Financial Crises – Lecture notes 1

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Course material

- Main material:
  - Allen and Gale (2007), *Understanding financial crises*, Clarendon Lecture in Finance

    (several copies available in the library)
  - Articles in the reading list
  - Lectures notes
- (Most) Material is available on my webpage:

  http://www.eui.eu/Personal/Carletti/

  – See syllabus of the course –
- Ask Julia Valerio or myself if you need help

Evaluation I

- You are required to:
  - know the material covered in class
  - complement it with the additional papers in the reading list and other relevant papers
- Evaluation:
  - Sit-in exam (55%)
  - Research proposal (40%)
  - Participation in class (5%)

Evaluation II

- Sit-in exam (date to define)
  - 2 hours
  - 4 questions (you have to choose 3)
- Research proposal (**no more than 5 pages**):
  - A precise research question with clear (economic) motivation (additional readings very useful for ideas)
  - (At least) sketch of how you would solve it – the more the better
  - Empirical ideas are also possible (but less preferable)

Important dates

- You have to decide **within two weeks** if you want to be evaluated for the course
- Research proposal must be returned by **April 8** (midnight!)
- Sit-in exam in the week of **April 8**
- Teaching assistant: ???

What do we do in this course?

- We study some economic theories that help explain
  - the existence and functioning of financial institutions (in particular, banks)
  - links among banks and their consequences in terms of financial stability and public intervention
  - financial markets and financial stability
  - functioning of interbank markets and central bank intervention
  - Accounting rules
  - Capital regulation
- With applications to 2007 crisis
- Link between micro and macro

The current crisis is not the first one…

- Crises are not a new phenomenon
- A few examples:
  - 19th and early 20th century crises in the US
  - Great depression in the 1930s
  - East Asia in 1997
  - Norway, Sweden and Finland in the early 1990's
  - Japan in the 1990s
  - Argentina crisis in 2001-2002
- They occurred in many countries where institutions are vastly different

- The experience of the 1930's was so bad that it led to regulation and direct government ownership of banks and other financial institutions in many countries
- This essentially eliminated the occurrence of crises in the period 1945-1971

...however...

- This "repression" prevented the financial system from doing its job of allocating resources and led to calls for deregulation
- The resulting financial liberalization led to the reemergence of banking crises after 1971

- Stark contrast between views of crises in the 30's and after 1971
  - In the 1930's crises were perceived as a market failure and government regulation and intervention was introduced
  - Today many regard crises as the result of a government failure (even the 2007 crisis)
- These two approaches have led to a number of theories:
  - Financial panic (multiple equilibria)
  - Business cycle (essential crises)
  - Inconsistent government macroeconomic policies
  - Bubble collapse
  - Amplification theories (fragility and contagion)
  - Government guarantee models

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Topic 1: Bank Runs

Why do banks exist?

1. Bank provide screening and monitoring functions vis a vis borrowers
   - Banks as “delegated monitors” (Diamond, 1984) and all subsequent relationship lending literature
2. Banks provide liquidity insurance to risk averse depositors
   - Demand deposits and vulnerability to runs when more than the “expected” fraction of early depositors withdraw prematurely (Bryant, 1980; Diamond and Dybvig, 1983)

Why do depositors run?

1. Bank runs as panic, sunspot, multiple equilibria
   - Diamond and Dybvig (1983)

2. Business cycle, essential crises, linked to fundamentals
   - Jacklin and Bhattacharya (1988)

3. A combination of the two
   - Chari and Jagannathan (1988)

Common elements (and basics for the future)

- Banks issue *liquid liabilities* in the form of demandable deposits
  - depositors can withdraw at any time
- **but** invest mainly in *illiquid assets*
  - which are costly to be liquidated prematurely

- This allows banks to provide **liquidity insurance** to depositors but also creates a **maturity mismatch** which exposes them to the possibility of runs

A model of bank runs I

- Three dates t = 0, 1, 2
- A single good that can be used for consumption or investment at each date
- Banks: At t=0 they raise 1 unit of deposits and invests **y** in a short asset and ***x*** in a long asset

t =	0	1	2
Short :	1	→ 1	→ 1
Long:	1	→ r	→ $R > 1$

A model of bank runs II

- Depositors:
  - Measure is 1, with an initial endowment of 1 each
  - Are subject to consumption shocks

    λ consume early at t = 1 (early type)

    $1-\lambda$ consume late at t =2 (late type)

  - Utility function $u(c_t)$ for t = 1,2

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

with u’ > 0 and u” < 0

A model of bank runs III

- Uncertainty about depositors' type is resolved at t=1
- Types are private information
- The bank cannot observe them
- This implies that a late depositor can mimic an early depositor and withdraw at t=1
- When this happens, the bank may not have enough funds to repay all depositors at t=1

What is a run and what generates it?

- A run occurs when *all* depositors withdraw at t = 1 so that the bank has to liquidate the long term asset
- Crucial elements:
  - Return of the long term asset R
    - Safe or risky asset – R deterministic or stochastic
  - Liquidation value
    - Liquid or illiquid asset – r equal to or less than 1
    - Exogenous or endogenous (price)
  - Structure of depositors' preference shocks
    - Fraction λ deterministic or stochastic – idiosyncratic or aggregate liquidity shocks

Panic runs (Diamond and Dybvig, 1983)

- Asset return R deterministic – safe asset
- Liquidation value r =1 – exogenous
- Fraction λ deterministic

We solve the model in steps

1. Autarky
2. Bank equilibrium
    1. Good equilibrium – *liquidity insurance*
    2. Bad equilibrium - *run*

The problem in autarky

Individual's problem is to choose portfolio (y,x) to

$$\max\ U(c_1, c_2) = \lambda u(c_1) + (1-\lambda)u(c_2)$$

subject to

$$x + y \leq 1$$

$$c_1 \leq y + rx$$

$$c_2 \leq xR + y$$

Solution to the autarky problem

Given $r = 1$, individuals are indifferent between long and short term assets so

$$y = 0$$

$$x = 1$$

$$c_1 = x + y = 1$$

$$c_2 = (x + y)R$$

Individuals consume just the return of the assets in both periods

Bank equilibrium I

- (c_1,c_2) is now the optimal deposit contract
- (x,y) is now the optimal portfolio of the bank
- Competitive banking sector:
  - This ensures that banks maximize the expected utility of depositors. Otherwise, another bank would enter and bid away all the customers

Bank equilibrium II

Bank's problem is

$$\max\ U(c_1, c_2) = \lambda u(c_1) + (1-\lambda)u(c_2)$$

subject to

$$x + y \leq 1$$

$$\lambda c_1 \leq y$$

$$(1\text{-}\lambda)c_2 \leq Rx$$

$$\mathrm{u}(\mathrm{c}_1) \leq u(c_2)$$

Good bank equilibrium I

From first order conditions:

$$\frac{u'(c_1)}{u'(c_2)} = R$$

so

$$c_1 < c_2 \qquad \text{since} \quad u'' < 0$$

This ensures that the contract is designed so that late consumers never want to imitate early consumers

Good bank equilibrium II

- When the budget constraints hold with equality, then
$$c_1 = y/\lambda$$
$$c_2 = R(1 - y)/(1 - \lambda)$$
- Is this more for the early consumers than in autarky?
- Yes, if $c_1 = y/\lambda > 1$. This happens when their relative risk aversion of depositors is greater than 1, that is when
$$-\frac{cu''(c)}{u'(c)} > 1$$

Good bank equilibrium III

- So the bank solution given by

$$y = \lambda c_1; \quad x = 1 - y$$

$$c_1 = \frac{y}{\lambda} > 1; \quad c_2 = \frac{R(1-y)}{(1-\lambda)} < R \qquad \text{with } c_1 \leq c_2$$

- This solution can be achieved for example for members of the HARA family such as $u(c) = c^{1-\gamma} / 1-\gamma$
- With this class of utility functions, the bank does strictly better than the market and offers depositors liquidity insurance against liquidity shocks

Bad bank equilibrium I

- The bank's deposit contract says that it must pay out the promised amount to anybody withdrawing at t = 1
- If $c_1 > 1$ and all depositors (early and late consumers) withdraw at t=1 then the bank will have to liquidate all its assets since

$$rx + y = x + y = 1$$

- Anybody who wait till t = 2 will be left with nothing since all the banks assets will be liquidated at t=1
- Hence, it becomes rational to run if everybody else is running

Bad bank equilibrium II

- One important element that produces the bad equilibrium is the assumption of *sequential service constraint*
- This means the depositors reach the bank one at a time and withdraw c_1 until all the bank‘s assets are liquidated
- This has two effects:
  - It gives an incentive for depositors to get to the front of the queue
  - It forces the bank to deplete its resources

Multiple equilibria – selection I

- How to select between the two equilibria?
- Diamond and Dybvig did not formally introduce the equilibrium selection mechanism
- One way to do this is through „sunspots“. When a sunspot is observed, depositors assume that there is a going to be a run
- Policy intervention can prevent sunspot runs
  - Deposit insurance
  - Central bank or government may be able to ensure that good equilibrium is chosen

Multiple equilibria – selection II

- But what determines the sunspot?
- It can be anything:
  - „Mob psychology“ or „Mass Hysteria“
  - Heartquake, etc.
  - Self fulfilling expectations
- It is not possible to know the ex ante probability of the occurrence of the run
- Equilibrium selection:
  - Postlewaite and Vives (1988)
  - Global game approach: Goldstein and Pauszner (2005) (Using Morris and Shin, 1998)

Additional references

- Postlewaite A. and X. Vives (1988), “Bank Runs as and Equilibrium Phenomen”, JPE, 95, 485-491

- Morris S. and H. Shin (1998), “Unique Equilibrium in a Model of Self-Fulfilling Currency Attacks”, AER, 88, 587-597

- Goldstein I. and A. Pauszner (2005), “Demand Deposit Contracts and Probability of Bank Runs”, JF, 60(3), 1293-1328

Business cycle, Fundamental runs: Evidence in Gorton (1988)

- Evidence supports the hypothesis that US banking panics in the late 19th and early 20th century were related to the business cycle

- Panics were systematic events: whenever the leading economic indicator represented by the liabilities of failed businesses reached a certain threshold, a panic occurred

(insert table)

Table 1

National Banking Era Panics

NBER Cycle Peak–Trough	Panic Date	%Δ(Currency/ Deposit)*	%Δ Pig Iron†
Oct. 1873–Mar. 1879	Sep. 1873	14.53	−51.0
Mar. 1882–May 1885	Jun. 1884	8.80	−14.0
Mar. 1887–Apr. 1888	No Panic	3.00	−9.0
Jul. 1890–May 1891	Nov. 1890	9.00	−34.0
Jan. 1893–Jun. 1894	May 1893	16.00	−29.0
Dec. 1895–Jun. 1897	Oct. 1896	14.30	−4.0
Jun. 1899–Dec. 1900	No Panic	2.78	−6.7
Sep. 1902–Aug. 1904	No Panic	−4.13	−8.7
May 1907–Jun. 1908	Oct. 1907	11.45	−46.5
Jan. 1910–Jan. 1912	No Panic	−2.64	−21.7
Jan. 1913–Dec. 1914	Aug. 1914	10.39	−47.1

*Percentage change of ratio at panic date to previous year's average.

†Measured from peak to trough.

(Adapted from Table 1, Gorton (1988), p. 233.)

Business cycle, Fundamental runs

- Asset return R stochastic – risky asset
- Liquidation value: $r < 1$ – exogenous
- Fraction λ deterministic

- At t = 1 (some) late depositors observe a signal on the project return at t=2
- They condition their withdrawal decision on this signal
- They withdraw if signal is bad enough

Jacklin and Bhattacharya (1988)

- Three dates t = 0, 1, 2, a single good
- Banks: At t=0 they raise 1 unit of deposits and invests **y** in a short asset and ***x*** in a long asset

t =	0	1	2
Short :	1	1	1
Long:	1	**0**	$\tilde{R} = \begin{cases} R > 1 & p \\ 0 & 1-p \end{cases}$

with $pR > 1$

- Depositors:
  - Measure 1, with an initial endowment of 1 each
  - Are subject to consumption shock

λ consume early at t = 1 (early type)

$1-\lambda$ consume late at t =2 (late type)

  - Smooth utility function over the two dates

$$U^1 = u(c_{11}) + \rho_1 u(c_{21})$$

$$U^2 = u(c_{12}) + \rho_2 u(c_{22})$$

where

- c_{ij} is the consumption at date i of an agent of type j and ρ_i is the intertemporal discount factor with $1 > \rho_2 > \rho_1 > 0$
- RRA = $-cu''(c)/u'(c) < 1$

- Information:
  - At t=1 a fraction α receives a signal s on the value of $\tilde{R}$ at t=2. In particular,

$$p = \Sigma_s prob(s)\hat{p}_s$$

where $\hat{p}_s$ is the value of $\hat{p}$ given that s is observed

Notes:

- Signal s is costless and „partial“
- Only an exogenous and deterministic fraction α of late depositors observes it
- Only this fraction of late depositors responds to the signal

Bank's problem is

$$\max\ U(c_{ij}) = E\left\{\lambda U^1(c_{11}, c_{12}(R)) + (1-\lambda)U^2(c_{21}, c_{22}(R))\right\}$$

subject to

$$x + y \le 1$$

$$\lambda c_{11} + (1-\lambda)c_{12} \le y$$

$$\lambda c_{21}(\mathrm{R}) + (1-\lambda)c_{22}(R) \le Rx \quad \forall R$$

$$\mathrm{U^k}(\mathrm{c_{1j}}, c_{2j}) \le \mathrm{U^k}(\mathrm{c_{1k}}, c_{2k}) \quad \text{for } j,k = 1,2 \text{ and } j \ne k$$

Solution:

$$1 > c_{11}^* > c_{12}^*$$

$$c_{22}^* > c_{21}^*$$

But still possibility of runs because of $r = 0$

- Depositors' withdrawal decisions at $t=1$:
  - λ early depositors withdraw
  - α late depositors withdraw if

$$\hat{E}\left[U^2(c_{12},\tilde{c}_{22})\right] < \hat{E}\left[U^2(c_{11},\tilde{c}_{21})\right] \qquad (*)$$

where $\hat{E}$ indicates the expectation calculated using the posterior $\hat{p}$

- That is a run occurs for all $\hat{p} < \overline{p}$ where $\overline{p}$ satisfies (*) with equality

Information-based run

- The first λ depositors receive the full amount c_{11}^{*}
- The remaining $(1-\lambda)$ receive only c_{12}^{*}
- It is a sort of *suspension of convertibility*
- Is the run efficient?
  - It can prevent the inefficient continuation of bad projects
  - **But** the welfare of both types of agents decreases
  - Is it efficient to avoid runs by making the contract incentive compatible after late type depositors have observed *s*? It depends(Alonso, 1996)

Runs as discipline devices

- Runs can be efficient and inefficient depending on the framework
- Why do banks issue demand deposits?
- Can a run be efficient?
  - Yes, when it prevents the continuation of valueless assets
- Note: „bank managers” do not play any role so far
  - Banks provide liquidity insurance to risk averse depositors but banks maximize depositors’ expected utility

- Assume that banks (or bank managers) choose among assets with different risk
- Then, bank runs can provide a mechanism to induce banks to choose the “right” asset at t=0
- That is, demandable debt can provide an incentive-compatible solution to the bankers‘ moral hazard problem arising in the investment choice
- Depending on the information available to depositors, runs can still be inefficient ex post
- Literature: Calomiris and Kahn (1991), various papers by Diamond and Rajan

Policy implications

- How do we discipline bankers?
- If bank runs are fully efficient, then we do not need regulation. Market discipline suffices
- If bank runs are not fully efficient, then regulation is needed
- What is market discipline and how efficient is it?

Market discipline

- There is a long standing debate on the role and effectiveness of market discipline
- A good reference is Flannery M. and S. Nikolova, 2004, "Market Discipline of U.S. Financial Firms: Recent Evidence and Research Issues," in Market Discipline across Countries and Industries, edited by C. Borio, W. Hunter, G. Kaufman, and K. Tsatsaronis, Cambridge, MA: MIT Press