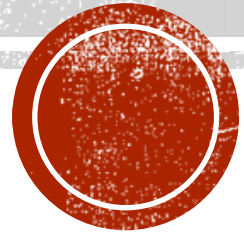
CENTRAL BANKS AS DOLLAR LENDERS OF LAST RESORT: IMPLICATIONS FOR REGULATION AND RESERVE HOLDINGS



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NON-U.S. CENTRAL BANKS HOLD LARGE DOLLAR RESERVES

- As of July 2023: $6.7T, with $3.8T in U.S. Treasuries.
- Dollar is dominant: 59% of all foreign currency reserves.
- Reserve managers were big sellers of USTs in March 2020 "dash for cash".

- Why? Non-financial firms run significant mismatch, over-borrow in dollars. A motive for CB to stockpile dollars so it can bail out banks in a crisis state.

- Reserve-holding decisions of individual CBs can be excessive relative to global planner optimum: they do not internalize impact on dollar interest rate and therefore on mismatch in other countries.

THE BASIC ARGUMENT

- Small-country CB faces risk of banking crisis which creates need for a bailout.
- Bailout costs are greater when firms have currency-mismatched borrowing.
- Dollar reserves can be used to reduce the need for distortionary ex post taxes to finance the bailout.
  - Reserves are worth more when bailout is most expensive—when dollar has appreciated.
- CB can also use ex ante regulatory tools, e.g. capital requirements.
- Tradeoff: capital requirements reduce profits of banking sector. But reserve holdings entail a carry cost due to low rate on dollar assets.

THE BASIC ARGUMENT

- The key externality: a small-country CB over-relies on reserves, and under-relies on capital requirements, because it takes dollar interest rate as given.
- Collectively, reserve holdings of all CBs push down dollar interest rate and worsen mismatch incentives in corporate sector.
- A global planner prefers reduced reserve holdings, tighter capital requirements. But only if they cannot control mismatch directly.
- A second-best argument for influencing interest rates to safeguard financial stability when financial regulation is helpful but imperfect.
  - Familiar in other contexts.

RELATED WORK

- Mercantilist view of reserve holdings: CB that seeks to protect tradable sector will accumulate reserves when it is running a trade surplus.
  - Dooley et al (2003), Aizenman-Lee (2010), Benigno-Fornaro (2012), Korinek-Serven (2016).
  - Fanelli-Straub (2021) also argue that individual countries may over-accumulate reserves.
- Precautionary view of reserve holdings: CB stockpiles reserves as a buffer against risk of adverse shock.
  - Caballero-Panageas (2008), Alfaro-Kanczuk (2009), Durdu-Mendoza-Terrones (2009), Jeanne-Ranciere (2011), Bianchi-Hatchondo-Martinez (2018), Cespedes-Chang (2020), Arce-Bengui-Bianchi (2022), Bianchi-Lorenzoni (2021), Obstfeld-Shambaugh-Taylor (2010).
  - We are closest to Bocola-Lorenzoni (2020) who also emphasize currency-mismatch motive.
- International coordination in financial regulation
  - Clayton-Schaab (2022).

SOME MOTIVATING EVIDENCE (WITH MANY CAVEATS)

- Goal: examine link between CB holdings of dollar reserves and dollar-denominated borrowing of their non-financial corporate sectors.
  - Focus on corporates, as banks tend not to run outright currency mismatches.

- Can only get data on dollar reserve holdings for 53 countries. We have a panel with 365 observations covering 2013-2020: 13 advanced economies, 29 emerging, 11 developing.

- Also, we can only get complete data on those dollar denominated loans to corporate sector that come from *cross-border banks*.
  - Data on dollar lending by local banks is only available for 21 countries. But in these 21, correlation of cross-border dollar lending and total dollar lending is quite high: 0.89 for advanced economies, 0.73 for emerging economies.

- Finally, we don't have data on bond-market lending (though maybe less relevant in a banking crisis?)

Figure 1
Nonfinancial company dollar loans and central bank dollar reserves: country averages (2013-20, 53 countries)

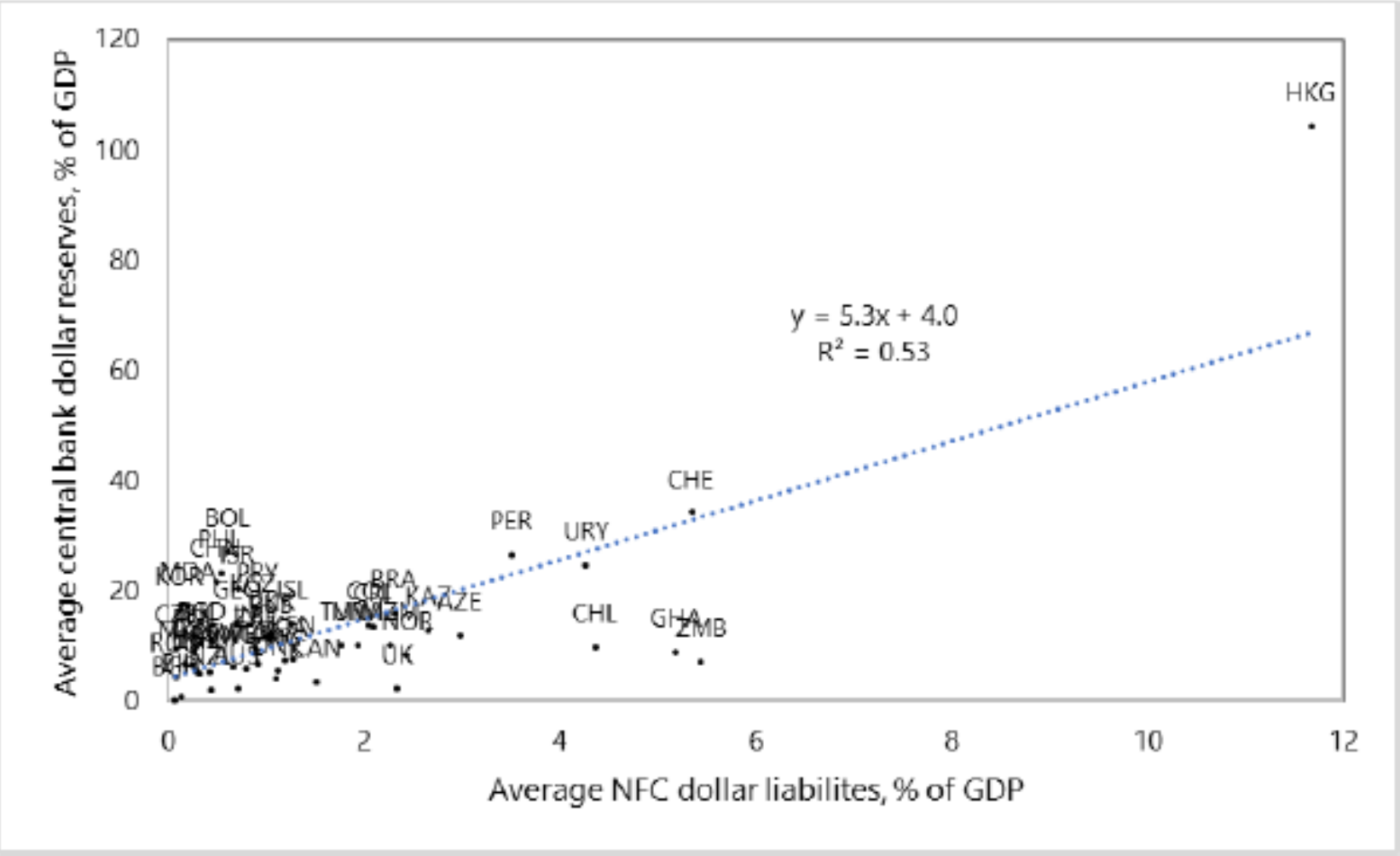


Figure 2
Nonfinancial company dollar loans and central bank dollar reserves: country averages excluding Hong Kong (2013-20, 52 countries)

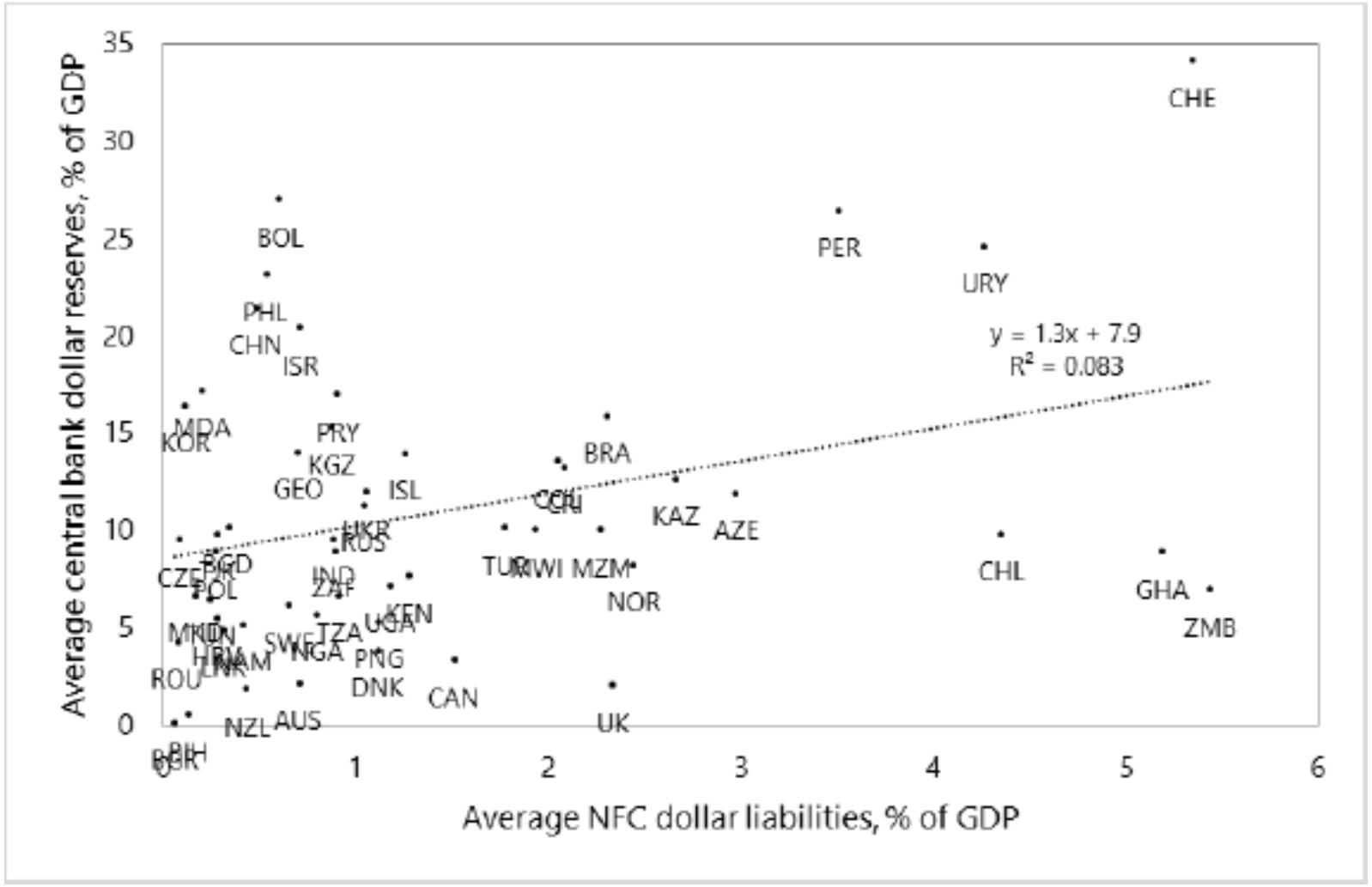
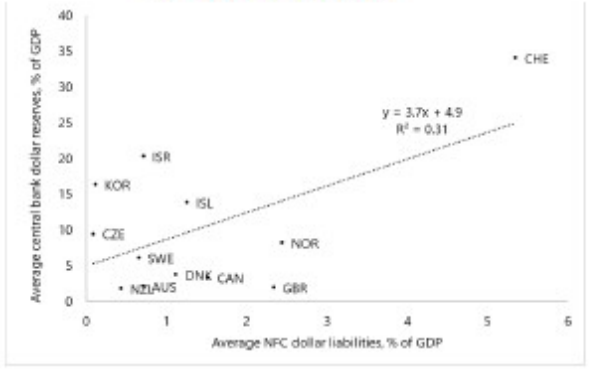
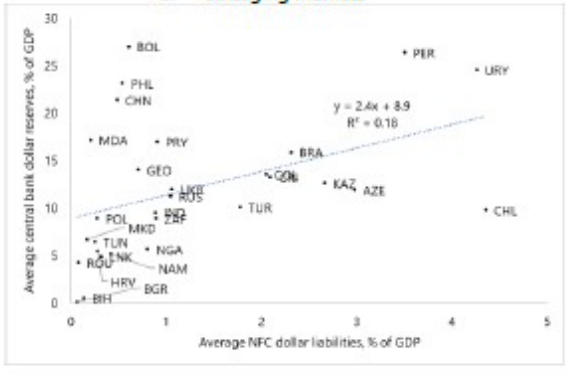


Figure 3
Nonfinancial company dollar loans and central bank dollar reserves: disaggregation across advanced, emerging and developing countries

a. Advanced economies



b. Emerging markets



c. Developing economies

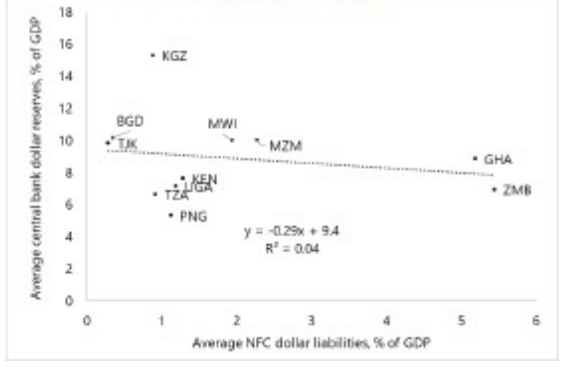


Table 2

Regressions of central bank dollar reserves vs. nonfinancial company dollar loans

Dependent variable: central bank dollar reserves as % of GDP

	No fixed effects				No fixed effects				Fixed effects			
	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)	(9)	(10)	(11)	(12)
	All	AE	EM	DE	All	AE	EM	DE	All	AE	EM	DE
NFC dollar liabilities	1.645*	3.825*	2.330**	-0.104	1.731*	3.274*	1.906**	0.0176	1.213**	3.566**	0.946**	0.466
	(0.918)	(1.756)	(0.885)	(0.177)	(0.954)	(1.794)	(0.737)	(0.258)	(0.594)	(1.445)	(0.433)	(0.392)
M2					0.0209	0.248***	-0.0624	0.102				
					(0.0492)	(0.0653)	(0.0494)	(0.108)				
Financial openness					-1.772	16.73	5.075	-1.781				
					(2.977)	(10.67)	(3.291)	(1.382)				
Bilateral trade w/US					0.141	0.130	0.153	0.345				
					(0.268)	(0.153)	(0.263)	(0.753)				
GDP per capita					-0.0230	-0.434	-0.442**	-0.0251				
					(0.0748)	(0.281)	(0.167)	(0.765)				
Ln Population					-0.325	-8.067***	0.970	-1.356				
					(0.627)	(2.268)	(0.743)	(1.284)				
Nominal dollar ER									2.074***	15.41**	2.884***	1.320
									(0.667)	(6.353)	(0.366)	(0.875)
Observations	357	93	184	80	345	89	184	72	356	93	183	80
# of Countries	52	12	29	11	52	12	29	11	51	12	28	11
Adj r-sq	0.117	0.352	0.178	0.003	0.138	0.625	0.385	0.195	0.862	0.934	0.861	0.437

Notes. NFC dollar liabilities are dollar liabilities to cross-border banks. AE, EM and DE are as per the IMF classification (Appendix Table 3). Standard errors are clustered by country. Central bank dollar reserves, NFC dollar liabilities, bilateral trade with the US, and M2 are in % of GDP. Nominal dollar ER is the nominal exchange rate vis-à-vis the U.S dollar. Columns (9)-(12) drop China for which we have only one year's data. *** p<0.01, ** p<0.05, * p<0.1.

REGULATION AND RESERVES IN A SMALL COUNTRY

- Model with two dates, 0 and 1. Households have linear utility over consumption of local goods. Can save in three types of assets: home-currency-denominated safe assets D_h, dollar-denominated safe assets $D_\$$, and home-currency equity K.

- Household utility is given by:

$$U \equiv C_0 + \beta E[C_1] + \underbrace{\theta_d(D_\$ + D_h)}_{\textit{Preference for Safe Assets}} + \underbrace{f(D_\$)}_{\textit{Extra Preference for the Dollar}}$$

- Household FOC yield: $Q_K = \beta,\ Q_h = \beta + \theta_d,\quad Q_\$ = \beta + \theta_d + f'(D_\$)$

- Time-1 exchange rate, denoted by $\tilde{e}$, takes on the values $(1 - z)$ and $(1 + z)$, each with probability ½.

"BANKS" (INTERPRETED AS BANKS PLUS CORPORATE SECTOR)

- At time 0, a bank raises funding for a fixed quantity of projects I. Issues three types of securities: B_h, $B_\$$ and K: deposits in home currency, deposits in dollars, and equity.

- Balance sheet at time 0 must satisfy: $Q_\$ B_\$ + Q_h B_h + Q_K K = I$.

- With prob q, there is a banking crisis at time 1: revenues of fraction p of banks fall to zero, remainder stay solvent. Banks whose revenues fall to zero have depositors bailed out by government.

- For now, assume prob of a crisis is independent of exchange rate.

"BANKS" (INTERPRETED AS BANKS PLUS CORPORATE SECTOR)

- If a bank is solvent, but home currency depreciates, (with probability $\frac{(1-pq)}{2}$), currency mismatch leads to liquidity-constraint cost for banks and customers of $\frac{\gamma B_{\$}^2}{I}$.

- With no regulation, bank choses: $B_{\$}^* = SI/\gamma, B_h^* = \frac{I - Q_{\$} B_{\$}^*}{Q_h}, K^* = 0$, where $S \equiv \left(\frac{Q_{\$}}{Q_h} - 1\right)$ is interest-rate spread between home-currency and dollar deposits.

- Simple tradeoff between cheapness of dollar deposits vs. liquidity-constraint costs of currency mismatch.

CENTRAL-BANK RESERVE HOLDINGS

- CB buys dollar reserves, $R_\$$, paying $Q_\$ R_\$$ at time 0. Holds size of balance sheet constant and finances by selling other assets (e.g., a portfolio of global stocks) that yield an equity-like rate of return.

- CB earns expected negative return (in time-1 units) of $S_K R_\$ \equiv \left(\frac{Q_\$}{\beta} - 1\right) R_\$$ on its reserve holdings, where S_K is spread between return on equity and dollar interest rate. A net transfer to foreigners that reduces domestic consumption at time 1.

- In crisis state, CB bails out depositors either by raising taxes, or by using net profits on reserve holdings. In crisis state, fiscal capacity is limited, and deadweight costs of taxation are $\psi\tau^2$.

CENTRAL-BANK RESERVE HOLDINGS

- This tradeoff leads to: $R_{\$}^{**} = pB_{\$} - \frac{S_K}{2qz^2\psi}$.

- With no carry costs S_K, CB holds enough reserves that it never has to tax in a crisis state. As S_K increases, optimal reserve holdings decline.

- Risk management logic: dollar reserves transfer wealth to states where it is most needed. Profits on reserve holdings are positive when dollar appreciates, and cost of bailout is higher.

- CB swap lines are not a substitute for reserves: swap lines don't transfer wealth across states.

FINANCIAL REGULATION: CAPITAL REQUIREMENTS

- Can write social welfare W as:

$$W = B_{\$}(Q_{\$} - \beta) + B_h(Q_h - \beta) + (f(D_{\$}) - D_{\$}f'(D_{\$})) - \beta\{(1 - pq)\gamma B_{\$}^2/2I + S_K R_{\$} + \Omega(\tau)\}$$

- If CB sets a capital requirement, this constrains sum of home-currency and dollar borrowing but cannot control them individually.

- Banks' choice of dollar borrowing $B_{\$}^* = SI/\gamma$ is independent of total amount of deposit funding. So capital requirement is equivalent to regulator picking home-currency borrowing B_h.

- FOC to max W with respect to B_h is: $B_h^{**} = \frac{(Q_h - \beta)}{2\beta\psi qp^2} - B_{\$}$.

FINANCIAL REGULATION: FUNDING MIX

- Can also ask what happens if regulator can further control mix of dollar and local-currency deposits.

- Not realistic, given that funding mismatch lives mostly on balance sheets of unregulated non-financial firms.

- But will be helpful for understanding economics of global-planner case.

- FOC for $B_\$$ in an interior optimum is: $B_\$^{**} = \frac{(Q_\$ - \beta) - 2\psi q \beta p^2 B_h^{**} + 2\psi q \beta p z^2 R_\$^{**}}{\left(\frac{\beta(1-pq)\gamma}{I}\right) + 2\psi q \beta p^2 (1+z^2)}$

WHAT IF BANKING AND CURRENCY CRISES ARE CORRELATED?

- To capture, assume increased prob $(q + h)$ of banking crisis when exchange rate is $(1 + z)$, i.e., when the local currency depreciates. And reduced prob $(q - h)$ of banking crisis when exchange rate is $(1 - z)$.

- Now an unregulated bank sets: $B_{\$}^{*} = \frac{I((1-qp)S+hpz)}{(1-p(q+h))\gamma}$

- Main change is *hpz* term in numerator. Moral hazard: bank is more likely to default when dollar appreciates, so it likes to borrow in dollars.

- CB now sets: $R_{\$}^{**} = \frac{ph(B_{\$}+B_h)}{qz} + pB_{\$} - \frac{S_K}{2qz^2\psi}$

- CB now holds reserves against local-currency deposits: an added hedging effect. Crisis is more likely when dollar is strong, so holding dollars is attractive to hedge bailout even of local-currency deposits.

Numerical Example: Set the parameter values as follows: $I = 100$; $\beta = 0.9$; $\theta_d = 0.045$; $p = 0.25$; $z = 0.75$; $q = 0.1$; $h = 0.07$; $\gamma = 0.06$; $\psi = 0.053$; and $Q_S = 0.97$. In this case, the solutions to the model are given in Table 3 below.

Table 3: Numerical Example

	No Regulation	Capital Regulation Only	Capital and Funding Regulation
$B_\$$	67.744	67.744	14.505
B_h	36.284	26.528	79.766
K	0	10.245	11.724
$R_\$$	28.165	25.888	12.578

GLOBAL EXTERNALITIES FROM RESERVE ACCUMULATION

- Global economy consists of unit measure of identical small countries.
- Plus the U.S., which issues Treasury bonds in amount $X_{\$}$, and hence has welfare $W_{US} = X_{\$}(Q_{\$} - \beta)$.
- Exchange rates and banking crises are correlated as before.
- All countries draw same exchange rate, and occurrence of banking crises is perfectly correlated across countries: all risks are non-diversifiable.
- Absent pecuniary externality with respect to dollar, no reason for global planner to differ from local planner.

GLOBAL EXTERNALITIES FROM RESERVE ACCUMULATION

- Taking account of U.S. welfare, aggregate global welfare is now:

$$W_G \equiv W_L + W_{US} = X_\$(Q_\$ - \beta) + B_\$(Q_\$ - \beta) + B_h(Q_h - \beta) + \left(f(D_\$) - D_\$ f'(D_\$)\right) - \beta\{\left(1 - p(q+h)\right)\gamma B_\$^2/2I + S_K R_\$ + \Omega(\tau)\}$$

- Market-clearing conditions: $B_\$ + X_\$ = R_\$ + D_\$;\ D_{hi} = B_{hi}.$

- Assume household utility from dollar assets is quadratic: $f(D_\$) = \theta_{\$1} D_\$ - \frac{1}{2}\theta_{\$2} D_\$^2$
- So price of safe dollar assets is: $Q_\$ = \beta + \theta_d + \theta_{\$1} - \theta_{\$2} D_\$$
- Key is global planner internalizes impact of reserve holdings on dollar interest rate. If $\theta_{\$2} = 0$, there is no wedge between global and local planner solutions.

A HELPFUL EXPRESSION

- After netting out various transfer terms, we can write:

$$\frac{dW_G}{dR_\$} = \underbrace{-(Q_\$ - \beta) - \beta\frac{\partial\Omega}{\partial R_\$}}_{Local\ Planner's\ FOC} + \underbrace{\phi\left((Q_\$ - \beta) - \beta\big(1 - p(q+h)\big)\gamma B_\$/I - \beta\frac{\partial\Omega}{\partial B_\$}\right)}_{Wedge\ Between\ Global\ and\ Local\ Planner}$$

where $\phi \equiv \frac{dB_\$}{dR_\$}$.

- There is a wedge between global planner and local planner only if $\frac{dB_\$}{dR_\$} < 0$.
- Global planner's sole motive in controlling reserves: an indirect way to reduce mismatch, via an increase in the dollar interest rate.
- We are assuming here that regulator sets capital requirement but does not directly control funding mix.

IMPLICATIONS FOR OPTIMAL RESERVE HOLDINGS

- **Proposition 1**: If, when evaluated at local planner's optimum, it is the case that $\left(\left(Q_{\$}^{**}-\beta\right)-\beta\left(1-p(q+h)\right)\gamma B_{\$}^{*}/I-\beta\,\frac{\partial\Omega}{\partial B_{\$}}\right)<0$, then $R_{\$}^{***}<R_{\$}^{**}$, i.e., the global planner chooses a lower level of reserves than the local planner.

- First term makes global planner want *more* reserves: because more dollar borrowing increases supply of safe dollar assets, increases household utility.

- Latter two terms make global planner want *less* reserves: because less dollar borrowing reduces mismatch liquidity costs and deadweight taxation costs.

IMPLICATIONS FOR OPTIMAL RESERVE HOLDINGS

- An alternative, more intuitive statement:

- **Proposition 2**: Suppose a more-empowered global planner could choose a value of $B_\$$ directly. Define mismatch as socially excessive if, when starting from the local planner's optimum, such an empowered global planner would choose a lower value than the bank's privately optimal value $B_\$^*$. If mismatch is socially excessive in this sense, then $R_\$^{***} < R_\$^{**}$, i.e., the less-empowered global planner chooses a lower level of reserves than the local planner.

- Only reason global planner differs from local planner is that global planner recognizes that $\phi \equiv \frac{dB_\$}{dR_\$} > 0$. So global planner will want to restrain reserve accumulation if and only if goal is to reduce $B_\$$.

WHAT IF REGULATORS CAN CONTROL MISMATCH DIRECTLY?

- **Proposition 3**: When regulators can directly control dollar mismatch $B_\$$, the outcome is the same under a global planner as under decentralized regulation by individual central banks.

- With direct control of $B_\$$, it is the case that $\phi \equiv \frac{dB_\$}{dR_\$} = 0$. So wedge between global and local planners disappears.

- Not intended as a description of real world. But highlights that externality in reserve accumulation only arises when regulatory toolkit is imperfect.

- More general theme: policymakers should consider impact of interest rates on financial stability if regulation is imperfect. Applies in other settings.
  - Monetary policy
  - Purely domestic bank liquidity regulation.

Table 4: Numerical Example

	No Regulation or Reserve Holdings	Local Planners Set Reserves and Capital	Global Planner Sets Reserves	Planner Also Sets Funding Mix
$Q_\$$	0.961	0.970	0.967	0.986
S	0.017	0.027	0.024	0.043
$B_\$$	51.744	67.737	63.140	37.084
B_h	53.196	26.538	17.923	45.243
K	0	10.242	24.422	22.996
$R_\$$	0	25.888	18.447	12.536

Table 5: Welfare Decomposition

	No Regulation or Reserve Holdings	Local Planners Set Reserves and Capital	Global Planner Sets Reserves and Capital	Planner Also Sets Funding Mix
Total Welfare	100	114.707	115.433	119.548
U.S. Welfare	42.057	48.188	46.426	58.907
Small-Country Welfare	57.943	66.519	69.007	60.641
Bank Profits	63.736	68.104	58.110	59.769
HH Utility	64.472	53.560	56.593	36.910
Reserves Carry	0	-20.791	-14.274	-12.307
Deadweight Tax	-62.324	-20.743	-19.595	-19.651
Liquidity Cost	-7.942	-13.610	-11.826	-4.079

AN EXTENSION: GLOBAL RISK SHARING

- If banking crises are imperfectly correlated across countries, may be scope for risk-sharing in reserve holdings. With uncorrelated crises, a fraction q of countries is always in trouble.
- Caveat: may need a supra-national institution (e.g., IMF) to allocate reserves.

- Two competing effects:
- Risk sharing: only takes reserves of $pqB_{\$}$, as opposed to $pB_{\$}$, to cover all possible needs. Points to lower reserves in uncorrelated case.
- Cost effectiveness: spending S_K to add a unit of reserves, buys more effective coverage than before, since reserves can be deployed more efficiently.
- Bottom line: risk-sharing effect dominates as long as S_K is not too large. If so, another reason why international coordination would lead to reduced reserves, higher dollar interest rates, and less mismatch.

THE IMF'S ROLE (?)

- IMF has credit-line facilities for member countries that look like what we have in mind: Flexible Credit Line and Precautionary and Liquidity Line. A form of insurance meant to substitute for reserve hoarding.
- But strict eligibility requirements mean only a few countries currently use them.

- Kristalina Georgieva (2023): "In a world with more frequent and severe shocks, countries have to find ways to cushion the adverse impacts on their economies and people. That will require building economic buffers in good times that can then be deployed in bad times. One such buffer is a country's international reserves—that is, the foreign currency holdings of its central bank…. No country should rely on its reserves alone, of course…. countries are better off if they can complement their own reserves with access to various international insurance mechanisms that are collectively known as 'the global financial safety net.' At the center of the net is the IMF, which pools the resources of its membership and acts as a cooperative global lender of last resort…Although self-insurance through international reserves has sharply increased for some countries, pooled resources centered on the IMF have increased far less than self-insurance and have shrunk markedly relative to measures of global financial integration. That is why the international community must strengthen the global financial safety net, including by expanding the availability of pooled resources in the IMF."

IN SUM

- CBs around the world hold large volumes of dollar reserves.
- Our empirical work suggests that one motive is concern with currency mismatch in capital structures of private sector firms.
- Ironically, collective reserve holding decisions of CBs drive down dollar interest rates, exacerbating this mismatch problem.

- A global planner would prefer to see individual CBs holding fewer dollar reserves and relying instead on more stringent capital requirements.
  - Assuming an inability to control dollar mismatch directly.

- Benefits of international cooperation in financial regulation are well-understood. Potential benefits of coordinating reserve holdings are less fully appreciated.
- Many practical challenges. But maybe worth starting a policy conversation?