Effectiveness and Functional Orientation of Monetary Policy Intermediate Targets: Evidence from China

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Background

1. Creation of AFRE

- In the pipeline of the 4-trillion policy to stimulate the economy, shadow banking business of commercial banks expanded rapidly, which greatly enriched financing channels of enterprises while evading financial regulations.
- To learn from lessons of the crisis — backwardness that financial statistics is insufficient to reflect financial changes;
- To comprehensively account for the growing financial innovations, including financial products and institutions, etc.;
- To strengthen macro-prudential management, the People's Bank of China (PBC) introduced the indicator of aggregate financing to the real economy (AFRE, hereafter) for the first time in 2011.

Background

2. Target Transformation and Functional Orientation

- As a monitoring indicator
  - Since the creation, the Chinese government has always emphasized to "maintain a reasonable growth in the scale of AFRE".
- As an intermediate target comparable to M2
  - Set targets for its growth rate in relation to M2 in 2016 (both around 13%) and 2017 (both around 12%)
- Target Transformation
  - Since 2019, the Chinese government has scrapped its original growth plans for both M2 and AFRE and adjusted them to "keep the growth rates of M2 and AFRE basically in line with the nominal economic growth".
- Functional Orientation
  - From then on, China's monetary policy intermediate target function will not rely on the expected growth target, but on growth matching target.

Research Questions

- Is this blurring in the targeting scheme a deliberate avoidance because AFRE is no longer effective, or an intention for other reasons?
- If deliberate, is it reasonable and effective to adjust the expected growth target to a growth matching target?
- Could it fulfil the function of an intermediate target?

Literature Review and Comments

1. Assessment of Intermediate Targets

- Three Criteria
  - measurability, controllability, and relevance (Belongia & Batten, 1992; Sheng et al., 2016).
- Target Transformation
  - Before the international financial crisis, academics generally supported the status of M1 (Y. Jiang et al., 2005; Geng & Hui, 2009).
  - With the advancement of interest rate liberalization, many studies verify the transmission to interest rates (He & Wang, 2012; Fu & Ho, 2022) and support the rule of interest rates which could be operational or intermediate targets (Laurens & Maino, 2007; Li & Wang, 2020), and declaring limitations of M1 as an intermediate target (Liu & Zhang, 2010).
  - Some studies still support the output effects of quantitative indicators or rules represented by M2 in China (K. Chen et al., 2016; Li & Liu, 2017).

Literature Review and Comments

2. Importance of the Credit Channel

- Shortcomings of the Money View and its incompatibility with China's current situation, the Credit View would be a good supplement to it (Sheng, 2013; Sheng & Xie, 2016).
- The credit channel has been important (Pan & Tao, 2006; Li et al., 2021) due to a special financial system dominated by commercial banks.
- Its effectiveness has been investigated in different perspectives, such as role of state-owned enterprises (H. Chen et al., 2019) and bank heterogeneity (Bashir et al., 2020), BigTech banking (Huang et al., 2022), interbank wholesale funding markets (K. Chen et al., 2022), interbank behaviors (H. Jiang et al., 2023).

Literature Review and Comments

2. Importance of the Credit Channel (Two Key Studies, Cont'd)

- Breitenlechner & Nuutilainen (2023) investigated the credit supply and demand two major dynamics of monetary policy transmission in loan markets based on a FAVAR model with zero and sign restriction identification using Chinese macro data from 2004M10 to 2016M6.
  - Results confirmed that the credit channel was an important channel for market-based policy instruments.
- Sheng & Xie (2016) referred to the New Keynesian paradigm and constructed a SVAR model using macro monthly data from 2002 to 2014, which was identified by the short-run zero restrictions under the economic assumptions.
  - Effectiveness of AFRE was better than that of RMB loans, highly consistent with M2, and could be used as a new intermediate or detective target.

Literature Review and Comments

3. Comments

- Despite considerable international research on the credit channel and domestic academics on AFRE as an intermediate target, global understanding of AFRE is still limited, especially lack of understanding of the PBC and specially its policy adjustments.
- Deficiencies of Sheng & Xie (2016):
  - though considering the impact of interest rate liberalization, the interest rate as an intermediate target neglected;
  - deficiencies in the model identification methodology led to the construction of multiple models to analyze the controllability and relevance of intermediate targets;
  - potential *price puzzle* would be overlooked

Our Work and Contribution

1. Our Work

- Construct a SVAR model identified by imposing sign and zero restriction based on directed acyclic graphs (DAGs) and using China's macro data from 2003M1 to 2022M12.
- Four endogenous variables are included in the model, i.e., (1) monetary policy, (2) monetary policy intermediate targets including interest rate, M2 and AFRE respectively, (3) output, (4) price level.
- Examine our conjecture using spread scissors between AFRE and M2 in TVP-VAR model incorporating interest rate as well as in time-varying Granger causality (TVGC) test.

Our Work and Contribution

2. Contribution

- Provide a novel identification method to overcome *price puzzle* under a unified modelling framework to assess effectiveness of different intermediate targets.
- Based on the results of the impulse responses, we formulate and confirm the conjecture and uncover more findings on the policy adjustments of the PBC.
- Provide robust empirical evidence for target transformation and orientation adjustment of PBC's monetary policy.

Contents

DAG-VAR-SR

- Generally, a SVAR model lagged p incorporating k internal variables could be written as,

$$\Gamma_0 y_t = \delta + \sum_{i=1}^{p} B_i y_{t-i} + e_t \tag{1}$$

where,

Γ_0: contemporaneous relation matrix

$\{y_t\}_{t=1}^{T}$: a column vector of k dimensions

δ: an intercept vector

$B_i\,(i = 1, \cdots, p)$: coefficient matrices needed estimation

$\{e_t\}$: a random disturbance sequence (also called as structural shock vector, or innovations) following white noise: $e_t \sim \left(0, \Sigma_k \Sigma_k^{'}\right)$.

DAG-VAR-SR

- Transform SVAR into reduced-form,

$$y_t = c + \sum_{i=1}^{p} \phi_i y_{t-i} + u_t \tag{2}$$

where,

$c = \Gamma_0^{-1}\delta$, $u_t = \Gamma_0^{-1} e_t$, $\phi_i = \Gamma_0^{-1} B_i \, (i = 1, \cdots, p)$

Since $\{e_t\}$ follows white noise, $\{u_t\}$ as a name of reduced shock vector, has zero means, constant variances/covariances, and little autocorrelation: $u_t \sim (0, \Omega)$.

- Traditional identification: Cholesky factorization

DAG-VAR-SR

- Identification Method Update
  - To impose short-run zero restrictions on structural matrices according to economic theory (Blanchard & Watson, 1986);
  - To impose constraints on the parameters of IRFs, e.g., long-run zero restriction (Blanchard & Quah, 1989);
  - To ensure "data talks", an innovative method of directed acyclic graph (DAG) is proposed to overcome drawbacks mentioned (Swanson & Granger, 1997; Spirtes et al., 2000; Bessler & Lee, 2002).
- Backwardness of DAG-SVAR (or Data-determined Constraints)
  - may not always align with economic theory and empirical knowledge;
  - may not accurately reflect the actual functioning of the economy;
  - even overlook or confuse contemporaneous causal relationships between variables.

DAG-VAR-SR

- Intro. and Adv. of SR
  - Allow for a reasonable integration of constraints driven by economic theory or empirical evidence with zero restriction based on DAG (data-determined constraints). Specifically,
  1. Pre-setting signs of confirmed impulse responses (IRs) can effectively avoid puzzles, e.g., *price puzzle* (Sims, 1992), while leaving rest shocks of interest with signs of unknown IRs unrestricted to let "data talks" as much as possible.
  2. Based on SR, the order of variables in SVAR does not affect the estimation results, making the empirical findings more robust.

TVP-VAR-SV

- Without loss of generality, Ω can be reduced by a lower triangular matrix Γ_0^{-1} as $\Gamma_0 \Omega \Gamma_0^{'} = \Sigma_k \Sigma_k^{'}$, so Eq.(2) can be rewritten as through factorization in a compact form:

$$y_t = X_t \beta_t + \Gamma_t^{-1} \Sigma_t \varepsilon_t, \ \varepsilon_t \sim (0, I_k) \tag{3}$$

- Let κ_t be a stacked vector of elements in Γ_0^{-1} and denote h_{jt} by $\log \sigma_{jt}^2$, σ_{jt} as the elements in Σ_t. Parameters are set as follows,

$$\begin{aligned} \beta_{t+1} &= \beta_t + \nu_t \\ \kappa_{t+1} &= \kappa_t + \zeta_t \\ h_{t+1} &= h_t + \eta_t \end{aligned} \qquad \begin{pmatrix} \varepsilon_t \\ \nu_t \\ \zeta_t \\ \eta_t \end{pmatrix} \sim N \left(0, \begin{pmatrix} I_k & 0 & 0 & 0 \\ 0 & V & 0 & 0 \\ 0 & 0 & S & 0 \\ 0 & 0 & 0 & W \end{pmatrix} \right)$$

Contents

Empirical Data

- Fundamental Model:

$$y_i = f[r,\ MPI_i,\ q,\ p]'$$

- Data: monthly; 2003M1–2022M12 (240 obs.)

	r	*i*	*m2*	*afre*	*q*	*p*
Mean	2.697	2.791	14.421	23.086	10.309	2.488
Median	2.555	2.599	13.621	20.983	9.683	2.131
Maximum	6.951	6.945	29.622	63.325	2.966	8.894
Minimum	0.832	0.833	7.850	9.644	-2.795	-1.879
S.D.	0.924	0.882	4.827	12.588	4.819	1.842
ADF (20)	-2.935**	-2.932**	-3.355*	-4.417***	-6.217***	-3.578**
KPSS	0.336***	0.360**	0.143**	0.108***	0.076***	0.054***

Table 1: Data Description

Contents

DAG

1. Generate a correlation matrix of residuals of a five-variable VAR;
2. Compute (conditional) correlation coefficients by PC-algorithm TETRAD II;
3. Determine the existence and directionality of their contemporaneous causal relationships at a significance level of 20% to Model (a) & (b) (Spirtes et al., 2000), but 30% to (c) (Awokuse & Bessler, 2003):

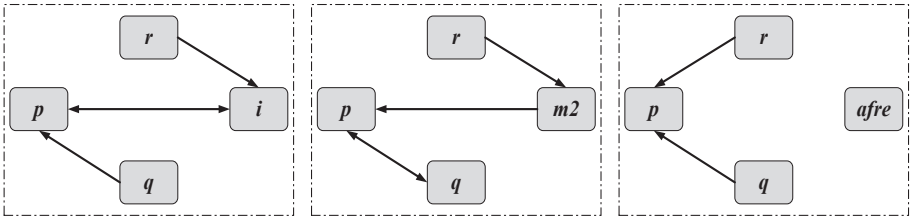
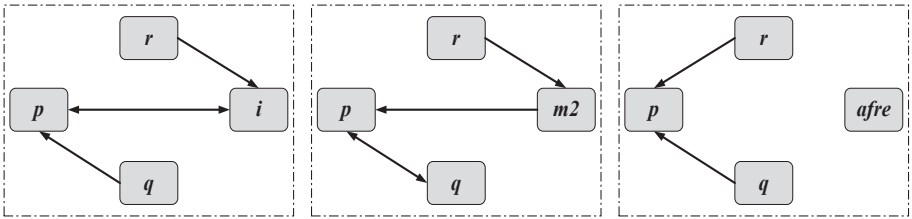


Figure 1: DAGs of Three Models

Hybrid Restriction on DAG

- Basic Principles of Imposing Restrictions
  1. When contemporaneous causality exists, ignore the directionality of causality and use it as a reference for sign restrictions;
  2. When no causality exists,impose zero restrictions, but for the price level, we impose sign restrictions uniformly and empirically to ensure the results comparable with each other.



Hybrid Restriction on DAG

1. No direct and contemporaneous impact of financial variables on the output;
2. To solve *price puzzle*, we loosen assumptions that financial variables have temporary impact on the price directly;
3. An increase of base rate has a positive impact on rates of the monetary markets, and vice versa;
4. Positive shocks from base rate could cause money supply decline but money demand unaffected;
5. As to base rate, no restrictions are set on positive shocks from funding demand or supply side to ensure the results compared.

Hybrid Restriction on DAG

	shock source	*r*	*i*	*m2*	*afre*	*q*	*p*
Model (a)	*base rate*	>0	>0			$\begin{cases}0, k\epsilon[0,K]\\ ?, k>K\end{cases}$	<0
	monetary market	>0	>0			$\begin{cases}0, k\epsilon[0,K]\\ ?, k>K\end{cases}$	<0
Model (b)	*base rate*	>0		<0		$\begin{cases}0, k\epsilon[0,K]\\ ?, k>K\end{cases}$	<0
	funding supply	?		>0		$\begin{cases}0, k\epsilon[0,K]\\ ?, k>K\end{cases}$	>0
Model (c)	*base rate*	>0			$\begin{cases}0, k\epsilon[0,K]\\ ?, k>K\end{cases}$	$\begin{cases}0, k\epsilon[0,K]\\ ?, k>K\end{cases}$	<0
	funding demand	?			>0	$\begin{cases}0, k\epsilon[0,K]\\ ?, k>K\end{cases}$	>0

Figure 2: Patterns of Hybrid Restriction

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Evaluation of Controllability for Intermediate Targets

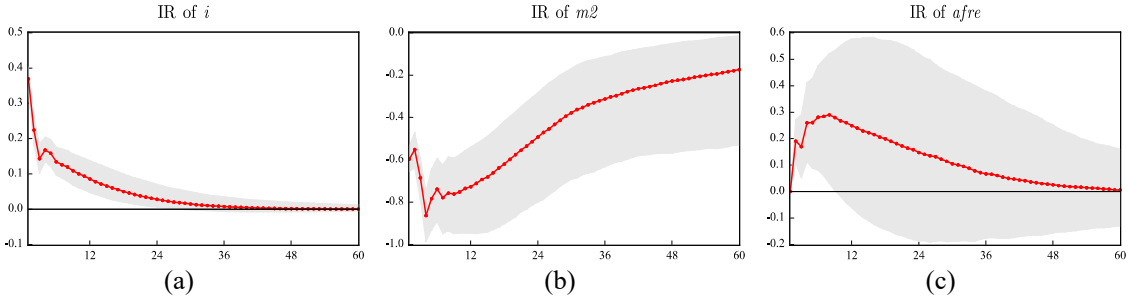


Figure 3: Impulse Responses of MPI to Shocks from the Base Rate

Evaluation of Controllability for Intermediate Targets

- Four Plausible Explanations:
  1. The two indicators reflect different characteristics and their influence by monetary policy.
     - The overall financing demand reflected by AFRE is more influenced by the behaviors of economic agents themselves, and the demand-side regulation of monetary policy affects financing supply directly and the financing behaviors indirectly.
  2. Tight monetary policy means the current overheated economic environment and the optimistic expectations for the future, and the resulting gradual increase of financing cost creates a *herd effect* among economic agents.
     - to satisfy and smoothen the future demand for investment or consumption;
     - strengthen their expectations and follow suit;
     - to transfer their deposits to investment in non-standard financial assets.

Evaluation of Controllability for Intermediate Targets

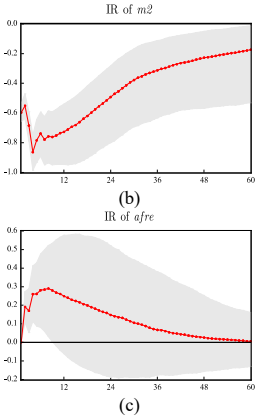
- Four Plausible Explanations:
  3. With the development of financial innovation and the diversification of financing channels, the off-balance-sheet and direct financing components of AFRE have accounted for an increasing proportion.
     - expansion of off-balance-sheet business, such as entrusted loans, trust loans and un-discounted bankers' acceptances;
     - rising in financing costs inhibits the scale of on-balance-sheet business, squeezing out some of the loans to off-balance-sheet ones;
     - lending by commercial (traditional) and shadow banks to a contractionary monetary policy reacts oppositely (Funke et al., 2015; Yang et al., 2019), as a result of expansionary shadow banking activities lowering social liquidity while increasing AFRE (He et al., 2017);
     - *moral hazard* would be triggered easily when economic agents obtaining the indirect financing, e.g., transferring the funds obtained from bond issuance by local governments to real estate investment.

Evaluation of Controllability for Intermediate Targets

- Four Plausible Explanations:
  4. AFRE flaws inherently in statistics, making it difficult to achieve its defined purpose, which in turn may generate abnormal IRs to monetary policy shocks.
     - mutual financing in the real economy always exists in the off-balance-sheet or direct financing;
     - undiscounted bankers' acceptances part is not suitable to be included along with on-balance-sheet business;
     - as a sum of funds calculated from asset side of *financial survey*, it is hard to fully supervise the use of funds.

Evaluation of Controllability for Intermediate Targets

- *opposite mirroring effect*
  1. long-run expansionary monetary policy during the sample period causes a positive IR to M2 as well as a negative IR to AFRE;
  2. IR of M2 to monetary policy is stronger and lasts longer than AFRE, and the same expansionary monetary policy causes a rapid and sustained tightening of the difference between the two IRs.



Evaluation of Controllability for Intermediate Targets

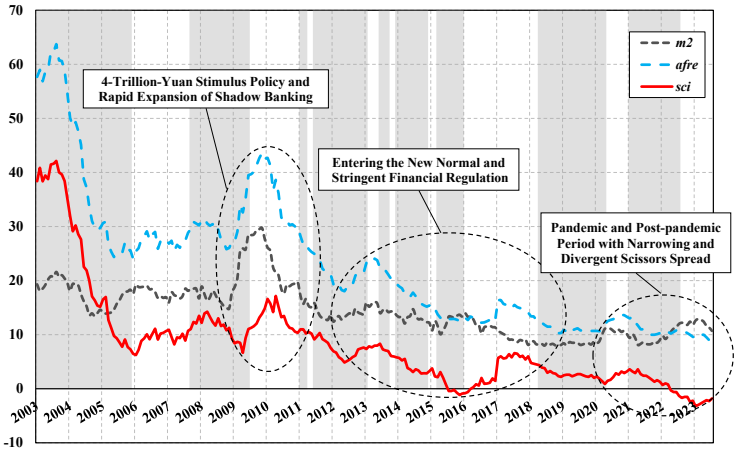


Figure 4: *Scissors Spread between Social Financing Demand and Monetary Supply (%).* Dash area represents periods of extended or rapid expansion in the price-based monetary policy implementation.

Evaluation of Controllability for Intermediate Targets

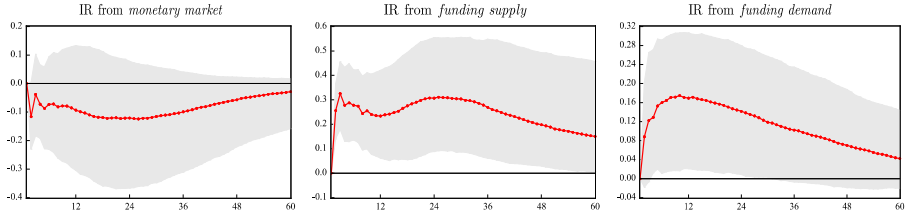
Our Conjecture

An expansionary monetary policy leads to a narrowing of the scissors, and even a divergence.

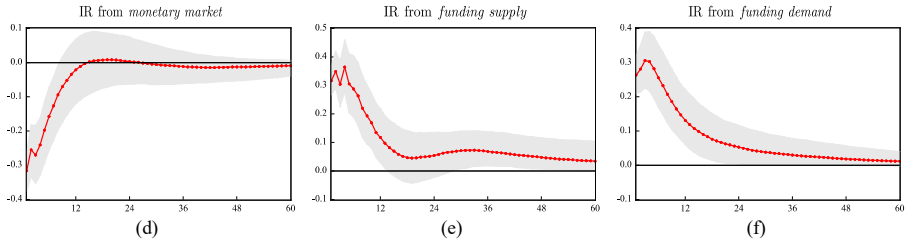
- Design Scheme
  - If an accommodative interest rate environment (or expansionary monetary policy) does lead to a reduction of the scissors, with a significant promotion in the time-varying characteristics, then we can argue that this shift helps to fulfil functions of the intermediate target.
  - Choose TVP-VAR without any restrictions to confirm our conjecture and use scissors spread to study the second question.

Evaluation of Relevance for Intermediate Targets

IRs of Output:



IRs of Inflation:



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Time-varying Impulse Response

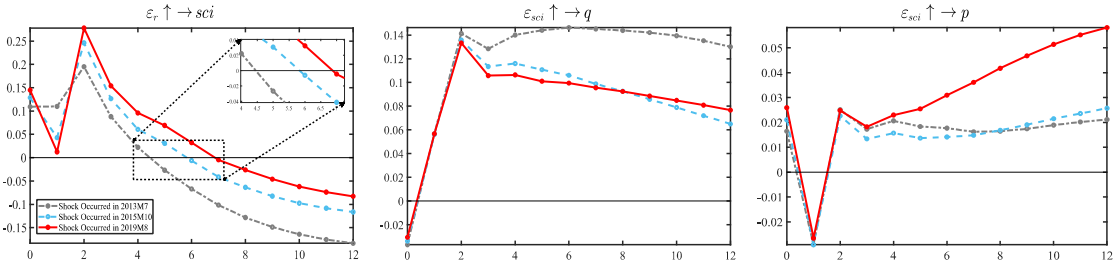
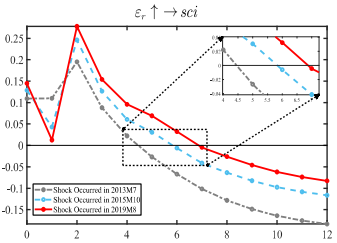


Figure 5: Periodic Impulse Responses

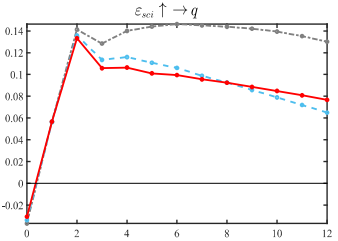
Time-varying Impulse Response

1. not only confirm our conjecture, but also reveal the asymmetry of the long- and short-run matching effect (Fig. 3);
2. expansion of the scissors gap is not definitely caused by the immediate or short-run tightening policy, but may be owing to the lagged effects of earlier expansionary policies;
3. Considering the process of interest rate liberalization, both magnitude and duration have been improved;
4. orientating the targeting function at the degree of matching effect can effectively monitor and adjust monetary policy in different periods.



Time-varying Impulse Response

1. IR levelling off at a high value, with some long memory;
2. degree of matching effect between the intermediate targets is strongly correlated with real output;
3. with financial regulation deepening, off-balance-sheet business being squeezed into on-balance-sheet ones, which provides poor support to the real economy;
4. a negative output caused by a negative or inversed scissors shock (indicating the deviation of AFRE and M2) weakens subsequently;
5. considering the reality of obstructed transmission and process of interest rate liberalization, effectiveness of arranging the matching effect at the actual output has improved.

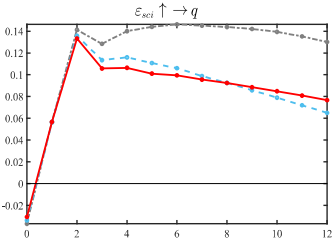


Time-varying Impulse Response

1. in terms of magnitude, the target matching effect is poorly correlated with inflation, not as strongly as with real output;

2. as LPR releases its guiding potential, effective demand on the credit side has been boosted, and off-balance-sheet expansion of financing demand has stimulated the recovery of consumption over the long run, pulling up CPI;

3. deflationary effect by the negative scissors shock (denoting the divergence between AFRE and M2) strengthens subsequently.



Time-varying Impulse Response

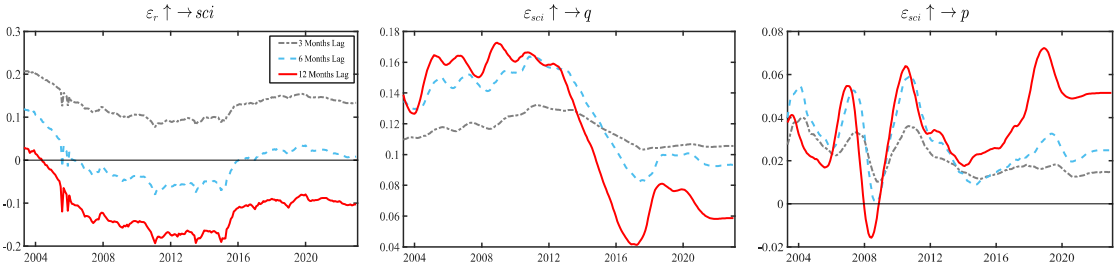


Figure 6: Isochronous Impulse Responses

Time-varying Granger Causality

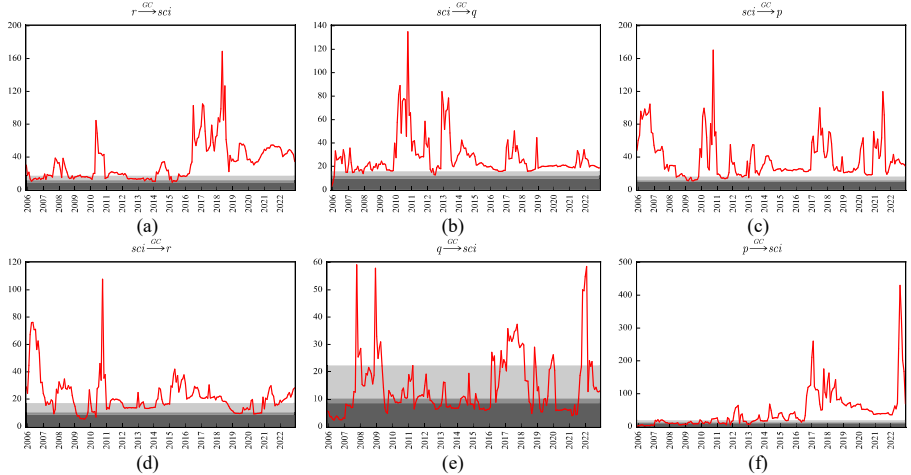


Figure 7: Bidirectional TVGC

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Robustness

- As to DAG-VAR-SR:
  1. a sample size of 200 are reexamined using the PC-stable algorithm;
  2. keep the same setting of the hybrid restrictions, the intercept term in the VAR is removed and the lag order of three models changes to 6;
  3. re-examine *opposite mirroring effect*: under zero restrictions imposed on M2 as well as under no restrictions on both M2 and AFRE;
  4. under the original setting, AFRE is replaced by RMB loans.
- As to TVP-VAR:
  1. adjust the sampling number to 15,000 times and the lag order of the model to 2.
- As to TVGC:
  1. perform a test using the heteroskedasticity-robust Wald statistic.

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Conclusion

1. M2 maintains dominant advantages, and the intermediate target functions of AFRE and market interest rates are highlighted.
2. Abundant liquidity environment will cause scissors contraction, namely strengthening the matching effect of AFRE and M2, whilst a certain weakening effect in the long run. And this strengthening effect will be further enhanced with the interest rate liberalization process.
3. Considering the interest rate liberalization and obstructed transmission at present, the effectiveness of arranging the matching effect at real output gets enhanced (more at nominal output) and it is not appropriate to locate it on inflation.

Conclusion

5. Especially for the level of real output, with the interest rate liberalization and the improvement of financial regulation, the output effect of quantity-based targets is gradually declining.
6. The scissors spread has a bi-directional Granger causality with monetary policy and inflation in most of the sample intervals.
7. Though the scissors is the Granger cause of real output, the time-varying Granger relationship behaves unstably, with multiple periods of unhooking, appearing a certain degree of unidirectionality.

Thank You!