Monetary policy surprises and investment of non-listed real sector firms in China

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A B S T R A C T

This study examines the dynamic effects of monetary policy on investment of non-listed real sector firms in China. We employ proxy vector autoregression analyses to extract China’s monetary policy surprises and use firm-level data to investigate the dynamic effects of monetary policy. Empirical findings show that unanticipated expansionary monetary policy prompts investment of China’s non-listed real sector firms in the first year of monetary policy surprises but has no positive accumulative effect on investment in the fourth year, suggesting that monetary easing shifts firms’ investment to an early date rather than increases investment permanently. Group-division results present discrepancies between state-owned and private firms and among firms with different sizes. Further analysis provides evidence that the effect of monetary policy on non-listed firms’ investment relates to external finance rather than investment opportunities.

1. Introduction

China has experienced rapid economic development for decades, and China’s monetary policy implemented by the People’s Bank of China (PBOC) has gradually attracted global attention. To attain a better understanding of development of China, it is essential to shed light on how monetary policy affects investment of real sector firms. This question is not easy to answer, albeit many classical theories provide predictions for developed countries (Friedman, 1956; Bernanke & Blinder, 1988, Bernanke and Gertler, 1989; Mishkin, 1995). Less developed financial markets and the trend of financialization can hinder financial resource allocation and drive real sector firms’ investment decisions in China to deviate from predictions of classic theories (Brandt and Li, 2003; Ge & Qiu, 2007; Guo, Jiang, & Shi, 2018; Shu, Zhang, & Zheng, 2018; Yang, Pu, & Su, 2020).

Ample empirical work has investigated how monetary policy influences investment in China. The macrolevel empirical literature characterizes the dynamic effect of China’s monetary policy on the aggregate output and investment and shows that China’s monetary easing increases both output and investment using vector autoregression methods (Mehrotra, 2007; Laurens & Maino, 2008; Li, Liu, & Pei, 2020). However, most of the macrolevel research has not emphasized the important role of the heterogeneous effects of monetary policy, while the existing literature from developed countries shows that firms with different scales of assets (Gertler & Gilchrist, 1994; Oliner & Rudebusch, 1996), leverage ratios (Hu, 1999), or credit history lengths respond differently to monetary policy (Cloyne, Ferreira, Froemel, & Surico, 2018, p. 25366).

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Microlevel empirical findings provide some evidence on how monetary policy heterogeneously influences investment of firms with different characteristics in China. Huang, Song, and Wang (2012) show that monetary easing increases listed firms’ investment in China, and firms with high leverage or high liquidity respond less to monetary policy. Yang, Han, Yin, and Tian (2017) find that contractionary monetary policy reduces investment in China, and cash holdings could weaken such effects for financially constrained firms, non-state-owned enterprises (non-SOEs), and firms located in underdeveloped financial markets. Zhao, Chen, and Hao (2018) reveal that the sensitivities of firms’ real investment to monetary policy differ among firms with or without political connections in China.

However, at least three issues require elucidation in the existing empirical studies from the microlevel perspective. First, the monetary policy variables (for example, M2 growth rate) are treated as exogenous variables in the aforementioned literature. However, the monetary policy responds to the expectation of the aggregate investment level, leading to the endogeneity problem in these studies (for example, Huang et al., 2012; Yang, Han, Yin, & Tian, 2017). Therefore, we should re-examine the empirical findings with a better identification strategy to isolate monetary surprises rather than using the original variable such as the M2 growth rate. In this study, we use price surprises in financial markets as an external instrument variable and employ the proxy vector autoregression analyses (proxy-VAR) to identify unanticipated monetary policy.

Second, the dynamic effects of monetary policy can be pivotal to the timing of firms’ investment decisions; however, these studies do not provide dynamic analysis since conventional panel models are not suitable for dynamic analysis. Moreover, conventional static empirical analysis cannot illustrate whether monetary policy drives firms to invest in advance or invest permanently, which is one of the potential issues related to the effectiveness of China’s monetary policy. This study utilizes an instrumented variation of local projection method (LP-IV) to estimate impulse responses for firms with different characteristics, providing more evidence for the effectiveness of China’s monetary policy.

Third, the aforementioned microlevel literature examines how monetary policy influences listed real sector firms’ investment but provides few analyses for non-listed firms. Although the data on listed firms are always more accessible owing to disclosure requirements, non-listed firms can play a more important (even dominant) role in China’s economy in terms of number of firms and scale of assets. For instance, the total assets of China’s A-share listed real sector firms were 50.8 trillion yuan in the end of 2018, while the total assets of China’s non-listed real sector firms were over 115.3 trillion yuan in 2018. As for the number of firms, there were only 3280 A-share listed real sector firms and more than 0.37 million non-listed real sector firms in China in 2018. Moreover, non-listed firms could well reflect the effects of China’s monetary policy changes under different financial constraints, since most listed firms tend to have access to multiple financial markets and are mostly financially unconstrained.

This paper provides empirical analysis to fill the gaps in the literature. We employ an econometric framework combining the proxy-VAR model (Gertler & Karadi, 2015) and the LP-IV method to solve potential endogeneity and dynamic estimation (Jordà, 2005; Cloyne et al., 2018, p. 25366; Jordà, Schularick, & Taylor, 2020), and we utilize a rich firm-level dataset from the RESSET Database covering China’s non-listed firms above designated size ranging in 2006–2014 to research non-listed real sector firms.

This study employs the price changes of financial derivatives to isolate unanticipated instantaneous monetary surprises and use the proxy-VAR model to extract the exogenous components of monetary policy following Gürkaynak, Sack, and Swanson (2005) and Gertler and Karadi (2015). Specifically, we calculate the price surprises in the one-year interest rate swap market around the time of monetary policy announcements by the PBOC, which is the external instrument variable for the monetary policy indicator (the M2 growth rate) and extract the residuals from the proxy-VAR model as the monetary policy surprises in microlevel analysis. The proxy-VAR model includes four economic or financial variables—the growth rates of M2, consumer price index (CPI), and industrial production, and the term premium of corporate bonds.

Our empirical analysis, using the method of the LP-IV and the abundant data on non-listed firms from the RESSET Database, provides microlevel evidence on the dynamic and heterogeneous effects on investment of non-listed real sector firms. The advantages of the LP-IV method and the novel dataset help us investigate the dynamic heterogeneous effects on numerous non-listed firms.

Our empirical results document that the average effect of monetary easing on non-listed real sector firms’ total investment and fixed investment is significantly positive in the first year. However, unanticipated monetary easing reduces new investment in the third year of the monetary policy surprise. These baseline results suggest that unanticipated expansionary monetary policy drive firms invest in advance; however, unanticipated expansionary monetary policy does not improve the long-run investment level of non-listed real sector firms.

These findings contribute to the literature on the effect of China’s monetary policy on non-listed firms’ investment. The existing literature addresses the issue of heterogeneous effect and asymmetric effect well and provides insights on how monetary policy influences individual firms’ investment decisions (Chen, Li, & Tillmann, 2019; Huang et al., 2012; Yang, Han, Yin, & Tian, 2017).

However, these microlevel empirical studies tend to take the instantaneous effect as the final/accumulative effect in the medium or long term. Our results in the dynamic perspective emphasize that the significant impact of monetary policy in the first year could be only caused by a shift of future investment rather than a permanent increase of investment in equilibrium.

This dynamic response pattern is consistent with the macroeconomic literature on the long-run neutrality of monetary policy, which claims that monetary policy could only influence business cycle but not long-run potential output (Ball & Romer, 1990; Friedman, 1968; Mankiw & Reis, 2002; Taylor, 1979, 1980). In the long run, firms can adjust prices and the amount of all factor inputs, which means that investments return to the level corresponding to potential output.

1 The data are from the CEInet Statistics Database, the RESSET Database and the authors’ calculation. The number of firms and scale of assets of non-listed real sector firms are the lower limits, since the firms whose operating revenues are lower than 5 million yuan are excluded.
Group-division findings in this study show that the stimulating effect of monetary easing on total investment of SOEs is more persistent than the effect on total investment of non-SOEs. Medium- and large-sized firms reduce new total investment since the third year of monetary easing, while small-sized firms do not significantly reduce new total investment. Moreover, the accumulative effect of monetary easing on total investment and fixed investment of small-sized firms in the fourth year of the monetary policy surprise is significantly positive, while that of medium- and large-sized firms in the fourth year is significantly negative.

Further empirical results reveal that the impulse response patterns of leverage ratio to monetary policy is highly related to those of investment for small- and medium-sized non-listed firms, and the impulse response functions of sales revenue can hardly explain the changes in investment. Non-listed firms tend to invest when they have access to debt financing and reduce new investments when they have difficulties to achieve debt financing. The results suggest that monetary policy changes transmit to investment decisions by external finance rather than investment opportunities or market capacity.

The remainder of this paper is structured as follows: Section 2 provides the identification of monetary policy and estimates the proxy-VAR; Section 3 describes the LP-IV method and the firm-level data; Section 4 presents baseline results and heterogeneity analysis; and Section 5 concludes.

2. Identification of monetary policy surprises and the proxy-VAR

In this section, we provide the method to identify monetary policy surprises. First, we use price changes in financial markets to separate instantaneous monetary policy shocks. Second, we regard the instantaneous monetary policy shocks as the external instrument to estimate the proxy-VAR, and the residuals of the monetary policy variable in the proxy-VAR are the exogenous monetary policy surprises.

To separate instantaneous monetary policy shocks, we follow Gürkaynak et al. (2005) and Gertler and Karadi (2015) and calculate the short-term price movements in the financial markets around the time when the PBOC releases central bank announcements. The rationale for this method is that prices in financial markets can reflect information on expectations; thus, price surprises can capture the exogenous components of monetary policy and remain independent to the endogenous components of monetary policy.

Specifically, we calculate the inter-day price movements of the one-year interest rate swap based on the seven-day fixing repo rate (FR007-IRS) when the reserve requirement ratio adjustments or benchmark interest rate announcements are released. Inter-day price movements refer to the difference of prices of the nearest trading day after the announcement and the nearest trading day before the announcement. Specifically, the event window spans from the announcement day to the next trading day after the announcement, if the PBOC releases the announcement in the trading day; the event window spans from the last trading day before the announcement to the next trading day after the announcement, if the PBOC releases the announcement in the non-trading day. The seven-day fixing repo rate (FR007) is a benchmark interest rate indicator in China, based on repurchase agreement trades from 9:00 a.m. to 11:00 a.m. in each day, which is released by China’s National Interbank Funding Center. The one-year FR007-IRS is based on the FR007 index, which is one of the most active contracts in China’s interest rate swap markets and can well capture the changes of monetary policy and market anticipation.

This study treats the PBOC’s adjustments relevant to the reserve requirement ratio and the benchmark interest rate as the monetary policy announcements because both interest rate policy and deposit reserve policy are the dominant monetary policies in the underlying sample period (2006–2014) for non-listed firms. Moreover, the frequency of these two types of central bank announcements is appropriate for our identification method using inter-day price surprises (though irregular). Table 1 provides the dates of the monetary policy announcements ranging from 2006 to 2018, and there are 27 benchmark interest rate adjustments, 44 reserve requirement adjustments, 6 targeted reserve requirement adjustments, and 2 reforms related to reserve requirement.

Monetary policy announcements distribute unevenly in terms of time in Table 1. The adjustments on benchmark interest rate and reserve requirement ratio are more frequent in 2008 and 2010–2011. The PBOC does not use benchmark interest rate policy after 2015 owing to the process of interest rate liberalization, and the PBOC tend to implement more targeted reserve requirement ratio cuts to support the real economy. Therefore, it is not adequate to directly employ the instantaneous price changes without further processing as monetary surprises in microlevel, on account of the uneven time distribution of monetary policy announcements.

As Gertler and Karadi (2015) point out, one of the limitations to this approach of financial prices is difficult to identify persistent impact. To address this problem, we follow Gertler and Karadi (2015) and Gerko and Rey (2017) and use the price surprises of the one-year IRS-FR007 as the external instrument in the proxy-VAR. The price surprises of the one-year FR007-IRS are aggregated to monthly frequency using summation method. The proxy-VAR introduced by Mertens and Ravn (2013) and Stock and Watson (2018) can measure both the instantaneous effect and the persistent impact of monetary policy.

We estimate a proxy-VAR model with monthly data ranging from March 2006 to December 2018, which includes the (year-on-year)

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Footnotes:
2 Because the PBOC always (if not always) releases important monetary policy announcements in the evening (around 6:00 p.m. or 7:00 p.m.), when the most domestic financial markets are close, the intraday price movements are not available. However, the inter-day price movements can reflect monetary policy surprises since the interest rate swaps in the inter-bank market are strongly related to monetary policy.
3 FR007 is one of an important interbank interest rates, which are operational targets of monetary policy in China. Therefore, FR007 is strongly related to unexpected changes of monetary policy stances.
4 Although China’s monetary policy has been experiencing a transition from a quantity-based to price-based regime, both quantity-based (reserve requirement policy) and price-based (interest rate policy) monetary policies are implemented.
5 If more than one monetary policy announcements are released in one day, we only keep one to calculate price surprises of one-year FR007-IRS.
growth rate of industrial production, the CPI growth rate, the term spread of 10-year and 1-year AAA corporate bonds (available since March 2006), and the M2 growth rate in China. The price surprise of FR007-IRS is the external instrument for the M2 growth rate in the proxy-VAR.\footnote{The M2 growth rate is still the major intermediate target of China’s monetary policy. However, the M2 growth rate is a quantity-based indicator, which is difficult to identify the surprises in the short term around the central bank announcements. Therefore, we use the price changes of FR007-IRS to instrument the M2 growth rate.}

The data on these monthly economic variables are available in the China Economic Information Database, and the data on the one-year FR007-IRS are from the Bloomberg Database. Fig. 1 reports the impulse responses to a M2 growth rate shock. The monetary policy easing will boost the CPI and industrial production in the short term, and the term premium decreases within a year.

We extract the residuals of the M2 growth rate in the proxy-VAR as the monetary policy surprises. Fig. 2 provides the monetary policy shocks are aggregated from monthly observations to annual frequency using equally weighted average method. It is widely acknowledged that PBOC implements a tight monetary policy in 2008 and dramatically changes its stance on monetary policy toward easy in 2010, which is consistent with monetary policy surprises in Fig. 2.

### 3. The LP-IV method and microlevel data

We employ a framework introduced by Cloyne et al. (2018) to estimate impulse responses of investment to monetary policy surprises. We estimate the dynamic effect of monetary policy on non-listed firms’ investment by an approach of local projection with an instrument variable, that is, the LP-IV method, and the instrument variable is the exogenous components of China’s monetary policy extracted by the proxy-VAR.\footnote{The M2 growth rate is still the major intermediate target of China’s monetary policy. However, the M2 growth rate is a quantity-based indicator, which is difficult to identify the surprises in the short term around the central bank announcements. Therefore, we use the price changes of FR007-IRS to instrument the M2 growth rate.}

The LP-IV method is used to flexibly estimate dynamic effects of monetary policy in our firm-level data, following Jordà (2005, 2020) and Cloyne et al. (2018). Compared to panel VAR used by Love and Zicchino (2006) and Abrigo and Love (2016), the LP-IV method is more flexible with rich microlevel data. Moreover, the LP-IV method could also be more robust because the panel VAR method needs to provide strict (but vulnerable) assumptions on the data generating process.

We pin down the following specification to estimate the dynamic effects of China’s monetary policy on firms’ investment:

\[
\Delta_h \text{Invest}_{i,t+h} = c_i^h + \sum_{g=1}^{G} \beta_g^h \theta_{i,t-1} \in g \cdot MP_g + \sum_{g=1}^{G} \alpha_g^h \delta_{i,t-1} \in g + \delta t + D_{i,t+h} + \epsilon_{i,t+h} \tag{1}
\]

where \( t \) refers to year, \( h \) refers to the lag horizon, and \( i \) refers to the individual firm \( i \). The dependent variable is defined as \( \Delta_h \text{Invest}_{i,t+h} = \text{Invest}_{i,t+h} - \text{Invest}_{i,t-1} \). \( MP_g \) is the monetary policy indicator (the M2 growth rate), which is instrumented using the monetary policy surprises (\( MPS_g \)) extracted by the proxy-VAR in the previous subsection. \( c_i^h, \delta t, \) and \( D_{i,t+h} \) control for the firm fixed effect, the potential time tendency, and the seasonality, respectively. We implement group-division analysis by dividing the sample into different groups based on firm characteristics. \( G \) is the number of all groups, and \( g \) is the specific group. \( \theta_{i,t-1} \) is characteristics of the firm \( i \) in year \( t \). The indicative function \( \text{If}\cdot J \) takes one only if \( \theta_{i,t-1} \in g \), otherwise zero. The coefficient \( \beta_g^h \) is the impulse response of our

### Table 1


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<th>Announcement</th>
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dependent variable to the monetary policy surprises for firms in the group $g$ at year $h$. Empirical results focus on the sign and time variations of $\beta_{gh}$. Standard errors are clustered by firm level.

If we let the amount of groups ($G$) in Equation (1) equal one, then we obtain the specification to estimate the aggregate effect of monetary policy:

$$\Delta_h \text{Invest}_{i,t+h} = c_i^h + \beta^h MP_t + \delta t + D_{i,t+h} + \epsilon_{i,t+h}$$

In these specifications of the LP-IV method, we employ the dataset of China’s non-listed firms from the RESSET Database. This dataset includes all the state-owned non-listed firms and non-state-owned firms with a prime operating revenue over 5 million yuan. There are over 0.28 million firms in the original dataset in 2014. We remove the firms without complete time series ranging from 2006 to 2014.

There are 40,059 non-listed real sector firms in 42 industries in our final sample. Specifically, there are 523 in mining, 3450 in food manufacturing, 870 in wood and furniture manufacturing, 4531 in rubber and plastics manufacturing, 8917 in equipment manufacturing, 2225 in metal smelting, 2650 in metal products manufacturing, 1248 in nonmetallic mineral products manufacturing, 2708 in recreation and sports appliance, 1424 in electricity and water resources, and 118 in others.

This dataset provides the unique identification number for each firm, and we can directly obtain firm-level panel data. Compared to another widely used database named Chinese Industrial Enterprises Database, this RESSET Database is more reliable and helps us to avoid potential errors in matching observations in different years. However, there are also some imperfections in this dataset. First, some variables are missing in 2010, including the value of fixed assets, liquid assets, and debt. Second, the statistical caliber of some variables varies across time including value added and profits, and we do not include these variables in empirical analysis.

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7 The industries classification is from China Securities Regulatory in 2002.
Considering that the dependent variable is in the form of difference in the specifications of the LP-IV method, we measure firms’ investment as the natural log value of the assets. Specifically, we define firms’ total investment as the log value of the total assets, and firms’ fixed investment is the log value of the total assets.\(^8\) The dependent variable \(\Delta_\text{Invest}_{i,t+h}\) is the accumulative change in the scale of assets, which can reflect the variations of firms’ investment. We obtain large firm-year observations in our regression analyses by this definition,\(^9\) and we keep the impulse response functions informative.

The variable definitions and descriptive statistics are reported in Table 2. All variables are winsorized at the level of 1% to limit the outlier effects. Table 2 shows that the variation of \(\text{MPS}\) is relatively small, and unanticipated monetary policy changes range from \(-0.48\%\) to \(+0.37\%\). The median level of total investment (\(\text{TotalInvest}\)) is 10.96, representing about 57 million yuan, while the total asset of the largest firm in our sample reaches at 3.95 billion yuan. Only 5.3% of non-listed firms in our sample are SOEs, which means non-SOEs dominate in non-listed real sector firms in China in terms of amount.

4. Empirical results

4.1. Dynamic effect of monetary policy on investment

To investigate the overall effect of monetary policy on non-listed firms’ investment, we use Equation (2) to generate the average dynamic effect of monetary policy on total investment in Fig. 3.

Fig. 3 shows the average effect of monetary policy on the aggregate total investment level of non-listed real sector firms. A 1% unanticipated increase of the M2 growth rate leads to a 2.38% increase of the investment level in the first year and a 5.46% increase in the second year, and this effect is economically and statistically significant. This result is consistent with the conclusion in the existing literature (for example, Huang et al., 2012; Chen et al., 2019). The accumulative effect of monetary easing goes down in the third year and fades in the fourth year of the monetary policy surprise.

One can see from Fig. 3 that unanticipated expansionary monetary easing significantly prompts non-listed firms’ total investment in the first two years; however, the accumulative effect diminishes after the third years (even turns non-significant in the fourth year). This timing pattern suggests that the stimulating effect of monetary policy on total investment is related to investment in advance. To the best of our knowledge, the microlevel empirical literature hardly points out this phenomenon.

We change the measure for non-listed firms’ investment to the log fixed assets and report the impulse response of fixed investment in Fig. 4. The non-listed real sector firms’ fixed investment significantly increases by 3.31% (1.54%) in the first (second) year of a 1% increase of the M2 growth rate; however, the effect turns negative since the third year of the monetary policy surprise.

The empirical results show that unanticipated expansionary monetary policy leads to an increase in non-listed firms’ liquid assets; however, the increase of firms’ liquid assets does not stimulate fixed investment in the medium term. A possible explanation is that materials, inventories, and account receivables drive the increase of liquid assets, and external finance still plays an essential role for firms to rapid expansion in fixed investment.

Although copious amounts of research states that monetary easing improves firms’ investment in the short run, the literature has not provided evidence on dynamic effects of monetary policy. Specifically, the microlevel empirical analysis does not focus on how monetary policy influences firms’ investment after the second year or later, because the conventional panel method is not suitable for dynamic estimation. This gap in econometric methods brings the intuitive conclusions that monetary easing increases investment permanently when the literature indicates that monetary policy significantly influences investment in the first or second year. However, monetary easing may increase investment temporarily and reduce new investment in the long run (or only in the medium term), which can lead to the same static empirical results. This equivalence may mislead the understanding of the effectiveness of monetary policy.

Our findings recall the conventional wisdom in the classic literature on the long-run neutrality of monetary policy. The literature suggests that monetary policy could only influence short-run business cycle rather than long-run real variables (Ball & Romer, 1990; Friedman, 1968; Lucas, 1972; Mankiw & Reis, 2002; Taylor, 1979, 1980). Our empirical results support the long-run neutrality of monetary policy rather than ineffectiveness or long-run non-neutrality of monetary policy. Since the microlevel literature on the firms’ reaction to monetary policy does not consider long-run neutrality, our study attempts to bridge the gap between microlevel empirical analysis and macrolevel classic literature.

Figs. 3 and 4 highlight that monetary easing makes non-listed real sector firms’ aggregate investment shift to the first or second year of the monetary policy surprise. The unanticipated monetary easing does not drive the economy to a new equilibrium of high investment, and only prompts non-listed real sector firms’ new investment in the first two years. In the following subsections, we explore the heterogeneous effect and possible factors of monetary policy.

4.2. Impulse response of real investment based on firm characteristics

In this subsection, we utilize the LP-IV method to analyze the heterogeneous effects of monetary policy allowing the variations

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\(^8\) In this setup, the coefficient \(\beta^g_h\) could represent the percentage change in investment. Therefore, we report the coefficient \(\beta^g_h\) in the form of percentage in our figures.

\(^9\) If we define investment as the year changes in total assets as Duchin, Ozbas, and Sensoy (2010), we will have almost no observations when the lag horizon \(h\) is larger than one in Equation (1).
among state-ownership and scale of total assets. We first examine whether the state-ownership influence the effect of monetary policy by estimating impulse response functions of SOEs and non-SOEs. The dynamic effects of unanticipated monetary easing on total investment and fixed investment of SOEs and non-SOEs are reported in Fig. 5.

The evidence in Panel A of Fig. 5 shows that SOEs make more total investment after the monetary policy surprise, and this promoting effect of monetary policy on the total investment level of SOEs remain at the level of 3% after the second year of monetary policy surprise. In contrast, a 1% unanticipated increase of the M2 growth rate leads to an average increase exceeding 5% of the total investment level of non-SOEs in the second year of the monetary policy surprise, which is higher than that of SOEs. However, the effect of monetary easing on the total investment of non-SOEs diminishes in the third year, and even dies out (both economically and statistically) in the fourth year of the monetary policy surprise.

Panel B of Fig. 5 provides analysis on the effect of monetary policy on fixed investment and presents that both SOEs and non-SOEs cut new fixed investment in the second and third years, after expanding investment in the first year of monetary policy surprise. Moreover, the fixed investment level of SOEs in the fourth year of monetary easing is slightly higher than the fixed investment in the absence of the unanticipated monetary easing; however, the fixed investment level of non-SOEs decreases in the fourth year owing to the policy of unanticipated monetary easing. Moreover, the fixed investment decisions of SOEs are economically significantly

| Table 2 |
|------------------|----------------|----------------|----------------|----------------|
| variables | definition | obs | mean | median | max | min | std |
| MP | (%) the year-on-year M2 growth rate | 360,531 | 15.888 | 15.427 | 23.462 | 12.237 | 3.327 |
| MPS | (%) monetary policy surprises extracted by the proxy-VAR | 320,472 | -0.047 | -0.086 | 0.370 | -0.480 | 0.233 |
| TotalInvest | total investment = log(total assets) | 360,422 | 11.109 | 10.961 | 15.193 | 8.40 | 1.351 |
| FixedInvest | fixed investment = log(fixed assets) | 318,141 | 9.695 | 9.621 | 14.252 | 5.979 | 1.587 |
| SOE | = 1 if it is state-owned, otherwise 0. | 360,531 | 0.053 | 0.000 | 1.000 | 0.000 | 0.224 |
| Sales | sales revenue level = log (sales revenue) | 360,305 | 11.465 | 11.294 | 15.174 | 9.143 | 1.213 |
| Lev | leverage ratio = total debt/total assets | 320,314 | 0.565 | 0.581 | 0.944 | 0.033 | 0.252 |

Fig. 3. Average effect of monetary policy on total investment
Note: The figure shows the impulse response functions of the total investment to a 1% unanticipated increase in M2 growth rate. The dotted lines report the 95% confidence level of the estimates of the effects. This figure is estimated by the LP-IV method. Standard errors are clustered by firm.

Fig. 4. Average effect of monetary policy on fixed investment
Note: The figure shows the impulse response functions of the fixed investment to a 1% unanticipated increase in M2 growth rate. The dotted lines report the 95% confidence level of the estimates of the effects. This figure is estimated by the LP-IV method. Standard errors are clustered by firm.
Influenced by monetary policy but are diversified (statistically non-significant) in the first year.

In summary, we show that the stimulating effect of monetary easing on the investment of SOEs could be more persistent than that of non-SOEs, and the accumulative effects of monetary easing on the investment of non-SOEs are not significantly positive in the long run. This suggests that unanticipated monetary policy has a redistributive effect: soft budget constraints make it possible for SOEs to deviate from potential outputs and increase investment more persistently than non-SOEs do. Perhaps SOEs’ investments are influenced by the order from the government and the support from state-owned banks (Deng, Morck, Wu, & Yeung, 2015). SOEs’ dramatic increase in fixed investment in the first year also shows that SOEs’ investments keep pace with monetary policy stance.

We now investigate how monetary policy influences investment of firms with different scales of assets. We split the full sample into three groups by the size of firm assets at the time of monetary policy surprises: the bottom 50% are defined as small-sized firms, the top 10% are defined as large-sized firms, and the firms whose scales of assets are between the quantiles of 50% and 90% belong to the group of medium-sized firms.

Fig. 6 illustrates how firms with different sizes heterogeneously respond to. Small-sized firms significantly improve total investment in the second year, and the total investment level does not dramatically decrease in the third and fourth years. Medium- and large-sized firms respond to unanticipated monetary policy surprises similarly: the effect of monetary easing on the total investment level of medium- and large-sized firms peaks in the second year of the monetary policy surprise and turns significantly negative in the fourth year.

Moreover, the cumulative effect of unanticipated contractionary monetary policy is significantly stimulating the total investment of medium- and large-sized firms in the fourth year. This cumulative effect under monetary tightening may be correlated with risk management decisions of banks and competition among firms in the long run. First, banks tend to hold less risky loans under

![Fig. 5. Effect of monetary policy on investment by ownership. Note: The figure shows the impulse response functions of the total investment and the fixed investment to a 1% unanticipated increase in M2 growth rate. The dotted lines report the 95% confidence level of the estimates of the effects. This figure is estimated by the LP-IV method. Standard errors are clustered by firm.](image)

![Fig. 6. Effect of monetary policy on total investment by firm size. Note: The figure shows the impulse response functions of the total investment of small-, medium-, and large-sized firms to a 1% unanticipated increase in M2 growth rate. The dotted lines report the 95% confidence level of the estimates of the effects (standard errors are clustered by firm).](image)
contractionary monetary policy and may shift the financial resources to relatively large-sized firms. The capital misallocation to large-sized firms and credit discrimination can support this possibility (Brandt and Li, 2003; Ge & Qiu, 2007; Gopinath, Kalemli-Ozcan, Karabarbounis, & Villegas-Sanchez, 2017). Second, medium- and large-sized firms tend to invest more to occupy a larger share of the product market, when small-sized firms (who probably have high productivity) have difficulty expanding investment under monetary tightening.

The cumulative effect of unanticipated expansionary monetary policy remains significant after four years of monetary policy implementation, suggesting another redistributive effect of monetary policy among firms with different size. Small-sized firms are typically severely financing constrained, despite high productivity, which means that they have underinvestment problems. After an unanticipated monetary policy shock, small-sized firms may have better access to credit resources and other external finance resources to get rid of underinvestment than before.

This study also examines the heterogeneous dynamic effect of monetary policy on the fixed investment of small-, medium- and large-sized firms (Fig. 7). Following an increase of unanticipated monetary easing, small-sized firms invest more on fixed assets in the first year of the monetary surprise and significantly reduce fixed investment in the third year. In the fourth year, the fixed investment of small-sized firms recovers to the level above that in the absence of unanticipated monetary easing. A 1% unanticipated increase of the M2 growth rate leads to an increase of the fixed investment of the medium- and large-sized firms in the first year, which is economically significant but statistically non-significant. This feature of impulse responses reflects dispersed fixed investment decisions among these firms in the first year. Moreover, the accumulative effect of monetary easing on the fixed investment level of medium- and large-sized firms is also significantly negative.

The estimates of impulse response functions in Fig. 7 offer three insights. First, the effect of monetary policy shows less dispersion on fixed investment of small-sized firms than that of medium- and large-sized firms. Second, the accumulative effect of monetary easing on fixed investment in the fourth year is significantly positive for small-sized firms, but significantly negative for larger firms. Third, monetary easing cannot spur large-sized firms’ fixed investments.

To capture the regional characteristics, this study presents the heterogeneous dynamic effect of monetary policy on firms located in provinces with different levels of marketization. We utilize the marketization index for 31 provincial regions in China ranging from 2006 to 2014 (Fan, Wang, & Zhu, 2016) to measure the level of marketization. We define that a province has a high level of marketization if its marketization index ranks in top one third, and a province has a low level of marketization if its marketization index ranks in bottom one third; otherwise, it is a province with a medium level of marketization.

The impulse responses of the total investment of firms located in provinces with different marketization levels are reported in Fig. 8, which shows that the total investment of firms located in provinces with high marketization level significantly respond earlier and more persistently to unanticipated expansionary monetary policy. The results suggest that firms have better access to financial markets may react earlier to unanticipated expansionary monetary policy.

We also present how unanticipated expansionary monetary policy influences the fixed investment of firms located in provinces with different marketization levels. Fig. 9 indicates that firms located in low marketization level dramatically increase fixed investment in the short term owing to the policy of unanticipated monetary easing, while firms located in high marketization level also invest more in fixed investment in the first year of unanticipated monetary easing. The firms located in provinces with medium marketization level cut new fixed investments in the first year of unanticipated monetary easing and invest more in fixed assets in the third year.

4.3. Effect of monetary policy on sales revenue and leverage ratio

We further examine the heterogeneous dynamic effect of monetary policy on sales revenue and leverage ratio of non-listed real sector firms. In this section, we focus on heterogeneous effects on firms with different firm sizes (for brevity, we do not present the aggregate impulse response).

We begin by investigating the effect of monetary policy on sales revenue, and the results are showed in Fig. 10. We can find that non-listed real sector firms in each group experience a significant increase of sales revenue in the first two years of the monetary easing. A 1% unanticipated increase of the M2 growth rate leads to around the 6% increases of the sales revenue of non-listed real sector firms in the first year, and this effect peaks in the second year of the monetary surprise, reaching a level of over 10%. This effect diminishes in the third year for all non-listed real sector firms, and present discrepancies among small-, medium- and large-sized firms in the fourth year. The effect of monetary easing on sales revenue of medium-sized firms rebounds, while this effect on large-sized firms fades. It is remarkable that the sale revenue is the flow rather than the stock, which means that the effect of monetary policy on sales revenue of firms in all groups keeps positive in all horizons.\(^\text{10}\)

Fig. 10 shows that the effects of monetary policy on sales revenue of non-listed firms do not turn negative, which illustrates that the changes in sales revenue could not explain why firms reduce new investment in the third year of the monetary policy changes. The changes in investment opportunities and market capacity do not dominate investment decisions for non-listed firms. The possible reason is that most non-listed firms are confronted with underinvestment problems, and the ability rather than the willing to investment matters for these firms.

We also examine the effect of monetary easing on leverage ratio of non-listed real sector firms. The impulse response patterns in Fig. 11 resemble the patterns of changes in investment in Fig. 7, especially in the parts of small- and medium-sized firms. The average

\(^{10}\) Only the effect of monetary policy on sales revenue of large-sized firms in the fourth year of the monetary policy surprise is non-significant.
leverage ratio of small-sized firms positively response to the monetary easing in the first year; however, the accumulative effect on small-sized firms’ leverage diminishes and turns negative in the third year. Subsequently, this effect fades in the fourth year of the monetary policy surprise.

For the medium-sized firms, an unanticipated increase of M2 growth rate leads to a 0.5% increase of the leverage ratio, and the effect of monetary easing turns non-significant since the third year. The impulse response of large-sized firms’ average leverage to monetary easing is not similar to the pattern of fixed investment, for the leverage ratio of large-sized firms dramatically increases in the first year. In addition, the accumulative effect of monetary easing on the leverage ratio of large-sized firms is negative (although not noticeable) in the fourth year.

**Fig. 7.** Effect of monetary policy on fixed investment by firm size
Note: The figure shows the impulse response functions of the fixed investment of small-, medium-, and large-sized firms to a 1% unanticipated increase in M2 growth rate. The dotted lines report the 95% confidence level of the estimates of the effects (standard errors are clustered by firm).

**Fig. 8.** Effect of monetary policy on total investment by regional marketization
Note: The figure shows the impulse response functions of the total investment of firms located in provinces with low, medium, and high marketization to a 1% unanticipated increase in M2 growth rate. The dotted lines report the 95% confidence level of the estimates of the effects (standard errors are clustered by firm).

**Fig. 9.** Effect of monetary policy on fixed investment by regional marketization
Note: The figure shows the impulse response functions of the fixed investment of firms located in provinces with low, medium, and high marketization to a 1% unanticipated increase in M2 growth rate. The dotted lines report the 95% confidence level of the estimates of the effects (standard errors are clustered by firm).

**Fig. 10.** Effect of monetary policy on sales revenue by firm size
Note: The figure shows the impulse response functions of the sales revenue of small-, medium-, and large-sized firms to a 1% unanticipated increase in M2 growth rate. The dotted lines report the 95% confidence level of the estimates of the effects (standard errors are clustered by firm).
Fig. 11 tells that the impulse response of small- and medium-sized firms’ leverage level is highly related to the response of fixed investment, which reveals that the changes in debt may explain the small- and medium-sized firms’ fixed investment decisions. These non-listed real sector firms with smaller size relatively rely on bank loans to fund for new investment projects. These small- and medium-sized firms invest more when they have better access to external finance, and they will not continue to make more additional fixed investments when the banks do not provide roll-over loans. Moreover, monetary easing instantaneously increases leverage ratio of large-sized firms; although, these non-listed large-sized firms do not significantly expand fixed investment immediately. For large-sized firms, they actively or passively incur debts in the short term in monetary easing (Deng et al., 2015), and do not roll-over these debts in the second year or later.

In summary, the effect of monetary policy on the investment decisions of non-listed firms could be roughly explained by the changes in external finance constraints rather than investment opportunities. Although we do not strictly check whether the interest rate channel or the bank lending channel could dominate in the monetary transmission mechanism, dictated by data availability, this study still highlights the role of external finance for non-listed firms in China.

5. Conclusion

This study isolates monetary policy surprises by using price changes in financial markets and the proxy-VAR model, and then employ the LP-IV method and firm-level data to investigate the effect of China’s monetary policy on non-listed firms’ investment. Specifically, we estimate heterogeneous dynamic effects of monetary policy and examine whether monetary easing permanently increases firms’ investment. The empirical results show that unanticipated expansionary monetary policy spurs total investment of China’s non-listed real sector firms in the first two years but reduces new total investment in the third and fourth year, leading to a non-significant cumulative effect on total investment in the end of the fourth year of the monetary surprise. For fixed investment, unanticipated monetary easing leads to an increase in fixed investment in the first year of the monetary surprise. However, the accumulative effect on fixed investment becomes negative in the third and fourth year. These results suggest that monetary easing shifts investment to an early date rather than increases investment permanently, which provides important insights to reconsider the effectiveness of China’s monetary policy.

Further, our group-division analysis explores how the firm characteristics including state-ownership and scale of assets influence effect of monetary policy on investment. The stimulating effect of monetary easing on the investment of SOEs could be more persistent than that of non-SOEs, and the effect on total investment of small-sized firms is more persistent than that of medium- and large-sized firms. Moreover, the accumulative effect of monetary easing on fixed investment in the fourth year is significantly positive for small-sized firms, but significantly negative for larger firms. Further analysis on sales revenue and leverage show that the responses of total and fixed investment of non-listed firms to monetary policy surprises is related the changes in external finance rather than investment opportunities or market capacity.

Our results also imply that unanticipated monetary policy can cause several unexpected side effects. Unanticipated monetary easing may not prompt investment in the medium and long terms, and it also leads to structural changes among firms with different sizes of assets and state-ownership.

Therefore, Chinese monetary authorities should judiciously implement monetary policy for its unexpected long-run and structural effects. Dramatic unanticipated monetary policy could not change long-run trends, and a monetary policy rule may achieve the goals to affect business cycle. Moreover, considering that unanticipated expansionary monetary policy allocates more funds to SOEs and unanticipated contractionary monetary policy shifts resources to relatively large-sized firms, monetary policy stance should be more stable to avoid resource misallocation in China.

The results could be instructive for other emerging market economies. It could not be adequate for monetary authorities in developing countries to implement radical unanticipated monetary policy when confronted with long-term downward economic trends.

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