Financial Frictions and Crises

- WEEK SEVEN -

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Today: Outline

1. Introduction
2. Agency Problems and Financial Accelerator
3. Diamond-Dybvig Model
4. Contagion
5. Government Guarantees and Moral Hazard

Introduction

Introduction

- In the models that we've seen so far the financial markets are perfect:
  - Households save or borrow to satisfy their Euler equations.
  - Firms borrow until the marginal product of capital = interest rate.
  - There are no defaults or borrowing constraints.
- The Crisis of 2007-8 demonstrated that even in the advanced modern economies this description could not be further away from the truth.
- There has been a tremendous increase in macro-finance research.
- Major issues this research is interested in:
  - Do financial markets amplify and propagate macroeconomic shocks?
  - Are financial markets an independent source of shocks to the economy?
  - Why do financial crises happen, and what should policymakers do? etc.

Plan of action

- There are potentially many different imperfections in the financial sector with important macroeconomic consequences.
- The literature is huge, and warrants a separate course.
- Today we will focus on three classic models that illustrate *some* of the most important issues in macro-finance:
    1. ‘Real’ financial frictions and financial accelerator
    2. Liquidity provision by banks and bank runs.
    3. Moral hazard created by government guarantees (time-permitting).
- We will discuss how these models fit in the modern macro-finance literature and help us shed light on complex events and policy choices.

Agency Problems and Financial Accelerator

Asymmetric information and agency problems in finance

- There are a lot of information asymmetries in the financial markets:
  - Firms are much better informed about their prospects than investors.
  - It may be difficult to tell good and bad entrepreneurs apart.
  - Managers that have limited liability may invest in too risky projects.
  - Firms' performance may be difficult to verify by external investors.
  - Fund managers may not exert effort to make the best investments etc.
- We therefore have institutions like banks, mutual funds, and credit rating agencies that specialise in acquiring & transmitting information.
- But as became obvious during the 2008 Crisis, such institutions themselves may not be immune to agency problems.
- Asymmetric information and agency costs can distort investment choices, as well as magnify effects of shocks to the economy.

A simple model of moral hazard in financial intermediaries

- Several ways agency problems are modelled in the literature:
  ⇒ Costly state verification, adverse selection, moral hazard etc.
- They all, however, have broadly similar implications:
  * It is important that agents (e.g. banks or entrepreneurs) have enough **‘skin in the game’**, i.e. their own resources they contribute to projects
  * The wealth, or **‘net worth’** of key players in the economy can thus have important macroeconomic consequences.
- Today we will focus on a particularly simple way to model moral hazard introduced by Gertler-Karadi (2011) & Gertler-Kiyotaki (2011)

⇒ Banks can default and do a runner with their depositors’ funds.

- The model predicts that the net worth of the banking sector becomes crucial to the efficiency of financial intermediation.

Setup

- There are two periods $\{1, 2\}$.
- There are households, banks, and firms in the economy.
- Each household has a unit mass of members, including a banker.
- A banker runs a bank that provides services to other households.
  - Generated profits shared with his own household.
- In period 1, a representative household has endowment y.
- Household deposits d with a bank in period 1.
- Deposits pay return R in period 2.
- Household receives profit π from the own banker in period 2.
- All members within a household consume the same amounts: c_1 in period 1, and c_2 in period 2.

Household problem

- A representative household maximizes utility:

$$\max_{c_1, c_2, d} U(c_1, c_2) = \sqrt{c_1} + \beta\sqrt{c_2} \tag{1}$$

- Subject to period 1 and 2 budget constraints:

$$c_1 + d = y \tag{2}$$

$$c_2 = Rd + \pi. \tag{3}$$

- Note that R and (lump-sum) π are treated *as given* by the household, but will be endogenously determined in the financial markets.
- Substitute constraints in and take the FOC to get the Euler equation:

$$\frac{1}{\sqrt{c_1}} = \beta \frac{1}{\sqrt{c_2}} R \quad \Longleftrightarrow \quad c_2 = c_1 (\beta R)^2 \tag{4}$$

Solution to household optimisation problem

- Three equations (2 BCs + Euler) and three unknowns: $c_1,\ c_2,\ d$.
- The solution is:

$$c_1 = \frac{y + \frac{\pi}{R}}{1 + \beta^2 R} \tag{5}$$

$$d = y - c_1 \tag{6}$$

$$c_2 = Rd + \pi \tag{7}$$

- Substitution effect dominates: c_1 is a decreasing function of R .
- Therefore, the supply of funds d by households increases in R.

Firms

- Produce goods for consumption in period 2.
- Constant return to scale technology: each unit of good invested in period 1 generates R^k goods in period 2 (R^k exogenously fixed).
- A representative firm borrows s from banks in period 1, and so generates sR^k in period 2.
- Firms are perfectly competitive, so entire return sR^k goes to banks.
- Note: Firms are unable to borrow directly from households.
  - $\Rightarrow$ Think about banks as relationship lenders that are able to screen and monitor firms they lend to, while households are not.

Bankers

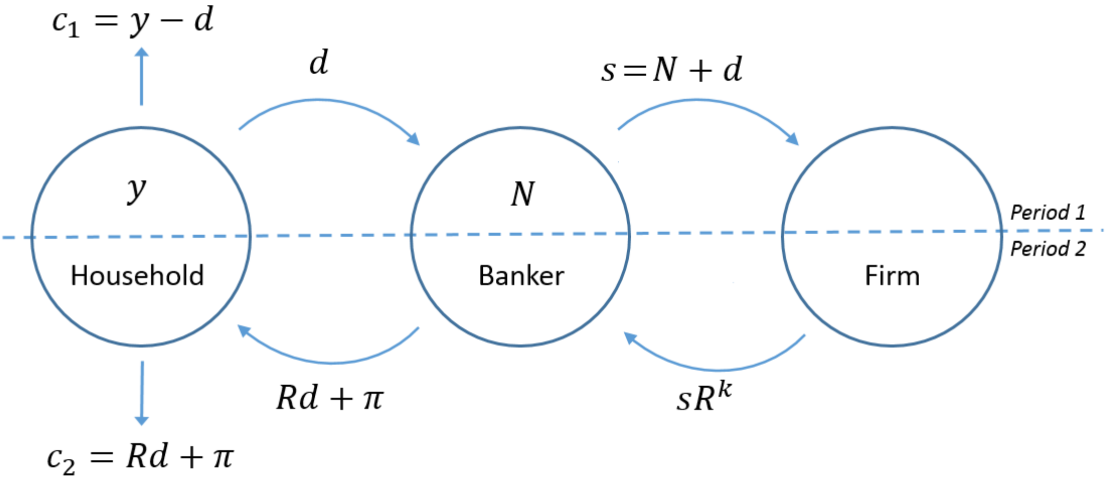
- A representative banker is endowed with N goods in period 1.
  - This is in addition to their household's endowment y.
  - We will refer to N as the banker's **net worth**.
- The bank accepts deposits d from households and lends s to firms.
- Takes market rates of returns on deposits R and loans R^k as given.
- Chooses d and s to solve

$$\max_{d,s} \; \pi = sR^k - Rd.$$

- Always maxes out on s, as loans pay positive return with certainly:

$$s = N + d.$$

Overview



$c_1 = y - d$
d
$s = N + d$
y
N
Period 1
Period 2
Household
Banker
Firm
$Rd + \pi$
sR^k
$c_2 = Rd + \pi$

Benchmark: equilibrium with no financial frictions

- Equilibrium requires
  1. Household maximises utility given R, π.
  2. Banker maximises profit given R, R^k.
  3. Markets clear.

- With no financial frictions, there is a unique equilibrium in which

$$R = R^k. \tag{8}$$

- Otherwise we would have a contradiction:
  * If $R > R^k$ then bank chooses $d = 0$, no financial intermediation.
  * If $R < R^k$ then bank chooses $d \to \infty$, demand for deposits explodes.

- With $R = R^k$, $\pi = NR^k$: banks earn market return on endowment N, but otherwise earn zero profit from intermediating deposits d.

- Can compute equilibrium $c_1,\ c_2,\ d$ using (5)-(8).

- Equilibrium is **first best**, as there are no inefficiencies.

Introducing moral hazard

- Moral hazard à la Gertler-Karadi (2011), Gertler-Kiyotaki (2011).
- The bank can default after receiving sR^k from firms in period 2.
- If the banker defaults, he absconds with a fraction θ of resources:
  $\Rightarrow$ $\theta R^k(N+d)$ goes to the banker, $(1-\theta)R^k(N+d)$ goes to depositors.
- The banker will not default if:

$$\underbrace{(N+d)R^k - Rd}_{\text{Profit when no default}} \geq \underbrace{\theta R^k(N+d)}_{\text{Profit when default}} \tag{9}$$

- $N\uparrow$ increases LHS more than RHS, so makes default less likely.

Equilibrium with no defaults

- Without loss of generality (WLOG), we can **restrict attention to equilibria in which banks never default:**
  - If there is an equilibrium in which banks default, the effective return on deposits that households get (after default) is:

$$R^{\text{effective}} = \frac{(1-\theta)R^k(N+d)}{d}. \tag{10}$$

  - Households anticipate the default, so use $R^{\text{effective}}$ rather than the promised return R when making their saving choices d.
  - But then there is also an equivalent equilibrium in which $R = R^{\text{effective}}$:
    - households supply the **same amount of savings** d.
    - banks do not default, since (9) holds with equality (easy to verify).
- Thus, we look for a symmetric equilibrium with no default:
  1. Household maximises utility given R, π.
  2. Banker maximises profit given R, R^k, and **no default condition** (9).
  3. Markets clear.

The banker's problem

- The representative banker solves:

$$\max_{d} \; \pi = (N+d)R^k - Rd \tag{11}$$

$$\text{s.t.} \quad (N+d)R^k - Rd \geq \theta R^k (N+d) \tag{12}$$

- There can be only two possibilities:
  1. The no-default constraint (12) is **slack** (does not bind) in equilibrium
  2. The no-default constraint (12) **binds** in equilibrium

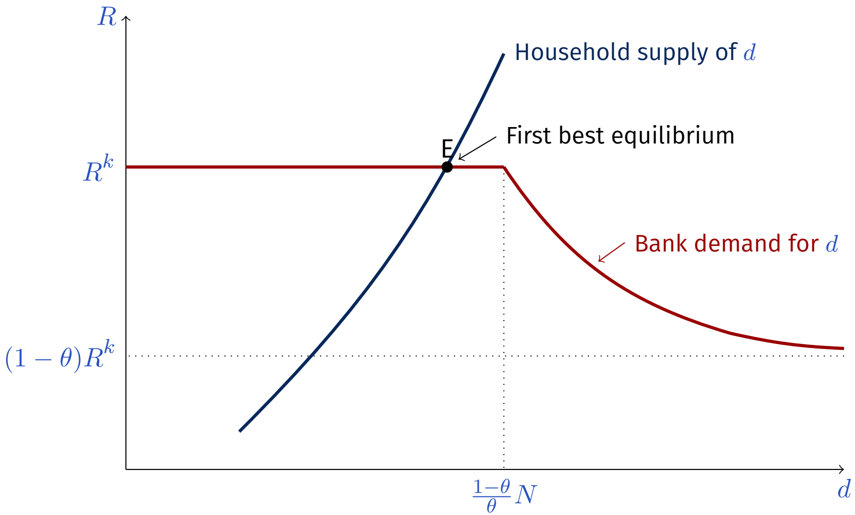
Case 1: The financial constraint is slack

- If the no-default constraint (12) is slack, then it is irrelevant, and analysis in the benchmark case applies.
- Thus $R = R^k$ and we again have the **first-best allocation.**
- This is indeed the equilibrium iff (12) is satisfied at $R = R^k$.
- Substituting for R and rearranging, yields:

$$d \leq \frac{1-\theta}{\theta} N \quad \text{or} \quad N \geq \frac{\theta}{1-\theta} d \tag{13}$$

- That is, the net worth of the banking sector has to be sufficiently high relative to the supply of funds by households.
- **Intuition:** high N implies bankers have enough 'skin in the game'.

First-best equilibrium when N is high



Case 2: the financial constraint binds

- The financial constraint (12) binds in equilibrium when N is low, i.e.

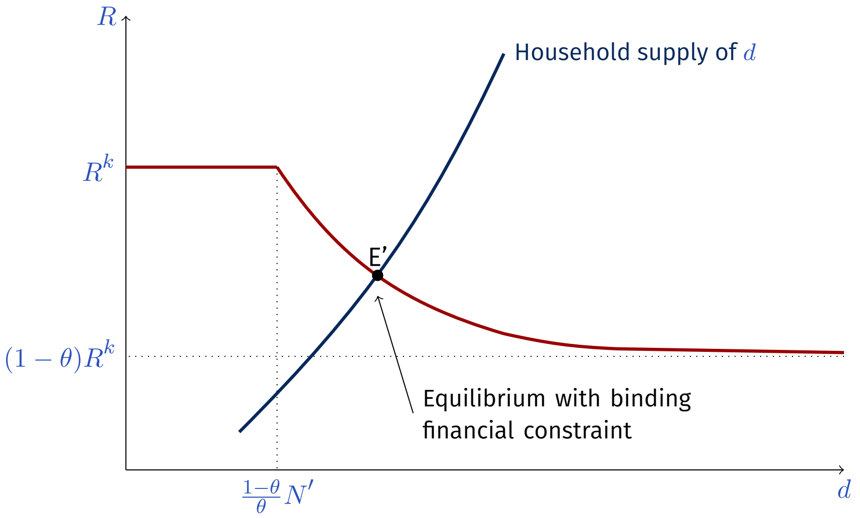
$$N < \frac{\theta}{1-\theta} d. \tag{14}$$

- Banks' demand for deposits is now a decreasing function of R.
- Indeed, binding (12) yields a downward-sloping curve in (d, R) space:

$$R = (1-\theta) R^k \left(\frac{N}{d} + 1 \right). \tag{15}$$

- **Intuition:** as d increases relative to N, banks have a stronger incentive to default, so R must fall to reduce their liabilities Rd.
- Equilibrium obtains where the household supply of d intersects (15).

Equilibrium when banks' net worth is low



Role of banker net worth

- Note that $R < R^k$ when the financial constraint binds in equilibrium.
- Thus there is a **positive spread** between the exogenous return R^k on technology and the deposit rate R.
  - $\Rightarrow$ R and d are less than socially optimal.
- Can verify by rearranging the binding constraint (12) and using (14):

$$\frac{R^k - R}{R^k} = \theta - (1-\theta)\frac{N}{d} > 0. \tag{16}$$

- $N \uparrow$ raises R nearer to R^k.
- $N \uparrow$ thus brings financial intermediation closer to the first best.
- Explains the desire to repair bank balance sheets after 2008-9 crisis.

The financial accelerator

- Our simple model only has two periods.
- With more periods, we would almost certainly get a **financial accelerator**, when negative shocks propagate through the fall in N.
- As we have seen, the net worth of banks (and agents more generally) is crucial to their ability to borrow an invest.
  - $\Rightarrow$ when N falls, there are less investments made, leading to output losses.
  - ∗ But agents' resources depend on output in the first place!
- **Financial accelerator** then appears naturally:
  - ∗ Suppose some shock reduces output
  - ∗ Due to lower output, the net worth of banks (and other agents) falls
  - ∗ Agency costs rise and investment falls
  - ∗ The initial fall in output is thus magnified
  - ∗ Leading to further fall in net worth etc. etc.

The financial accelerator and asset prices

- Most firms hold a variety of assets they use as collateral for loans.
- Their net worth thus depends on the market value of their assets.

⇒ Financial accelerator can magnify shocks via the value of collateral.

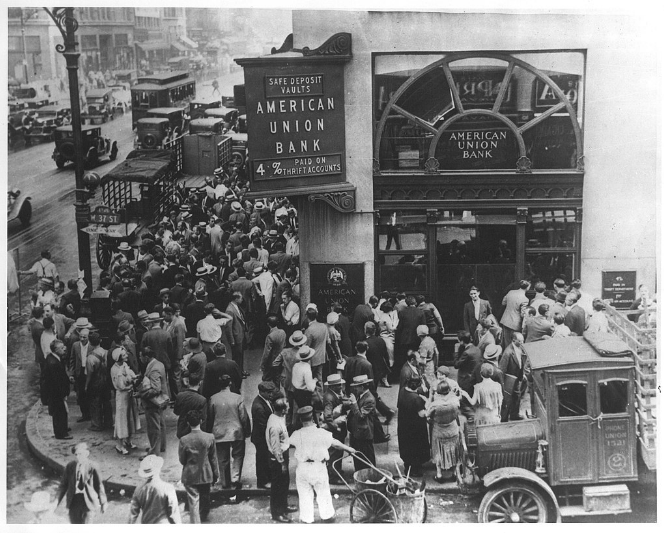
- Kiyotaki & Moore (1997) model the vicious amplification cycle:
  - A bad shock reduces net worth and increases agency costs of lending.
  - The ability of constrained firms to borrow and purchase assets falls.
  - More assets are held by unconstrained firms, which are less productive on the margin (since they already hold lots of assets and produce a lot!)
  - Asset prices and the value of collateral fall.
  - The net worth of constrained firms further falls.
  - Agency problems become even worse.
  - The ability of constrained firms to borrow and invest falls further.
  - etc etc.

What have we achieved?

- We have seen a simple model in which a fall in net worth of banks can lead to a fall in lending, and distort investment.
  - Theory not limited to banks, and applies also to firms, households, etc.
  - Alternative formulations of agency problems lead to similar conclusions.
- Because the model does not feature money or any role for liquidity, these mechanisms are known as **real financial frictions.**
- Financial frictions are present and cause welfare losses all the time:
  - Significant empirical evidence that there're financially constrained firms,
  - implying that average investment may be inefficiently low, while
  - business cycles are amplified and propagated by financial accelerator.
- But agency problems can become particularly bad during crises:
  - Baron et al (2020) document that large declines in bank equity are associated with substantial credit contractions and output losses.
  - Financial accelerator can make the situation a lot worse.
- We now turn to the issues of liquidity.

Diamond-Dybvig Model

A run on American Union Bank, New York. April 26, 1932



Diamond-Dybvig (1983) model: an overview

- Financial markets are subject to sudden, convulsive changes.
  - A bank that appears to function normally can suddenly be in trouble.
  - Financial crises typically unfold very rapidly.
- In the seminal paper, Diamond and Dybvig (1983) model **bank runs** as a spontaneous switch between **multiple equilibria.**
- Both earned a Nobel prize in 2022 for this work!
- The model makes two fundamental predictions:
  1. Banks improve social welfare because they **provide liquidity**;
  2. But bank runs are possible exactly because banks' liabilities are liquid.
- Key: **maturity mismatch** of banks' liquid liabilities & illiquid assets.

Setup

- There are three periods, denoted $\{0,\ 1,\ 2\}$.
- There is a continuum of agents of mass 1.
- Each agent is endowed with 1 unit of consumption good in period 0.
- **Investment technology:** each unit invested in period 0 yields
  - $R > 1$ if held to maturity in period 2;
  - only 1 if the project is liquidated in period 1.
- Agents can also freely store the good between periods.
- Because the investment technology dominates storage (since it pays out at least 1), all endowments are invested in period 0.
- Agents decide whether to liquidate projects in period 1, and how much to consume in periods 1 and 2, c_1 and c_2, respectively.

Types of agents and liquidity shocks

- 2 types of agents in the economy:
  - **'type-a'**, or **'impatient'** individuals only value consumption in period 1:

$$U^a = \ln c_1^a. \tag{17}$$

  - **'type-b'**, or **'patient'** agents are willing to consume in period 1 or 2:

$$U^b = \rho \ln(c_1^b + c_2^b), \quad \rho \in (0,1), \quad \rho R > 1. \tag{18}$$

- $\rho < 1$ implies that impatient agents value consumption more.
- All agents are identical ex ante: type is unknown in period 0.
- In period 1, a fraction $\theta \in (0,1)$ of agents learn that they are **type-a**, and a fraction $1-\theta$ learn that they are **type-b**.
  - Each agent thus faces a probability θ of being impatient ex ante.
  - Once realised, an individual's type is not observable by others.
- 'Impatience' here is a metaphor for **liquidity needs** more generally.

Benchmark 1: competitive equilibrium

- Agents hold investments directly and every period there is a **competitive market for claims** on future consumption goods.
- Because agents' types are not observable, such claims cannot be contingent on buyers' or sellers' types.
- Period-1 price of a claim on a unit of period-2 consumption is $1/R$.
  * If it was above, type-a agents would keep their investments and sell such claims to finance their consumption, but there would be no buyers.
  * If it was below, type-b agents would liquidate their investments and buy such claims, but there would be no sellers.
- Similarly, equilibrium in period 0 requires that
  * price of period-1 consumption is simply 1;
  * price of period-2 consumption is simply $1/R$.
  * Otherwise everybody would want to buy 'underpriced' claims or sell 'overpriced' ones, which cannot be an equilibrium.

Benchmark 1: competitive equilibrium (cont.)

- Agents are identical in period 0, so there is **no trade** at these prices.
- Each individual invests their own unit of endowment.
  - In period 1, impatient agents liquidate their projects and consume 1.
  - Patient agents wait until period 2 and thus consume R.
- Allocation is therefore the same as under **autarky**, since markets serve no useful purpose here.
- Expected utility is

$$\mathbb{E}[U^{\text{autarky}}] = \theta \ln 1 + (1-\theta)\rho \ln R = (1-\theta)\rho \ln R. \tag{19}$$

- Is this competitive equilibrium efficient?

Benchmark 2: first-best social optimum

- Suppose there is a social planner that observes individual types.
- Social planner chooses consumption levels of each type (c_1^a and c_2^b) to maximize the expected utility of a representative agent:

$$\mathbb{E}[U] = \theta \ln c_1^a + (1-\theta)\rho \ln c_2^b. \tag{20}$$

- Note that the planner always sets $c_2^a = c_1^b = 0$,
  - ⇒ type-a's do not value consumption in period 2, while consumption and utility of type-b's can be increased by waiting until period 2.
- Social planner must respect the resource constraint:

$$(1-\theta)c_2^b = (1-\theta c_1^a)R, \tag{21}$$

where θc_1^a is the fraction of investments liquidated in period 1.

Benchmark 2: first-best social optimum (cont.)

- Substituting for c_2^b in the objective function from the constraint, taking the first-order condition w.r.t. c_1^a, and solving for c_1^a yields:

$$c_1^{a*} = \frac{1}{\theta + (1-\theta)\rho} > 1. \tag{22}$$

⇒ Impatient agents' c_1^{a*} is higher than in the competitive/autarky case.

- The constraint (21) then implies:

$$c_2^{b*} = \frac{\rho R}{\theta + (1-\theta)\rho} < R. \tag{23}$$

⇒ Patient agents' c_2^{b*} is lower than in the competitive/autarky case.
  - Although still higher than c_1^{a*}, since $\rho R > 1$.

- The **competitive outcome is thus not socially efficient!** Why?
  - Social optimality requires greater liquidation of projects in period 1,
  - i.e. patient agents insuring individuals with liquidity shocks.
  - But because types are unobservable, such insurance **market is missing.**

Introducing a bank

- **Key insight:** we do not need a social planner or observability of agents' types to achieve the first best, all we need is to set up a bank!
- The banks offers **deposit contracts** on the following terms:
  - agents deposit their unit endowments to the bank in period 0.
  - anyone, regardless of their type, can withdraw c_1^{a*} units in period 1.
  - Whatever funds the bank has in period 2 are divided equally between the remaining depositors who did not withdraw in period 1.
- The bank invests all deposits in the projects, and liquidates investments as required to meet the demand for early withdrawals.

Supporting the social optimum

- Suppose **only** impatient agents withdraw in period 1 and get c_1^{a*}.
- The amount that patient depositors receive in period 2 is then c_2^{b*}:

$$c_2 = \frac{(1 - \theta c_1^{a*})R}{1 - \theta} = c_2^{b*}. \tag{24}$$

- This is exactly the socially optimal allocation we saw before!
- It is also a **Nash equilibrium**, since no-one has incentives to deviate:
  * Impatient agents always prefer to withdraw in period 1, not 2.
  * Because $c_2^{b*} > c_1^{a*}$, patient agents indeed prefer to wait and withdraw in period 2, not 1.
  * All agents indeed have incentives to deposit their endowments in period 0, since their expected utility is greater than under autarky.
- Banks are socially useful: they **provide liquidity.**

Bank runs

- What happens, however, if **all agents try to withdraw** in period 1?
  - The bank cannot pay $c_1^{a*} > 1$ to everyone.
- The **sequential-service constraint** (aka first-come, first-served):
  - Pays c_1^{a*} to as many agents as possible, until runs out of resources.
  - Since types are not observable, those who are paid are chosen randomly.
  - E.g. who happens to reach the queue first.
  - The remaining depositors get nothing.
- Unfortunately, such a **bank run** is also a Nash equilibrium:
  - If all agents withdraw early, there is nothing left in period 2.
  - Thus, if all patient agents believe that other patient agents will try to withdraw in period 1, they prefer trying to withdraw in period 1 too.
  - Better a probability of something than certainty of nothing!
- Why would anyone deposit in the bank in period 0 then?
  - Can construct cases when it's still optimal if a run probability is small.
- Possibility of a bank run is thus another **key result** of the model.

Taking stock

- We saw that banks support two types of equilibria:
  1. Socially optimal equilibrium $\succ$ competitive equilibrium/autarky
  2. Bank run equilibrium $\prec$ competitive equilibrium/autarky.
- The second equilibrium exists because of **maturity mismatch**: bank has illiquid assets, but liquid liabilities.
- In the model, a run is a **pure liquidity crisis** for the bank:
  - Bank is **solvent** in the sense that it would have enough funds to make promised payments in period 2 (which is not always the case!).
  - The problem is that all depositors panic and demand funds immediately.
- Diamond & Dybvig consider several policies to prevent liquidity runs.

Policy #1: Suspension of convertibility

- Modify the deposit contract: pay out c_1^{a*} to *at most* fraction θ of depositors, and then suspend payments until period 2.
- Success: type-b agents no longer have incentives to run.
- This is what XIX and early XX century banks actually did.
- However, if aggregate liquidity needs are uncertain (e.g. fraction θ of impatient agents is random), this is does not maximize social welfare.
- Moreover, in practice there is a risk that insolvent banks may suspend payments, even though liquidation is preferable.

Policy #2: A lender of last resort

- Government (central bank) can also act as a **lender of last resort**.
- I.e. stand ready to lend to the bank at a gross interest rate c_2^{b*}/c_1^{a*}.
- Suppose fraction $\phi > \theta$ of agents withdraw.
  - Bank pays θ of them by liquidating projects, and $\phi - \theta$ by borrowing.
  - Bank thus has $(1 - \theta c_2^{a*})R = (1 - \theta)c_2^{b*}$ resources in period 2.
  - Uses $(\phi - \theta)c_2^{b*}$ to repay the central bank and $(1 - \phi)c_2^{b*}$ to pay remaining depositors, who thus get c_2^{b*} each.
  - But now all type-b depositors prefer to withdraw in period 2.
- How does the central bank finance its lending to the affected banks?
  1. Backed by fiscal authority: tax early withdrawers.
  2. CB can **supply new money** (if we introduce it into the model):
     - Assume that deposits are denominated in nominal terms.
     - CB lending to the bank increases money supply and nominal prices of goods in period 1 $\Rightarrow$ real consumption of early withdrawers falls.
- Government **power to tax and create inflation is crucial**.

Lender of last resort: Diamond-Dybvig vs. Bagehot dictum

- Note that because $c_2^{b*}/c_1^{a*} = \rho R < R$, the CB **lends at the discount** compared to the market rate R.
- This can generate a **moral hazard**:
  * Bank has incentives to borrow rather than liquidate assets in period 1.
  * This leaves the bank with a profit at the expense of the central bank and taxpayers, since its projects generate more than it has to repay.
  * The solution is a **reserve requirement**: the bank must meets first θ withdrawers by liquidating own assets before it can borrow from CB.
- W. Bagehot (1873) argued that the lender of last resort should:
  1. lend freely against a good collateral
  2. but at a penalty interest rate to discourage unnecessary draws.
- The Diamond-Dybvig model supports #1, but not #2.

Policy #3: Deposit insurance

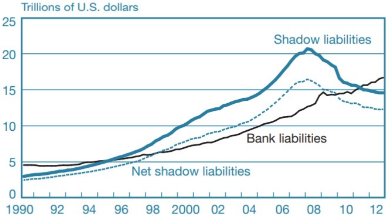
- Government guarantees that all who wait until period 2 get c_2^{b*}.
- Government finances these payments by **levying a tax** on those who withdraw in period 1, if more than fraction θ withdraw.
- Again, type-b agents no longer have incentives to run.
- Run equilibrium is eliminated by the mere presence of deposit insurance, the government never needs to make actual payments.
- Policy widely introduced around the world after the banking crises that accompanied the Great Depression in 1930s.
  - $\Rightarrow$ Arguably, traditional runs on commercial banks are left in the past.
- But, as we will see now, it does not mean that there can be no panics in the modern financial system.

Panics during the 2008 Financial Crisis?

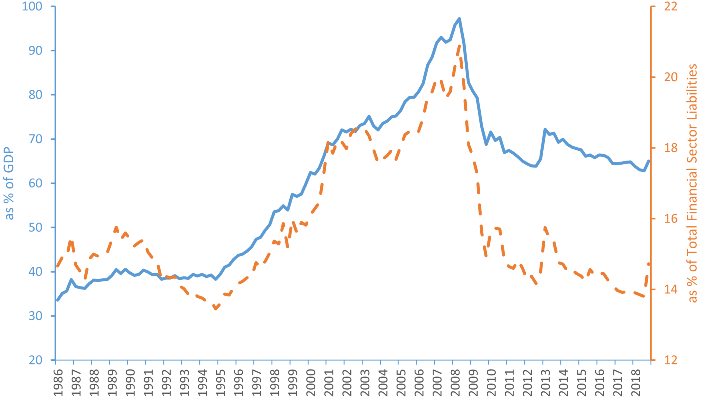
- Modern 'bank runs' can take various forms.
- Gorton and Metrick (2012) argue that the panic of 2007-2008 was effectively a **run on the repo** (sale and repurchase) market:
  - repos = very short-term, collateralized transactions widely used as a primary source of financing by institutions like investment banks.
  - Not commercial banks $\longrightarrow$ not subject to deposit insurance.
  - Repo run = many investors simultaneously **refusing to roll over** their loans, or demanding much tougher terms.
  - The bank is thus forced to liquidate investments early, and may fail.
  - Therefore, a repo run can be a **self-fulfilling equilibrium**: once many investors refuse to roll over loans, everybody refuses.
  - just as in the Diamond-Dybvig model!
- Similarly, Covitz et al. (2013) document runs on asset-backed commercial paper (ABCP) in 2007.

The rise of shadow banking

- Repos and ABCP are prominent examples of shadow banks' liabilities.
- **Shadow banks** are non-bank financial institutions that perform many banks' functions: credit, maturity and liquidity transformation.
- E.g. investment banks, money market funds, mortgage companies etc.
- Mostly outside normal banking regulations $\Rightarrow$ subject to runs.
- Shadow banking grew dramatically since 1990s (Pozsar et al. 2013):



Runnable liabilities in the US before and after the Crisis



Notes. The data on aggregate runnable liabilities comes from Bao et al. (2015). It includes uninsured deposits, repurchase agreements, securities lending, commercial paper, money market mutual funds shares, variable-rate demand obligations, federal funds borrowed, and funding agreement backed securities. The data on total financial sector liabilities is from the Board of Governors of the Federal Reserve System.

Contagion

Macroeconomic contagion

- Financial crises are characterised by simultaneous difficulties faced by many financial institutions, firms, and individuals.
- But if e.g. we introduce many banks in the Diamond-Dybvig model, there is no reason why a run on one bank would spread to others.
- We will now briefly discuss the issue of **contagion**: how do financial troubles faced by individual agents spread at macro level?
- There are several major sources of contagion:
  1. Counterparty contagion
  2. Confidence contagion
  3. Fire-sale contagion
  4. Macroeconomic contagion.

Sources of contagion

1. **Counterparty contagion**
   - In practice, financial institutions often hold claims on one another.
   - When one fin. institution faces a run and a risk of failure, institutions that are exposed to it may see the value of their claims fall,
   - and ultimately suffer similar fate.
2. **Confidence contagion**
   - Recall that the Diamond-Dybvig model is that of a pure liquidity run.
   - But a run could also happen when investors suspect that there is a risk that the bank may be insolvent.
   - In fact, bank runs tend to happen when fundamentals are weak.
   - If a large bank faces a run, it could provide a negative signal about its solvency and the value of its assets.
   - But this could lead investors of other banks that hold similar assets to question their solvency and run as well.

Sources of contagion (cont.)

3. **Fire-sale contagion**
   * An institution facing a run or a large increase in borrowing costs is likely to have to sell assets.
   * But if many institutions do it simultaneously in an imperfect financial market, this leads to a fall in asset prices.
   * Decrease in the value of collateral leads to a further round of insolvencies, runs, and fire sales.
4. **Macroeconomic contagion**
   * Difficulties faced by borrowers are likely to reduce economic activity
   * Which in turn reduces asset prices and agents' net worth
   * Leading to further increases in borrowing costs etc.

   This is the financial accelerator again.

Government Guarantees and Moral Hazard

Government guarantees and moral hazard: an overview

- In the wake of the 2008 Financial crisis, governments responded with interventions of unprecedented scale:
  - Involved both recapitalizations and lowering borrowing costs for banks.
  - In line with the models we have covered so far.
- But if banks anticipate such policy response, it creates moral hazard:
  - Banks have incentives to increase leverage and invest in riskier projects.
  - This increases their returns in the upside, while possible losses in the downside are borne by the government and taxpayers.
- Indeed, prior to the Crisis, large-scale maturity mismatch and exposure to systematic risks appeared to be widespread among fin. institutions

  $\Rightarrow$ likely increased both ex-ante likelihood and ex-post costs of the Crisis.
- Such seminal papers as Kareken and Wallace (1978), Farhi and Tirole (2012) and others formalise this argument.
- We will now consider a very simple model that captures its essence.

Setup

- There are two periods $\{0, 1\}$
- Households have a wealth endowment of 1 in period 0.
- Households only consume in period 1, and their utility is given by:

$$U = -(c - \bar{c})^2, \tag{25}$$

where $\bar{c} > c$ is the 'satiation' consumption level.

- In period 0, a representative bank invests the endowment on behalf of a representative household, and acts to max. their expected utility.
- The bank has access to two assets:
  1. **Safe asset** that pays a certain return $R > 1$ in period 1.
  2. **Risky asset** that pays either $\theta - \varepsilon$ or $\theta + \varepsilon$, each with probability $1/2$.
- The risky asset offers a higher average return than the safe asset, i.e. $\theta > R$, but performs worse in the downside, i.e. $\theta - \varepsilon < R$.

Benchmark: no government guarantees

- The Bank allocates $\mu \in [0,1]$ to the risky asset, and $1-\theta$ to the safe asset to maximize the consumer's expected utility:

$$\max_{\mu} \mathbb{E}[U] = -\frac{1}{2}[(1-\mu)R + \mu(\theta - \varepsilon) - \bar{c}]^2 - \frac{1}{2}[(1-\mu)R + \mu(\theta + \varepsilon) - \bar{c}]^2 \tag{26}$$

- Taking FOC and solving for μ yields

$$\mu^* = \frac{(\bar{c} - R)(\theta - R)}{\varepsilon^2 + (\theta - R)^2}. \tag{27}$$

- $\mu^* < 1$, assuming $\bar{c} - R$ is sufficiently small.
- Bank invests in a balanced portfolio that maximizes welfare.

The effect of a government guarantee

- Suppose now that the government guarantees that bank investors receive a return of at least R whatever the state of the world.
  - This could be either an explicit deposit insurance in place to prevent panics, or an implicit guarantee that the gvt. will not let banks fail.
  - It is only invoked when the return on the risky asset is low.

- Anticipating this government policy, the bank now maximizes:

$$\max_{\mu} \mathbb{E}[U] = -\frac{1}{2}[R - T - \bar{c}]^2 - \frac{1}{2}[(1-\mu)R + \mu(\theta+\varepsilon) - \bar{c}]^2. \tag{28}$$

- To finance assistance in the low state, the gvt. imposes lump-sum tax:

$$T = \mu(R - \theta + \varepsilon). \tag{29}$$

- But a bank takes T *as given* and unaffected by its private choice of μ.
- Since $\theta + \varepsilon > R$, (28) increases in μ, so bank sets $\mu = 1 > \mu^*$.
- **Risk shifting:** bank shifts more of the downside risk on the gvt.

Welfare and policy consequences

- Exposure to risk is now inefficiently high:
  - Substituting T from (29) into (28), the welfare of a representative agent is still given by (26), but now with higher μ.
  - Government guarantees are unambiguously bad in this simple model.
- Does it mean that the government should not assist banks in crises?
  - No! We have seen that there are good reasons for intervention.
  - Crisis is also not a time to worry about moral hazard.
  - Caballero (2010) compares crisis to a heart attack: we would save people with heart attacks even if we knew that the presence of defibrillators incentivizes them to lead unhealthy lives in the long run.
  - The government may simply not be able to commit not to intervene.
- So what can we do to prevent crises then?
  - Need to regulate fin. sector: risk-adjusted capital requirements, liquidity requirements, stress tests and other **prudential policies.**
  - But all these can also increase costs of intermediation in normal times.
  - Getting the balance right is a very important and active research area.

Conclusion

- Financial markets are complex: we have seen various mechanisms that can generate financial frictions and trigger financial crises.
- These issues are all inter-related:
  - For example, in practice it is often difficult, if not impossible, to distinguish between illiquid and insolvent banks.
  - A bank may be solvent under normal macro conditions and asset prices.
  - But insolvent once there are widespread runs on its counterparties and a collapse in asset prices.
- Modern macroeconomic models often combine different mechanisms.
- Gertler and Kiyotaki (2015) is a great example:
  - Their model features the conventional financial accelerator.
  - But systemic bank runs are also possible.
  - Run equilibria exist only in recessions when the macroeconomic fundamentals are sufficiently bad, which is realistic.