Alessandro Missale

FINANCIAL INTEGRATION AND CRISES

2021

Lecture 11

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Liquidity Crises

- Third Generation Models of Financial Crises
  - Liquidity crises and Balance Sheet crises
- Liquidity crises
  - Chang and Velasco (2001) Model
    - Sudden stops modeled as bank runs
    - Crises like self-fulfilling banking panics
  - Policy implications

Reference: Chang and Velasco (QJE 2001)

Third Generation Models of Financial Crises

Third generation models

- **Liquidity Crises**
- **Balance Sheet Crises**

These Models assign a key role to

- **The financial structure of the economy:**
  - Models of liquidity crises focus on country's assets and liabilities; in particular, on mismatches in their maturity structure.
  - Models of Balance sheet crises focus on firms' leverage, and more generally, on the quality of firms' balance sheets: currency-mismatches; net worth deterioration with output contraction.
- **Expectations**: Crises can be self-fulfilling.
  - The Asian crisis of the1997-98 brought **Contagion** to light; possibly the result of self-fulfilling changes in market sentiment.

Liquidity crisis models

Liquidity Crisis Models

The idea is that a country that is solvent:

- $A_S + A_L > L_S + L_L$

but with a maturity mismatch:

- $L_S > A_S$

is vulnerable to a liquidity crisis:

- $L_S > A_S +$ Liquidation Value (A_L)

These models

- Formalize the effects of Sudden Stops;
- Explain the coincidence of sudden stops and banking crises.

Chang and Velasco (2001) Liquidity Crisis Model

Chang-Velasco (QJE 2001) model

It is the open-economy version of the Diamond-Dybvig (JPE 1983) model.

It was written to explain the South-East Asian crisis of 1997-1998.

- Banks pool hydiosincratic risk and increase welfare;
- Banks are illiquid and thus vulnerable to runs;
- Panic leads to a self-fulfilling collapse of the financial system.

- **International illiquidity plays a key role for financial vulnerability**
  - Crises are the result of the interaction of foreign creditors' panic with domestic depositors' panic.
- The Model also shows the prevention role of:
  - Long maturity debt
  - Foreign reserves
  - Creditors coordination mechanisms
  - International Lender of Last Resort

Model Assumptions

There are three periods: $t = 0, 1, 2$

- **Investment decisions** are made in period $t = 0$

Each agent is endowed with $e > 0$, that can be invested in:

- **Financial assets** with gross return $R^* = 1$, i.e. invest 1 get 1;
- **A long-term technology** that yields $R > 1$ at $t = 2$, but **is Illiquid**: it yields $r < 1$ if liquidated at time $t = 1$.

Agents consume in period $t = 1$ or in period $t = 2$ depending on their preferences, that they do not known at time $t = 0$

- with prob. λ they are impatient: $U^I = u(c_1) = \frac{1}{1-\sigma} c_1^{1-\sigma}$
- with prob. $1 - \lambda$ they are patient: $U^P = u(c_2) = \frac{1}{1-\sigma} c_2^{1-\sigma}$

At t =1 consumers discover their type

- Agent's type is private information
- There is no aggregate uncertainty: λ = fraction of impatients
- Population is normalized $=1$

Utility

Funds can be borrowed or lent on world capital markets at $R^* = 1$, but there is a **borrowing constraint**:

- Total amount country can borrow $\leq F$

Expected utility of any agent and total utiliy of population

- $U_0 = \lambda u(c_1) + (1-\lambda)u(c_2)$

Under certainty:

- $c_1 = e$ and $c_2 = Re + \frac{1}{1-\lambda} F(R-1)$

With uncertainty, in autharchy, investment is lower than optimal because of liquidity risk;

- There is a clear opportunity for sharing risk (no aggregate uncertainty)
- Pooling resources in a bank eliminates individual liquidity risk
- A "bank" --a coalition of consumers-- is welfare improving

Bank's Maximization Problem

The best allocation attainable by the bank (system) is the social optimum

- The bank maximizes the utility of the representative consumer/depositor
- Max $U_0 = \lambda \frac{1}{1-\sigma} c_1^{1-\sigma} + (1-\lambda) \frac{1}{1-\sigma} c_2^{1-\sigma}$ (1)

s.t. $K \leq d + e$ $d \equiv$ foreign borrowing at $t = 0$ (2)

$\lambda c_1 \leq b + rL$ $L \equiv$ liquidated amount of K (3)

$b \equiv$ foreign borrowing at $t = 1$

$(1-\lambda)c_2 \leq R(K-L) - d - b$ (4)

$d \leq F$ (5)

$d + b \leq F$ (6)

$c_2 \geq c_1$ Incentive Compatibility (7)

$c_1, c_2, K, L \geq 0$ (8)

Solution

The optimal contract implies no costly liquidation:

- $L^* = 0 \quad \rightarrow \quad \lambda c_1 = b$ from equation (3)

In order to maximize investment, **withdrawals by impatient consumers are financed by b**, by foreign borrowing in period 1:

- $b > 0 \quad \rightarrow \quad d + b = F$; while $d \leq F$ is not binding in eq. (5)

Intuitively, borrowing to invest in the high return project is optimal.
Then, take $d > 0$ Invest as much as possible, $F - b$, in the long project

- Noting that $K = e + d$, from equation (4) we have:
- $(1-\lambda)c_2 + d + b = R(e+d)$ (A)
- $(1-\lambda)c_2 + d + b = R(e+d+b) - Rb$ (B)
- $(1-\lambda)c_2 + F = Re + RF - R\lambda c_1$ (C)
- $(1-\lambda)c_2 + R\lambda c_1 = Re + (R-1)F = Rw$ (D)

where $w \equiv$ present value of total resources

The Best Allocation

Max $\lambda \frac{1}{1-\sigma} c_1^{1-\sigma} + (1-\lambda) \frac{1}{1-\sigma} c_2^{1-\sigma} + \gamma[Rw - (1-\lambda)c_2 - R\lambda c_1]$

FOC

- $c_1^{-\sigma} = \gamma R$; $c_2^{-\sigma} = \gamma$ (E) (F) which imply
- $c_2 = R^{1/\sigma} c_1 \rightarrow c_2 > c_1$ (G) incentive compatibility is satisfied

Using $(1-\lambda)c_2 + R\lambda c_1 = Rw$ with (G)

- $\lambda c_1^* = b^* = \theta w$ with $\theta = \frac{\lambda}{\lambda + (1-\lambda)R^{(1-\sigma)/\sigma}}$ (9)
- $(1-\lambda)c_2^* = R(1-\theta)w$ (10)
- $K^* = R^{-1}[(1-\lambda)c_2^* + F]$ (11)
- $d^* = K^* - e$ (12)

Demand Deposit Contract

- **The best allocation can be decentralized as a deposit contract:** consumers deposit e to the bank and are allowed to withdraw c_1^* on demand. (Agents also give their capacity to borrow abroad to the bank)

Characteristics of solution:

- At $t=0$ the bank invests in K^* all e and d^* borrowed on world markets.
- At $t=1$ the bank borrows b^* to finance withdrawals of impatient consumers.
- At $t=2$ the bank repays $F = d^* + b^*$ to foreign investors and gives c_2^* to patient consumers.

The "bank solution" is welfare improving over autharchy,

- **But the maturity mismatch opens up the possibility of runs if the bank must respect a sequential service constraint.**

Domestic Panic and Bank Runs

Assume the Bank is committed to always repay all foreign debt so that $R(K-L) \geq F$, then, liquidation of long-term investment is limited to:

- Maximum Liquidation: $L^{+} = K^{*} - F/R \;\; = (1-\lambda)c_2^{*}/R$ (13)

The bank services withdrawal requests c_1^{*} sequentially by borrowing abroad $b^{*} = F - d^{*}$ and liquidating up to L^{+}

- If requests $> b^{*} + rL^{+}$, the bank pays F and closes. (Recall $r < 1$)
- Otherwise, at $t = 2$, the bank repays F and distributes returns on $K^{*} - L^{+}$ to other depositors.

There is a "good" equilibrium where only impatient consumers withdraw. But, there may also be a “bad” equilibrium in which all consumers want to withdraw c_1^{*} :

- Since liquid assets $b^{*} = \lambda c_1^{*} < c_1^{*}$ – **maturity mismatch** –

If local depositors panic, the bank faces a run

Domestic Bank Run Equilibrium

Domestic Liquidity Crisis

- A Bank Run where all depositors attempt to withdraw c_1^* at $t = 1$ is an equilibrium if this behavior forces the bank to finish resources and fail
- Bank fails if: $Z^+ = c_1^* - (b^* + rL^+) > 0$ (14)

  and, thus, using equations (13), (9), (10)

Run can be an equilibrium if $R^{(\sigma-1)/\sigma} > r \quad \leftarrow \quad \sigma \geq 1$ sufficient

- If this condition holds, it is individually rational to run if one expects everybody else to do the same.

Note: 1) Suspension of payments after λ withdrawals can stop the run, but is difficult to implement if λ is uncertain and the bank has enough resources to service depositors.

2) The social planner problem is an approximation of true problem where the probability of a run is taken into account (solvable with run depending on a sunspot variable with low probability).

Foreign Panic, Sudden Stop and Liquidity Crisis

Sudden Stop

- If the bank cannot commit to always repay all foreign debt, foreign lenders may panic and refuse to extend credit at $t = 1$.

Assume **bank can only commit to repay two-period debt, d^*.**

Then, liquidation of investment is limited to:

- Max liquidation: $L^S = K^* - d^*/R$ (15)

- If a run occurs at t=1 and foreigners stop lending $b = 0$, then

An International Liquidity Crisis – a bank run is an equilibrium if

- $Z^S = c_1^* - rL^S = c_1^* - rK^* + rd^*/R > 0$ (16)

Recalling $Z^+ = c_1^* - (b^* + rL^+) = c_1^* - \boldsymbol{b^*} - rK^* + \boldsymbol{rb/R} + rd^*/R$ (14)

- we have $Z^S > Z^+$ → a bank run is more likely to be an equilibrium

The bank is more vulnerable to runs with sudden stops

If condition (16) holds and foreign lenders cannot coordinate, for them it is individually optimal to stop lending expecting everybody else to do the same.

Self-fulfilling Lenders' Expectations

Role of Expectations

- Foreign lenders' fears of a run make the liquidity crisis happen; expectations are self-fulfilling.
- Condition (16) for a sudden stop can hold even if condition (14) for a domestic bank run does not. Then, a crisis is possible only if foreign creditors stop lending.
- In the latter case, if the bank could commit to liquidate $\leq L^+$, i.e. to repay all foreign debt, then there would be no sudden stop and crisis.

Role of Reserves

- If the bank borrows F at $t = 0$ and keeps a fraction b^* liquid; i.e. if it holds foreign reserves, the crisis can be avoided.
- In the real world, holding reserves as self-insurance is a costly strategy It was adopted after the crises of the late 1990s.

A Debt-Bank Run with Short-Term Debt

Capital Reversal – Debt Run

- If the initial debt, d, is short-term, eg one-period loans, then the bank is even more vulnerable to a crisis because, in period $t = 1$, creditors may rationally refuse to roll over the debt. (There is a capital reversal)

A Debt-Bank Run –A Liquidity Crisis– is an equilibrium if:

- $Z^D = c_1^* + d^* - rK^* > 0$ (17)

Recalling the condition for a sudden stop

- $Z^S = c_1^* - rL^S = c_1^* - rK^* + r\,d^*/R > 0$ (16)
- We have $Z^D > Z^S > Z^+$

A crisis is more likely to be an equilibrium.

- Short term debt exposes the country to the risk of capital reversals.

If condition (17) holds while condition (16) for a Sudden Stop does not, a run is possible if and only if creditors refuse to roll-over the debt.

Long and short term capital inflows

Do larger capital inflows, F, i.e. greater financial integration, expose countries to an enhanced risk of liquidity crises?

- The answer depends on the maturity of capital inflows; short-term debt increases vulnerability, while long-term capital inflows are less risky.

The effect of an increase in F – e.g. the removal of capital controls –

Suppose debt, d, is short-term.

Divide condition (17) for a debt-bank run $Z^D = c_1^* + d^* - rK^* > 0$ by w

- $$\frac{Z^D}{w} = \frac{\theta}{\lambda} + (1-r)\frac{d^*}{w} - r\frac{e}{w} > 0 \qquad (18)$$

Large short-term capital inflows increase vulnerability to a liquidity crisis

- As $w = e + (R-1)F/R$ then $F \uparrow$ implies $w \uparrow$ and $re/w \downarrow$
- As $d^*/w = F/w - b^*/w = F/w - \theta$; then $F \uparrow$ implies $\uparrow d^*/w$

Long debt makes financial integration safer

Long-term capital inflows

- Suppose debt, d, is long-term

Divide condition (16) for a sudden stop $Z^S = c_1^* - rK^* + rd^*/R > 0$ by w

- $\frac{Z^S}{w} = \frac{\theta}{\lambda} - \frac{(R-1)}{R}\frac{rd^*}{w} - r\frac{e}{w} > 0$ (19) using $K^* = d^* + e$
- $F \uparrow$ implies, as before, $re/w \downarrow$ but also $d^*/w \uparrow$
- The second effect reduces the vulnerability to a crisis

Large long-term capital inflows have a minor effect on vulnerability

Intuition: as b^* is given by optimal consumption, c_1^*, an increase in capital inflows, F, in the form of long-term debt, increases roll-over risk only in part, to the extent that it increases c_1^*.

Policy for Crisis Prevention

Policy prescriptions

- **Avoid short-term borrowing and accumulate foreign reserves** (but, some authors contends that short-term debt has an incentive role).
- Make more information available; increase transparency.
- Avoid sequential service by designing workout mechanisms, e.g. a Sovereign Debt Restructuring Mechanism (see Lecture 8 slide 17), to **coordinate creditors on the good equilibrium**.
- **Create an international lender of last resort** like the IMF (or the ECB with OMTs). The LLR by making credit available to countries in crisis may
  - avoid foreign creditor panic and liquidity crises;
  - prevent contagion and negative spillovers.

BUT Arguments against LLR

- It may **create Moral Hazard**: increase risk taking and lessen incentives for crisis prevention, sound macroprudential policies, etc.
- Difficult to distinguish liquidity crises from crises due to fundamentals.

The role of the IMF

Economists have opposing views on the role of the IMF

- Some believe IMF should act as pure lender of last resort. In their view crises are mainly of liquidity, due to market failures, change in market sentiment, contagion.
- Others contend that IMF should not even lend as it creates moral hazard. In their view, crises are rooted in bad policies and fundamentals.

IMF financial assistance traditionally relied on:

- Surveillance according to Article IV consultations;
- **Ex-post Conditionality**: loans are conditional on implementation of adjustment programs.

Now IMF assistance is also based on **ex-ante conditionality**

- IMF introduced in 2009 the "**Flexible Credit Line**", a short-term liquidity facility that countries can freely access if they meet rigorous eligibility criteria: sound policies, debt sustainability, etc.
- The IMF also introduced the **Precautionary and Liquidity Line** in 2011.