Financial Crises – Lecture notes 1

Elena Carletti
European University Institute

February - March 2013
Course material

• Main material:
    (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/](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
• 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
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

$$
t = \begin{array}{ccc} 0 & 1 & 2 \\
\text{Short :} & 1 & \rightarrow 1 & \rightarrow 1 \\
\text{Long :} & 1 & \rightarrow r & \rightarrow R > 1 \\
\end{array}$$
A model of bank runs II

- Depositors:
  - Measure is 1, with an initial endowment of 1 each
  - Are subject to consumption shocks
    \( \lambda \) 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 $\lambda$ 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 $\lambda$ 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

\[
\begin{align*}
x + y & \leq 1 \\
c_1 & \leq y + rx \\
c_2 & \leq xR + y
\end{align*}
\]
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’s problem is

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

subject to

$$x + y \leq 1$$
$$\lambda c_1 \leq y$$
$$(1-\lambda)c_2 \leq Rx$$
$$u(c_1) \leq u(c_2)$$
Good bank equilibrium I

From first order conditions:

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

so

\[c_1 < c_2 \quad \text{since} \quad u'' < 0\]

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
  \[ c_1 = \frac{y}{\lambda} \]
  \[ c_2 = \frac{R(1 - y)}{(1 - \lambda)} \]
- Is this more for the early consumers than in autarky?
- Yes, if \( c_1 = \frac{y}{\lambda} > 1 \). 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

\[ y = \lambda c_1; \quad x = 1 - y \]

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

- 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 $c_I$ 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


• 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>
<thead>
<tr>
<th>NBER Cycle</th>
<th>Panic</th>
<th>%Δ(Currency/ Deposit)*</th>
<th>%Δ Pig</th>
<th>Iron†</th>
</tr>
</thead>
<tbody>
<tr>
<td>Oct. 1873–Mar. 1879</td>
<td>Sep. 1873</td>
<td>14.53</td>
<td>−51.0</td>
<td></td>
</tr>
<tr>
<td>Mar. 1882–May 1885</td>
<td>Jun. 1884</td>
<td>8.80</td>
<td>−14.0</td>
<td></td>
</tr>
<tr>
<td>Mar. 1887–Apr. 1888</td>
<td>No Panic</td>
<td>3.00</td>
<td>−9.0</td>
<td></td>
</tr>
<tr>
<td>Jul. 1890–May 1891</td>
<td>Nov. 1890</td>
<td>9.00</td>
<td>−34.0</td>
<td></td>
</tr>
<tr>
<td>Jan. 1893–Jun. 1894</td>
<td>May 1893</td>
<td>16.00</td>
<td>−29.0</td>
<td></td>
</tr>
<tr>
<td>Sep. 1902–Aug. 1904</td>
<td>No Panic</td>
<td>−4.13</td>
<td>−8.7</td>
<td></td>
</tr>
<tr>
<td>May 1907–Jun. 1908</td>
<td>Oct. 1907</td>
<td>11.45</td>
<td>−46.5</td>
<td></td>
</tr>
</tbody>
</table>

*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: $r < l$ – exogenous
- Fraction $\lambda$ 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 Bhattacharyya (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

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

with $pR > 1$
• Depositors:
  - Measure 1, with an initial endowment of 1 each
  - Are subject to consumption shock
    \[ \lambda \text{ consume early at } t = 1 \text{ (early type)} \]
    \[ 1 - \lambda \text{ consume late at } t = 2 \text{ (late type)} \]
  - 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 \(\rho_i\) is the intertemporal discount factor with \(1 > \rho_2 > \rho_1 > 0\)
    - RRA = \(-cu''(c)/u'(c) < 1\)
• Information:
  – At $t=1$ a fraction $\alpha$ receives a signal $s$ on the value of $\tilde{R}$ at $t=2$. In particular,

  \[ p = \sum_s prob(s) \hat{p}_s \]

  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 $\alpha$ of late depositors observes it
- Only this fraction of late depositors responds to the signal
Bank’s problem is

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

subject to

\[
\begin{align*}
x + y & \leq 1 \\
\lambda c_{11} + (1 - \lambda)c_{12} & \leq y \\
\lambda c_{21}(R) + (1 - \lambda)c_{22}(R) & \leq Rx \quad \forall R \\
U^k(c_{1j}, c_{2j}) & \leq U^k(c_{1k}, c_{2k}) \text{ for } j, k = 1, 2 \text{ and } j \neq k
\end{align*}
\]

Solution:

\[
1 > c^*_1 > c^*_2 \\
c^*_2 > c^*_1
\]

But still possibility of runs because of \( r = 0 \)
• Depositors’ withdrawal decisions at $t=1$:
  - $\lambda$ early depositors withdraw
  - $\alpha$ late depositors withdraw if

$$\hat{E}[U^2(c_{12}, \tilde{c}_{22})] < \hat{E}[U^2(c_{11}, \tilde{c}_{21})] \quad (\ast)$$

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 (\ast) with equality
Information-based run

• The first $\lambda$ 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