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The Price of Copper: A Conductive Measure of Chinese Monetary Policy

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China and its monetary policy

- China is the largest manufacturer in the world
  - The second and third most prominent trade partners of the euro area (2021) and the US (2024), respectively.
- Projected to be the world's largest economy in mid-2030s
- Unique and globally important monetary policy
- 5 key challenges to the study of PBoC monetary policy
  1. Changing policy framework over time
  2. Multiple, changing policy objectives
  3. Plethora of rates and policy instruments for different concerns (real estate, stock market, etc.)
  4. No similar asset to Fed funds futures (and would not have worked)
  5. Decisions often announced when markets are closed
- Need a summary measure of policy shock

What was done

- Chen, Ren, and Zha (2018) – M2 growth rate residuals after projection on controls to capture the regime-dependent policy function of the PBoC
- Miranda-Agrippino, Nenova, and Rey (2025) & Ferriani and Gazzani (2025) – nonlinear refinement of Chen et al (2018) to study transmission to commodities
- He, Jia, Li, and Wu (2024) – Daily close-open average market responses of issuance interest rates of Negotiable Certificate Deposits (NCD), following Bu, Rogers, and Wu (2021)
- Shieh (JIMF 2024) – PCs of daily close-open average rate responses
- Lu, Tang, and Zhang (2023) – Daily open-to-open market responses of China's 5-year treasury bond futures
- Das and Song (2023) – Daily close-to-close response of 1-year interest rate swaps based on the 7-day repo rate
- Ma, Rebucci, Zhou (2025) – 1-year interest rate swap rate revisions around the announcement dates
- Bahaj and Reis (2025) – The anatomy of a peg: Lessons from China's parallel currencies
- Gutierrez, Turen, Vicondoa (2024) – Chinese macro news and spillovers

Really smart work, but...

PBoC Governor Yi Gang (2018)

- ... the correlation between M2 and the real economy will be on the decline
- ... economy becomes more and more developed and market-oriented
- ... in 2012 we adopted the concept of the scale of social financing offered by the financial sector to the real economy, and the indicator includes loans, bonds, stock, and trust, etc.

Source: PBoC webpage

- In general, multi-instrument frameworks cannot be summarized by a single measure
- (or can they be?)

Comparison of PBoC's policy framework (I/II)

	PBoC	Advanced Economy Central Banks
High-level objective(s)	Multiple objectives: price stability, economic growth, employment, and broadly maintaining balance of payments; financial reform and opening up, and financial market development	Single, dual, or triple mandate
Intermediate target(s)	Inflation	
	M2	
	Total social financing (TSF)	
	Credit to MSEs	
	Exchange rate	Inflation

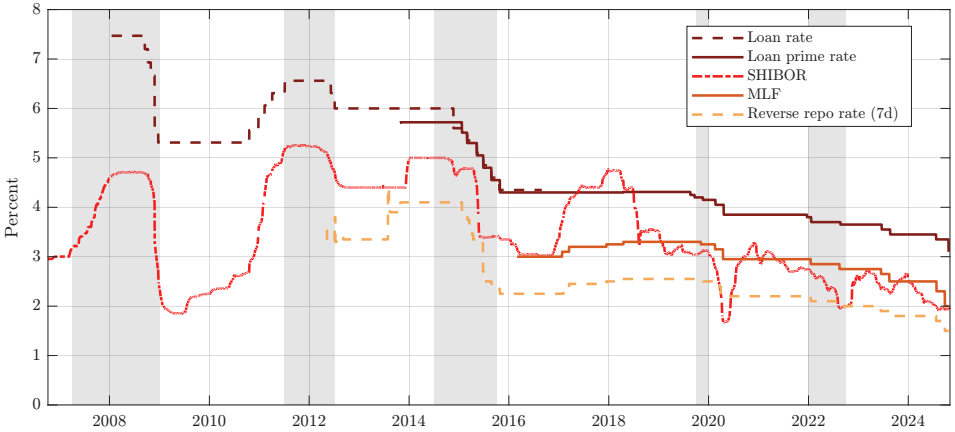
Source: Das & Song (2023).

Comparison of PBoC's policy framework (II/II)

	PBoC	Advanced Economy Central Banks
Operational target(s)	Monetary base 7-day interbank repo rate (DR007) Loan prime rate (LPR) Reserves/asset purchases	Overnight cash rate target
Primary instrument(s)	PBC 7-day repo rate in corridor system Open market operation Benchmark lending/deposit rates Lending facility rates, notably MLF rate Required reserve ratio (broad and targeted) Administered rates: floor system	Open market operations: corridor system

Source: Das & Song (2023).

Asynchronously changing interest rates



Note: Loan Prime Rate is the benchmark lending rate for clients in China. SHIBOR reflects the average cost at which major banks lend unsecured funds to each other in the Shanghai interbank market. MLF is the Medium-term Lending Facility rate, the 1-year lending rate from the central bank to commercial banks. Reverse repo is a short-term liquidity tool used mainly for emergency or fine-tuning operations. The grey bands denote periods of cyclical troughs and peaks as identified via The China Cyclical Activity Tracker compiled by the Federal Reserve Bank of San Francisco.

▸ Changes ▸ Required reserve ratio

What we need

- An asset that is:
  1. Sensitive to the broad Chinese monetary policy stance
  2. With a stable sensitivity to Chinese demand
  3. With a market price, not an administered price
  4. Traded when the Chinese policy is announced
  5. Liquid enough so that its price changes reflect Chinese policy news immediately
- Copper futures!

PBoC and commodity demand

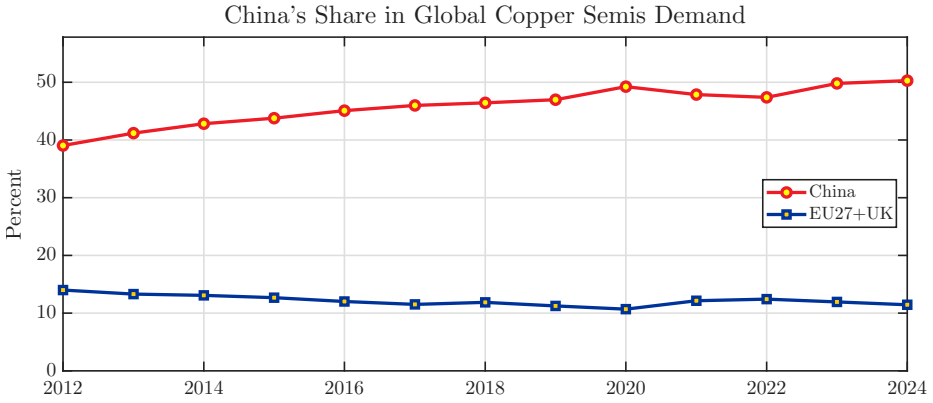
- Using high-frequency interest rates to measure MP surprises is difficult for China
- Yet, changes in demand due to MP should reflect in commodity markets
- Idea: to measure policy-induced surprises by leveraging the dominant role of China in the global commodity market
- Underlying mechanism:

  Tightening Chinese monetary policy
  $\Longrightarrow$ Weaker domestic demand
  $\Longrightarrow$ Weaker production and investment incentives for firms
  $\Longrightarrow$ A signal of lower demand for industrial inputs
  $\Longrightarrow$ Downward pressure on global commodity prices

Why copper?

- Nickel experienced substantial price volatility and market disruption in 2022
- Steel and coal do not have intraday trading data
- Crude oil does not see a dominant role for China
- Aluminium and lead do not have a stable Chinese absorption (share in global demand) over the sample period
- Zinc might have worked but yields a weak instrument (Why? Yet to know.)
- Copper has deep markets & China has dominant market share!
  $\Longrightarrow$ LME Copper 3-month rolling forward contracts (futures contract)

China's copper demand



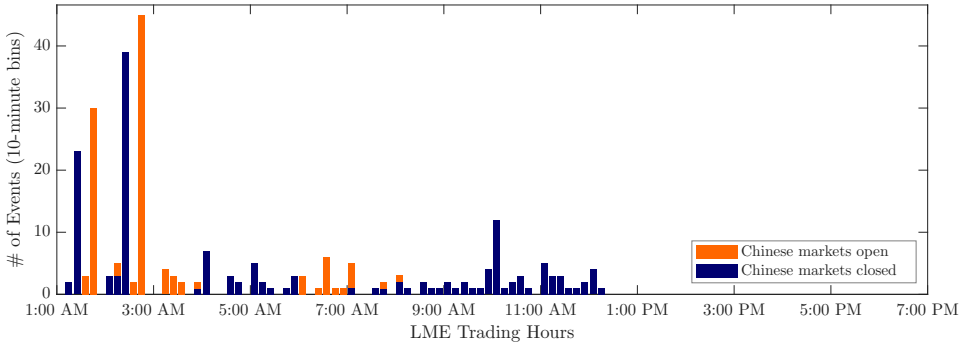
Semi-finished copper products include: copper wire rod, copper wire, copper rods, bars and sections, copper plate, sheet and strip (including foil), and copper tube. Source: IWCC

- Copper demand from the Chinese economy has remained exceptionally strong and stable over an extended period

LME copper futures contract specifications

Contract code	CA
Underlying metal	Grade A copper
Lot size	25 tonnes
Prompt dates	Daily: up to 3 months Weekly: 3 to 6 months Monthly: 7 to 123 months
Price quotation	US dollars per tonne
Clearable currencies	USD, JPY, GBP, EUR
Last trading day	Up to the close of the first Ring on the day before the prompt date
Settlement type	Physical
Trading venues	Ring, LMEselect, inter-office telephone
Margining	Contingent variation margin applied

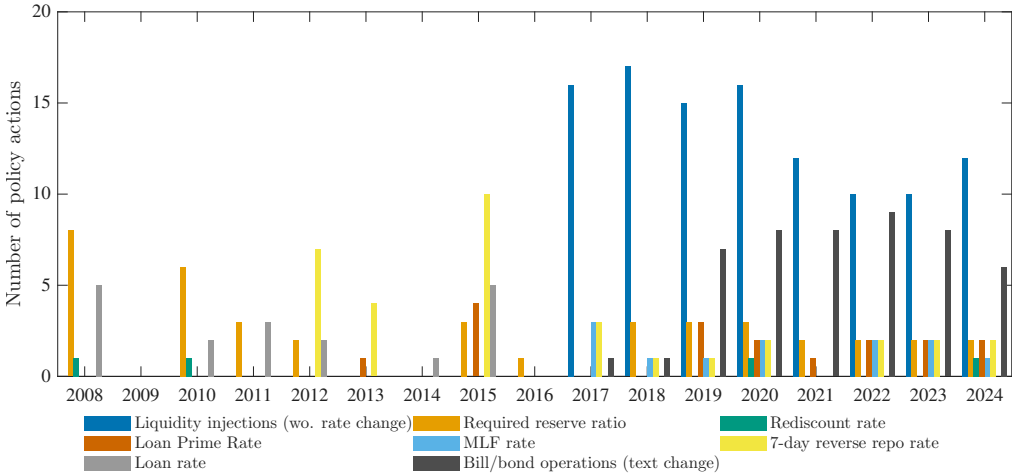
Chinese MP events & LME trading hours



Note: All times are reported in London local time. China does not observe Daylight Saving Time, London does. Opening and closing of Chinese markets occur at different London-time hours throughout the year, despite remaining fixed in China Standard Time (CST).

- Trading hours of the London Metal Exchange encompass all policy announcements (except those on bank holidays)

Chinese monetary policy announcements

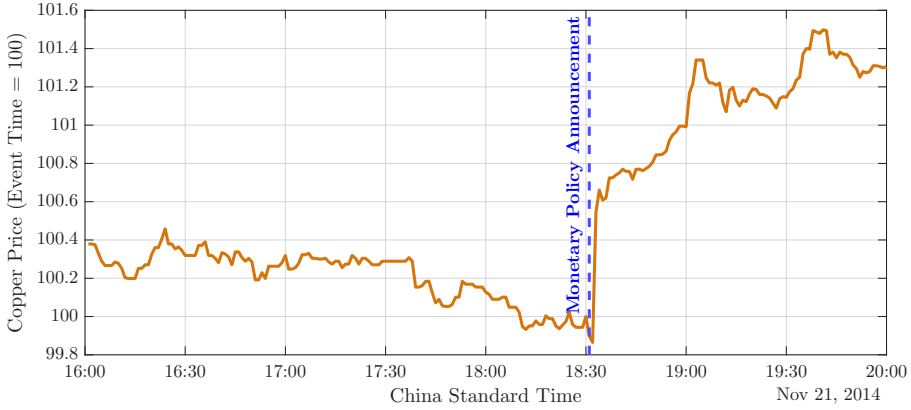


Note: In 16 events, multiple announcements are issued simultaneously. No events occurred in 2009, and only a single event was recorded in each of the years 2014 and 2016.

21 Nov. 2014

Loan rate 6.00→5.60

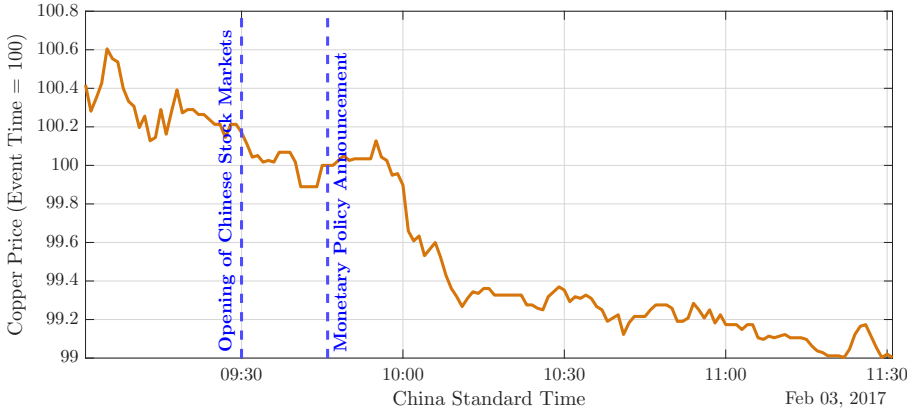
Bloomberg: China cut benchmark interest rates for the first time since July 2012 as leaders step up support for the world's second-largest economy, sending global shares, oil and metals prices higher.



3 February 2017

7-day reverse repo rate: 2.25 $\rightarrow$ 2.35

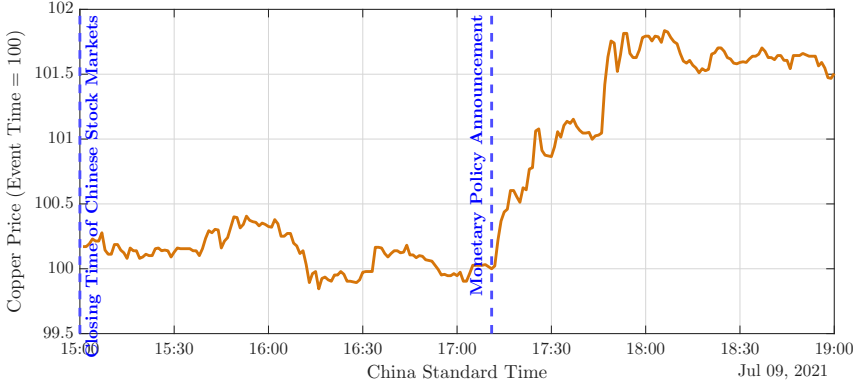
Reuters: An unexpected Chinese interest rate raise on Friday hit emerging stocks led down by weakness across Asia.



9 July 2021

RRR: 9.40→8.90

UOB Group: The reserve requirement ratio (RRR) cut is the first monetary policy move in more than a year... The broad-based cut was **more aggressive than expected as market** (including ourselves) was widely expecting a targeted RRR cut and the decision **also came sooner than expected** following hints from the State Council on Wednesday (7 July).



Event counts

	Count	Percent
Total number of events	270	
Total number of event days	265	100%
Intraday data unavailable	5	1.9%
Weekends	11	4.2%
UK holidays	7	2.6%
Intraday data available	242	91.3%
(of which) 2020 MP days	34	12.8%
Days with two events	5	1.9%
Number of events in sample	247	

Note: Intraday data are available starting in 2008. There are five events for which no intraday data are available on the Bloomberg Terminal.

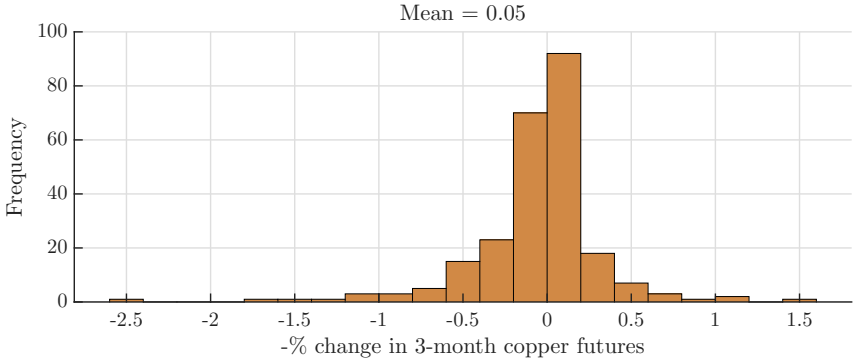
▸ Missing events

Intraday copper returns around MP announcements

Sign-reversed to match policy shock

Intraday copper returns around MP announcements

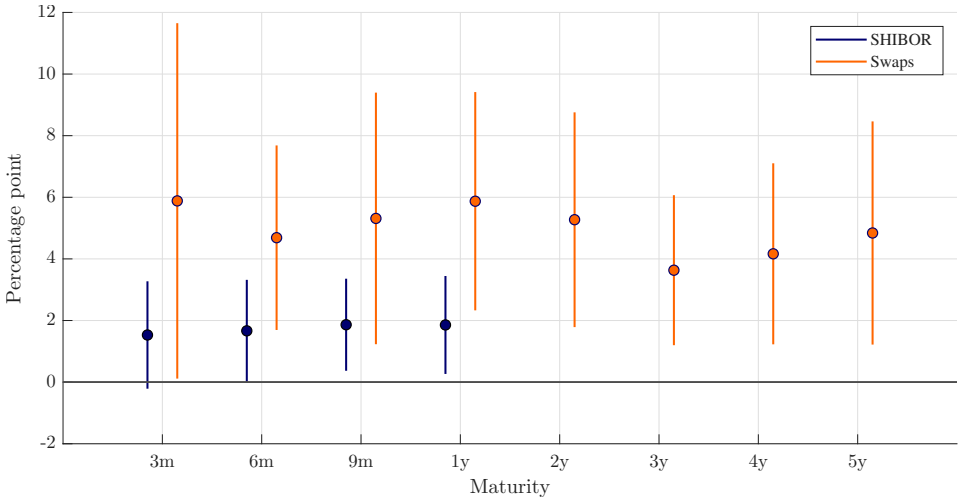
Sign-reversed to match policy shock



Asset price responses

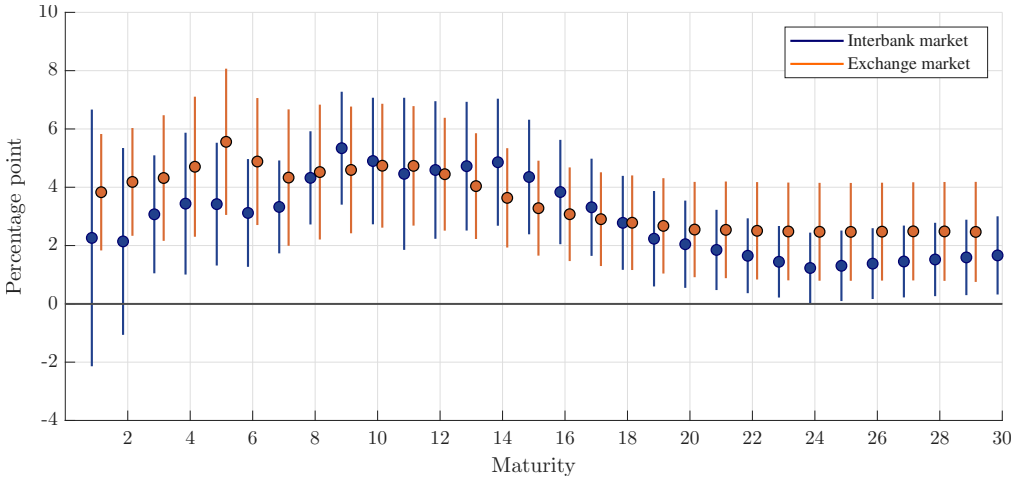
- Interest rate swap rates
- SHIBOR
- Government bond yields
- Stock market indices (Asia, North & South Americas, Europe)

Interest rates: SHIBOR and interest rate swaps



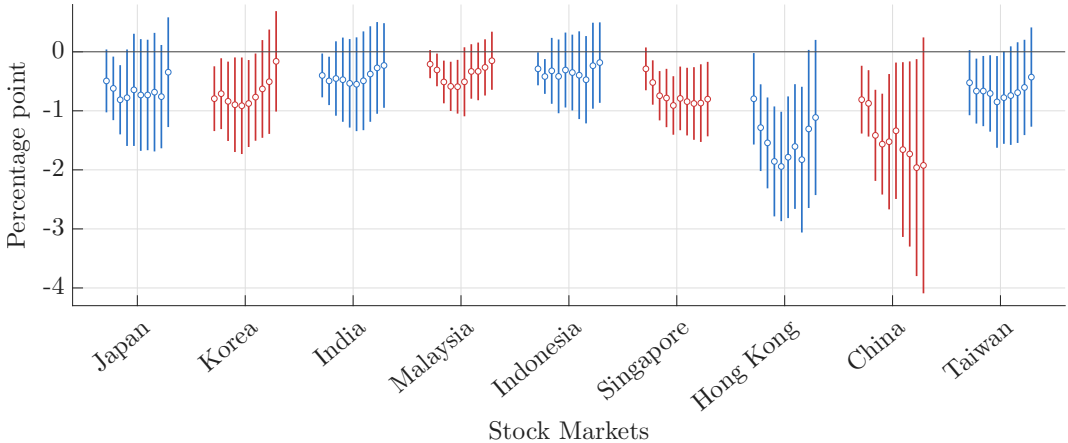
Note: Interest rate swaps are indexed to the 7-day repurchase rate. SHIBOR reflects the average cost at which major banks lend unsecured funds to each other in the Shanghai interbank market. The sample period is January 2012 to November 2024, 2020 (COVID period) excluded.

Interest rates: Chinese government bond yields



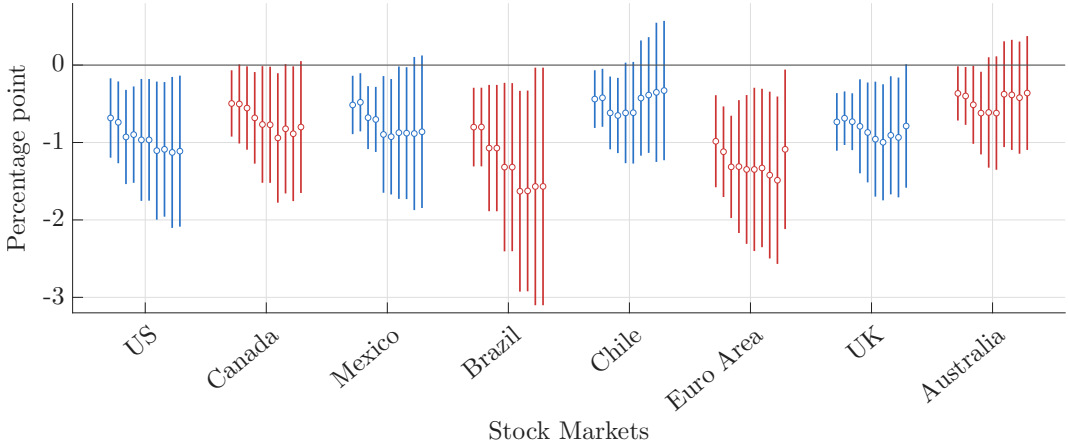
Note: January 2012 to November 2024, 2020 (COVID period) excluded. The regressions relate percentage-point changes in bond yields from $t-1$ to $t+1$ to copper returns. This specification is chosen because zero-coupon yields are computed as daily averages, which creates the risk of missing monetary policy effects on day t when announcements occur late in the trading session or after the market close.

Stock markets: daily



Note: January 2012 to November 2024, excluding the 2020 COVID period. The dependent variable is stock market returns constructed over progressively expanding return windows. In the first regression, returns are measured at the daily frequency. In subsequent regressions, the return window is expanded sequentially to include the next opening and the next closing prices. The reported coefficients correspond to the estimates obtained at each step of this expanding-window procedure.

Stock markets: daily



Note: January 2012 to November 2024, excluding the 2020 COVID period. The dependent variable is stock market returns constructed over progressively expanding return windows. In the first regression, returns are measured at the daily frequency. In subsequent regressions, the return window is expanded sequentially to include the next opening and the next closing prices. The reported coefficients correspond to the estimates obtained at each step of this expanding-window procedure. For the regressions involving the Chilean stock market, the period from July to September 2022, characterized by "disorderly market conditions", was excluded; however, including this interval does not affect the statistical significance of the estimated coefficients.

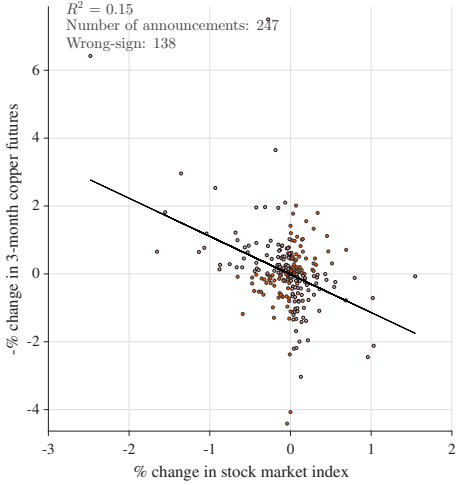
Methodology

1. **High-frequency surprises:** measured using high-frequency intraday changes in Copper futures price within narrow announcement windows around PBoC policy communications
2. **Orthogonalization:** surprises are orthogonalized w.r.t. lagged domestic stock market returns to remove predictable information components (Miranda-Agrippino and Ricco 2021, Bauer and Swanson 2023)
3. **Monetary policy indicator:** constructed as the first principal component of multiple policy-rate and money-market instruments
4. **Bayesian proxy VAR:** The orthogonalized monetary policy surprises as an external IV in BVARs to study the dynamic effects of Chinese MP shocks

High-frequency surprises

$$r_t^{Cu} = 100 \times \frac{\text{median}\{P_\tau : \tau \in [t{+}20, t{+}30]\} - \text{median}\{P_\tau : \tau \in [t{-}10, t{-}5]\}}{\text{median}\{P_\tau : \tau \in [t{-}10, t{-}5]\}}$$

Copper vs. stock market returns



Note: Intraday copper futures returns. Stock market returns are measured either from the opening to the closing price or from the closing price to the subsequent opening price.

- PBoC is likely to have private information not shared with the market
- Nontrivial number of days where equity returns move in the opposite direction of copper price change
- (Copper returns are intraday, stock price changes are daily)
- We do not control (yet) for this!

Orthogonalizing the instrument

- Regress the intraday copper returns on lagged stock market returns
- Removes predictable components to isolate unanticipated policy-related variation

Details

The policy indicator

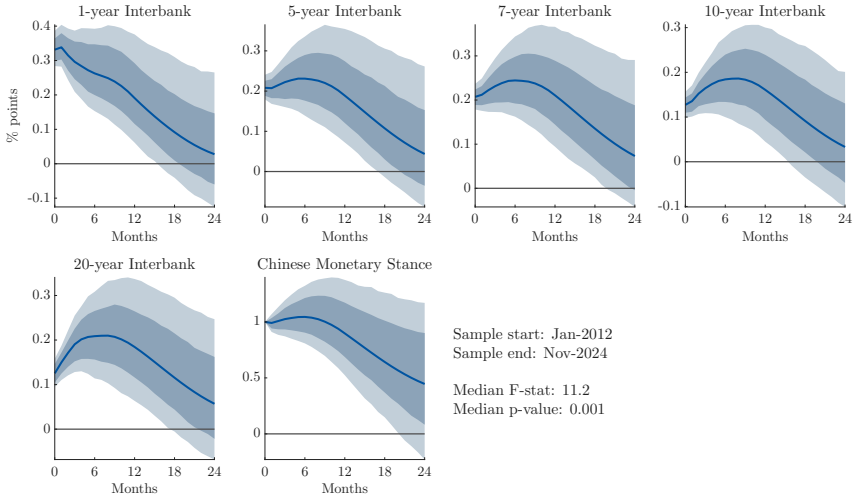
- Our PBoC monetary stance indicator – first PC of
  - 1-year loan prime rate
  - Required reserve ratio
  - Rediscount rate
  - 1-year SHIBOR
  - 3-year deposit rate
  - 5-year interest rate swap
  - Government bond rates (6- to 10-year)
- Endogenous indicator
- IV to identify exogenous policy shocks

▸ PCA results

Sample period

- Baseline results on the sample 2012–2024 (excluding 2020, COVID)
  - 192 events out of 247 (i.e. 78% of all the events)
  - PBoC started in 2012 to focus on market rates and providing liquidity to the real economy (Aggregate Financing to the Real Economy)
  - China's copper demand stabilized after 2012
  - Results including COVID in robustness

Effect on yield curve: interbank market



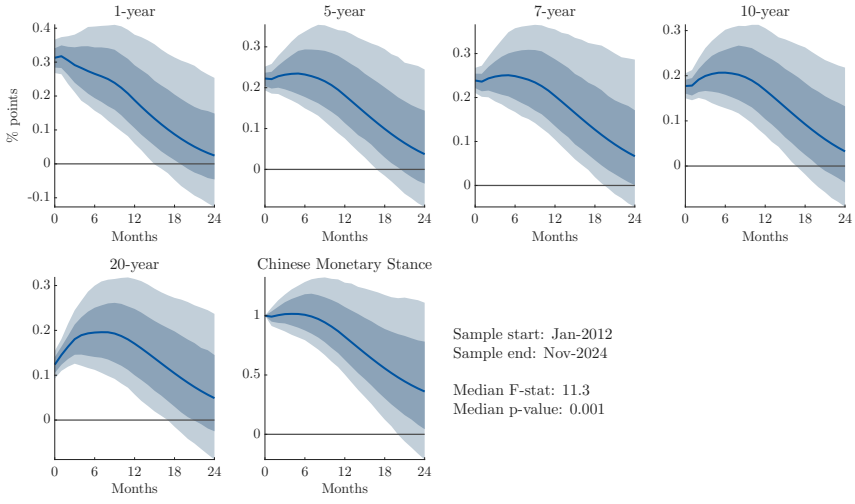
Sample start: Jan-2012
Sample end: Nov-2024

Median F-stat: 11.2
Median p-value: 0.001

Note: COVID period is excluded. Shaded areas represent the 68% and 90% confidence bands.

▸ with COVID

Effect on yield curve: exchange market



Sample start: Jan-2012
Sample end: Nov-2024

Median F-stat: 11.3
Median p-value: 0.001

Note: COVID period is excluded. Shaded areas represent the 68% and 90% confidence bands.

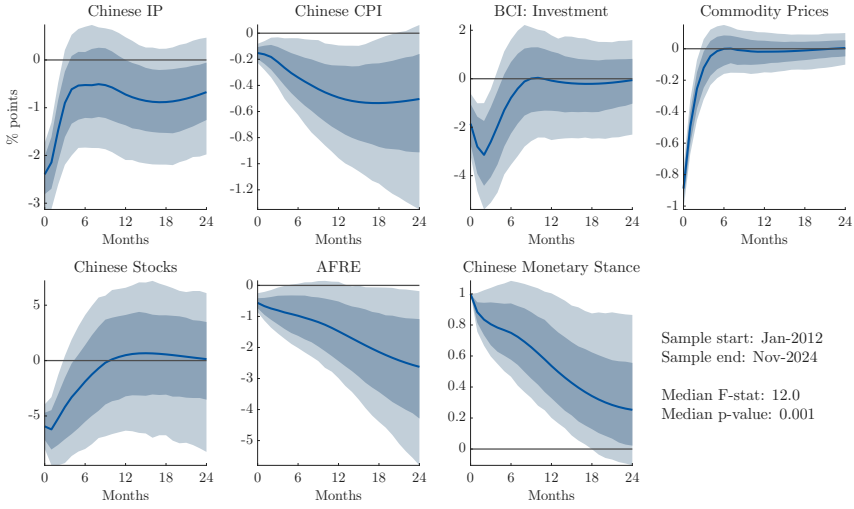
▸ with COVID

Domestic effects: variable definitions

Variable	Definition / Description
Chinese IP	CICC Cyclical Momentum Index: Industrial production (CEIC)
Chinese CPI	Consumer Price Index (Chen, Higgins, and Zha, JIMF, 2024)
BCI: Investment	CKGSB Business Conditions Index: Investment (CEIC)
Commodity Prices	Real Commodity Price Factor (Baumeister & Guerin, IJF, 2021)
Chinese stocks	Shanghai–Shenzhen CSI 300. Index of blue-chip Chinese companies listed on the Shanghai and Shenzhen stock exchanges (Bloomberg)
AFRE	Aggregate Financing to the Real Economy, a.k.a. total social financing, a broad measure of domestic credit and liquidity extended to non-financial corporations, households, and the public sector; seasonally adjusted via TRAMO–SEATS (Wind)
Chinese Monetary Stance	First principal component of interest rates

Note: CICC Cyclical Momentum Index is a proprietary indicator designed to provide a comprehensive assessment of China's economic cycle. It aggregates a wide range of timely indicators across industrial production, domestic and external demand, and prices to track nominal growth momentum, sectoral demand conditions, and corporate profitability. The CKGSB Business Conditions Index is a monthly survey of China's private-sector executives that tracks short-term expectations for sales, profits, financing, inventories, and investment over the next six months. Based on sentiment from a large network of businesses, it provides a real-time gauge of economic conditions.

Domestic effects



Note: COVID period is excluded. Shaded areas represent the 68% and 90% confidence bands.

▸ with COVID

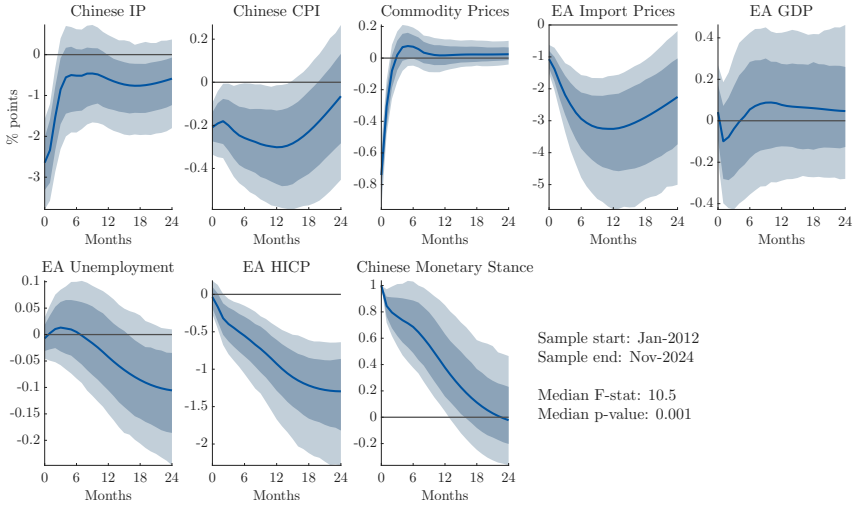
Domestic effects: findings

- The IV works
- PBoC monetary policy exerts conventional effects on the domestic economy
- A tightening causes declines in output, consumer prices, equity prices, investment sentiment, and liquidity extended to non-financial corporations, households, and the public sector
- Contemporaneous effects are very large

International spillovers: variable definitions

Variable	Definition / Description
EA Import Prices	Import prices in industry: Mining and quarrying; manufactured products; electricity, gas, steam and air conditioning; natural water; water treatment and supply services (Eurostat)
EA GDP	Real Gross Domestic Product, interpolated, linearly, seasonally adjusted (Eurostat)
EA Unemployment	Percent of labor force, 15 to 74 years (Eurostat)
EA HICP	Harmonised Index of Consumer Prices (Eurostat)
US Import Prices	Import Price Index: All Commodities
US Unemployment	Percent of labor force, 16 years of age and older (FRED)
US GDP	S&P Global Market Intelligence's Monthly GDP Index, seasonally adjusted (FRED)
US CPI	Consumer Price Index for All Urban Consumers: All Items in U.S. City Average (FRED)

Spillovers to the euro area



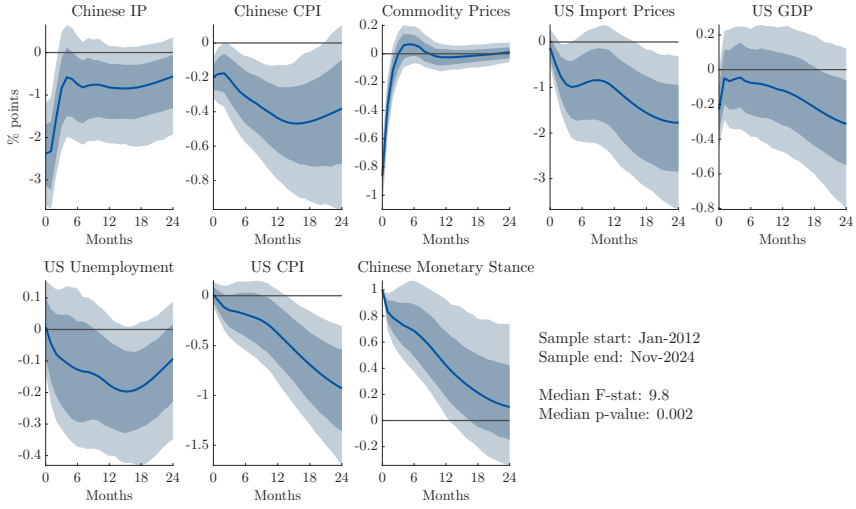
Sample start: Jan-2012
Sample end: Nov-2024

Median F-stat: 10.5
Median p-value: 0.001

Note: COVID period is excluded. Shaded areas represent the 68% and 90% confidence bands.

▸ with COVID

Spillovers to the United States



Sample start: Jan-2012
Sample end: Nov-2024

Median F-stat: 9.8
Median p-value: 0.002

Note: COVID period is excluded. Shaded areas represent the 68% and 90% confidence bands.

▸ with COVID

International spillovers: findings

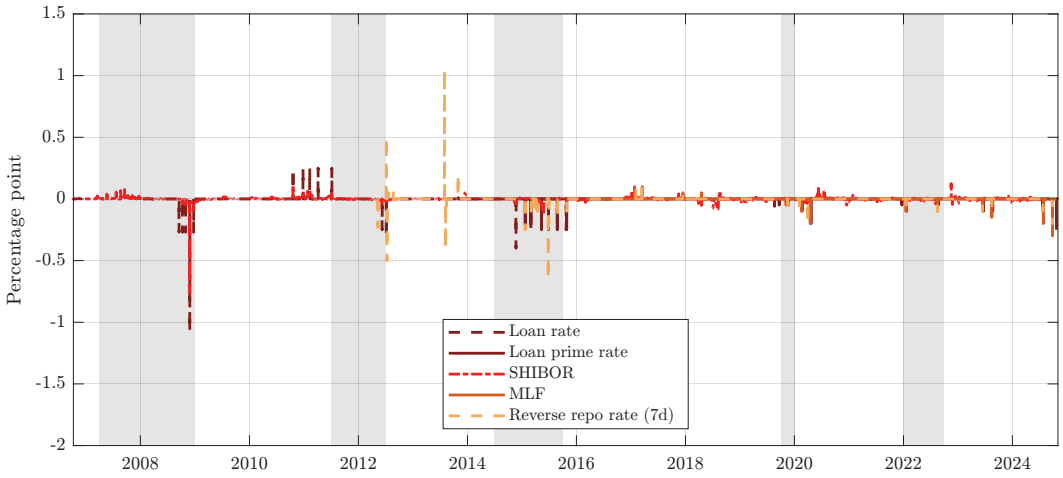
- A tightening in China lowers headline inflation in the U.S. and the euro area
- Negligible output effects

Conclusions and to come

- Chinese monetary policy has conventional effects domestically
- A commodity-price channel (?) transmits PBoC monetary policy to the global economy
  - A tightening puts disinflationary pressures on the euro area and the U.S.
- Next on the agenda:
  - The PBoC information channel
  - Understanding the dynamics during the COVID period
  - Identifying spillovers to the euro area and the US via trade channels, such as import prices, separating commodity prices from Chinese exports, and external demand
  - Exchange rate and monetary policy interactions
  - Assessing the effects on emerging market economies
  - Thinking about the policy mix: are fiscal policy and regulation also changing as MP is changing?

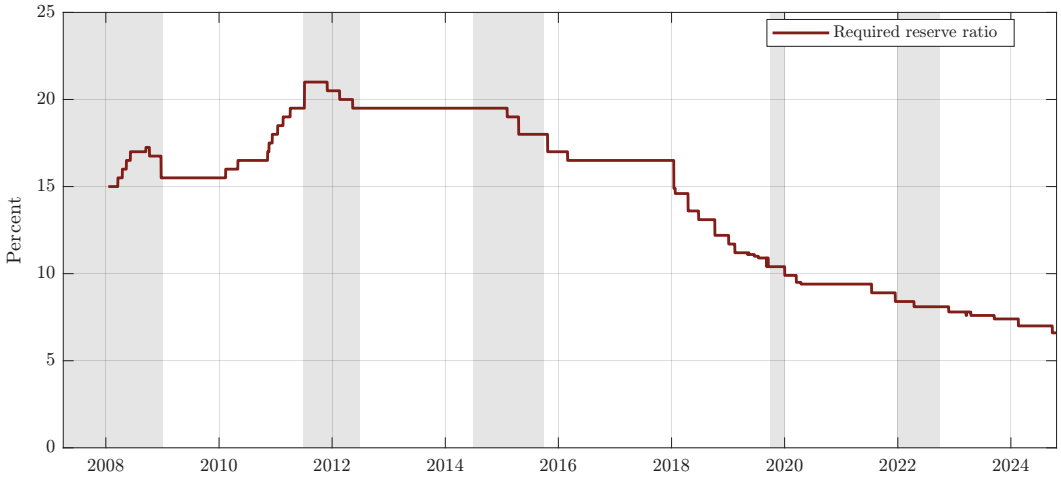
Thank You

Changes in the main interest rates



Back

Required reserve ratio



Back

Missing events (18 days)

Date	Req. Reserve	Rediscount	LPR	MLF	7d RevRepo	Loan Rate (<1y)	Notes
Intraday data unavailable							
18-Mar-2011	19.0 → 19.5						
17-Apr-2011	19.5 → 20.0						
12-May-2011	20.0 → 20.5						
14-Jun-2011	20.5 → 21.0						
03-Jul-2012					3.30 → 3.95		
Weekends							
07-Jun-2008	16.5 → 17.0						Saturday
02-May-2010	16.0 → 16.5						Sunday
25-Dec-2010		1.80 → 2.25				5.56 → 5.81	Saturday and Christmas Day
18-Feb-2012	20.5 → 20.0						Saturday
12-May-2012	20.0 → 19.5						Saturday
01-Mar-2015			5.51 → 5.30				Sunday
19-Apr-2015	19.0 → 18.0						Sunday
27-Jun-2015			5.05 → 4.80				Saturday
24-Jun-2018	13.6 → 13.1						Sunday
07-Oct-2018	13.1 → 12.2						Sunday
18-Feb-2024				Liq. Inj.			Sunday
Holidays							
17-Apr-2017							Good Friday
06-May-2019	11.2 → 11.1						Early May Bank Holiday
26-Aug-2019				Liq. Inj.			Summer Bank Holiday
01-Jan-2020	10.4 → 9.9						New Year's day
15-Apr-2022	8.4 → 8.1						Good Friday
26-Aug-2024				Liq. Inj.			Summer Bank Holiday
25-Dec-2024				Liq. Inj.			Christmas Day

Note: Units are percentages.

Back

Orthogonalizing the instrument

- Compute 30-minute intraday returns of copper prices around the policy event:

$$r_t^{Cu} = 100 \times \frac{\text{median}\{P_\tau : \tau \in [t{+}20, t{+}30]\} - \text{median}\{P_\tau : \tau \in [t{-}10, t{-}5]\}}{\text{median}\{P_\tau : \tau \in [t{-}10, t{-}5]\}}$$

- Reverse the sign to match the monetary policy direction

- Regress copper returns on lagged stock market returns up to five trading days:

$$-r_t^{\text{Cu}} = \alpha + \sum_{k=1}^{5} \beta_k r_{t-k}^{\text{Stocks}} + \gamma D_t^{\text{COVID}} + \sum_{k=1}^{5} \delta_k \left(r_{t-k}^{\text{Stocks}} \cdot D_t^{\text{COVID}} \right) + u_t$$

- Excluding COVID: Adjusted $R^2 = 0.08$, $F = 4.47$, $p = 0.000$
- With COVID dummies: Adjusted $R^2 = 0.06$, $F = 2.38$, $p = 0.008$
- This removes predictable components associated with lagged financial market responses, isolating the unanticipated policy-related variation.
- Instrument: u_t

Back

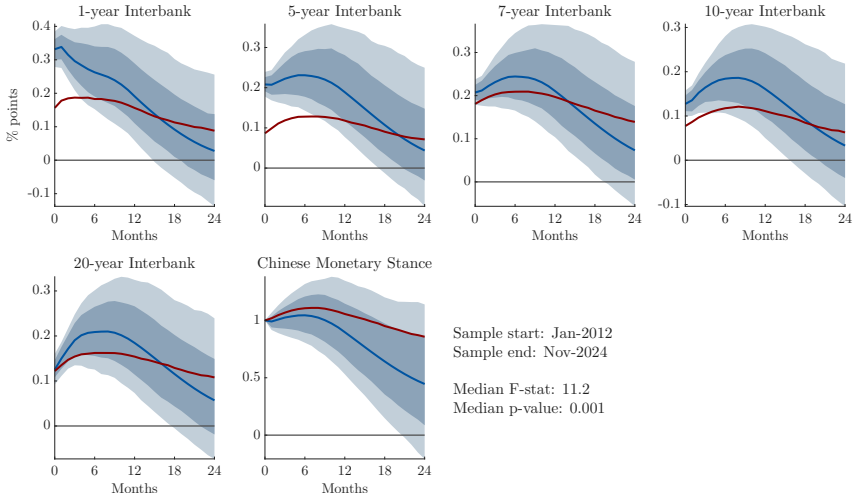
Policy indicator: principal component analysis

Variable	Loading
Required Reserve Ratio	0.9028
One-year Shanghai Interbank Offered Rate (SHIBOR)	0.1692
One-year Loan Prime Rate	0.1641
Three-year Bank Deposit Rate	0.1209
Five-year Interest Rate Swap	0.0977
Rediscount Rate	0.0276
6-year Government Bond Yield (Spot)	0.0829
6-year Interbank Government Bond Yield (Spot)	0.0809
6-year Government Bond Yield (Yield to Maturity)	0.0821
7-year Government Bond Yield (Spot)	0.0796
7-year Interbank Government Bond Yield (Spot)	0.0795
7-year Government Bond Yield (Yield to Maturity)	0.0793
8-year Government Bond Yield (Spot)	0.0856
8-year Interbank Government Bond Yield (Spot)	0.0819
8-year Government Bond Yield (Yield to Maturity)	0.0829
8-year Government Bond Yield (Spot)	0.0876
8-year Interbank Government Bond Yield (Spot)	0.0843
8-year Government Bond Yield (Yield to Maturity)	0.0847
10-year Government Bond Yield (Spot)	0.0877
10-year Interbank Government Bond Yield (Spot)	0.0868
10-year Government Bond Yield (Yield to Maturity)	0.0851

Notes: The first principal component explains 89.9% of the total variance and has an eigenvalue of 26.2. The sample period extends from January 2008 through November 2024.

Back

Effect on yield curve: interbank market with COVID



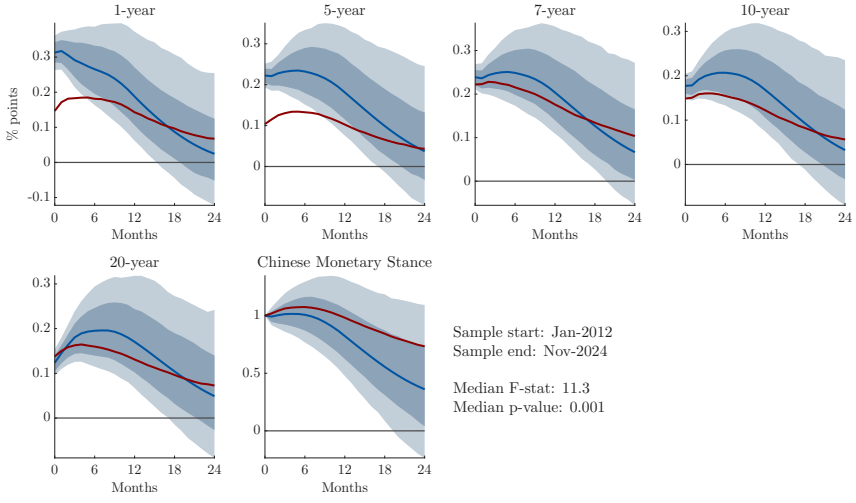
Sample start: Jan-2012
Sample end: Nov-2024

Median F-stat: 11.2
Median p-value: 0.001

Note: Shaded areas represent the 68% and 90% confidence bands. Red lines represent the median IRFs estimated from samples that include the COVID period.

Back

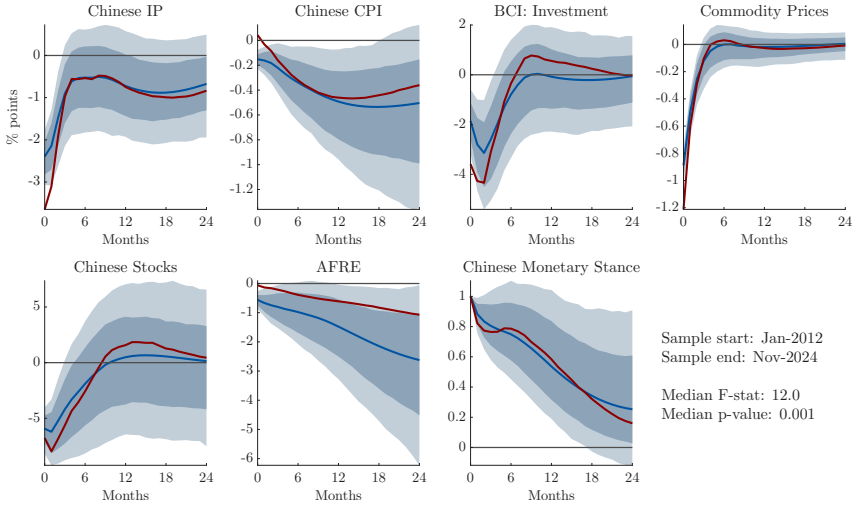
Effect on yield curve: exchange market with COVID



Note: Shaded areas represent the 68% and 90% confidence bands. Red lines represent the median IRFs estimated from samples that include the COVID period.

Back

Domestic effects: with COVID



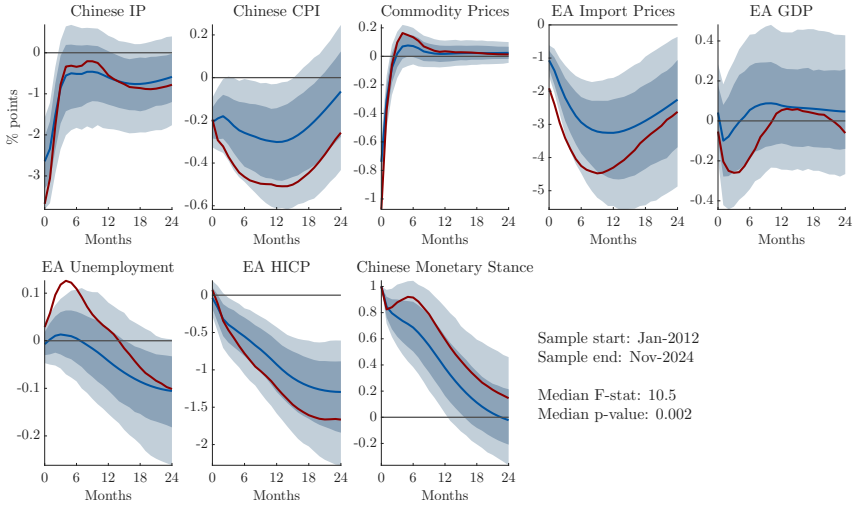
Sample start: Jan-2012
Sample end: Nov-2024

Median F-stat: 12.0
Median p-value: 0.001

Note: Shaded areas represent the 68% and 90% confidence bands. Red lines represent the median IRFs estimated from samples that include the COVID period.

Back

Spillovers to the euro area: with COVID



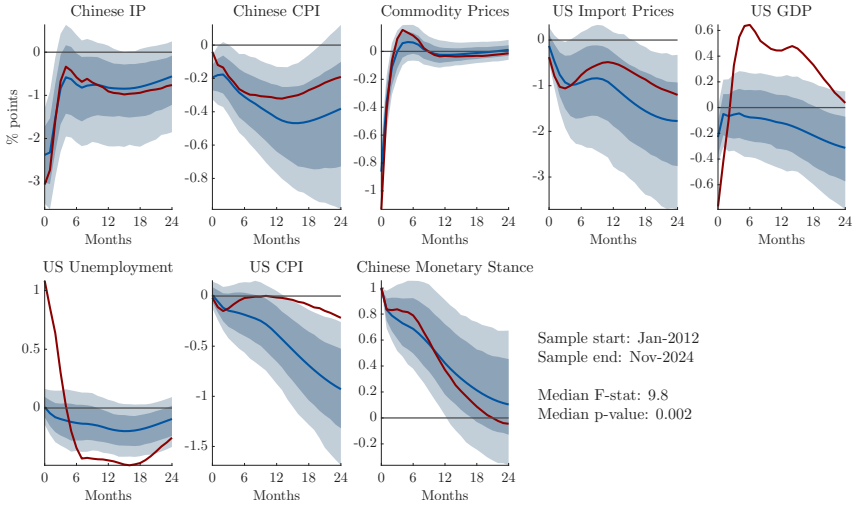
Sample start: Jan-2012
Sample end: Nov-2024

Median F-stat: 10.5
Median p-value: 0.002

Note: Shaded areas represent the 68% and 90% confidence bands. Red lines represent the median IRFs estimated from samples that include the COVID period.

Back

Spillovers to the United States: with COVID



Note: Shaded areas represent the 68% and 90% confidence bands. Red lines represent the median IRFs estimated from samples that include the COVID period.

Back