

# Banking, Liquidity Transformation, and Bank Runs

ECON 30020: Intermediate Macroeconomics

Prof. Eric Sims

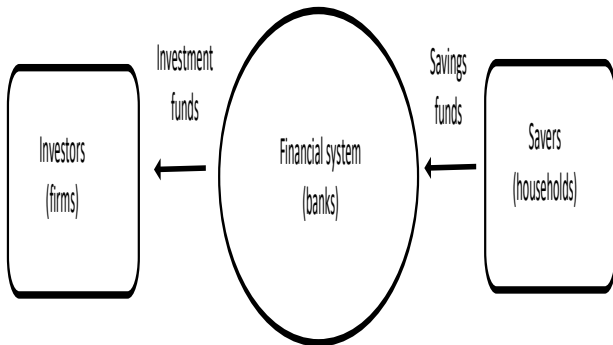
University of Notre Dame

Spring 2018

# Readings

- ▶ GLS Ch. 28
- ▶ GLS Ch. 30 (don't worry about model details)

# Financial Intermediation



- ▶ Financial intermediation: funnels savings from households to investment by firms
- ▶ Will refer to intermediaries as “banks” but definition of what is and isn’t a bank is increasingly less clear

# The Business of Banking

- ▶ Banks “borrow” funds from savers and lend to firms, hopefully at a higher interest rate ( $r_t$  in the notation we’ve been using)
- ▶ Why don’t firms use their own internal funds to finance investment projects, raise funds through equity (i.e. issuing stock), or borrow directly from households (bond issuance)?
- ▶ Some do, but many don’t, particularly smaller firms
- ▶ Two principal reasons:
  1. Asymmetric information
  2. Liquidity transformation
- ▶ Banks are useful because they (i) are good at dealing with asymmetric information problems and (ii) engage in liquidity transformation – they create liquid assets (e.g. deposits) and finance illiquid projects (e.g. new buildings)

# Asymmetric Information

- ▶ Asymmetric information describes a situation in which two parties to a transaction are not equally well-informed
- ▶ Two kinds of asymmetric information:
  1. **Adverse Selection**: information asymmetry about characteristics of the parties **before** a transaction takes place
  2. **Moral Hazard**: information asymmetry about actions taken by parties **after** a transaction takes place
- ▶ Both types of information asymmetries can cause markets to break down
- ▶ In our context/application, a firm with a profitable investment idea may not be able to access funds to do the investment with so-called direct finance. Banks can help solve this.

## Adverse Selection in Financial Markets

- ▶ Classic example of adverse selection is the “lemons” problem in used car markets (Akerlof, 1970)
- ▶ Basic idea: presence of “bad” cars (lemons) makes it hard to sell “good” cars (peaches) because buyers can’t distinguish between the two types
- ▶ Similar idea in financial markets
- ▶ Suppose there are two types of firms – “safe” and “risky.” Both need \$1 to undertake an investment project
- ▶ Safe firm: earns \$1.20 with certainty
- ▶ Risky firm: earns \$1.50 with probability  $p = \frac{1}{2}$ , loses everything with probability  $1 - p = \frac{1}{2}$

## Symmetric Information

- ▶ Household can directly lend to firm at (net) interest rate  $r$ . Household only gets paid in event project succeeds (limited liability)
- ▶ Suppose it can tell risky and safe firms apart
- ▶ Expected net returns of lending to each:

$$E[\text{profit}_{\text{safe}}] = r$$

$$E[\text{profit}_{\text{risky}}] = \frac{1}{2}r - \frac{1}{2}1$$

- ▶  $0 \leq r \leq 0.2$ : both household and safe firm earn something in expectation
- ▶ Only way household can earn money by lending to risky firm is if  $r \geq 1$ , which firm will not take (it would lose money)
- ▶ End result: safe firm gets a loan, risky firm does not

## Asymmetric Information

- ▶ Now suppose household can't tell firms apart. Just knows that  $q \in [0, 1]$  of firms are risky and  $1 - q$  are safe
- ▶ Expected profit from lending to a firm when you don't know its type:

$$E[\text{profit}] = (1 - q)r + \frac{q}{2}r - \frac{q}{2}$$

- ▶ Suppose  $q = \frac{1}{2}$ . For the household to be willing to lend, would need  $r \geq \frac{1}{3}$
- ▶ But  $r \geq \frac{1}{3}$ : safe firm would never take the funding. But then household would know it is dealing with a risky firm and would require  $r \geq 1$ , which risky firm won't take
- ▶ End result: neither kind of firm gets a loan
- ▶ Market breaks down entirely!



# Moral Hazard in Financial Markets

- ▶ Moral hazard problem is similar but with a relabeling
- ▶ Now there are not two types of firms, but two types of projects a firm can undertake once given funding
- ▶ Basic idea: once you give the firm funding, you can't control what it does with it
- ▶ Because of limited liability, firm has incentive to gamble once it gets funds
- ▶ But lender knows this up front, which can cause market to break down

## Two Types of Projects

- ▶ Suppose a firm gets funding of \$1
- ▶ Once it has funding, it can undertake two projects:
  - ▶ Safe: project nets \$0.2 with certainty
  - ▶ Risky: nets \$0.5 with  $p = \frac{1}{2}$ , loses the funding entirely with probability  $1 - p = \frac{1}{2}$
- ▶ *Same* numbers as before, but different setup – here information asymmetry is what happens **after** funds are given
- ▶ Suppose you lend money at  $r = 0.1$
- ▶ Safe project: firm earns \$0.1 with certainty
- ▶ Risky project: firm earns \$0.4 with probability  $\frac{1}{2}$ , earns nothing (limited liability) with probability  $\frac{1}{2}$  – expected return of \$0.2 from taking risky project
- ▶ Firm prefers risky project, but lender does not!
- ▶ To prevent firm from taking on risk, need to charge a sufficiently high  $r$ , but then firm would only prefer taking on the risk, and funding is not extended

# Financial Intermediation and Information Asymmetry

- ▶ Financial intermediaries play an important role in ameliorating market failures due to information asymmetries
- ▶ Banks become **experts** in evaluating firm types and credit risk (adverse selection)
- ▶ Banks can engage in **monitoring** to ensure firms are using the funds in the most desirable way and can impose covenants and loan restrictions (moral hazard)
- ▶ Household does not have resources to do either of these things on his or her own
- ▶ Makes sense to give funds to intermediary to lend; indirect finance
- ▶ Return to intermediation in our notation is  $r_t^I - r_t = f_t$ . When markets are working well, information asymmetries aren't such a problem, and  $f_t$  is low. When informational asymmetries are bad,  $f_t$  will be high

## Liquidity Transformation

- ▶ An **asset** is something which entitles the holder to some future flow payouts or benefits – house, stock, bond, savings account, checking account, etc.
- ▶ An asset's **liquidity** refers to the ease with which it can be used as a medium of exchange (i.e. money)
- ▶ A house is not very liquid in sense it is difficult to convert it into money on short notice at a fair price
- ▶ A checking account, in contrast, is essentially perfectly liquid in that it can itself be used in exchange for goods and services
- ▶ Households have some wealth they want to transfer across time. But they may not be sure when they will need to spend that wealth. So other things being equal they have a preference to hold liquid assets
- ▶ Many investment projects undertaken by firms are highly illiquid – projects will not generate cash flows for a long time
- ▶ For this reason households may not want to directly investment in them

## Equity, Assets, and Liabilities

- ▶ We refer to **liquidity transformation** as the process by which banks simultaneously invest in illiquid projects but provide households with liquid assets (i.e. deposits)
- ▶ It is sometimes said that banks “create money [deposits] out of thin air.” This isn’t quite right. Banks create one kind of asset (deposits) from pooling funds and investing in other types of assets (commercial and residential loans)
- ▶ A bank begins with some **equity** – these are funds the owner(s) of the bank puts up as the initial investment
- ▶ Then the bank takes in money from different sources and issues them checkable deposits on which transactions can be undertaken. These are called **liabilities**
- ▶ The bank takes the funds and invests in **assets**, chiefly loans to businesses and individuals
- ▶ In a static sense,  $\text{equity} = \text{assets} - \text{liabilities}$
- ▶ In a dynamic sense, bank makes a profit (and increases equity) if assets earn more than liabilities cost

# Bank Balance Sheet

- ▶ Summarize a bank's balance sheet via a T-account
- ▶ Suppose a bank begins with \$20 in equity sitting as cash. Balance sheet is:

Assets	Liabilities plus Equity
Cash Reserves: \$20	Equity \$20

- ▶ Cash doesn't earn anything
- ▶ Instead of holding cash, bank could use some of its equity to make loans:

Assets	Liabilities plus Equity
Loans: \$10	
Cash Reserves: \$10	Equity \$20

## Attracting Deposits

- ▶ In setup above, bank can only make investments limited to its equity
- ▶ This limits potential returns
- ▶ Bank can also borrow money – take in funds from households, give households checking accounts in exchange, and invest the proceeds:

Assets	Liabilities plus Equity
Loans: \$110	Deposits: \$100
Cash Reserves: \$10	Equity: \$20

- ▶ **Equity multiplier**: ratio of assets to equity (here it is 6). Closely related to **leverage ratio**, which is ratio of liabilities to equity (in this case 5).  $\text{Equity multiplier} = 1 + \text{leverage ratio}$
- ▶ **Liquidity ratio**: ratio of liquid assets (cash) to liabilities (here 0.1)

## Leverage and Returns

- ▶ Assume deposits cost bank  $r = 0.1$ . Bank earns  $r^l = 0.15$  on loans. Cash reserves earn nothing
- ▶ In example above, assuming nothing unexpected happens, bank earns  $0.15 \times 110 = 16.5$  on loans, pays  $0.1 \times 100 = 10$  on deposits, for profit of 6.5
- ▶ Its **return on equity** is profit divided by equity, or 32.5 percent
- ▶ Return on assets is profit divided by assets  
( $6.5/120 = 0.0542$ )
- ▶ Return on equity linked to return on assets and leverage via:

$$ROE = (1 + \text{Leverage Ratio}) \times ROA$$

- ▶ Natural incentive to “lever up” to maximize returns



# Managing the Balance Sheet

- ▶ Bank's objective is to maximize ROE but needs to take into account downside risk
- ▶ Two forms of risk in terms of the balance sheet:
  1. Credit risk: assets may underperform (i.e. loans are defaulted upon)
  2. Liquidity risk: may face a withdrawal of liabilities which could force "fire sales" of assets that might result in losses
- ▶ We are going to focus mostly on liquidity risk – **bank runs**
- ▶ Bank runs can happen if depositors begin to doubt the soundness of the bank's investments or simply if depositors think enough other depositors will withdraw
- ▶ For what follows, suppose that loans are illiquid in the precise sense that they can only be sold quickly for a discount of 50 percent
- ▶ When there is an unexpected withdrawal of liabilities, banks may have to sell assets to raise cash

## Withdrawal Shock

- ▶ Suppose bank begins with balance sheet:

Assets	Liabilities plus Equity
Loans: \$110	Deposits: \$100
Cash Reserves: \$10	Equity: \$20

- ▶ Bank can stomach up to a \$10 withdrawal without selling any assets

Assets	Liabilities plus Equity
Loans: \$110	Deposits: \$90 (-10)
Cash Reserves: \$0 (-10)	Equity: \$20

- ▶ Another \$10 withdrawal necessitates selling \$20 of loans and taking a \$10 loss:

Assets	Liabilities plus Equity
Loans: \$90 (-20)	Deposits: \$80 (-10)
Cash Reserves: \$0	Equity: \$10 (-10)

# Insolvency

- ▶ Another \$10 withdrawal shock would leave the bank **insolvent** (zero or negative equity):

Assets	Liabilities plus Equity
Loans: \$70 (-20)	Deposits: \$70 (-10)
Cash Reserves: \$0	Equity: \$0 (-10)

- ▶ A bank without a sufficient liquidity ratio (ratio of liquid assets to liabilities) can become insolvent if it faces a big enough withdrawal shock
- ▶ Obvious policy solution: mandate banks maintain certain liquidity ratios (e.g. required reserve ratios)
- ▶ The downside to this is that it limits the beneficial aspects of liquidity transformation – if bank just sits on cash, illiquid but beneficial projects aren't getting undertaken

# Liquidity Transformation

- ▶ Without banks, households would not want to directly fund many investment projects because of the illiquidity of those projects
- ▶ Banks (or financial intermediation more generally) are socially beneficial because by aggregating liabilities, banks can “create” liquid, short term assets (i.e. deposits, which can be used in exchange) while investing in longer term, illiquid assets
- ▶ This is the gist of the famous Diamond and Dybvig (1983) model (GLS Ch. 30)
- ▶ But the socially beneficial aspect of liquidity transformation comes with a cost
- ▶ Banking is **inherently** susceptible to liquidity risk – i.e. “runs”

## Bank Run – *It's a Wonderful Life*



# Policies to Deal with Bank Runs

- ▶ Bank runs can be disastrous. A fundamentally sound bank (i.e. it owns good assets) can fail if it is subject to heightened withdrawals, which can in turn trigger other failures
- ▶ Historically banking panics have been *very* costly
- ▶ Policies to deal with crises:
  1. Suspension of convertibility
  2. Lender of last resort
  3. Deposit insurance (FDIC)

## Withdrawal Shock: Lender of Last Resort

Assets	Liabilities plus Equity
Loans: \$90	Deposits: \$70 (-10)
	Borrowings: \$10 (+10)
Cash Reserves: \$0	Equity: \$10 (no change)

- ▶ Faced with a withdrawal shock, instead of selling assets, bank borrows from the central bank – **lender of last resort** (discount window)
- ▶ In a dynamic sense, still costs the bank something, so it would prefer to not have to do this (it has to pay interest on loan), but better than selling assets at a depressed price
- ▶ Lender of last resort role was the principal reason for the founding of the Federal Reserve System in the wake of the “Panic of 1907”

## Deposit Insurance

- ▶ The Fed didn't fully understand its role as lender of last resort, and many banks failed during the Great Depression
- ▶ In the wake of bank runs during the Great Depression, the FDIC was created to insure deposits up to a given amount in the event of a bank failure
- ▶ The amount is now up to \$250,000
- ▶ Basic idea: deposit insurance **guarantees** your funds (up to a certain level), so there is no reason to “run” on a bank – should limit/eliminate liquidity risk
- ▶ Downside is that insurance encourages bank risk-taking; because of this moral hazard issue, banks are heavily regulated in practice and are restricted in the kinds of assets they can hold
- ▶ In practice, deposit insurance eliminated bank runs (which were very common) in the US
- ▶ Until the Financial Crisis



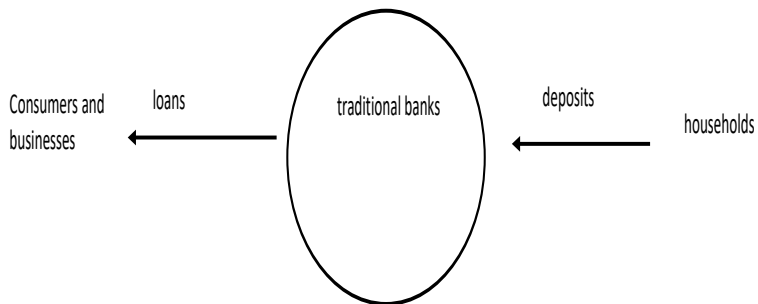
# Shadow Banking

- ▶ The banking system has evolved, in part in response to regulations
- ▶ Much of financial intermediation has moved out of the traditional, regulated “depository” banking system and into the so-called “shadow banking” system
- ▶ There is nothing shadowy about shadow banks – they engage in normal financial intermediation. They borrow funds and use the proceeds to purchase assets. This is what banking is
- ▶ But what is different is that they don’t borrow funds via traditional deposits – no deposit insurance and not clear whether the Fed’s lender of last resort role applies
- ▶ But because shadow banks are engaged in liquidity transformation, they are susceptible to runs
- ▶ This is in essence what happened in the Financial Crisis

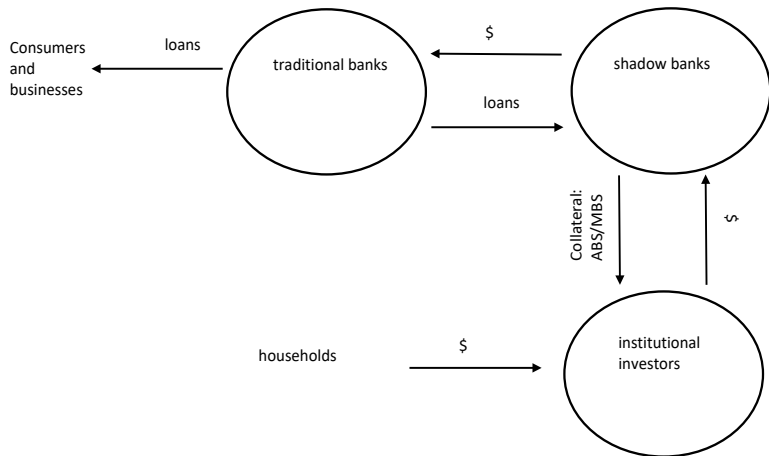
# Securitized Banking

- ▶ Gorton and Metrick (2012) refer to the modern banking system as “securitized banking”
- ▶ Traditionally, banks made loans and held them on their balance sheets
- ▶ Not so anymore – typically loans are sold and “securitized” – asset-backed securities and mortgage-backed securities (MBS)
- ▶ Why?
  1. Regulatory arbitrage: banks face regulatory capital ratios (ratio of equity to assets). This lowers return on equity, other things being equal. Keeping loans “on books” makes you bump into capital ratio constraint
  2. Rise of large institutional investors (pension funds, money market mutual funds): have a desire for “checking account like” short term assets, but no deposit insurance
- ▶ Securitized loans are thought to be safe, and serve as collateral for short term “repurchase agreements” (repo) that look like checking accounts. If shadow bank doesn't give you cash when you redeem Repo, you get to keep the MBS

# Traditional Banking



# Modern Banking



## T-Account for Hypothetical Shadow Bank

Assets	Liabilities plus Equity
MBS \$500	Repo: \$500
Cash: \$100	Equity \$100

- ▶ Instead of deposits, we have Repo, and instead of loans, we have MBS
- ▶ Otherwise fundamentally the same as standard bank
- ▶ There is a liquidity/maturity mismatch just as in traditional banking – liabilities are more liquid / shorter term than assets

## Run on Repo

- ▶ During financial crisis, institution investors became afraid of value of backing collateral in Repo transactions (MBS)
- ▶ Essentially have a withdrawal of Repo – a liquidity crisis

Assets	Liabilities plus Equity
MBS \$500	Repo: \$400 (−100)
Cash: \$0 (−100)	Equity \$100

- ▶ Any further “withdrawal” necessitates selling MBS to raise cash, which causes (i) losses and (ii) depresses value of MBS and housing-related assets more generally