Empirically: countries accumulate substantial debt and reserves

Sovereign debt capacity puzzle
  - Cannot commit to repay; strategic default
  - Trouble generating sufficient debt in Eaton-Gersovitz (1981) setting
  - What are the costs of default?

Reserves worsen the problem
  - Complete markets: Bulow and Rogoff (1989) puzzle

Twin sovereign and banking crises
  - Empirical regularity (Reinhart and Rogoff (2011))
  - Missing from workhorse Eaton-Gersovitz models
Goal: framework to address these puzzles

Start from workhorse Eaton-Gersovitz setting, but
- No exogenous default costs
- Allow for reserve accumulation
- Can save in autarky

Add two key ingredients:
- Growth
- Liquidity provision

Sustained growth requires
- Invest in long term, high yielding, but illiquid projects
- Liquidity buffer needed for effective maturity transformation
Sources of liquidity:
- Self provision: hoard reserves
- Borrow: subject to sovereign risk
  - Sovereign debt smooth liquidity needs
  - On top of traditional consumption smoothing role

Costs of default and debt capacity:
- Insufficient reserves: liquidate projects
- Hoard more reserves: foregone investment/growth opportunities
- Costs higher during good times (better investment opportunities)
- Endogenously generates counter-cyclical sovereign default
• Trade-offs for reserve holdings:
  • Too much reserves $\rightarrow$ forgone investments and consumption
  • Not enough reserves $\rightarrow$ limits capacity for foreign liquidity; will have trouble with liquidity risk management
  • Interaction of investment/growth/liquidity risk management/sovereign risk pins down reserves

• Twin crises:
  • Apply Diamond and Dybvig (1983) logic to this setting
  • Endogenous feedback: sovereign risk $\leftrightarrow$ domestic banking fragility $\leftrightarrow$ output
  • War chest of reserves to stabilize domestic banking sector and increase sovereign debt capacity
Baseline Model: Households

- Infinite horizon. Small open economy.
- Liquidity modeled following Diamond and Dybvig (1983)
  - Continuum of ex-ante identical households
  - Fraction $\lambda_t$ of households impatient
  - Liquidity needs $\lambda_t$ time varying and exogenous
    - Endogenize later in twin crises model
  - Certainty equivalent value at start of the period:

$$U_t = \left[ \lambda_t C_{1t}^{1-\eta} + (1 - \lambda_t) C_{2t}^{1-\eta} \right]^{\frac{1}{1-\eta}}$$

- Focus on planner’s problem: standard time separable preferences over $U_t$
Production & Liquidation Costs

- **AK model.**
  - Capital accumulation: \( K_{t+1} = (1 - \delta + i_t)K_t \)
  - Cost of investment: \( \phi(i_t)K_t, \ i_t \geq 0 \)

- **Production**
  - Produce \( Y_t = Z_tK_t \) seeds at the start of each period
  - Seeds ripen at the end of period.
    - 1 unit ripe fruit = 1 unit consumption
  - Unripe fruit can be harvested early.
    - 1 unit unripe fruit = 1 \( - L \) units consumption
  - Fraction of fruit harvested early: \( h_t \in [0, 1] \)

\[ Y_t \text{ seeds} \downarrow \quad \text{Unripe fruit: } h_t(1 - L)Y_t. \]
\[ \text{Early consumers: } \lambda_t C_{1t} \downarrow \quad \text{Ripe fruit: } (1 - h_t)Y_t. \]
\[ \text{Late consumers: } (1 - \lambda_t)C_{2t} \downarrow \quad t \rightarrow t + 1 \]
Non-state contingent. Risk free return $r$

Invested at end of period $t$, smooth consumption and liquidity for period $t+1$.

Reserve choice $S_{t+1}$ not contingent on liquidity need $\lambda_{t+1}$
Inter-period debt

The standard one period debt in the literature

- Does not directly alleviate liquidity constraints
Intra-period debt

- A credit line
- Directly alleviates liquidity constraints
- Key differences with reserves:
  - Added state contingency
  - Intra-period debt: sacrifice today’s budget constraint
  - Reserves: sacrifice yesterday’s budget constraint
  - Distinction is important when there is growth
  - Presence of intra-period debt increases the costs of default
Equilibrium

- Rest of model follows standard Eaton-Gersovitz setting
- Planner is strategic. Compare autarky value with credit access value.
- If default:
  - No borrowing for an exogenous period
  - Can still save
  - All debt forgiven upon reentry
- Standard Markov equilibrium.
Framework can generate realistic levels of debt and reserves
- 70% debt to (quarterly) gdp and 30% reserves to (quarterly) gdp
- These are empirical values for Argentina (1993-2001)

Requires the process $\lambda_t$ to have disaster risk like properties
- Most of the time liquidity needs are moderate
- Sometimes it can get really high

Naturally begs the question: what is $\lambda_t$?
Extension: Twin-Crises Model

- Microfoundation: connect \( \lambda_t \) to coordination problems within the domestic banking sector
  - Demand deposits
  - Domestic households can run
- Use global game methods for equilibrium selection
  - Extend Goldstein and Pauzner (2005) and embed in current framework; \( \lambda_t \) depends on
    - Output (macro fundamentals)
    - Total liquidity supply (domestic and foreign)
    - Expenditures
    - Sovereign bond prices directly affect liquidity supply and expenditures
- Self-filling outcomes and feedback
- On equilibrium path \( \lambda_t \) could be small while off equilibrium path \( \lambda_t \) large
  - War chest of reserves rule out bad equilibria; even thought sitting idle on the equilibrium path.
Embed growth and liquidity concerns into Eaton-Gersovitz framework

Can rationalize
- Sovereign debt capacity
- International Reserves
- Twin (banking and sovereign) crises