5. Banking

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Road Map

Asset Transformation

Credit Risk

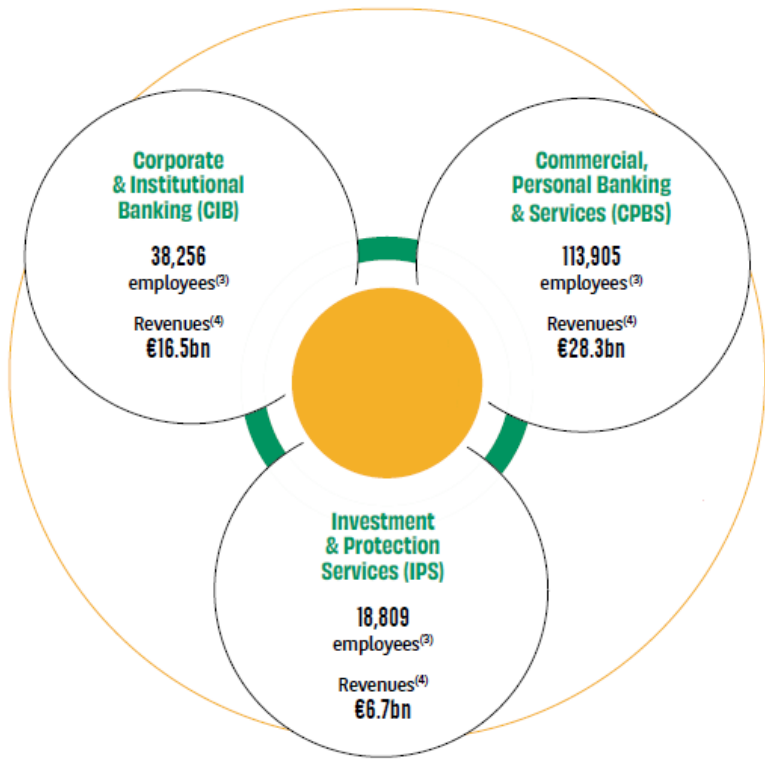
Interest Rate Risk

Liquidity Risk

Banking Regulation

Banks

- Large banks are active in
  - Commercial banking: take deposits, make loans
  - Investment banking: underwriting, M&A, trading
  - Asset management
- Ex.: BNP Paribas



Commercial Banking

- Today: focus on commercial banking

What are the economic functions of commercial banks – why don't households lend directly to firms and to other households?

Asset Transformation

Take deposits + Make loans = Asset transformation

Asset Transformation

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1. **Liquidity transformation**
    - Deposits are liquid: they are demandable
    - Loans are illiquid: banks cannot call loans; secondary market for loans exists but is illiquid

Asset Transformation

Take deposits + Make loans = Asset transformation

1. **Liquidity transformation**
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2. **Maturity transformation**
   - Borrow short-term: deposits, certificates of deposits
   - Lend long-term: business loans, mortgages, government bonds

Asset Transformation

Take deposits + Make loans = Asset transformation

1. **Liquidity transformation**
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2. **Maturity transformation**
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   - Lend long-term: business loans, mortgages, government bonds
3. **Credit risk transformation**
   - Deposits are safe
   - Loans are risky

Asset Transformation

- Remark: The notions of liquidity transformation and maturity transformation are related (the fact that deposits are demandable make them both liquid and short-term) but different

Q. Can you name assets that are both liquid and long-term?

Asset Transformation

- Liquidity transformation and credit risk transformation are achieved through diversification
  - Not all depositors withdraw their deposits at the same time
  - Not all loans default
- Maturity transformation cannot be diversified away
  - Interest rate risk is systematic risk

Risks

Transforming illiquid, long-term, risky assets into liquid, short-term, safe liabilities exposes banks to:

1. Liquidity risk

2. Interest rate risk

3. Credit risk

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Credit Risk

How do banks manage credit risk?

- Screening: See lecture #3
- Collateral: Loans may be secured by a specific asset

  Ex.: Equipment, real estate, account receivables, entrepreneurs' personal assets
- Monitoring: Loans may include covenants

  Ex.: Limit on debt-to-EBITDA or interest coverage; if breached, interest rate goes up or repayment is accelerated. Limits on dividends. Negative pledge clause.
- Diversification: Hold many loans (in different sectors and locations)
- Securitization: Sell part of the loans cash flow
- Hedging using credit default swaps (uncommon)
- Hold equity to absorb losses due to remaining credit risk

Road Map

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Interest Rate Risk

By borrowing short-term and lending long-term (at fixed rate), banks:

- Earn positive net interest income on average because long rates are usually higher than short rates (i.e., the yield curve is usually upward slopping—the so-called term premium)

- Are exposed to the risk of an increase in interest rate

Interest Rate Risk: Example

- Deposits 100: demandable, interest rate 1%/year
- Loans 100: maturity 5 years, interest rate 2%/year (fixed rate)
- Cash flow if no change in interest rates (ignoring compounding)

	year 0	year 5
deposits	100	–105
loans	–100	110
total		+5

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	year 0	year 5
deposits	100	−105
loans	−100	110
total		+5

- If the yield curve shifts up by 2%

	year 0	year 5
deposits	100	−115
loans	−100	110
total		−5

Interest Rate Risk: Duration (Refresher)

- The loss of 10 can be also calculated from the duration

- Duration of assets: 5 years
  Duration of liabilities: 0

- Yield curve shifts up by 2%

$\Rightarrow$ Δ value of assets $\simeq -5 \times 2\% = -10\%$
Δ value of liabilities $\simeq 0$

Interest Rate Risk

How do banks manage interest rate risk?

- Manage the mismatch between assets duration and liabilities duration
  - Borrow longer term
  - Lend shorter term
  - Lend at variable rate
- Hedging using interest rate derivatives
- But: a lower duration mismatch also means giving up on the term premium
- Hold equity to absorb losses due to remaining interest rate risk

U.S. Banking System, March 2023

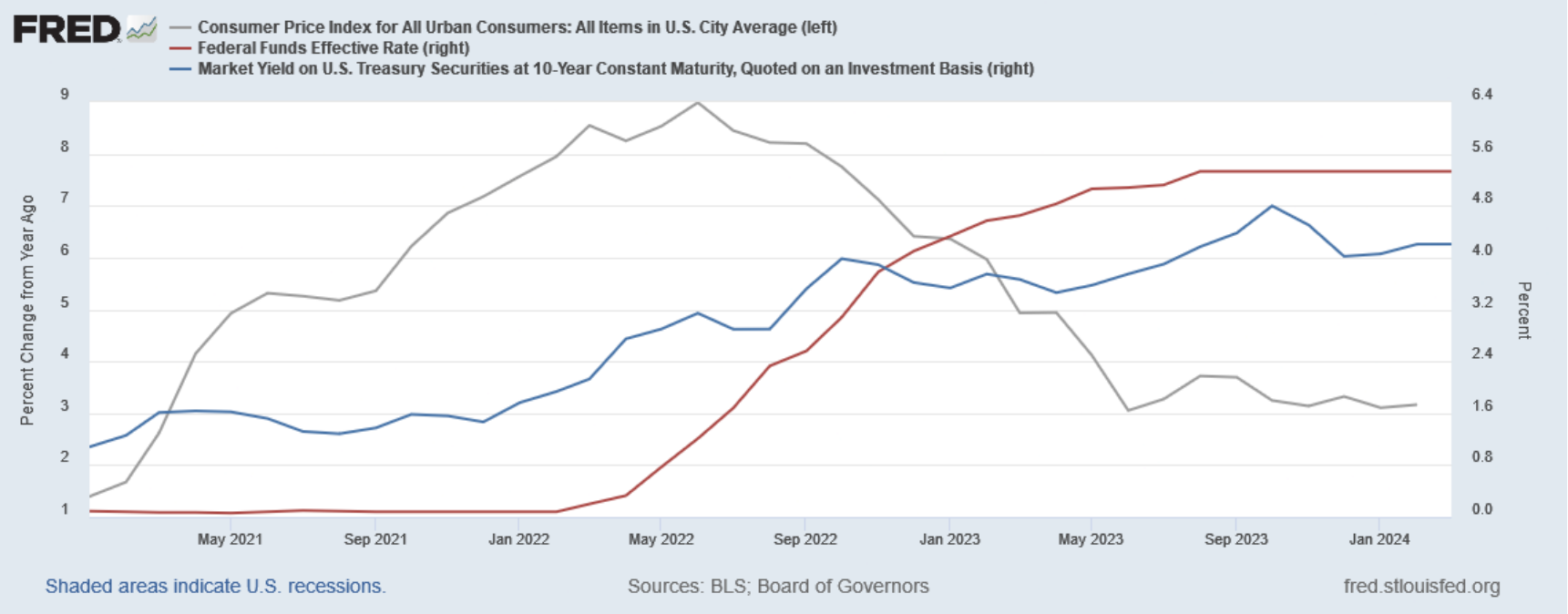
Bank Asset Composition – 2022Q1

Total Asset $	24T
Number of Banks	4844
(Percentage of Asset)	
Cash	14.1
Security	25.2
Treasury	6.1
RMBS	12.1
CMBS	2.3
ABS	2.7
Other Security	2.1
Total Loan	46.6
Real Estate Loan	21.9
Residential Mortgage	10.6
Commercial Mortgage	2.2
Other Real Estate Loan	9.1
Agricultural Loan	0.3
Commercial & Industrial Loan	9
Consumer Loan	7.7
Loan to Non-Depository	2.8
Fed Funds Sold	0.1
Reverse Repo	1.2

Bank Liability Composition – 2022Q1

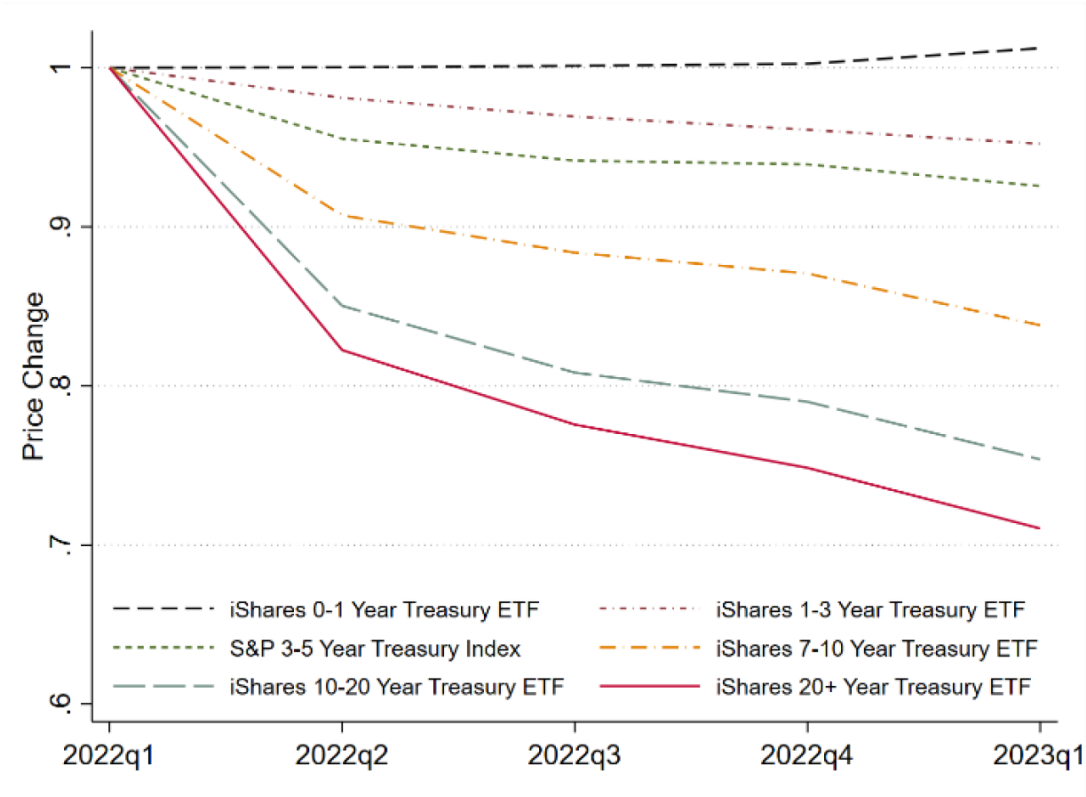
Total Liability	90.5
Domestic Deposit	76.6
Insured Deposit	41.1
Uninsured Deposit	37.4
Uninsured Time Deposits	1.8
Uninsured Long-Term Time Deposits	0.4
Uninsured Short-Term Time Deposits	1.3
Foreign Deposit	6.5
Fed Fund Purchase	0.1
Repo	0.6
Other Liability	2.3
Total Equity	9.5
Common Stock	0.2
Preferred Stock	0.1
Retained Earning	4

U.S. March 2023



Source: https://fred.stlouisfed.org/

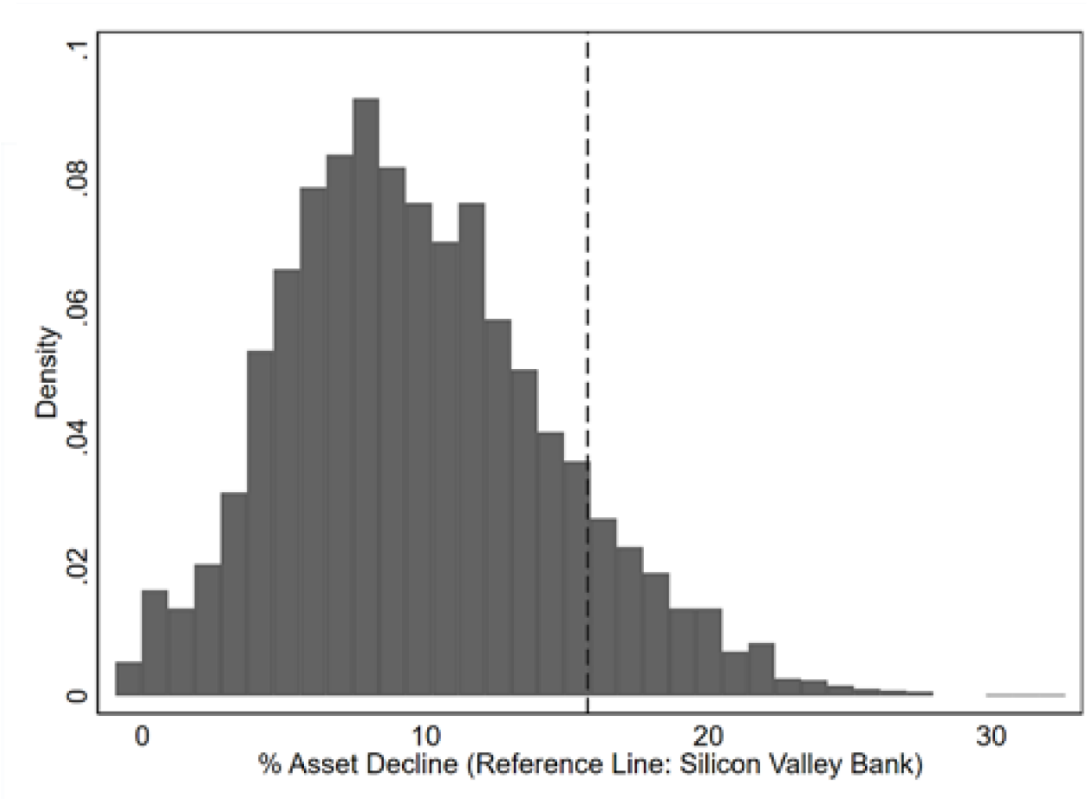
U.S. Banking System, March 2023



(c) Treasury by Maturity

U.S. Banking System, March 2023

Distribution of Change in Asset Value ("Marking to Market")



Source: Jiang, Matvos, Piskorski and Seru, "Monetary Tightening and U.S. Bank Fragility in 2023: Mark-to-Market Losses and Uninsured Depositor Runs?" Journal of Financial Economics, 2024 [pdf]

Interest Rate Risk

🤔 Most U.S. banks did not fail in 2023 despite large losses, sometimes larger than equity. Why not?

Interest Rate Risk: Sticky Deposit Rates

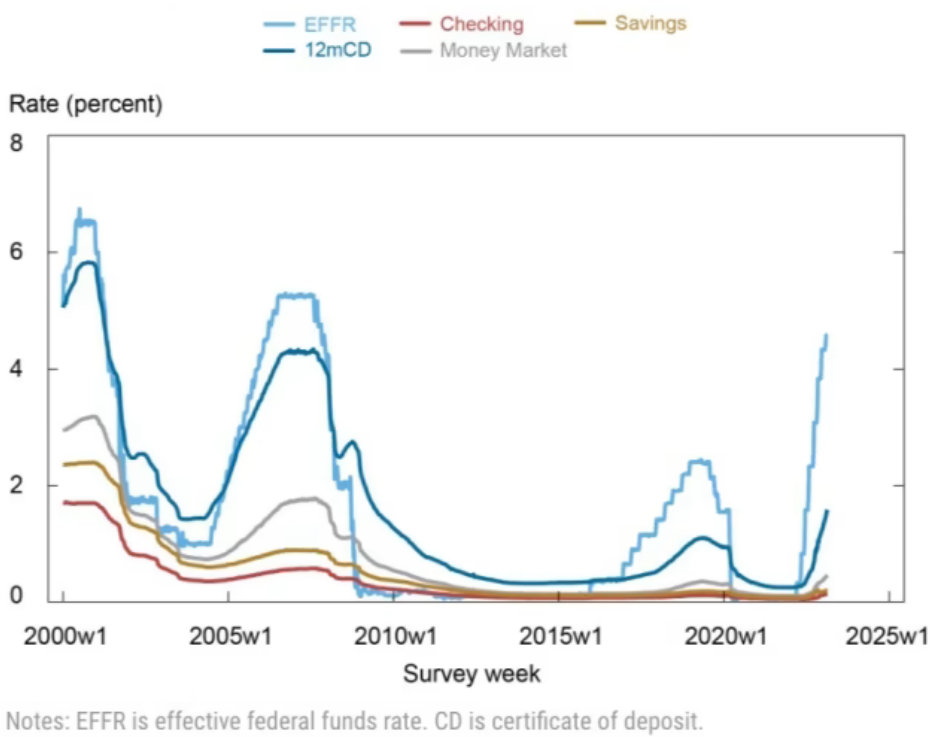
🤔 Most U.S. banks did not fail in 2023 despite large losses, sometimes larger than equity. Why not?

- Deposits do not fully reprice
  - Back to our example: deposit rate 1%, 5-year loan fixed rate 2%
  - Suppose yield curve shifts up by 2%

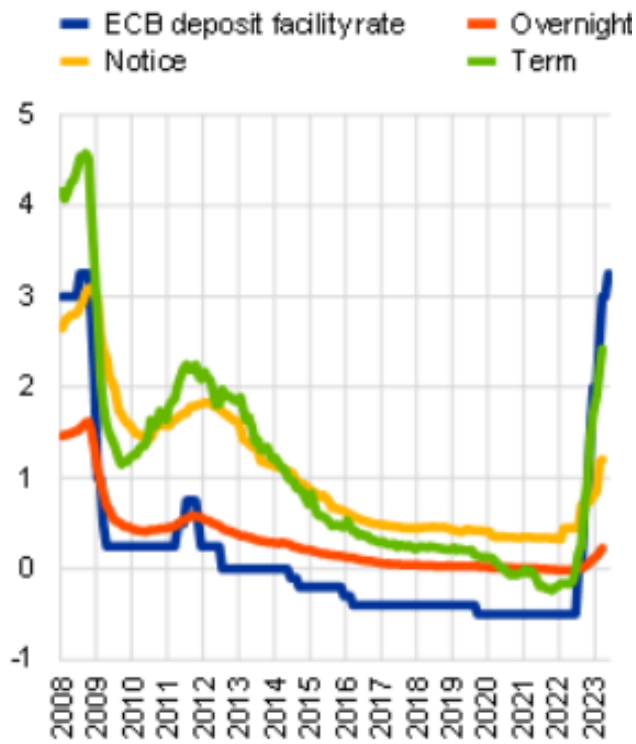
    . . . but deposit rate increases by 1% only

	year 0	year 5
deposits	100	~~−115~~ −110
loans	−100	110
total		~~−5~~ 0

Interest Rate Risk: Sticky Deposit Rates



United States



Euro Area

- The **deposit beta**, defined as the sensitivity of deposits rates to changes in the short rate, is far below one
- Due to depositors "sleepiness," giving banks market power in deposits rate setting

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Liquidity Risk — Game

- Players
  - 1 bank: Johan
  - N short-term creditors: You and the N-1 other students in the room
- You hold 100 worth of debt on the bank expiring now. Choose btw:
  - Roll-over at 2% interest rate → the bank owes you 102 at maturity
  - Stop lending → the bank pays you 100 now
- Bank's balance sheet:

Assets	Liabilities
Loans: $N \times 100$	Short-term debt: $N \times 100$

- Bank's assets payoff to the bank (per \$1 of book value today):
  - 1.05 at maturity if held until maturity
  - 1 now if liquidated now

Play!

Please decide whether to roll-over or stop lending

https://forms.gle/jXmcEkGFKT94fRnw5

Illiquid Bank's Assets

- Now, the bank's assets are illiquid. They pay off:

  1.05 at maturity if held until maturity

  0.80 now if liquidated now

- The rest is the same

Play!

Please decide whether to roll over or stop lending

https://forms.gle/jXmcEkGFKT94fRnw5

Bank Runs

- Best response depends on expectations of what other depositors do
  - If other depositors roll over → optimal to roll over
  - If other depositors stop lending → optimal to stop lending

⇒ Two possible (self-fulfilling) equilibria

  - Business as usual: all depositors roll over
  - "Bank run": all depositors stop lending

How to avoid bank runs?

Deposit Insurance

- Deposit insurance: Government commits to repay depositors if the bank is insolvent $\Rightarrow$ Depositors have no incentives to run $\Rightarrow$ Self-fulfilling

- Costless for the government since run does not actually occur

- Deposits are usually insured up to a maximum amount (France €100k, US $250k)

Silicon Valley Bank, March 2023

- 90% of SVB's deposits were uninsured

Runs

- Banks' other short-term liabilities are not insured ⇒ subject to runs
  - Ex.: certificates of deposits (purchased by money market mutual funds)
- Non-bank financial intermediaries' ("shadow banks") short-term liabilities are not insured ⇒ subject to runs
  - Investment banks (Lehman Brothers bankruptcy in 2008)
  - Hedge funds (Long-Term Capital Management failure in 1998)
  - Mutual funds invested in illiquid asset classes (e.g., corporate bonds)
  - Non-bank lenders

Banks and Runs

Douglas Diamond
Nobel Prize 2022

Philip Dybvig
Nobel Prize 2022

Fresh Money Injection — With Illiquid Assets

- Suppose creditors are uninsured. We go back to the point in time just after creditors have decided to roll over or not, but before the bank liquidates assets at 80 cents on the dollar
- A deep pocket investor steps in and can provide fresh money to the bank. If this happens, the deep pocket investor's claim is junior to the existing creditors
- Please form groups of two persons: one is the bank, one is the deep pocket investor
- Goal of each party: maximize his or her profit
- Negotiations open!

Fresh Money Injection — With Impaired Assets

- Now, the bank's assets are illiquid and impaired: they pay off
  - 0.95 at maturity if held until maturity
  - 0.80 now if liquidated now
- Negotiations open!

Back to Rollover Decisions

- You are a short-term creditor again, deciding whether to roll-over or not
- As before, the bank can raise fresh money from a deep pocket investor after rollover decisions are made but before assets are liquidated
- Please decide whether to roll over or stop lending

1. If the bank's assets are illiquid and not impaired
2. If the banks' assets are illiquid and impaired

https://forms.gle/5n9JHhfyFbuMfkPm6

Banks Runs — Summary

- *Definitions:*

  A **liquid** bank can repay short-term creditors even if they don't roll over.
  An **illiquid** banks can't

  A **solvent** bank can repay creditors if they roll over until asset maturity.
  An **insolvent** bank can't

- When the bank is liquid and solvent:
  - Only equilibrium: No-run

Banks Runs — Summary

- When the bank is illiquid and solvent:
  - Multiple equilibria: No-run and Run
  - Depositors sleepiness mitigates run risk. Digital banking amplifies run risk
  - Deposits insurance prevents run
  - Without deposits insurance, a solvent bank can raise new funds (which may even prevent the run)
- When the bank is illiquid and insolvent:
  - Run
  - An insolvent bank can't raise new funds $\Rightarrow$ Default (ex.: Lehman Brothers in 2008) or Bailout (Silicon Valley Bank in 2023)
  - Deposits insurance may delay but not avoid run and failure

Can you think of a potential problem created by deposit insurance? 

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Asset Transformation

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Asset Choice

- Consider a bank with balance sheet

Assets		Liabilities	
To be invested	100	Equity	5
		Deposits (deposits rate 0%)	95

- Deposits are insured by the government
- The bank has two options to invest assets
  - Safe: pay off 100 for sure
  - Risky: pay off 102 (probability 0.9) or 82 (probability 0.1)
- Discount rate: 0%

Q1. Which asset choice has the higher NPV?

Q2. Which asset choice maximizes shareholder value? [spreadsheet]

Moral Hazard

- The banks increases asset risk due to expectations of bailout if equity turns negative
- . . . even if increasing asset risk has negative NPV
- Such value-destroying incentives represent **moral hazard**

Moral Hazard

- The banks increases asset risk due to expectations of bailout if equity turns negative
- . . . even if increasing asset risk has negative NPV
- Such value-destroying incentives represent **moral hazard**

What would happen if deposits were not insured?

Without Insurance Deposits

- *Ex post:* If the bank takes excessive risks and risks realize, depositors run and the bank defaults
- *Ex ante:* If depositors anticipate this, they may:
  - Require higher equity to absorb losses
  - Require lower asset risk
  - Require higher a interest rate
- *Historical evidence:* Uninsured banks before the creation of the FDIC had lower leverage. The introduction of deposits insurance in the early 20th century led to higher leverage and more risky lending (Calomiris and Jaremski, 2019)
- *Evidence from shadow banks:* Lenders that don't take deposits and thus don't benefit from deposits insurance (a.k.a. shadow banks) have lower leverage (Jiang, Matvos, Piskorski and Seru, 2023)

Moral Hazard

- Moral hazard represents a **market failure**

What can be done to mitigate moral hazard at banks?

Banking Regulation

- Market failure $\Rightarrow$ Rationale for **regulation**
- Banks are subject to regulatory **capital requirements**
- Terminology: "Equity" is often called "capital" in banking
- Banks are required to maintain minimum capital ratios

Banking Regulation

- Banks are also subject to regulatory **liquidity requirements**
- Banks must hold sufficient amount of liquid assets to prevent runs
- The rationale for liquidity requirements is more debatable because illiquid but solvent banks should not be subject to runs

Thank You!

- Practice problems and practice exam with solution on Blackboard
- Group assignment due on March 6th
- New exam time: March 19th at 1 PM
- I hope you enjoyed the class and learnt a lot!