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Monetary Policy Announcements and Market Interest Rates' Response: Evidence from China

Rongrong Sun¹

Abstract: This paper uses the event study to estimate the impact of various monetary policy announcements on market interest rates in China over the 2002-2017 period. I find that financial markets understand the quantitative signals better: the market response to an announced adjustment of the regulated retail interest rate and the required reserve ratio is positive and significant at all maturities of bond rates, but smaller at the long end of the yield curve. However, the market barely responds to announced changes in the qualitative policy stance index, which contains limited vague information and is easily anticipated. Two newly introduced central bank lending rates do not appear to be sufficient to replace the retail interest rate and the reserve ratio in guiding market rates in the post-deregulation era. My results suggest that the PBC adopts a publicly announced short-term interest-rate operating target regime, similar to the Fed's federal funds rate target.

Key words: announcement effect, event study, monetary policy, monetary transmission, China

JEL-Classification: E52, E58

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1. Introduction

It is the emerging consensus that the policy communication and forward guidance play an important role in the monetary policy implementation. As Friedman and Kuttner (2010) put it, today's central banks set the short-term interest rates more through announcement effects rather than the conventional liquidity effects by manipulating the supply of banking system reserves. However, it remains unclear what roles different policy announcements play in affecting financial markets in emerging economies due to very limited studies along this line. This paper studies the Chinese case to address this question. More precisely, I examine the policy announcement effect on market interest rates in China over the 2002-2017 period, given that one of crucial monetary transmission mechanisms rests on the sensitivity of market interest rates to policy changes. I then compare different announcement effects and assess the central bank's communication efficiency.

This paper studies three kinds of policy announcements. The first two are announcements of policy instrument adjustments. The People's Bank of China (PBC) does not have a clearly announced operating target. Instead, it uses multiple instruments to achieve multiple objectives, as its counterpart in many emerging economies. Among them, two monetary policy tools are on a discretionary basis: the policy interest rates (the regulated retail interest rate) and the required reserve ratio. The PBC makes announcements upon their adjustments. The third announcement that this paper considers is the news release following the PBC's quarterly Monetary Policy Committee (MPC) meeting. It briefly outlines the Committee's perceptions about the current and future economic condition as well as its decision on the policy stance for the coming quarter. Based on it, Sun (forthcoming) builds a narrative monetary stance index (hereafter, Sun-MP index).² The changes in this index are used as the third measure of announcements.

The event-study approach is then used to examine the over-day responses of market interest rates to these three policy announcements. Over the 2002-2017 period, 89 policy change announcements are identified. The regression estimation suggests that financial markets understand the quantitative signals better: the market response to an announced increase in the regulated bank rate and the required reserve ratio is positive and significant at all maturities of bond rates, but smaller at the long end of the yield curve. On average, a 1-percentage-point announced change in the regulated retail interest rate is associated with about a 20-basis-point change in the short-term bonds rates with maturities of the 3-, 6- and 12-month; a 1-percentage-point announced adjustment of the required reserve ratio is associated with about a 11-basis-point change in these short-term bonds rates. However, the market barely responds to announcements of changes in the qualitative policy stance index.

The preliminary assessment of two newly introduced central bank lending rates indicates that they are not

² The index measures the PBC's policy stance with an integer ranging from -2 to 2 on the basis of the degree of policy tightness. It is updated regularly and available at my personal google webpage: <https://sites.google.com/site/rongrongsun2013>.

sufficient to replace the regulated retail interest rate and the required reserve ratio in guiding market interest rates in the post-deregulation era. Rather, the PBC needs to pin down its operating target regime and publicly announce this target upon any adjustment. The international experience suggests that clear communication and transparency help build up a well-functioning interest-rate transmission mechanism. There is rich literature that uses the event study to examine the information content of Federal Reserve policy announcements and their effects on asset prices. For example, Cornell (1983) finds that the unexpected component of money supply announcement is correlated with asset price changes. Cook and Hahn (1988, 1989) provide positive evidence for significant responses of rates on Treasury securities to discount rate announcements and reported target funds rate changes, respectively. Kuttner (2001) uses data from the futures market for federal funds to decompose changes in the announced target funds rate into anticipated and unanticipated parts.³ His estimation of interest rates' response to unanticipated target changes is much larger and significant, compared to that to anticipated target changes. This finding lends strong support for the argument that forward-looking financial markets respond very differently to anticipated and unanticipated elements of monetary policy actions. More recent work follows this practice to measure the Fed's surprise component of announcements while estimating the announcement effect on financial markets (e.g., among others, Bernanke & Kuttner 2005; Gertler & Karadi 2015; Gorodnichenko & Weber 2016).

By contrast, (to my knowledge) there is only one study that uses the event-study approach to examine the communication effect of the PBC on financial markets. That is, Garcia-Herrero and Girardin (2013) study responses of the conditional volatility of the repo rates to the speeches delivered by the PBC's governing body and find that the repo market responds significantly to these speeches.

There are some other studies akin to my research question, though they use different approaches and do not directly address the announcement effect. Rather, they focus on the link between the policy actions and market interest rates.⁴ For example, He and Wang (2012) estimate a linear regression model to assess the response of the repo rate and bond yields to changes in the benchmark deposit rate and the required reserve ratio, while also controlling for other macroeconomic and financial market liquidity factors. Their estimated coefficients are positive at all maturities and significant in most of cases. El-Shagi and Jiang (2017), following a two-step approach, use both the state space model and a standard monetary structural VAR to assess Chinese monetary policy transmission through the bond market into the real economy, while taking both the regulated retail interest rate and money market interest rate shocks into account.

³ The unanticipated component is defined as the difference between the yield of the next expiring futures on federal funds, taken just before an FOMC announcement, and the target federal funds rate actually announced.

⁴ Two other studies, Fan and Johansson (2010) and Hong *et al.* (2010), do not estimate the links of the official rate and market rates directly. Rather, they use data to empirically test various models. Fan and Johansson (2010) show that the model that incorporates the benchmark deposit interest rate as a state variable characterizes the changing shape of the yield curve well. Hong *et al.* (2010) document that Chinese spot rates are subject to both market and administrative forces.

All these studies contribute to a better understanding of transmission of monetary policy to market interest rates in China. My work contributes to this existing literature, using the event-study approach to identify the policy announcements and estimating their immediate effect on financial markets with a regression model. The discussion of monetary transmission in this paper is narrowed to how monetary policy announcements feed through to various nominal interest rates, while the effects from policy to real activity are left out of the discussion.

The novelty of this paper is twofold. First, this paper studies the reaction of markets to announced policy changes around announcements, rather than when they are effective. The difference of these two dates matters when one uses daily or weekly data, even monthly data. For example, the announcement and the effective date of the reserve ratio change can fall in different months. Forward-looking market participants will incorporate new information into prices, rather than waiting till it is effective. Estimating policy effect based on the realized policy actions might miss a lot of market responses.

Second, another advantage in working with the event study is that the observation interval can be greatly reduced, which differs from studies using other approaches that rely on monthly or quarterly data, including the studies on China mentioned above. Studies using the event study to examine the relation between market interest rates and announced changes use observation intervals of from 30 minutes to hours or one trading day. Unless the impact of monetary changes on asset prices persists for a quarter or more, tests based on the shorter observation interval are more powerful. In this paper, the event window is set as one trading day.

The advantage of focusing on a short window is that movements in interest rates are dominated by the monetary announcement. Furthermore, any systematic response of the central bank to information about the economy that is public at the time of the announcement is already incorporated into financial markets, and, therefore, does not show up as spurious variation in the error term of the regression. A simple regression can thus be used to estimate the announcement effect. On the contrary, employing other approaches that use low-frequency continuous data, one needs to fully model all impact factors, both macroeconomic and financial. This modelling complexity increases the modelling uncertainty. For example, it might be more likely to encounter omitted-variable bias.⁵

One of the limitations, in comparison to studies on the Fed announced funds rate target changes, is that this paper is not able to disentangle the unanticipated component in announced policy changes. Due to the fact that the PBC is not following a single-instrument regime that targets a short-term interest rate on an

⁵ For example, one obvious challenge is how to measure the market participants' expectation of the economy, which has impact on both market interest rates and monetary policy. In case that one fails to incorporate such expectation terms when examining the links between monetary policy and market interest rates on a monthly or quarterly basis, the error term is correlated with measured monetary policy changes.

On the other hand, this concern is limited for the event-study regression. Note that the expectation based on previous information is already contained in both monetary policy decision and asset prices. As long as there is no big news arrival on the event day, the market's expectation of the economy, other than monetary policy, should hold constant over that day. A tight window helps alleviate concerns about omitted variables.

operating basis, as the Fed does, this paper considers announced changes in the regulated retail interest rate and the required reserve ratio as well as announced shifts of the policy stance. There are no good data to proxy the financial market's expectation about these three measures and hence it is impossible to determine the size of the unexpected component of each announcement.

However, the announced policy changes in the regulated retail interest rate and the required reserve ratio take place on a discretionary basis. Financial markets might be able to form the right expectation of the trend of these changes, but it would be difficult to predict the exact announcement date. In other words, these two announcements might not be fully anticipated by markets. The estimation of the over-day market interest rates' responses to these two announcements can be regarded as the lower bound of the true policy announcement effect.

By contrast, the MPC meeting takes place at a regular quarterly basis, with the meeting dates publicly announced. The press release follows the meeting, with a delay of a few days. Furthermore, it does not cover the information on what actions the PBC is going to take and what targets it is going to meet on the operating basis. Only a vague description of the following quarter's policy stance is given as tightening, neutral or easing. Such an overall trend of monetary policy could be well anticipated by market participants. Neither the announcement timing nor the announcement content of this MPC's news release is likely to surprise markets. This in turn explains the estimation results that markets are not sensitive to the policy-stance shift announcements.

This paper proceeds as follows. Section 2 briefly outlines the monetary operating framework in China over the 2000-2017 period. Section 3 identifies policy change announcements. Section 4 sets up a regression model, presents and discusses estimation results. Section 5 provides the robustness test and one extension. Section 6 concludes.

2. Monetary policy in China

The current monetary policy in China is characterized with a multiple-instrument and multiple-objective operating regime, with growth rates of M2 and the total new bank lending as its intermediate targets (see, e.g., Zhang & Ji 2012; Bell & Feng 2013; Sun 2015; Klingelhöfer & Sun 2017, 2018; Sun forthcoming). The PBC's policy objectives, defined the People's Bank of China Act, are threefold: price stability, economic growth, and financial stability. To achieve various policy objectives, the PBC uses various instruments, including both monetary and credit policy instruments.⁶ This paper uses the event-study approach to examine the transmission of announced policy changes in two discretionary monetary policy

⁶ For more details, see Sun (2013) and Klingelhöfer and Sun (2017).

In this paper, the credit policy is not of interest given that it is to direct bank lending and hence shape the structure of bank loans. Rather, this paper focuses on monetary policy that is aimed to alter the stock of high-powered money outstanding and hence to influence the interest rate. The transmission of regular policy actions (i.e., open market operations on a daily basis now) and central bank lending facilities will be studied in another paper, employing a different estimation approach.

instruments, the benchmark lending rate and the required reserve ratio, to market interest rates. The announced changes are effective immediately or on the future specified date. Changes in these instruments send strong signals to markets about the PBC's policy stance (see, e.g., He & Pauwels 2008; Xiong 2012; Chen *et al.* 2013; Sun 2013, 2015, forthcoming), which, I expect, will arouse large responses of market interest rates.⁷

The third policy announcement is the PBC's news release following its MPC meeting, measured with the Sun-MP index (Sun forthcoming).

The sample starts with 2002, given that the data on the bond rates are available only since then. The 2002-2017 period has seen the transition of the PBC's operating procedures from a direct control on the retail interest rates to the deregulation of this control. Commercial banks used to set their deposit- and lending-rate according to the benchmark rates specified by the PBC, subject to the limited adjustment bands. The interest-rate deregulation started in 1993 and was completed in 2015, when the last control on the deposit rate was lifted off (Sun 2018). Together with this retail-interest-rate marketization process, the PBC's operating regime is trying "to strengthen the role of open market operations in guiding money-market interest rates" (*China Monetary Policy Report 2012Q3*: 18), which is typical in the advanced economies at normal times. Consequently, the central bank lending has been slowly replaced with overnight funding through the inter-bank money market.

In one of its recent official articulations, the PBC further specifies the excess reserve ratio and the money market interest rate as its operating targets (Zhang & Ji 2012). However, confusion remains about these operating targets as it is impossible to target both the quantity and the price at the same time. Nor has the PBC announced any concrete targets for these two variables or referred to any of them in its monetary policy analysis. Implicitly, large fluctuations in the money market rate, e.g., in mid-2013,⁸ seem to suggest that currently, the PBC is more likely to follow a quantity operating target, which is however inconsistent with its resolution to reform the operating regime to more price-oriented, as specified in the 12th and 13th Five-Year Plan (*China Monetary Policy Report 2012Q2*; 2018Q1).⁹

Over the sample period, the PBC switched to a frequent use of the required reserve ratio in mid-2006, mainly to meet liquidity management needs arisen from foreign exchange market interventions under the

⁷ It is worthwhile to note that the monetary transmission mechanism works through both pricing channels (via various asset prices) as well as credit supply restrictions (via credit policies as well as via changes in monetary policy tools) (see, e.g., Boivin *et al.* 2010). For example, a tightening of the regulated retail interest rate and the reserve ratio will both have effects on asset prices and the credit supply. That is, the deposit-rate ceiling limits the interest rate that banks can pay on their deposits, which will restrict the banks' ability to acquire funds; an increase in the reserve ratio will reduce the banks' ability to issue new credit, both of which will cause large swings in credit supply and hence have the real effect on the economy. To study either the credit supply channel itself or the implications of an absence of this channel to the effect of monetary policy on the real economy requires a fully specified model with necessary financial and macroeconomic variables included, rather than using the event-study approach, which is outside the scope of this paper.

⁸ The PBC then chose not to accommodate a rise in the demand for money market funds (*China Monetary Policy Report 2013Q4*: 21).

⁹ The 12th (13th) five-year plan covers the 2010-2015 (2016-2020) period.

current managed floating exchange rate regime¹⁰ (see. e.g., Sun 2015; Klingelhöfer & Sun 2017, 2018). But the required reserve ratio is likely to be less often used once there is no “sterilization” need due to a declining pressure from trade surpluses and a more flexible RMB exchange rate. This trend is reflected in the PBC continuous downward adjustment of the required reserve ratio, starting in 2012, to release the liquidity to the market. More recently, the use of this tool has declined. Over the 2016-2017 period, there were only two cuts of the reserve ratio. The PBC relies mainly on open market operations (i.e., reverse repos) to inject liquidity into the market. In the near future when the foreign reserves as well as the subsequent liquidity management is not necessary any more, the required reserve ratio might be kept constant at its desired level as in many advanced economies.¹¹

3. Identifying policy change announcements

Table 1 lists three kinds of identified policy announcements, dated, for the period from 2002 through 2017. They are 89 announced changes, consisting of 28 interest rate change announcements, 45 announced required reserve ratio changes and 16 announced policy stance shifts.

The first announcement is on the policy interest rates. This paper uses the benchmark retail interest rate to represent all policy interest rates. The adjustments of this interest rate attracted a lot of attention and send strong policy signals. It was regarded as the main reference for the PBC’s policy stance on interest rates in the prior-2016 period when the PBC had direct control on retail interest rates. Other policy interest rates in the PBC’s toolkit include various central bank lending interest rates (e.g., the discount rate and the rediscount rate)¹² and the interest rates on required reserves as well as on excess reserves. The PBC did not adjust these other policy rates often in the regulated-retail-interest-rate era. Over the sample period, eight such adjustments are found, four of which were accompanied with changes in the retail interest rates, as highlighted with \surd in the last column of Table 1.¹³

The benchmark retail interest rate consisted of both the rate on deposits and bank loans. Most of time, the PBC adjusted them simultaneously with a comparable magnitude.¹⁴ Hence, in practice it makes no significant difference which one to use. This paper uses the benchmark lending rate. The adjustments were

¹⁰ The current exchange rate regime (since March 2014) allows a daily movement up to ± 2 per cent in bilateral exchange rates, as a result of several gradual extensions (± 0.3 per cent in July 2005; ± 0.5 per cent in May 2007; ± 1 per cent in April 2012).

¹¹ The argument against the frequent adjustment of the required reserve ratio is mainly indebted to Friedman (1960), where he argues that a change in this ratio is discontinuous in time and proceeds by large doses, which is not optimal for fine-tuning monetary policy. Also, this ratio imposes a kind of tax on (depository) banks, which distorts market competition.

¹² The role of two newly introduced central bank lending rates (the SLF and MLF rates) in guiding market interest rates will be elaborated in Section 5.

¹³ The other four were found on Dec 21, 2003; Mar 25, 2004; Mar 17, 2005; Jan 1, 2008. Two of them (Dec 2003 and Mar 2005) involve cuts of the interest rate on excess reserves to encourage banks to cut the holding of excess reserves. The remaining two (Mar 2004 and Aug 2008) involve hikes of the discount rate, of which the March-2004 one was accompanied with an announced tightening of the policy stance. Alternatively, I test the interest-rate model based on the sample of 32 observations with these four announcements included. In general, the model fit for bond rates is getting worse, despite a larger sample. On the other hand, the advantage of using the BLR sample is that I could focus to explore the transmission of this regulated retail rate. Very likely, the impact of this regulated retail interest rate differs from that of other central bank lending rates.

¹⁴ There are two exceptions over the sample period, as noted in Table 1.

announced to be effective immediately. The 28 interest rate change announcements, listed in Table 1, are dated according to the announcement days. The event dates are assigned to the announcement days or the first ensuing trading day in case that the announcements came on non-trading days. Both the benchmark rate and its changes are expressed in percentage points. These 28 announcements constitute the first event sample (the BLR sample, hereafter), with the first found on February 21 2002 and the last on October 24 2015 that marked the end of the deposit-rate control. More than half of the adjustments were clustered in these three years: 2007, 2008 and 2015.

The second policy announcement is about the required reserve ratio (the RRR hereafter). As discussed above, the required reserve ratio has been widely used as a liquidity management tool under the current managed exchange rate regime. Nevertheless, changes in this ratio have strong impact on the liquidity condition in the market, attracting a lot of attention from the press and market participants. For example, four cuts of the reserve ratio by cumulative 2 percentage points in the second half of 2008 resulted in a total of 800 billion yuan of liquidity release by the end of 2008, according to the PBC's trend calculations (*China Monetary Policy Report 2008Q4:11*).

The RRR adjustments are announced in advance. The gap between the announcement and effective days varies over time. In general, the gap was larger upon RRR hikes during the early period. Then it narrowed to about 2-4 days for RRR cuts during 2015-2016 period. The changes in this RRR on effective days are expected by financial markets and would have been priced in.¹⁵ This paper focuses on the market response to the ratio announcements instead.

The 45 RRR adjustment announcements, listed in Table 1, are dated according to the announcement days with the effective days in parentheses, with the first on August 23, 2003 and the last on September 30, 2017. Both the required reserve ratio and its changes are expressed in percentage points. Over the sample period, most of the RRR adjustments were announced in the late afternoon (5 – 7 p.m.),¹⁶ when the interbank money market and the bond market were already closed, and sometimes on the weekends. The RRR event date is assigned to the first trading day ensuring the announcement. The adjustments are then quantified as the announced change in the RRR. These days consist of the second event sample (the RRR sample, hereafter). Three quarters of all the adjustments were hikes, while cuts of this ratio were found in the 2008Q4 and in the post-2011 period. Most of RRR-adjustments took place in 2007, 2008, 2010 and 2011.

The third policy indicator is the Sun-MP qualitative measure of policy stance (Sun forthcoming), derived from the information on the PBC's news release on the quarterly MPC meetings. The news release came

¹⁵ Indeed, I use the same regression, as specified in Eq. (1) to examine the over-day market response on the effective days, and find that the estimated responses are weaker, with a deteriorated significance level of estimated coefficients and *R*-squared. Several estimated coefficients are either insignificant or significant at the 10 percent level. Given the limited space, these results are not reported in the paper, but they are available upon the request.

¹⁶ One exception is 2004 announcement that came in the early morning and its announcement date is assigned as the event date.

normally several days after the meeting, in the early morning for the prior-2004Q3 period and afterwards, in the afternoon. The news release days, or the first ensuing trading day in case that the news release took place on weekends, are assigned as the MP event days.¹⁷ The 16 announced shifts in the MP stance are listed in Table 1, dated according to the news release days with the first one on July 22, 2002 and the last one on December 29, 2017. These consist of the MP sample (the Sun-MP sample, hereafter).

The last column marks those market days of multiple policy events. Apart from those policy interest rate concurrences mentioned above, there are eight such market days that two of the three policy indicators count as event days. They are seven double announced adjustments of the benchmark lending rate and the required reserve ratio, and one double adjustment of the benchmark lending rate and the Sun-MP index. They are marked with “x” and “Δ”, respectively.

4. Estimation results

To test the effects of these three policy actions, I run regression of over-day changes in market interest rates on the announced change in monetary policy,

$$\Delta R_t = a + b\Delta M_t + \varepsilon_t \quad (1)$$

where R_t represents the market interest rate that takes the value of i^{1d} , i^{1m} , i^{3m} , i^{6m} , i^{1y} , i^{3y} , i^{5y} , i^{10y} and i^{30y} in turn;¹⁸ ΔM_t is announced change in monetary policy, measured with the announced change in the BLR (i_t^L), the announced change in the RRR (RRR_t), and the announced shifts in the Sun-MP index (MP_t) each time in turn. Time index, t , is the event day, identified in three event samples.

The error term, ε_t , represents factors other than monetary policy announcements that affect market interest rates on event days. It is crucial to ensure the event-study results that these factors, either economic or financial, are orthogonal to the changes in monetary policy ΔM_t . In other words, news about the economy on event days does not affect the policy choice, to which only information available the previous day is relevant. It is plausible given the event days are defined either as the market trading days following the policy announcements (for the RRR sample) or the announcement days but the policy decisions on the policy stance for the next quarter are made prior (for the Sun-MP sample). As for the benchmark lending rate, there is no reason (e.g., any particular event) to believe that over the 2002-2017 period the PBC made an extemporaneous policy adjustment decision about it on the announcement day after observing the new information. Rather, its changes were likely apparent to market participants before policy shift announcements. For example, two benchmark lending rate cuts in 2015 (in May and August) took place in weekdays and were announced in the afternoon. But the loan prime rate (LPR)¹⁹, published at 11.30 a.m., already incorporated the exact amount of cuts on these two announcement days.

¹⁷ The timing uncertainty is tested in two ways, reported in Table 6 and 7 and will be elaborated in the following paragraphs.

¹⁸ The superscript gives the maturity, with d standing for day, m for month and y for year.

¹⁹ It is a reference prime loan interest rate of 1-year maturity, introduced in October 2013, based on quotes collected from 10 big commercial banks every morning, published at 11.30 a.m. by the National Interbank Funding Center on its website.

Another concern is the simultaneity issue that there is a contemporaneous response of monetary policy to market interest rates. However, there is no clear evidence showing that the PBC's policy decisions to adjust these three policy measures under the examination are driven by its expectation of market interest rates. Even to the extent the PBC did respond in this way, it would tend to reduce the size of the estimated response to policy announcements. Moreover, the endogeneity issue is less relevant to the over-day or day-ahead policy changes than it is for average monthly (or quarterly) policy changes (see, e.g., Bernanke & Kuttner 2005). The coefficient, b , in this regression, gauges the market response to policy changes and not the reverse.

This event-study regression offers a simple identification strategy. The dominant shock on event days is the monetary policy announcement; the immediate impact on financial markets is examined within a 1-day window, measured with the estimated coefficient b .

There are however some limitations to this approach. The event-study approach, because of the focus on a narrow time window, is not able to capture possible lagged effects and reversals. Also, it is difficult to identify how persistent the impact is. Neither is it possible to examine the response of economic activity variables such as output and inflation.²⁰ Either the first task or the latter would require a more fully specified econometric analysis, which, in the case of complexity of Chinese monetary operating procedures, might suffer from a low fit. This is outside the scope of this paper.

The over-day changes in nine market interest rates are used as the regressand each time in turn. The first one is the overnight money-market interest rate, China Interbank Offered Rate (the CHIBOR), obtained from the CEIC,²¹ while all the others are secondary market government bond yields (i^{TB}), obtained from China Central Depository & Clearing Co. Ltd. The sample ends on December 31, 2017. The timing of the daily data disclosure also matters. Trading in the interbank money market (i^{1d}) and the bond market (i^{TB}) ends at 5 p.m.²² Hence, the market interest rates used in the analysis usually would have incorporated the policy news given that the event days, listed in Table 1, are specified as the first ensuing trading days when the policy announcements came in the late afternoon or on weekends.

Table 2 presents selective descriptive statistics on the announced policy changes and market interest rates in four different samples: full sample and three samples containing event days identified by three policy announcements. In the full sample, the over-day change in market interest rates is close to zero on average,

²⁰ The more recent development in this line in the literature is to adopt a hybrid approach that employs the event study to pin down the exogenous policy shocks in a tight window around the policy announcements, which is referred to as high-frequency identification (HFI) measures of policy surprises, as external instruments in a set of VAR to identify the effects of monetary shocks on a set of variables of interest, for example, various interest rates, inflation and output (e.g., Gürkaynak *et al.* 2007; Gertler & Karadi 2015; Gorodnichenko & Weber 2016). The HFI approach overcomes the simultaneity problem that is inherent in the identification of policy shocks in the VAR with financial variables included and helps identify policy surprises that can be considered exogenous with respect to both the economic and financial variables in the VAR.

²¹ The CHIBOR is a transaction-based price, a weighted average of the interbank money market interest rates. Another interbank offered rate is Shanghai Interbank Offered Rate (the SHIBOR) that, analogous to LIBOR, is a quote-based reference money market interest rate and was officially introduced in January 2007. In general, the CHIOBR is more volatile.

²² Trading in bonds in the stock exchange market ends at 3 p.m.

which is also confirmed by the zero medians. However, the volatility is high as measured by the standard deviation, particularly, at both ends of the yield curve. China's money market is known for its high volatility, partly due to seasonal factors and some ad-hoc factors (such as capital inflows and initial public offerings) (HSBC 2014).

In the individual event-day samples, over-day changes in market interest rates seem to be less volatile, while their means or their medians turn out non-zeros. The signs of the event-day sample means are roughly consistent with the signs of the average announced policy change, as shown in the last column. This seems to suggest that policy actions induce market reactions of some kind.

Table 2. Descriptive statistics of over-day changes in market interest rates across samples

	i^{1d}	i^{1m}	i^{3m}	i^{6m}	i^{1y}	i^{3y}	i^{5y}	i^{10y}	i^{30y}	Policy indicator ^a
Full sample (observations: 3958 / 3993)										
Mean	0.0001	0.0004	0.0004	0.0003	0.0003	0.0003	0.0002	0.0002	0.0000	
Median	-0.0004	0	0	0	0	0.0004	0.0003	0.0001	0	
Std. Dev.	0.334	0.244	0.215	0.204	0.186	0.126	0.086	0.085	0.364	
Benchmark-lending-rate sample (observations: 28)										
Mean	-0.0441	-0.0153	-0.0153	0.0002	0.0008	-0.0068	-0.0029	-0.0192	0.0005	-0.054
Median	-0.0132	-0.0156	-0.0156	0.0145	0.0146	0.0102	-0.0002	-0.0025	0.0025	-0.035
Std. Dev.	0.267	0.118	0.118	0.111	0.112	0.103	0.104	0.107	0.082	0.34
RRR-announcement sample (observations: 45)										
Mean	-0.0205	0.0038	0.0038	0.0020	0.0036	-0.0053	0.0009	-0.0061	-0.0095	0.233333
Median	-0.0008	0.0111	0.0111	0.0100	0.0050	0.0100	0.0201	0.0120	0.0019	0.5
Std. Dev.	0.218	0.102	0.102	0.102	0.094	0.081	0.083	0.066	0.049	0.53
Sun-MP-index sample (observations: 16)										
Mean	0.1023	0.0012	0.0012	0.0081	0.0134	0.0058	0.0032	-0.0059	0.0035	0.1875
Median	0.0057	-0.0195	-0.0195	-0.0043	-0.0021	-0.0050	0.0003	-0.0025	-0.0017	1
Std. Dev.	0.299	0.172	0.172	0.166	0.154	0.114	0.083	0.059	0.048	1.56

Note: All the over-day changes are in percentage points, except those of the policy indicator in the last sample (Sun-MP index), which is expressed in integer. The number of observations for each sample is reported in parentheses.

a. The policy indicator is the announced benchmark lending rate change for the benchmark-lending-rate sample, the announced required reserve ratio adjustment for the RRR-announcement sample and the announced change in the Sun-MP index for the Sun-MP-index sample.

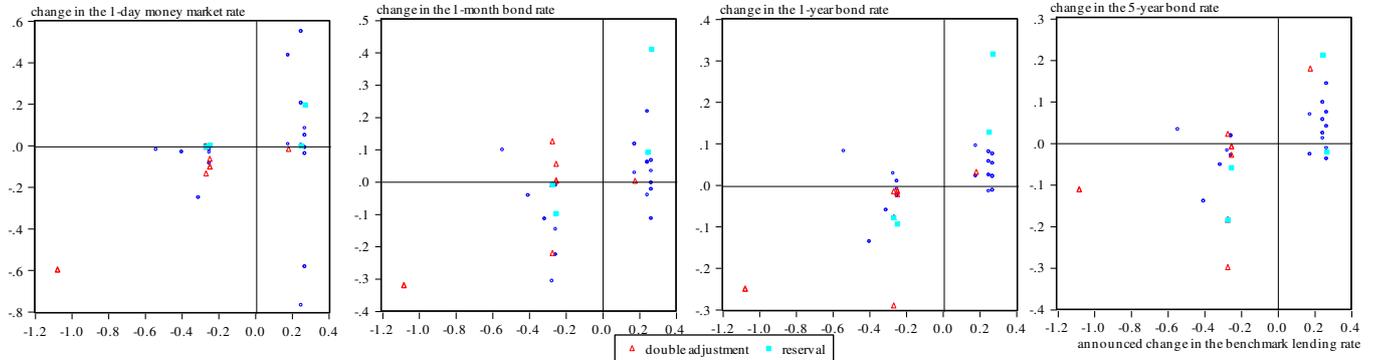
Source: Author's estimation based on the data from the CEIC, National Interbank Funding Center and China Central Depository & Clearing Co. Ltd.

Fig. 1 scatterplots the identified policy changes together with market interest rates at four selective maturities. Fig. 1.3 suggests that the announced monetary policy stance changes bear little relation to changes in market interest rates. By contrast, the positive relationship between the announced benchmark lending rate changes / the announced reserve requirement changes and market interest rate changes is readily visible in Figs. 1.1 and 1.2, respectively. Such a pattern is most apparent for the 1-year bond rate

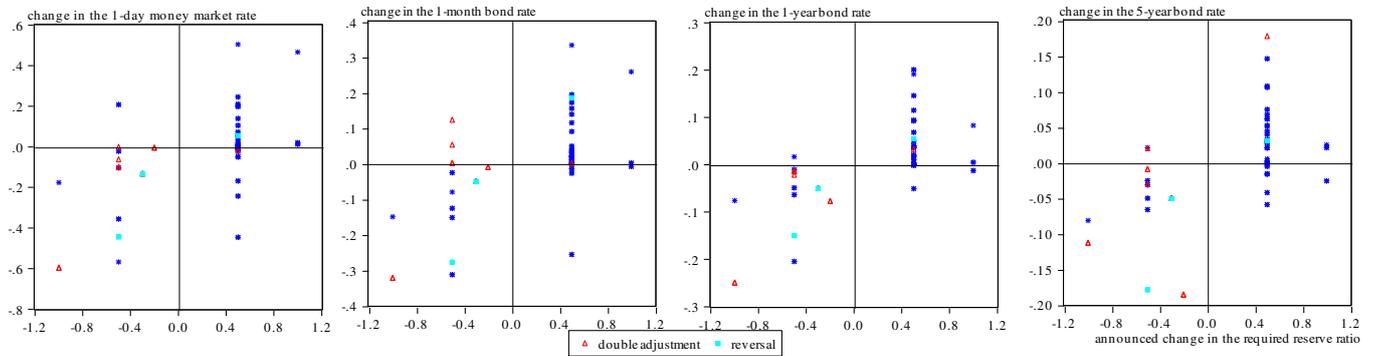
in both figures: most of observations lie neatly in southeast and northwest quadrants, where announced BLR changes and RRR adjustments are positively associated with bond market rallies.

Figure 1. Policy adjustment announcements and changes in the selective market interest rates

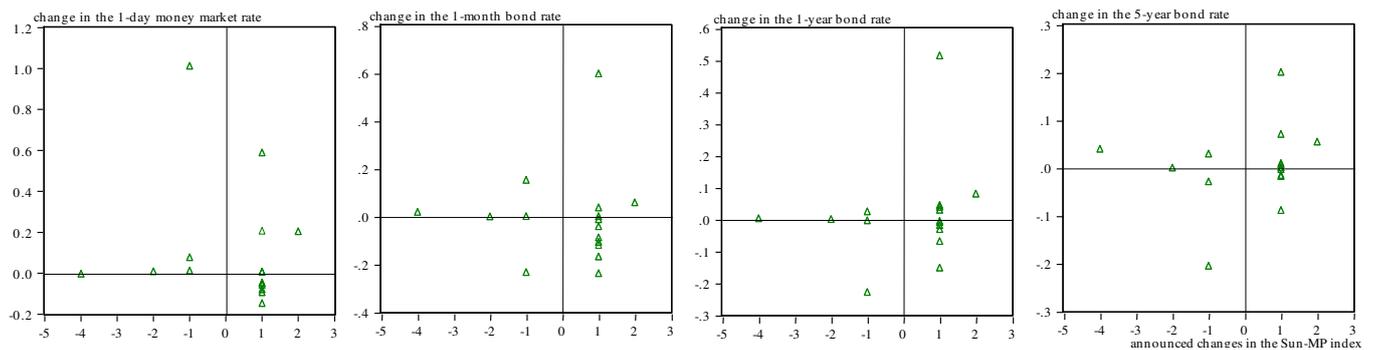
1.1 Announced benchmark lending rate changes and changes in the market interest rates



1.2 Announced required reserve ratio changes and changes in the market interest rates



1.3 Announced shifts in the Sun-MP index and changes in the market interest rates



Note: As listed in Table 1, there are 28 BLR changes displayed in Fig. 1.1, 45 announced RRR adjustments in Fig. 1.2 and 16 announced Sun-MP shifts in Fig. 1.3.

In Figs 1.1 and 1.2, 7 double adjustments of the benchmark lending rate and the required reserve ratio are highlighted with red triangles and 4 (3) policy reversal adjustments in Fig. 1.1 (Fig. 1.2) with bright green squares. The latter will be elaborated in Section 5.

Source: Market interest rates from the CEIC, National Interbank Funding Center and China Central Depository & Clearing Co. Ltd.

In general, the figures do not suggest obvious outliers. Neither do the figures suggest for an asymmetric announcement effect on market interest rates that the market's response depends on the signs of shocks. In Figs. 1.1 and 1.2, seven double announced adjustments of the benchmark lending rate and the required

reserve ratio are highlighted, including six double cuts and one double hike. Yet, the figures do not seem to suggest for an apparent stronger market response to these double adjustments.

Baseline estimates of the 1-day response of market interest rates to announced BLR changes, announced adjustments of the RRR and announced policy stance shifts are reported in Table 3. The market interest rates are expressed in basis points, while announced changes in monetary policy are in percentage terms in Panels (1)-(2) or in an integer in Panel (3). Except the estimated response of the overnight money market rate in the Sun-MP event sample, all the other estimated responses, b 's, have the positive sign, as expected. On average, market interest rates rise with an announced increase in the BLR, an announced hike of the RRR, or an announced shift to policy tightening. Yet, the significance level of estimated coefficients and explanatory power of the model differ.²³

Panel (1) of the table presents the estimated relationship between the announced rate changes and market interest rates. On average, announced benchmark rate changes have statistically significant impact on all the market interest rates, though this significance level of the estimate for the overnight money market rate is slightly weaker, only at the 10 percent level. The estimated impact on the overnight money market rate and the 1-month bond rate is around 24-25 basis points. Then, a 1-percentage-point announced change in the retail interest rate is associated with about a 20-basis-point change in the 3-, 6- and 12-month bond rates. The results are getting weaker at the long end of the maturity spectrum. In general, the PBC policy announcement accounts for a nontrivial portion of the variance of short- and medium-term bond rate fluctuations on event days, from 30% for the 1-month bond rate to about 50% for the 3-year bond rate. But clearly, it is far from the only piece of new information affecting market interest rates.

Two possible channels help explain the transmission from the BLR change announcement to market interest rates. First, the benchmark rate change announcement conveys a strong signal of the PBC's intended interest rate level. Second, a higher regulated retail interest rate increases an opportunity cost of holding bonds, putting upward pressure on bond yields regardless of the liquidity level in the banking sector.

Estimates of the model for the announced RRR adjustments are presented in Panel (2) of the table. Compared to the baseline BLR model results, the RRR announcement response is in general more precisely estimated, with the coefficient, b , all highly significantly different from zero at the 1 percent level. The possible explanation might be due to the larger number of observations – 45 RRR adjustment announcements, compared with 28 BLR changes. The estimated response is larger at the short end of the yield curve: the overnight money market rate and the 1-month bond rate rise about 22 and 15 basis points, respectively, in response to an announced one-percentage-point increase in the reserve ratio. Then it declines steadily through the 30-year bond rate. On average, a 1-percentage-point announced change in

²³ The comparison across the different panels should not focus on the magnitude of the estimated market responses given that the policy measures used in these models are not comparable.

the required reserve ratio is associated with about a 11-basis-point change in the 3-, 6- and 12-month bond rates. At the long end of the yield curve, the response of the 30-year bond yield to the RRR announcement is about 5 basis points, but still significant at the 1 percent level. Announced adjustments of the reserve ratio explain about 30-40% of the fluctuations in the market interest rates on event days.

The possible explanations for this ratio announcement effect include the signal channel, where the reserve ratio change announcement sends a clear signal to the market and the market responds. Also, a higher announced reserve ratio implies a contracting liquidity condition in the banking sector, putting upward pressure on market interest rates.

Table 3. Baseline estimates of the 1-day market responses to three policy change announcements

	i^{1d}	i^{1m}	i^{3m}	i^{6m}	i^{1y}	i^{3y}	i^{5y}	i^{10y}	i^{30y}
(1) $\Delta R_t = a + b\Delta BLR_t + \varepsilon_t$									
b	24.89*	24.41***	19.5***	19.55***	20.91***	21.07***	16.37***	15.23***	9.00**
	(1.71)	(3.30)	(3.51)	(3.85)	(4.21)	(4.98)	(3.25)	(2.83)	(2.07)
R ²	0.10	0.30	0.32	0.36	0.40	0.49	0.29	0.24	0.14
(2) $\Delta R_t = a + b\Delta RRR_t + \varepsilon_t$									
b	22.38***	15.24***	11.00***	10.63***	11.23***	9.87***	8.49***	7.91***	5.01***
	(4.20)	(4.69)	(4.54)	(4.33)	(5.30)	(5.54)	(4.19)	(5.31)	(4.16)
R ²	0.29	0.34	0.32	0.30	0.39	0.42	0.29	0.40	0.29
(3) $\Delta R_t = a + b\Delta MP_t + \varepsilon_t$									
b	-1.84	0.03	0.91	0.73	1.81	1.66	0.85	1.06	0.14
	(-0.36)	(0.01)	(0.31)	(0.26)	(0.70)	(0.87)	(0.61)	(1.09)	(0.16)
R ²	0.01	0.00	0.01	0.00	0.03	0.05	0.03	0.08	0.00

Note: This table reports the baseline results from regressions of 1-day response of market interest rates on announced BLR changes in Panel (1), announced RRR adjustments in Panel (2) and announced shifts of the monetary policy stance in Panel (3). The sample contains 28 observations in Panel (1) (the BLR model), 45 in Panel (2) (the RRR model) and 16 in Panel (3) (the Sun-MP model), respectively, which corresponds to the number of identified policy announcements each in turn as reported in Table 1.

The estimated constant, a , is not of interest and hence not reported in the table to save the space.

The market interest rates are expressed in basis points, while announced changes in monetary policy are in percentage terms in Panels (1)-(2) or in an integer in Table Panel (3).

In parentheses are t -statistics reported. *, ** and *** denote significant at the 10%, 5% and 1% level, respectively.

Source: Author's estimation.

In contrast, the response of all bond yields to announced shifts in the policy stance measured with the Sun-MP index, reported in Panel (3) of the table, is small and statistically insignificant, with the R -squared close to zero. The estimated response of the overnight money market rate even takes a wrong sign.

To fully explore the MPC meeting announcement effect, I redefine the policy surprise in a broader way. The argument behind it is that the central bank could sometimes surprise markets through its inaction rather than its actions and of course, markets might also react to the lack of a change in monetary policy (see, for example, Bernanke & Kuttner 2005; Swanson 2017). A zero change in the policy stance could be a potential surprise if financial markets expect a change but the MPC news release announces no change.

This implies that the MPC meetings not listed in Table 1 could also have potential impact on asset prices. The sample is extended to cover all the MPC meeting announcements, including 48 zero changes in the policy stance as well as 16 identified policy stance shifts. I re-estimate Eq. (1) using this sample and report the results in Table 4. All the estimated response of market interest rates to the MPC announcements is small and statistically insignificant, with all the R^2 's close to zero. Qualitatively, the conclusion based on this extended sample is same as the one from the baseline model in Table 3.

Table 4. The 1-day response of market interest rates on all the MPC news release days

	i^{1d}	i^{1m}	i^{3m}	i^{6m}	i^{1y}	i^{3y}	i^{5y}	i^{10y}	i^{30y}
b	-0.51 (-0.05)	0.24 (0.07)	1.06 (0.43)	0.85 (0.36)	1.94 (0.96)	1.73 (1.41)	0.82 (0.78)	0.90 (0.45)	0.08 (0.01)
R^2	0.00	0.00	0.00	0.00	0.01	0.03	0.01	0.00	0.00

Note: The table reports the results from regressions of 1-day response of market interest rates on the measured policy stance changes on all the MPC news release days. The sample contains 64 observations, corresponding to the 64 MPC news releases over the 2002-2017 period. See also the notes to Table 3.

Source: Author's estimation.

One possible explanation for the lack of market response to the MPC news release is that the information it delivers is anticipated by financial markets and has already been priced in. Indeed, the news release briefly announces the policy stance for the following quarter as neutral or appropriately tight /easy. It seems that markets anticipate the general trend of the monetary policy stance well and do not respond to this announcement.

This finding differs from the important role that the monetary policy committee has been playing in many other countries, such as the Fed's FOMC, the BoE's MPC and the ECB's Governing Council. On the other hand, markets respond immediately to announced BLR and RRR adjustments. It seems that the PBC's policy intentions behind BLR and RRR announcements are more efficiently communicated. To replace the BLR and RRR's role in guiding the market, the PBC needs to improve its communication efficiency by including more concrete policy description, such as the actions that it is going to take or the targets that it is going to meet. A quantitative operating target, similar to the federal funds rate target in the U.S., would be helpful for the PBC to send a clearer policy signal.

Besides these three individual policy event samples, two pooled samples are considered. The first one is the all-in sample, defined as all days counted in the BLR sample, the RRR sample and the Sun-MP baseline sample. The second is the BLR-RRR sample, defined as all days counted in the BLR sample and the RRR sample. Using the pooled samples, I regress over-day market rate changes on various announced policy changes. This regression helps control for the impact of other policy actions on market interest rates, particularly on the days of multiple policy events, including, for example, seven event day coincidences of announced BLR and RRR adjustments, as listed in Table 1.

Table 5 reports the estimation results, with the upper panel based on the all-in sample of 81 observations and the lower panel for the BLR-RRR sample of 66 observations. In Column 1, only reserve ratio adjustment announcements are estimated to have significant impact on the overnight money market rate, while the BLR announcements are not in both pooled samples. Besides it, extending samples does not change the key findings reported in Table 3, though the estimated announcement effects in Table 5 are all smaller and less statistically significant than those reported for individual event samples. The bond rates respond to the BLR changes and RRR adjustments announcements, but as reported in Panel (3) of Table 3, their responses to the announced shifts of the policy stance are not statistically significant.

Table 5. The 1-day market response to announced policy changes, two pooled samples

	i^{1d}	i^{1m}	i^{3m}	i^{6m}	i^{1y}	i^{3y}	i^{5y}	i^{10y}	i^{30y}
(1) All-in Sample									
b_1 (BLR)	17.29 (1.21)	17.71** (2.17)	15.32** (2.43)	15.36** (2.47)	16.46*** (2.95)	17.37*** (4.20)	13.02*** (3.11)	12.20*** (3.29)	7.13** (2.36)
b_2 (RRR)	16.24** (2.31)	11.79*** (2.94)	7.91*** (2.55)	7.07** (2.32)	7.38*** (2.70)	6.01*** (2.96)	5.65*** (2.75)	5.52*** (3.03)	2.85* (1.92)
b_3 (MP)	-1.09 (-0.27)	-0.18 (-0.08)	0.72 (0.41)	0.56 (0.32)	1.63 (1.04)	1.47 (1.26)	0.69 (0.58)	0.92 (0.88)	0.09 (0.10)
R^2	0.11	0.19	0.19	0.17	0.24	0.33	0.24	0.27	0.14
(2) BLR-RRR Sample									
b_1 (BLR)	14.40 (1.11)	17.69** (2.46)	15.39*** (3.08)	15.37*** (3.07)	16.71*** (3.78)	17.61*** (5.29)	13.17*** (3.28)	12.42*** (3.246)	7.09** (2.30)
b_2 (RRR)	18.75*** (2.92)	11.78*** (3.30)	7.94*** (3.20)	7.14*** (2.87)	7.36*** (3.35)	5.98*** (3.61)	5.60*** (2.80)	5.44*** (2.86)	2.92* (1.92)
R^2	0.17	0.28	0.31	0.29	0.37	0.48	0.30	0.30	0.17

Note: The table reports the results from regressions of 1-day response of market interest rates on various announced policy changes with the upper panel based on the all-in sample (of 81 observations) and the lower panel using the BLR-RRR sample (of 66 observations).

See also the notes to Table 3.

Source: Author's estimation.

The estimation based on the baseline model and pooled samples both suggests that the average pass-through of changes in the regulated retail interest rate to market interest rates is moderate, all below 25 percent. There are two possible explanations. This event-study approach defines the event window as one day in this paper and estimate over-day response of market interest rates to BLR changes on event days. Neither earlier nor delayed responses of market interest rates will be captured in the regressions. The first explanation is due to earlier responses. Changes in the benchmark lending rate could be anticipated. The expected BLR change would have already been priced in before the announcements. Second, the market response could be delayed. I test these two hypotheses. Unfortunately, I cannot measure the exact timing

of the expected policy changes. Neither can I know the exact timing of the response delay. However, a natural guess is that both might be around the event days.

Table 6. The market response to announced policy changes on days surrounding the event day

ΔR_j	i^{1d}		i^{3m}		i^{1y}		i^{5y}		i^{10y}		
	b	R ²	b	R ²	b	R ²	b	R ²	b	R ²	
(1)	$\Delta R_j = a + b\Delta BLR_t + \varepsilon_j$										
j = t-2	11.89 (0.23)	0.00	0.38 (0.16)	0.00	-0.95 (-0.44)	0.01	0.79 (0.34)	0.00	-1.96 (-0.76)	0.02	
j = t-1	-2.27 (-0.09)	0.00	7.33 (1.53)	0.08	5.03* (2.24)	0.16	9.66*** (2.92)	0.25	7.61** (2.26)	0.16	
j = t	24.89* (1.71)	0.10	19.5*** (3.51)	0.32	20.91*** (4.21)	0.40	16.37*** (3.25)	0.29	15.23*** (2.83)	0.24	
j = t+1	-9.67 (-0.87)	0.03	1.81 (0.56)	0.01	2.37 (0.77)	0.02	0.98 (0.37)	0.01	0.46 (0.13)	0.00	
j = t+2	-1.84 (-0.16)	0.00	-7.95* (-1.86)	0.12	0.34 (0.14)	0.00	0.60 (0.29)	0.00	-1.55 (-0.75)	0.02	
(2)	$\Delta R_j = a + b\Delta RRR_t + \varepsilon_j$										
j = t-2	-2.26 (-0.32)	0.00	1.32 (1.53)	0.05	1.62** (2.19)	0.10	0.76 (0.81)	0.01	0.13 (0.10)	0.00	
j = t-1	-10.01 (-1.32)	0.04	0.67 (0.73)	0.01	0.54 (0.52)	0.01	3.31*** (3.05)	0.18	2.89*** (2.85)	0.16	
j = t	22.38*** (4.20)	0.29	11.00*** (4.54)	0.32	11.23*** (5.30)	0.39	8.49*** (4.19)	0.29	7.91*** (5.31)	0.40	
j = t+1	2.41 (0.75)	0.01	2.30 (1.58)	0.05	1.45 (0.93)	0.02	2.49** (2.02)	0.09	1.87* (1.73)	0.07	
j = t+2	5.52 (1.40)	0.04	3.10 (1.38)	0.04	1.91 (1.55)	0.05	0.77 (1.19)	0.03	-0.79 (-0.98)	0.02	
(3)	$\Delta R_j = a + b\Delta MP_t + \varepsilon_j$										
j = t-2	4.91 (1.73)	0.18	0.00 (0.00)	0.00	-0.19 (-0.15)	0.00	-0.09 (-0.15)	0.00	-0.16 (-0.58)	0.03	
j = t-1	4.94 (1.12)	0.08	1.09 (0.58)	0.02	0.05 (0.04)	0.00	0.48 (0.69)	0.03	0.67 (0.67)	0.03	
j = t	-1.84 (-0.36)	0.01	0.91 (0.31)	0.01	1.81 (0.70)	0.03	0.85 (0.61)	0.03	1.06 (1.09)	0.08	
j = t+1	3.93 (0.53)	0.02	-1.10 (-1.10)	0.10	-0.46 (-0.66)	0.03	-0.46 (-0.90)	0.06	-0.32 (-0.53)	0.02	
j = t+2	-3.67 (-0.60)	0.03	-3.23 (-1.05)	0.07	-1.46 (-0.51)	0.02	0.16 (0.12)	0.00	0.77 (0.94)	0.06	

Note: The table reports market responses to the policy announcements on days surrounding 28 BLR changes in Panel (1), those surrounding 45 RRR adjustment announcements in Panel (2) and those surrounding 16 policy stance shift announcements in Panel (3).

See also the notes to Table 3.

Source: Author's estimation.

Another advantage of this exercise is that it helps clarify timing uncertainty problem about policy announcement events (see, e.g., Cook & Hahn 1988). All these three policy changes are publicly announced and event days are defined, based on the PBC's news updating time on its webpage. One concern is that there might be certain information leakage via other channels.

I re-estimate Eq. (1), using daily changes in the market interest rates on the two days before and the two market days after the identified BLR, RRR and Sun-MP index event days, respectively. Table 6 reports partial results for five selected interest rates – i^{1d} , i^{3m} , i^{1y} , i^{5y} and i^{10y} . For a comparison purpose, the announcement effects from the baseline model obtained in Tables 3 are re-presented, highlighted in the light grey.

In all these specifications, no clear, coherent pattern is observable. Most of estimated coefficients are statistically insignificantly different from zero. Neither are regression R^2 's high. These estimates do not suggest for any significant effect of lagged or led policy actions on market interest rates or an alternative timing of the event days.

However, the results that the lagged market interest rates do not respond significantly to policy announcements, as reported in the first two rows in Panels (1)-(2), do not necessarily mean that policy actions are not anticipated before the announcements. Rather, it might be because this timing specification could not well capture the expected part of policy actions, even if there is some. Indeed, it is unrealistic to assume that policy adjustments are uniformly anticipated one or two trading days ahead of the announcements. As reported in the last two rows in these two panels, there is little significant response to lagged policy actions, suggesting that these two policy adjustments are clearly communicated and financial markets respond immediately.

As shown in the last two rows in each Panel of Table 6, some of the point estimates of the lagged response to policy announcements are negative, inconsistent with that the policy effects predict. It could be due to the reverse or reboundness of market rates after initial reactions on event days. An alternative way to measure the market response, while taking such reverse into consideration, is to focus on the market reaction at an extended event window. This will also help shed light on the persistence of market response to policy actions. However, a longer window would pick up the effects of other shocks on financial markets. I extend the event window to two days, with the market interest rate changes defined as accumulated 2-day changes following policy changes (with the policy event day included). I re-estimate Eq. (1), using these accumulated 2-day changes as regressands each time in turn. The results are reported in Table 7.

In general, both the estimation precision and the model fitness deteriorate, compared to the baseline 1-day interest rate response estimation in Table 3. In Panel (3), the 2-day market response to announced policy stance shifts is statistically insignificant at all maturities, with the R -squared close to zero. In Panel (1), the estimated 2-day market response to BLR change announcements is similar to that 1-day response, in

magnitude, except for a larger coefficient for the 30-year bond rate. It seems that including second-day interest-rate changes into the regressand essentially does not alter the estimation results, except for a minor precision deterioration. This confirms the result reported in Table 6 that there is little lagged market response to the BLR announcements.

However, in Panel (2), the estimated cumulative responses to announced reserve ratio adjustments are all significant at the 1 percent level and about 1-2 basis points larger almost at all maturities than the 1-day estimation reported in Table 3, indicating a cumulative market response to RRR adjustment announcements. The possible explanation for it is that banks slowly adjust their liquidity holding to meet the new requirement. The effect of announced reserve ratio adjustments on the liquidity condition in markets and hence asset prices is persistent.

Table 7. The accumulated 2-day response of market interest rates to policy change announcements

	i^1d	i^1m	i^3m	i^6m	i^1y	i^3y	i^5y	i^10y	i^30y
(1) $\Delta R_t = a + b\Delta BLR_t + \varepsilon_t$									
b	15.23 (1.03)	23.41** (2.44)	21.31*** (3.24)	21.66*** (3.76)	23.28*** (3.70)	24.17*** (3.53)	17.35** (2.66)	15.69*** (2.81)	14.98*** (2.99)
R ²	0.04	0.19	0.29	0.35	0.34	0.32	0.21	0.23	0.26
(2) $\Delta R_t = a + b\Delta RRR_t + \varepsilon_t$									
b	24.79*** (3.85)	15.01*** (3.32)	13.30*** (4.26)	13.51*** (4.27)	12.68*** (4.32)	12.74*** (4.60)	10.98*** (4.49)	9.78*** (4.83)	6.56*** (3.70)
R ²	0.26	0.20	0.30	0.30	0.30	0.33	0.32	0.35	0.24
(3) $\Delta R_t = a + b\Delta MP_t + \varepsilon_t$									
b	1.87 (0.22)	-0.16 (-0.03)	-0.19 (-0.06)	0.14 (0.05)	1.35 (0.49)	1.48 (0.72)	0.38 (0.25)	0.73 (0.78)	0.24 (0.31)
R ²	0.00	0.00	0.00	0.00	0.02	0.04	0.00	0.04	0.01

Note: The table reports the 2-day response of interest rates to three policy actions: BLR changes (Panel (1)), announced RRR adjustments (Panel (2)), and announced policy stance shifts (Panel (3)). The BLR sample consists of 28 BLR changes; the RRR sample contains 45 announced RRR adjustments; the balanced MP sample size consists of 16 announced policy stance shifts.

See also the notes to Table 3.

Source: Author's estimation.

Two key findings have emerged from this section. First, the baseline results of the regulated retail interest rate model, in particular, those for short-term interest rates, are comparable to the estimated market interest rates' reaction to overall federal funds target rate changes in the U.S. in the 1989-2000 period, reported in Kuttner (2001), but smaller and less significant than those for the 1975-1979 sample, estimated by Cook and Hahn (1989), where they report a uniform 50–55 basis point response of short-term bill rates to one percentage-point changes in the target rate. In the literature, the explanation of a declining market response from the 1970s through 1990s in the U.S. is that more components of funds target rate changes were anticipated by the market in the 1990s. Indeed, when he decompose the overall funds target rate changes

into anticipated and unanticipated components, Kuttner (2001) reports a similarly uniform 71–79 basis point response of bill rates to surprise actions. However, due to the data unavailability this paper is not able to disentangle unanticipated announcement components from expected ones in this paper, though certain announced policy changes are apparent to market participants before the announcements. Neither can the market’s pricing-in behaviour of expected policy change components be easily traced with uniform timing-shift exercises as those in Table 6. However, it seems safe to proceed using the event-study approach. One just needs to bear in mind that it may yield conservative estimates of financial markets’ reaction to monetary policy (see, e.g., Bernanke & Kuttner 2005).

Another key finding is that the interest rates of shorter maturities respond more strongly. This finding is consistent with the literature on the expectations theorem. It is widely believed that the monetary authority can most directly influence short-term interest rates, while the long-term interest rate depends not only the current monetary policy but the expected future monetary policy. The coefficients estimated in the baseline regressions in two upper panels in Table 3, which relate changes in market interest rates at different maturities to announced benchmark lending rate changes and reserve ratio adjustments, roughly outline a downward sloping term structure, but with a relative flat stretch over the yield curve from 3-12 months.

5. Robustness and extension

This part presents one robustness test and one extension. For the robustness test, I follow Demiralp and Jorda (2004) and extend Eq. (1) to incorporate a dummy variable in the BLR and the RRR model to examine the hypothesis whether a reversal in the policy stance, measured in a different direction of changes in the benchmark lending rate and the required reserve ratio, respectively, has a stronger announcement effect on markets.²⁴ As shown in Table 1, the PBC typically adjusted the benchmark lending rate and the required reserve ratio in the series of 25 (or 27) basis point and 50 basis point hikes/cuts in the same direction, respectively. The reversal of the general trend of these changes was rare. Over the sample period, such a reversal occurred only four times for the BLR series and three times for the RRR series. These four BLR reversals and three RRR reversals are highlighted with light green squares in Fig. 1.1 and Fig. 1.2. They all lie in southeast and northwest quadrants, suggesting for a positive relationship between the policy reversal announcements and market interest rate responses.

I rewrite Eq. (1), with the dummy incorporated:

$$\Delta R_t = a_0 + a_1 d_t + b_0 \Delta M_t + b_1 d_t \Delta M_t + \varepsilon_t \quad (2)$$

where $\Delta M_t = \Delta i_t^L$ in the BLR model, while $\Delta M_t = \Delta RRR_t$ in the RRR model; $d_t = 1$ in four (three) cases when the PBC announced a reversed change in the benchmark lending rate (the required reserve ratio) in the BLR (RRR) model, compared to the previous change and $d_t = 0$, otherwise.

²⁴ Given a small sample size of the Sun-MP model, I skip this exercise for it.

The interpretation of coefficients is as follows: (1) the effect of an announced adjustment of the BLR and RRR, respectively, along the same direction of their previous change (measured by b_0); (2) the effect of an announced reversal adjustment of the BLR and RRR, respectively (measured by $b_0 + b_1$).

Table 8 reports the estimates of Eq. (2) for the BLR model in Panel (1) and the RRR model in Panel (2). A reversal policy adjustment, either the BLR reversal or the RRR reversal, does not seem to have a strong significant impact on the overnight money market rate, as reported in Column 1. By contrast, incorporating the policy reversal impact turns to improve the model fit for bond rates. The highest estimated R -squared, 0.62, is found with the BLR model for the 3-year bond rate.

Table 8. The policy reversal effect, the BLR and the RRR model

	i^{1d}	i^{1m}	i^{3m}	i^{6m}	i^{1y}	i^{3y}	i^{5y}	i^{10y}	i^{30y}
(1) $\Delta R_t = a_0 + a_1 d_t^r + b_0 \Delta BLR_t + b_1 d_t^r \Delta BLR_t + \varepsilon_t$									
b_0 (along the trend)	24.67 (1.57)	20.26** (2.78)	15.18*** (3.04)	15.79*** (3.31)	16.74*** (3.69)	17.66*** (4.43)	14.18** (2.72)	16.24*** (2.93)	5.70 (1.36)
b_0+b_1 (reversal)	19.95 (0.39)	59.34** (2.50)	56.82*** (3.50)	53.30*** (3.44)	59.73*** (4.05)	56.19*** (4.34)	41.34** (2.44)	11.31 (0.63)	41.88*** (3.07)
R^2	0.12	0.42	0.54	0.53	0.58	0.62	0.36	0.32	0.33
(2) $\Delta R_t = a_0 + a_1 d_t^r + b_0 \Delta RRR_t + b_1 d_t^r \Delta RRR_t + \varepsilon_t$									
b_0 (along the trend)	20.63*** (3.69)	13.08*** (4.06)	9.36*** (3.92)	8.94*** (3.70)	9.55*** (4.71)	8.48*** (4.94)	6.41*** (3.65)	6.82*** (4.70)	3.73*** (3.62)
b_0+b_1 (reversal)	42.41* (1.69)	47.65*** (3.30)	25.25** (2.36)	26.18** (2.42)	26.98*** (2.97)	24.00*** (3.12)	26.83*** (3.40)	18.74*** (2.88)	16.79*** (3.63)
R^2	0.31	0.43	0.42	0.41	0.51	0.52	0.53	0.49	0.54

Note: The table reports the 1-day response of market interest rates to two policy actions: BLR changes (Panel (1)) and announced RRR adjustments (Panel (2)), with a policy reversal dummy incorporated. The sample size is 28 and 45 for the BLR and the RRR model, respectively. In parentheses are t -statistics of the Wald test for the null hypothesis of the sum of estimated coefficients equal to zero.

See also the notes to Table 3.

Source: Author's estimation.

In both panels, the adjustment along the general direction of the policy stance has a similar but slightly smaller impact on the bond rates, as what is obtained in baseline model reported in Table 3. However, a reversal policy adjustment of the benchmark interest rate and the reserve ratio both turns to have a substantial significant effect on the bond rates, which is about tripled compared to the estimated impact of the policy adjustment along the general trend. The bond rates immediately respond to new information, featured here as policy stance reversals. One exception in Panel (1) is that the estimated impact on the 10-year bond rate is small and insignificant. But the pass-through of a policy rate reversal to the short- and medium-term bond rates is more than 50%. In Panel (2), the bond rates respond to such a reversal strongly,

although this response substantially declines as the maturity of the bond rates increases (from a value of about 48 to 17 basis points, significant in all cases).

This finding about a huge magnitude difference between the estimated impact of a continuous policy change and that of a policy reversal for bond rates but not for the overnight money market rate is consistent with the expectations theorem. A policy reversal announcement leads financial market participants to update their expectations of the path of future monetary policy. Note that the PBC does not reverse the policy trend often. When such a reversal occurs, it implies that the PBC would follow the reversed policy trend in the near future. Revised expectations of future monetary policy have impact on the short-, medium- and long-term interest rates, as the theorem predicts, but not the overnight money market rate.

The extension is to assess the two newly introduced central bank lending rates and their roles to guide market interest rates. Through a number of lending facilities, the PBC lends to banks to ensure appropriate liquidity in financial markets. The two newly introduced lending facilities are the standing lending facility (SLF, introduced in early 2013) and the medium-term lending facility (MLF, introduced in September 2014), with the SLF rates to “serve as the ceiling of the interest-rate corridor”²⁵ and the MLF rates to “serve as the mid-term policy interest rates and to guide ... (the) lending rates” (*China Monetary Policy Report 2015Q4*: 20).

Four SLF and MLF rate changes are identified in 2017; all are hikes.²⁶ They are listed in Table 9, together with the over-day market interest rate movements on these announced adjustment days. The market interest rates are expressed in basis points, while announced changes in two central bank lending rates are in percentage points.

The lower panel presents the average change of these interest rates and the sample mean standard deviations in parentheses, in three differently defined samples. Two of the three average over-day changes in the money market rate in these central bank interest rate adjustment days are suspiciously negative, though insignificant. On average, the bond rates followed an SLF or MLF rate increase, but the average response magnitude is substantially smaller than the estimated BLR impact and not statistically significantly different from zero in all these three samples. Although this assessment is preliminary (given the limited observations), it still deserves the attention and effort to figure out why the signal effects of these two new rates are so weak. The possible explanation is that the central bank lending plays only a limited role in determining the market liquidity and market interest rates as well. That is also the reason that other central banks, like the Fed, stopped using the discount rate and instead, switched to the federal funds rate to guide market interest rates.

²⁵ Sun (2018) examines the role of the SLF rate as the upper bound of the interest-rate corridor and does not find that money market interest rates have been effectively confined to this upper bound.

²⁶ Only starting from 2017, the information of the exact adjustment dates is available. Prior to it, there were a few adjustments of SLF and MLF rates, but only the months when such adjustment occurred are mentioned in the PBC’s documents.

Table 9. Over-day rate movements following announced changes in the SLF and MLF rates

Date	Day	Δi_{SLF}^{7d}	Δi_{MLF}^{1y}	Δi^{1d}	Δi^{1m}	Δi^{3m}	Δi^{6m}	Δi^{1y}	Δi^{3y}	Δi^{5y}	Δi^{10y}	Δi^{30y}
1/24/2017	Tue		0.10	-1.68	-6.24	-0.17	0.96	-0.11	1.53	1.62	4.08	2.97
2/3/2017	Fri	0.10		-51.71	-2.47	11.00	6.25	6.45	3.39	4.16	7.49	5.21
3/16/2017	Thu	0.10	0.10	5.50	6.20	-1.32	3.49	2.25	0.22	-1.90	-4.27	-2.87
12/14/2017	Thu		0.05	1.52	3.28	2.00	-1.19	-0.65	-2.02	-1.45	-1.99	0.49
average change (full sample)		0.10	0.08	-11.59 (26.91)	0.19 (5.60)	2.88 (5.59)	2.38 (3.21)	1.98 (3.23)	0.78 (2.28)	0.61 (2.84)	1.33 (5.41)	1.45 (3.47)
average change (SLF sample)		0.10		-23.11 (40.45)	1.87 (6.13)	4.84 (8.71)	4.87 (1.95)	4.35 (2.97)	1.80 (2.24)	1.13 (4.29)	1.61 (8.32)	1.17 (5.71)
average change (MLF sample)			0.08	1.78 (3.60)	1.08 (6.51)	0.17 (1.69)	1.09 (2.34)	0.50 (1.54)	-0.09 (1.80)	-0.58 (1.92)	-0.73 (4.32)	0.20 (2.93)

Note: The table reports the over-day market rate movements following announced changes in the SLF and MLF rates. The lower panel presents the average change over the samples. The policy interest rate changes are expressed in percentage points, while market interest rate changes are in basis points. In parentheses are the sample mean stand deviations reported.

Source: Author's estimation.

6. Conclusions

This paper examines the response of market interest rates to monetary policy announcements in China, measured in three ways. I find that the response to an announced adjustment of two quantitative measures, the benchmark lending rate and the required reserve ratio, is positive and significant at all maturities of the bond rates, but smaller at the long end of the yield curve. However, the market barely responds to qualitative policy stance shift announcements.

This finding that the announced reserve ratio channel works, parallel to the benchmark lending rate channel, in transmitting the policy intentions to market interest rates suggests that there is no decoupling between monetary policy and market interest rates even when the PBC shut down the BLR channel in the post-deregulation era. However, in the medium run, the PBC needs to find alternatives to replace both channels in guiding the market given that the change in the required reserve ratio is also fading out of its frequent use. The preliminary assessment of two newly introduced central bank lending rates does not indicate that they are sufficient to replace the BLR and RRR channels. Rather, my results suggest for a framework with explicit announcements of a short-term interest-rate operating target for the post-deregulation era, either at or out of the PBC's MPC meeting news release.

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