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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. How much the market listens and, possibly, understands the People's Bank of China (PBoC) should be a key question for the central bank in modernising its monetary policy toolkit. In this paper, we tackle this issue empirically and find that China's money markets not only listen to the PBoC's words but understand the tone of monetary policy which the PBoC intends to convey in its messages. First, we find that the volatility and volume of money market rates change right after communication from the PBoC's governing body. Second, we find a statistically significant rise in interbank rates following communication with a hawkish tone. All in all, our results show strong evidence of effective oral and written communication by the PBoC aimed at China's money markets.

Keywords: China Monetary Policy Communication, Money Market

JEL Classification: E52, E58, E43

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1. Introduction

Central bank communication has become a key issue for monetary policy, beyond the traditional monetary targets and instruments. The economic literature has dubbed this dual dimension of modern monetary policy with two concepts, namely *words* versus *deeds*. *Words* refer to the external announcement made by a central bank governing body, either in terms of speeches or written statements, while deeds involve actions taken by the central bank through market and non-market based instruments.

Communication by monetary authorities has grown in importance hand in hand with financial liberalization. The literature, as thoroughly surveyed by Blinder et al. 2008, has highlighted that central bank communication in developed financial systems helps to make monetary policy more predictable. This is because the final goal of central bank communication is managing financial market's 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 with which to conduct monetary policy than a proof of transparency.

In the 1990s, central banks in many developed countries tried to improve communication through different means depending on their target audience, be it the public or financial markets. Central banks now publish their own assessment of the economic outlook and sometimes even hint at future monetary policy action (BIS, 2009; Filardo et al., 2008).

China's monetary policy has gradually been moving towards that of developed countries not only in terms of *deeds* but also *words*. In fact, the People's Bank of China (PBoC) introduced short-term interest rates as an operational target in the late 1990s and began publishing statements summarizing the meetings of its Monetary Policy Committee (MPC) in 2001. Its governing body has also become much more active in delivering speeches on monetary policy issues and the outlook for the Chinese economy.

The PBoC's statements and speeches point to a much more transparent central bank but they are not enough to assess how *predictable* the PBoC is in communicating its messages to the financial markets. In fact, a central bank can be extremely transparent but markets may not bother to *listen* to the central bank. It may also be that markets do listen but do not *understand* the messages. In other words, the ability 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.

In addition to increasing predictability, central bank communication may have a different objective in the case of China, namely effectively *steering* financial markets by having a tangible impact on them. China still has a relatively underdeveloped financial market with controlled interest rates and tight capital controls. In addition, quantitative instruments such as reserve requirements and even credit

targets are still actively used, as well as window guidance. The active use of the latter as a quick way to implement China's large stimulus package during 2008-09 clearly illustrates this point.

Within this framework, the PBoC communication may be a very good reflection of the monetary policy stance, given the unobserved nature of many of the monetary policy instruments. In other words, 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 only deeds. Such communication would raise the signal-to-noise ratio, providing market participants with news on unobserved monetary policy decisions and limiting the guess work on the part of the public.

All of these arguments call for attaching great importance to central bank communication in China's case. Yet hardly any research has been conducted to date. The only instances to the best of our knowledge are Ng and Shu (2010) and Xiang (2011), where central bank written statements are used, in a low-frequency study, to better understand the determinants of monetary policy in China. The focus in our case, as will be explained later, is the impact of communication on financial markets.

Our paper extends the coverage of communication by recording all the speeches delivered by PBoC's governing body, which enables us to construct a higher frequency (daily) indicator of the PBoC "words" since the mid 2000s. Given that such "words" are a complement to the "deeds" (i.e., the monetary policy instruments) in the Chinese case, our indicator could serve as the basis for a high frequency indicator of China's monetary policy stance, with multiple potential uses beyond the one favoured in this paper.

When analyzing the impact of central bank communication, it is important to decide which market to focus on in order to measure the impact. A logical place to start is in the upstream part of the transmission mechanism, namely the over-night money market. It is only if this segment of the money market is affected that we can credibly expect longer maturities to be impacted. This is even more true in the case of China where the money market is the most developed segment of financial markets and, at the short end, the most liquid.

The objective of this paper is to assess whether the PBoC "words" have an impact on financial markets beyond "deeds". To that end, we first investigate whether China's money markets "listen" to the PBoC's messages and, possibly, whether they "understand" them. Following the literature, we interpret "listening" as the central bank's ability to "steer" the markets when making a verbal or written statement. The usual way to measure this is to assess empirically whether the volatility of financial markets changes following a PBoC statement. Our results show statistically significant changes in the volatility and trading volume of money market rates after PBoC communication is released.

Whether financial markets understand the PBoC is a much more demanding question which requires a different empirical strategy. In fact, we need to differentiate across PBoC messages in terms of their monetary policy stance and see whether money markets react to an announced stance in the

right direction. We find strong evidence to suggest a good understanding of the PBoC statements, measured by money market rates increasing immediately after a hawkish statement from the PBoC and the other way round (reduction in rates after dovish statements).

Our study presents two main innovations: first, it constructs a comprehensive high–frequency measure of PBoC communication, based on our own recording of PBoC speeches and statements. Given the complementaries we find between communication and the monetary instruments for the PBoC, our indicator can go beyond measuring communication to being part of a full-fledged proxy for the monetary stance. Such a high frequency measure of China's monetary stance should be extremely useful for any analysis of monetary policy and financial markets.

The second innovation is to better measure the response of financial markets by extending the focus beyond prices towards trading volumes. In fact, the volume of the money market trading appears to be strongly sensitive to PBoC communication. Together with the effect of volume on the volatility of the money market itself, this points to a substantial impact of PBoC communication of the money market, which is generally disregarded in the communication literature. Our finding points to attaching more importance to microstructure channels when analyzing the effects of communication.

The paper is structured as follows. Section 2 reviews the related literature and describes the paper's objective in detail. Section 3 presents our methodology as well as data compilation, with particular attention to our measure of central-bank communication. It also lays out some stylized facts on China's money markets. Section 4 shows our empirical results and interpretation. Finally, Section 5 draws policy conclusions.

2. Central-Bank Communication and Interbank Markets: A Concise Look at the Literature

The existing economic literature on communication shows (Blinder et al. 2008) how central bank communication enhances the predictability of monetary policy in well functioning financial systems with rational expectations, no frictions, and symmetric information. In such a stationary economic environment, where the central bank is credibly committed to a policy rule, central-bank communication has no independent role to play. 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).

Any departure from the above assumptions should make central-bank communication relevant for policy action. This 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.

It seems quite clear that many economies in the world suffer from information asymmetries and other imperfections, which explains the increase in 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 developed countries, they have been neglected in the case of emerging markets. 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 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 assessing whether such communication works. Namely, changes in the volatility of asset prices following central-bank communication are identified. Fleming and Remolona's (1999) study is an early example, which goes much beyond many others by studying the response of trading volumes – and not only the volatility of prices – to communication.

As for the expected sign, the literature, including Fleming and Remolona (1999) has long understood that increases in the volatility of asset prices should be expected as a confirmation of markets listening to the central bank. The underlying idea is that central bankers' messages convey new information which tends to move markets. More recently, however, a reduction in volatility has been interpreted as a sign that central bank communication can calm markets. Geraats (2002) explains this phenomenon in terms of the degree of uncertainty before the central bank speaks and also the clarity of its speech. She argues that central banks may confuse markets (increasing volatility) or clarify the situation (reducing volatility).

As for the measure of Central Bank communication, most studies use a dummy variable identifying the moment at which statements (and sometimes speeches) are published. Very few studies go further to identify the tone of the speech in terms of the expected monetary policy stance. The best example is Ehrman and Fratzscher (2007) which focuses on the ECB and the FED.

As far as we are aware, there is no existing empirical analysis on the effectiveness of the PBoC communication on financial markets. There are, however, two studies – by Ng and Shu (2010) and Xiong (2012) – which construct an index of monetary policy based on central bank written statements to investigate the determinants of the monetary policy stance. The authors code the PBoC statements use this summary variable to estimate a Taylor Rule (Taylor, 1993) with quarterly data. They find that the rule works better than if based on interest rates only, and conclude that "words" help "deeds" in terms of explaining China's monetary policy.

Although not directly related to communication, there are a number of papers on the effects of China's monetary policy on money markets. Li and Zou (2008) find increased volatility and correlation between stock and bond prices during periods of restrictive monetary policy. In the same vein, Fan and Johansson (2010) analyze the effects of changes in official interest rates on the yield curve. Fan and Zhang (2006 and 2007) do the same for term premia in the repo market.

There are three relevant studies on the functioning of China's money market. The first, by Porter and Xu (2009), models competitive profit-maximizing and price-taking commercial banks which target the holding of excess reserves with the central banks. These banks face a number of regulated prices: deposit and lending rates, required-reserve ratios, 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. In their empirical strategy, Porter and Xu (2009) (see also Qi and Zhang, 2010) make the level of the interbank interest rate depend on 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 reason for including this last variable is the liquidity lock up in the banking system one week prior to an IPO; other studies have found it to be significant (Dong and Zheng, 2010).

The second by Chen et al. (2011) extends the model by Porter and Xu (2009) to illustrate how the interbank and retail lending are determined in an environment where deposit and lending rates are regulated. The authors find that the impact of monetary policy on interbank rates and bank loans depends on whether regulated rates are above or below the respective unobserved equilibrium levels, defined as the rate in the absence of any regulation.

The third and final paper by He and Wang (2012) extends previous theoretical models by deepening the analysis on the effects of financial repression. They show that a rise in the deposit rate ceiling generates a rise in market rates only when the ceiling is binding. In the same vein, changes in the reserve requirement ratio and issuance of central bank bills have an impact, but not the floor of the lending rate.

3. Methodology and Data

In order to assess empirically the impact of communication on China's money markets, we consider a number of issues. First, as previously mentioned, we differentiate between "listening" and "understanding" by studying separately the effects on volatility and mean interest rates. Second, we investigate direct effects (measured by prices) as well as indirect effects through volumes which have been neglected in the literature. This enables us to account for microstructure effects as well. We carefully choose our data to represent the most active and liquid segment of the Chinese money market, namely the overnight repo market.

3.1 Methodology

To evaluate the impact of PBoC communication on China's money markets, we adopt an encompassing approach using estimates of the mean and volatility equations of the repo overnight rate. As a first step, we focus on whether money markets listen to the PBoC by assessing empirically whether central bank communication influences the *volatility* of financial variables as in Connolly and Kohler (2004) and Ehrmann and Fratzscher (2007). The underlying hypothesis is that the volatility of asset returns should change in as far as there is new – and relevant – information being distributed, *everything else equal*. A more debatable issue is whether volatility should increase or decrease. This depends on the degree to which new information surprises the markets or calms them. This may depend, in turn, on the uncertainty of the environment prior to an announcement by the central bank. We estimate the impact of communication on the volume of the overnight repo market as an indirect channel affecting volatility.

Measuring volatility has always been a challenging task for financial economists. Previous literature modeling the impact of communication on volatility in the money market has mostly focused on conditional volatility models following a GARCH framework (Blinder et al. 2008). However this only considers the difference in the closing money market rates. In this paper, we go deeper in measuring volatility by using the logarithm of the price range, defined as the difference between the highest and lowest interest rate. The range is a superior volatility proxy to absolute or square returns (Alizadeh, Brandt and Diebold, 2002; and Brandt and Diebold, 2002) since it takes into account the intraday sample path. The range is also less subject to microstructure noise than realized volatility (as championed by Andersen et al. 2001). Furthermore, the logarithm of the range is a preferable measure to the simple range because it filters out outliers (Brandt and Diebold, 2002).

In a second step, we test whether money markets understand the PBoC's words, following Ehrmanm and Fratzscher. (2007). This means that we assess whether our index of the monetary policy stance, based on the PBoC words, affects the mean repo rate in the intended direction. In other words, we investigate whether hawkish (dovish) communication led to an increase (decrease) in the repo rate. Such an exercise obviously introduces a degree of subjective judgment and therefore possible measurement error.

Beyond monetary policy communication, we need to control for the key variables which may affect China's money market. The PBoC instruments, which constitute the *deeds* of monetary policy, are the most important controls since we aim to assess the complementary of words and deeds when conducting monetary policy. In addition, following Porter and Xu (2009), we also include relevant time-series controls, such as seasonality and any relevant ad hoc events.

Regarding monetary policy instruments, we include changes in as many as four different types of interest rates given that they are all tightly controlled. These are the deposit rate (ΔDR), the lending rate (ΔLR), the interest rate on excess reserves (ΔER) and that on required reserves (ΔIR). Quantity

based monetary instruments are also included, such as the amount of net bill issuance by the PBoC (BILL), and the announced changes in the required-reserve ratio (ΔRRA). These are preferred to the actual changes since they are likely to pick up unexpected information.

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) prior to an IPO. Finally, we allow for calendar effects such as end-of-week (W), end-of-month (M) and Chinese holiday effects. We specify the latter as a dummy on the eve of the public holidays (PH_n), as well as on the first day of trading ($PH1_n$) after the vacations. We consider three public holidays in China, i.e. the Lunar-New-Year (n=NY), the National-Day (n=ND) and May-Day (n=MD) vacations. Finally, we control for key data releases, namely GDP and CPI announcements with a dummy (MACRO) which takes a value of one on days of GDP growth or inflation releases, and zero otherwise.

Based on all the issues above, we model the repo rate in two ways: the volatility equation (1) and the mean equation (5). We also estimate a volume equation (3), to investigate the possibility of an indirect channel for PBoC communication to affect the money market.

The volatility equation addresses whether money markets listen to the PBoC, using the log range of the overnight repo rate as a proxy for volatility. We model the heteroscedasticity of the residuals using a GARCH model.[1] Controlling for the above determinants, the logarithm of the range of the repo rate may be explained as stated below:

$$\ln(range)_t = a_0 + a_1 \ln(range_{t-1}) + a_2\ A\Delta RRA_t + a_3\ A\Delta LR_t + a_4\ A\Delta DR_t + a_5\ ABILL_t + a_{6j}\ W_t + a_7\ M_t + a_8\ PH_{nt} + a_9\ PH1_{nt} + a_{10}\ IPO_t + \sum_{j=0}^{4} a_{11j}\ COM_{t-j} + a_{12}\ MACRO_t + a_{14}\ln(VOLUME)_t + (h_t)^{1/2}\nu_t \quad \textbf{(1)}$$

with

$$(h_t) = a_0 + \beta\ (h_{t-1}) + \alpha\ (\nu_{t-1})^2 \quad \textbf{(2)}$$

where the α coefficient is for the ARCH term, and β the GARCH term, while ν_t is a unit-variance, serially uncorrelated, zero mean, i.i.d., error term. Finally, the letter A before some of the control variables stands for absolute value. As an example, AΔRRA stands for the absolute value of the announced change in the required reserve ratio. We note COM the communication variable to be detailed later. Due to the ubiquitous 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, or the student t distribution (Hansen, 1994), when appropriate.

An extensive series of work in financial economics provide evidence of a positive correlation between contemporaneous trading volume and volatility. This positive correlation was rationalized initially by Clark (1973), who put forward the Mixture of Distribution Hypothesis (MDH), with further refinements provided by Epps and Epps (1976), Tauchen and Pitts (1983) and Harris and Raviv (1993). The MDH assumes that asset price movement and trading volume are both determined by an unobservable flow of information. In line with the mixture of distribution hypothesis, we thus include daily volume as a potential determinant of volatility.

We now specify the model to estimate the impact of PBoC communication on the transaction volume of the repo market. In this way, we can investigate whether there is an additional indirect effect of communication on the repo market. We use the log of the daily volume of the overnight repo market (V) controlling for the above determinants as shown below:

$$\ln (V_t)= b_0 + b_1 \ln(V_{t-1}) + b_2\ A\Delta RRB_t + b_3\ A\Delta LR_t\ + b_4\ A\Delta DR_t + b_5\ BILL_t + \ b_{6j}\ W_t + b_7\ M_t + b_8\ PH_{nt} + b_9\ PH1_{nt} + b_{10}\ IPO_t + \sum_{j=0}^{4}\ b_{11j}\ COM + b_{12}\ \ MACRO_t + \ (h_t)^{1/2}\nu_t \quad \textbf{(3)}$$

with

$$\ln (h_t)= a_0 + \beta\ \ln(h_{t-1})+ \alpha\ |\nu_{t-1}\ /(\ h_{t-1})^{1/2}|+ \lambda\ [\nu_{t-1}\ /(\ h_{t-1})^{1/2}] \quad \textbf{(4)}$$

where the same notations and specification are used as in equations (1) and (2).

In the conditional variance equation, a negative shock is allowed to exert a larger impact than a positive shock, as in Nelson's (1991) Exponential-GARCH model.

Lastly, to assess whether money markets understand the PBoC, we model the change in the repo rate, to be explained by PBoC words as well as deeds and other control variables, as shown below:

$$\Delta i_t= c_0 + \textstyle\sum_{j=1\ to\ p}\ c_{1j}\ \Delta i_{t-j} + c_{2j}\ COM_t + c_3\ \Delta RRC_t + c_4\ \Delta LR_t\ + c_5\ \Delta DR_t + \ c_6\ \Delta IR_t + c_7\ BILL_t + \sum_{j=0}^{5}\ \ c_{8j}\ W_{jt} + c_9\ M_t + c_{n10}\ PH_{nt} + c_{n11}\ PH1_{nt} + c_{12}\ IPO_t + c_{13}\ \ MACRO_t + (h_t)^{1/2}\nu_t \quad \textbf{(5)}$$

with

$$(h_t)= a_0 + \beta\ (h_{t-1}) + \alpha\ (\nu_{t-1})^2 \quad \textbf{(6)}$$

[1] Asymmetry, as in a Exponential-GARCH model à la Nelson, 1991, did not prove significant.

with the same notations as in equations (1) and (2). A GARCH model was used since no evidence of asymmetry was found in the conditional variance of the change in the repo rate.

Our estimated equation is in changes, rather than levels, due to evidence of non-stationarity. This contrasts with Porter and Xu (2009) which makes our results not fully comparable. Unlike He and Wang (2012), we allow for autoregressive coefficients to correct residual autocorrelation.

3.2 Data

There are two potential problems when evaluating the effectiveness of central bank communication. One is a sample-selection problem and the other one is measurement error. The former is more likely to occur when oral communication is measured by an intermediary, namely newswire reports and not at source. While newswire are the source used in the existing literature (see Jansen and De Haan, 2005 and Ehrmann and Fratzscher 2007), we try to reduce the potential sample-selection problem by checking two different sources of PBoC speeches: the DOW JONES FACTIVA database and the LexisNexis one. The latter problem of measurement error is related to the way speeches are coded. To reduce the subjective bias associated to our classification, the recording of speeches was conducted independently by two researchers, and we use two different types of codification of statements, as will be explained later.

For the speeches, we focus on the governor of the PBoC, Mr. Zhou Xiaochuan, and a prominent academic member of the MPC during our sample: Dr. Fan Gang. There are several reasons for focusing on these two. First of all, they have clear responsibility for monetary policy. Second, the governor and Fan Gang are the MPC members who have delivered most speeches. Third, they were part of the MPC for our whole sample period (bar the last month in the case of Dr Fan Gang) so we do not need to deal with different personalities.

After screening thousands of reported speeches, we keep 209 by the Governor and 50 by Dr. Fang Gang. The others are not related to monetary policy issues or China's economic outlook. Each speech is selected only once, on the basis of its first recording. We construct three variables. The first is a dummy which takes the value of 1 on the day the speech is issued, and zero otherwise (COM1). The second and third characterize the speech based on its information content. Both variables take a higher value the more hawkish the speech and a lower value the more dovish the speech.

As mentioned, we prefer to have two different directional measures of the monetary policy stance so that we can reduce the measurement bias intrinsically related to coding communication. The first one is a discrete variable (COM3) with three possible values: 1 (hawkish), 0 (neutral) or -1 (dovish). The second, also a discrete variable (COM5), 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), and examples are provided in Appendix 4 for each of the five categories. The latter follows Rosa and Verga (2007) and Musard-Gies (2006), inverting the classification pioneered by Boschen and Mills

(1995). Overall we have 165 speeches with a non-zero coding. In order to construct an encompassing measure of communication, we code written quarterly statements by the PBoC in a similar way to speeches and include in our overall measure of communication (COM dummies) the 17 statements expressing a policy stance**.** It did not prove possible to examine the separate effects of speeches and written statements since the latter frequently occur either on the same day or on an adjacent day to speeches (especially over the 2006-2008 period), but we also report the results with the speech-only dummy (SPEECH).

As for the endogenous variable, namely the money market rate, we opt for the repo rate which is the benchmark for money market participants.[2]. We attempted to use the Shanghai Interbank Offered Rate (SHIBOR), obtained in a fixing procedure similar to the LIBOR, since it is based on a more liquid market than the cash one (the China Interbank Offered Rate, CHIBOR), and because it is based on actual trades. However, liquidity in the SHIBOR is not deep enough for it to be regarded as a good signal of the functioning of money markets.

We focus on the collateralized ('Buy Out') repo market, since the uncollateralized part is a narrow and recent market. The repo market involves eleven maturities, from overnight, to one and two weeks, as well as one, two, three, four, six, nine and twelve months (Thornston, 2007; Xu, 2007). The relevance of the different maturities can be gauged by examining turnover on the collateralized repo market. As shown in Figure 1, the bulk of volume for such a repo market is concentrated in the low end of the maturity spectrum[3]. Moreover, since the mid 2000s, the one-day turnover is much higher than one-week turnover (previously, as in April 2004, their respective ranking was inverted, with 27 and 46 % respectively), and this is increasingly true over the last two years of our sample while the share of other maturities has become negligible. Accordingly we will focus our subsequent analysis only on the shortest, namely the overnight, repo rate (excluding the observations during weekends and holidays). This will also ensure that our estimates do not suffer from an overlapping observation bias since the frequency of our data is also daily.

The high and low daily quotes of the one-day repo used to compute the range are extracted from RESSET. The same is true for the daily volume of the one-day repo market. However, the source of the daily close data is CEIC, which is also used for the control variables.

The period just after the start of the global crisis was characterized by a drop in volatility to levels not seen since the mid 2000s (Figure 2). By contrast, since the Summer 2008, daily volume (Figure 3) on the one-day repo market has risen to a much higher level compared to the previous period. The overall rise in volume is a positive sign of a much more active repo market. The underlying number of daily trades which was initially below 100, rose four-fold by the autumn 2008, and subsequently

[2] Preliminary empirical results for the SHIBOR market are available upon request.

[3] The CHIBOR market has a much lower volume, at least by a factor of three for the one-day maturity

stayed at that new level. Descriptive statistics for the repo rate, the daily range and volume over the full sample as well as four subsamples are presented in Appendix 1, Table A.1.

The timeframe covered in our sample is 22nd July 2005 to 27th April 2010. This spans different exchange rate regimes. It starts with a one-off revaluation of the RMB followed by a switch to a managed-float, with initially limited changes in the value of the RMB against the USD, followed after early October 2006 by more rapid appreciation of the Chinese currency. Finally July 2008 is marked by a return to a fixed-exchange-rate. Our sample covers different phases in the economic cycle. It includes a period during which the economy overheated which is followed by the major shock stemming from the global financial crisis in the fall 2008, and China's quick recovery one year after. These cyclical changes are reflected in monetary policy changes, as well as in the tone of the PBoC's communication as shown in Figure 4 which plots our five-category communication variable (COM5). On the basis of the above information, we break our sample into four sub-periods. The first period up to October 7, 2006 involves low inflation (Figure 5) and low volatility of the repo rate. The second period ending on 7th October 2008 covers a period of overheating in the economy. The third period, the year to 7th October 2009, represents the worst of the global financial crisis as far as China is concerned. From October 8th, 2009 until the end of our sample, the main theme is China's fast recovery once the fiscal stimulus package had had its full impact and the rest of the world has started to recover. We also estimate the model over the full sample to analyze the general effect of PBoC communication independently of the exchange rate or cyclical situation.

When looking at the classification of communication across these periods, a mainly hawkish stance is evident up to early October 2008, followed by a dovish one, beginning at the same time as the first phase of Quantitative Easing in the US (when the Fed funds rate was slashed) and lasting until early October 2009. A shift to a more hawkish stance occurs in the subsequent period. The stance implied by communication over these four periods matches developments in Chinese inflation and industrial output growth as plotted in Figure 5.

4. Effects of PBoC Communication on Money Markets

In this section we show the results from estimating our model which address the two key questions in this paper. For the question of whether money markets listen to the PBoC words, we investigate direct and indirect channels of influence. In both cases, we first of all need to determine the right specification for our equations by conducting standard stationarity tests.

4.1 Stationarity Tests

The detection of possible non-stationarity is key for our modeling strategy. In particular, it enables us to determine whether the log of the range and volume are stationary (for the first question) and whether the repo rates should be modeled in level or first differences (for the second question). For robustness, we use two unit-root tests: the Elliott et al. (1996), and the Ng and Perron (2001) tests, as

well as a stationarity test proposed by Kwaitkowski et al. (1992). With respect to the log of the range and the volume, the unit root is rejected in all (but one) of our sub-samples, and stationarity is accepted in only few cases. On the basis of these results we decide to model the logarithm of the range and volume in levels. As for the second, the tests conclude against stationarity for the level of the repo rate although the two tests show different results according to the sample considered (Appendix 2, Table A2). We therefore conduct additional tests to determine our empirical strategy, namely regressions on the REPO rate in levels. The sum of autoregressive parameters was often very close to unity for all of our sub-samples (this is also the case of the results obtained for the seven-day repo rate for a sample ending in the Summer 2008 by Porter and Xu, 2009), confirming the rejection of stationarity implied by the Kwaitkowski et al. test (Appendix 2, Table A2, col. 3). As a result of all these preliminary tests, we consider models with repo rates in first differences for all sub-samples. This is in line with previous work on communication (Connolly and Kohler; 2004; Ehrmann and Fratzscher, 2007; Reeves and Savicki, 2007; Rosa and Vega, 2007).

4.2 Do Money Markets Listen to the PBoC? Repo Volatility and Volume

We test the hypothesis that the volatility of the repo rate (from equation 1 above) may move in a statistically significant way following PBoC communication.

The results in Table 1 (Panel A) confirm the hypothesis that money markets listen to PBoC communication as evidenced by the significant change in the daily log range following communication between July 2005 and April 2010. This result generally carries over to other sub-samples. The sign of the change in volatility is positive in most cases, which indicates that the PBoC words convey information that markets perceive as relevant. This is in line with Remolona and Fleming (1999) and Ehrmann and Fratzscher (2007). In only one sub-sample, right after the switch to managed floating, communication seems to calm the money market as shown by the significant and large negative coefficient. Following Geraats (2002), this phenomenon could reflect a relatively higher degree of uncertainty before the central bank's words during this period or, alternatively, greater clarity in the speeches delivered during this period.

As for the central bank monetary instruments, the volatility of the repo rate seldom moves when the required reserve ratio or the deposit rate are changed (Appendix 3, Table A.3.1. Following a general to specific strategy, only significant coefficients are reported). In turn, the net issuance of PBoC bills is the most effective in influencing volatility: the coefficient tends to be positive and significant (i.e., volatility increases with new issuances of PBoC bills). Finally, the volatility of repo rates seems to rise with IPOs, as one would expect, but the coefficient is only significant for the 2006-2008 sub-sample.

When looking at the potential indirect influence of PBoC communication on the money market through volume, we find a clear impact for the full period as well as for all of the sub-samples (Table 1, Panel B). This is also true for the impact of monetary policy instruments on volume, especially the net bill

issuance as in the case of volatility (Appendix 3, Table A.3.2).[4] This supports the view that indirect channels can play a substantial role in understanding how monetary policy (words or deeds) affects money markets. It also points to the importance of accounting for microstructure effects when analyzing the impact of monetary policy.

4.3 Do Money Markets Understand the PBoC?

As a second step, we regress the mean of the repo rate changes on PBoC communication (following equation (4) above). We focus again on the repo with the most liquid maturity, the overnight repo. In a first exercise, we use the five-category variable constructed to summarize the directional intent and intensity of communication (COM5). We also consider separately the sole influence of speeches (SPEECH). We, then, do a robustness test with the simpler three-category variable for communication (COM3).

We find a highly significant and positive change in the repo rates after communication is delivered (Table 2, row 1) for the overall period as well as the sub-samples. The more hawkish the communication by China's central bankers, the larger tends to be the increase in the repo rate. When only speeches are included in the communication index (i.e., excluding the MPC statements), we obtain similar positive effects (Table 2, Row 2). These results show that China's money markets pay attention to PBoC communication and understand its messages.

When looking at monetary policy instruments, the most significant impact was found for open-market operations, as for volatility and volume (Appendix 3, Table A.3.3). More specifically, an increase in the PBoC's net bill issuance affects the overnight repo rate positively (except in the post-crisis subsample). This finding should not come as a surprise, given the increasingly large amounts of sterilization of foreign-currency reserve accumulation that the PBoC needs to undertake. Against this background, Porter and Xu (2009) document the opposite result (insignificant effect of bill issuance) with the seven-day repo rate, which may be related to the lack of liquidity in that market as compared to that in the one day market, or perhaps the level specification used. Other than the bill issuance, we find a positive effect of deposit rate changes on the overnight repo (as in He and Wang, 2012). Changes in the required reserve ratio are only occasionally significant. Finally, macroeconomic data announcements and IPOs tend to influence the interbank rate as well.

As a robustness test, we look into a simpler measure of the tone of PBoC words by merging the previously five-pronged coding of statements and speeches into three (COM3)[5]. The previous results are fully confirmed (Table 3).

4 Macro news does not have any significant effect on volume.

5 This follows Ehrmann et al. (2007).

5. Conclusions

This paper provides the first evidence of the ability of PBoC communication to steer the money markets. In fact, money markets not only react to communication (i.e., to listen to the PBoC) but also move in the intended direction (i.e., to understand it).

These findings can be interpreted as the PBoC being a very predictable central bank since they are similar to those for peer central banks in developed economies, such as the U.S., the U.K. and the euro area (Kohn and Sack, 2004; Connolly and Kohler, 2004; Reeves and Savicki, 2007; and Ehrmann and Fratzscher, 2007). However, an alterative explanation may be particularly relevant to the Chinese case. The relative underdevelopment of its financial system and still heavy use of window guidance may be behind the effectiveness of the PBoC communication. In fact, the PBoC words may actually act as deeds in as far as the deeds are not always observed. This brings us to a key conclusion of our study, namely, that existing measures of the PBoC monetary stance could benefit by incorporating measures to reflect the policy direction implicit in PBoC speeches and statements. An additional benefit is that this would give a higher frequency indicator of the monetary stance. This is all the more important for studies investigating the response of financial markets to monetary policy. We find evidence that trading volumes in the money market are sensitive to PBOC communication. This suggest that the existing empirical literature on the efficacy of central bank communication could benefit from more emphasis on volumes as well as prices.

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Table 1. Effect of PBoC Communication on Range and Volume of Repo Rate

	Full sample (22 Jul 2005 – 7 Apr 2010)	22 Jul 2005 – 7 Oct 2006	12 Oct 2006 – 7 Oct 2008	8 Oct 2008 – 7 Oct 2009	8 Oct 2009 – 27 Apr 2010
A. Log Repo range					
$\sum_{j=0}^{n} COM1_{t-i}$	0.086**	-0.206***	0.125*	0.020**	0.112*
(n)	(0)	(3)	(3)	(0 to 3)	(0)
B. Log REPO volume					
$\sum_{j=0}^{n} COM1_{t-i}$	0.0215***	0.060***	0.038***	-0.006**	-0.044*
(n)	(0 to 2)	(2)	(0)	(0 to 4)	(0 to 1)

Panel A corresponds to equation (2) where we do not report the coefficients of control variables (see Appendix 3), and which is estimated jointly with equation (1). Panel B corresponds to equation (3) where we do not report the coefficients of control variables (see Appendix 3), and which is estimated jointly with equation (4).

The table presents the sum of the coefficient of coded speeches and statements over the current and previous days. The COM1 dummy takes a value of one when a speech or a written statement occur and zero when there is no speech or statement. EGARCH estimation with Generalized Error Distribution. The optimum lag is selected on the basis of Akaike's and Schwartz's Bayesian information criteria. Only significant effects are reported: *** significant at the 1% (**5; * 10%) on the basis of the z-statistics.

Table 2. Effect of PBoC Communication (Classified in 5 Categories) on REPO-Rate Changes

REPO change	22 July 2005 - 27 April 2010	22 July 2005 - 7 Oct 2006	12 Oct 2006 - 7 Oct 2008	8 Oct 2008 - 7 Oct 2009	8 Oct 2009 - 27 April 2010
$\sum_{j=0}^{n} COM5_{t-i}$	0.00028***	0.004***	0.0041***	0.0009***	0.0011***
(n)	(1)	(0)	(1 to 3)	(3)	(1)
$\sum_{j=0}^{n} SPEECH_{t-i}$	0.0003***	0.0039***	0.0007***	0.00077***	0.0028***
(n)	(0 to 1)	(0)	(0 to 3)	(0 to 3)	(1)-

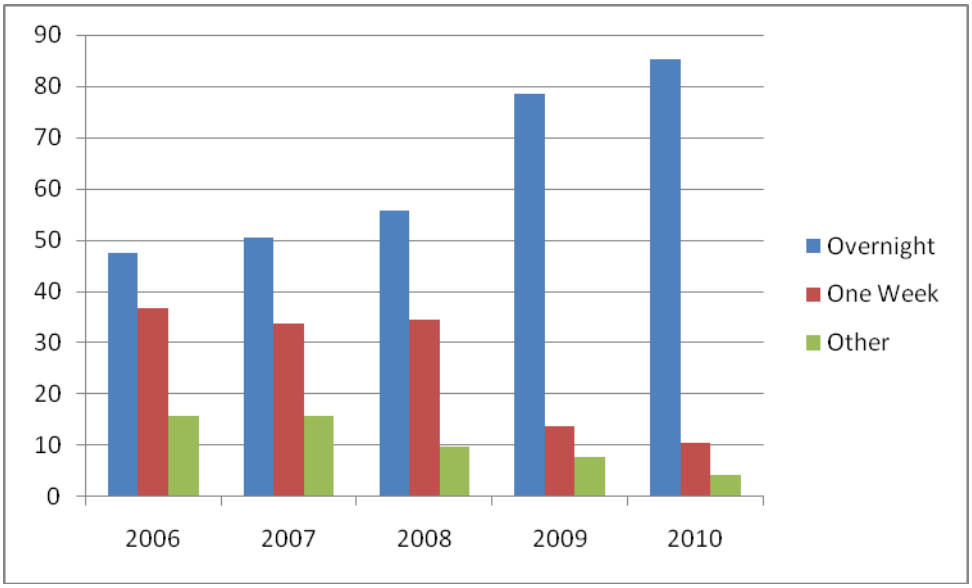
This corresponds to equation (5) (we report the coefficients of control variables in Appendix 3), which is estimated jointly with equation (6). First difference of one-day repo in all cases in the mean equation. The COM5 dummy for communication and the SPEECH dummy for speeches only have a five-pronged classification as very dovish (-2), dovish (-1), neutral (0), hawkish (+1) and very hawkish (+2). These dummies are included alternatively in the equation. GARCH estimation with Generalized Error Distribution. This corresponds to equation (5) where we do not report the coefficients of control variables, and is estimated together with equation (6). Only significant effects are reported: *** significant at the 1% on the basis of the z-statistics.

Table 3. Effect of Three-Category Coded Communication on Mean Repo-Rate Changes

REPO change	22 July 2005 – 27 April 2010	22 July 2005 – 7 Oct 2006	12 Oct 2006 – 7 Oct 2008	8 Oct 2008 – 7 Oct 2009	8 Oct 2009 – 27 April 2010
$\sum_{j=0}^{n} COM3_{t-i}$ (n)	0.000440.00066** (0 to 1)	0.0048*** (0)	0.0036*** (0 to 3)	0.0011** (3)	0.0004*** (1)

First difference of repo rate in all cases in the mean equation. The table reports the coefficient of speeches or written statements coded in a COM3 dummy as (-1) when dovish, (0) neutral and (+1) hawkish. GARCH estimation with Generalized Error Distribution. Only significant effects are reported: *** significant at the 1% (** 5%; and * 10%) levels on the basis of the z-statistics. This corresponds to equation (5) where we do not report the coefficients of control variables, and is estimated together with equation (6). Detailed results are not reported since they are close to those presented in Table A.3.3.

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. "Other" means maturities ranging from two weeks to one year.

Figure 2. Logarithm of the Daily Range of the One-Day Repo (22nd July 2005-27th April 2010)

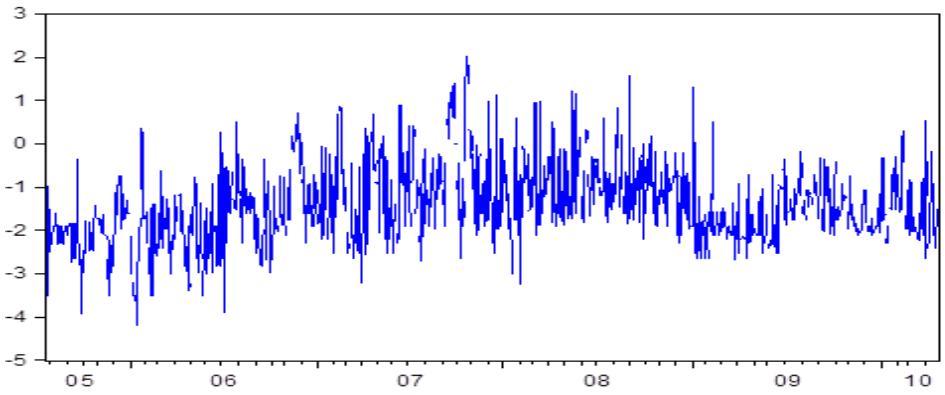


Figure 3. The Daily Volume of the One-Day REPO Market (22nd July 2005-27th April 2010): number of trades

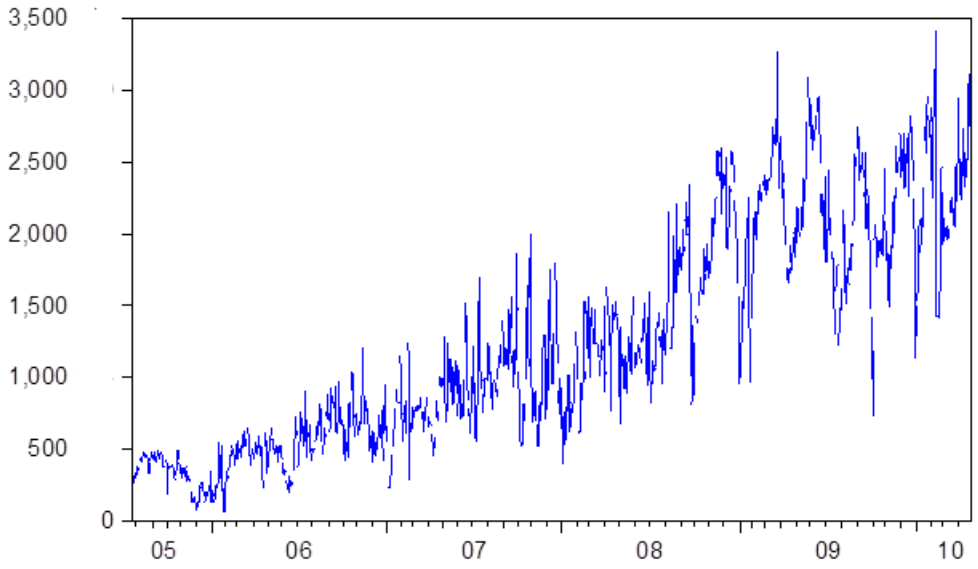


Figure 4. The Stance of Chinese Monetary Policy as Indicated by PBoC Communication (22nd July 2005-27th April 2010)

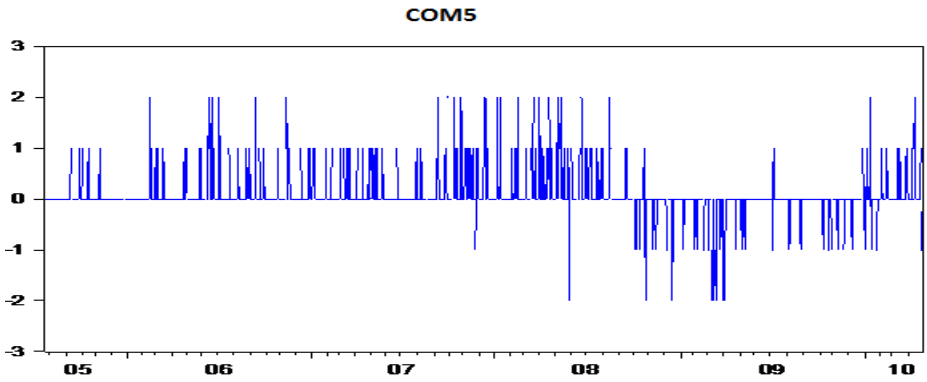
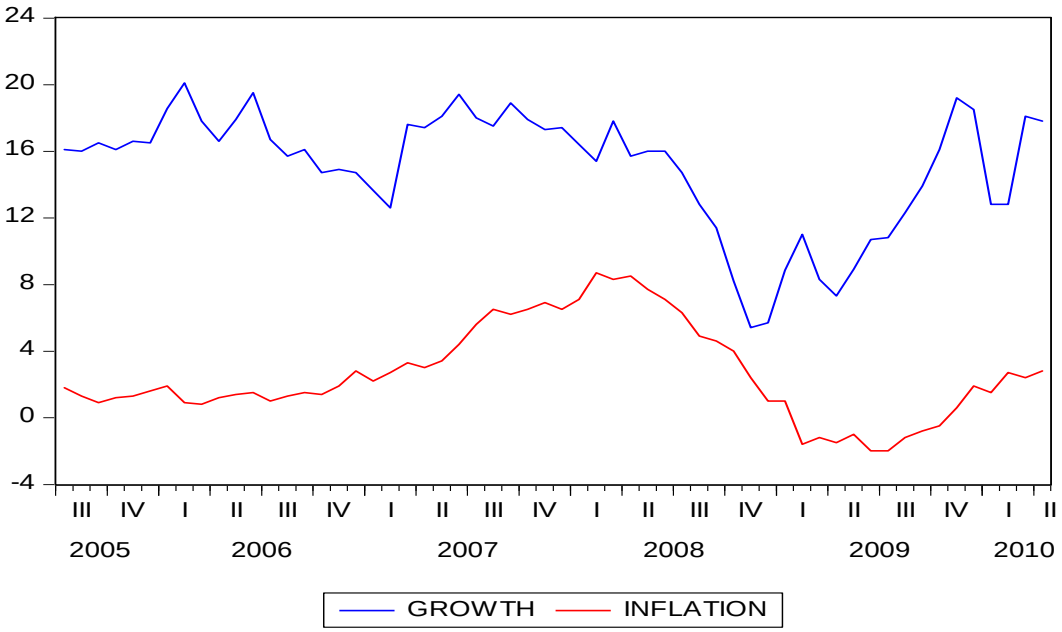


Figure 5. Monthly CPI Inflation and Industrial Output Growth (Year on Year)



Source: IMF, International Financial Statistics.

Appendix 1. Descriptive Statistics

Table A1. Descriptive Statistics on Repo Rate, Range and Volume

	22 Jul 05 – 27 Apr 10	22 Jul 05 – 7 Oct 2006	12 Oct 2006 – 7 Oct. 2008	8 Oct. 2008 – 7 Oct 2009	8 Oct 2009 – 27 Apr. 2010
Repo-rate change					
Mean	0.0005	0.0046	0.002	-0.005	-0.003
Std. dev	0.252	0.098	0.375	0.068	0.12
Skewness	-7.06	-0.965	-5.17	-2.75	2.18
Kurtosis	244.5	55.72	119.8	45.4	45.1
Range					
Mean	0.398	0.193	0.61	0.29	0.258
Std. dev	0.611	0.205	0.84	0.344	0.227
Skewness	5.56	3.83	4.11	6.29	3.72
Kurtosis	4.94	22.8	25.9	55.5	20.06
Volume					
Mean	1243701	434794	1022806	2095329	2255422
Std. dev	765801	0.205	374002	443183	431324
Skewness	0.52	0.38	0.73	-0.225	-0.08
Kurtosis	2.12	3.20	3.55	2.80	2.68

Computed with data extracted from CEIC (repo) and RESSET (Range and Volume).

Appendix 2. Unit Root Tests

We use the General-Least-Squares version of the Phillips-Perron (1988) unit root test, suggested by Ng and Perron (2001), MZa , where the null hypothesis is the presence of a unit root. In order to maximize power, such a test relies on a Generalized-Least-Squares detrending technique as presented in Elliott (1999), and employs an 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 employ the Kwaitkowski et al (1992) test with stationarity as the null hypothesis.

The hypothesis of a unit root is accepted with both the Elliott et al. and the Ng and Perron tests for REPO rate over the samples 2005-2006 and 2008-2009, while it is rejected over other sub-samples (Table A2, col. 1 and 2). By contrast there is no ambiguity with the Kwaitkowski et al. test which rejects the null of stationarity, over the whole sample and all subsamples (Table A2, col. 3).

Table A.2. Stationarity and Unit-Root Tests

Variable (sample)		Elliott et al.	Ng and Perron (MZa)	Kwatkowski et al.
Repo level				
	(Whole sample)	0.66***	-30.2***	0.82°°
	(1)	5.79	-6.04*	1.60°°°
	(2)	0.43***	-81.8°°°	0.70°°
	(3)	84.1	-0.23	0.69°
	(4)	0.94***	-26.17***	0.45°
Log Range				
	(Whole sample)	0.20***	-125.5***	0.94°°°
	(1)	0.62***	-50.2***	0.33
	(2)	0.78***	-19.22***	0.28
	(3)	1.96**	-2.35	0.47°°
	(4)	0.46***	-43.2***	0.144
Log Volume				
	(Whole sample)	8.65***	-2.52***	4.13°°°
	(1)	1.02***	-27.13***	0.82°°°
	(2)	0.83***	-41.7***	2.09°°°
	(3)	2.62**	-10.96**	0.13
	(4)	1.07***	-25.6***	0.25

***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) 07:22:2005-10/07/2006 (2) 10/12/2006-10/07/2008; (3) 10/08/2008-10/07/2009; (4) 10/08/2009-04/27/2010.

Appendix 3. The Effects of Control Variables

Table A.3.1. Coefficients of Control Variables in the Model for Log Daily Range of One-Day Repo

a.Mean	**22 Jul 2005-27Apr2010**	**22 Jul 2005-7 Oct 2006**	**12 Oct 2006-7 Oct. 2008**	**8 Oct. 2008-7 Oct 2009**	**8 Oct 2009-27 Apr. 2010**
Intercept	-0.370**	-2.07***	-4.61***	-0.318***	-0.866***
Σ AR(p)	0.78***	0.66***	0.510**	0.80***	0.507***
	(p=4)	(p=3)	(p=2)	(p=3)	(p=1)
W	-	-	0.249**	-	-
M	0.223***	-	0.505**	-	0.719***
CN Year	-0.604**	--	-	-	-
NatDay	-	-	-	-	-
NatDay+1	--	-	-		-
AΔDR	-	-	-	-	-
AΔRRRA	-	-	-	-	-
BILL	0.202***	-	-	0.226***	0.377***
AΔIR	-	-	-	-	-
AΔER	-	-	-	-	-
IPO	-	-	8.86E-06*	-	-
Σ COM_{t-n}	0.086**	-0.206***	0.125*	0.020***	0.112*
(n)	(3)	(2)	(3)	(0 to 3)	(0)-
MACRO	-	-	0.237**	-	-
LVolume	-	0.110**	0.291***	-	
b.Variance					
a_0	0.072***	-	0.118*	0.20***	-
α	0.246***	0.12***	0.135**	0.405**	0.06*
β	0.634***	0.87***	0.663***	-	0.93***

GED (a)	1.34***	1.17***	(b)	1.29***	1.21***
Adj. R2	0.373	0.257	0.304	0.311	0.170
Log lik.	-1165.0	-270.5	-554.8	-189.4	-89.06
AIC	2.04	1.92	2.33	1.64	1.42
SC	2.10	2.02	2.46	1.83	1.57
HQ	2.06	1.96	2.38	1.71	1.48
Q(10)	13.9	13.8	4.71	7.55	13.9
	[0.17]	[0.18]	[0.90]	[0.67]	[0.17]
ARCH-LM	0.21	0.40	0.09	0.46	2.40
	[0.64]	[0.52]	[0.75]	[0.49]	[0.12]

In all cases Log range is the dependent variable. Panel A corresponds to the estimation of the mean equation (1) and Panel B to the conditional variance equation (2). Variables are defined as in these equations. We report only significant variables selected with a general-to-specific approach. Dummies: 10/23/2007; 02/01/2008; 12/31/08; 01/06/09.

GARCH model with (a) Generalized-error distribution (GED), or (b) Student-t distribution.

Only significant effects are reported : *** significant at 1%, (**5% and * 10%) on the basis of the z-statistics; [p-value]

Table A.3.2. Coefficients of Control Variables in the Model for Volume of One-Day Repo

a.Mean	**22 Jul 2005-27Apr2010**	**22 Jul 2005-7 Oct 2006**	**12 Oct 2006-7 Oct. 2008**	**8 Oct. 2008-7 Oct 2009**	**8 Oct 2009-27 Apr. 2010**
Intercept	0.217***	1.56***	1.80***	1.61***	2.71***
Σ AR(p)	0.983***	0.879***	0.870**	0.889***	0.810***
	(p=5)	(p=1)	(p=3)	(p=1)	(p=1)
W	-0.0172**	-0.051**	-	-0.020**	-
M	-	-	-	-	-
CN Year	-0.561***	-	-	-	-
CNYear+1	-	-	-	-	-
NatDay	-0.305***	-0.269***	-	-	-
NatDay+1	-	-	-	-	-
LRange-1	-	-	-	-0.009*	-0.032***
AΔDR	-	-	-	0.366***	-
AΔRRRA	-0.057*		-	-0.009***	
BILL	0.056***	0.129***	0.084***	0.044***	0.045**
AΔIR	-	-	-		-
AΔER	-			-	-
IPO	-	-	4.51E-06***	-	6.86E-06***
$\Sigma COM1_{t-n}$	0.0215**	0.060***	0.038***	-0.006**	-0.044***
(n)	(0 to 1)	(2)	(0)	(0 to 4)	(0 to 1)
			(b)	**(c)**	
b.Variance					
a_0	-0.694***	-1.27***	0.035**	0.003***	-3.25***
γ	-0.085***	-0.186***	-	-	-0.475***
α	0.465***	0.589**	0.189*	0.462**	-
β	0.901***	0.752***	-	0.376**	0.276*

GED (a)	1.11***	1.24***	1.16***	0.911***	0.986***
Adj. R2	0.932	0.785	0.692	0.748	0.619
Log lik.	494.1	83.8	100.4	252.0	124.7
AIC	-0.82	-0.48	-0.37	-1.91	-1.67
SC	-0.74	-0.32	-0.28	-1.67	-1.41
HQ	-0.79	-0.42	-0.33	-1.81	-1.56
Q(10)	9.55	12.4	15.2	10.2	10.0
	[0.48]	[0.25]	[0.13]	[0.42]	[0.43]
ARCH-LM	0.47	1.14	0.13	0.01	0.05
	[0.49]	[0.28]	[0.71]	[0.90]	[0.81]

In all cases 'Buy out' repo Volume in log as dependent variable. Panel A reports the estimation of the mean equation (3) and Panel B to the conditional variance equation (4). Variables are defined as in these equations. We report only significant variables selected with a general-to-specific approach. Dummies for 01/25/2006; 01/26/2006.

(a) EGARCH, (b) ARCH, and (c) GARCH model with Generalized-error distribution (GED). Only significant effects are reported. *** significant at 1%, (**5% and * 10%) on the basis of the z-statistics; [p-value]

Table A.3.3. Coefficients of Control Variables in the Model for Mean One-Day Repo (With Five-Pronged Speech Coding)

a.Mean	(I) 22 Jul 2005-27Apr2010	(II) 22 Jul 2005-7 Oct 2006	(III) 12 Oct 2006-7 Oct. 2008	(IV) 8 Oct. 2008-7 Oct 2009	(V) 8 Oct 2009-27 Apr. 2010
Intercept	-6.47E-05***	-0.0005	-0.003***	-9.68E-05*	-0.0011***
Σ AR	0.150***	0.437***	0.140***	0.056***	0.071***
(p)	(p=9)	(p=4)	(p=9)	(p=11)	(p=8)
CN Year	-	-0.981***	0.389***	-	-0.376***
CNYear+1	-0.171***	-0.544***	-0.174***	-	-0.693***
NatDay	0.021***	-	-1.78***	0.472***	-
NatDay+1	-0.0092***	-	-		-
ΔDR	0.314***	0.394***	-	0.604***	-
ΔRRRA	-0.0052***	-	-	-	-0.026***
ΔLR	-	-	-	-	-
BILL	0.0014***	0.0066***	0.00092***	0.0013***	-
IPO	-1.3E-07***	7.40E-06***	-	2.40E-06***	-
$\Sigma COM5_{t-n}$	-0.0006***	0.0039***	0.0041***	0.0009**	0.0011***
(n)	(0 to 1)	(0)-	(1 to 3)	(0 to 3)	(1)
MACRO	-0.0018***	-0.0046***	-	-	-
b.Variance					
a_0	-	-	-	-	-
α	0.14***	0.07***	0.080***	0.10***	0.15***
β	0.85***	0.92***	0.914***	0.89***	0.83***

GED (a)	0.450***	0.94***	0.384***	0.462***	0.371***
Adj. R2	0.711	0.93	0.714	0.743	0.812
Log lik.	2124.7	736.8	542.7	713.5	402.1
AIC	-3.61	-4.97	-2.11	-5.68	-5.70
SC	-3.48	-4.72	-1.89	-5.41	-5.33
HQ	-3.26	-4.87	-2.03	-5.57	-5.55
Q(10)	4.06	6.30	7.30	16.4	6.18
	[0.94]	[0.78]	[0.69]	[0.12]	[0.80]
ARCH-LM	0.02	0.33	0.05	1.41	0.004
	[0.89]	[0.56]	[0.94]	[0.23]	[0.94]

In all cases REPO one day is in first difference. Panel A corresponds to the estimation of the mean equation (5) and Panel B to the conditional variance equation (6). Variables are defined as in these equations. We report only significant variables selected with a general-to-specific approach. Dummies:

(I) 01/25/2006; 03/23/2006; 02/09/2007; 02/12/2007; 09/14/2007; 09/28/2007; 10/25/2007; 10/26/2007; 10/29/2007; 02/12/2007.
(II) 01/25/2006; 01/26/2006; 05/08/2006; 02/07/2006; 01/20/2006; 03/23/2006;
(III) 10/26/2007; 10/29/2007; 02/16/2007; 10/25/2007; 10/26/2007; 02/12/2007.
(IV) 10/30/2008; 11/05/2008; 12/10/2008; 07/17/2009; 07/29/2009,
(V) 02/11/2010; 01/25/2010.

(a) GARCH model with Generalized-error distribution (GED).

Only significant effects are reported : *** significant at 1%, (**5% and * 10%) on the basis of the z-statistics; [p-value]

Annex 4. Examples of FACTIVA Reports and their Coding

Xinhua, March 6th, 2009: China has acted fast amid the global financial crisis to ease its monetary policy that is beginning to take effect, said central bank governor **Zhou Xiaochuan** on Friday. China has shifted from a tight monetary policy implemented in early 2008 to a moderately easy one as the international financial turmoil spread in the second half of the year, he told a press conference on the sidelines of the parliament's annual session. "We would rather act faster and take more forceful measures" to shore up confidence "as long as the measures can check slip of confidence and spur fast recovery of the economy amid the crisis," he said. "We have learned lessons from some countries that once the confidence dips, it needs a fairly long time to restore," he said.
Coded: -2.

CDBANK, January, 7th, 2009: China's central bank still has room to take many monetary policy steps to support the economy, if the economic situation makes them necessary, an adviser to the central bank said on Jan 7th, 2009. "I believe decision-makers are ready to take big steps when necessary to prevent the economy from deteriorating rapidly," **Fan Gang**, who holds the academic seat on the central bank's monetary policy committee, said in a speech to a financial forum.
Coded: -1.

Reuters, December 15th 2008: China will face pressure to cut interest rates until the middle of 2009, but any decision will depend on the rate of inflation, **Zhou Xiaochuan**, governor of the People's Bank of China, said on Tuesday. "First we care about the cost of capital for enterprises and secondly the interest rate should be linked with CPI," the central bank governor told reporters in Hong Kong. "It will depend on our estimates and the actual statistics of CPI for us to make rate decisions," he added.
Coded: 0

MNI, December 10th, 2007: The People's Bank of China, or central bank, will stick to a tight monetary policy as long as economic problems remain, bank advisor **Fan Gang** said in an interview with State TV. "There is always room for (monetary) policy adjustment as long as economic trends remain unchanged," said Fan, the only academic member on the central bank's monetary policy committee. "We will continue with this tightening policy to prevent any rebound in the economy," he added. The central government last week shifted to a "tight" monetary policy from the "prudent" policy it had maintained for the previous decade.
Coded: 1

CHIKNO, October. 29th, 2007: Retail commodity prices added 3.2% year-on-year in the same period, while factory prices for industrial products increased 2.7%, and raw material, fuel and power prices jumped by 3.8%. **Zhou Xiaochuan**, president of the central bank, People's Bank of China, said that the bank would continue raising interest rate to curb inflation.
Coded: 2