PRELIMINARY DRAFT: DO NOT QUOTE

China's monetary policy communication:

Money markets not only listen, they also understand

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Abstract

Central bank communication is becoming a key aspect of monetary policy as a consequence of financial liberalization and the introduction of market instruments to conduct monetary policy. In the same vein, China's financial system is slowly becoming more sophisticated and its monetary policy more market oriented. This makes effective communication all the more important for the People's Bank of China (PBoC) so that its messages are understood by the relevant actors without necessarily resorting to compulsory and/or administrative measures. We assess whether China's interbank market reacts to the PBoC communication tools, i.e., speeches of its governing board but also statements after the meetings of its monetary policy committee (MPC). We find that China's money markets not only listen to the PBoC's words, as shown by the change in the conditional and realized volatility of interbank interest rates right after a speech from the PBoC's governing body, but they also understand the tone of monetary policy which the PBoC intends to convey in its messages. This is shown by the statistically significant increase in interbank rates the more hawkish the speeches are. All in all, our results show strong evidence of effective communication from the PBoC towards China's money markets.

Key words: China monetary policy communication; money market

JEL classification: E52, E58, E43

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1. Introduction

Central bank communication has become a hot topic as a consequence of the liberalization of financial markets and the move of central banks to market-oriented monetary instruments. The more market-oriented the instruments the more the central bank needs to rely on a good transmission of its intentions through other means than imposing administrative limits, be it quantitative or price limits.

In the 1990s central banks in many OECD countries have tried to improve communication through different means depending on their target audience, be it the public or financial markets. As regards the latter, central banks now publish their own assessment of the economic outlook and even hints to their future monetary policy action (BIS, 2009; Filardo et al., 2008). Academic research (as surveyed by Blinder et al. 2008) has provided mounting evidence that communication is an important and powerful tool for central banks to conduct a more predictable monetary policy, the more so the more developed the financial system where such monetary policy is conducted. This is because the final goal of central bank communication is managing financial markets' expectations and these are better managed when financial markets are forward-looking (Garcia-Herrero and Remolona, 2008). This brings central bank communication closer to an instrument to conduct monetary policy than a proof of transparency. In fact, as Svensson (2004) put it, "monetary policy is to a large extent the management of expectations."

China has moved more slowly, especially when compared with advanced industrial countries, in introducing market-oriented monetary instruments. This is, of course, quite logical if one considers the country's still relatively controlled financial system. In any event, in the same way as China's economy catches up with the most advanced ones, its monetary policy framework is gradually getting closer to that of its counterparts. This is not only the case for the PBoC's instruments but also for its communication. On the former, China has introduced short term interest rates as operational targets instead of quantitative monetary targets. However, credit targets still play an important guiding role. On the latter, the PBoC has also started publishing statements summarizing the meetings of its monetary policy committee (MPC). It has also become much more active in delivering speeches by its governing body, which are focused on monetary policy issues and the outlook of the Chinese economy.

Both PBoC's statements and speeches point to a much more transparent central bank but they are not enough to assess how effective the PBoC is communicating its messages to the

financial markets. In fact, a central bank can be extremely transparent but markets may not bother, i.e., markets may not listen to the central bank. It may also be that markets do listen but do not understand the messages. In other words, the capacity of a central bank to communicate should rather be measured by the presence of a reaction of money and financial markets to central bank messages in the intended direction. For example, if a central bank delivers a hawkish statement or speech, a good understanding of such communication should imply that interest rates in the money markets increase due to the expectation of future hikes in policy interest rates.

In the case of China, however, central bank communication does not simply provide signals about future interest-rate changes. It also sends signals on the current and future moral suasion or window guidance being used by the monetary authorities as a full policy instrument. Most central banks nowadays inform the public about their interest-rate decisions or provide hints about their future actions. In the case of the PBoC, communication may simply reflect some unobserved current or future moral suasion or window guidance from the part of the PBoC to achieve its targets. Accordingly, analyzing the way the PBoC communicates may well go beyond a simple measure of transparency but rather enable us to identify real monetary policy action through words and not deeds. In other words, such communication would raise the signal-to-noise ratio, providing market participants with news on unobserved monetary policy decisions and leading to a reduction in noise by limiting the guess work on the part of the public.

The objective of this paper is to assess whether China's money markets listen to the PBoC's words and, even more importantly, whether they understand them. As regards listening, we assess empirically whether the conditional and realized volatilities of interbank rates change right after a speech from the PBoC's governing body. In principle, such change should be an increase in volatility – and not a reduction – in as far as news generally bring new information and, thereby, more uncertainty. However, in some cases, new information could actually calm the markets. It, thus, seems clear that any change in volatility – be it an increase or a reduction - should be an indication of news being provided by the PBoC's words to which money markets listen to. We do find statistically significant changes in the volatility of money market rates after PBoC speeches are released so as to confirm the hypothesis that money markets do listen to the PBoC.

Whether money markets understand the PBoC is a much more demanding question that just listening. It, thus, requires a different empirical strategy. To that end, we look into the

reaction of interbank rates to the type of messages provided by the PBoC. We find strong evidence in favor of money market rates increasing after a hawkish statement from the PBoC and the other way around (reduction in rates after dovish statements). All in all, our results show strong evidence of effective PBoC's communication as concerns the money market.

The paper is structured as follows. Section 2 reviews the related literature and describes the paper's objective. Section 3 reports on how we have compiled our measure of central bank communication and the rest of the data requirements and the methodology used. It also shows some stylized facts on China's money market. Section 4 discusses the empirical results and Section 5 draws some policy conclusions based on the results.

2. Central-bank communication and interbank markets: a concise look at the literature.

In a stationary economic environment where the central bank is credibly committed to a policy rule and expectations are rational, central-bank communication has no independent role to play (Blinder et al. 2008). In other words any systematic pattern in the way monetary policy is conducted is correctly inferred from the central bank's observed behavior (Woodford, 2005) so that central bank communication is redundant.

A departure from the assumptions underlying such an extreme case should make central-bank communication relevant for policy action. This obviously includes, among other features, non-rational expectations or asymmetric information between the public and the central bank. China is a clear case of departure from the above assumptions for two main reasons. First, in a non fully-liberalized financial system asymmetric information is the rule. Second, the economy is still in transition towards a market system. The public might, thus, not necessarily understand intentions from observable data. This makes central-bank communication extremely important for the PBoC to fulfill its mandate.

Beyond China, it seems quite clear that most economies in the world – if not all – suffer from information asymmetries and other imperfections, which explains the recently booming literature on central-bank communication. In fact, central-bank communication, or more generally the management of expectations, has become a major policy tool at the disposal of monetary authorities. While its effects have been extensively studied for O.E.C.D. countries (Blinder et al. 2008), the case of emerging markets has been relatively neglected. This is all the more surprising if one considers that in such countries, and especially China, standard tools of monetary policy, like interest rate changes, may not have the usual effectiveness for the reasons already mentioned. Accordingly monetary authorities in emerging economies

can only gain from taking advantage of the market-expectations channel, working through the term-structure of interest rates or other means. This might be behind the increasing transparency of central banks in emerging markets (Garcia-Herrero and Remolona, 2008, show evidence for Asia).

The empirical literature on central-bank communication generally follows a very simple approach to assess whether such communication works. Namely, changes in asset prices following central bank words are identified when controlling for other factors which may affect asset prices (see Blinder et al. 2008 as an example). While the focus is on asset prices, the underlying rationale is the following: central-bank communication should rapidly influence expectations of future short-term rates, which, in turn, would quickly impact on long-term rates and other financial-market prices. Such asset-price movements would, in turn, influence inflation and output, but only gradually, with well-known long and variable lags.

The logical first step in the analysis of the effects of central bank communication is to start by the upstream part of the transmission mechanism and focus on the effects of central-bank signals on money markets. From money markets, central bank words should eventually also affect financial markets including the longer end of the yield curve and even stock markets. In our paper, we shall follow this logical order and focus on the impact of the PBoC's communication policy on China's money markets. This is even more understandable in the case of China where capital markets are still relatively underdeveloped. Finally, to evaluate the impact of central bank communication a key issue is the measurement of communication. Subjective communication indicators are constructed *ex post* and may not accurately reflect how financial markets understood the signals at the time such signals were issued. As we know, efficient financial markets should react only to the *unexpected* component of central bank communication. The study we propose presents two innovative features: the construction of a high-frequency database on verbal communication by the PBoC, and the examination of the impact of such central-bank communication on the Chinese interbank market. To that end, we use high-frequency interbank interest rates at different maturities.

There is no previous empirical analysis on the effectiveness of PBoC's communication that we are aware of. However, there are a number of related papers worth reviewing. The first, by Li and Zou (2008), looks into the effect of the PBoC's monetary policy – and not its communication - on financial markets. The authors find increased volatility and correlation between stock and bond prices during periods of restrictive monetary policy. In the same

vein, Fan and Johansson (2009) analyze the effects of the official interest rate on the yield curve (see also Fan, and Zhang, 2006 and 2007 on term premia in the repo market).

As regards the modeling of the interbank market in China, a key contribution is that of Porter and Xu (2009). The authors model competitive profit-maximizing and price-taking commercial banks which target the holding of excess reserves with the central bank. These banks face a number of regulated prices: the deposit and lending rates, the required-reserve ratio, as well as an exogenous amount of central-bank bond issuance (aimed at sterilizing foreign-currency reserve inflows). In equilibrium, the interbank rate is a positive function of the lending rate and the central-bank net bill issuance but the sign of its response to a rise in the required-reserve ratio is ambiguous. The empirical strategy followed by Porter and Xu (2009) uses an asymmetric specification of conditional volatility (EGARCH framework), which is generally considered appropriate for China's interbank interest rates (see Qi and Zhang, 2010). In fact, Porter et. al. (2009) make the interbank interest rate depend on the lending and deposit rates, the rate of required reserves as well as the net issuance of central bank bills. Calendar effects are also controlled for, as well as initial public offerings (IPOs) in the stock market. The underlying reason to include this last variable is the liquidity lock up in the banking system one week prior to the IPO. Furthermore, separate literature has found it significant (Dong and Zheng, 2010).

3. Methodology and Data.

Methodology

To evaluate the impact of PBoC communication on China's money markets, we adopt an encompassing approach in the spirit of Ehrmann et al. (2007). As a first step, we focus on whether money markets listen to the PBoC. Following Kohn and Sack (2004) we look into the effects of central bank communication on the *volatility* of financial variables as in Connolly and Kohler (2004), and Reeves and Sawicki (2007). The underlying hypothesis is that the volatility of asset returns should be higher on days of central bank communication, *everything else equal*, because such signals contain news. However, as previously mentioned, a reduction in volatility could also be a response to central-bank communication in as far as the situation prior to such news was very uncertain and it helps calm down the market.

In a second step, we analyze empirically whether money markets understand the PBoC's words. Following Ehrmann et al. (2007), we examine whether speeches move mean interest rates in the intended direction. This requires coding the directional intent of speeches; i.e.,

classifying speeches according to the information they provide (how hawkish as opposed to how dovish they are).

The model is, thus, composed of two different estimation equations: Equation (2) looks into the volatility of the interbank rate and how central-bank announcements may affect it. To that end, it uses a conditional volatility model with asymmetries, namely an exponential GARCH model (which is commonly used in the analysis of communication on volatility, e.g. Sebestyen and Sicilia, 2005). Equation (1) analyses how central-bank communication affects the mean interbank rates.

We follow Porter and Xu (2009) for our empirical specification. We make the interbank interest rate (the SHIBOR rate for reasons which will be explained later) depend on variables which have been found relevant in the previous empirical literature. Our objective is to examine the impact of central-bank communication which we measure by speeches by the PBoC's governing body (SPEECH) and other communication means, namely the PBoC statements right after its MPC meeting. This variable is a dummy (MPC) which takes the value of one after a written statement is released, and zero otherwise. Both communication variables enter the equation at time t and the second is also included with five lags (see data section below). The control variables are the deposit rate (DR), the required-reserve ratio (RR), the lending rate (LR) and the net bill issuance by the PBoC (BILL). We also include the amount of initial public offerings (IPO) given the evidence of a liquidity lock-up in the money market reported by Porter and Xu (2006). Finally, we allow for calendar effects such as day-of-week (W_j), end-of-month (M) and Chinese-New-Year (NY) effects. We specify the latter as a dummy on the eve of the New Year, as well as on the first day of trading after the New-Year vacations (NY1). Finally, we control for the GDP announcements with a dummy (MACRO) which takes a value of one on days of GDP releases, and zero otherwise.

More specifically, the SHIBOR rate (i) is modeled in two ways: the mean equation (1) and the volatility equation (2).

The mean equation addresses the more difficult question of whether money markets understand the PBoC. The specification we use is as follows:

$$i_t = a_0 + \sum_{j=1to5} a_{1j}\, i_{t-j} + \sum_{j=0to5} a_{2j}\, SPEECHP_{t-j} + a_3\, MPC_t + a_4\, RR_t + a_5\, LR_t + a_6\, DR_t + a_7\, BILL_t + \sum_{j=1to5} a_{8j}\, W_{jt} + a_9\, M_t + a_{10}\, NY_t + a_{11}\, NY1_t + a_{12}\, IPO_t + a_{13}\, IPO_{t+5} + a_{14}\, IPO_{t+10} + a_{15}\, MACRO_t + a_{16} \log(h_t) + (h_t)^{1/2} v_t \quad \textbf{(1)}$$

The volatility equation addresses whether money markets listen to the PBoC. We use an exponential GARCH model (as in Nelson, 1991) controlling for the above-mentioned determinants. The time-varying variance of the SHIBOR rate is noted as h_t; ν_t is a unit-variance, serially uncorrelated, zero mean, i.i.d. error term.

$$\ln(h_t) = a_0 + \gamma \ln(h_{t-1}) + \alpha \left|\nu_{t-1} / (h_{t-1})^{1/2}\right| + \lambda \left[\nu_{t-1} / (h_{t-1})^{1/2}\right] + a_2 ARR_t + a_3 ALR_t + a_4 ADR_t + a_5 ABILL_t + \sum_{j=1to5} a_{6j} W_{jt} + a_7 M_t + a_8 NY_t + a_9 NY1_t + a_{10} IPO_t + a_{11} IPO_{t-5} + a_{12} IPO_{t-10} + \sum_{j=0to5} a_{13j} SPEECH_{t-j} + a_{14} MPC_t + a_{15} MACRO_t \quad \textbf{(2)}$$

where the α coefficient is for the ARCH term, the γ for the GARCH term, and the λ term indicates the presence of an asymmetry in the impact of either positive or negative innovations to the standardized residuals. Finally, the letter A stands for absolute value of four of the five control variables. As an example, ARR stands for absolute value of the change in the required-reserve ratio. Due to the ever-present non-normality in the residuals, we use the Generalized-Error Distribution suggested by Nelson (1991), which embodies several other distributions depending on the value of the tail-thickness parameter. We allow for a GARCH-in-mean effect also developed by Nelson (1991), with the possibility of a negative coefficient, as documented by Glosten et al. (1993).

Data

We extract the speeches of the members of the Monetary Policy Committee, including the governor, from the DOW JONES FACTIVA database. We focus on the governor of the PBoC, Mr. Zhou Xiaochuan, and a prominent academic member of the MPC, Dr. Fan Gang. There are several reasons why we focus on those two: First of all, they have clear responsibilities for monetary policy. Second, both the governor and Fan Gang are the two MPC members who have delivered most speeches. Third, both were part of the MPC for our whole sample (except for the last month in the case of Dr Fan Gang) so that we do not need to deal with different personalities for the same position.

After screening thousands of reported speeches, we keep 209 by the Governor and 50 by Fang Gang. The others are dispelled being unrelated to monetary policy issues or China's economic outlook. Each speech is selected only once, on the basis of first recording. We construct three kinds of variables. The first is a dummy which takes the value of 1 on the day the speech is issued (SPEECH). The second and third intend to characterize the speech based on its information content (SPEECHP, with p=1,2). In fact, both variables take a

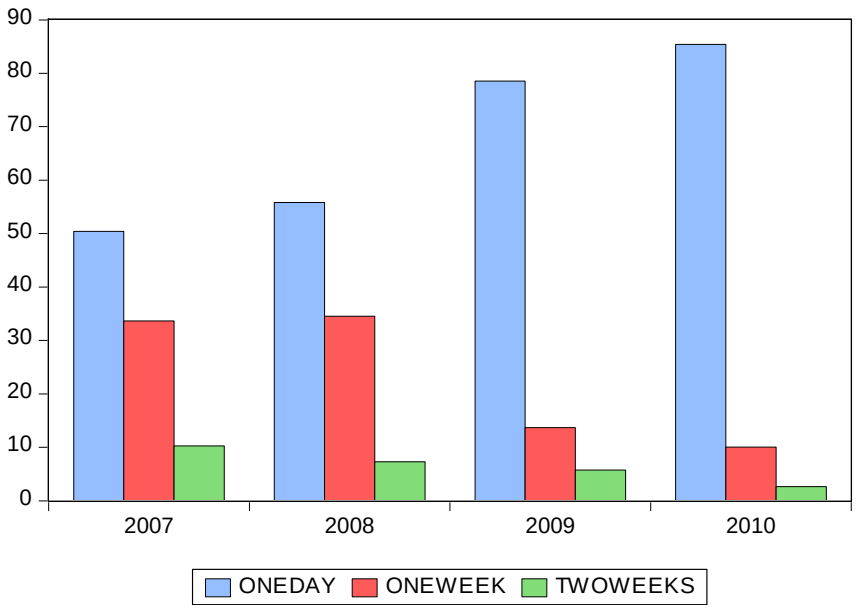
higher value the more hawkish the speech and a lower value the more dovish the speech. The first one (SPEECH1) is a discrete variable with three possible values: 1 (hawkish), 0 (neutral) or -1 (dovish). The second, also a discrete variable (SPEECH2), allows more nuances than the former one since it has five possible values: 2 (very hawkish), 1 (hawkish), 0 (neutral), -1 (dovish) and -2 (very dovish). The latter follows Rosa and Verga (2007) and Musard-Gies (2006).

We also constructed a 0/1 dummy for written quarterly statements by the PBoC, and a similar one for days of GDP announcements by China's National Bureau of Statistics. We take into account all the control variables identified by Porter and Xu (2009) since a rise in observed volatility, or in mean SHIBOR rates, may reflect the reaction of interbank markets to shocks other than central-bank communication.

As for the endogenous variable, the interbank-bank-market interest rate, we focus on the so-called Shanghai Interbank Offered Rate (SHIBOR) which came into operation on 4th January 2007 although it was launched on a trial basis in the last three months of 2006. This clearly improved upon the existing benchmark rate, the China Interbank Offered Rate (CHIBOR), since the trading volume of this cash market is too narrow and it is based on quotes rather than actual traded rates. Furthermore, the SHIBOR had the clear objective of becoming a true market signal of the functioning of the money market, improving thereby the transmission mechanism of PBoC's monetary policy. The SHIBOR is obtained in a fixing procedure similar to the LIBOR. It is the average of the prime rates offered by 12 among 16 foreign and local banks in China's money market. SHIBOR is published every working day at 11.30 am, and is thus available daily even without any actual transaction.

The SHIBOR market involves eight maturities, from overnight, to one week, two weeks, one, three, six, and nine months as well as one year. There is no data on the liquidity of the different SHIBOR maturities. However since SHIBOR rates and Repo rates move in tandem, the relevance of the different maturities can be gauged by examining turnover on the collateralized Repo market, rather than on the CHIBOR cash market, whose volume is substantially lower (at least by a factor of three for the one-day maturity). As shown in Figure 1, the bulk of volume is concentrated in the low end of the maturity spectrum. Moreover, contrary to what is widely believed, the one-day turnover is much higher than the one-week one, and increasingly so over the last two years. Accordingly we will put more emphasis in the interpretation of subsequent results on the shortest maturities.

Figure 1: Average share of turnover on the repo market by maturity (%)



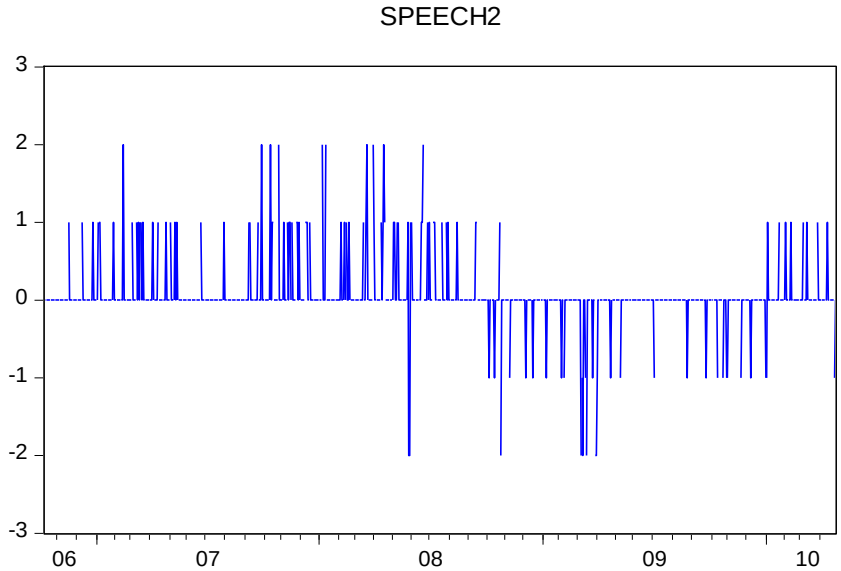
Source: Computed from CEIC data. We report the daily average turnover in April for each year. The residual amounts are distributed between the maturities ranging from 3 weeks to one year.

The different SHIBOR rates have somewhat distinct features beyond the differences in liquidity already mentioned. On the one hand, the 3-month, 6-month, 9-month and 1-year rates are generally less volatile and the term spread between them hardly moves. We, thus, use the six-month SHIBOR maturity as representative of these four maturities. On the other hand, the overnight, 1-week and 2-week SHIBOR rates are generally characterized by high variance. The 1-month SHIBOR is in the middle of the two groups. Therefore, this paper focuses on the analysis of the overnight, 1-week, 2-week, 1-month and 6-month SHIBOR maturities and starts the sample with the creation of the SHIBOR on a trial basis on Oct. 8, 2006. Our sample ends on April 27, 2010. We obviously exclude weekends and holidays from our sample. The source of the data is CEIC, which is also used for control variables included in equations (1) and (2). Descriptive statistics for these five maturities of SHIBOR over three subsamples are presented in Appendix 1, Table A.1.

The timeframe covered in our sample is October 2006 to 27 April 2010. This spans includes different exchange rate regimes, which is worth mentioning. In fact, it starts with a managed-float with relatively large changes in the value of the RMB against the USD followed by a fixed-exchange-rate period after July 2008. Furthermore, our sample includes a major shock stemming from the global financial crisis in the fall 2008 and China's reaction to it, thereafter. These different periods are also reflected in the conduct of monetary policy as well as in the tone of the PBoC's speeches as shown in Figure 2. We, thus, break our sample

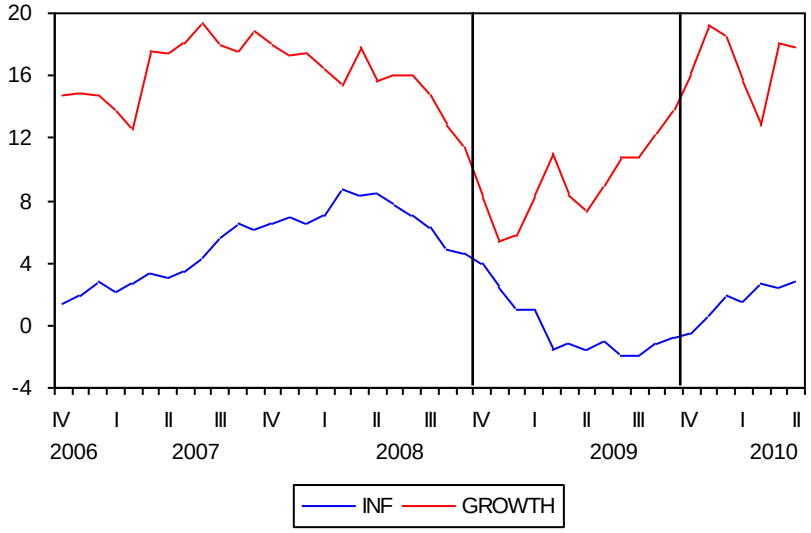
into three sub-periods. The first period ends on 8 October 2008 and is characterized by China's overheated situation. The second sub-period, between that date and 8 October 2009, represents the worst of the global financial crisis as far as China is concerned. From October 8, 2009 until the end of our sample, the main common theme is China's fast recovery once the fiscal stimulus package had had its full impact and the rest of the world had started to recover.

Figure 2: The stance of Chinese monetary policy as indicated by PBoC speeches (12. Oct 2006-27 April 2010).



When looking at the classification of speeches across the three subperiods, a mainly hawkish stance is manifested up to early October 2008 followed by a dovish one, beginning at the same time as Quantitative Easing in the US (when the Fedfunds rate was slashed), up to early October 2009. Finally, a new shift to a hawkish stance occurs in the third period around the beginning of 2010. The stance implied by speeches over these three sub-samples match very well developments in Chinese inflation and industrial output growth as plotted in Figure 3.

Figure 3: Monthly CPI Inflation and industrial output growth (year on year).



Source: IMF, International Financial Statistics.

4. Effects of PBoC communication on money markets

Stationarity tests

The detection of possible non-stationarity is key for our modeling strategy in this empirical exercise. In particular, it enables us to determine whether SHIBOR rates for different maturities should be modeled in level or first differences. For robustness, we use two unit-root tests: the Elliott et al. (1996), and the Ng and Perron (2001) tests, as well as a stationnarity test proposed by Kwaitkowski et al. (1992). The stationarity test concludes against stationarity for all maturities and all subsamples, while the two-unit root tests obtain different results according to the sample, and sometimes conflicting ones. (Appendix 2, Table A2).

We conducted additional tests to determine our empirical strategy, namely regressions on SHIBOR rates in levels. The sum of autoregressive parameters was very often close to unity for all sub-samples, confirming the results of the Kwaitkowski et al. test. The results on the effect of oral communication were not qualitatively different from those with the first differenced-SHIBOR. As a result of all these preliminary tests, we only consider models with SHIBOR rates in first differences for all maturities and all subsamples.

Do money markets listen to the PBoC? SHIBOR volatility

We test the hypothesis that the conditional volatility of SHIBOR (from equation 2) may change in a statistically significant way right after the PBoC members speak. This would imply that money markets do pay attention to PBoC speeches.

As previously mentioned, the literature tends to focus on increases in volatility as a confirmation of markets listening to central bank communication. This is why we would prefer, in principle, increases in volatility rather than only changes in volatility. Still, a reduction in volatility could imply that speeches calm markets in a very uncertain period.

Results in Table 1 below confirm the hypothesis that money markets listen to the PBoC speeches in as far as conditional volatility increases in a very significant way right after speeches are delivered. This is especially true for the (most liquid) one-day maturity of the money markets during the initial hawkish period from October 2006 to October 2008. However this result does not carry over to the one-week (and two-week) SHIBOR rate(s) where volatility does not respond in a significant way. It should be noted though that the one-week SHIBOR market suffered a sharp reduction in liquidity during that period as shown in Figure 1 above. In the most liquid money market (the one day), the positive coefficient of conditional volatility is significant even at the 1% level. The sum of the coefficients of the five days after the speech is also positive for the one-day maturity. In other words, the information received by money markets seems to continue in the five days after the speeches are issued.

During the crisis and hawkish periods, from October 2008 to April 2010, the volatility of the one-day SHIBOR is reduced – and not increased - in a significant way right after a speech from PBoC senior officials. In the hawkish period, it actually increases during the next five days following such release. In other words, any hawkish statement from the PBoC during this new boom period actually seems to immediately calm the money market and only increase its volatility thereafter.

Table 1. Effect of MPC speeches on the conditional volatility of the SHIBOR rate for one-day to six-month maturity.

SHIBOR	**12 Oct 2006- 7 Oct 2008**	**8 Oct 2008- 7 Oct 2009**	**8 Oct 2009- 27 April 2010**
1 Day			
$SPEECH_t$	0.60***	-0.064***	-0.038***
Σ SPEECH $_{t\text{-}1 \text{ to } t\text{-}5}$	1.22***	-0.26***	0.015***
1 Week			
$SPEECH_t$	0.29	0.118	-1.28
Σ SPEECH $_{t\text{-}1 \text{ to } t\text{-}5}$	-0.24**	0.45	1.44
2 weeks			
$SPEECH_t$	-0.029	-0.432	0.127
Σ SPEECH $_{t\text{-}1 \text{ to } t\text{-}5}$	0.35	1.14	-0.85
1 Month			
$SPEECH_t$	-0.504	-0.0034*	0.956***
Σ SPEECH $_{t\text{-}1 \text{ to } t\text{-}5}$	(-1) 0.574***	0.013***	2.60***
6 Months			
$SPEECH_t$	-0.49***	-0.304***	2.45E08***
Σ SPEECH $_{t\text{-}1 \text{ to } t\text{-}5}$	0.040	1.43***	5.11E08***

This corresponds to equation (2) where we do not report the coefficients of control variables, and which is estimated jointly with equation (1).

First difference of SHIBOR in all cases in the mean equation. The table presents the response on the same day (first two of each panel) and the sum of the coefficient of speeches over the previous five days (second row). The (SPEECH) dummy takes a value of one when a speech with substance occurs and zero when there is no speech or a speech with no directional intent EGARCH estimation with Generalized error distribution.

** significant at the 5% level (resp (10%) on the basis of the z-statistics

As for the control variables, only the releases of macroeconomic data and the IPO variable are significant.
The macro announcements seem to reduce volatility, which could be understand as the market generally not been negatively surprised by the releases of such data.

Robustness tests: Realized volatility

Realized volatility should be a more accurate measure than conditional volatility. However, it requires intraday data, which only exists for two maturities of SHIBOR: one week and one month, with 16 observations per day. We, thus, compute realized volatility using the daily sum of squared changes in quotes of money market rates, as in Andersen et al. (2003). We then replicate the estimation of equation (2) on realized volatility, with an autoregressive specification of order five. As before, the results show a statistically significant impact of PBoC communication on volatility, (Table 2). The direction of change in volatility differs in some instances but, all in all, the results are relatively similar.

Table 2. Realized volatility of one week and one month SHIBOR.

SHIBOR	**12 Oct 2006- 7 Oct 2008**	**8 Oct 2008- 7 Oct 2009**	**8 Oct 2009- 27 April 2010**
1 Week			
$SPEECH_t$	0.03	0.000001	-0.01**
Σ SPEECH $_{t-1 \text{ to } t-5}$	-0.13**	0.003**	0.03**
1 Month			
$SPEECH_t$	-0.011**	0.00002	-0.00001
Σ SPEECH $_{t-1 \text{ to } t-5}$	0.054**	0.00001	0.03**

The estimated equation conditions realized volatility on all the variables listed in equation (2), and keeps only the significant ones. The table presents the response on the same day (first row of each panel) and the sum of the coefficient of speeches over the previous five days (second row). The (SPEECH) dummy takes a value of one when a speech with substance occurs and zero when there is no speech or a speech with no directional intent.

** significant at the 5% level (resp (10%) on the basis of the z-statistics. This corresponds to a stochastic equivalent of equation (2) with five autoregressive lags, where we do not report the coefficients of control variables.

The finding that speeches do influence volatility implies that PBoC oral communication does convey relevant information to market participants. However this does not tell us whether speeches can also move markets in the intended direction. In order words, we still do not know whether money markets understand the PBoC.

Do money markets understand the PBoC?

We regress the mean of the SHIBOR rate for its different maturities on PBoC speeches (following equation 1 above). To that end we use the five-category variable constructed to summarize the directional intent and intensity of speeches (SPEECH2).

We generally find highly significant and generally positive coefficients for the SHIBOR when a speech is delivered and during the five days thereafter (Table 3). In other words, the more hawkish the speech, the larger tends to be the rise in the SHIBOR. In the case of the most relevant maturities (i.e., the most liquid ones), the one day SHIBOR behaves as described but also the second most liquid (i.e., the one week). The exception is the last subperiod where the mean interest rate tends to fall after a hawkish statement. This might be due to the excessive liquidity which may be distorting the functioning of the money market.

Table 3. Effect of five-category coded speeches on mean of SHIBOR rate for one-day to six-month maturity.

SHIBOR	**12 Oct 2006- 7 Oct 2008**	**8 Oct 2008- 7 Oct 2009**	**8 Oct 2009- 27 April 2010**
1 Day			
$SPEECH2_t$	0.0227***	0.0015**	0.0013**
Σ $SPEECH2_{t-1 \text{ to } t-10}$	0.035**	0.0063**	-0.0016**
1 Week			
$SPEECH2_t$	0.015**	0.011***	-0.028**
Σ $SPEECH2_{t-1 \text{ to } t-5}$	0.015***	-0.03***	0.038**
2 weeks			
$SPEECH2_t$	0.0019***	0.0048***	-0.0083***
Σ $SPEECH2_{t-1 \text{ to } t-5}$	0.016***	0.0004	0.0227***
1 Month			
$SPEECH2_t$	-0.004	0.0012***	0.0015***
Σ $SPEECH2_{t-1 \text{ to } t-5}$	0.015***	-0.0042***	-0.0007***
6 Months			
$SPEECH2_t$	1.50E06***	0.0021*	2.45E08***
Σ $SPEECH2_{t-1 \text{ to } t-5}$	-1.17E05***	-0.0102***	5.11E08***

This corresponds to equation (1) where we do not report the coefficients of control variables (except for the one-day maturity in Appendix 3), and which is estimated jointly with equation (2). First difference of SHIBOR in all cases in the mean equation. The table the sum of the coefficient of speeches over the previous five days, with speeches coded in the SPEECH2 dummy as (-2) for sharply dovish, (-1) when mildy dovish, (0), neutral, hawkish (+1) and (+2) very hawkish. EGARCH estimation with Generalized error distribution.

** significant at the 5% level (resp (10%) on the basis of the z-statistics. See equations (1) and (2).

As for the control variables, the PBoC's increase in the net bill issuance positively affects the SHIBOR during the crisis period but the opposite is true thereafter. This, again, might be related to the distortionary effects of excess liquidity in China's money market. Finally, the fact that the PBoC releases a statement tends to increase the SHIBOR in two of the three subsamples considered. The announcements of macroeconomic data and IPOs are not significant in this equation.

Finally, as a robustness test, we look into a simpler measure of the tone of PBoC announcements for the relevant maturities (i.e., with the highest liquidity). We, thus, use the more-simple three-pronged coding (SPEECH1) as in Ehrmann et al. (2007). The results are confirmed as the mean coefficient of the SHIBOR also proves to be mostly positive and significant for the one-day maturity over the first two subsamples (Table 4). The great advantage of this alternative coding is that it enables us to compare our results with similar empirical literature dealing with other major Central banks.

Our results as presented in Table 4 point to speeches increasing SHIBOR by up to 1.2 basis points on the same day for the one-week maturity during the initial hawkish (Oct. 2006- Sept.

2008) period as well as during the dovish one (Oct 2008- Oct 2009). When compared with that found for other central banks – in particular the ECB – such reaction of the money market rate is quite significant. In fact, the PBoC seems to be in the same league as the ECB at least when comparing our results with previous estimates, in particular Ehrmann et al. (2007).

Table 4. Effect of three-category coded speeches on the mean of SHIBOR rates for one-day to one-week maturity.

SHIBOR	**12 Oct 2006- 7 Oct 2008**	**8 Oct 2008- 7 Oct 2009**	**8 Oct 2009- 27 April 2010**
1 Day			
$SPEECH1_t$	0.0021***	0.0058***	0.00131***
$\Sigma SPEECH1_{t-1 \text{ to } t-5}$	0.0035***	0.0167***	-0.0016***
1 Week			
$SPEECH1_t$	0.0121***	0.0124***	-0.022***
$\Sigma SPEECH_{t-1 \text{ to } t-5}$	0.012*	-0.024	0.044***

First difference of SHIBOR in all cases in the mean equation. The table the sum of the coefficient of speeches over the previous five days, with speeches coded in a SPEECH1 dummy as (-1) when dovish, (0), neutral and (+1) hawkish. EGARCH estimation with Generalized Error Distribution.

** significant at the 5% level (resp (10%) on the basis of the z-statistics.. This corresponds to equation (1) where we do not report the coefficients of control variables, and is estimated together with equation (2).

5. Conclusions

This paper shows evidence of an efficient PBoC communication in the money market. Our sample covers the last three and a half years, which are a very interesting period for China for two reasons. First, the monetary policy stance changed substantially before, during and after the global crisis; and, second, the SHIBOR market was introduced just at the beginning of our sample to act as a new benchmark for China's money market. We first provide evidence that the money markets listen to the PBoC in as much as volatility tends to increase on the very day of PBoC speeches. The results are robust to using alternative volatility measures. This result found for the PBoC is in line with those previously found for the US, the UK, and some other O.E.C.D. countries (Kohn and Sack, 2004; or Connolly and Kohler, 2004; and Reeves and Savicki, 2007).

In a second step we address a more difficult question, namely whether money markets understand the PBoC's messages in its speeches. In particular we test empirically whether money markets understand the stance of monetary policy which the PBoC intends to convey in its speeches. To that end, speeches are quantified using a coding according to their likely intention (from the most hawkish to the most dovish). We find that SHIBOR rates, in particular the most liquid ones (one day but also one week), respond to PBoC's speeches in

the intended direction. In other words, SHIBOR rates tend to increase after a hawkish speech, other things given. The opposite is true for dovish speeches.

We, thus, conclude that Chinese money markets understand the directional intent of PBoC members' speeches. Moreover, the magnitude of such effects seems comparable to that of other similar central banks. In particular, the coefficient we find for the response of interest rates to PBoC speeches appears to be as large as that of the ECB as found by Ehrmann et al. (2007).This could be interpreted as the PBoC's oral communication now becoming as effective as that of its peers in the community of central banks of large monetary areas.

Appendix 1: Descriptive statistics on SHIBOR

Table A1: Descriptive statistics for SHIBOR rates across maturities.

SHIBOR	1-day	1 week	2 weeks	1 month	6 months
10 Dec 2006- 7 Oct. 2008					
Mean	2.24	2.86	3.22	3.40	3.75
Std. dev	0.60	0.98	1.13	0.88	0.75
Skewness	3.01	2.43	2.98	2.45	-0.04
Kurtosis	26.61	14.1	20.3	11.5	1.19
8 Oct. 2008- 7 Oct 2009					
Mean	1.18	1.44	1.47	1.55	2.10
Std. dev	0.52	0.67	0.68	0.68	0.96
Skewness	1.54	1.38	1.31	1.34	1.65
Kurtosis	4.24	3.76	3.61	3.59	4.17
8 Oct 2009- 27 Apr. 2010					
Mean	1.26	1.56	1.62	1.76	1.95
Std. dev	0.18	0.18	0.16	0.06	0.06
Skewness	3.48	2.94	2.02	2.05	0.10
Kurtosis	21.3	17.1	11.8	8.34	1.31

Appendix 2 : Unit root tests

We use the General Least Squares version of the Phillips-Perron (1988) unit root tests, suggested by Ng and Perron (2001), MZa and MZt, where the null hypothesis is the presence of a unit root. In order to maximize power, such tests rely on the a Generalized Least Squares detrending technique as presented in Elliott (1999), and employ a new autoregressive-lag truncation parameter aimed at minimizing size distortion, based on a Modified Akaike Information Criterion (MAIC). We also use the Elliott et al (1996) unit root test. Besides, we use the Kwatkowski et al (1992) test with stationarity as the null hypothesis.

The hypothesis of a unit root is rejected with the Ng and Perron test for SHIBOR rates with maturity one day, one and two weeks over the samples 2006-2008 and 2009-2010, as well as for the one-month maturity over the former sample (Table A2, col. 2). In all other cases the presence of a unit root is accepted. With the Elliott et al test, the unit root is rejected for all maturities except the six-month one in the first subsample, but is accepted for all maturities in the second sample (Table A2, col. 1). Finally in the last subsample a unit root is accepted for the shortest and longest maturities but rejected for the one-week to one-month ones. The Kwaitkoski et al. test rejects the null of stationarity in all cases (Table A2, col. 3).

Table A.2. Stationnarity and unit-root tests.

SHIBOR (sample)		**Elliott et al.**	**Ng and Perron (MZa)**	**Kwatkowski Et al.**
1 Day	(1)	0.48***	-79.0***	0.72°°
	(2)	111.9	-0.07	0.69°°
	(3)	5.62	-5.95*	0.40°
1 Week	(1)	0.59***	-77.6***	0.84°°°
	(2)	116.7	-0.08	0.68°°
	(3)	1.42***	-18.4***	0.65°°
2 Weeks	(1)	0.42***	-98.2***	0.71°°
	(2)	137.4	0.07	0.64°°
	(3)	1.59***	-10.43***	0.46°°
1 Month	(1)	1.10***	-12.2***	0.78°°°
	(2)	179.8	0.12	0.72°°
	(3)	3.77*	-4.64	0.52°°
6 Month	(1)	460.0	0.86	2.72°°°
	(2)	291.6	0.38	1.11°°
	(3)	234.4	1.38	1.31°°°

***Unit root is rejected at the 1% level (** : 5%; *: 10%).
°°° Stationarity rejected at the 1% level (°°: 5%; °: 10%). Sources of Critical values :
Elliott et al (1996): Ng and Perron (2001), Kwiatkowski et al. (1992)
Subsamples: . (1) 10/12/2006-10/07/2008; (2) 10/08/2008-10/07/2009; (3) 10/08/2009-04/27/2010.

Appendix 3: The effects of control variables on one-day SHIBOR (only significant variables reported)

Table A.3: Coefficients of control variables in the model for one-day SHIBOR.

Mean	**10 Dec 2006- 7 Oct. 2008**	**8 Oct. 2008- 7 Oct 2009**	**8 Oct 2009- 27 Apr. 2010**	**Variance**	**10 Dec 2006- 7 Oct. 2008**	**8 Oct. 2008- 7 Oct 2009**	**8 Oct 2009- 27 Apr. 2010**
Σ AR(p)	0.168*** (p=12)	0.14*** (p=9)	0.549*** (p=10)	a_0	-2.38***	-4.76***	-4.93***
W_1 (Monday)	-0.004***						
W_3 (Wednesday)	-0.0016***	-0.0014***	-0.0037***	γ	0.733***	0.107***	0.009***
W_5 (Friday)	-0.0041***	-0.0013***	-0.0033***	α	- 0.322***	-0.67**	0.05***
M	0.014***			λ	0.45***	0.302***	0.196***
CN Year	0.275***						
CNYear+1	-0.057***			SPEECH	0.59**	-0.064***	-0.0038*
BILL		0.002***	-0.004***				
MPC	0.025***	-0.007***	0.0013***	Σ SPEECH (t-1 to t-5)	0.22***	-0.26***	0.015***
SPEECH2	0.0227**	0.0014***	-0.0016***	MACRO	-0.09***	-0.05***	-0.02***
Σ Speech2 (t-1 to t-10)	0.041***	0.0063**	0.0154**	IPO	0.000002***		
Log (h_t)	-0.019***	-0.023***	-0.395***	M	0.40***		
GED 1/	0.32***	0.328***	0.247***				
L lik.	595.1	694.3	445.2				
AIC	-2.23	-5.25	-5.85				
SC	-1.80	-4.71	-5.05				
HQ	-2.06	-5.03	-5.53				
Q(15)	13.5 [0.19]	12.0 [0.67]	18.4 [0.24]				
$Q^2(15)$	6.00 [0.98]	0.16 [0.99]	2.38 [0.99]				
ARCH-. LM	0.14 [0.70]	0.003 [0.95]	0.17 [0.67]				

In all cases SHIBOR is in first difference. The first three columns correspond to the estimation of equation (1) and the last three to equation (2). Variables are defined as in these equations.
1/ EGARCH-M model with Generalized-error distribution (GED).
** significant at 5% (* 10%) on the basis of the z-statistics; [p-value]

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