Foreign Currency Debt, Risk Premia and Macroeconomic Volatility

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Motivation

1. Foreign currency debt in emerging economies:
   - has pro-cyclical pay-offs
   - often plays important role in financial instability

2. Many emerging markets made a push to develop local currency debt markets over the past decade

Objective of this paper:

- develop a simple portfolio model of foreign & local currency debt
- examine role for exchange rate policy to improve attractiveness of local currency debt markets
- study macroeconomic implications
Benchmark Model

Defining feature: mutual endogeneity of

- portfolio choice, i.e. currency demination of debt
- macroeconomic volatility
- risk premium on local currency debt

![Diagram showing relationships between amount of dollar debt, macroeconomic volatility, and risk premium]
Benchmark Model

- Small open economy with two types of agents:
  - representative domestic borrower
  - large international lenders

- Two time periods: $t = 0, 1$, productivity shock $\omega \in \Omega$ in period 1

- Two goods:
  - tradable good $T$ with price $p_T^\omega \equiv 1$
  - non-tradable good $N$ with price $p_N^\omega$
  $\rightarrow$ real exchange rate

- Two assets in which to denominate initial debt $D$:
  - dollar debt $F$: return $R_F$
  - local currency debt $L$: return $R_L p_N^\omega$
Domestic Agents

- Utility from tradable and non-tradable consumption:
  \[ U = E \left\{ \hat{u}(C_T^{\sigma}C_N^{1-\sigma}) \right\} \]
  (or \( u(C_T) \) in simplified notation)

- Period 0:
  - allocate existing debt \( D \) in foreign and local currency:
    \[ D = F + L \]

- Period 1:
  - observe realization of endowment shock \( (Y_T^\omega, \bar{Y}_N) \)
  - repay creditors and consume
  - budget constraint:
    \[ C_T^\omega + p_N^\omega C_N = Y_T^\omega + p_N^\omega \bar{Y}_N - R_FF - R_LLp_N^\omega \]
International Lenders

Large, risk-averse international lenders:

- Exogenous pricing kernel $M_t^\omega$
- Return on dollar debt: $R_F = 1 / E[M_t^\omega]$
- Risk premium on local currency debt s.t. $(1 - \rho) R_L = R_F$

$\rightarrow$ solve for $\rho = - \text{Cov} \left( \frac{p_{N,1}^\omega}{E[p_{N,1}^\omega]}, R_F M_1^\omega \right)$
Period 1 Equilibrium

Equilibrium as a function of \((F, L)\) determined by two equations:

1. **FOC\((C_N)\):**
   \[
   p_N^\omega = MRS = \frac{1-\sigma}{\sigma} \cdot \frac{C_T^\omega}{Y_N} = \psi C_T^\omega
   \]

2. **BC:**
   \[
   C_T^\omega = Y_T^\omega - R_FD - R_LL \left\{ p_N^\omega - (1 - \rho)E[p_N^\omega] \right\}
   \]

**Figure:** Equilibrium exchange rate and consumption for \(Y \in \{Y_L, \bar{Y}, Y_H\}\) and (i) \(L = 0\), (ii) \(L > 0\), and (iii) \(L < 0\)
Period 1 Equilibrium

Equilibrium as a function of \((F, L)\) determined by two equations:

1. **FOC** \((C_N)\):
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   p_N^\omega = MRS = \frac{1-\sigma}{\sigma} \cdot \frac{C_T^\omega}{\bar{Y}_N} = \psi C_T^\omega
   \]

2. **BC**:
   \[
   C_T^\omega = Y_T^\omega - R_FD - R_LL \{ p_N^\omega - (1 - \rho)E[p_N^\omega] \}
   \]

**Solution**:

\[
C_T^\omega = \frac{Y_T^\omega - R_FD + \psi R_LL \cdot (1 - \rho)E[C_T^\omega]}{1 + \psi R_LL}
\]

**Note**:

\[
\frac{dC_T^\omega}{dY_T^\omega} = \frac{1}{1 + \psi R_LL}
\]
Consumption as a Function of Output

Level of consumption $C_{T,1}^{\omega}$ vs. Realization of output $Y_{T,1}^{\omega}$

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Consumption as a Function of Output

Level of consumption $C_{T,1}$

Realization of output $Y_{T,1}^\omega$

more

$EY_{T,1}$

$C_{T,1}$
Consumption as a Function of Output

Level of consumption $C^0_{T,1}$

Realization of output $Y^\omega_{T,1}$

$EY_{T,1}$

$C_{T,1}$

$L_1$

more
Description of Period 1 Equilibrium

Lemma (Amplification/Mitigation of Shocks)

The higher local currency debt $L$, the lower the impact of a given shock on consumption, the lower the volatility of consumption and the exchange rate, the lower the risk premium on local currency debt, and the lower expected consumption.

All four relationships are convex.
Lemma (Natural Foreign Currency Debt Limit)

If $R_F F \rightarrow \bar{Y}_T$, the economy reaches its natural foreign currency debt limit at which volatility diverges.

Lemma (Current Account)

If $L > 0$ the current account covaries positively with output $Y^\omega_T$, otherwise negatively.
Period 0 Equilibrium

Optimality condition for borrowers (‘demand’ locus DD):

\[ FOC(L) : \quad E \left\{ u'(C_T^\omega) R_L \left[ \rho_N^\omega - (1 - \rho) E(\rho_N^\omega) \right] \right\} = 0 \]

→ substitute \( \rho_N^\omega = \psi C_T^\omega \)
→ use 2\textsuperscript{nd} order Taylor approximation:

\[ \rho \frac{E[C_T^\omega] u'(E[C_T^\omega])}{u''(E[C_T^\omega])} = \text{Var}(C_T^\omega) \]

Optimality condition for lenders (‘supply’ locus SS):

\[ \rho E[C_T^\omega, 1] = -R^* \text{Cov} (C_T^\omega, M_1^\omega) \sim \text{Std}(C_T^\omega, 1) \]
Period 0 Equilibrium

\[ \rho \text{ Var}(C_T^\omega) \]
Description of Period 0 Equilibrium

Proposition (Changes in Risk Aversion)
An increase in global risk aversion raises the risk premium, which leads to a reduction in local currency debt and an amplified response of the emerging economy to output shocks.

Proposition (Change in Domestic Risk)
An increase in domestic output risk will be offset by higher insurance using local currency debt.
Increase in Global Risk Aversion

Risk premium $\rho$

Consumption volatility $\text{Var}(C_T^\omega)$

Amount of local currency debt $L$

Risk premium $\rho$
Increase in Domestic Output Risk

\[ \rho \]

\[ \text{Var}(C_T) \]

\[ D_1 = D_2 \]

\[ S_1 = S_2 \]

\[ E_1 = E_2 \]

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Comparison with Constrained Planner

- Assume planner is constrained to take the equilibrium conditions that determine $\rho$ and $\{p^\omega_{N,1}\}$ as given.

- Comparison of first-order conditions:

\[
FOC(L)_{CE} : \quad E \left\{ u'(C^\omega_T) \cdot \frac{\partial C^\omega_T}{\partial L} \right\} = 0
\]

\[
FOC(L)_{SP} : \quad E \left\{ u'(C^\omega_T) \cdot \frac{dC^\omega_T}{dL} \right\} = 0
\]

Proposition (Competitive Equilibrium and Social Optimum)

In our benchmark model, the decentralized equilibrium and the constrained social optimum coincide.
Extended Model

Add an additional time period to benchmark model:

$$\max U = u(C_{T,1}^\omega) + \beta u(C_{T,2}^\omega)$$

s.t.  
$$C_{T,1}^\omega = Y_T^\omega - R_F D - R_L L \{ p_N^\omega - (1 - \rho) E[p_N^\omega] \} + F_2^\omega$$
$$C_{T,2}^\omega = Y_T^\omega - R_F F_2^\omega$$

Euler equation DE:
$$u'(C_{T,1}^\omega) = u'(C_{T,2}^\omega)$$

Euler equation SP:
$$u'(C_{T,1}^\omega) = u'(C_{T,2}^\omega) + \frac{\psi R_L L}{1 + \psi R L L} E[u'(C_{T,1}^\omega)] \cdot \left\{ \frac{u'(C_{T,1}^\omega)}{E[u'(C_{T,1}^\omega)]} - \frac{M_1^\omega}{E[M_1^\omega]} \right\}$$
Extended Model

Interpretation of planner’s Euler equation:

\[ u'(C_{T,1}^\omega) = u'(C_{T,2}^\omega) + \frac{\psi R_L L}{1 + \psi R_L L} E[u'(C_{T,1}^\omega)] \cdot \left\{ \frac{u'(C_{T,1}^\omega)}{E[u'(C_{T,1}^\omega)]} - \frac{M_1^\omega}{E[M_1^\omega]} \right\} \]

- Planner can influence exchange rate through \( p_{N,1}^\omega = \psi C_{T,1}^\omega \)
  \( \rightarrow \) exchange rate intervention

- If risk markets complete, then \( \frac{u'(C_{T,1}^\omega)}{E[u'(C_{T,1}^\omega)]} = \frac{M_1^\omega}{E[M_1^\omega]} \)
  \( \rightarrow \) planner’s condition reduces to standard Euler equation
Optimal Exchange Rate Intervention

Interpretation of planner’s Euler equation:

$$u'(C^ω_{T,1}) = u'(C^ω_{T,2}) + \frac{\psi RL}{1+\psi RL} E[u'(C^ω_{T,1})] \cdot \left\{ \frac{u'(C^ω_{T,1})}{E[u'(C^ω_{T,1})]} - \frac{M^ω_1}{E[M^ω_i]} \right\}$$

For $L > 0$ planner uses “pro-cyclical” exchange rate intervention:

- if $\frac{u'(C^ω_{T,1})}{E[u'(C^ω_{T,1})]} < \frac{M^ω_1}{E[M^ω_i]}$ in state $ω$, domestic agent is relatively better off than international investor
  - planner’s Euler equation implies $u'(C^ω_{T,1}) < u'(C^ω_{T,2})$
  - planner increases period 1 consumption to appreciate the exchange rate and increase repayments to international investors

- if $\frac{u'(C^ω_{T,1})}{E[u'(C^ω_{T,1})]} > \frac{M^ω_1}{E[M^ω_i]}$ opposite results
Optimal Exchange Rate Intervention

Proposition (Optimal Exchange Rate Intervention)

The planner chooses her intertemporal allocations so as to modify the asset span of the economy to allow for better risk sharing.

For $L > 0$ ($L < 0$) this implies pro-cyclical (counter-cyclical) exchange rate interventions.

In general equilibrium:

- better insurance opportunities increases $L$
- domestic economy obtains more insurance for cheaper price
Illustration of Exchange Rate Intervention

Figure: Relative marginal utilities under autarky
Illustration of Exchange Rate Intervention

Figure: Relative marginal utilities in decentralized equilibrium
Illustration of Exchange Rate Intervention

Figure: Relative marginal utilities in constrained planner’s equilibrium
Illustration of Exchange Rate Intervention

Figure: Relative marginal utilities under Arrow-Debreu markets
Conclusions

1. Model of debt denomination in emerging economies as outcome of optimal portfolio choice problem

2. Local currency $L$ debt mitigates volatility

3. Economy responds differently to shocks when $L$ endogenized

4. Planner may engage in exchange rate policy to improve risk sharing with international investors