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Abstract:

In this paper we examine how stock returns in China respond to monetary policy announcements made by PBC in a short term around announcement day. We employ a nonparametric event-study method to investigate such reactions. We arrive at the following conclusions. Firstly, there is information leakage of monetary policy changes, which is verified by significant changes in stock returns before monetary policy announcement and quietness of stock market after announcement. Secondly, financially constrained and financially unconstrained firms respond quite similarly to monetary policy shocks, which disobeys credit channel of monetary policy transmission in the short run. Thirdly, reserve ratio changes cause stronger responses than loan interest rate changes, which demonstrate power of reserve ratio as a monetary policy instrument.

Keywords: Monetary policy, Stock market,, Financial constraint, Event study

Contents

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1 Introduction

The driving factors and ultimate objectives of monetary policy are associated with unemployment rate, output growth, and inflation rate. As it takes time for monetary policy to change fundamentals of real economy, central bank governors need to be forward-looking and make decisions in time to curb inflationary trend and help real economy out of potential deflation. While nominal economic variables such as interest rate and asset prices are not affected by monetary policy in the long term according to classic Keynesian theory, in the short time, asset prices usually react promptly to monetary policy changes, which is interpreted as typical consequence of monetary policy adjustment by journalists and many practitioners. It is important to understand links between ultimate objectives of monetary policy and short-term responses of capital market, because this not only helps explain transmission mechanism of monetary policy, but also enables policy makers to adjust their actions through monitoring market responses. For common investors, it is also quite necessary to understand effects of monetary policy and forecast potential policy changes so that they can reoptimize their portfolios.

Usually in the wake of long-standing boom in asset prices are bubble bursts, followed by significant and persistent recession in real economy. This kind of scenario has been seen for several times in the past two decades. After the global financial crisis, it is hotly debated whether central banks should take asset prices into consideration when making monetary policies, which has two implications for empirical research. Firstly, are central banks better than market participants at judging market movements, and can market information helps in making reasonable monetary policy? Secondly, how will asset prices react to these monetary policies and can reasonable policies lead to a healthy financial market?

The principle objective of our research is to examine whether there is some significant relationship between monetary policy and stock price movement in the short term around announcement day. We may suspect that not all monetary policies will produce significant impact on asset prices. Even the same policy change at different time can cause distinct market responses, because these new policies influence asset prices not only through economic channel but also through affecting market participants' expectations that are adjusted according to signals contained in new policies. Therefore, we investigate announcement effects at an aggregate level, which means that we examine effects from expanding and deflationary monetary policy announcements on the whole rather than investigate each an-

nouncement one by one. It has been well documented in the literature (e.g. Bernanke and Kuttner (2005)) that monetary policy adjustment causes market volatility not because of the policy itself but because of unexpected shocks from policy changes. When contents of monetary policies are anticipated by market participants, effects from policy changes may have already been reflected in asset prices preceding announcement. Some evidence of information leakage exists in the literature, which is more common at emerging market. Information leakage does not refer to illegal or unethical leakage of monetary policy news here, and instead it means that market participants infer potential policy actions from research on some related news and economic data released by officials. The inference of monetary policy is based on economic situation and common practice of PBC. PBC usually announces new monetary policies during weekend or on vacation days. Taking two announcements of reserve requirement ratio changes in 2010 for instance, PBC raised reserve requirement ratio by 0.5 percent respectively on 12nd February (before Chinese Spring Festival) and 2nd May (before Labor Day). Such arrangement is to reduce market volatility on trading day right after policy changes.

Various monetary policy instruments can also induce different consequences. For example, regular open market operation by trading desk of central bank may only change liquidity of money market for a very short period and have quite limited or no effect on other asset prices. On the contrary, increasing reserve ratio can rein in excessive credit creation from banks and may indicate signal of contractionary monetary policy path in the future, and stock prices experience sharp declination after such announcement as a result. Our research will study price movement before and after monetary policy announcements in stock market. If there are some statistically significant responses in stock market, it shows that expectations on policy actions have been formulated. If a new monetary policy is totally unexpected, it may cause large shocks to stock market on the day of announcement and takes several days for stock prices to absorb this information. By comparing impact of announcement on reserve requirement ratio and loan interest rate, which are two most important monetary policy instruments for PBC, we can find some reasons why central banks of developed economies abandon reserve requirement ratio as a policy tool while PBC used it often in previous years.

Firms with various financial characteristics and in different industries may be affected by monetary policy changes to different extents. In our paper, we will construct two kinds of stock portfolios, which are financially constrained or unconstrained. By referring a company to be financially constrained, we mean frictions that prevent the firm to invest in profitable

projects. When a company with good growth opportunity can not fund desirable investments with its own retained earning, it relies heavily on external financing. In emerging market like China, loan from banks is the most important source of external financing. When reserve ratio of saving banks and other financial institutions is increased, credit creation is tightened and therefore less loans are available to those firms relying on external financing to finance profitable investment. From the above discussion, we formulate a hypothesis that stock prices of financially constrained firms will be more volatile to monetary policy changes than financially unconstrained firms, which is aimed to test for the credit transmission channel of monetary policies in the short term. If monetary policy works through credit channel, then firms that are more constrained by credit will be more sensitive to policy changes and their stocks in the period around policy announcement will also price this new information into prices.

This paper takes monetary policies of the central bank of China (People's Bank of China, PBC) as research objective, and examines how policy announcements made by PBC affect stock returns of all firms listed in Shanghai and Shenzhen stock exchange. Reasons for this research are based on the following aspects. Firstly, stock price is a main kind of asset prices that are sensitive to policy changes, and stock market is the most important capital market in China. Secondly, China is one of the most important emerging economy, and the interaction between monetary policies and stock market in emerging market may be different from that in mature market. Lastly but most importantly, in the past several years, PBC adjusted monetary policies more frequently according to domestic and global economic situations. This have been seen especially in 2007 and 2008, when China's stock market reached peak and then experienced drastic downturn. A detailed list of monetary policy changes is given in the appendix. Relatively frequent monetary policy announcements provide us a natural experimental design to study announcement events on stock returns.

The structure of this paper will be arranged as follows. Section 2 introduces related literature, section 3 briefly introduces monetary policy practice in China and outlines research methodology, section 4 explains research data and formulate financial constrained portfolios, section 5 presents our empirical findings, and section 6 concludes.

2 Related Literature

2.1 Selected literature on stock market return and monetary policy

The examination of monetary policy effects on stock market follows research on whether monetary policy can affect interest rates in the literature. Cook and Hahn (1989) estimated responses of interest rates to changes in the federal fund rate targets from September 1974 to September 1979. In 1970s, the Federal Reserve set a range over which fund rate can vary in each month. Cook and Hahn regressed changes in interest rates on changes in the midpoint of the target range on each resetting day of target rate, which is called event study method in later research. Cook and Hahn found that short-term interest rate moves in the same direction as federal fund rate changes. Thorbecke (1997) employed impulse-response functions and variance decomposition from identified vector autoregression (VAR) to examine relationship between monetary policies and stock returns. Thorbecke found significant relationship between monetary policy shocks and subsequent stock return variations.

As anticipated policy changes have little effect on stock prices, it is of vital importance to isolate unexpected monetary policy shocks from expected changes contained in monetary policy announcements. Both changes of midpoint of target range and innovations of policy shocks from identified VAR are not persuasive. Kuttner (2001) provided a market-based method to gauge monetary policy expectations by exploring information contained in federal funds futures contract. Specifically, Kuttner extracted market expectation of target rate changes from differences in the future contract's price between the day preceding policy action and the action day. Gurkaynak et al. (2007) compared ability of a variety of financial instruments to measure near-term expectation of federal fund rate, and they found that federal fund futures contract dominates other financial instruments in predicting future monetary policy path. Bernanke and Kuttner (2005) used Kuttner's method to isolate expected and unexpected changes in fund rate target and regressed stock returns on interest rate changes on days of scheduled meetings of the Federal Open Market Committee. Rigobon and Sack (2003) found that short-term interest rate reacts significantly to returns of broad equity indexes, so when we regress stock returns on changes of interest rate, we will encounter endogeneity problem. Rigobon and Sack (2004) devised an estimator to overcome this simultaneous regression problem, and show that event-study regression is only a special case of their estimator.

2.2 Implications from literature review

From the above review, there are several facts worth attention. Firstly, some researchers just adopt simple event-study regression to capture the impact of monetary policy announcements on stock returns. This method runs into the omitted variable problem, because there may be some other factors besides changes in federal fund rate target influencing stock returns. Gurkaynak et al. (n.d.) found that this kind of research needs two factors, which are interpreted as "current federal funds rate target" and "future path of policy factor". Secondly, endogeneity problem exists in event-study regression since central bank policymakers may react to asset prices when shaping monetary policies. This evidence can be found in Rigobon and Sack (2003). Lastly but most importantly, we can not find similar financial market instrument as in Kuttner (2001) to gauge market expectations of PBC's policy actions. Till now, there is no interest rate futures contract in China, and forward contracts of interest rate in OTC market can not be used to measure policy expectations because they are newly introduced and not traded actively at all.

We choose traditional event-study methodology in finance literature to examine how events of monetary policy announcements by PBC affect returns of A-share stocks in China. This method has the following three advantages. Firstly, it does not involve omitted variable or endogeneity problem in model specification. Secondly, as the impact of monetary policy announcements on stock market may be temporary, our event-study approach enables us to examine responses on days around policy announcements flexibly. Thirdly, since market expectations can be reflected in abnormal returns of stocks before announcements, we avoid to measure expectations of monetary policies directly. Detailed introduction of event-study approach will be presented in part 3.

3 Research design and methodology

3.1 Monetary policy instruments in China

In order to study the impact of monetary policy announcements made by PBC on stock returns in China, we need to have a brief view of the monetary policy instruments in China. There are several monetary policy instruments applied by PBC, including reserve requirement ratio, central bank base rate, rediscounting, central bank lending and open market operation. Among these instruments, daily open market operation is used most regularly by trading desk of central bank to adjust liquidity of money market, which is aimed to make market interest rate fluctuate slightly around interest rate target. Reserve requirement ratio regulates the minimum reserves commercial banks should hold to customer deposits and notes. The reserve ratio instrument is rarely used by central banks in developed countries, because its adjustment will change money multiplier and cause drastic liquidity problems for banks. However, this instrument has been employed frequently by PBC to rein in excess liquidity to fight against inflation or inject liquidity to promote economy. The reserve ratio was changed for 10 and 9 times by PBC respectively in 2007 and 2008. The central bank base rates set lower bound for bank loans and upper bound for deposits. Although interest rate marketization in China has been progressing gradually, PBC still plays a key role in forming capital cost. Among all maturities of interest rates, the one-year loan interest rate is adjusted most frequently to guide market interest rate. Compared with the above instruments, rediscounting, central bank lending and interest rate of excessive reserves are rarely used by PBC.

3.2 Research design and hypothesis

In this paper, we treat announcements of reserve ratio changes and new one-year loan rate from year 2002 to 2010 as events, and examine how these two kinds of announcements will affect A-share stock returns in China. The mechanism of reserve requirement ratio was reformed in 1998, so in order to avoid structural changes resulted from this reform we eliminate all announcements in 1998 and 1999. In 2000 and 2001, there were no announcements on reserve ratio rate or loan interest rate. Therefore we only consider the two kinds of announcements from 2002 to 2010, and a detailed list of these events can be found in appendix. We choose A-share stocks rather than B-share stocks as research target, because

they cover much larger samples and have more common investors involved so that they will better reveal market responses to monetary policy announcements. In this part, we propose the following hypothesis to be tested in our empirical part.

(1) Research on the credit channel of monetary policy transmission has been intrigued by Bernanke and Blinder (1988). Bernanke and Blinder (1992) found that banks react to reduced deposit, which can be caused by increased reserve ratio for example, firstly by selling off securities in the short term and then reducing loans in the longer run. Kashyap et al. (1993) found evidence of loan-supply monetary-policy transmission. They showed that firms switch to other external financing when available bank loans decline. Ehrmann and Fratzscher (2004) found that individual stocks react heterogeneously to monetary policy shocks, and firms that are financially constrained respond significantly more than unconstrained ones.

As changes in reserve ratio influence access to credit and variations in loan rate affect capital cost of financing, firms that need bank loans to different extent may suffer or benefit heterogeneously to monetary policy changes. We formulate two portfolios of stocks, which are financially constrained or unconstrained, to investigate how stocks with different financial status react to monetary policies. By referring to financially constrained, we mean the situation that firms with good growth opportunities rely heavily on external financing to fund profitable investment. Here growth opportunity can be reflected by some financial variables such as sales growth and net income margin (refer to Cleary (1999)). We use price-to-book value (PTBV) to measure growth opportunity, because PTBV factors investors' valuation on potential growth opportunities in stock prices. If returns of financially constrained firms suffer more from deflationary monetary policy than unconstrained firms in the short run, this will support the credit transmission channel of monetary policy because participants expect that financial constrained firms will be affected more severely by tightened bank credit in the medium and long period.

(2) We divide all policy announcements into expanding and deflationary groups, and examine their influences on stock returns on the whole. Expanding group includes all announcements of decreased reserve requirement ratio or loan interest rate, while deflationary group refers to the case of decreased reserve requirement ratio or loan interest rate[①] . As

[①] The ideal way to classify expanding and deflationary groups is to compare actual monetary policy actions with market expectations on monetary policy. For instance, if market participants expect that central bank will raise base loan interest rate with a large magnitude to curb high inflation, while the interest rate is increased only by a moderate level, then this seeming contractionary policy is actually expansionary. However, we fail to do this because we can not find a good measure of market expectation on monetary policy in China.

monetary policies made under different economic conditions indicate distinct information about central bank's regulation path and even the same kind of announcement may induce different responses of stock returns, examining announcements one by one will make our conclusion less obvious. We expect that on days around announcements decreased reserve ratio and loan interest rate boost abnormal returns of A-shares because of either more credit available or lower capital cost, and vice versa. When information of new monetary policies is leaked before announcement, A-share stocks react significantly and systematically prior to announcement of monetary policies. When there is no information leakage and monetary policy changes bring shocks to stock market, there will be systematic and significant reaction in returns of A-share stocks after announcement. The hypothesis can be stated as follows:

H1. leaked expanding monetary policies cause positive abnormal returns of A-share stocks preceding policy announcements.

H2. leaked deflationary monetary policies cause negative abnormal returns of A-share stocks preceding policy announcements.

H3. Expanding monetary policy shocks induce positive abnormal returns of A-share stocks on days of announcement or after announcement days.

H4. Deflationary monetary policy shocks induce negative abnormal returns of A-share stocks on days of announcement or after announcement days.

H1-H4 are a set of complementary hypothesis. There are several situations we can imagine. For example, when a deflationary policy is announced after several expanding policy releases, stock market may be shocked by this policy change, and reacts drastically on announcement day or even after announcement day. When the path of future monetary policy is anticipated and only the extent of change is new for market participants, shocks caused by policy changes are much less strong and stock market may stay comparatively calm on announcement day. When a monetary policy is leaked before announcement, such news will be reflected in stock returns before announcement.

(3) 28 of the 34 events we examined are announcements of deflationary monetary policy. We study the impact of the 8 increased loan rates and 19 increased reserve ratios separately to investigate how announcement effects of different monetary policy instrument differ[①] . We also examine the effect of monetary policy announcements on property stocks on purpose.

[①] One announcement that contains both increased reserve ratio and increased loan rete is deleted.

3.3 Event Study Methodology

We apply classic event-study methodology in finance literature to examine how stock market react to monetary policy changes before and after announcement. The first trading day after announcement is labeled as day 0. Our event window is from day -2 to day +2 so that responses triggered by monetary policy changes are not contaminated by other policy announcements[①] . The estimation window covers days from day -102 to day -3[②] . For each announcement, there are many stocks simultaneously affected by the same shock, and we treat each firm-announcement combination as an event.

Let R_{it} denote daily return of stock i on day t. Using the continuously compounding method, we can calculate the return as follows,

$$R_{it} = \ln P_{it} - \ln P_{i,t-1}, \text{ where } p_{it} \text{ is adjusted price of stock } i \text{ on day } t. \tag{3.1}$$

We use two regressions to capture abnormal returns A_{it}. The first method is market model, which can be described as:

$$\begin{aligned} &R_{it} = \alpha_i + \beta_i R_{mt} \ , \\ &A_{it} = R_{it} - (\hat{\alpha}_i + \hat{\beta}_i R_{mt}) \text{ , where } R_{mt} \text{ is market return on day } t \end{aligned} \tag{3.2}$$

The second one is Fama-French three-factor model, described as:

$$\begin{aligned} &R_{it} - R_{ft} = \beta_{i1}(R_{mt} - R_{ft}) + \beta_{i2} SMB_t + \beta_{i3} HML_t \ , \\ &A_{it} = R_{it} - R_{ft} - \hat{\beta}_{i1}(R_{mt} - R_{ft}) - \hat{\beta}_{i2} SMB_t - \hat{\beta}_{i3} HML_t \end{aligned} \tag{3.3}$$

In equation 3, R_f is risk-free return, $R_m - R_f$ is market factor which is defined as returns on all A-share stocks minus risk-free return and can be interpreted as risk premium of A-share stock index, SMB denotes size factor which is return on small firms deducted by that on large firms, and HML stands for book-to-market factor which is return on high book-to-market stocks minus that on low book-to-market stocks and can be interpreted as relative performance of value stocks to growth stocks. Abnormal returns are regression residuals that can not be explained by risk factors in asset pricing models.

① Although we can not distinguish responses caused by monetary policy news and other policy announcements that are either domestic or international, we choose short event window to mitigate this problem because this shortened window will include less influential announcements to overlap with monetary policy announcement, and we assume that other policy announcements will not cause systematic error to our research design.

② This length of estimation window enables us to estimate a stable relationship between stock returns and pricing factors, and the window is not too long to include potential structural breaks in relationship between stock returns and risk factors.

There are two kinds of event-study test in the literature, cross-sectional test and nonparametric test. Under the three assumptions that all events are independent, event has no impact on variance of returns in event window and the abnormal returns are normally distributed, Brown and Warner (1985) derived cross-sectional test statistic. Collins and Dent (1984) relaxed assumptions by allowing for cross-sectional dependence in returns and possible increase in return variances from estimation window to event window. Bernard (1987) and other researchers relax assumptions of cross-sectional test further in other aspects. However, to the best knowledge of us, all these tests depend on certain assumptions and are not robust in our research. As firms are influenced by the same announcements, their event window overlaps and therefore there is clustering problem. Besides, variance of returns may be probably increased during event window with unknown pattern, therefore using variance estimator in estimation window to substitute variance in event window is inappropriate.

Nonparametric event-study test is represented by rank test proposed by Corrado (1989) and generalized sign test introduced by Cowan (1992). We use the latter one because generalized sign test allows for cross-sectional dependence and asymmetry of returns and outperforms rank test when variance of returns increases in event window or stocks are thinly traded.

The generalized sign test compares the number of stocks with positive or negative (cumulative) abnormal returns in the event window to that in the estimation window. When we test for the hypothesis that expanding monetary policy brings positive abnormal returns, we define $\hat{p}$ as the proportion of the number of positive abnormal returns over estimation window applied to all firms and corresponding events,

$$\hat{p} = \frac{1}{n} \sum_{i=1}^{n} \frac{1}{100} \sum_{t=E_1}^{E_{100}} S_{jt} \ ,$$

where n is the number of events with announcements of expanding monetary policy and

$$S_{jt} = \begin{cases} 1 & \text{if } AR_{jt} > 0 \\ 0 & \text{otherwise} \ , \end{cases}$$

When we test for the hypothesis that deflationary monetary policy induces negative abnormal returns, $\hat{p}$ stands for the proportion of the number of negative abnormal returns applied

to all firms and events with announcement of deflationary monetary policy, and

$$S_{jt} = \begin{cases} 1 & \text{if } AR_{jt} < 0 \\ 0 & \text{otherwise ,} \end{cases}$$

Define w as the number of stocks in event window for which the abnormal return is positive or negative, generalized sign test can be written as

$$Z_G = \frac{w - n\hat{p}}{\sqrt{n\hat{p}(1-\hat{p})}} , \tag{3.4}$$

which has an asymptotic standard-normal distribution. We employ one-tail normality test of generalized sign test statistic in remaining part. For both expanding and deflationary monetary policies, if the number of positive or negative abnormal returns in event window is significantly larger than the counterpart in estimation window, Z_G is expected to be larger than critical value of standard normal distribution with 95% or 99% confidence level.

4 Financially Constrained Portfolio

4.1 Method to construct financially constrained portfolio

In this research, we pick out all A-share stocks listed at Shanghai or Shenzhen exchange and keep only those firms that are either financially constrained or unconstrained. We identify firms that have good growth opportunities and rely heavily on external financing as financially constrained ones, and that do not finance profitable investment or have enough internal fund as financially unconstrained ones. There are four major methods in the literature to categorize firms into financially constrained or unconstrained groups. Kaplan and Zingales (1997) extracted financial status of 49 firms from their financial reports year by year, and regressed financial status on a set of financial variables using ordered logit model to provide an overall measure of financial constraint. The disadvantage of their method is that it is not manageable to include large research sample because it is too time-consuming to identify financial status through reading financial reports year by year and firm by firm. Whited and Wu (2006) built an intertemporal investment model under certain assumptions, and estimated this model by GMM method to construct a financial constraint index. Cleary (1999) classified firms into groups according to whether they increased or decreased dividends in the past year, and used linear discriminant analysis to construct financial constraint index. This method is not applicable in our research, because underlying assumptions of discriminant analysis are not satisfied. Some other empirical researches just categorize firms according to rank of certain financial variables, such as firm size, dividend ratio, Tobin's Q and so on.

We use a simple scheme to provide a measure of financial status to each firm year by year. Our method is implemented in the following steps:

(1) We specify a binary variable to indicate whether a firm is financially constrained or not. Specifically, we rank firms according to their firm size represented by book value of their total assets, and divide them into three groups, i.e., the smallest, medium and largest group. Firms that lie in the lowest one third of firm size and decreased dividend per share during the past year are classified as constrained. In a similar way, firms that fall into the highest one third and increased dividend per share during the past year are classified as unconstrained. This categorization is based on the following two reasons. Firstly, large firms are easier to raise fund from external financing, because they have

more collateral to apply for loans and less prone to go bankruptcy. Secondly, increased dividend per share of a firm indicates that the firm's cash flow is at least not bad, or else it will retain cash flow for investments and other expenses.

(2) We use four financial variables to comprehensively reflect financial performance of each firm. Specifically, These four variables are indicators of leverage, profitable investment opportunities, profitability of assets and liquidity, which are represented by long-term debt ratio (Debt), price-to-book ratio (PTBV), return on assets (ROA), and current ratio (Current). Definitions of variables are as follows,

$$\text{Debt} = \frac{\text{long-term debt}}{\text{Book value of total assets}}$$

$$\text{PTBV} = \text{Price-to-book value} = \frac{\text{Market price per share}}{\text{Book value per share}}$$

$$\text{ROA} = \text{Return on asset} = \frac{\text{Net income+Interest Expense-Interest tax savings}}{\text{Average total assets}}$$

$$\text{Current} = \frac{\text{Current assets}}{\text{Current liabilities}}$$

The choice of these four financial variables is not at random. Firstly, each variable is commonly interpreted as an indicator of certain aspect of a firm's financial performance, and they together describe the whole picture of the firm. Secondly, we also tried other indicators to represent the four aspects of a firm's financial performance, but they are outweighed by the above financial variables in the sense of regression fitness.

(3) We use a Probit model to construct financial constraint index,

$$\text{Prob}(Y = 1|X) = \int_{-\infty}^{X'\beta} \phi(t)dt = \Phi(X'\beta) \tag{4.1}$$

As $\Phi(X'\beta)$ is a strictly increasing function with respect to $X'\beta$, we define financial constraint index (FT) as,

$$\text{FT}_{it} = \text{constant} + \beta_1\text{Debt}_{it} + \beta_2\text{PTBV}_{it} + \beta_3\text{ROA}_{it} + \beta_4\text{Current}_{it}\ , \tag{4.2}$$

where i denotes firm i and t refers to year t.

We repeat to construct financially constrained and unconstrained portfolios year by year by utilizing annual financial data, and categorize firms whose FT index falls into the largest one third as financially constrained, and firms whose financial index falls into the lowest one third as financially unconstrained, with the middle one third being deleted.

In order to capture financial performance of each company comprehensively, the above four financial variables should be of equal importance in constructing FT index. In practice, we delete those firms which have extreme value of the four variables because variables with extreme value will dominate others when combined to construct FT index. Specifically, we delete those firms that have any of the four variables smaller than corresponding 1 centile or larger than 99 centile.

4.2 Data and classification results

We use all A-share stocks listed at Shanghai and Shenzhen exchange as research sample. The time ranges from year 2002 to 2008, during which frequent monetary policies were announced and enough research sample in classified groups exists. We approximate risk-free interest rate by return of one-year central bank bill, which is neither too volatile to be interpreted as risk-free nor almost fixed and controlled by government. Market return is represented by return on A-share stock market index. Data sets of risk-free interest rate, market return and Fama-French three factors are all from Resset Database. The other data including prices of A-share stocks and annual financial variables are all from Datastream.

Table 1 shows sample size in each year from 2002 to 2008 except 2005, because there was no policy announcement in 2005. Effective firms refer to those firms that do not have missing value in DPS, firm size, Debt, PTBV, ROA and Current, and whose values of the latter four variables do not lie in the largest or lowest 1 centile. Constrained denotes firms that have firm size in the lowest one third and decreased DPS in the past year, and unconstrained refers to firms that have firm size in the highest one third and increased DPS in the past year. We call such categorization original groups in remaining part. We find that composition and proportion of financially constrained and unconstrained portfolio vary from year to year, which in all takes about 1/6 to 1/5 of effective samples. As can be seen, most of policy changes happened in 2007 and 2008, when stock market reached peak and then experienced drastic declination because of financial crisis.

Table 2 presents probit regressions to construct financial constraint index. As can be seen, the selected four financial variables do well in summarizing financial status of a firm since most of the coefficients are statistically significant, and their signs and magnitude are relatively stable over years except Debt in 2007. FT is weighted sum of financial variables with weight being corresponding coefficients. We classify 50 firms in effective sample with the lowest FT index as unconstrained and 50 firms with the highest FT as constrained. We

can find that constrained firms have significant lower historical returns on assets but brighter growth opportunities implied by higher price-to-book value. This is the same as our expectation. When firms have less retained earnings resulted from lower return on assets, they rely more on external financing to fund investment and tend to be more constrained. Constrained firms also have higher current ratio, which means that they keep more current assets on balance sheet to handle liquidity needs. For the composition of debts, there is evidence that unconstrained firms are able to raise more long-term debts to finance investment and other expenses. Pseudo-R^2 is McFadden's goodness-of-fit measure, which is an analog of R^2 in linear regression. Pseudo-R^2 is defined as

$$\text{Pseudo-}R^2 = 1 - \frac{\ln L}{\ln L_0}\,, \tag{4.3}$$

where $\ln L_0$ is log-likelihood of constrained model, and $\ln L$ is that of unconstrained model. The larger the Pseudo-R^2, the better the goodness-of-fit. All probit regressions have reasonable magnitude. We also use LR test statistic to test for joint hypothesis that all coefficients in probit model are not significant, which is rejected at 99.9% confidence level.

We provide summary statistics for financial variables in financially constrained and unconstrained portfolios. Table 3 presents means of variables in original groups. Constrained firms have smaller average of DPS and total assets than unconstrained firms, which is determined by our categorization scheme. Constrained firms also have lower values in returns on assets and higher price-to-book value, which supports our finding in probit regression. For long-term debt ratio and current ratio, they reveal the same fact as in table 2.

Table 4 shows summary statistics of financial variables in classified portfolios. We classify 50 firms with the highest FT index as constrained and 50 ones with lowest FT index as unconstrained. As unconstrained firms have systematically higher DPS and firm size, the other four financial variables succeed in predicting the two indicators used to categorize original groups. The difference in debt, ROA, price-to-book value between constrained and unconstrained portfolios have the same characteristics as in original groups, which verifies soundness of our classification method.

Table 4.1 Number of Effective Firms in Original Groups from 2002 to 2008 (except 2005)

Year	2002	2003	2004	2006	2007	2008
Constrained	50	115	65	52	52	49
Unconstrained	157	99	100	137	120	172
Effective number of firms	982	1053	1100	1219	1221	1297
Number of policy changes	1	1	2	5	15	10

Original groups denote groups that we construct according to DPS and firm size. Constrained refers to firms that have firm size in the lowest one third of all firms and decreased dividend per share in the past year, while unconstrained stands for firms that have firm size in the largest one third of all firms and increased dividend per share in the past year.

Table 4.2 Classification by Probit Model from Year 2002 to Year 2008 (except 2005)

Year	2002	2003	2004	2006	2007	2008
Constant	-1.63***	-1.58***	-.80*	-.92***	-.08	-.99***
Debt	-2.11	-2.64*	-4.82**	-3.25**	-12.54***	-5.66***
PTBV	.18***	.50***	.45***	.37***	.13	.14***
ROA	-.12***	-.16***	-.31***	-.13***	-.17***	-.09***
Current	.33**	.20	.55***	.24***	.51***	.44***
LR statistic	72.74	122.76	92.84	48.79	72.37	51.29
Pseudo-R^2	0.32	0.42	0.42	0.22	0.34	0.22
FT (con.)	.2184	1.5208	.9466	-.0347	.1877	-.2987
FT (uncon.)	-1.1838	-.7403	-1.2789	-.9707	-1.5312	-1.2079

*, ** and *** mean that parameters are significantly different from 0 at 90%, 95% and 99% level correspondingly. LR statistic follows $\chi^2(4)$ distribution, with critical value at 99% being 18.4668.

Table 4.3 Variable Means of Original Groups

Year	2002	2003	2004	2006	2007	2008
Total Assets(con)	605972.6	703037.5	757141.9	734876.1	769992.3	807044.3
Total Assets(uncon)	4277884	9085227	7919918	1.24e+07	1.44e+07	1.88e+07
DPS(con)	.0404	.0276	.0234	.0223	.0329	.0239
DPS(uncon)	.1755	.1044	.1256	.1474	.1699	.1861
Current(con)	1.82	1.48	1.76	1.84	1.71	1.58
Current(uncon)	1.52	1.54	1.33	1.31	1.22	1.22
Debt(con)	4.36	3.74	3.83	3.47	1.61	3.02
Debt(uncon)	7.97	7.64	9.51	9.49	9.06	9.72
ROA(con)	2.61	.53	2.77	2.81	3.87	5.16
ROA(uncon)	5.46	5.72	6.60	6.17	6.95	8.45
PTBV(con)	9.36	6.03	4.04	2.47	2.10	4.52
PTBV(uncon)	4.38	3.31	2.84	1.99	2.03	3.97

Debt and ROA are in percentiles, unit of Total Assets is thousand Chinese Yuan, and unit of DPS is Chinese Yuan. Original groups denote groups that we construct according to DPS and firm size. Constrained refers to firms that have firm size in the lowest one third of all firms and decreased dividend per share in the past year, while unconstrained stands for firms that have firm size in the largest one third of all firms and increased dividend per share in the past year.

Table 4.4 Variable Means of Classified Groups

Year	2002	2003	2004	2006	2007	2008
Total Assets(con)	1004487	631895.9	1090277	997829.9	1303674	1818864
Total Assets(uncon)	5632426	1.56e+07	8322659	2.27e+07	1.41e+07	1.84e+07
DPS(con)	.0552	.0238	.0594	.0084	.0088	.0146
DPS(uncon)	.0854	.0838	.0976	.1106	.1066	.0922
Current(con)	1.04	.78	.87	.85	1.71	1.97
Current(uncon)	1.14	1.27	1.15	.84	.95	.63
Debt(con)	1.71	2.84	2.83	1.37	1.32	0.92
Debt(uncon)	11.96	15.99	16.91	2.27	3.21	22.54
ROA(con)	-8.67	-13.19	-12.65	-18.81	-12.52	-3.07
ROA(uncon)	8.89	7.36	10.13	6.97	6.40	11.95
PTBV(con)	18.63	16.00	10.03	6.73	4.02	15.16
PTBV(uncon)	3.58	2.31	2.11	.44	1.81	1.33

Debt and ROA are in percentiles, unit of Total Assets is thousand Chinese Yuan, and unit of DPS is Chinese Yuan. Classified groups refers to groups constructed by financial constraint index. Constrained (con) stands for 50 firms whose FT index are the largest among effective firms, while unconstrained (uncon) are 50 firms whose FT index are the lowest among effective firms.

5 Empirical Results

5.1 The impact of monetary policy announcements on stock market

This part presents empirical findings of the impact of monetary policy announcements on stock returns. We delete stocks that have less than 80 observations in each estimation window or less than 4 observations in each event window, which aims to avoid the problem of thinly trading. Table 5 explains reactions of constrained firms and unconstrained to monetary policy announcements. Part A uses the market model to capture abnormal returns, and Part B uses the Fama-French three-factor model. Part A shows that stock market has already anticipated both expanding and deflationary policy news before announcement. Expanding monetary policies make more stocks obtain positive abnormal returns on the trading day prior to announcement, and deflationary monetary policies induce more stocks to suffer from negative abnormal returns. It is also obvious that stocks almost have no response on days of announcement. These evidence implies that contents of announcements have been leaked to market participants so that monetary policy announcements can not bring strong shock to the market when they are released. When we apply Fama-French model to measure abnormal returns in Part B, similar information leakage is found. The main difference between A and B is that there is some reaction on days of announcement in Part B when monetary policy is expanding. Table 6 applies the same method as Table 5 to classified groups. The finding is quite different from that of original groups, with less obvious evidence of response before announcement. The common findings of Table 5 and table 6 are that financially constrained and unconstrained firms react quite similar to monetary policy shocks, which implies that the credit channel of monetary policies does not exist in the short run. This result is different from Ehrmann and Fratzscher (2004), which found that financially constrained and unconstrained firms respond differently to monetary policy in the U.S. market. One possible reason is that even monetary policy changes affect the amount and cost of credit available to firms, they may only work in the medium and long term and it takes time for distinction between financially constrained and unconstrained firms to be reflected.

Table 7 examines deflationary announcements of reserve ratio changes and loan rate changes separately to original groups. We find that there is no announcement effect for loan rate changes. In contrast, stock market reacts to reserve ratio changes on days of

announcement. Another finding is that there is no evidence of pre-announcement effects when we separate announcements into reserve ratio changes and interest rate changes. Table 8 applies the same method as table 7 to classified groups. It is the same that stocks do not respond to interest rate changes, and there are also pre-announcement effects and some reactions after announcement.

In summary, there are three facts worth emphasizing. Firstly, as shown in Table 5 and 6, the stock market responds before news of monetary policy changes is publicly known, which is quite surprising, because unlike monetary policy practice in U.S., there is no fixed schedule for PBC to hold routing meetings or make announcement of monetary policy but market participants still anticipate policy changes and adjusts preceding announcement. Secondly, reserve ratio changes impose much stronger influence on the stock market while there is almost no effect caused by loan interest rate changes. One possible reason is that PBC usually adjust market interest rate gradually, and therefore market participants can infer potential policy actions from market movement and factor the information in stock prices before news release. Thirdly, as reserve ratio changes suddenly affect balance sheet of banks and monetary multiplier, this blunt instrument has already been abandoned by central banks of most developed economies. However, PBC prefers reserve ratio instrument since it can rein in and inject liquidity to market in a short period, and this instrument was frequently used in 2006 to 2008 to reduce excessive liquidity brought by expanding trade surplus.

5.2 A special case: monetary policy effects on property industry

We study stocks in property industry on purpose in this part, because property firms in China rely heavily on bank loans and therefore are more sensitive to adjustment of monetary policy. As indicated in previous research, there is significant pre-announcement effect for both expanding and deflationary monetary policies. And it can be seen from Table 9, property stocks react to deflationary announcements on days of announcement. When we examine the impact of interest rate changes and reserve ratio changes separately, we find property stocks respond more strongly to interest rate changes. Table 8 presents the effects of two recent announcements in 2010. For the first increase of reserve ratio in 2010, much more stocks react negatively prior to announcement, while stocks remain relatively calm before the second change in reserve ratio. This is because the first reserve ratio change happened after a series of expanding monetary policies in 2008 and there was no monetary policy announcement in 2009. This announcement signals a directional change in monetary policy path, and the market expectation that stimulating policies during financial crisis will

Table 5.1 Abnormal returns caused by monetary policies (Original groups)

Part A: Market Model				
Portfolio	Financially Constrained		Financially Unconstrained	
Policy	Expanding	Deflationary	Expanding	Deflationary
Event day	$\hat{p} = 0.481$	$\hat{p} = 0.535$	$\hat{p} = 0.487$	$\hat{p} = 0.546$
-2	0.487	0.494	0.525**	0.523
-1	0.558**	0.573***	0.555***	0.570***
0	0.451	0.492	0.496	0.524
1	0.544**	0.530	0.463	0.522
2	0.473	0.492	0.447	0.533
Part B: Fama-French				
Portfolio	Financially Constrained		Financially Unconstrained	
Policy	Expanding	Deflationary	Expanding	Deflationary
Event day	$\hat{p} = 0.449$	$\hat{p} = 0.563$	$\hat{p} = 0.460$	$\hat{p} = 0.555$
-2	0.434	0.564	0.513***	0.562
-1	0.549***	0.592**	0.543***	0.589***
0	0.549***	0.550	0.509***	0.539
1	0.500	0.589**	0.428	0.539
2	0.416	0.557	0.410	0.552

** and *** denote significance at 95% and 99% level respectively using a one-tail test. We define original groups as follows. When an announcement of monetary policy happens, there are both financially constrained and unconstrained firms according to DPS and firm size. We combine all constrained and unconstrained firms across events that are expanding or deflationary.

end brings stronger reaction before news release.

Table 5.2 Abnormal returns caused by monetary policies (Classified groups)

Part A: Market Model				
Portfolio	Financially Constrained		Financially Unconstrained	
Policy	Expanding	Deflationary	Expanding	Deflationary
Event day	$\hat{p} = 0.485$	$\hat{p} = 0.526$	$\hat{p} = 0.486$	$\hat{p} = 0.547$
-2	0.485	0.512	0.547**	0.504
-1	0.515	0.541	0.580***	0.563
0	0.464	0.474	0.497	0.505
1	0.515	0.506	0.486	0.542
2	0.387	0.453	0.459	0.516
Part B: Fama-French				
Portfolio	Financially Constrained		Financially Unconstrained	
Policy	Expanding	Deflationary	Expanding	Deflationary
Event day	$\hat{p} = 0.435$	$\hat{p} = 0.562$	$\hat{p} = 0.452$	$\hat{p} = 0.552$
-2	0.387	0.593**	0.541***	0.541
-1	0.459	0.574	0.575***	0.567
0	0.541***	0.529	0.497	0.503
1	0.500	0.584	0.492	0.560
2	0.309	0.511	0.436	0.537

** and *** denote significance at 95% and 99% level using a one-tail test. We define classified groups as follows. When an announcement of monetary policy happens, there are both financially constrained and unconstrained firms according to rank of FT index. We combine all constrained and unconstrained firms across events that are expanding or deflationary.

Table 5.3 Comparison of effects from interest rate changes and reserve ratio changes (Original groups)

Part A: Market Model				
Portfolio	Financially Constrained		Financially Unconstrained	
Instrument	Reserve ration	Interest rate	Reserve ration	Interest rate
Event day	$\hat{p} = 0.475$	$\hat{p} = 0.472$	$\hat{p} = 0.453$	$\hat{p} = 0.457$
-2	0.483	0.512	0.498***	0.480
-1	0.479	0.405	0.463	0.401
0	0.537***	0.464	0.523***	0.423
1	0.492	0.506	0.450	0.459
2	0.535***	0.583***	0.486**	0.462
Part B: Fama-French				
Portfolio	Financially Constrained		Financially Unconstrained	
Instrument	Reserve ration	Interest rate	Reserve ration	Interest rate
Event day	$\hat{p} = 0.438$	$\hat{p} = 0.438$	$\hat{p} = 0.449$	$\hat{p} = 0.447$
-2	0.400	0.429	0.444	0.477
-1	0.421	0.440	0.445	0.419
0	0.477**	0.429	0.519***	0.448
1	0.421	0.405	0.434	0.444
2	0.506***	0.440	0.469	0.448

** and *** denote significance at 95% and 99% level using a one-tail test. We define original groups as follows. When an announcement of monetary policy happens, there are both financially constrained and unconstrained firms according to DPS and firm size. We combine all constrained and unconstrained firms across events that are caused by reserve ratio or loan rate changes.

Table 5.4 Comparison of effects from interest rate changes and reserve ratio changes (Classified groups)

Part A: Market Model				
Portfolio	Financially Constrained		Financially Unconstrained	
Instrument	Reserve ration	Interest rate	Reserve ration	Interest rate
Event day	$\hat{p} = 0.465$	$\hat{p} = 0.465$	$\hat{p} = 0.455$	$\hat{p} = 0.451$
-2	0.505**	0.495	0.484***	0.454
-1	0.461	0.354	0.449	0.375
0	0.521***	0.471	0.595***	0.413
1	0.454	0.495	0.486***	0.453
2	0.524***	0.471	0.477**	0.429
Part B: Fama-French				
Portfolio	Financially Constrained		Financially Unconstrained	
Instrument	Reserve ration	Interest rate	Reserve ration	Interest rate
Event day	$\hat{p} = 0.439$	$\hat{p} = 0.434$	$\hat{p} = 0.447$	$\hat{p} = 0.441$
-2	0.434	0.438	0.439	0.429
-1	0.424	0.377	0.424	0.375
0	0.456	0.438	0.482***	0.398
1	0.415	0.387	0.479***	0.416
2	0.468	0.387	0.467**	0.390

** and *** denote significance at 95% and 99% level respectively using a one-tail test. We define classified groups as follows. When an announcement of monetary policy happens, there are both financially constrained and unconstrained firms according to rank of FT index. We combine all constrained and unconstrained firms across events that are expanding or deflationary.

Table 5.5 Effects from monetary policies on property industry (2002-2008)

Part A: Effects from expanding and deflationary monetary policies				
Model	Market model		Fama-French	
Policy	Expanding	Deflationary	Expanding	Deflationary
Event day	$\hat{p} = 0.481$	$\hat{p} = 0.535$	$\hat{p} = 0.450$	$\hat{p} = 0.549$
-2	0.451	0.568***	0.437	0.601***
-1	0.518**	0.566***	0.526***	0.582***
0	0.516	0.567***	0.545***	0.598***
1	0.354	0.500	0.316	0.523
2	0.431	0.507	0.385	0.522
Part B: Comparison of deflationary reserve ratio and loan rate changes				
Model	Market model		Fama-French	
Instrument	Reserve ration	Interest rate	Reserve ration	Interest rate
Event day	$\hat{p} = 0.466$	$\hat{p} = 0.535$	$\hat{p} = 0.453$	$\hat{p} = 0.550$
-2	0.504**	0.610***	0.499**	0.654***
-1	0.465	0.587***	0.472	0.615***
0	0.337	0.541	0.332	0.581**
1	0.499	0.509	0.458	0.523
2	0.462	0.499	0.414	0.501

** denotes significance at 95% level, using a one-tail test

*** denotes significance at 99% level, using a one-tail test

We do not consider policy changes in 2010, because we want to compare the property industry with average market during the same period.

Table 5.6 Influence of recent two reserve ratio changes on stocks in property industry (2010)

Reserve ratio increased on 12/01/2010					
Event day	day -2	day -1	day 0	day 1	day 2
Market model ($\hat{p} = 0.5702$)	0.9167***	0.7037***	0.5741	0.5741	0.1482
Fama-French ($\hat{p} = 0.5450$)	0.8704***	0.7222***	0.4352	0.6574	0.1204
Reserve ratio increased on 12/02/2010					
Event day	day -2	day -1	day 0	day 1	day 2
Market model ($\hat{p} = 0.5745$)	0.2887	0.5876	0.7217***	0.6495	0.4021
Fama-French ($\hat{p} = 0.5438$)	0.4742	0.6701***	0.5773	0.3608	0.4124

** denotes significance at 95% level, using a one-tail test

*** denotes significance at 99% level, using a one-tail test

We choose these two announcements as special cases since there is no announcement on either reserve ratio or loan interest rate in 2009 and the two announcements are after global financial crisis.

6 Conclusion

Research on the impact of monetary policy announcements on stock market can not only improve our understanding of how monetary policies transmit in short term, but also enables us to investigate market expectation and information content of monetary policy changes. In contrast with event-study regression of Bernanke and Kuttner [2005], we employ a non-parametric event-study methodology in finance literature to study announcement effects on stock market.

In order to compare reactions of stocks with varying characteristics, we construct a financial constraint index to classify firms into financially constrained and unconstrained portfolios. We arrive at the conclusion that there is no significant difference in reaction of constrained and unconstrained stocks, which suggests that the credit transmission channel of monetary policies does not exist in short term.

We investigate information leakage of monetary policies through generalized sign test. Generally, we find that more stocks gain positive abnormal returns before announcement of expanding policies and suffer losses before release of deflationary policies. The existence of reactions preceding announcement implies information leakage of monetary policy changes. When we examine reserve ratio and loan rate changes separately, we find that stock returns react more strongly prior to reserve ratio changes, which suggests the power of reserve ratio as a monetary policy instrument. We treat property stocks as a special case, and find that they respond more drastically than the average stock market, which can be supported by the existence of response both before and on days of announcement. In the two recent changes of reserve ratio in 2010, property stocks react more before the first policy change, which may indicate a directional change of monetary policy path.

7 Appendix: Time table of monetary policy announcements

Table 7.1 Time table of policy changes

Event day	Reserve ratio	One-year loan rate
02/25/2002		from 5.85% to 5.31%
08/25/2003	from 6% to 7%	
04/12/2004	from 7% to 7.5%	
10/29/2004		from 5.31% to 5.58%
04/28/2006		from 5.58% to 5.85%
06/19/2006	from 7.5% to 8%	
07/24/2006	from 8% to 8.5%	
08/21/2006		from 5.85% to 6.12%
11/06/2006	from 8.5% to 9%	
01/08/2007	from 9% to 9.5%	
02/26/2007	from 9.5% to 10%	
03/19/2007		from 6.12% to 6.39%
04/06/2007	from 10% to 10.5%	
04/30/2007	from 10.5% to 11%	
05/21/2007	from 11% to 11.5%	from 6.39% to 6.57%
07/23/2007		from 6.57% to 6.84%
07/31/2007	from 11.5% to 12%	
08/22/2007		from 6.84% to 7.02%
09/07/2007	from 12% to 12.5%	
09/17/2007		from 7.02% to 7.29%
10/15/2007	from 12.5% to 13%	
11/12/2007	from 13% to 13.5%	
12/10/2007	from 13.5% to 14.5%	
12/21/2007		from 7.29% to 7.47%
01/17/2008	from 14.5% to 15%	
03/19/2008	from 15% to 15.5%	
04/17/2008	from 15.5% to 16%	
05/13/2008	from 16% to 16.5%	
06/10/2008	16.5% to 17%, then to 17.5%	
09/16/2008	from 17.5% to 16.5%	from 7.47% to 7.2%
10/09/2008	from 16.5% to 16%	from 7.2% to 6.93%
10/30/2008		from 6.93% to 6.66%
11/27/2008	from 16% to 15%	from 6.66% to 5.58%
12/23/2008	from 15% to 14.5%	from 5.58% to 5.31%
01/13/2010	from 14.5% to 15%	
02/22/2010	from 15% to 15.5%	

Event day refers to the first trading day after an announcement of policy change was released. The above information is based on announcements from People's Bank of China, refer to www.pbc.gov.cn

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