FX Intervention, Reserves Accumulation, and Financial Intermediation

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Introduction and Motivation

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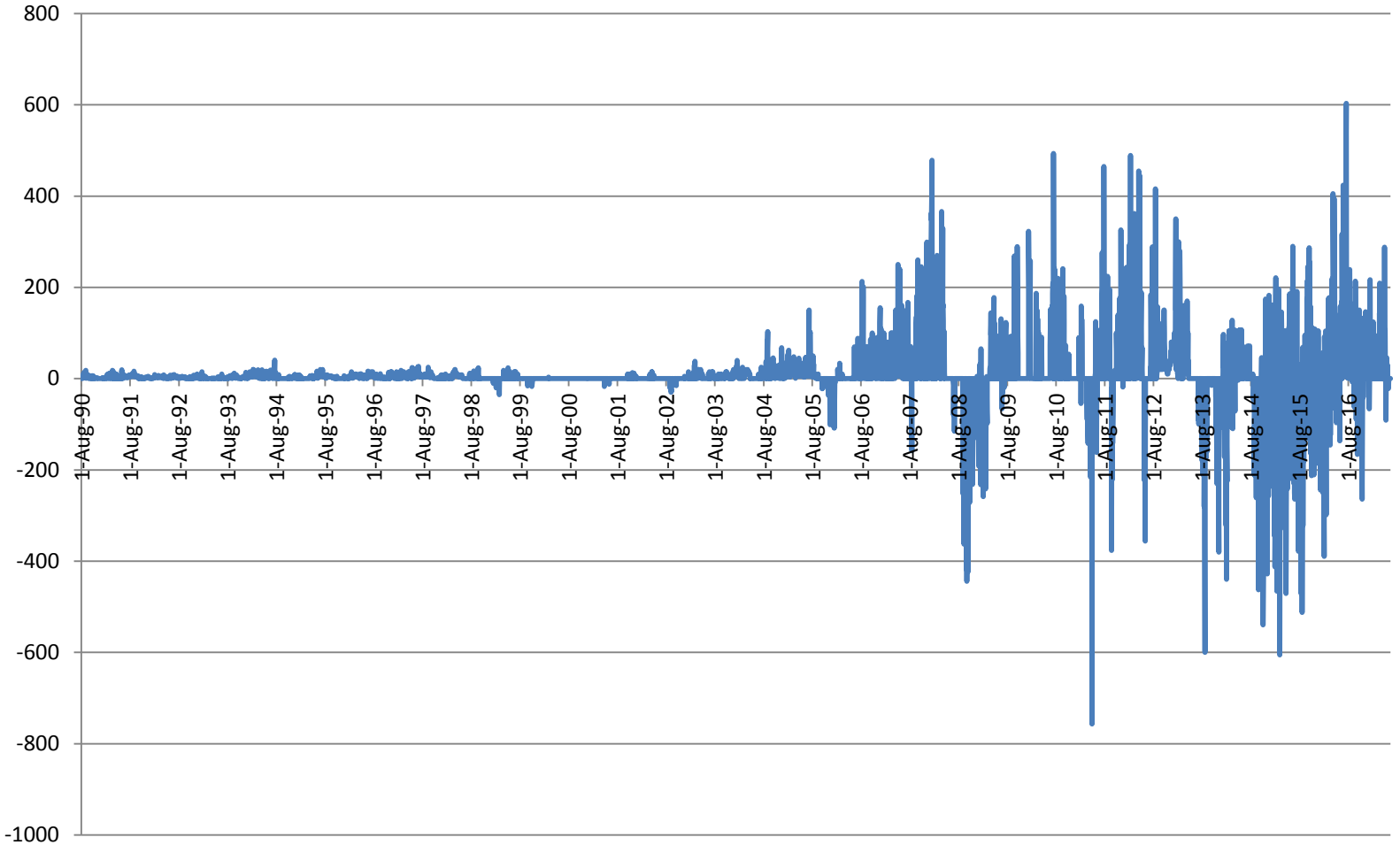
2. Reserves Accumulation

Peru: FX Intervention (Daily, US$ Millions)



Source: Central Bank of Peru

Left axis: FX Intervention, Percent of GDP; Right axis: Exchange Rate

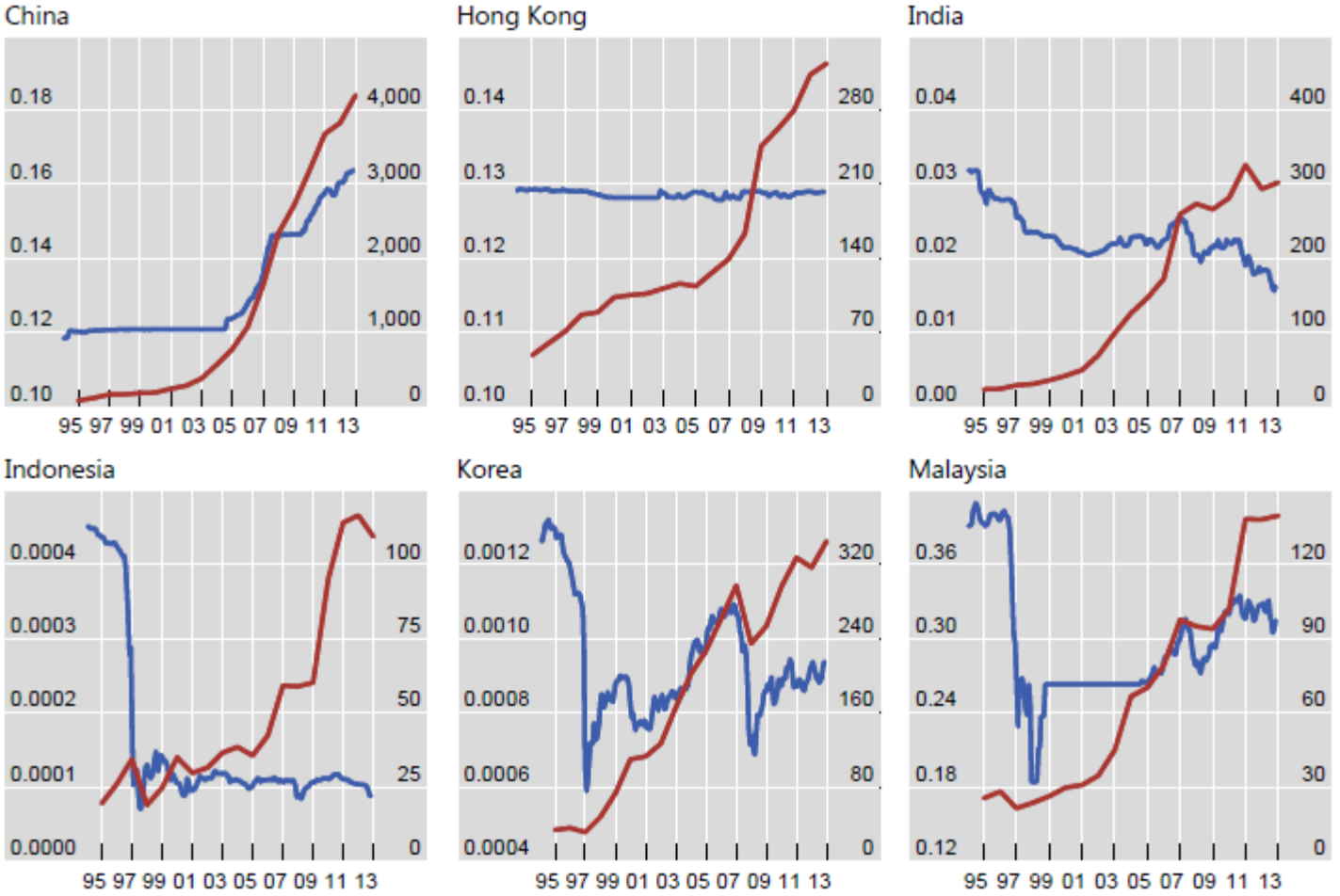
Source: Adler and Tovar (2011)

Table 1. Stylized Facts of Foreign Exchange Purchases, 2004–10

	Frequency (Percent of working days)	Intensity			
		Cumulative intervention as percent of GDP[1,2]	Daily average (Millions of U.S. dollars)[1]	Daily maximum (Millions of U.S. dollars)[1]	Has there been active FX intervention in 2011?
Chile	6	3.8	50	50	yes
Colombia	32	10.3	34	733	yes
Guatemala	19	1.6	9	332	yes
Mexico[3]	1	0.6	600	600	yes
Peru	39	36.1	55	494	yes
Latin America[4]	**19**	**10.5**	**150**	**442**	
Others					
Australia[5]	62	2.5	15	377	n.a.
Israel	24	22.3	84	300	no[6]
Turkey	66	12.5	61	4966	yes

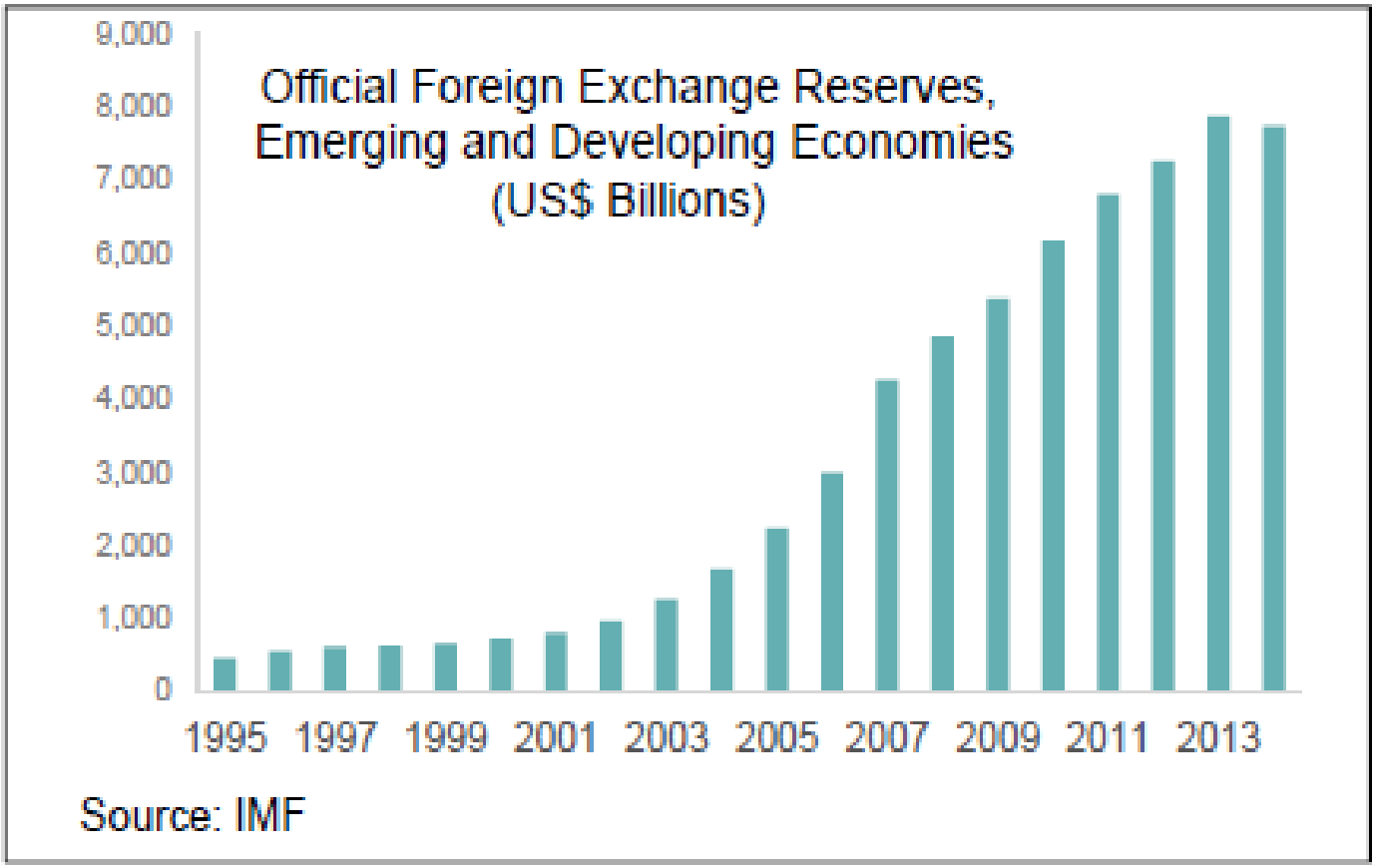
Source: Adler and Tovar (2011)

Foreign exchange reserves and exchange rates Graph 1

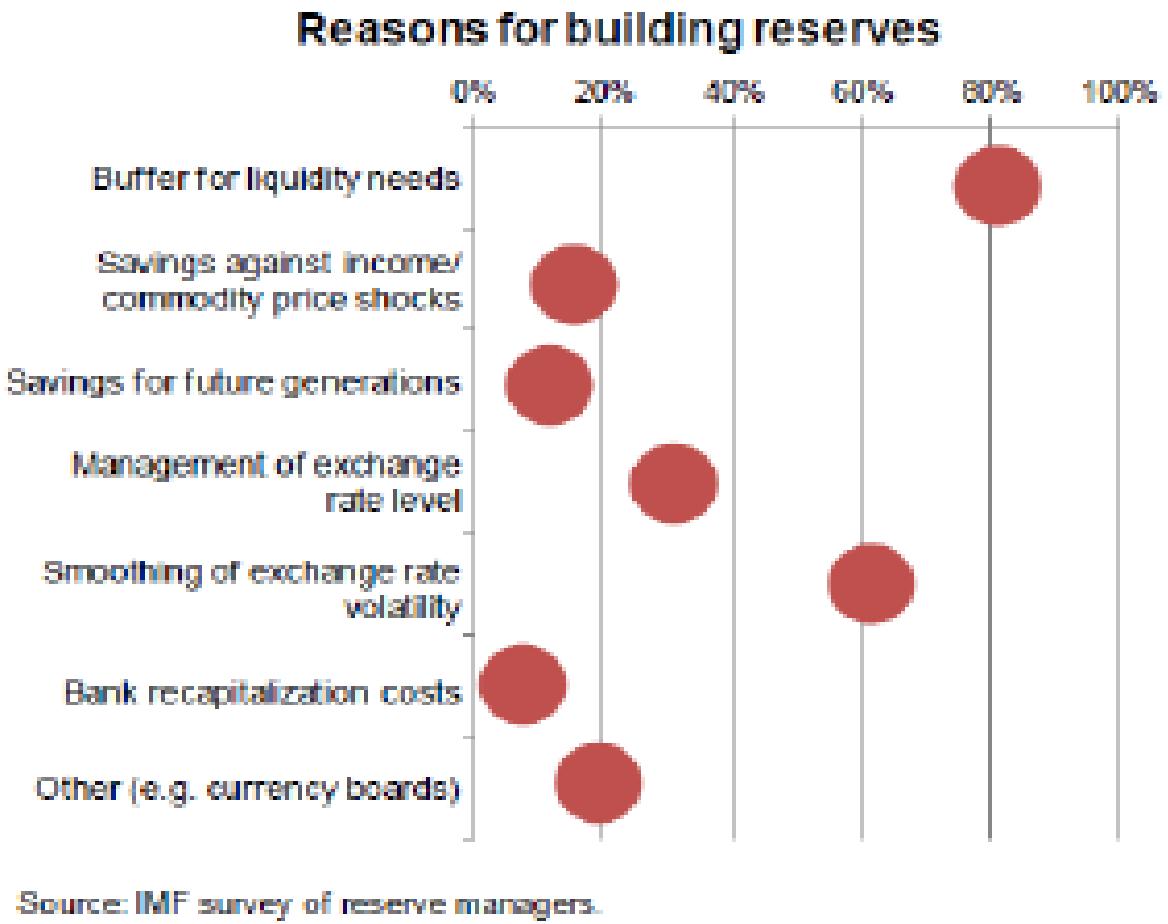


Left axis: US$ per domestic currency. Right axis: US$ billion

Source: Chutasripanish and Yetman (2015)



Source : Irina Bunda (2016)



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- What are the determinants of optimal reserves?
- What are the costs and benefits of reserves?

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- We build a model of financial intermediation with frictions
- In the model, external constraints can become binding endogenously and result in a credit crunch
- International reserves enable the central bank to provide international liquidity and alleviate financial constraints when they bind
- The optimal level of reserves is tightly linked to the impact and nature of *ex post* intervention

Some Lessons

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1. Precautionary savings ameliorates but does not eliminate inefficient financial crunches
2. Optimal reserves depend on nature and degree of financial frictions and financial development
3. And on the specific policies that the central bank can use in the event of a liquidity crunch
4. An increase in *ex ante* uncertainty also justifies a buildup of reserves

Related Literature

- Recent work on fx intervention and "unconventional" monetary policy: Chang (2018), Céspedes-Chang-Velasco (2018)

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- Optimal Reserves: Jeanne-Korinek

A Basic Model

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- Two goods: tradables (numeraire) and non tradables
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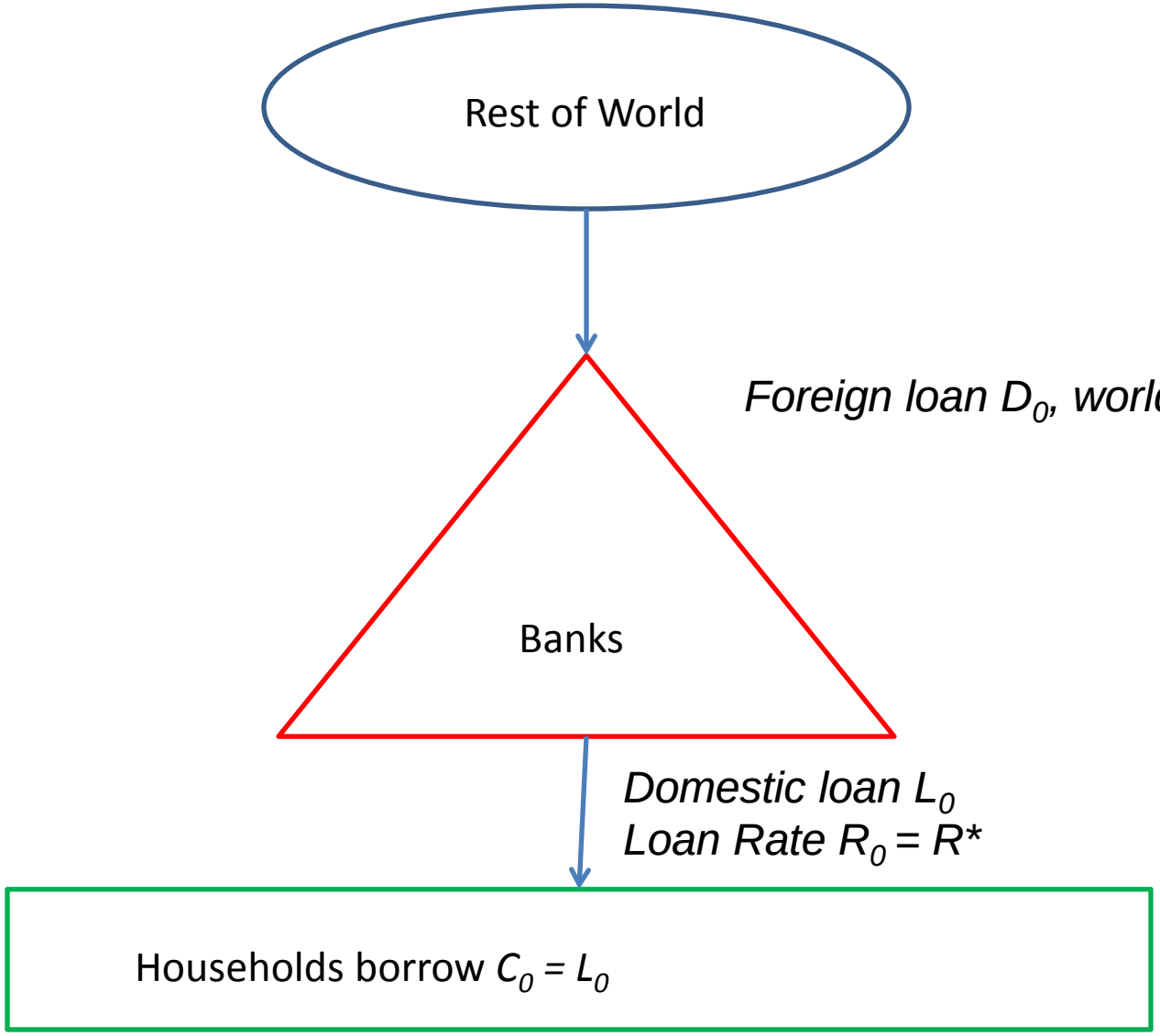
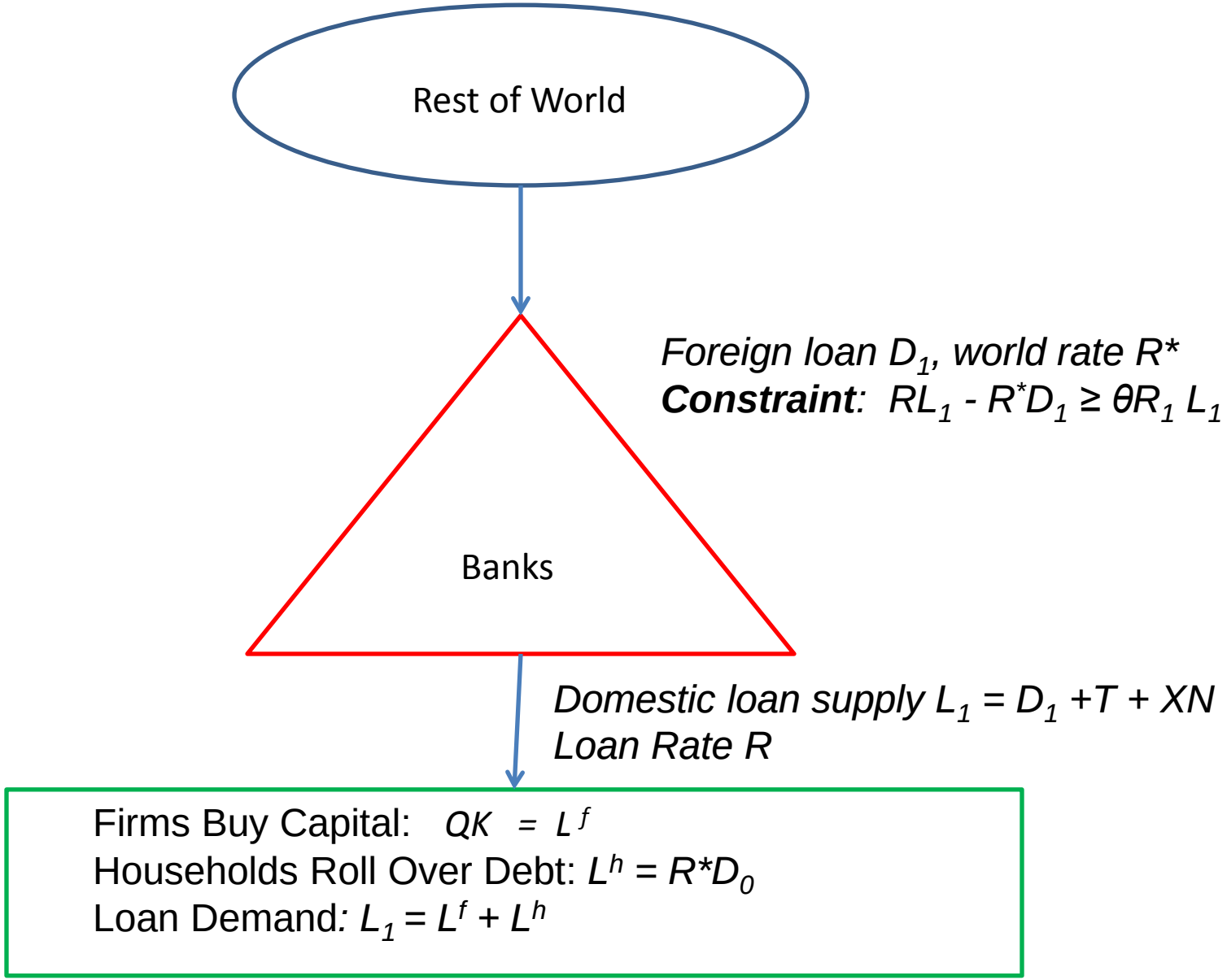
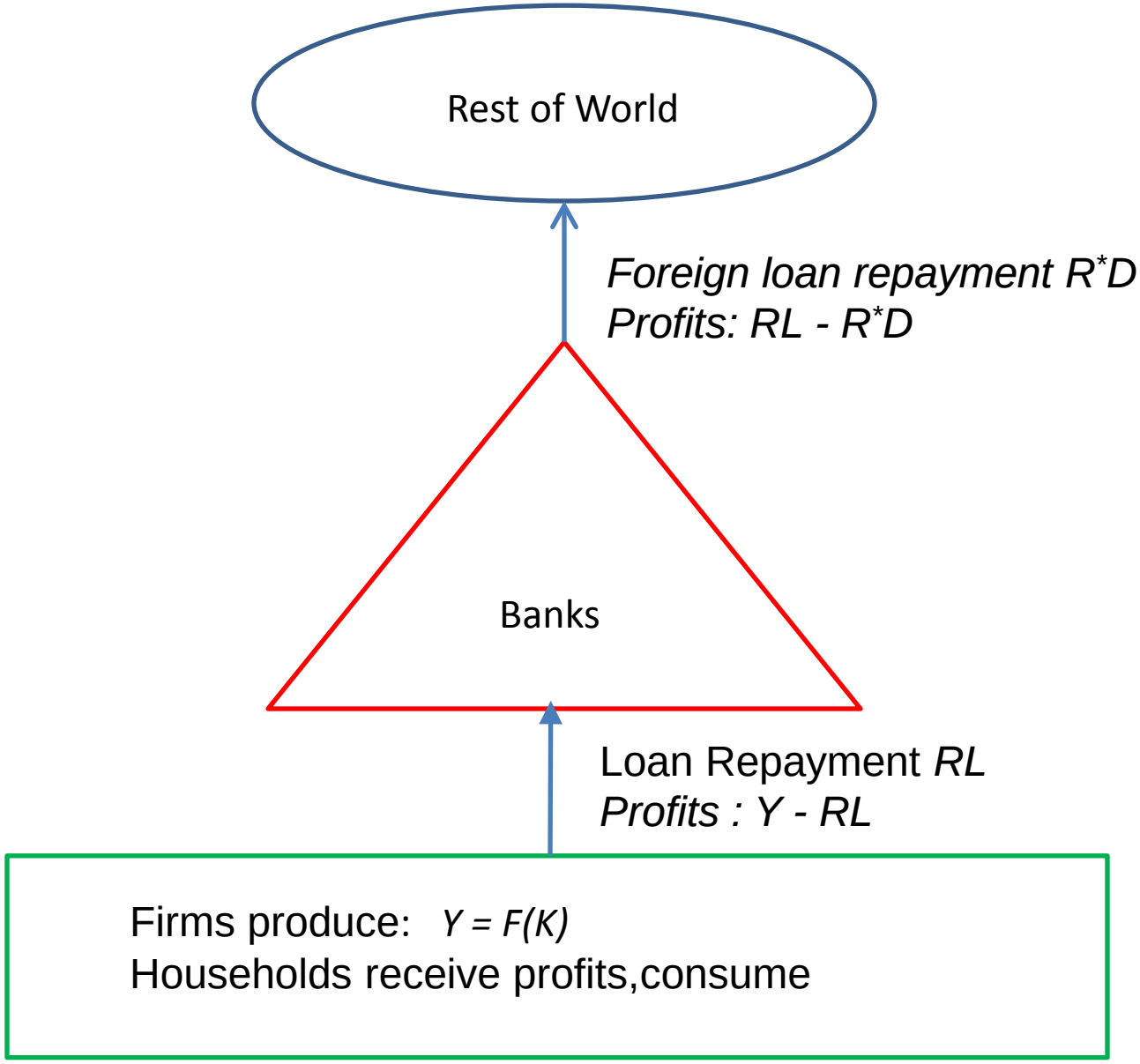
- Financial intermediation subject to frictions and shocks



Initial Period


Rest of World
Foreign loan D_1, world rate R^*
Constraint: $RL_1 - R^*D_1 \geq \theta R_1 L_1$
Banks
Domestic loan supply $L_1 = D_1 + T + XN$
Loan Rate R
Firms Buy Capital: $QK = L^f$
Households Roll Over Debt: $L^h = R^*D_0$
Loan Demand: $L_1 = L^f + L^h$
Investment Period


Rest of World
Foreign loan repayment R^*D
Profits: $RL - R^*D$
Banks
Loan Repayment RL
Profits : $Y - RL$
Firms produce: $Y = F(K)$
Households receive profits,consume
Repayment Period

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$$u(C_0) + \beta E C_2$$

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- $t = 1$: they roll over their debt, and hence $L_1^h = R_0^* L_0^h$
- $t = 2$:

$$\begin{aligned} C_2 &= \Pi^b + \Pi^f - R_1 L_1^h \\ &= \Pi^b + \Pi^f - R_1 R_0^* C_0 \end{aligned}$$

Initial consumption (and debt) are then given by the first order condition:

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$==>$ Note that if $ER_1 > R_1^*$, borrowing is inefficiently low

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- Demand for capital is then given by:

$$\alpha AK_2^{\alpha-1} = R_1 Q_1$$

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$$K_2 = \kappa I_{h1}^{\gamma} I_{w1}^{1-\gamma}$$

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- In equilibrium $I_{h1} = N$, so K_2 and Q_1 are pinned down by X_1

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- $t = 2$: Bank profits are

$$\Pi^b = R_1 L_1 - R_1^* D_1$$

Credit Constraint

At $t = 1$, crucially, banks face the **financial constraint**

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- This is the only source of uncertainty (for now, at least)

Laissez Faire Equilibrium

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  where X_{1f} is the **frictionless** exchange rate
- If $R_1 > R_1^*$, the bank borrows as much as it can, and lends

$$L_1 = \frac{1}{1-(1-\theta)\phi}(T + X_1 N)$$

  where $\phi = R_1 / R_1^*$ is the interest rate spread.

If financial constraints do **not** bind, $R_1 = R_1^*$, and all other variables take their frictionless (**f**) values:

$$\alpha A K_{2f}^{\alpha-1} = R_1^* Q_{1f} = R_1^* X_{1f}^{\gamma}$$

$$\frac{X_{1f} N}{I_{wf}} = \frac{\gamma}{1-\gamma}$$

$$K_{2f} = \kappa N^{\gamma} I_{wf}^{1-\gamma}$$

Hence the collateral constraint will not bind in the continuation if:

$$L_1 = R_0^* C_0 + Q_{1f} K_{2f} \leq \frac{1}{\theta}(T + X_{1f} N)$$

i.e. if $\theta \leq \hat{\theta}$, where

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- Note that $\hat{\theta}$ is endogenous and, in particular, falls with C_0

If $\theta \leq \hat{\theta}$, then $R_1 > R_1^*$ and relative prices adjust to clear markets.
In particular, the equilibrium exchange rate solves:

$$R_0^* C_0 + Q_1 K_2 = \frac{1}{1-(1-\theta)\phi}(T + X_1 N)$$

where the spread ϕ is given by

$$\phi = R_1 / R_1^* = \left(\frac{X_f}{X_1}\right)^{\gamma+(1-\alpha)(1-\gamma)}$$

Initial Debt

Recall that, in any continuation equilibrium

$$\begin{aligned} R_1 &= R_1^* \text{ if } \theta \leq \hat{\theta} \\ &= \rho(C_0, \theta) \text{ if } \theta > \hat{\theta} \end{aligned}$$

The Euler equation

$$u'(C_0) = \beta R_0^* E R_1$$

becomes

$$u'(C_0) = \beta R_0^* \left[R_1^* F(\hat{\theta}) + \int_{\hat{\theta}}^{\bar{\theta}} \rho(C_0, \theta) F(d\theta) \right]$$

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- (Note that $\hat{\theta}$ depends on C_0)

Some Implications

Determinants of Crises

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- Other ones are novel
- Most interesting: an increase in uncertainty (a mean preserving spread in θ) can lead to higher crises probability

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- Consider a planner that sets only initial consumption and debt, $C_0 = D_0 = L_0$, and leaves the rest of the economy to subsequently adjust to equilibrium.
- The planner would then maximize $u(C_0) + \beta E C_2$ subject to the laissez faire equilibrium conditions, except the Euler equation

The solution to the planner's problem can be written as:

$$U'(C_0) - \beta R_1^* R_0^* = \beta R_0^* E \left\{ (R_1 - R_1^*) EI_D^X \frac{I_w}{R_0^* C_0} \right\}$$

where $EI_D^X = -\frac{C_0 dX_1}{X_1 dC_0} \geq 0$ is the elasticity of the xrate X_1 wrt initial debt $D_0 = C_0$

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This has a nice interpretation:

- The LHS is the social net value of a marginal unit of debt at $t = 0$
- The RHS is the cost, which is expressed by the spread (divergence between marginal benefit of tradables investment and world interest rate)

Forex Reserves and Intervention

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- The central bank can invest F in the world market and earn R_0^* or R_1^*.
- But in period $t = 1$ it also has the option to use F to enact policies aimed at alleviating financial frictions, if these turn out to be binding.

Key Questions

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$==>$ The answers depend on the policies that the central bank implements in $t = 1$.

Reserves and Ex Post Policy

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- In terms of Gertler-Kiyotaki (2010), the central bank provides "liquidity facilities ".
- CCV (2018): this is equivalent to other interesting policies, and more effective than providing loans to households or firms, in particular.

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- loan supply is now constrained by

$$L_1 \leq \frac{1}{1-(1-\theta)\phi}(T + X_1 N + F)$$

Is It Optimal to Eliminate Crises?

Theorem

If the term premium $\tau = 0$, F will be large enough to drive the probability of crises to zero. If $\tau > 0$, however, it is not optimal to eliminate crises completely.

Intuition

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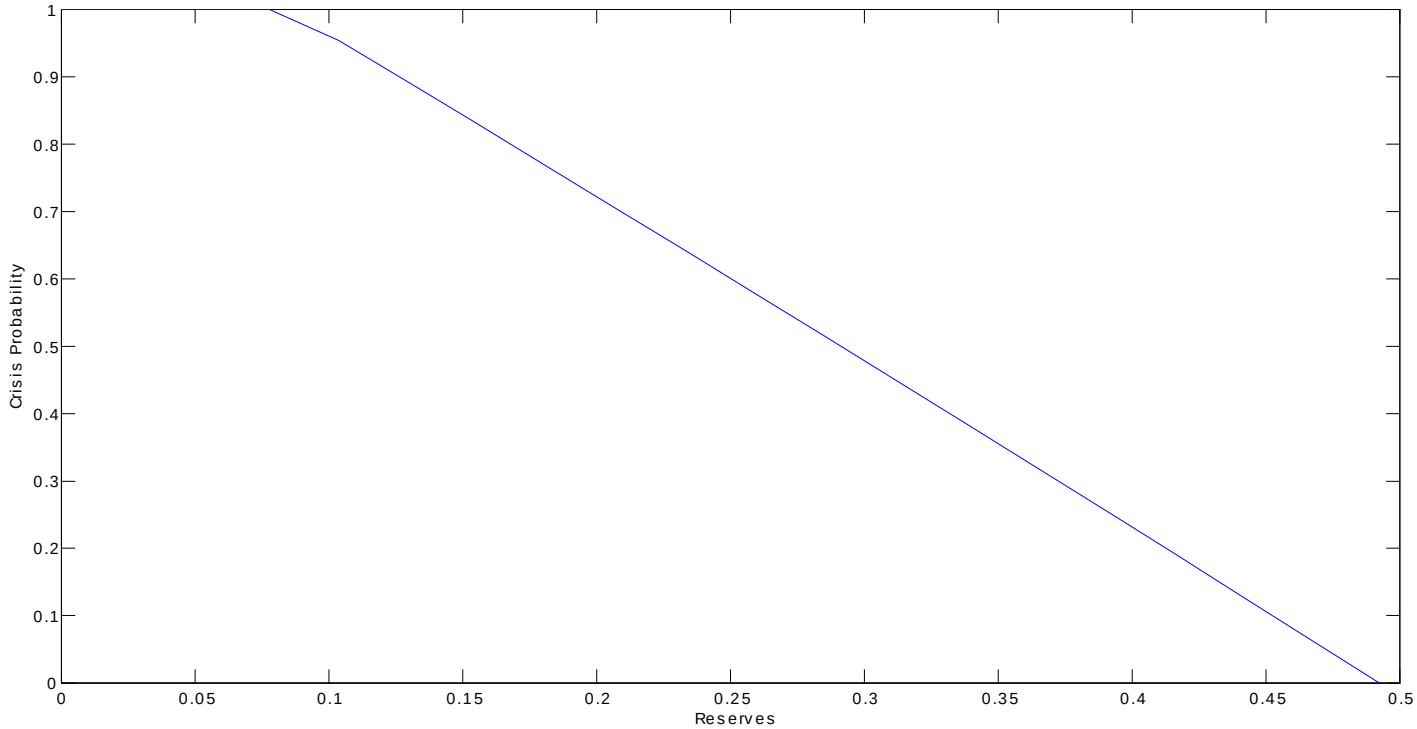
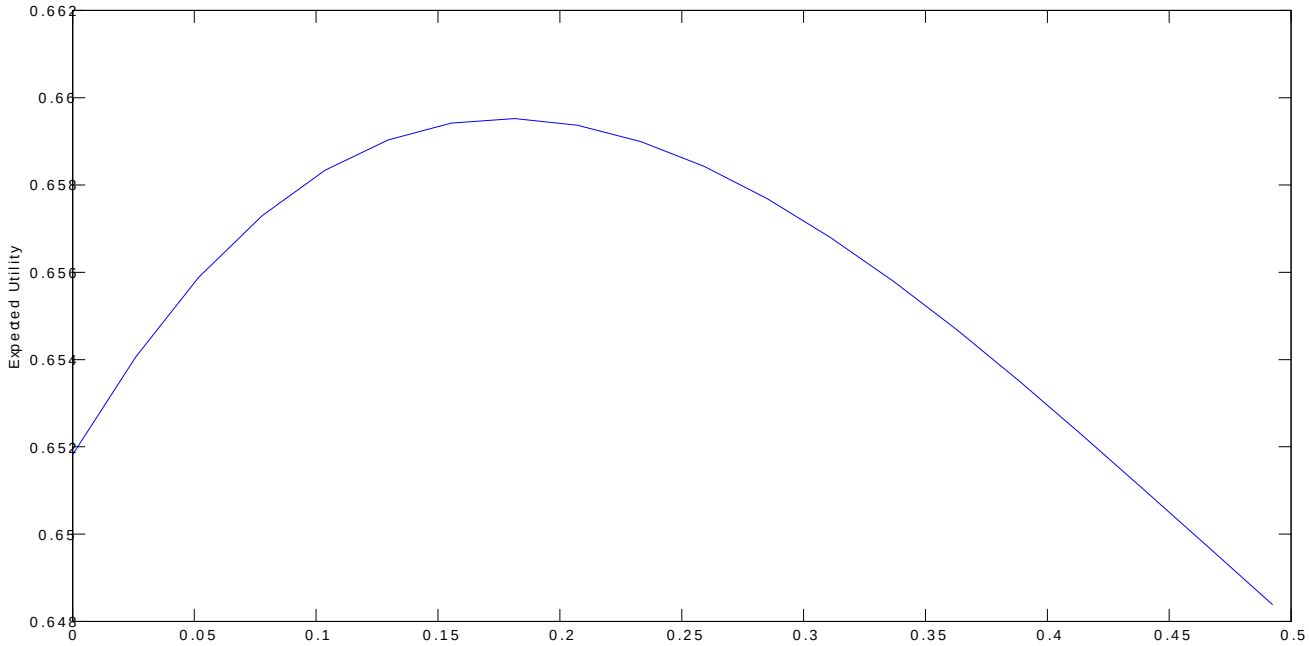
- The marginal gain to eliminating crises completely is of second order, so it is not optimal to do that if $\tau > 0$

Numerical Illustrations



Large enough reserves can eliminate crises completely...



...but it is not optimal, if term premium is positive

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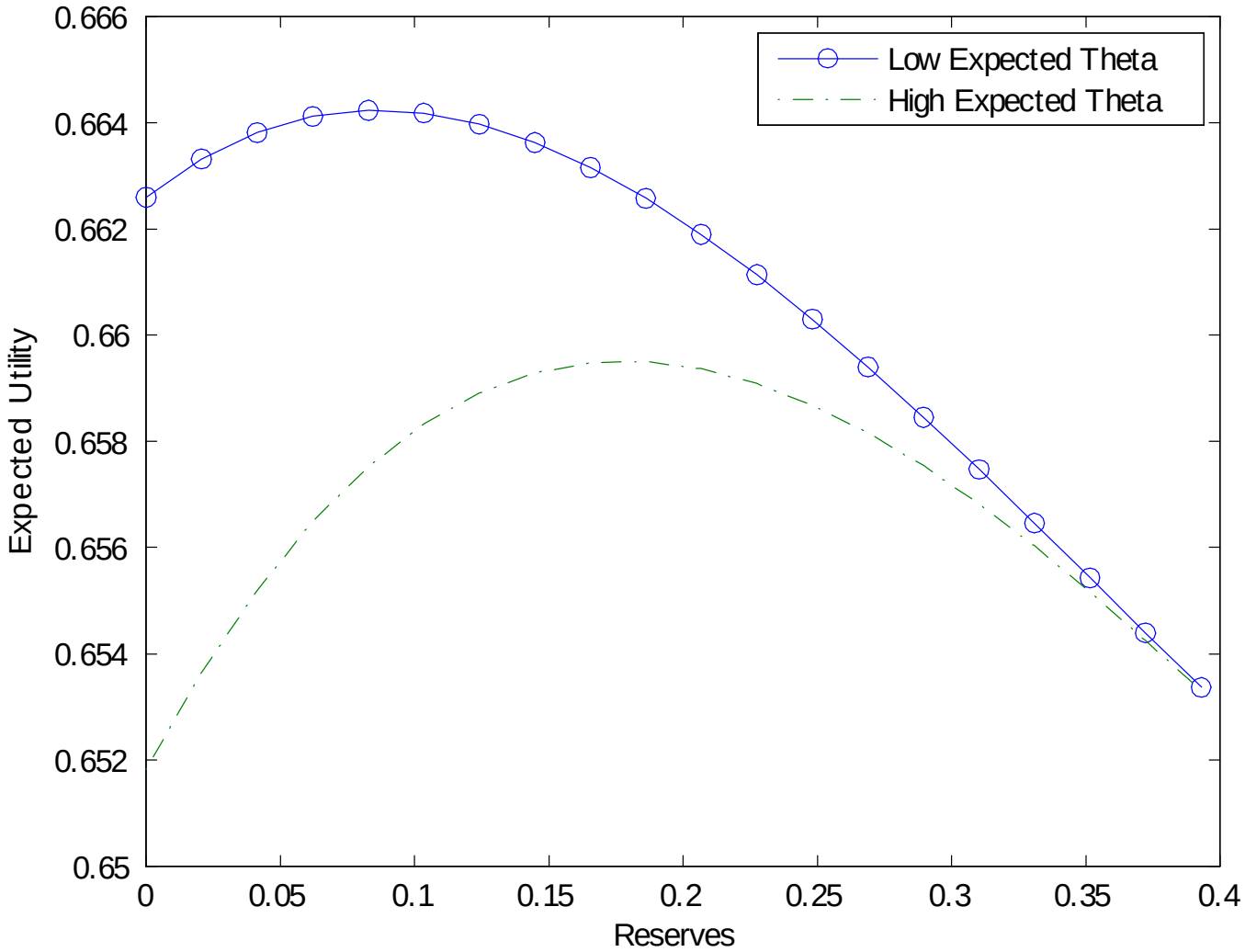

Reserves and Expected Utility with $\theta = 0.38$ and $\theta = 0.4$

Optimal Reserves and Uncertainty

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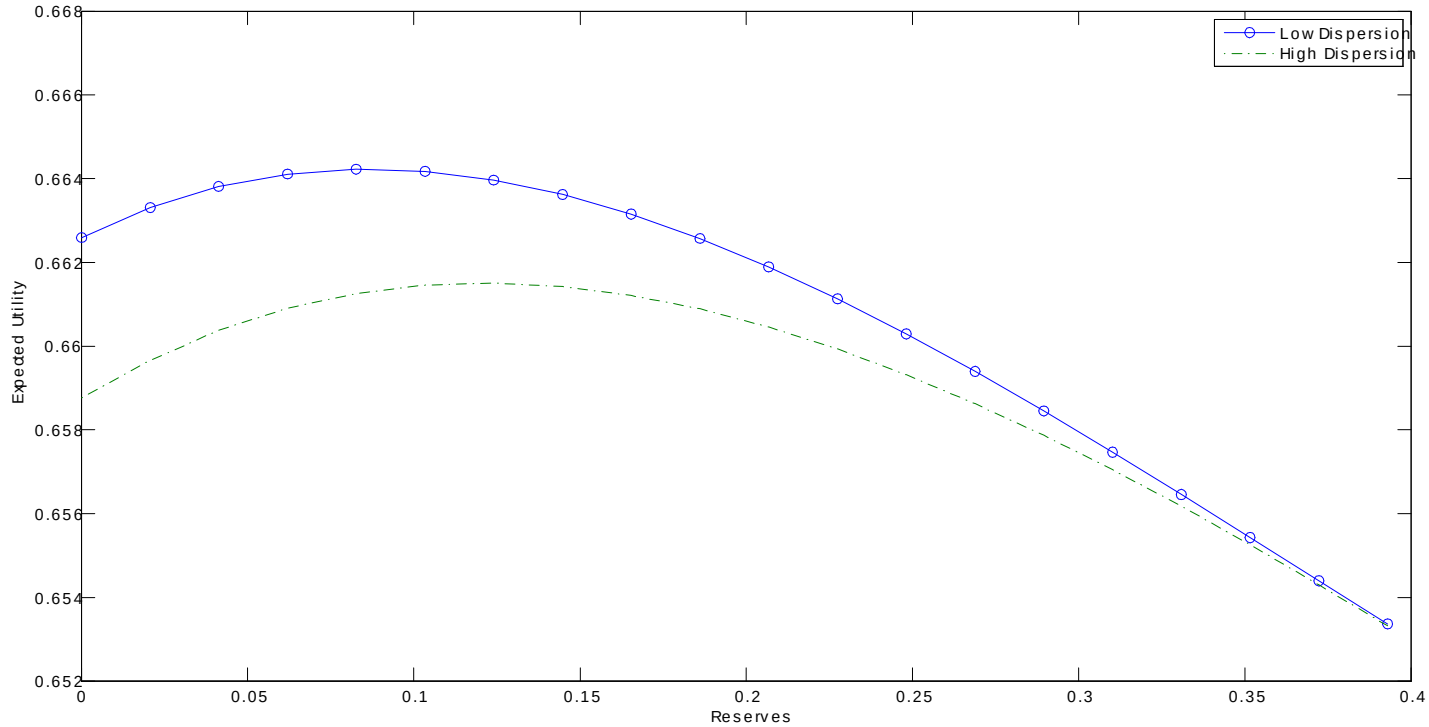
- This is in line with intuition, and with observed experiences



Uncertainty and Optimal Reserves

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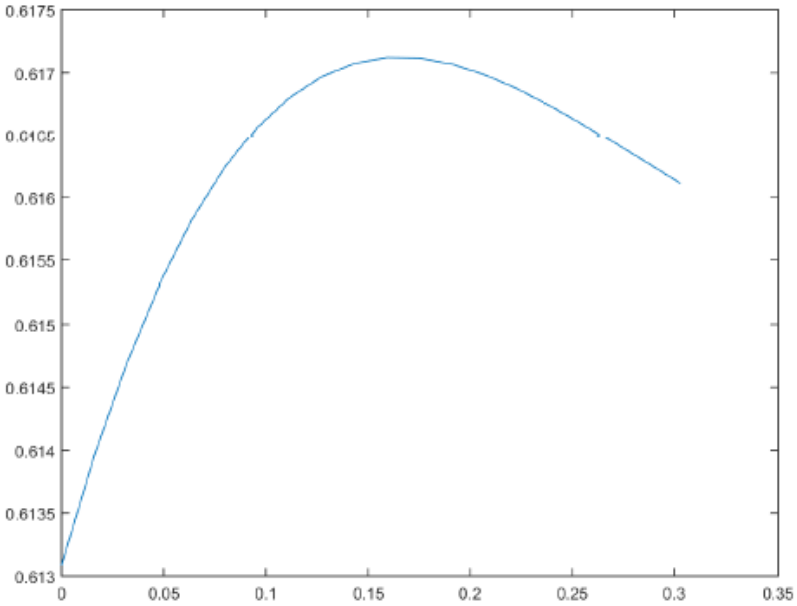
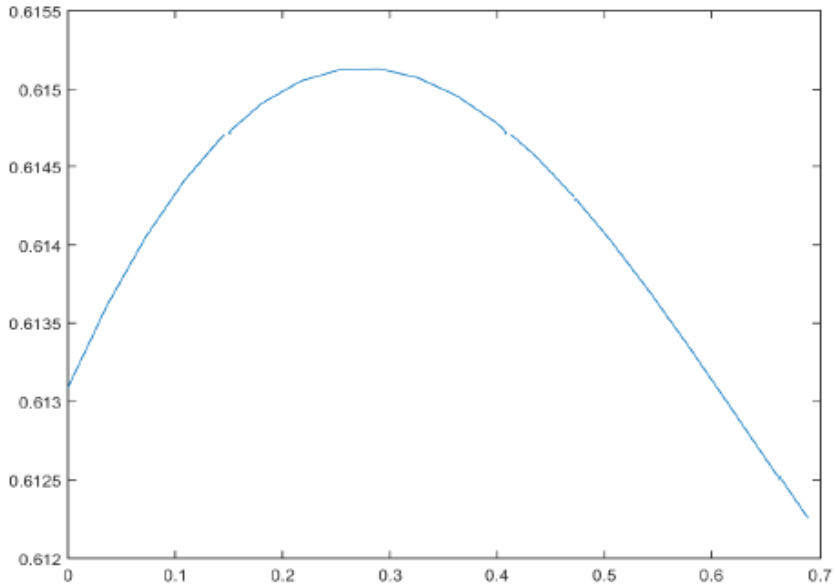
- But direct lending may be more feasible because of other reasons (e.g. political)
- With direct lending, optimal reserves must be larger





FX Reserves and Mode of Intervention:
Left: Equity Injections
Right: Direct Lending

Final Remarks

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- Thank you!!