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Twelve Blind Men and the PBoC

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Abstract

Over the past decade, several dozen papers have been written that identify the People's Bank of China's monetary policy shocks. Yet, what often seems like minor differences in measurements of monetary policy and identifying assumptions yield vastly different implied shocks. In this paper, we pitch 21 shock time series from the literature against each other in a horse race. We use a local projections framework to produce impulse responses based on all shocks for production, prices, money and interest rates and use them to assess the economic plausibility of the competing results. Our results confirm the frequently mentioned relevance of monetary aggregates for Chinese monetary policy but also point the importance of using forward looking policy reaction functions (or account for forward looking variables in a VAR framework) when identifying monetary policy shocks.

1. Introduction

The People’s Bank of China (PBoC) is now responsible for conducting monetary policy for one of the largest economies on the globe, it regulates one of the largest bond markets in the world and manages the largest reserves of any central bank. While this spurred a large empirical literature on Chinese monetary policy in recent years, results differ starkly even in their most fundamental conclusions, such as the direction of monetary policy shocks at a given time. Therefore, in the present paper, we will compare different monetary policy shocks identified for China, demonstrate which methodological choices explain identified shocks being different or similar, and how the economic consequences of those estimated shocks differ.

The main factor that makes it so difficult to identify the “correct” shock is that PBoC never commited to an official intermediate target or defined a primary instrument of monetary policy. Quite a few papers argue that Chinese monetary policy should be measured through a monetary aggregate since the PBoC started only a few years ago to emphasize interest rates more strongly in their policy and traditionally

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paid more attention to monetary aggregates.[1] Others have moved beyond models that merely replace interest rates with money growth, and stress the importance of explicitly acknowledging the broader toolbox of the PBoC. Sun (2013) and Sun (2015) propose narrative indicators based on the PBoC's monetary policy reports. He and Wang (2012), El-Shagi and Jiang (2023) and Fu and Wang (2020) all account for several instruments separately.

At first glance, these might seem like minor differences in the pursuit to identify shocks a little bit more efficiently. Money, its price (i.e., the interest rate), and what the PBoC announces to do to influence the money market are all perfectly legitimate and reasonable measures of monetary policy. Yet, it turns out the differences are quite substantial. Looking at a sample of 21 shock time series collected from the literature, there is not a single quarter that is covered by five or more shock time series where all shocks match direction, i.e., agree on the direction of the surprise component of monetary policy. One might argue, that this is to be expected as the papers we compare are fundamentally different in their estimation technique. Most employ vector autoregressive models, but some are looking at DSGE models, and some merely at the deviation from an empirically estimated policy rule. However, all papers aim (among other issues) to identify the same economic phenomenon, namely the monetary policy shock. This invokes associations with the famous East Asian parable (and the equally famous American poem) about six blind men inspecting an elephant, all returning with entirely different impressions. In this paper, we utilize the fact that we might not know how the elephant looks, but we have a fairly good idea how a location where elephants grazed looks like. Or, to abandon the metaphor, we have a fairly good idea how the response to a monetary policy shock looks like, even though we might have trouble identifying the PBoC's monetary policy shocks. Thus, in this paper, we take all the shocks out of their original modeling environment and estimate impulse responses for each shock using the same local projections framework. This allows us to see which shocks produce impulse responses that are consistent with economic theory when the impulse responses are not restricted (as they often are as part of the identification procedure).

With this horse race approach, we do not only provide an overview of the current situation of the literature on monetary policy in China, but also contribute to the economic issue at hand by identifying directions that have proven promising.

Our paper adds to the growing literature on meta-analyses of China's monetary policy (see, e.g., Cheung and He; 2022; Bineau; 2010; El-Shagi and Zheng; 2020; Mi et al.; 2021), although not being a traditional meta-study itself. Most meta-approaches have been developed to deal with a single parameter that is comparable across the literature (see Stanley; 2005, for an overview). Even papers that deal with relatively sophisticated and heterogeneous models, such as DSGEs, typically aim to summarize the key question into a few select numbers, such as De Grauwe and Costa Storti (2004) and Fidrmuc and Lind (2020). For entire time series, such as the monetary policy shocks that we are interested in, that is impossible. Thus, to some degree our work

[1]However, money being the intermediate target of monetary policy does not necessarily make it a good measure of the policy stance. Before the introduction of the euro, the Bundesbank for example, one of the most prominent examples for a monetarist central bank, conducted its policy through interest rates while targeting money,i.e., the growth of a broad monetary aggregate.

rather is a statistically supported survey study than a full fledged meta analysis. However, we add a new spin applicable to the meta-study literature – i.e., the literature on the statistical analysis of empirical results by proposing a framework that fits cases where the main result cannot be summarized in one (or few) parameter estimates.

The remainder of the paper is structured as follows. In Section 2, we introduce our shock database and provide a detailed narrative and preliminary graphical analysis of the differences and similarities we find. In Section 3, this is followed by a brief description of our local projections framework. We present our results and their implications in Section 4 and Section 5 concludes.

2. Data

Measurement and Identification

Candidate papers for our study are identified through google scholar, using the keywords "China", "monetary policy" and "shock". We screen the papers to make sure they actually estimate "monetary policy shocks", i.e., surprise changes to monetary policy.[2] Since Chinese monetary policy has evolved considerably,[3] we focus on papers published starting in 2012. In this way, we identify more than 30 papers that estimate monetary policy shocks for China in the past five years. We contacted all authors and received information for 12 papers covering 21 time series of shocks. While M2 is the measure used most often, in total more papers use interest rates (9) than money (5).[4] Two papers use the narrative indicator proposed by Sun (2013), that uses information from the press releases on the MPC's quarterly meetings and the China Monetary Policy Report to generate a judgment based indicator ranging from -2 (for highly expansionary policy) to 2 (strong tightening). See Figure 1 for a complete overview.

The earliest series we have starts in 1998Q2 and the latest ends in 2019Q2. Figure 2 shows the individual sample periods for all 12 papers. In each paper within our sample, all estimated shocks are estimated for the same period, i.e., there is no within paper variation in the sample size. Most replies came from authors with rather recent contributions with samples starting well in the 2000s. Therefore, the fixed exchange rate regime, that dominated China's monetary policy in its earlier stages (Nicholas R, Lardy; 2005; Mehrotra, Aaron and José R, Sánchez-Fung; 2010; Danne and Schnabl; 2008). Yet, intensive exchange rate management still persists after abolishing the peg for quite some time. However, since China's capital markets are highly restricted, independent monetary policy (and thus actual policy shocks) are still possible, unlike in other countries with exchange rate management and open capital markets.

With the exception of He et al. (2013) – who estimate monthly shocks –all papers are natively using quarterly data. For He et al. (2013), we cumulate monthly

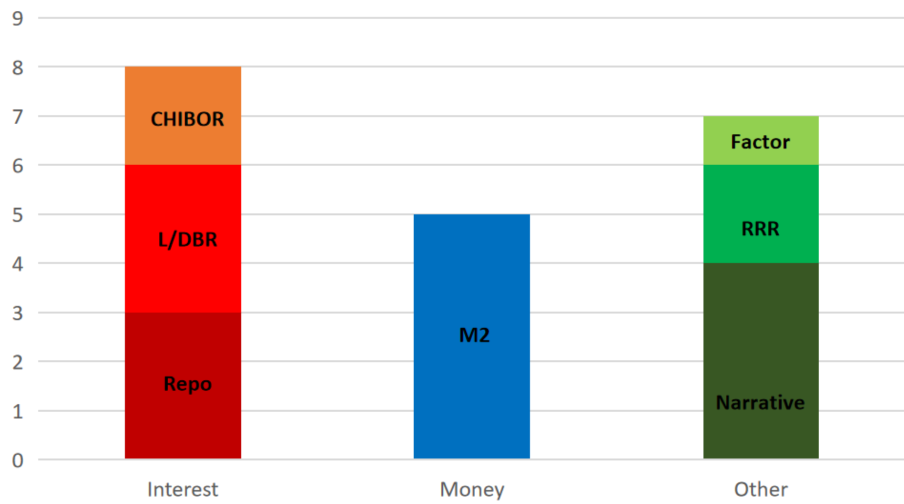
[2] This is not necessarily the main contribution of the respective papers. However, all the time series considered in our paper are clearly identified by the authors of the original papers as their "shock". There are far more papers dealing with the consequences of Chinese monetary policy that do not explicitly estimate a shock, and are thus excluded from our analysis, such as Yang et al. (2021) and Wang et al. (2023).

[3] For a summary of changes see, e.g., Long et al. (2023).

[4] Note that we consider the paper by Zhang et al. (2021) that uses Treasury Bond Futures price changes around monetary policy events to be using interest rates, as the theory their paper is based on, refers to the underlying changes in the implied yield.

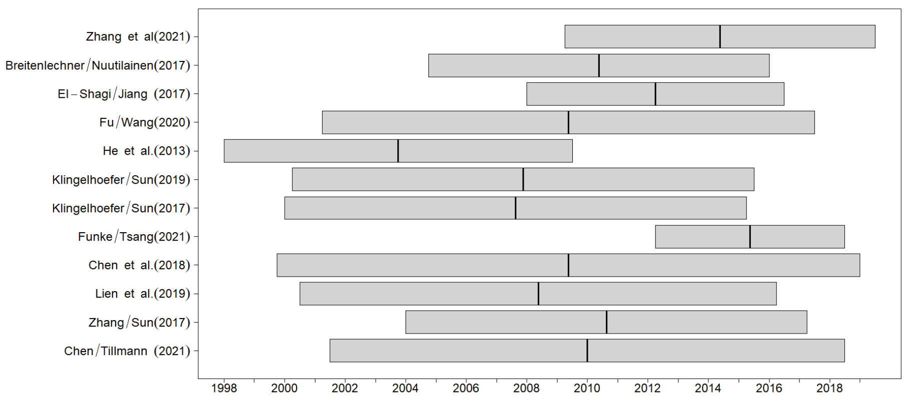
shocks to obtain quarterly shocks. All quarterly shocks are normalized to mean 0, a standard deviation of 1, and recalibrated so that an increase indicates expansionary monetary policy (in line with M2, the most frequently used MP indicator). While the original shocks are hard to interpret outside the context of their own modelling framework, those standardized MP shocks should measure the same economic phenomenon on the same way – granted that the interpretation of the original authors as monetary policy shock is correct.

Figure 1 Distribution of Measures of Monetary Policy in China



Notes: L/DBR = Loan/Deposit Benchmark Rate; RRR = Required Reserve Ratio

Figure 2 Periods Covered by Sample Paper



The vast majority of shocks (16 out of 21) is identified using Structural VARs. Zhang and Sun (2017), Klingelhöfer and Sun (2019), and Chen and Tillmann (2021) use a standard (OLS estimated) VAR for the underlying reduced form; He et al. (2013)

and Breitenlechner and Nuutilainen (2017) use factor augmented VARs (FAVAR); Lien et al. (2021) a regime switching smooth transition VAR, Fu and Wang (2020) a VAR with time varying parameters and stochastic volatility; and El-Shagi and Jiang (2023) use a LASSO-VAR to reduce the number of parameters due to their relatively short sample. With the exception of El-Shagi and Jiang (2023), Breitenlechner and Nuutilainen (2017) and Zhang et al. (2021) all VAR based approaches use a recursive identification scheme where monetary policy shocks are ordered last, i.e., are assumed to not affect the economy contemporaneously. El-Shagi and Jiang (2023) use a block recursive identification, where monetary policy is wedged between the real economy and the financial sector (which responds contemporaneously to monetary policy shocks). Breitenlechner and Nuutilainen (2017) combine a block recursive approach with sign restrictions to disentangle loan supply and loan demand based monetary policy shocks. Zhang et al. (2021) stands out the most among the VAR models using a proxy VAR with high frequency changes of futures prices around monetary policy announcements as instrument for shock identification. Two papers (with three shocks in total) interpret the deviation of a policy indicator from a policy rule as shock, namely Klingelhöfer and Sun (2018) who estimate both a simple OLS based policy function and a regime switching policy function based on multiple regime threshold regression (MRTR), and the already seminal paper by Chen et al. (2018). The remaining two shocks – both proposed by Funke and Tsang (2021) – are a direct measure based on interest rate swaps and the shock series implied by a New Keynesian DSGE of the Chinese economy. For a summary of both the underlying measures of monetary policy and the used identification scheme, see Table 1.

The papers we could not obtain shocks for, are generally following similar approaches. There is one major difference: While our sample only includes one DSGE, five of the remaining papers used New-Keynesian DSGE models. Otherwise, differences are fairly minor and do not seem to be systematic. There is a slightly higher representation of nonstandard measures, in particular the required reserve ratio. One paper uses the Central Bank Bill Yield, an interest rate used relatively rarely in the literature. While all the authors using money growth that replied to us use M2 in their estimation, there is some variety in the monetary indicator used in the remaining literature, with several authors using money base and/or open market operations. Lastly, some of the papers consider the new tools of unconventional monetary policy in particular the short and medium term lending facilities - that were introduced by the PBoC in the wake of the financial crisis to better steer the yield curve.

Comparing shocks

Except during the first and last few quarters of our combined sample, which are covered by less than five shock time series, there is major disagreement between the shocks, to the extent that they do not even agree on the direction of the shock, see Figure 3. El-Shagi and Jiang (2023), both models proposed by Breitenlechner and Nuutilainen (2017) and Fu and Wang (2020) identify two monetary policy shocks from a single model to account for the broad range of tools the PBoC uses. Since those shocks are orthogonal by construction, this might explain the disagreement to some degree. However, removing those papers from the sample only yields a single quarter where the remaining shock series agree on the direction of the monetary policy shock.

Table 1 Money Measures and Identification Strategies

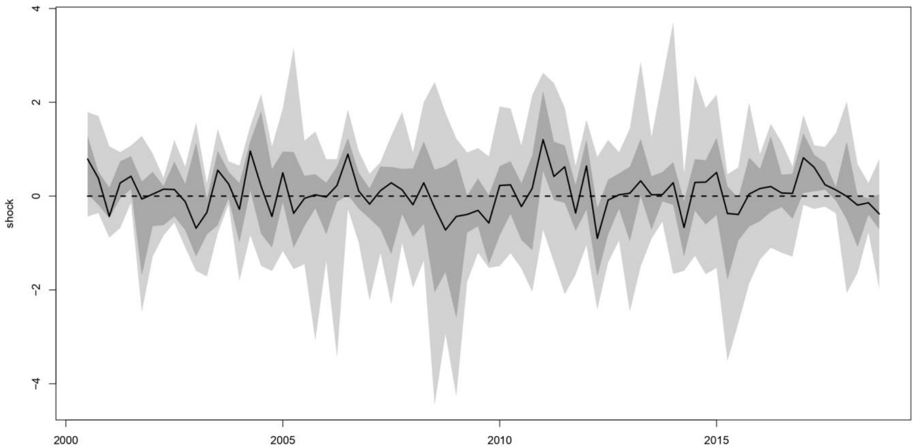
Paper	*Variable*	*Estimation*	*Identification*
Breitenlechner and Nuurilainen (2017)	RRR[1]	FAVAR	Block recursive + sign restrictions
	DBR[1]	FAVAR	Block recursive + sign restrictions
Chen et al. (2018)	M2	OLS	Deviation from policy rule
El-Shagi and Jiang (2017)	Repo + LBR	LASSO-VAR	Blockwise recursive
Chen and Tillmann (2021)	narrative	VAR	Recursive
Fu and Wang (2020)	M2 + Repo	TVP-VARSV	Recursive
Funke and Tsang (2021)	Factor[2]	DSGE	
	Repo	Model free	Interest rate swaps
He et al. (2013)	M2	FAVAR	Recursive
Klingelhöfer and Sun (2018)	narrative[3]	OLS	Deviation from policy rule
	narrative[4]	MRTR	Deviation from policy rule
Klingelhöfer and Sun (2019)	narrative	VAR	Recursive
Lien et al. (2019)	CHIBOR	STVAR	Recursive
	M2	STVAR	Recursive
Zhang and Sun (2017)	M2	VAR	Recursive
	CHIBOR	VAR	Recursive
Zhang et al. (2021)	Treasury futures	VAR	Instrument/Proxy

Notes: [1] Both models identify two shocks each based on the same measure of money but distinguishing loan supply and loan demand driven shocks. [2] The factor includes Repo, RRR, open market operations, midterm lending facility and pledged supplemental lending withdrawal. TVP-VAR-SP: Time varying parameter VAR with stochastic volatility, STVAR: Smooth transition VAR. [3], [4] and [5] The models identify the shocks based on the sun.index which is scaled from -2 to 2.

Monetary policy uncertainty and uncertainty in shock identification

In recent years, several papers have discussed monetary policy uncertainty (MPU) in China (Li and Zhong; 2020; Lien et al.; 2021; Li et al.; 2020; Li and Zhong; 2020). While not the same, this is related to our finding regarding the disagreement about monetary policy shocks. This disagreement essentially reflects model uncertainty, and when the academic community is so uncertain about something, it seems plausible that market participants are too. We find indeed, that monetary policy uncertainty (more precisely the measure of MPU proposed by Li et al. (2020)) is positively related to the standard deviation of identified shocks over time. However, the relation is relatively small, and a visual inspection (see Figure 5) quickly reveals that it is mostly driven by the period around the financial crisis, when different models yield hugely different outcomes and market participants were uncertain on how the PBoC would respond.

Figure 3 Different Estimates of Monetary Policy Shocks

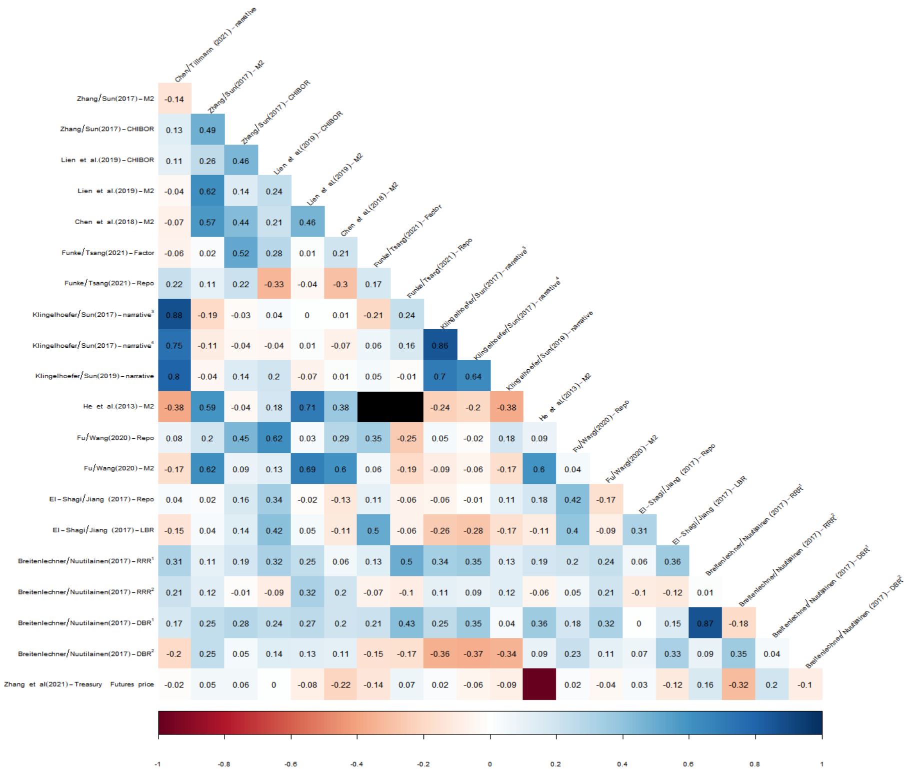


Notes: Light grey shaded area reflects the range from minimum to maximum, dark grey the range from the 20th to the 80th percentile, and the solid blackline the median estimate. The figure only considers the part of our sample, for which at least 5 of the studies considered estimated a shock.

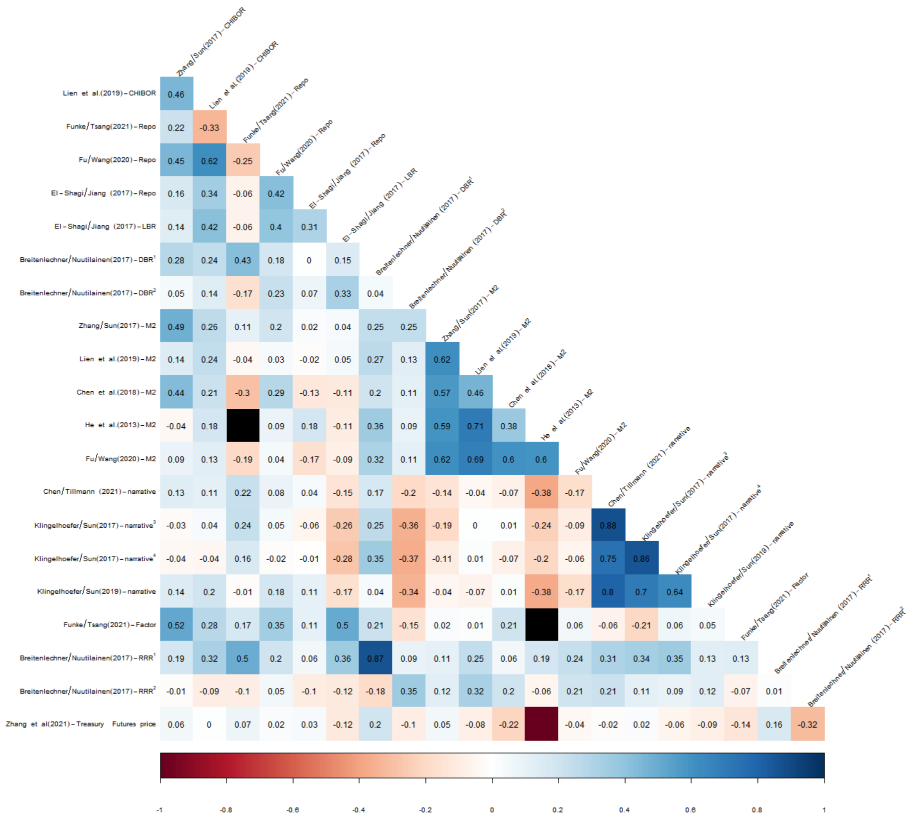
Other Macrodata

For our local projections model introduced in the next section, we also use the logarithms of real GDP, CPI and M2, as well as the 1-day repo rate. All variables are seasonally adjusted using X11. Our macro time series end in 2019Q4. That is, the last few quarters of shocks have to be dropped for longer horizon forecasts for Chen and Tillmann (2021) and Funke and Tsang (2021), that are available until 2019Q2, and Chen et al. (2018) where the authors kindly provided an updated shock series that ends in 2019Q4.

Figure 4 Pairwise Shock Correlations

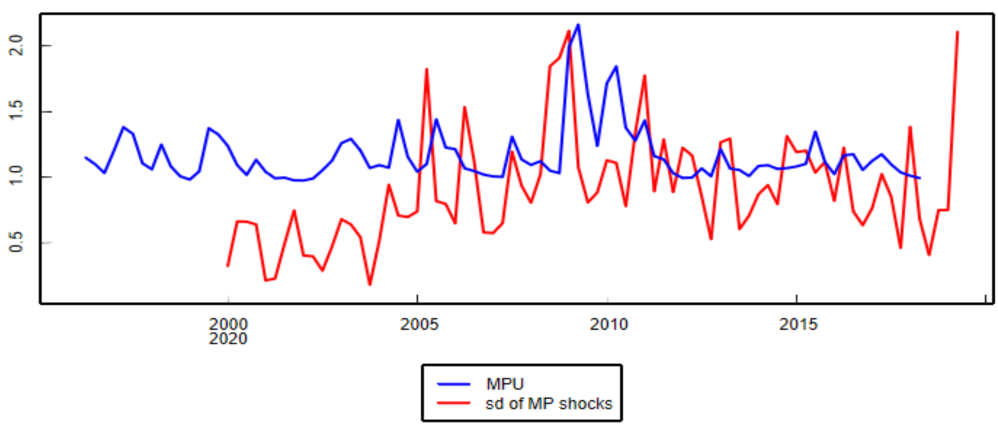


(a) Grouped by paper



(b) Grouped by MP measure

Figure 4 Monetary Policy Uncertainty and Disagreement on Shock



3. Estimation

3.1 Explaining Similarity

In a first attempt to understand what produces similar or dissimilar shocks, we run a simple regression on the correlation coefficients obtained in Section 2. We use an OLS approach explaining correlation through dummies reflecting similar or identical modelling choices and sample overlap. While our dependent variable is technically bounded, our sample shows no sign of truncation at −1 or 1. Our model does not predict any correlation out of bounds and the residuals follow a classical bell shape.

Our baseline approach takes:

$$r_{ij} = \alpha_0 + \alpha_1 \mathbb{1}_{m_i=m_j} + \alpha_2 \mathbb{1}_{s_i=s_j} + \alpha_3 c_{ij} + \varepsilon_{ij} \quad (1)$$

where r_{ij} is the correlation between the shock measures used in papers i and j, m is the general type of monetary policy measure (such as ‘interest rate’ or ‘money’), and s is the general estimation strategy (DSGE, structural VAR or deviation from policy rule). The indicator functions in the equation thus are dummies reflecting the use of identical policy measure ($\mathbb{1}_{m_i=m_j}$ is 1 if $m_i = m_j$ and 0 otherwise) and estimating strategy ($\mathbb{1}_{s_i=s_j}$ is 1 if $s_i = s_j$ and 0 otherwise) respectively, both defined broadly. c is the sample overlap measured in quarters covered by both papers i and j divided by the quarters covered by either sample (i.e., c = 1 implies identical samples).

In the second stage, we go into more detail and distinguish between exact matches and type matches, e.g., distinguish papers that both use the CHIBOR from papers that both use an interest rate albeit different ones.

This yields the following equation:

$$\begin{aligned} r_{ij} = \alpha_0 + \alpha_1 \mathbb{1}_{\tilde{m}_i=\tilde{m}_j} + \alpha_2 \left(\mathbb{1}_{m_i=m_j} - \mathbb{1}_{\tilde{m}_i=\tilde{m}_j}\right) + \alpha_3 \mathbb{1}_{\tilde{s}_i=\tilde{s}_j} \\ + \alpha_4 \left(\mathbb{1}_{s_i=m_j} - \mathbb{1}_{\tilde{s}_i=\tilde{s}_j}\right) + \alpha_5 c_{ij} + \varepsilon_{ij} \end{aligned} \quad (2)$$

where $\tilde{m}$ and $\tilde{s}$ denote the exact monetary policy measure (Repo, CHIBOR, M2,etc.) and strategy (FAVAR, STVAR, etc.) respectively. I.e., the simple indicator functions now reflect exact matches of policy variable and estimation strategy. The differences between index functions essentially work as “but not” operator, measuring similarity (i.e., identity of the broad category) but not identity.

3.2 Local Projections

We estimate impulse responses to all 21 shocks for the four variables that are typically included in the canonical small-scale monetary VAR, namely production, prices, money and interest rate. The impulse response functions are estimated using local projections in the spirit of Jordà (2005). Local projections were explicitly developed with the idea of estimating impulse responses for shocks that are measured (or estimated) outside of the model that is used to estimate the impulse response functions themselves, making them particularly suited for our question. Recent years have seen a number of refinements (see e.g., Jordà (2009), El-Shagi (2019) and

Barnichon and Brownlees (2019)). Most of those restrict the shape of estimated IRFs to get more smooth and economically plausible results. However, since our objective is to assess the shocks we compare in a framework that is as open as possible, we refrain from any restriction and use the original Jordà (2005) approach.

This yields a set of forecasting equations of the form:

$$x_{t+h} = \beta_h + \phi_h s_t + \Gamma_h(L)Z_t + \varepsilon_{t+h}^h \quad (3)$$

where x is one of our four variables of interest, y (log real GDP), p (log CPI), m (log M2) or r (the Repo rate), s is one of our 21 shocks, $Z = [y\ p\ m\ r]$, t is the time index and h the forecast horizon. The impulse response function is then given by the sequence $[\emptyset_1, \emptyset_2, \cdots, \emptyset_H]$ (where H is the maximum forecast horizon considered). In the appendix, we report IRFs for eight quarters. However, for our evaluation, we focus on the first few quarters after the impulse, where "normal" results – such as decreasing prices after monetary tightening– should prevail, whereas opposite effects are well within theoretical expectations at longer horizons due to the cyclical nature of the economy.

3.3 Evaluating IRFs

When evaluating the economic plausibility, we check whether the IRFs estimated through (unrestricted) local projections move in the expected direction. We focus on the four variables that are the building blocks of the standard small scale macroeconomic VAR (for China), i.e., production (GDP), prices (CPI), and the monetary policy indicators M2 and the interest rate (more specifically the repo rate). Since our shocks are aligned to match the direction of interest rate shocks, a positive shock is a contractionary policy shock, that is expected to decrease production and prices, decrease money and/or increase the interest rate. In spirit, this is not unlike the idea behind sign restrictions, where decompositions of the covariance matrix yielding estimates that do not meet economic expectations are discarded.

We use two approaches to assess whether theoretical expectations are met. For both, we assign a plausibility score to each set of IRFs. First, we assess whether theoretical expectations are met period by period both on impact and for the first few periods following a shock, where we award 2 points for each period where the effect has the expected sign and is significant, deduct 2 points for significant results in the opposite directions, and award and deduct one point for the corresponding insignificant results (see Table 2). Following the logic from the seminal paper on sign restrictions by Uhlig (2005), we focus on the first two quarters (in his case 6 months) after the shock, as the theoretical expectations at longer horizons are quite controversial.

In a second – far more subjective – approach, we grade the full 8 quarters ahead IRFs based on a visual inspection. This allows to properly appreciate the plausibility of IRFs, that imply longer lags of monetary policy but are generally showing expected results, IRFs that imply very short (but again plausible) effects, or IRFs that show counterintuitive results that are so small that they are economically irrelevant. In the interest of transparency, the full set of IRFs, including the scores we assign, are presented in the appendix.

Table 2 Scoring Procedure

	negative/ sign	*negative/ insig*	*positive/ insig*	*positive/ sign*
GDP	+2	+1	-1	-2
CPI	+2	+1	-1	-2
M2	+2	+1	-1	-2
Repo	-2	-1	+1	+2

Notes: Each shock is scored on impact and for the first two periods after the shock, yielding a total score between -24 for significantly defying every theoretical prediction and +24 for full and significant compliance.

4. Results

4.1 (Dis)agreement on Shocks

The regression results summarized in Table 3 confirm our ad hoc interpretation of the correlation table. The correlation between shocks that do not share a measure or method is statistically indistinguishable from zero. This is not just a matter of uncertainty in our estimation but the point estimates are indeed close to zero with relatively narrow confidence bounds. While we find positive coefficients for identical or similar modeling choices, the coefficients are small and only statistically significant for identical estimation strategies.

Our baseline model (Equation 1) indicates that only similar measures of monetary policy drive shock similarity in a quantitatively meaningful and statistically significant manner. When distinguishing between similar but not identical vs. identical measures (Equation 2), it seems that this is driven by shocks based on identical measures. However, it has to be kept in mind, that only for interest rates our sample actually includes various measures (namely CHIBOR, repo rates and the deposit benchmark rate). When looking at interest rates only (column 3), we find that identity within group does not matter too much here, but rather that the correlation between interest rate based models is generally low. While the sample size for interest rate only correlations is low, it should be noted that there is not just a lack of significance because the standard errors are larger (as is to be expected in small samples), but that the point estimates are very close to zero. In a similar vein, we assess the subsample where both shocks underlying the correlation coefficient are based on a VAR model. Here, we find that the result persists, i.e., that identical types of VAR do indeed produce results slightly higher correlated than different types of VAR.

Interestingly, overlap between the models in terms of the sample period plays little to no role. Especially given the speed of institutional change in China, it would not have been surprising, if different results were driven by different models focusing on different episodes in Chinese monetary policy. This would then yield differences in the estimated underlying economic dynamics and/or policy reaction functions, which would in turn yield different estimates in periods covered by both samples.[5] Yet, this does not seem to be the case. In the VAR only subsample we find a slightly highly coefficient that borderlines significance. But even if we do take the point estimate at face value, completely identical samples would merely imply a correlation coefficient

[5]It should be noted, that this would still mean that at least one of the two papers considered produces a wrong estimate of the shock in the overlap period by applying an inappropriately parametrised model.

that is 0.0.8 higher than to samples with 50% overlap.[6]

Table 3 Explaining the Correlation of Shocks

	(1)	*(2)*	*(3)*	*(4)*	*(5)*	*(6)*
const	0.021	0.027	0.041	0.022	-0.139	-0.027
	0.340	0.426	0.637	0.416	-0.789	-0.379
(a) $m_i = m_j$	0.269**	0.270**				
	2.208	2.241				
(b) $s_i = s_j$	0.021		0.032			
	0.579		0.942			
(c) $\tilde{m}_i = \tilde{m}_j$				0.457***	0.011	0.411***
				4.254	0.058	3.241
(a) and not (c)				0.060		0.090
				1.563		1.460
(d) $\tilde{s}_i = \tilde{s}_j$				0.0375***	0.062	0.027***
				2.905	0.690	3.501
(b) and not (d)				0.040	0.188	
				1.334	1.325	
overlap c_{ij}	0.065	0.0736	0.119	0.046	0.221	0.164
	0.715	0.842	1.335	0.628	1.273	1.603
Adj R^2	0.190	0.194	0.134	0.312	0.423	0.272
observations	168	168	168	168	21	91

Notes: *** denotes significance at the 1% level. m is the general type of monetary policy measure (such as 'interest rate' or 'money'), and s is the general estimation strategy (DSGE, structural VAR or deviation from policy rule). where ˜m and s˜ denote the exact monetary policy measure (Repo, CHIBOR, M2, etc.) and strategy (FAVAR, STVAR, etc.) respectively. Columns (1) to (4) use the full sample. Column (5) uses only correlations from models both using interest rates, column (6) only uses correlations from models both estimating VARs. Standard error are two-way clustered at the level of each model underlying the correlation.

As a robustness test, we also run models, where we account for impact of papers by looking at their citations. We consider three separate indicators. First, we include a dummy indicating that both papers are well cited (i.e., have more than 10 citations each) to see whether there is more agreement within the more widely cited and thus presumably more "mainstream" papers. Second, we look at the squared difference in the log number of citations. Similarly, this allows to check whether there are clusters of low and high citation papers (again indicating a mainstream and a heterodox line of literature that have within group similarity). Finally, we check a a dummy indicating that one paper received many (again more than 10) citations, while the other paper underlying the correlation coefficient did not. This would pick up, if there are clusters of low citation papers following a high impact paper thus creating similar outcomes. However, all three turn out to be insignificant and are therefore omitted in the benchmark model to avoid over-parametrization. The results can be found in the Appendix in Table A1.

4.2 Economic Plausibility

None of the shocks included in our survey entirely produces the IRFs that we

[6] 0 overlap is not a valid reference point since then the correlation would no longer be defined.

would theoretically expect, see Table 4 for a summary. Both shocks identified by Zhang and Sun (2017) come closest. Still, both of them produce a price puzzle, which becomes more pronounced when the CHIBOR is used to identify monetary policy, and the M2 shock finds interest rate not only returning but dropping (insignificantly) below its original level very quickly. Generally, models using M2 produce more economically plausible results with not a single monetary model producing an overall negative plausibility score. Interest rates perform very mixed, with CHIBOR consistently producing the more plausible results compared to repo rates. Surprisingly, narrative indicators that look into policy making with great scrutiny produce negative scores without exception. However, this does not necessarily imply problems with the measure itself. By construction, the narrative measures are discrete (ordinal) indicators with few abrupt changes. The models that were used to demonstrate their usefulness typically treated them as continuous for simplicity. This might create undesired behavior in the identified shocks. Very much in line with this interpretation, we find similarly implausible results for shocks based on the RRR, which shares the discrete nature of the narrative measures.

Generally, the results regarding money growth and interest rates come much closer to theoretical expectations, than the results regarding GDP and CPI. The prize puzzle, i.e., the negative reaction of CPI that most models find, might be explained by a neo-Fisherian effect. However, given that both CPI and GDP move in the wrong, i.e., theoretically unexpected, direction suggests another explanation, namely the fact that the vast majority of the models are not forward looking.[7] If the central bank is responding to negative future growth and/or inflation expectations, this might easily produce IRFs of the shape that we typically find. This is very much in line with the fact that the only paper that finds a positive response of GDP is the paper by Zhang and Sun (2017) who include indices of consumer and entrepreneur confidence, which are highly related to future growth expectations.

Overall, the average plausibility score is slightly positive, i.e., most papers still “hit” more often than they “miss”. It stands to reason that most shock measures do include some information on monetary policy surprises despite their identification problems.

All the results reported in Table 4 use local projections with four lags of GDP, CPI, money and interest rate, matching the order of magnitude that is typically found in quarterly VARs. In the appendix, we report the corresponding result using a more parsimonious specification with a single lag (see Table A3) and based on the visual inspection described in the previous chapter (see Table A2). While there are some changes, the qualitative results that are interpreted in the previous paragraphs remain unchanged.

4.3 Robustness to Data Reliability Issues

In the past, the reliability of Chinese GDP and CPI data has been questioned. On the one hand, there is quite a large literature arguing that Chinese data is overall reliable (see most notably the paper by Chow (2006) in defense of Chinese GDP

[7] The DSGE by Funke and Tsang (2021) does of course feature forward looking behavior, but no actually forward looking variables are included, i.e., future expectations are determined by the past development of the observable variables.

statistics), its quality is improving over time (Fernald et al.; 2021), and a recent comparison by Owyang and Shell (2017) suggests that Chinese data is above average quality for a country of China's development. While there seems potential for manipulating data, Holz (2014) shows the evidence at the federal level speaks against deliberate data manipulation, although things might be different at the regional level as argued by Chen et al. (2019). At the same time, while trends seem to accurately reflect the true development, short term fluctuations seem to be substantially understated (Nakamura et al.; 2016; Chenet al.; 2019; Lai and Zhu; 2022).

To account for this possiblity, we run our local projections with alternative measures to capture output fluctuations and prices. For prices, we use the producer price index (mostly based on anecdotal evidence regarding its superior accuracy), and we substitute production by the China Cyclical Activity Tracker (China CAT) proposed by (Fernald et al.; 2021) (available through the Federal Reserve Bank's website),[8] all the results are reported in Table 5. By and large, our results are robust. The forward looking models by Zhang and Sun (2017) are now ranked second and third (rather than first and second). While we no longer find that all papers using M2 are in the top half of the field, money still performs clearly better on average. The IRFs of the China CAT are not quite as implausible as the IRFs of GDP, but still clearly one of the weak spots of most papers.

[8] Additionally, we run a robustness test where – in the spirit of The Economist's Keqiang index – we use electricity production. The Keqiang index itself is not available for a sufficiently long time period. The results are largely the same and available from the authors on request.

Table 4 Plausibility Scores Based Local Projections with 4 lags; h=0 to h=2

Paper	***Variable***	***n***	***GDP***			***M2***			***CPI***			***Repo***			***Σ***
			h = 0	***h = 1***	***h = 2***	***h = 0***	***h = 1***	***h = 2***	***h = 0***	***h = 1***	***h = 2***	***h = 0***	***h = 1***	***h = 2***	
Zhang and Sun (2017)	M2	54	1	2	1	2	2	2	-1	1	1	1	-1	-1	10
Zhang and Sun (2017)	CHIBOR	54	1	1	1	2	2	2	-1	-1	-1	2	1	1	10
Breitenlechner and Nuutilainen (2017)[1]	DBR	46	1	1	-1	1	1	1	-1	1	1	1	1	1	8
Chen et al. (2018)	M2	78	-1	1	1	2	2	2	-1	-1	-1	2	1	-1	6
He et al. (2013)	M2	47	-1	-1	-1	2	1	1	1	-1	-1	2	1	1	4
Lien et al. (2021)	CHIBOR	64	-1	-1	-1	1	1	1	-1	-1	-1	2	2	2	3
Fu and Wang (2020)	M2	66	-1	-1	-1	2	2	1	1	1	2	1	-2	-2	3
Lien et al. (2021)	M2	64	-2	-1	-1	2	1	1	1	1	1	1	-1	-1	2
Funke and Tsang (2021)	Factor	26	-1	-1	-1	1	1	1	-1	1	-1	1	1	1	2
Fu and Wang (2020)	Repo	66	-1	-1	-1	1	1	1	-1	-1	-1	2	2	1	2
Breitenlechner and Nuutilainen (2017)[1]	RRR	46	1	1	-1	-1	1	1	-1	-1	-1	1	1	1	2
Klingelho¨fer and Sun (2018)[4]	narrative	62	1	-1	1	-1	-1	-1	1	1	1	1	-1	-1	0
El-Shagi and Jiang (2023)	LBR	35	-1	-1	-1	-1	1	2	-2	-1	-1	2	2	1	0
Klingelho¨fer and Sun (2019)	narrative	62	-1	-1	1	-1	-1	1	-1	-2	-1	1	1	1	-3
Zhang et al. (2021)	treasury futures	42	-1	-1	-1	1	1	1	-2	-1	-1	1	-1	1	-3
Funke and Tsang (2021)	Repo	26	-1	-1	-1	-1	-1	1	-1	1	-1	-1	1	1	-4
Klingelho¨fer and Sun (2018)[3]	narrative	62	-1	-1	-1	-1	-1	-1	-1	-1	1	1	1	1	-4
El-Shagi and Jiang (2023)	Repo	35	-1	-1	-1	1	-1	-1	1	-1	-2	2	-1	1	-4
Breitenlechner and Nuutilainen (2017)	RRR[2]	46	-1	-1	-1	1	-1	-1	1	-1	-1	-1	1	1	-4
Chen and Tillmann (2021)	narrative	69	-1	-1	1	-1	-1	-1	-1	-2	-2	1	1	2	-5
Breitenlechner and Nuutilainen (2017)	DBR[2]	46	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	1	-1	-8
Mean			-0.57	-0.48	-0.43	0.53	0.43	0.62	-0.52	-0.43	-0.48	1.14	0.52	0.48	

Notes:[1] - loan supply based policy,[2] - loan supply based policy,[3] - OLS model, [4]- MRTR model

4.4 Subsamples

To some degree, the result we find might be driven by the major changes in monetary policy in China. We therefore also assess whether the plausibility changes, when we only consider macroeconomic data from before or after the global financial crisis respectively. Our results are by and large confirmed for the subsample studies. There is, however, one remarkable difference. While narrative indicators perform extremely bad in the pre-crisis period (Table 7), they perform quite well in the post-crisis period (Table 6), to the degree that the most plausible model is now based on a narrative index. This might indicate that the PBoC became substantially more transparent in the past years, making their statements of intended outcomes more meaningful than they were in the early years of our sample.

5. Conclusions

Since the reform and opening up, China's monetary policy has undergone a transformation from a planned economy to a market economy, and has gradually formed a policy framework based on quantitative tools. However, with the rapid development and increasing instability of China's economy, the complexity of monetary policy has increased, making it more difficult to accurately identify monetary policy shocks in macroeconomic models. Although the macroeconomic literature on China has emancipated itself from the roots in the analysis of Western central banks and tries to account for Chinese characteristics, we are still far from a consensus regarding the appropriate way to identify monetary policy shocks.

In order to improve our understanding of the PBoC, we explore the measurement and identification of the Chinese monetary policy shocks. We extract monetary policy shocks from the literature related to the transmission of Chinese monetary policy. In a first step we assess the correlation between those shocks and the reasons for high and low correlation between the different estimates of the monetary policy shock. In a second step, we integrate all shocks into a unified framework using local projections. Based on whether the transmission effects of these monetary policy shocks on macroeconomic variables align with economic expectations, the paper establishes a scoring system to compare the quality of different monetary policy shocks.

Table 5 Plausibility Scores Based Local Projections with 4 lags; *h* = 0 to *h* = 2 Using Alternative Outcome Measures

Paper	***Varibale***	***n***	***China CAT***			***M2***			***R1dRepo***			***PPI***			***Σ***
			h=0	***h=1***	***h=2***	***h=0***	***h=1***	***h=2***	***h=0***	***h=1***	***h=2***	***h=0***	***h=1***	***h=2***	
Chen et al. (2018)	*M2*	78	1	1	1	2	2	2	2	2	2	2	1	1	19
Zhang and Sun (2017)	*M2*	54	2	1	1	2	2	2	1	2	2	1	-1	1	16
Zhang and Sun (2017)	*CHIBOR*	54	1	-1	1	2	2	2	1	1	1	2	1	1	14
Fu and Wang (2020)	*M2*	66	1	1	1	2	2	1	1	1	1	1	-1	-1	10
Lien et al. (2021)	*M2*	64	1	-1	-1	2	2	1	1	1	1	1	-1	-1	6
Fu and Wang (2020)	*Repo*	66	-1	-1	-1	2	2	1	-1	-1	-1	2	2	2	5
Klingelhöfer and Sun (2019)	*narrative*	62	-1	-1	1	-1	-1	1	1	1	1	1	1	2	5
Klingelhöfer and Sun (2018)[3]	*narrative*	62	-1	-1	-1	1	-1	1	1	1	1	1	1	1	4
Lien et al. (2021)	*CHIBOR*	64	-1	-1	-1	1	2	1	-1	-1	-1	2	2	2	4
Klingelhöfer and Sun (2018)[4]	*narrative*	62	-1	-1	-1	1	-1	-1	1	1	1	1	1	1	2
Chen and Tillmann (2021)	*narrative*	69	-1	-1	-1	-1	-1	1	1	1	-1	1	2	2	2
El-Shagi and Jiang (2023)	*Repo*	35	-1	-1	1	1	1	1	-1	-1	-1	2	-1	1	1
Breitenlechner and Nuutilainen (2017)[1]	*DBR*	46	-1	-1	-1	1	1	1	-1	-1	-1	2	1	1	1
El-Shagi and Jiang (2023)	*LBR*	35	-1	-1	-1	-1	1	2	-1	-2	-1	2	2	1	0
Funke and Tsang (2021)	*Factor*	26	-1	-1	1	1	1	1	-1	-1	-1	1	1	-1	0
He et al. (2013)	*M2*	47	1	-1	-2	2	1	1	1	1	1	-1	-2	-2	0
Breitenlechner and Nuutilainen (2017)[1]	*RRR*	46	-1	-1	-2	1	1	1	-1	-1	-1	1	1	1	-1
Funke and Tsang (2021)	*Repo*	26	-1	-1	-1	-1	-1	1	1	1	-1	-1	-1	1	-4
Breitenlechner and Nuutilainen (2017)[2]	*RRR*	46	-1	-1	-1	1	-1	-1	1	1	1	-1	-1	-1	-4
Breitenlechner and Nuutilainen (2017)[2]	*DBR*	46	-1	-2	-2	-1	-1	-1	-1	-1	-1	1	1	-1	-10
Mean			-0.35	-0.75	-0.45	0.85	0.65	0.9	0.25	0.25	0.1	1.05	0.45	0.55	3.5

Notes: 1 - loan supply based policy, 2 - loan supply based policy, 3 - OLS model, 4 - MRTR mod

Table 6 Plausibility Scores Based Local Projections with 4 lags for Subsamples after Crisis; *h* = 0 to *h* = 2

Paper	*Varibale*	*n*	*GDP*			*M2*			*CPI*			*Repo*			*Σ*
			h=0	*h=1*	*h=2*	*h=0*	*h=1*	*h=2*	*h=0*	*h=1*	*h=2*	*h=0*	*h=1*	*h=2*	
Chen and Tillmann (2021)	narrative	36	-1	-1	-1	2	2	1	2	1	-1	2	-1	-1	4
Fu and Wang (2020)	M2	32	1	1	1	2	1	-1	1	-1	1	1	-2	-1	4
Fu and Wang (2020)	Repo	32	-2	-2	-1	2	2	1	1	1	-1	2	-1	1	3
El-Shagi and Jiang (2023)	Repo	28	-1	-1	1	1	1	-1	1	1	1	2	-1	-1	3
Breitenlechner and Nuutilainen (2017)[2]	DBR	26	1	1	1	-1	-1	1	1	-2	1	1	-1	1	3
Funke and Tsang (2021)	Factor	26	-1	-1	-1	1	1	1	-1	1	-1	1	1	1	2
Breitenlechner and Nuutilainen (2017)[2]	RRR	26	1	1	1	1	-1	-1	-1	-1	1	1	-1	1	2
Zhang and Sun (2017)	M2	31	-1	-1	-1	2	1	1	-1	-1	1	1	-1	1	1
Zhang and Sun (2017)	CHIBOR	31	-2	-2	-1	1	1	1	-1	1	-2	2	1	1	0
Lien et al. (2021)	M2	27	-1	-1	1	1	-1	-1	1	-1	1	1	-1	1	0
Klingelhöfer and Sun (2019)	narrative	38	1	-1	1	1	-1	-1	1	-1	1	-1	-1	1	0
Chen and Tillmann (2021)	narrative	36	-1	-1	-1	1	1	1	-1	-1	-1	-1	1	1	-2
Lien et al. (2021)	CHIBOR	27	-1	-1	-1	1	1	-1	1	1	-1	1	-1	-1	-2
Klingelhöfer and Sun (2018)[3]	narrative	23	-1	-1	1	-1	-1	1	1	1	-1	-1	1	-1	-2
Klingelhöfer and Sun (2018)[4]	narrative	23	-1	-1	1	-1	-1	1	1	1	-1	-1	1	-1	-2
El-Shagi and Jiang (2023)	LBR	28	-1	-1	-1	-1	-1	1	1	-1	-1	1	1	1	-2
Breitenlechner and Nuutilainen (2017)[1]	RRR	26	1	1	1	-1	-2	1	-1	-1	-1	-2	1	1	-2
Funke and Tsang (2021)	Repo	26	-1	-1	-1	-1	-1	1	-1	1	-1	-1	1	1	-4
Breitenlechner and Nuutilainen (2017)[1]	DBR	26	1	1	1	-1	-2	-1	-1	-1	-1	-2	1	1	-4
Zhang et al. (2021)	treasury futures	40	-1	-1	-1	1	-1	1	-1	-1	-1	-1	-1	1	-6
mean			-0.5	-0.6	0	0.5	-0.1	0.3	0.15	-0.15	-0.35	0.3	-0.15	0.4	

Notes: [1] - loan supply based policy, [2] - loan supply based policy, [3] - OLS model, [4] - MRTR mode

Table 7 Plausibility Scores Based Local Projections with 4 lags for Subsamples Before Crisis; *h* = 0 to *h* = 2

Paper	*Varibale*		*GDP*			*M2*			*CPI*			*Repo*			*Σ*
			h=0	*h=1*	*h=2*	*h=0*	*h=1*	*h=2*	*h=0*	*h=1*	*h=2*	*h=0*	*h=1*	*h=2*	
Chen et al. (2018)	M2	40	-1	-1	-1	2	2	2	-1	-1	-1	2	2	1	5
Fu and Wang (2020)	M2	34	-1	-1	1	2	2	1	-1	-1	1	2	1	-1	5
Zhang and Sun (2017)	M2	34	1	1	-1	1	-1	-1	1	1	1	1	1	-1	4
Lien et al. (2021)	CHIBOR	37	-1	1	1	1	1	1	-1	-1	-1	1	1	1	4
Zhang and Sun (2017)	CHIBOR	23	1	1	2	-1	1	1	-1	-1	-2	-1	1	1	2
He et al. (2013)	M2	23	-1	-1	-1	2	1	1	1	-1	-1	2	1	-1	2
Fu and Wang (2020)	Repo	34	-1	-1	-1	1	1	1	1	-1	-1	2	1	-1	1
Lien et al. (2021)	M2	37	-2	-1	-1	2	1	1	-1	-2	-1	1	1	1	-1
Klingelhöfer and Sun (2018)[4]	narrative	39	1	1	1	-1	-1	-1	-1	-1	1	-1	-1	-1	-4
Klingelhöfer and Sun (2019)	narrative	38	-1	-2	-1	-1	-1	1	-1	-1	-1	1	1	1	-5
Chen and Tillmann (2021)	narrative	33	-1	-1	1	-1	-1	1	-1	-1	-1	-1	-1	1	-6
Klingelhöfer and Sun (2018)[3]	narrative	39	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	-1	1	-10
Mean			-0.583	-0.417	-0.083	0.500	0.333	0.583	-0.500	-0.917	-0.583	0.667	0.583	0.167	

Notes: [3] - OLS model, [4] - MRTR model

Our findings give some pointers regarding the most promising directions of how to better understand the PBoC and its policy.

First, similarity between shocks is largely driven by similar (or identical) measures of policy rather than by similar identification strategy. In other words the key issue is not that macroeconomic dynamics are wrongly captured by standard models, but that we need to understand which tools the PBoC truly employs. Second, the macroeconomic effects of quantity-based monetary policy shocks are consistent with economic expectations. This confirms the importance of monetary aggregates in identifying monetary policy shocks in China despite the growing importance of interest rates in the past decades. Finally, the most reasonable results are produced by shocks that include expectations, which point to the necessity to use forward-looking models when assessing the PBoC's behavior.

APPENDIX

Table A1 Explaining the Correlation of Shocks

	(1)	*(2)*	*(3)*
const	0.017	0.017	0.031
	0.238	0.236	0.447
$m_i = m_j$	0.266**	0.271**	0.267**
	2.096	2.137	2.101
$s_i = s_j$	0.025	0.022	0.022
	0.405	0.353	0.357
overlap c_{ij}	0.049***	0.065***	0.061***
	6.449	8.529	8.028
citations for both > 10	0.048		
	0.469		
square log diff of citations		0.001	
		0.006	
citations for one > 10			-0.015
			-0.150
R^2	0.192	0.186	0.187
observation	168	168	168

Notes:$***$ denotes significance at the 1% level. m is the general type of monetary policy measure (such as ‘interest rate’ or ‘money’), and s is the general estimation strategy (DSGE, structural VAR or deviation from policy rule

Table A2 Plausibility Scores Based on Visual Inspection

Paper	*Variable*	*GDP*	*M2*	*CPI*	*Repo*	*Σ*
Breitenlechner and Nuutilainen (2017)1	DBR	1	1.5	1	1	4.5
Chen et al. (2018)	M2	2	2	0	0	4
Breitenlechner and Nuutilainen (2017)	CHIBOR	1.5	2	-1	1	3.5
Breitenlechner and Nuutilainen (2017)	M2	2	2	0	-1	3
Klingelho¨fer and Sun (2019)	narrative	1.5	1.5	-1.5	1	2.5
He et al. (2013)	M2	0	1.5	-1.5	2	2
Fu and Wang (2020)	Repo	-0.5	2	-2	2	1.5
Lien et al. (2021)	CHIBOR	-1	2	-1.5	2	1.5
Breitenlechner and Nuutilainen (2017)1	RRR	-1	1.5	-1.5	1.5	0.5
Chen and Tillmann (2021)	narrative	1.5	-1	-1.5	1	0
El-Shagi and Jiang (2023)	LBR	-1	1	-2	2	0
Fu and Wang (2020)	M2	-2	2	2	-2	0
Lien et al. (2021)	M2	-2	2	1.5	-1.5	0
Zhang et al. (2021)	treasury futures	-1	1	-0.5	0.5	0
Funke and Tsang (2021)	Factor	-2	2	-1.5	1	-0.5
Funke and Tsang (2021)	Repo	0	-1	-1	1.5	-0.5
Breitenlechner and Nuutilainen (2017)	RRR2	0	0.5	-1.5	0	-1
Breitenlechner and Nuutilainen (2017)	DBR2	-1	-1	-1.5	2	-1.5
Klingelho¨fer and Sun (2018)3	narrative	-1.5	-1	-0.5	1	-2
El-Shagi and Jiang (2023)	Repo	-1	-1	-1.5	1	-2.5
Klingelho¨fer and Sun (2018)4	narrative	-1	-2	1.5	-1.5	-3
Mean		-0.26	0.83	-0.7	0.7	

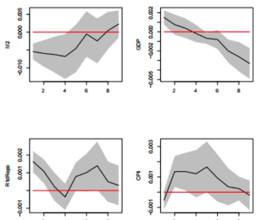
Notes: [1] - loan supply based policy, [2] - loan supply based policy, [3] - OLS model, 4 - MRTR model

Table A3 Plausibility Scores Based on Local Projections with One Lag

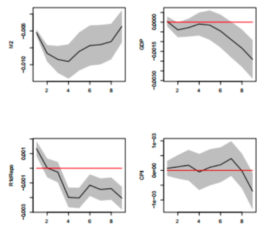
Paper	*Variable*	*n*	*GDP*			*M2*			*CPI*			*Repo*			*Σ*
			***h* = 0**	***h* = 1**	***h* = 2**	***h* = 0**	***h* = 1**	***h* = 2**	***h* = 0**	***h* = 1**	***h* = 2**	***h* = 0**	***h* = 1**	***h* = 2**	
Breitenlechner and Nuutilainen (2017)[1]	DBR	46	2	2	2	1	2	2	-2	-2	-1	2	2	2	12
Zhang and Sun (2017)	M2	54	2	2	2	2	2	2	-2	-2	-1	2	1	1	11
Zhang and Sun (2017)	CHIBOR	54	1	2	2	2	2	2	-2	-2	-2	2	2	2	11
Chen et al. (2018)	M2	78	-1	1	1	2	2	2	-1	-1	-1	2	1	1	8
Breitenlechner and Nuutilainen (2017)[1]	RRR	46	1	1	1	1	2	2	-2	-2	-2	2	2	2	8
Funke and Tsang (2021)	Factor	26	-1	-1	-1	1	2	1	-1	2	-1	2	1	1	5
Lien et al. (2021)	CHIBOR	64	-1	-1	-1	2	2	2	-2	-2	-2	2	2	2	3
He et al. (2013)	M2	47	-1	-1	-1	2	2	2	-1	-1	-1	2	1	-1	2
Fu and Wang (2020)	Repo	66	-1	-1	-1	1	1	1	-1	-1	-2	2	2	2	2
El-Shagi and Jiang (2023)	LBR	35	-1	-1	1	-1	1	1	-1	-1	-1	2	2	1	2
Breitenlechner and Nuutilainen (2017)[2]	RRR	46	-1	-1	1	1	1	1	1	-1	-1	-1	1	1	2
Breitenlechner and Nuutilainen (2017)[2]	DBR	46	-1	1	1	1	1	1	-2	-2	-2	2	1	1	2
Fu and Wang (2020)	M2	66	-1	-1	-1	2	2	2	-1	-1	1	1	-1	-1	1
El-Shagi and Jiang (2023)	Repo	35	1	-1	1	1	1	-1	-1	-1	-1	2	-1	1	1
Klingelho¨fer and Sun (2018)[3]	narrative	62	-1	-1	-1	-1	-1	-1	1	1	1	1	1	1	0
Klingelho¨fer and Sun (2019)	narrative	62	-1	-1	1	-1	1	1	-1	-2	-2	1	1	2	-1
Lien et al. (2021)	M2	64	-1	-1	-1	2	2	1	-1	-1	-1	1	-1	-1	-2
Funke and Tsang (2021)	Repo	26	1	-1	-1	-1	-1	1	-1	1	-1	-1	1	1	-2
Chen and Tillmann (2021)	narrative	69	-1	-1	1	-1	-1	1	-1	-2	-2	1	1	2	-3
Klingelho¨fer and Sun (2018)[4]	narrative	62	-1	-1	-1	-1	-1	-1	1	1	1	-1	-1	-1	-6
Zhang et al. (2021)	treasury futures	42	-1	1	-1	1	-1	-1	-2	-1	-1	-1	-1	1	-7
	Mean		-0.33	-0.19	0.19	0.76	1	1	-1.05	-0.95	-1.05	1.19	0.81	0.95	

Notes: 1 - loan supply based policy, 2 - loan supply based policy, 3 - OLS model, 4 - MRTR model

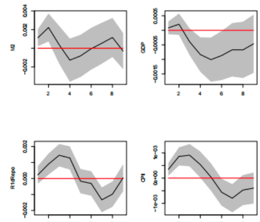
Figure A2 Overall Caption for the Figure



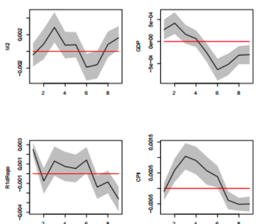
(a) He et al. (2013)



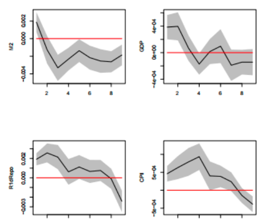
(b) Chen et al. (2018)



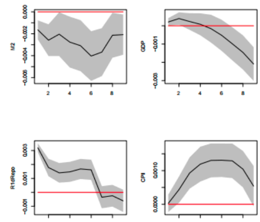
(c) Chen and Tillmann (2021)



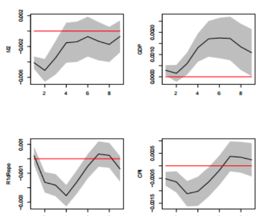
(d) El-Shagi and Jiang (2023)(Repo)



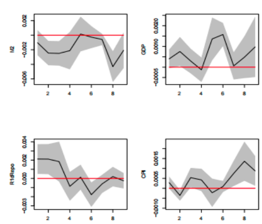
(e) El-Shagi and Jiang (2023)(LBR)



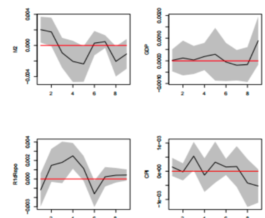
(f) Fu and Wang (2020)(Repo)



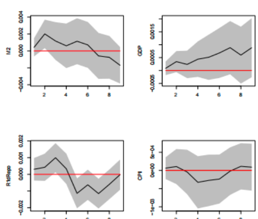
(g) Fu and Wang (2020)(M2)



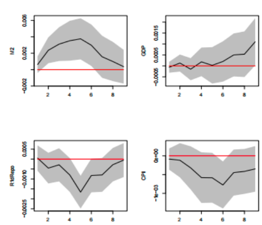
(h) Funke and Tsang (2021)(Factor)



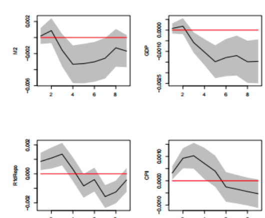
(i) Funke and Tsang (2021)(Repo)



(j) Klingelhöfer and Sun (2018)(OLS)

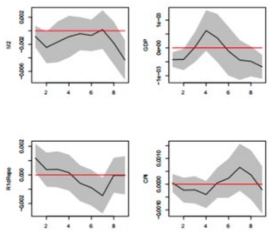


(k) Klingelhöfer and Sun (2018)(MRTR)

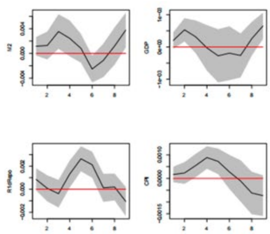


(l) Klingelhöfer and Sun (2019)

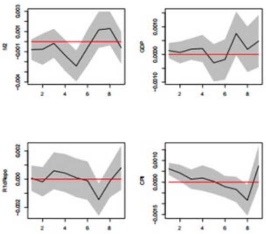
Figure A2 Overall Caption for the Figure (Continued)



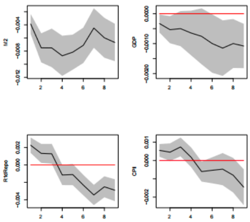
(s) Breitenlechner and Nuutilainen (2017)(DBR[1])



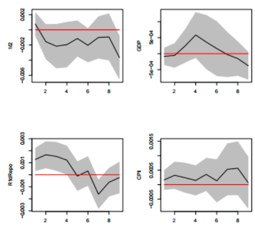
(t) Breitenlechner and Nuutilainen (2017)DBR[2]



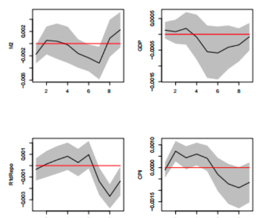
(u) Zhang et al. (2021)



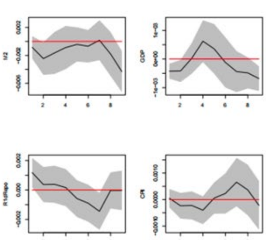
(p) Zhang and Sun (2017)(CHIBOR)



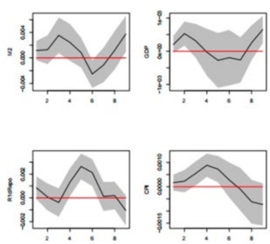
(q) Breitenlechner and Nuutilainen (2017)(RRR[1])



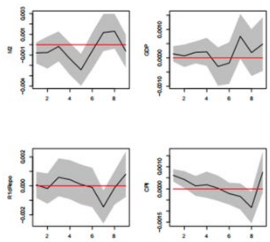
(r) Breitenlechner and Nuutilainen (2017)(RRR[2])



(s) Breitenlechner and Nuutilainen (2017)(DBR[1])



(t) Breitenlechner and Nuutilainen (2017)DBR[2]



(u) Zhang et al. (2021)

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