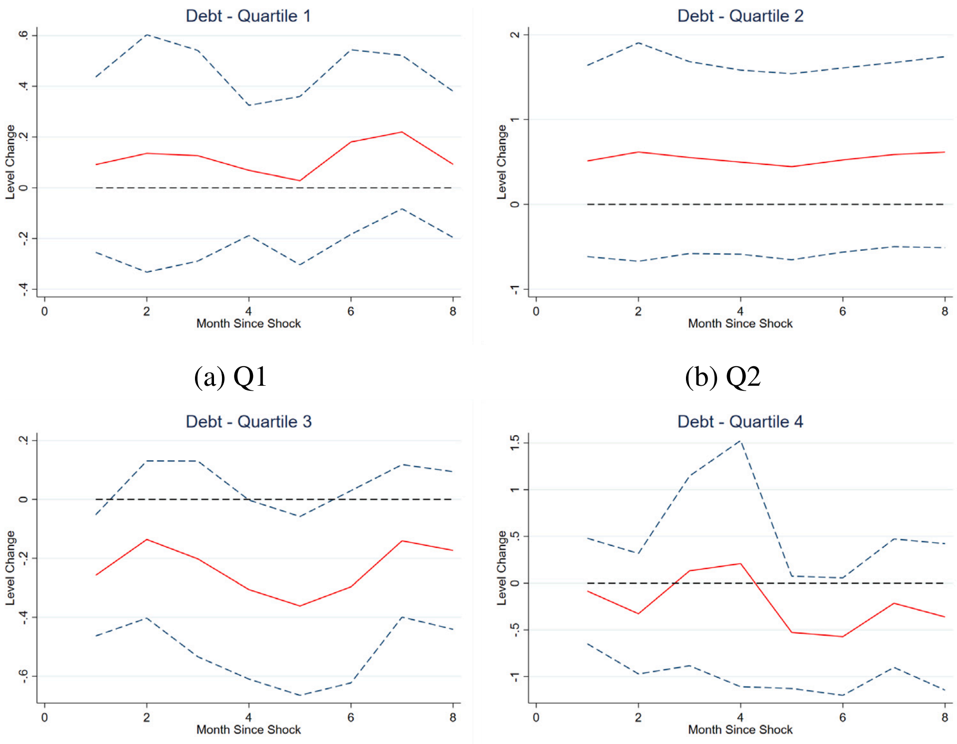
Fig. 5. Impulse Responses of Excess Returns using Combined Criteria (BRW Measure).
Notes: This figure shows the impulse responses (using local projections) of excess returns to monetary policy shocks (BRW measure) for firms classified by combined criteria of age, size, and debt levels. Panel (a) shows the responses based on age and size, Panel (b) depicts responses based on age and debt and Panel (c) presents responses based on size and debt. The solid line represents the baseline response for each group, while the dashed lines demonstrate the 95% confidence interval at each time period.



(a) Short Term Debt/Total Debt above/below median

(b) Short Term Debt/Total Debt above/below 50%

Fig. 6. Impulse Responses of Excess Returns by Short Term Debt (Short Term Debt to Total Debt) using the BRW Measure.
Notes: This figure shows the impulse responses (using local projections) of excess returns to monetary policy shocks (BRW measure) for firms classified by their short-term debt ratio relative to total debt. Panel (a) splits firms into subsamples at the median, while Panel (b) splits firms into subsamples of firms with short-term debt greater or less than 50% of total debt. The solid line represents the baseline response for each group, while the dashed lines demonstrate the 95% confidence interval at each time period.



(a) Q1 (b) Q2

(c) Q3 (d) Q4

Fig. 7. Impulse Responses of Excess Returns by Quartiles using the BRW Measure.
Notes: This figure shows the impulse responses (using local projections) of excess returns to monetary policy shocks (BRW measure) for firms divided into quartiles based on leverage (debt-to-assets ratio). Panels (a) through (d) show the responses for quartiles one through four, respectively. The solid line represents the baseline response for each quartile, while the dashed lines demonstrate the 95% confidence intervals.

The outcome of this process is presented in Figs. 7 (for the BRW measure) and 8 (for the FF4 measure) and the findings show that the firms in the third quartile appear to drive our previous results. While the timing of the responses differs similarly to before, based on whether we use the "unanticipated" rather than the "unconventional" monetary policy shocks, the impulse response functions are significant only for the firms belonging to the third quartile.[12]

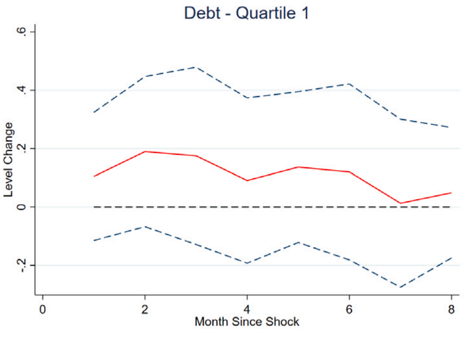
This analysis serves two purposes. First, it confirms that monetary policy shocks affect only firms with above-median levels of indebtedness. This is an outcome that adds to the robustness of our earlier findings. Second, the fact that firms belonging to the third quartile, by indebtedness, drive the responses to monetary policy shocks opens up a new strand of discussion regarding the nature of firms belonging to this quartile.

The reason why Q4 firms appear to be unresponsive, which is a somewhat unexpected finding, deserves further analysis. As reported in Table 2, the standard deviation of the debt-to-assets ratio is about 9.5 times larger for companies belonging to the fourth quartile compared to firms in the third quartile. Consequently, we propose two possible explanations for such a result: (a) the heterogeneity (in terms of leverage) of firms in the fourth quartile which potentially prohibits any significant effects; (b) further firm-specific qualitative characteristics in this subsample which result in different responses and thus non-significant effects. This is an interesting issue to examine, however, the nature of our data does not allow us to investigate the above issues any further and could be the subject of further research.

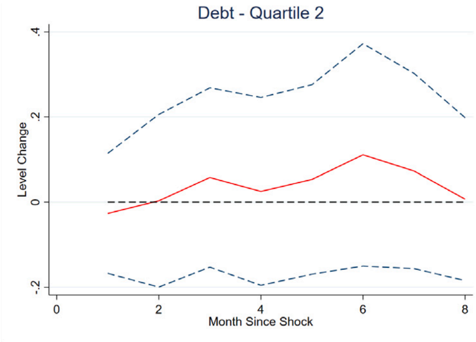
5.4. Further robustness checks

To further challenge the robustness of our results, we ran a battery of robustness checks. First, to alleviate the potential issue associated with the zero lower bound (following the 2008 global financial crisis) and the Gertler and Karadi (2015) measure of monetary policy shocks, this section presents results using our benchmark model (sample split by debt) with the sample truncated

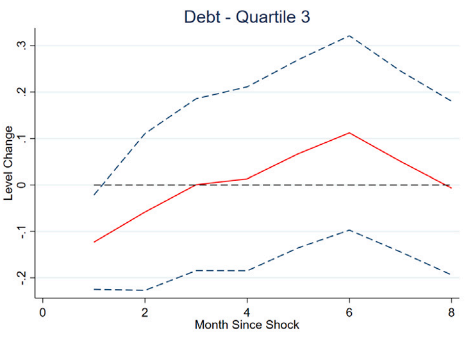
[12] It is worth noting that the outcome for the firms belonging to the fourth quartile falls just short of being statistically significant. Hence, even if the p-values of the third and fourth quartile firms would possibly be close (with the *p*-value of the third quartile firms being just above 95% and one of the fourth quartile firms being just below 95%), our findings cannot suggest a non-zero response for the fourth quartile firms within the 95% confidence interval.



(a) Q1



(b) Q2



(c) Q3

(d) Q4

Fig. 8. Impulse Responses of Excess Returns by Quartiles using the FF4 Measure.
Notes: This figure shows the impulse responses (using local projections) of excess returns to monetary policy shocks (FF4 measure) for firms divided into quartiles based on leverage (debt-to-assets ratio). Panels (a) through (d) show the responses for quartiles one through four, respectively. The solid line represents the baseline response for each quartile, while the dashed lines demonstrate the 95% confidence intervals.

Table 2
Summary statistics (quartiles based on leverage).

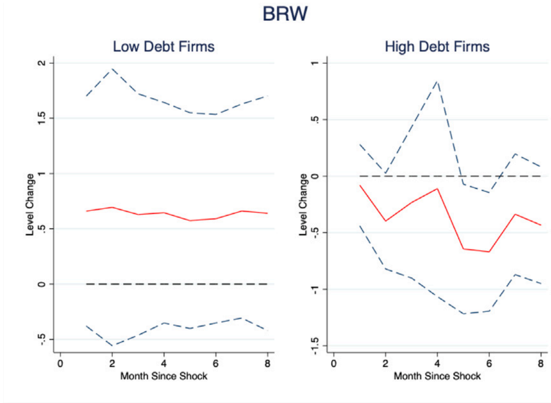
	Variable	Mean	Std. Dev.
Third Quartile			
	Stock Returns	−0.003	0.168
	Excess Stock Returns	0.019	1.262
	Size	1,258.9	4,791.1
	Size (ln)	5.0	2.1
	Age	231.0	165.1
	Leverage	0.647	0.062
Fourth Quartile			
	Stock Returns	−0.003	0.173
	Excess Stock Returns	0.039	2.040
	Size	1,556.3	7,585.8
	Size (ln)	5.1	2.2
	Age	177.4	141.3
	Leverage	0.943	0.594

Notes: This table reports the summary statistics for control and dependent variables, dividing firms into quartiles based on leverage. It presents information on stock returns, excess stock returns, firm size, age and leverage for the third and fourth quartiles.

at 2008. The results, presented in Fig. 9, are qualitatively the same, suggesting that our analysis appears robust to the zero lower bound witnessed in the period 2008–2012.

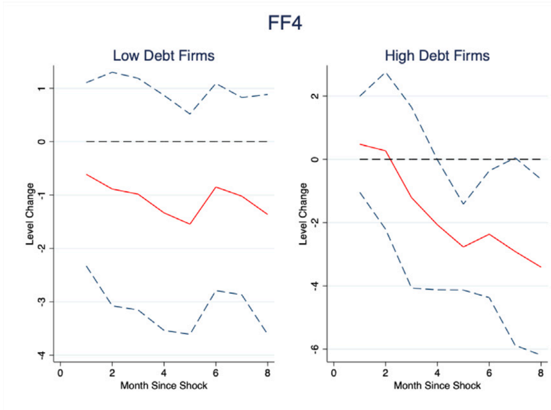
Moreover, we consider an alternative definition for “small” and “large” firms. As the distribution of firms, by size, shows a pronounced skewness, the cut-off point is now set at the 80th percentile. The results, presented in Fig. 10, remain similar to the benchmark results indicating that the presence of potential outliers did not undermine our previous findings.

(a) BRW - Until 2008



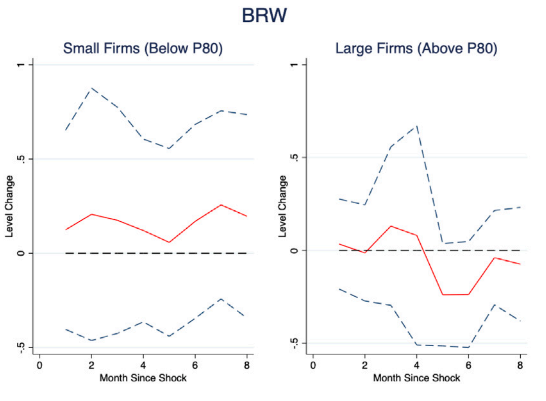
(b) BRW - After 2008

(c) FF4 - Until 2008

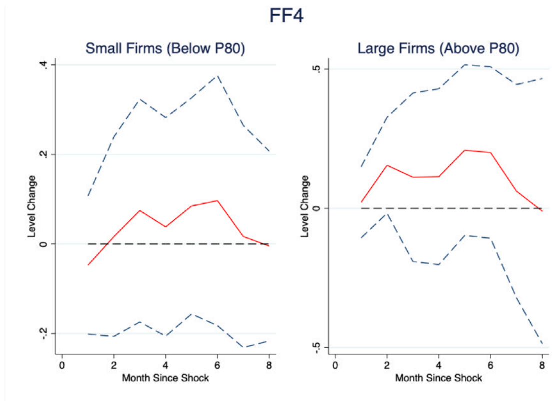


(d) FF4 - After 2008

Fig. 9. Impulse Responses of Excess Returns Splitting the Sample at 2008.
Notes: This figure shows the impulse responses (using local projections) of excess returns to monetary policy shocks, with the sample split at 2008 to account for the zero lower bound period. Panels (a) and (b) show the responses for the BRW measure before and after 2008, respectively, while Panels (c) and (d) present the responses for the FF4 measure. The solid line represents the baseline response for each period, and the dashed lines demonstrate the 95% confidence intervals.

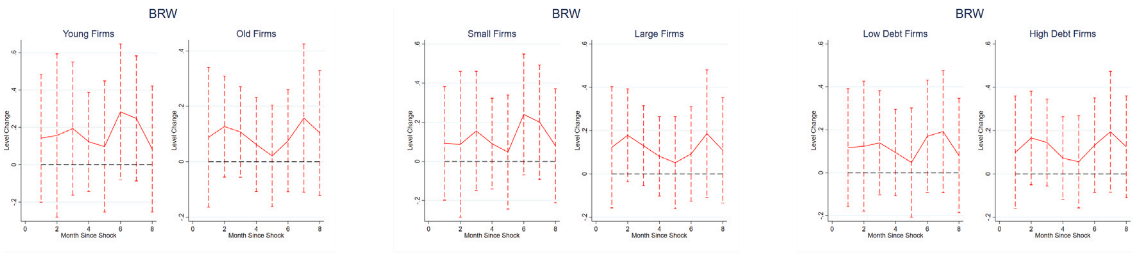


(a)



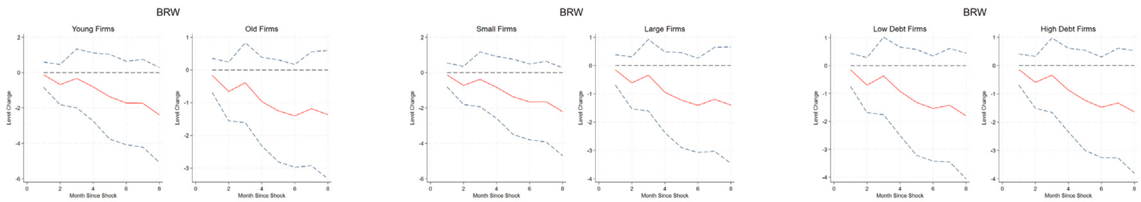
(b)

Fig. 10. Impulse Responses of Excess Returns by Size at the 80th Percentile.
Note: This figure shows the impulse responses (using local projections) of excess returns to monetary policy shocks for firms grouped by size, with the 80th percentile used as the cut-off point. Panel (a) shows the responses to the BRW measure, while Panel (b) presents the responses to the FF4 measure. The solid line represents the baseline response for each period, and the dashed lines demonstrate the 95% confidence intervals.



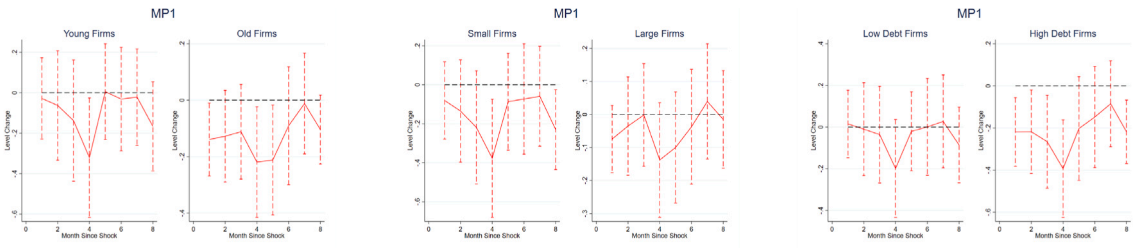
(a) Split by Age (b) Split by Size (c) Split by Debt

Fig. 11. Impulse Responses of Stock Returns relative to the T-Bill.
Notes: This figure shows the impulse responses (using local projections) of stock returns relative to the T-bill rate to monetary policy shocks (BRW measure). Panels (a), (b) and (c) show responses for firms grouped by age, size and debt, respectively. The solid line represents the baseline response for each group, while the dashed lines demonstrate the 95% confidence interval at each time period.



(a) Split by Age (b) Split by Size (c) Split by Debt

Fig. 12. Impulse Responses of Nominal Returns relative to the T-Bill.
Notes: This figure shows the impulse responses (using local projections) of nominal returns relative to the T-bill rate to monetary policy shocks (BRW measure). Panels (a), (b) and (c) show responses for firms grouped by age, size and debt, respectively. The solid line represents the baseline response for each group, while the dashed lines demonstrate the 95% confidence interval at each time period.



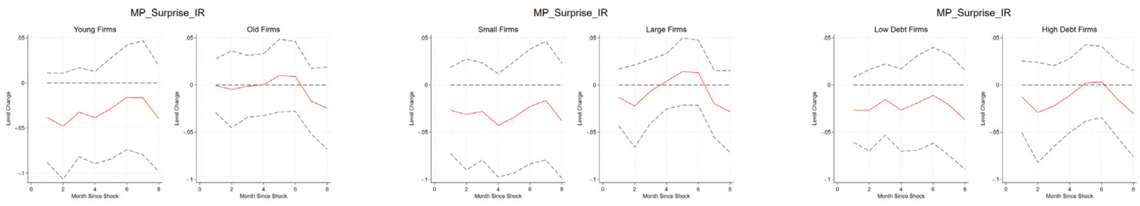
(a) Split by Age (b) Split by Size (c) Split by Debt

Fig. 13. Impulse Responses of Excess Returns using the Paul (2020) Monetary Surprise.
Notes: This figure shows the impulse responses (using local projections) of excess returns to the Paul (2020) monetary policy surprise measure (MP1). Panels (a), (b) and (c) show responses for firms grouped by age, size and debt, respectively. The solid line represents the baseline response for each group, while the dashed lines demonstrate the 95% confidence interval at each time period.

Another configuration of our modeling approach relates to examining alternative measures of firm performance. For this purpose, we build model configurations that have as dependent variable the real returns (Ehrmann and Fratzscher, 2004; Chava and Hsu, 2019) and also the nominal returns relative to the US T-bill rate (Patelis, 1997). The results are presented in Figs. 11 and 12 respectively. We note that no significant impact is computed in these figures, suggesting that our excess-return measure is appropriate in capturing the impact of monetary policy surprises on firm performance.

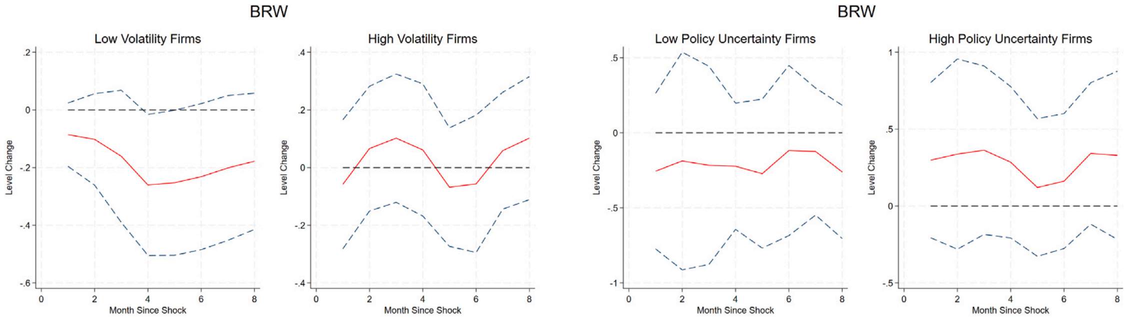
Further to changing the dependent variable, we also examine changes alternative measures of monetary policy surprises. More specifically, we use two alternative measures, namely the MP1 measure of Paul (2020),[13] as well as measure computed by the authors as the difference of the average nowcasting from experts to the effective interest rate. The results are demonstrated in Figs. 13 and 14 respectively. We note that the Paul (2020) measure captures a very strong response in high debt firms, but also captures other

[13] This measure essentially consists of the surprise component on the 30-day forward Federal Funds rate, computed as the change in the current month's Federal Funds rate in a 30-minute window around the FOMC announcement.



(a) Split by Age (b) Split by Size (c) Split by Debt

Fig. 14. Impulse Responses of Excess Returns using Average Nowcasting relative to Effective Interest Rate.
Notes: This figure shows the impulse responses (using local projections) of excess returns to shocks in the average nowcasting measure relative to the effective interest rate. Panels (a), (b) and (c) show responses for firms grouped by age, size and debt, respectively. The solid line represents the baseline response for each group, while the dashed lines demonstrate the 95% confidence intervals.



(a) Split by Volatility (b) Split by Uncertainty

Fig. 15. Impulse Responses of Excess Returns to Monetary Policy Surprises (BRW) by Volatility and Uncertainty.
Notes: This figure shows the impulse responses (using local projections) of excess returns to monetary policy shocks (BRW measure). Panel (a) splits the sample using firms' volatility while Panel (b) splits the sample according to periods of uncertainty. The solid line represents the baseline response for each group, while the dashed lines demonstrate the 95% confidence intervals.

responses, some symmetrical (age) and some asymmetrical (size — captured only for small firms). This, in our view, confirms our findings of a high-debt firms being the transmission mechanism of monetary policy to the economy. Our computed monetary policy surprise does not capture any significant responses.

Furthermore, we implemented alternative switching variables, examining firm volatility and policy uncertainty as the potential defining characteristic that helps describe the response of firm performance to monetary policy surprises. Both variables were considered due to their potential impact on the transmission of monetary policy shocks to asset prices (Benchimol et al., 2023). The results can be found in Fig. 15 and we can see again that no significant impact is noted, suggesting that neither volatility nor uncertainty can help explain firm responses to monetary policy surprises.

6. Conclusions and policy implications

This paper, using monthly data for 15,510 publicly listed firms (the entire population) from January 1990 to December 2020, investigates the effect of monetary policy shocks on U.S. firms' stock market returns. We contribute to this literature by exploiting firm demographics and providing a potential explanation for the absence of significant results in previous work. We consider several dimensions that are relevant for the effectiveness of the monetary policy, namely firms' age, debt (leverage) and size. Clymo and Rozsypal (2022) suggests that both size and age are important firm-level-specific factors. However, using local projections, our results highlight the importance of *debt* rather than age or size for understanding financial market responses to monetary policy shocks. We assess our empirical findings' robustness by considering two measures of monetary policy shocks and implement a battery of robustness checks to test the validity of our empirical results, including quartile analysis, the results of which suggest that the results are driven by the third quartile.

Our results have important implications for policy makers, as they suggest that the nature of firms' debt should be explored and incorporated into central bank decision-making. As noted before, the excess returns of firms in the highest quartile appear to be non-responsive to monetary policy shocks, suggesting that financial markets already factor in the effect of a high-debt burden. Nevertheless, since indebtedness ratios are dynamic, company balance sheets must be monitored continuously and considered when forecasting the impact of policy changes on firms' stock returns. The latter would affect economic activities via firms' ability to access credit and, consequently, investments. Thus, given the specific characteristics of the underlying firm population, monetary policy decisions may have muted or delayed effects and this needs to be considered by policy makers.

Future policy suggestions could be further strengthened by incorporating quantitative analysis and alternative policy tools. Estimating the economic impact of varying debt levels on policy effectiveness would enhance the robustness of policy implications that may result from future work. As evidenced by firm-level responses to monetary policy shocks, indebtedness significantly influences cross-firm variation in stock price reactions. Employing quantitative simulations and scenario analyses that account for these variations could refine future policy recommendations, providing a more detailed roadmap for policymakers, resulting in mitigation of unintended consequences. Further to the above, future work can explore the role of other firm characteristics beyond size, age, and indebtedness in explaining responses to monetary policy shocks, such as industry-specific factors, ownership structure or geographic location could provide deeper insights into how these variables may moderate the effects of monetary policy. What is more, researchers can explore the time lag between monetary policy shocks and firm responses. While our paper observes significant effects within certain time frames, understanding the reasons behind variations in the timing of responses across firms or sectors could be further analyzed. Finally, extending the analysis to other countries or regions with differing financial systems and market structures could provide valuable cross-country comparisons and enhance the generalizability of the findings.

Declaration of competing interest

The authors declare that they have no known competing financial interests or personal relationships that could have appeared to influence the work reported in this paper.

References

Adnan, W., Arin, K.P., Corakci, A., Spagnolo, N., 2022. On the heterogeneous effects of tax policy on labor market outcomes. South. Econ. J. 88 (3), 991–1036. http://dx.doi.org/10.1002/soej.12546.

Anderson, E., Inoue, A., Rossi, B., 2016. Heterogeneous consumers and fiscal policy shocks. J. Money Credit Bank. 48 (8), 1877–1888. http://dx.doi.org/10.1111/jmcb.12366.

Arin, K., Devereux, K., Mazur, M., 2023. Taxes and firm investment. J. Macroecon. 76 (C), S0164070423000174.

Baker, S.R., Bloom, N., Davis, S.J., 2016. Measuring economic policy uncertainty. Q. J. Econ. 131 (4), 1593–1636.

Benchimol, J., Ivashchenko, S., 2021. Switching volatility in a nonlinear open economy. J. Int. Money Finance 110, 102287. http://dx.doi.org/10.1016/j.jimonfin.2020.102287.

Benchimol, J., Saadon, Y., Segev, N., 2023. Stock market reactions to monetary policy surprises under uncertainty. Int. Rev. Financ. Anal. 89, 102783. http://dx.doi.org/10.1016/j.irfa.2023.102783.

Bernanke, B.S., Gertler, M., 1999. Monetary policy and asset price volatility. Econ. Rev. 84 (Q IV), 17–51.

Bjornland, H.C., Leitemo, K., 2009. Identifying the interdependence between US monetary policy and the stock market. J. Monetary Econ. 56 (2), 275–282. http://dx.doi.org/10.1016/j.jmoneco.2008.12.001.

Black, B.S., Jang, H., Kim, W., 2006. Predicting firms' corporate governance choices: Evidence from Korea. J. Corp. Financ. 12 (3), 660–691.

Bouakez, H., Essid, B., Normandin, M., 2013. Stock returns and monetary policy: Are there any ties? J. Macroecon. 36, 33–50. http://dx.doi.org/10.1016/j.jmacro.2013.01.002.

Bredin, D., Hyde, S., Nitzsche, D., O'reilly, G., 2007. UK stock returns and the impact of domestic monetary policy shocks. J. Bus. Financ. Account. 34 (5–6), 872–888.

Bu, C., Rogers, J., Wu, W., 2021. A unified measure of fed monetary policy shocks. J. Monetary Econ. 118, 331–349.

Caines, C., Winkler, F., 2021. Asset price beliefs and optimal monetary policy. J. Monetary Econ. 123, 53–67. http://dx.doi.org/10.1016/j.jmoneco.2021.07.006.

Chava, S., Hsu, A., 2019. Financial constraints, monetary policy shocks, and the cross-section of equity returns. Rev. Financ. Stud. 33 (9), 4367–4402.

Cheung, Y.-W., Lai, K.S., 1995. Lag order and critical values of the augmented Dickey–Fuller test. J. Bus. Econom. Statist. 13 (3), 277–280.

Chodorow-Reich, G., 2014. Effects of unconventional monetary policy on financial institutions. Brook. Pap. Econ. Act. 155–204.

Choi, S., Willems, T., Yoo, S.Y., 2024. Revisiting the monetary transmission mechanism through an industry-level differential approach. J. Monetary Econ. 103556. http://dx.doi.org/10.1016/j.jmoneco.2024.103556.

Christiano, L., Motto, R., Rostagno, M., Ilut, C., 2008. Monetary Policy and Stock Market Boom-Bust Cycles. Working Paper Series 955, European Central Bank.

Cloyne, J.S., Ferreira, C., Froemel, M., Surico, P., 2023. Monetary policy, corporate finance, and investment. J. Eur. Econom. Assoc. jvad009.

Cloyne, J.S., Ferreira, C., Surico, P., 2019. Monetary policy when households have debt: New evidence on the transmission mechanism. Rev. Econ. Stud. 87 (1), 102–129. http://dx.doi.org/10.1093/restud/rdy074.

Cloyne, J.S., Surico, P., 2016. Household debt and the dynamic effects of income tax changes. Rev. Econ. Stud. 84 (1), 45–81. http://dx.doi.org/10.1093/restud/rdw021.

Clymo, A., Rozsypal, F., 2022. Firm Cyclicality and Financial Frictions. CFM, Centre for Macroeconomics.

Crouzet, N., Mehrotra, N.R., 2020. Small and large firms over the business cycle. Amer. Econ. Rev. 110 (11), 3549–3601. http://dx.doi.org/10.1257/aer.20181499.

De Pooter, M., Favara, G., Modugno, M., Wu, J., 2021. Reprint: Monetary policy uncertainty and monetary policy surprises. J. Int. Money Finance 114 (C), http://dx.doi.org/10.1016/j.jimonfin.2021.1.

Di Giovanni, J., Hale, G., 2022. Stock market spillovers via the global production network: Transmission of US monetary policy. J. Finance 77 (6), 3373–3421.

Dwyer, G.P., Gilevska, B., Nieto, M.J., Samartín, M., 2023. The effects of the ECB's unconventional monetary policies from 2011 to 2018 on banking assets. J. Int. Financ. Mark. Inst. Money 87, 101800.

Ehrmann, M., Fratzscher, M., 2004. Taking stock: Monetary policy transmission to equity markets. J. Money Credit Bank. 719–737.

Eskandari, R., Zamanian, M., 2020. Marginal Tax Rates and Investment Behavior of Small and Large Firms. Working Paper 3392479. SSRN.

Gertler, M., Gilchrist, S., 1994. Monetary policy, business cycles, and the behavior of small manufacturing firms. Q. J. Econ. 109 (2), 309–340.

Gertler, M., Karadi, P., 2015. Monetary policy surprises, credit costs, and economic activity. Am. Econ. J.: Macroecon. 7 (1), 44–76. http://dx.doi.org/10.1257/mac.20130329.

Gilchrist, S., Leahy, J.V., 2002. Monetary policy and asset prices. J. Monetary Econ. 49 (1), 75–97. http://dx.doi.org/10.1016/S0304-3932(01)00093-9.

Herwartz, H., Roestel, J., 2022. Asset prices, financial amplification and monetary policy: Structural evidence from an identified multivariate GARCH model. J. Int. Financ. Mark. Inst. Money 78, 101568.

Holm, M.B., Paul, P., Tischbirek, A., 2021. The transmission of monetary policy under the microscope. J. Polit. Econ. 129 (10), 2861–2904. http://dx.doi.org/10.1086/715416.

Ioannidis, C., Kontonikas, A., 2008. The impact of monetary policy on stock prices. J. Policy Model. 30 (1), 33–53. http://dx.doi.org/10.1016/j.jpolmod.2007.06.015.
Ippolito, F., Ozdagli, A.K., Perez-Orive, A., 2018. The transmission of monetary policy through bank lending: The floating rate channel. J. Monetary Econ. 95, 49–71.
Iwanicz-Drozdowska, M., Rogowicz, K., 2022. Does the choice of monetary policy tool matter for systemic risk? The curious case of negative interest rates. J. Int. Financ. Mark. Inst. Money 79, 101608.
Jordà, Ò., 2005. Estimation and inference of impulse responses by local projections. Am. Econ. Rev. 95 (1), 161–182.
Kim, S.T., Rescigno, L., 2017. Monetary policy shocks and distressed firms' stock returns: Evidence from the publicly traded US firms. Econ. Lett. 160, 91–94.
Kuttner, K.N., 2001. Monetary policy surprises and interest rates: Evidence from the Fed funds futures market. J. Monetary Econ. 47 (3), 523–544. http://dx.doi.org/10.1016/S0304-3932(01)00055-1.
Li, Y.D., Iscan, T.B., Xu, K., 2010. The impact of monetary policy shocks on stock prices: Evidence from Canada and the United States. J. Int. Money Finance 29 (5), 876–896. http://dx.doi.org/10.1016/j.jimonfin.2010.03.008.
Li, E., Palomino, F., 2014. Nominal rigidities, asset returns, and monetary policy. J. Monetary Econ. 66, 210–225.
Loughran, T., Ritter, J.R., 1997. The operating performance of firms conducting seasoned equity offerings. J. Finance 52 (5), 1823–1850.
Maddala, G.S., Wu, S., 1999. A comparative study of unit root tests with panel data and a new simple test. Oxf. Bull. Econ. Stat. 61 (S1), 631–652.
Marmora, P., 2022. Does monetary policy fuel bitcoin demand? Event-study evidence from emerging markets. J. Int. Financ. Mark. Inst. Money 77, 101489.
Orphanides, A., 2003. Historical monetary policy analysis and the Taylor rule. J. Monetary Econ. 50 (5), 983–1022.
Patelis, A.D., 1997. Stock return predictability and the role of monetary policy. J. Finance 52 (5), 1951–1972.
Paul, P., 2020. The time-varying effect of monetary policy on asset prices. Rev. Econ. Stat. 102 (4), 690–704.
Rigobon, R., Sack, B., 2004. The impact of monetary policy on asset prices. J. Monetary Econ. 51 (8), 1553–1575. http://dx.doi.org/10.1016/j.jmoneco.2004.02.004.
Sleibi, Y., Casalin, F., Fazio, G., 2023. Unconventional monetary policies and credit co-movement in the eurozone. J. Int. Financ. Mark. Inst. Money 85, 101779.
Strebulaev, I.A., Yang, B., 2013. The mystery of zero-leverage firms. J. Financ. Econ. 109 (1), 1–23.
Thorbecke, W., 1997. On stock market returns and monetary policy. J. Finance 52 (2), 635–654.