Alessandro Missale

FINANCIAL INTEGRATION AND CRISES 2021

Lecture 12

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Third Generation Models of Financial Crises

❑ Liquidity crises and Balance Sheet crises

❑ **Balance Sheet crises**

▪ Krugman (1999) model

 ▪ Sudden Stops and the Exchange Rate

 ▪ Policy implications and the IMF dilemma

References: Krugman (ITPF 1999)

Third Generation Models of Financial Crises

Third generation models focus on financial fragility

❑ **Financial Structure, firms' leverage, quality of balance sheets have a key role as well as Expectations** (crises are self-fulfilling)

Balance Sheet Crises models focus on: firms' leverage, and more generally, on the quality of firms' balance sheets: i) mismatches in the currency denomination of assets and liabilities; net worth (and investment) sensitivity to output fluctuations.

Models

❑ Formalizes the <u>effects of Sudden Stops on exchange rate and real activity</u>

❑ Explains the coincidence of sudden stops, financial crises and currency crises

Krugman (1999) model: a country with dollar-denominated liabilities is vulnerable to exchange rate movements driven by self-fulfilling expectations about investment growth.

Krugman (1999) Balance Sheet Model

Krugman (1999) contends that:

❑ **Evidence of "contagion" resolves the dispute in favor of self-fulfilling stories and against explanations based on bad fundamentals.**

He argues against the "Fundamentalist view" that a poorly regulated banking sector with implicit government's guarantees "over-invested" in bad/risky projects because of moral-hazard (see eg Corsetti, Pesenti and Roubini, 1998).

❑ **Fragility of the banking sector was not the full story**
The crisis displayed an epidemic of firms' distress that cannot be resolved simply by fixing the banks, by avoiding: i) bank lending to bad projects due to moral hazard; ii) financial fragility and self-fulfilling bank runs.

❑ **The macroeconomic crisis is at the center stage**
Companies that looked solvent before the crisis have gone bankrupt because of the severe recession, or because the currency depreciation that made their dollar debt explode.

Firms' balance sheets play key role

Krugman emphasizes the impact of:

- **Real exchange rate depreciation and low sales on firms' balance sheets**
  Balance sheets worsened because of the explosion of dollar denominated debt and because of the contraction in aggregate demand.

Consider the following loop:

- **Low investment** (and capital inflows) make the exchange rate depreciate;
- **Real depreciation** impacts on dollar-denominated debt and balance sheets;
- **Balance sheet deterioration** impairs firms' ability to borrow and invest.

This loop makes a self-fulfilling crisis possible

A crisis can be triggered by pessimistic expectations about investment/growth: Low foreign credit and investment lead to real depreciation and output contraction that worsen firms' net worth (balance sheets) and imply a further reduction in credit and investment.

The model

Output, or the domestic good, is produced with capital and labor

- $Y_t = F(K_t, L_t) = K_t^{\alpha} L_t^{1-\alpha}$ (1)

☐ Capital depreciates in one period; it depends on last period investment;

☐ Entrapreneurs own capital, and save-invest all their income.

☐ Workers consume all their income: **consumption C = labor income**;

Domestic and foreign goods are imperfect substitutes:

- μ = constant share of consumption and investment spent on foreign goods;
- $1 - \mu$ = constant share of C and I spent on domestic goods.

The country is small relative to the world economy:

☐ p_t = **real exchange rate** (domestic goods needed for 1 foreign good)

- X = exports in terms of foreign goods;
- pX = exports in terms of domestic goods.

Exports X are given in terms of foreign income spent on them (zero marginal propensity to spend on domestic goods by rest of the world).

Real exchange rate

Real exchange rate determination

❑ Market clearing for domestic goods:

▪ $Y = (1 - \mu)C + (1 - \mu)I + pX$ (2)

❑ Noting that $C = (1 - \alpha)Y$ as $1 - \alpha =$ labor share in income

▪ $Y = (1 - \mu)(1 - \alpha)Y + (1 - \mu)I + pX$ (3)

Output, Y, is supply determined

❑ The real exchange rate clears the market

▪ $p_t = \dfrac{1}{X}[1 - (1 - \mu)(1 - \alpha)]Y_t - \dfrac{1}{X}(1 - \mu)I_t$ (4)

An increase in investment leads to a real appreciation;

The price of domestic goods must increase to clear their excess demand (the real exchange rate p_t must fall; i.e. appreciate)

Investment decision

Investment decision

❑ Entrepreneurs invest in the domestic technology as long as the real return on domestic investment $1 + r_{t+1}$ is greater than the world real return $1 + r^*$ in terms of foreign goods:

- $1 + r_{t+1} \geq (1 + r^*)(p_{t+1}/p_t)$ *Sort of Real UIP*   (5)

where the real return $1 + r_t$ is equal to the marginal product of capital

- $1 + r_{t+1} = F_k(K_{t+1}, L_{t+1}) = F_k(f(I_t), L_{t+1})$ (6)

Capital, K_t (in terms of domestic goods) is accumulated using both domestic and foreign investment goods and is clearly a function $f(.)$ of the income spent on investment goods, I_t. Note: $I_t \uparrow \rightarrow r_{t*1} \downarrow$

In the Appendix it is shown that $K_t = p_{t-1}^{-\mu} I_{t-1}$; but this specific result is not important for Krugman's argument.

Investment constraints

Investment demand

- $1 + r_{t+1}(I_t) \geq (1 + r^*)(p_{t+1}/p_t)$ (7) [from (5) and (6)]

Investment increases with r_{t+1} , it decreases with r^* and exp. real depreciation

Investment constraint: there is a maximum Financeable Investment, I^f

- $I_t \leq I^f \equiv (1 + \lambda)W_t$ (8) W_t = wealth in period t

- ❏ Lenders impose a limit on leverage, consistently with the "credit view" approach –Think of W_t as collateral–.

- ❏ The constraint on Investment needs not be binding.

Non-negative constraint

- $I_t \geq 0$ (9)

Investment cannot be negative.

Depending on circumstances (7), (8), or (9) may be the binding constraint.

Firms' balance sheet – net worth

Entrepreneurs' net wealth

- $W_t = \alpha Y_t - D_t - p_t F_t$ (10)

- ❑ Entrepreneurs own all domestic capital; since capital lasts only one period, its value is simply the income accruing to capital within the current period; i.e. the capital share in income, αY_t .

- ❑ Entrepreneurs have debts to foreigners (net of foreign assets) in either "domestic currency" D_t or "foreign currency" F_t.

Investment and quality of balance-sheets are self-reinforcing

- ❑ The amount that entrepreneurs can borrow from foreign lenders to finance investment depends on their wealth; on the quality of their balance sheets.

- ❑ BUT the wealth of each individual entrepreneur depends on the level of investment in the economy because investment affect the real exchange rate and hence the value of foreign-currency-denominated debt.

- $I \uparrow \rightarrow p \downarrow \rightarrow pF \downarrow \rightarrow W \uparrow \rightarrow I^f \uparrow$

Financeable investment

- ❑ The effect of (expected) investment, I, on "financeable" investment, I^f, can be derived by looking at the effect of investment on wealth (via the exchange rate) and at the effect of wealth on financeable investment.

Financeable investment

- $$I_t^f = (1 + \lambda)W_t \qquad (11)$$

Effect of investment on wealth (via real appreciation)

- $$\frac{\partial W}{\partial I} = \frac{\partial W}{\partial p}\frac{\partial p}{\partial I} = F_t\frac{(1-\mu)}{X} \qquad (12)$$

Effect of investment on financeable investment:

- $$\frac{\partial I^f}{\partial I} = \frac{\partial I^f}{\partial W}\frac{\partial W}{\partial I} = (1+\lambda)F_t\frac{(1-\mu)}{X} \qquad (13)$$

Financial Crisis

The narrative

❑ Expectations of low investment and low growth trigger a sudden stop.
A financial crisis develops because the contraction of foreign credit
adversely affects firms' ability to borrow and invest, with self-reinforcing
effects as real depreciation worsens firms' balance sheets.

The equilibrium

❑ The supply of credit depends on what foreign lenders think will be future
investment and thus the value of borrowers' wealth/collateral.
(In fact, the value of wealth depends on the level of investment as the latter
affects the exchange rate).

❑ This gives rise to the possibility of **self-fulfilling multiple equilibria:**
If lenders expect investment to fall and firms' balance sheets to worsen,
they stop lending, investment will fall and balance sheets will worsen thus
validating their expectations.

Relation expected investment – actual investment

Actual Investment

45-degree

H

L

Expected Investment
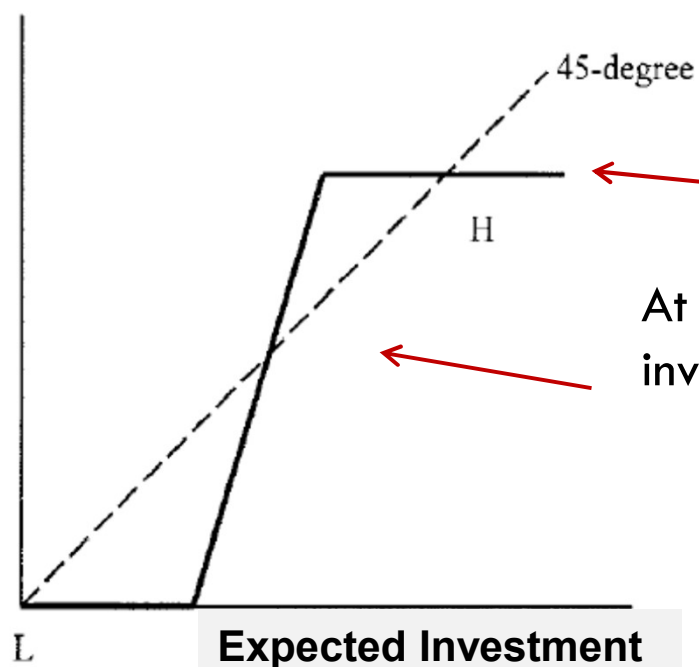
At high levels of expected investment, the rate-of-return constraint determines the maximum investment level such that

$$1 + r_{t+1}(I_t^{Max}) = (1 + r^*)(p_{t+1}/p_t)$$

At intermediate levels of expected investment, investment is determined by the finance constraint

$$I_t^f = (1 + \lambda)W_t$$

At low levels of expected investment, firms are bankrupt (because of $\uparrow pF$) no investment takes place. The non-negativity constraint sets
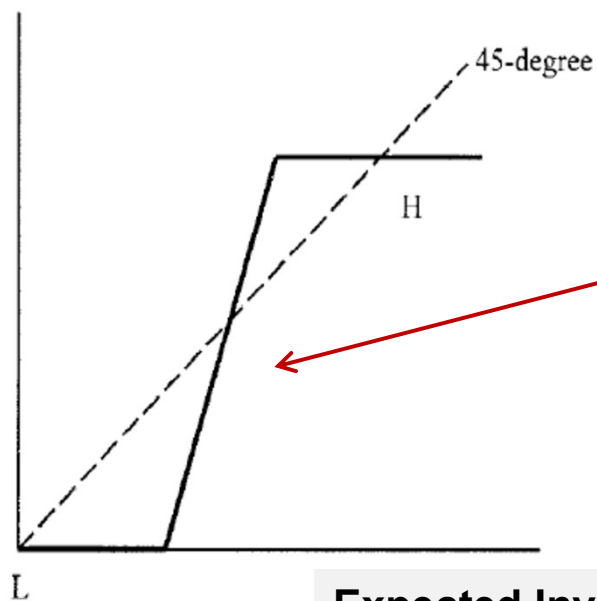
$$I_t^{Min} = 0$$

Rational expectations equilibria

Necessary condition for multiple equilibria

For multiple equilibria must be
$$\frac{\partial I^f}{\partial I} = (1+\lambda)F_t\frac{(1-\mu)}{X} > 1 \qquad (14)$$

(Expected) investment must have a multiplicative effect on financeable investment

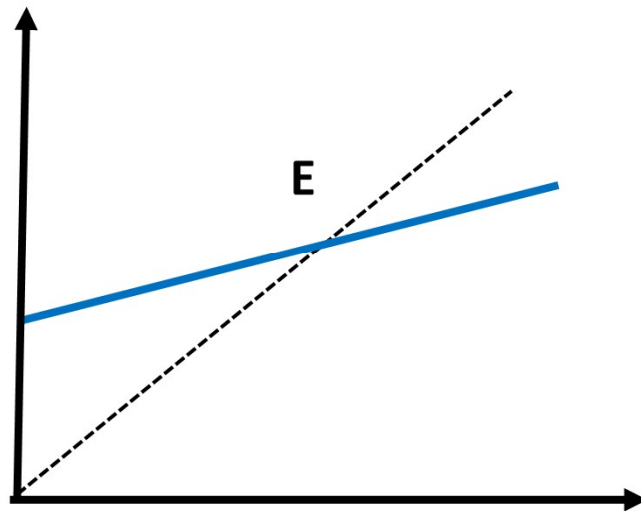**Actual Investment**

45-degree

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Expected Investment

Investment as determined by the finance constraint under the assumption that
$$\frac{\partial I^f}{\partial I} = (1+\lambda)F_t\frac{(1-\mu)}{X} > 1$$
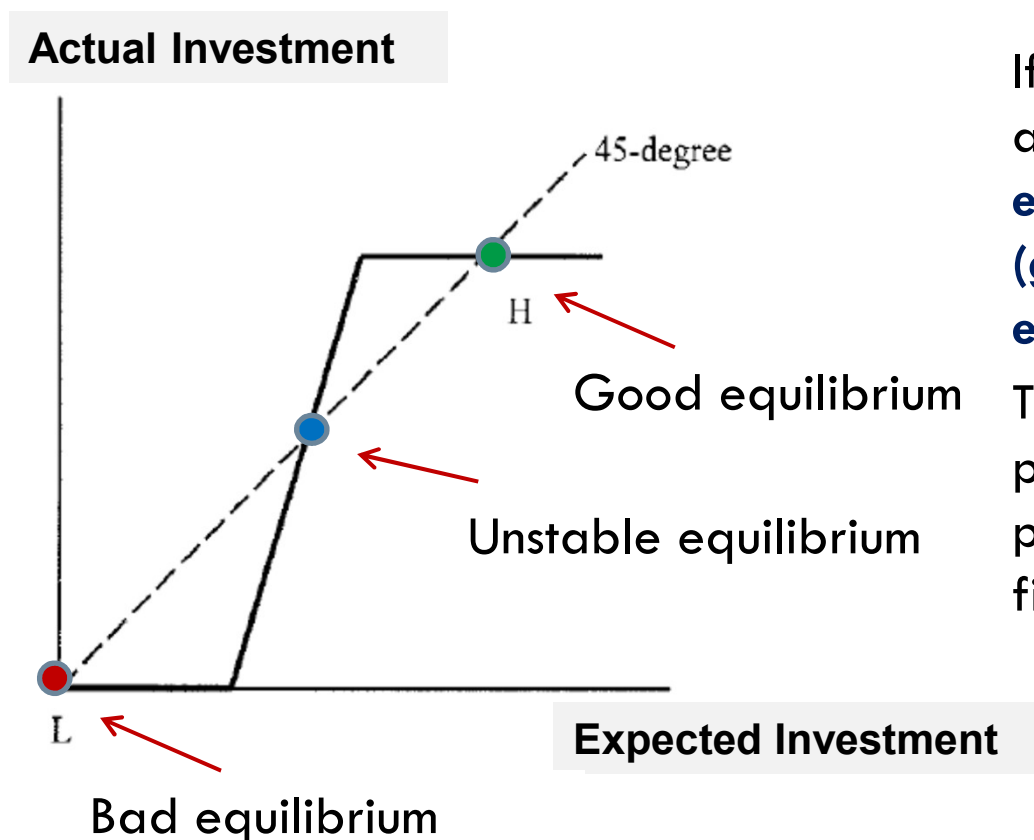
Unique equilibrium

Unique Equilibrium

$$\frac{\partial I^f}{\partial I} = (1 + \lambda)F_t \frac{(1 - \mu)}{X} < 1$$

Multiple Equilibria

Three rational expectations equilibria are possible

Actual Investment

45-degree

H

Good equilibrium

Unstable equilibrium

L

Expected Investment

Bad equilibrium

If lenders become suddenly pessimistic about entreprenurs' wealth, **the economy can move from the good (green) equilibrium to the bad (red) equilibrium**.

The collapse does not indicate that the previous investments were unsound; the problem is instead one of firms' financial fragility.

Rational expectations equilibrium

A rational-expectations equilibrium is:
"a set of self-confirming guesses"

❑ Note: no need for strategic interaction or trade-off facing authorities

❑ **Equilibrium is at the point in which actual investment is equal to expected investment**

❑ Formally, in Krugman's words: "The actual investment that takes place, given the credit offers, must match the expected level of investment that motivates those credit offers" (i.e. expectations must be correct).

Sources of financial fragility and crisis

Condition for crisis equilibrium

- $\dfrac{\partial I^f}{\partial I} = (1 + \lambda)F_t \dfrac{(1-\mu)}{X} > 1$ (14)

Factors of financial fragility that make a collapse possible:

- High leverage λ.
- Large foreign-currency debt relative to exports F/X
- Low marginal propensity to import μ.

Note the difference with the factors stressed by Chang-Velasco (2001): Maturity mismatch, lack of foreign reserves.

❑ What made Asian economies peculiarly vulnerable to financial crisis, was **high leverage**: all affected countries had unusually high levels of λ.

❑ It didn't happen before, because **foreign debt** became substantial only in the 1990s.

The Exchange Rate Dilemma

Exchange rate intervention

❑ Foreign-currency denominated debt creates a **policy dilemma**:

  ▪ Defend the exchange rate with high interest rates to avoid firms' and banks' failures due to foreign-currency debt;

  ▪ Let the currency depreciate to avoid a severe recession.

❑ The high foreign-currency debt of Asian countries was a major reason for the much-criticized "IMF strategy" of defending the exchange rate.

Modelling the IMF strategy of constant $p_t = \bar{p}$

❑ As a price rigidity is introduced output is no longer supply-determined but depends on investment demand. Rearranging equation (2-4):

  ▪ $$Y_t = \frac{\bar{p}X + (1-\mu)I_t}{1-(1-\mu)(1-\alpha)} \qquad\qquad (15)$$

❑ Lower investment leads to an output contraction.

A self-reinforcing output contraction

❑ **A decline in investment and output reduces entrepreneurs' wealth** (because a share of output, αY_t, goes to profits) and thus financeable investment. Recalling that $W_t = \alpha Y_t - D_t - \bar{p} F_t$ and using eq. (15)

▪ $$\frac{\partial I^f}{\partial I} = \frac{\partial I^f}{\partial W} \frac{\partial W}{\partial Y} \frac{\partial Y}{\partial I} = (1 + \lambda)\alpha \frac{(1-\mu)}{1-(1-\mu)(1-\alpha)} \qquad (16)$$

❑ A necessary condition for a crisis is that this derivative is > 1

❑ Defending the real exchange rate closes one channel for financial collapse, but opens another: if leverage is high, **the output contraction is self-reinforcing** through its effect on firms' balance sheets and thus firms' access to credit.

Policy Implications

Prevention
- Avoid foreign-currency debt of **any maturity** because it magnifies the exchange-rate impact of adverse shocks (long-term foreign debt does not rule out a crisis).
- A transparent, regulated banking system with safe capital standards is not enough to protect from the risk of a self-reinforcing financial collapse.

Dealing with crisis
- Defending or depreciating the exchange rate can be equally harmful;
- Emergency credit lines , say from the IMF, must be very large to support investment demand and are politically infeasible.
- Imposing emergency capital controls can help stop capital flights.

After the crisis
- To resume growth, a country must either rescue bankrupt firms or promote the growth of new ones. FDI can be source of new entrepreneurs.
- (Bank restructuring and recapitalization is not suffficient)