The Expansionary Lower Bound: Currency Mismatches and Monetary Spillovers*

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*The views expressed herein are those of the authors and should not be attributed to the IMF, its Executive Board, or its management.

Introduction

- 7 years of extraordinary monetary accommodation in the US
  $\Rightarrow$ EMs have increased dollar liabilities
- Recent US liftoff, tightening cycle may follow
  $\Rightarrow$ Several EMs' currencies under pressure
- Can EMs use monetary policy (MP) to offset US monetary shocks?
  - Trillemma, Bernanke (2015): yes with flexible exchange rates
  - Rey (2015,2016), Rajan (2015): no, global financial cycle

Our contribution

- Tractable model to analyze possible constraints to MP in EMs
- Two main ingredients
  - Currency mismatches: US dollar liabilities, domestic currency assets
  - Collateral constraints
- We identify "Expansionary Lower Bound" (ELB)
  - Policy rate below which monetary easing becomes contractionary
  - Potentially tighter than "Zero Lower Bound" (ZLB)
  - ELB is affected by US monetary conditions
- We analyze policies to escape ELB
  - both from ex-post
  - and ex-ante perspective

Model setup

- Small open economy
- 3 period model, $t \in \{0, 1, 2\}$
- 2 main sectors
  - Real sector (households and firms) $\Rightarrow$ consumption and production
  - Financial sector $\Rightarrow$ dollar debt vs domestic currency loans
- Deterministic model (so far)

Households' problem

- Households solve

$$\max \sum_{t=0}^{2} \beta^t \ln \left[C_{H,t}^{1-\iota} C_{F,t}^{\iota} \right]$$

subject to

$$\begin{aligned} \overbrace{P_{H,t}C_{H,t} + P_{F,t}C_{F,t}}^{P_t C_t} + L_t I_t^L &= P_{H,t}Y_{H,t} + \delta_t + L_{t+1} \\ L_3 &= 0 \end{aligned}$$

where I_t^L is the domestic lending rate.

Households' FOCs

- Intra-temporal first order conditions

$$\begin{aligned} P_{H,t}C_{H,t} &= (1-\iota)P_tC_t \\ P_{F,t}C_{F,t} &= \iota P_tC_t \end{aligned}$$

- Inter-temporal Euler equation

$$P_{t+1}C_{t+1} = \beta I^L_{t+1}P_tC_t$$

Foreign households

- Foreign households follow similar FOCs

$$
\begin{aligned}
P^*_{H,t} C^*_{H,t} &= \xi P^*_t C^*_t \\
P^*_{t+1} C^*_{t+1} &= \beta^* I^*_{t+1} P^*_t C^*_t
\end{aligned}
$$

where I^*_{t+1} is the foreign policy rate and $\beta < \beta^*$.

- The law of one price implies

$$
\begin{aligned}
P_{H,t} &= e_t P^*_{H,t} \\
P_{F,t} &= e_t P^*_{F,t}
\end{aligned}
$$

where e_t is the nominal exchange rate.

Domestic banks

- Banks' net worth is given by

$$N_t = I_t^L L_t + I_t B_t - e_t I_t^* D_t^*$$

L_t and B_t are domestic loans and bonds, D_t^* is foreign currency debt

- Banks act competitively and solve

$$\max \sum_{t=0}^{2} \frac{\delta_t}{I_{t+1}^L}$$

subject to

$$\begin{aligned} L_{t+1} + B_{t+1} + \delta_t &= N_t + e_t D_{t+1}^* \\ L_2 &\leq (1+\phi) N_1 \end{aligned}$$

Banks' FOCs

- Banks' FOCs imply

$$\begin{aligned} I_{t+1} &= I^*_{t+1}\frac{e_{t+1}}{e_t} \\ I^L_{t+1} &= I_{t+1} + \lambda \end{aligned}$$

where $\lambda \geq 0$ is shadow cost of lending constraint

- We assume that
  - banks enter period 0 with no foreign debt, $D^*_0 = 0$
  - banks distribute net worth to households in period 2, $\delta_2 = N_2$
  - domestic bonds are in zero net supply, $B_t = 0$

Market clearing and nominal anchor

- Domestic lending rate I_t^L has to clear loan market

$$P_t C_t + L_t I_t^L - \left(P_{H,t} Y_{H,t} + \pi_t^f \right) = N_t + e_t D_{t+1}^*$$

- The exchange rate e_t has to ensure market clearing in domestic goods

$$P_{H,t} Y_{H,t} = (1 - \iota) P_t C_t + e_t \xi P_t^* C_t^*$$

- We assume that time-2 nominal spending is equal to money supply

$$\begin{aligned} P_2 C_2 &= M_2 \\ P_2^* C_2^* &= M_2^* \end{aligned}$$

Outline

- We first characterize the time-1 equilibrium, taking as given

$$\begin{aligned} \mathbb{L}_1 &= I_1^L L_1 \\ \mathbb{D}_1^* &= I_1^* D_1^* \end{aligned}$$

- We then solve for the time-0 equilibrium and endogeneize $\mathbb{L}_1$ and $\mathbb{D}_1^*$

Time-1 equilibrium when banks are unconstrained

- If banks are unconstrained $\Rightarrow I_2^L = I_2$ and

$$\begin{aligned} P_{H,1}Y_{H,1} &= (1-\iota)\frac{M_2}{\beta I_2} + e_1 \frac{\xi M_2^*}{\beta^* I_2^*} \\ e_1 &= \frac{\frac{\iota M_2}{\beta I_2}(1+\beta)}{\frac{\xi M_2^*}{\beta^* I_2^*}(1+\beta^*) - \mathbb{D}_1^*} \end{aligned}$$

- A domestic interest rate cut stimulates spending on domestic goods
  - It increases domestic demand
  - It increases foreign demand by depreciating the exchange rate
- With flexible exchange rates and no collateral constraints

  $\Rightarrow$ Domestic MP can offset output effects from foreign MP

  $\Rightarrow$ Neoclassical trilemma holds even under currency mismatches

Time-1 equilibrium when banks are constrained

- If banks are constrained $\Rightarrow I_2^L > I_2$ and

$$
\begin{aligned}
P_{H,1}Y_{H,1} &= \frac{1-\iota}{\iota}\phi\mathbb{L}_1 + \frac{e_1}{\iota}\left(\frac{\xi M_2^*}{\beta^* I_2^*} - (1+\phi)(1-\iota)\mathbb{D}_1^*\right) \\
e_1 &= \frac{\frac{\iota M_2}{\beta I_2} + \phi\mathbb{L}_1}{\frac{\xi M_2^*}{\beta^* I_2^*} + \phi\mathbb{D}_1^*}
\end{aligned}
$$

- A domestic interest rate cut
  - still depreciates the exchange rate
  - but the effect on nominal spending on domestic goods is ambiguous

    $\rightarrow$ Foreign demand increases

    $\rightarrow$ Domestic demand declines because the lending rate increases

Constrained time-1 equilibrium

- If foreign debt is sufficiently small

$$\mathbb{D}_1^* < \frac{\xi M_2^*}{\beta^* I_2^*} \frac{1}{(1+\phi)(1-\iota)} = \tilde{\mathbb{D}}_1^*$$

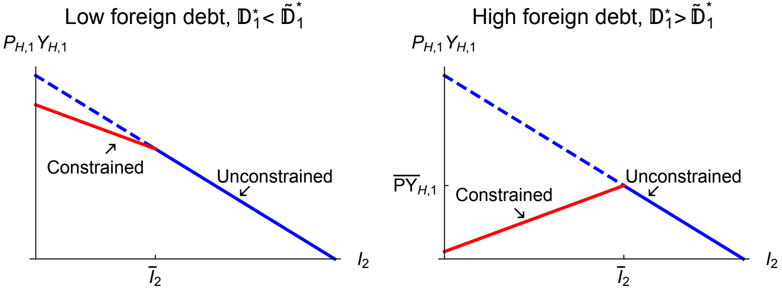
$\Rightarrow$ Interest rate cuts remain expansionary, albeit less effective

- If foreign debt is sufficiently large

$$\mathbb{D}_1^* > \tilde{\mathbb{D}}_1^*$$

$\Rightarrow$ Interest rate cuts have contractionary effects

Domestic policy rates and nominal spending



- If $\mathbb{D}_1^* > \tilde{\mathbb{D}}_1^*$

  $\Rightarrow$ MP is constrained by "Expansionary Lower Bound" $\bar{I}_2$

  $\Rightarrow$ Impossible to increase spending beyond $\overline{PY}_{H,1}$

The Expansionary Lower Bound

- The ELB is equal to

$$\bar{I}_2 = \frac{\iota M_2}{\phi \mathbb{L}_1 \beta} \frac{\frac{\xi M_2^*}{\beta^* I_2^*}(\beta^* - \beta) + \mathbb{D}_1^*(\phi + \beta(1+\phi))}{\frac{\xi M_2^*}{\beta^* I_2^*}(1+\beta^*) - \mathbb{D}_1^*}$$

- Nominal spending on domestic goods at the ELB is

$$\overline{PY}_{H,1} = \frac{\phi \mathbb{L}_1}{\iota} \left(1 - \iota + \frac{(1+\beta)\left(\frac{\xi M_2^*}{\beta^* I_2^*} - \mathbb{D}_1^*(1+\phi)(1-\iota)\right)}{\frac{\xi M_2^*}{\beta^* I_2^*}(\beta^* - \beta) + \mathbb{D}_1^*(\phi + \beta(1+\phi))} \right)$$

The ELB and foreign currency debt

- The ELB increases with the stock of foreign debt

$$\frac{\partial \bar{I}_2}{\partial \mathbb{D}_1^*} > 0$$

while maximum spending declines

$$\frac{\partial \overline{PY}_{H,1}}{\partial \mathbb{D}_1^*} < 0$$

- The ELB is tighter than ZLB, $\bar{I}_2 > 1$, if foreign debt is high enough

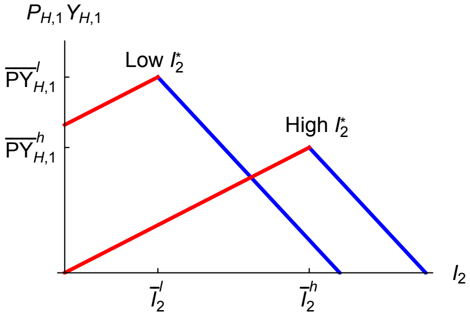
$$\mathbb{D}_1^* > \frac{\xi M_2^*}{\beta^* I_2^*} \frac{\frac{\iota M_2}{\beta}\left(\beta - \beta^*\right) + \phi \mathbb{L}_1 \left(1 + \beta^*\right)}{\frac{\iota M_2}{\beta}\left(\beta + \phi\left(1 + \beta\right)\right) + \phi \mathbb{L}_1}$$

The ELB and foreign monetary policy

- A foreign MP tightening raises the ELB and reduces $\overline{PY}_{H,1}$

$$\frac{\partial \bar{I}_2}{\partial I_2^*} > 0 \quad , \quad \frac{\partial \overline{PY}_{H,1}}{\partial I_2^*} < 0$$

$\Rightarrow$ Foreign MP tightening can push EMs into recession



Escaping the ELB

Can EMs escape the ELB?

- Forward guidance ineffective
  - $\rightarrow$ Higher M_2 lowers $\bar{I}_2$, but no effect on $\overline{PY}_{H,1}$
  - $\rightarrow$ Differently from ZLB, ELB is endogenous
- Recapitalization policies may help
  - $\rightarrow$ Equity injections relax collateral constraints and support lending
- Capital controls or foreign exchange rate intervention may work too
  - $\rightarrow$ Helpful to delink domestic monetary conditions from exchange rate

Time-0 equilibrium

- We now endogeneize $\{\mathbb{L}_1, \mathbb{D}_1^*\}$
- To simplify expressions, we assume $\beta_2 = \beta^* = 1$
- If ELB binds at time 1, then

$$\begin{aligned} \mathbb{D}_1^* &= \frac{\xi M_2^*}{I_2^*} \cdot \left(\frac{3}{1 + 2\beta_1} - 1 \right) \\ \mathbb{L}_1 &= \mathbb{L}_0 I_1 \cdot (1 + 2\phi) \end{aligned}$$

ELB and US monetary policy from ex-ante perspective

- Using endogenous $\{\mathbb{L}_1, \mathbb{D}_1^*\}$, the ELB and associated output become

$$\bar{I}_2 = \frac{\iota M_2}{\phi \mathbb{L}_0 I_1 \beta_1} \cdot \frac{1-\beta_1}{3}$$

$$\overline{PY}_{H,1} = \frac{\phi \mathbb{L}_0 I_1}{\iota} \cdot \left(\iota + \frac{3\beta_1}{1-\beta_1}\right)$$

- The above expressions are not a function of I_2^*
- US commitment to avoid future tightening (i.e. lower I_2^*)
  - does NOT help EMs to support domestic output
  - since it increases foreign currency debt $\mathbb{D}_1^*$

ELB and ex-ante domestic monetary policy

- What about the implications for domestic MP at time 0?
- ELB at time 1 imposes constraints to MP at time 0 too!
- If ELB binds at time 1, I_1 no longer affects spending at time 0

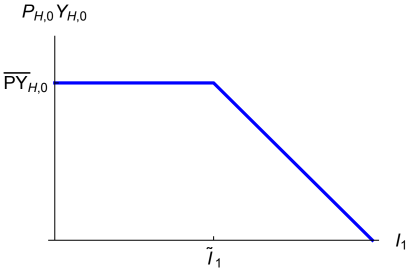
$$\overline{PY}_{H,0} = \phi \mathbb{L}_0 \cdot \frac{3}{1-\beta_1}\left(\frac{1-\iota}{\iota} + \frac{1+2\beta_1}{3}\right)$$

Tighter MP today, greater monetary space tomorrow

- However, higher I_1 can relax time-1 ELB and boost time-1 output

$$\overline{PY}_{H,1} = \frac{\phi \mathbb{L}_0 I_1}{\iota} \cdot \left(\iota + \frac{3\beta_1}{1-\beta_1} \right)$$

$\Rightarrow$ Optimal to tighten MP ex-ante to create monetary space ex-post



Conclusion

- Because of currency mismatches and collateral constraints
  $\Rightarrow$ Monetary policy in EMs is potentially constrained by ELB
  $\Rightarrow$ Significant departure from neoclassical trilemma
- ELB is tighter than ZLB if currency mismatches are severe
- From ex-post perspective
  - US monetary tightening can have recessionary consequences in EMs
  - To escape ELB, EMs can use recapitalizations and capital controls
- From ex-ante perspective
  - US commitment to lower rates has no effect on EMs output
  - Tighter domestic MP can help overcome future ELB