

# THE ANATOMY OF A PEG: LESSONS FROM CHINA'S PARALLEL CURRENCIES

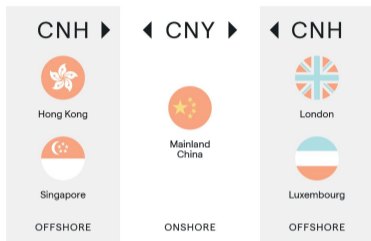
Saleem Bahaj<sup>1</sup> Ricardo Reis<sup>2</sup>

<sup>1</sup>UCL and Bank of England

<sup>2</sup>LSE

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# CHINA'S LARGE-SCALE MONETARY EXPERIMENT



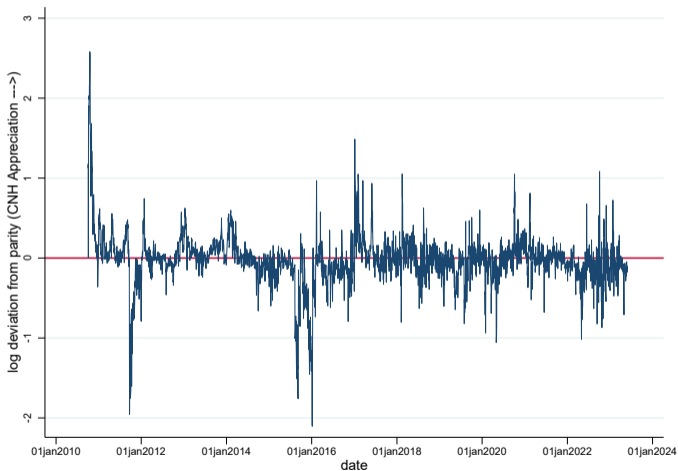
## Free current account, closed capital account

- CNY: mainland currency
- CNH: parallel currency
- Controls to convert CNH-CNY

- No limits in using CNH for payments or in converting to foreign currency
- Only Chinese can use CNY, needed to invest in domestic assets and source of resources to invest abroad.
- Conversion: quotas for FDI and investment, as well as for household transfers. Firms can transfer CNH revenues to CNY against export invoices. Banks can borrow/lend in CNY/CNH with limits.

# GRESHAM'S LAW: THE PEG TO PARITY AND SUCCESS

The tension: if  $e = \ln(E) \neq 0$  for too long, capital controls will fail under the weight of arbitrage.



# 1. MONETARY POLICY OPERATIONS: TEXTBOOK

## Central Bank

Assets	Liabilities
(A) Government Bonds	(D) Reserves
(B) Lending Facilities	(E) Bills
(C) FX and Other Assets	(F) Equity, Others

## Commercial Banking System

Assets	Liabilities
(G) Government Bonds	(K) Demand Deposits
(H) Central Bank Bills	(L) CB Facilities
(I) Reserves	(M) Equity, Others
(J) Loans, Others	

- Open market operation: (A) up, (D) up, (G) down, (I) up. Then, “multiplier” (J) up and (K) up.
- Not in CNH, as there are no CNH government bonds.

# MONETARY POLICY OPERATIONS: REPURCHASES

Central Bank	
Assets	Liabilities
(A) Government Bonds	(D) Reserves
(B) Lending Facilities	(E) Bills
(C) FX and Other Assets	(F) Equity, Others

Commercial Banking System	
Assets	Liabilities
(G) Government Bonds	(K) Demand Deposits
(H) Central Bank Bills	(L) CB Facilities
(I) Reserves	(M) Equity, Others
(J) Loans, Others	

- Swap reserves for bills: (D) up, (E) down, (H) down, (I) up.

# MONETARY POLICY OPERATIONS: LENDING FACILITY

## Central Bank

Assets	Liabilities
(A) Government Bonds	(D) Reserves
(B) Lending Facilities	(E) Bills
(C) FX and Other Assets	(F) Equity, Others

## Commercial Banking System

Assets	Liabilities
(G) Government Bonds	(K) Demand Deposits
(H) Central Bank Bills	(L) CB Facilities
(I) Reserves	(M) Equity, Others
(J) Loans, Others	

- Lending facility: (B) up, (D) up, (I) up, (L) up

# MONETARY POLICY OPERATIONS: CNH

## People's Bank of China

Assets	Liabilities
(a) CNY Assets	(c) CNY Onshore Reserves
(b) FX Assets	(d) CNY Clearing Bank Reserves
	(e) CNH Bills
	(f) Equity, Others

## Offshore Clearing Banks

Assets	Liabilities
(g) CNY Clearing Bank Reserves	(i) CNH Commercial Bank Sight Deposits
(h) Other Assets	(j) CNH HKMA Deposits
	(k) CNY Equity, Others

## Hong Kong Monetary Authority CNH

Assets	Liabilities
(l) Deposits at Clearing Banks	(p) Equity, Others
(m) PLP Balances	
(n) Liquidity Facilities	
(o) Other Assets	

## Hong Kong Commercial Banks CNH

Assets	Liabilities
(q) Deposits at Clearing Banks	(t) Demand Deposits
(r) PBoC Bills	(u) PLP Balances
(s) Loans, Others	(v) HKMA Facilities
	(w) Equity, Others

- PBoC weekly manages  $M$  through bills: (e) falls (d) up; (g) up (i) up ; (q) up, (r) down.
- HKMA hourly manages  $M$  through lending facility: (l) down (m) up ; (q) up, (u) up.

## 2. THEORY: THE CAUSAL EFFECT OF $M$ ON $E$

- No arbitrage condition for a bank that can have reserves in CNY or CNH

$$R^{m,o} - \phi^{o'}(m^{o},.) = \left( \frac{\mathbb{E}(E')}{E} \right) (R^m - \phi'(m,.) )$$

- Exchange rates question: **Is  $\phi'(M,.) = 0$ ?**
  - Is money a pure financial asset?
  - Does the demand for money slope down?
  - Are there liquidity effects on UIP?



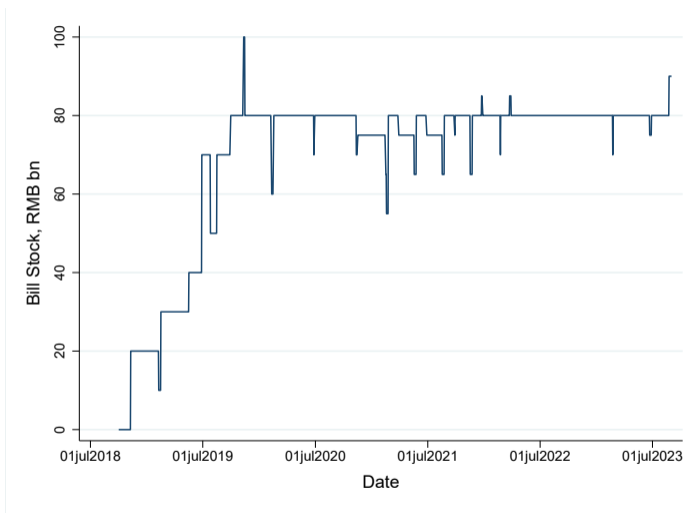
## 2. THEORY: THE CAUSAL EFFECT OF $M$ ON $E$

- No arbitrage condition for a bank that can have reserves in CNY or CNH

$$\underbrace{R^{m,o} - \phi^{o'}(m^o, \cdot)}_{=1} = \left( \frac{\overbrace{\mathbb{E}(E')}}{E} \right) \underbrace{(R^m - \phi'(m, \cdot))}_{=1} \quad \text{so} \quad E = 1 - \phi'(M, \cdot)$$

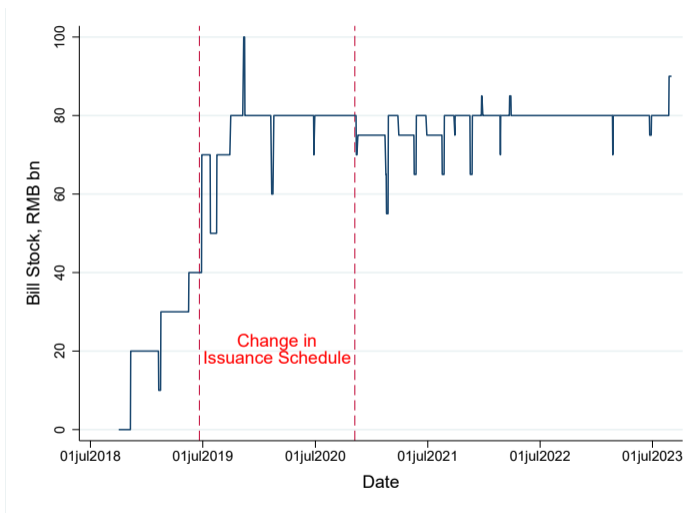
- Exchange rates question: Is  $\phi'(M, \cdot) = 0$ ?
- CNH-CNY is a good testing ground since:
  - CNH reserves are not remunerated  $R^m = 1$ , all action in  $M$
  - Onshore monetary policy independent of offshore exchange rate:  $R^{m,o} - \phi^{o'}(\cdot) = 1$
  - Monetary policy rule is known and credible  $\mathbb{E}(E') = 1$
- Are there high-frequency (no omitted macro variables), exogenous (no reverse causality from  $E$ ) transitory (no effect on expectations) **changes in  $M$** ?

# TEST: HIGHER CNH MONEY SUPPLY DEPRECIATES CNH



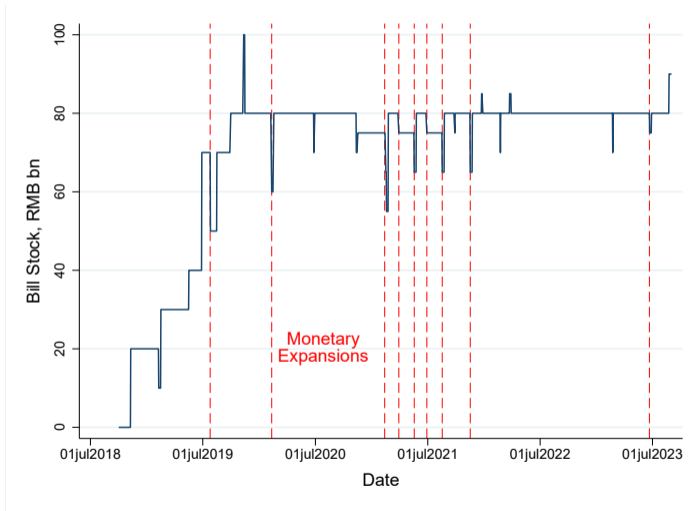
Bill issuance: November 2018 goal was 40bn of 3M bills and 10bn of 12M bills.

# TEST: HIGHER CNH MONEY SUPPLY DEPRECIATES CNH



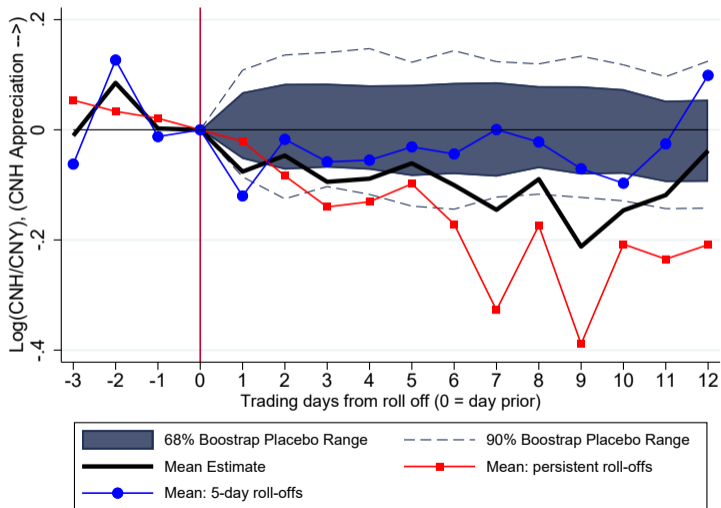
8 Aug 2019: new goal of 20bn of 3M and 6M and 40bn of 12M. 6 Nov 2020: switch to 10bn of 3M and 6M and 60bn of 12M

# TEST: HIGHER CNH MONEY SUPPLY DEPRECIATES CNH



# MONEY SUPPLY SHOCKS: EVENT STUDIES

## Inference vis-a-vis placebos



## 2. ANATOMY OF THE PEG

- Banks supply deposits, give loans (return 1), face liquidity cost per unit of deposits  $\phi(m/d)$

$$\left(\frac{\mathbb{E}(E')}{E}\right) \left[ R^d + \phi(m/d) - \left(\frac{m}{d}\right) \phi'(m/d) \right] = 1$$

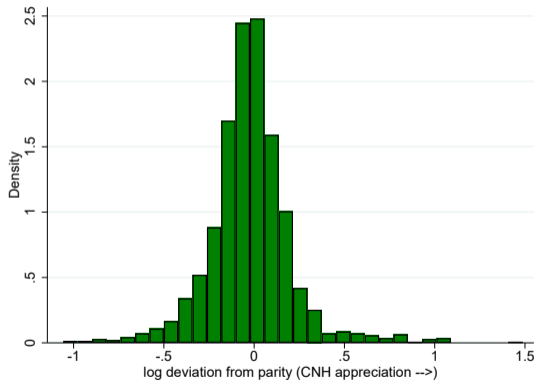
- Households demand deposits for their liquidity services:

$$\left(\frac{\mathbb{E}(E')}{E}\right) R^d = 1 - vD^{-\alpha}$$

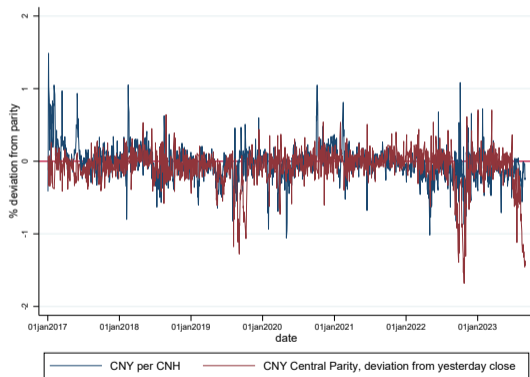
- With supply equal demand, have two equations in two unknowns  $E, D$  with two shocks  $M, v$ . Model of private and public money, with demand and supply.
- **Higher private demand for CNH  $v$** : appreciate  $E$ , followed by **increase in  $M$**  to re-set parity.

# TEST: DEVIATIONS FROM PEG AS SHOCKS TO MONEY DEMAND

## Histogram of $e$

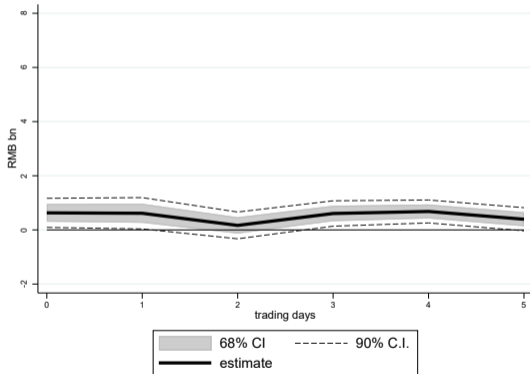


## Instrument for deviations from parity

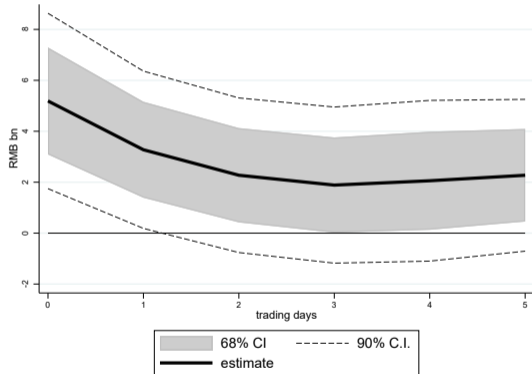


# RESPONSE OF $M$ TO MONEY DEMAND SHOCK

## Local Projection



## LP-IV



If  $z$  is PLP drawing, then plot from regression  $y_{t+h} = \beta_h e_t + \gamma_h e_{t-1} + \delta_h y_{t-1} + \text{error}$



## 4. LIQUIDITY MANAGEMENT AND FINANCIAL INNOVATION

- Expected liquidity costs  $\phi(\cdot)$ : random withdrawal shock  $\Omega(\omega)$ , match in interbank market with prob.  $\Psi_+(\theta), \Psi_-(\theta)$ , tightness  $\theta$ , pay bargained rate  $R^f(\theta)$ , or go to discount window  $R^z$ .

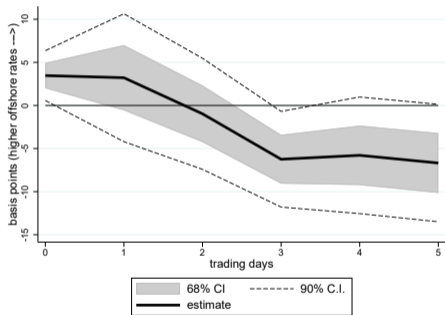
$$\phi(m/d)d = - \underbrace{\Psi_+(\theta)}_{\text{prob. find borrower}} \times \underbrace{(R^f(\theta) - R^m)}_{\text{lending profit}} \times \underbrace{\int_{\bar{\omega}}^{\infty} s(\omega) d\Omega(\omega)}_{\text{liquidity surpluses}}$$

$$- \left[ \underbrace{\Psi_-(\theta)(R^f(\theta) - R^m)}_{\text{interbank borrowing}} + \underbrace{(1 - \Psi_-(\theta))(R^z - R^m)}_{\text{CB borrowing}} \right] \underbrace{\int_{-1}^{\bar{\omega}} s(\omega) d\Omega(\omega)}_{\text{liquidity deficits}}$$

- **Increase in demand for CNH deposits:**  $v$  rises.
  - Tightness rises in interbank market:  $\theta$  rises (bid rate for bills falls)
  - Interbank rate rises:  $R^f(\theta)$  up (3M market rate rises)
  - Monetary accomodation in response,  $R^f(\theta)$  down and less use of intraday facility

# TEST: THE INTERBANK MARKET AND THE BILL AUCTIONS

## 3M interbank interest differential

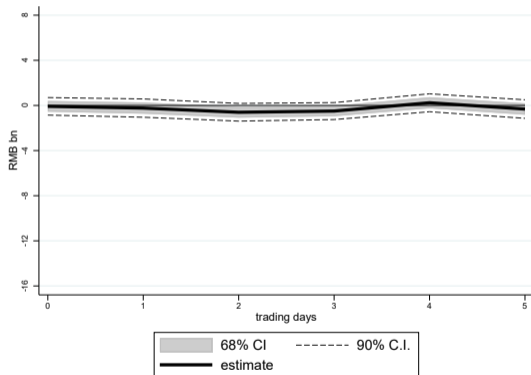


Regression of bill auction subscription rate (bids / bills auctioned) on the exchange rate

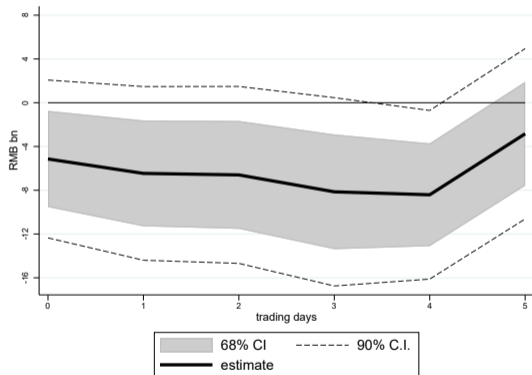
bill maturities	All	12M	6M	3M
	(1)	(2)	(3)	(4)
$\frac{1}{5} \sum_0^4 e_{t-h}$	-2.76*** (0.93)	-3.38*** (1.10)	-2.78*** (0.93)	-3.38*** (1.12)
Auctions	35	19	16	19
$R^2$	0.142	0.335	0.131	0.324

# TEST: RESPONSE OF DISCOUNT WINDOW DRAWINGS TO SHOCK

## Local Projection



## LP-IV



$z$  is intraday facility drawing, plot from regression  $z_{t+h} = \beta_h e_t + \gamma_h e_{t-1} + \delta_h z_{t-1} + \text{error}$

## 5. LIQUIDITY POLICIES

- Marginal benefit of innovation:

$$-\phi'(M/D) = (1 - \Psi_-(\theta))(R^z - R^m)\Omega(\bar{\omega})$$

- Financial innovation—lower  $\Omega(\bar{\omega})$ , higher  $\Psi_-(\theta)$ , lower  $\theta$ —lowers the marginal benefit of offshore reserves, puts pressure on the peg. **Goodhart's law**.
- **Liquidity policies** in response: raising interest rate on central bank lending (higher  $R^z$ ) raising reserve requirements (higher  $\rho$ ) helicopter drop of money (lower  $M$  without change in bills).
- **Liquidity controls**: on deposit and reserve flows

$$d \int_{-1}^{\infty} \omega d\Omega(\omega) = W^d \quad \text{and} \quad \theta = \frac{-\int_{-1}^{\bar{\omega}} s(\omega) d\Omega(\omega)}{\int_{\bar{\omega}}^{\infty} s(\omega) d\Omega(\omega) - G + W^m}$$

## FOREIGN EXCHANGE RATE

- $\hat{E}$  between offshore and foreign money,  $E$  between onshore to offshore.
- Modified UIP for USD exchange rate  $\hat{E}$

$$\frac{\mathbb{E}(\hat{E}')}{\hat{E}} = \frac{R^{m, \text{RoW}} + w}{E + \phi'(M/D) - \phi'(M^{\text{RoW}}/D^{\text{RoW}})}.$$

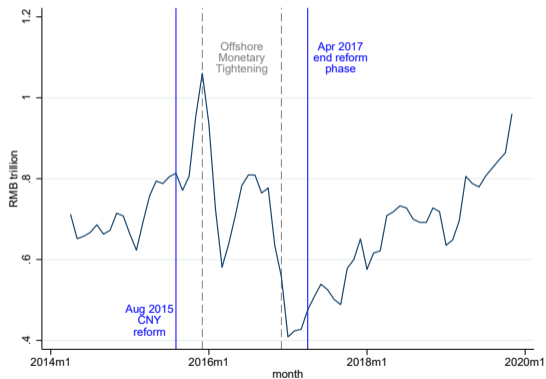
- $E$  is pressure valve for  $\hat{E}$ : why they move together in the data.
- Liquidity policies or controls are other tools for exchange rate.

# THE 11/8/2015 DEPRECIATION AND LIQUIDITY CONTROLS

## CNH/USD and CNY/USD exchange rates



## RMB flows from onshore to offshore



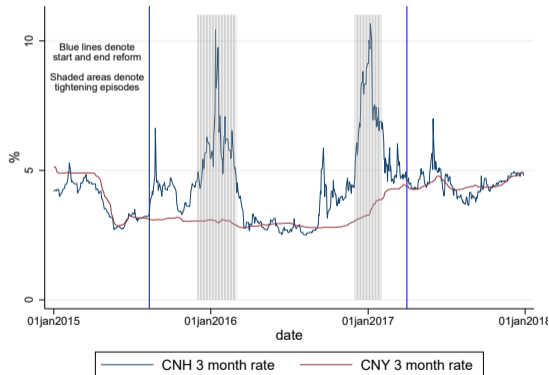
# THE 11/8/2015 DEPRECIATION AND LIQUIDITY CONTROLS

Deposits fall, interbank rate rises

## Relative stock of CNH-CNY deposits and $e$



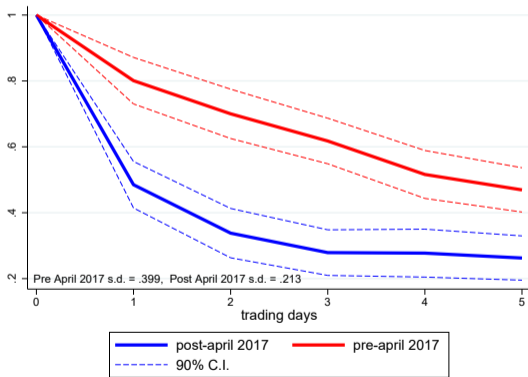
## 3-month interbank rates for CNH and CNY



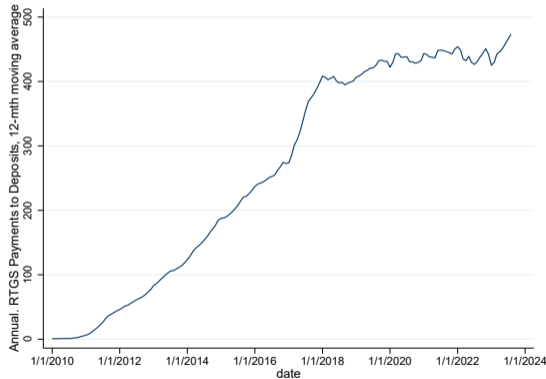
# THE 11/8/2015 DEPRECIATION AND LIQUIDITY CONTROLS

Death of the Hong Kong market and reform of the framework

## Persistence of $e$ pre and post April 2017



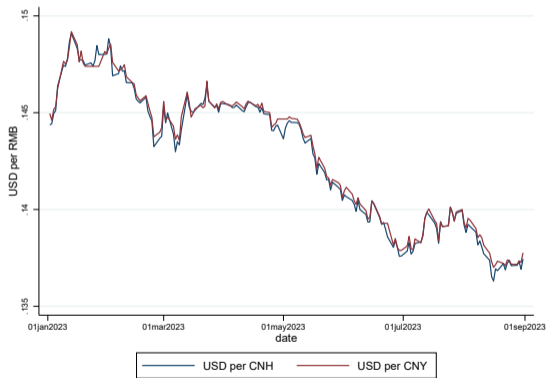
## CNH velocity



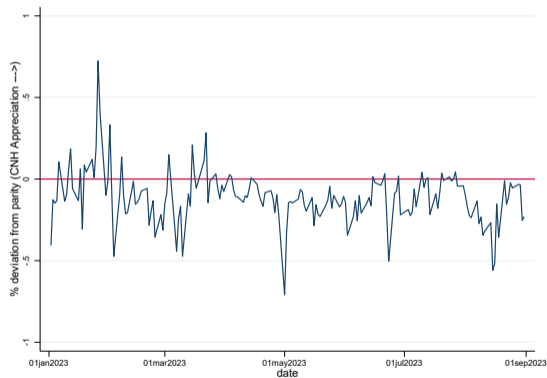


# SUMMER 2023 AND MONETARY / LIQUIDITY POLICIES

## CNH/USD and CNY/USD exchange rates

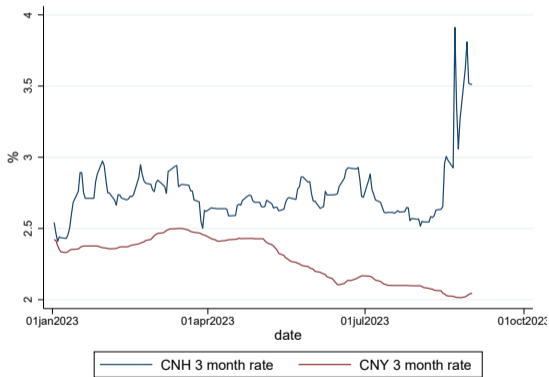


## CNH/CNY exchange rate

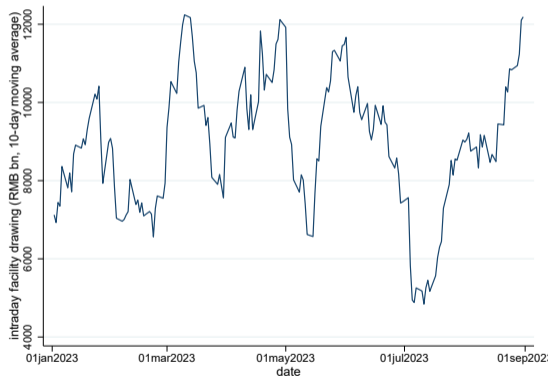


# SUMMER 2023 AND MONETARY / LIQUIDITY POLICIES

## 3-month interbank rates for CNH and CNY



## Intraday liquidity facility borrowing



## 7. CONCLUSION

- China has offshore currency to enforce capital controls while allowing for an open current account and internationalization of the yuan.
- Exogenous transitory increases in the money supply depreciate the exchange rate.
- Successful peg because the central banks involved have responded to increases in the demand for money by raising the money supply.
- Liquidity policies and controls complement monetary tools.
- Can use parallel currencies to manage foreign exchange rate, and recent use leaves optimism.