Economics 435
The Financial System
(10/28-11/2/2021)

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Introduction

- Most people use the word *bank* to describe a depository institution.

- There are depository and non-depository institutions that differ by their primary source of funds - the liability side of their balance sheet.

- Depository institutions include
  - Commercial banks, savings and loans, and credit unions.

TABLE 1 Balance Sheet of All Commercial Banks (items as a percentage of the total, June 2014)

Assets (Uses of Funds)*		Liabilities (Sources of Funds)	
Reserves and cash items	19%	Checkable deposits	11%
Securities		Nontransaction deposits	
U.S. government and agency	13	Small-denomination time deposits	47
State and local government and	6	(<$100,000) + savings deposits	
other securities		Large-denomination time deposits	11
Loans		Borrowings	20
Commercial and industrial	12	Bank capital	11
Real estate	25		
Consumer	8		
Interbank	1		
Other	7		
Other assets (for example,	9		
physical capital)			
Total	100	Total	100

*In order of decreasing liquidity.

Source: http://www.federalreserve.gov/releases/h8/current/.

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Balance Sheet of Commercial Banks: Changes in Assets Over Time

Figure 12.1 U.S. Commercial Bank Assets, 1973–2009

Legend: Securities — Real Estate — Consumer Loans — C&I Loans — Cash
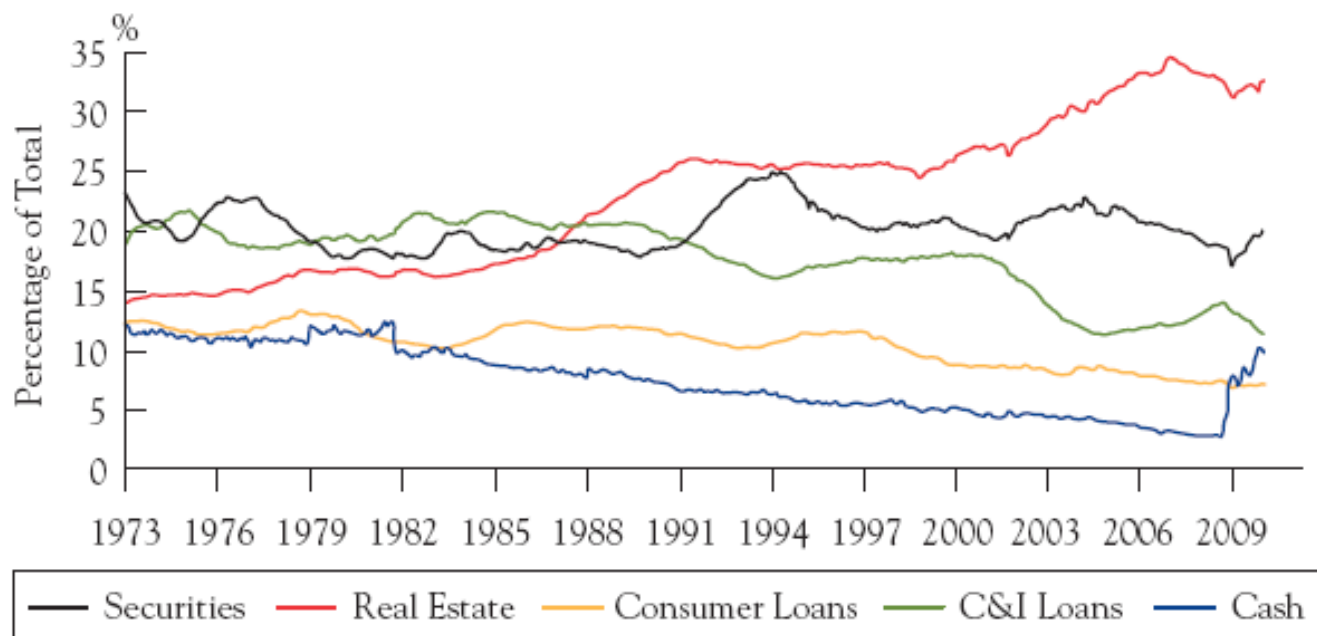
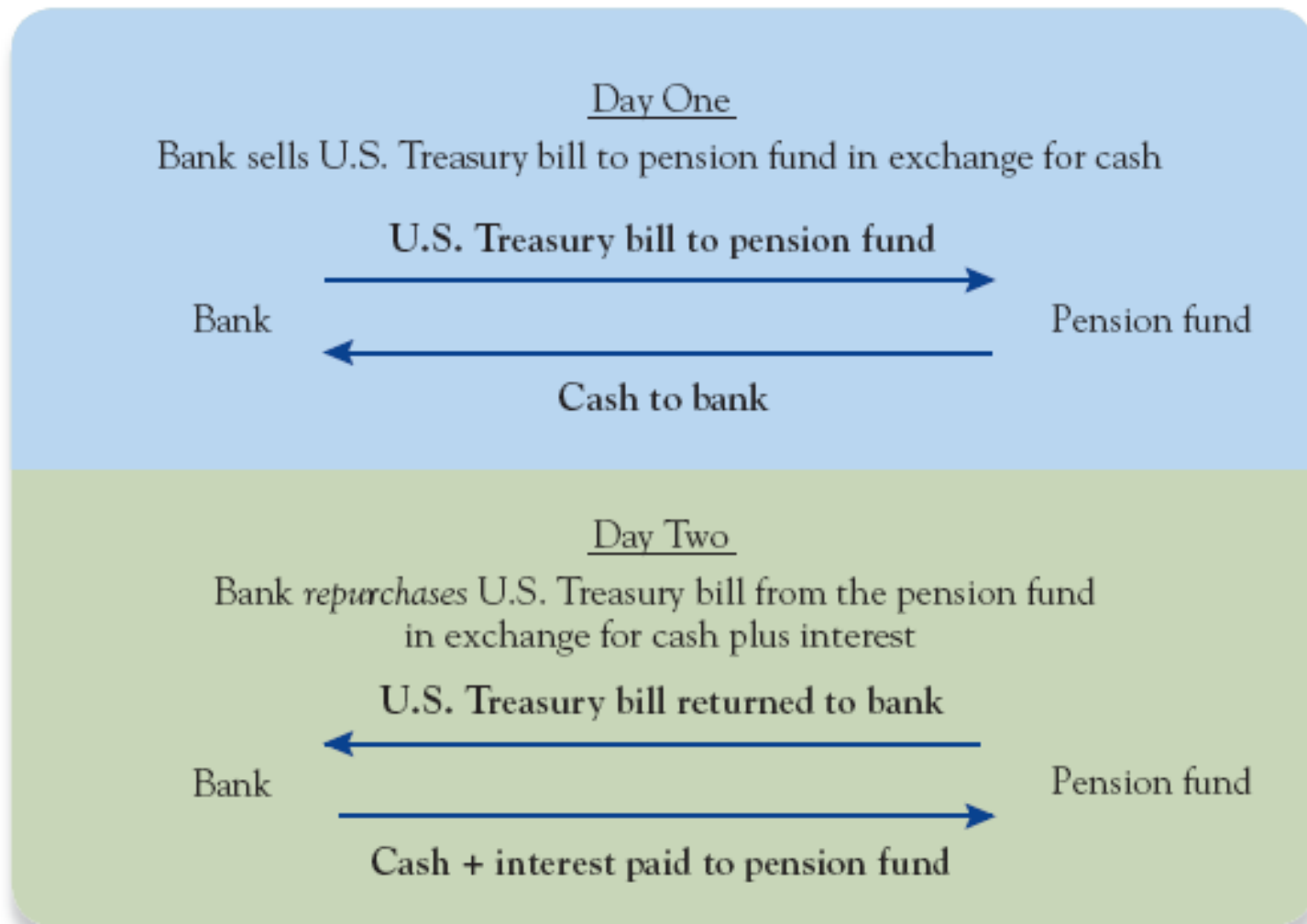# Borrowings

- Banks finally can borrow using an instrument called a repurchase agreement, or repo.
  - A short-term collateralized loan in which a security is exchanged for cash.
  - The parties agree to reverse the transaction on a specific future date.

Figure 12.3 Mechanics of an Overnight Repurchase Agreement

Day One

Bank sells U.S. Treasury bill to pension fund in exchange for cash

U.S. Treasury bill to pension fund

Bank → Pension fund

Cash to bank

Day Two

Bank *repurchases* U.S. Treasury bill from the pension fund
in exchange for cash plus interest

U.S. Treasury bill returned to bank

Bank ← Pension fund

Cash + interest paid to pension fund

Bank Risk

Table 12.3 Risks Banks Face and How They Manage Them

Type of Risk	Source of Risk	Recommended Responses
Liquidity Risk	Sudden withdrawals by depositors or takedowns of credit lines	1. Hold sufficient cash reserves to meet customer demand. 2. Manage assets–sell securities or loans (contracts the size of the balance sheet) 3. Manage liabilities–attract more deposits (maintains the size of the balance sheet)
Credit Risk	Default by borrowers on their loans	1. Diversify to spread risk. 2. Use statistical models to screen for creditworthy borrowers. 3. Monitor to reduce moral hazard.
Interest-Rate Risk	Mismatch in maturity of assets and liabilities coupled with a change in interest rates	1. Closely match the maturity of both sides of the balance sheet. 2. Use derivatives such as interest-rate swaps.
Trading (Market) Risk	Trading losses in the bank's own account	Closely monitor traders using risk management tools, including value at risk.

Liquidity Risk

- Liquidity risk is the risk of a sudden demand for liquid funds.

- Banks face liquidity risk on both sides of their balance sheets.

  - Deposit withdrawal is a liability-side risk.

  - Lines of credit are an asset-side risk.

- Even if a bank has a positive net worth, illiquidity can still drive it out of business.

- In the financial crisis of 2007-2009, banks could neither sell their illiquid assets nor obtain funding at a reasonable cost to hold those assets.

Dealing with Liquidity Risk

Figure 12.6 Balance Sheet of a Bank Following a $5 Million Withdrawal and Asset Adjustment

Withdrawal Is Met by Selling Securities

Assets		Liabilities	
Reserves	$10 million	Deposits	$95 million
Loans	$100 million	Borrowed funds	$30 million
Securities	$35 million	Bank capital	$20 million

Withdrawal Is Met by Reducing Loans

Assets		Liabilities	
Reserves	$10 million	Deposits	$95 million
Loans	$95 million	Borrowed funds	$30 million
Securities	$40 million	Bank capital	$20 million

Deposits initially at $100m; Loans at $100m, Securities at $40m

Dealing with Liquidity Risk

Balance Sheet of a Bank Following a $5 Million Withdrawal and Liability Adjustment

Withdrawal is Met by Borrowing

Assets		Liabilities	
Reserves	$10 million	Deposits	$95 million
Loans	$100 million	Borrowed funds	$35 million
Securities	$40 million	Bank capital	$20 million

Withdrawal is Met by Attracting Deposits

Assets		Liabilities	
Reserves	$10 million	Deposits	$100 million
Loans	$100 million	Borrowed funds	$30 million
Securities	$40 million	Bank capital	$20 million

Deposits initially at $100m; borrowed funds at $30m.

Credit Risk

- Credit risk analysis produces information that is very similar to the bond rating systems.

  – Banks do this for small firms wishing to borrow, and credit rating agencies perform the service for individual borrowers.

  – The result is an assessment of the likelihood that a particular borrower will default.

- In the financial crisis of 2007-2009, banks underestimated the risks associated with mortgage and other household credit.

Credit Risk/Capital Adequacy Management:
Screen assets or keep **high capital**

Commercial Bank (Before)			
Assets		Liabilities	
Reserves	$10M	Deposits	$90M
Loans (Mortgages, CRE) T-Bills Other bonds (GSEs)	$90M	Bank Capital (or "equity"	$10M

Commercial Bank (After)			
Assets		Liabilities	
Reserves	$10M	Deposits	$90M
Loans (Mortgages, CRE) T-Bills Other bonds (GSEs)	$81M	Bank Capital (or "equity")	$01M

Assume a $9 million loss to loans

Credit Risk/Capital Adequacy Management:
Consider in contrast a **low capital bank**

Commercial Bank (Before)			
Assets		**Liabilities**	
Reserves	$10M	Deposits	$95M
Loans (Mortgages, CRE) T-Bills Other bonds (GSEs)	$90M	Bank Capital (or "equity"	$5M

Commercial Bank (After)			
Assets		Liabilities	
Reserves	$10M	Deposits	$91M
Loans (Mortgages, CRE) T-Bills Other bonds (GSEs)	$81M	Bank Capital (or "equity")	$0M

Assume $9 million loss, no government intervention so that depositors take some losses

Bank Capital and Profitability

There are several measures of bank profitability.

1. Return on assets (ROA): ROA is the bank's profit left after taxes divided by the bank's total assets.

2. return on equity (ROE). The bank's return to its owners. This is the bank's net profit after taxes divided by the bank's capital.

3. Net interest income. Difference between interest rates on assets, liabilities.

4. Net interest margin. Net interest income divided by assets.

NB: "Leverage" is bank assets to capital

Capital Adequacy Management:
Returns to Equity Holders

Return on Assets: net profit after taxes per dollar of assets

$$\text{ROA} = \frac{\text{net profit after taxes}}{\text{assets}}$$

Return on Equity: net profit after taxes per dollar of equity capital

$$\text{ROE} = \frac{\text{net profit after taxes}}{\text{equity capital}}$$

Relationship between ROA and ROE is expressed by the

Equity Multiplier: the amount of assets per dollar of equity capital

$$\text{EM} = \frac{\text{Assets}}{\text{Equity Capital}}$$

$$\frac{\text{net profit after taxes}}{\text{equity capital}} = \frac{\text{net profit after taxes}}{\text{assets}} \times \frac{\text{assets}}{\text{equity capital}}$$

$$\text{ROE} = \text{ROA} \times \text{EM}$$

Incentives: High & Low Capital Banks

Commercial Bank (Before)			
Assets		**Liabilities**	
Reserves	$10M	Deposits	$90M @2%
Loans (Mortgages, CRE) T-Bills Other bonds (GSEs)	$90M @5%	Bank Capital (or "equity"	$10M

Commercial Bank (Before)			
Assets		**Liabilities**	
Reserves	$10M	Deposits	$95M @2%
Loans (Mortgages, CRE) T-Bills Other bonds (GSEs)	$90M @5%	Bank Capital (or "equity"	$5M

ROE for high capital firm = ((0.05-0.02)*90)/10 = 27%

ROE for low capital firm = (0.05*90-0.02*95)/5 = (2.6)/5 = 52%

Leverage in 2007
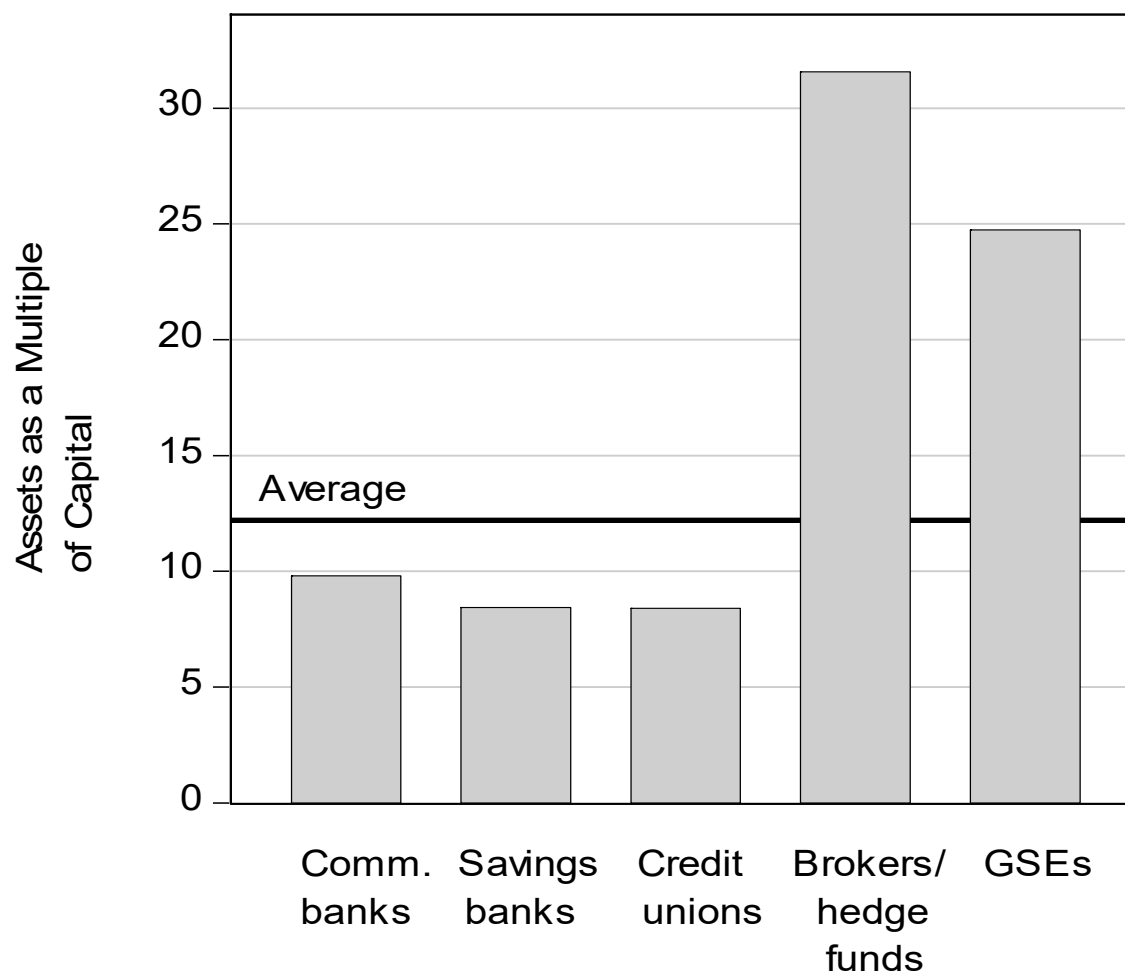
Leverage, measured as assets to capital, in the financial sector, in July-September 2007.
GSE's are Fannie Mae and Freddie Mac. Source: Greenlaw, Hatzius, Kashyap, and Shin (2008).

- *Mark-to-market* accounting rules require banks to adjust the recorded value of the assets on their balance sheets when the market value changes.

  – When the price falls, the value is "written down" and *writedowns* reduce a bank's capital.

- Banks don't like to hold a large capital cushion because capital is costly.

- The more leverage the greater the possible reward for each unit of capital and the greater the risk.

Interest-Rate Risk

- A bank's liabilities tend to be short-term, while assets tend to be long term.

  - The mismatch between the two sides of the balance sheet create interest-rate risk.

- When interest rates rise, banks face the risk that the value of their assets will fall more than the value of their liabilities, reducing the bank's capital.

  - Rising interest rates reduce revenues relative to expenses, directly lowering a bank's profits.

Interest-Rate Risk

- The term *interest-rate sensitive* means that a change in interest rates will change the revenue produced by an asset.

- When a bank's liabilities are more interest-rate sensitive than its assets, an increase in interest rates will cut into the bank's profits.

- Managers must compute an estimate of the change in the bank's profit for each one-percentage-point change in the interest rate.

- This procedure is called *gap analysis*.
  - This can be refined to take account of differences in the maturity of assets and liabilities, but it gets complicated

Interest-Rate Risk

- Bank managers can use a number of tools to manage interest-rate risk.

1. They can match the interest-rate sensitivity of assets with that of liabilities.

   - Although this decreases interest-rate risk, it increases credit risk.

2. Alternatives include the use of derivatives, specifically interest-rate swaps.

Table 12.2   An Example of Interest-Rate Risk

The impact of an interest-rate increase on bank profits (per $100 of assets)

	Assets	Liabilities
Interest-rate sensitive	$20	$50
Not interest-rate sensitive	$80	$50
Initial interest rate	5%	3%
New interest rate on interest-rate-sensitive assets and liabilities	6%	4%
	Revenue from Assets	**Cost of Liabilities**
At initial interest rate	(0.05 × $20) + (0.05 × $80) = $5.00	(0.03 × $50) + (0.03 × $50) = $3.00
After interest-rate change	(0.06 × $20) + (0.05 × $80) = $5.20	(0.04 × $50) + (0.03 × $50) = $3.50
Profits at initial interest rate: ($5.00) − ($3.00) = $2.00 per $100 in assets		
Profits after interest-rate change: ($5.20) − ($3.50) = $1.70 per $100 in assets		
Gap Analysis		
Gap between interest-rate-sensitive assets and interest-rate-sensitive liabilities:		
(Interest-rate-sensitive assets of $20) − (Interest-rate-sensitive liabilities of $50) = (Gap of −$30)		

Trading Risk

- Today banks hire traders to actively buy and sell securities, loans, and derivatives using a portion of the bank's capital.

- Risk that the instrument may go down in value rather than up is called trading risk, or *market risk*.

- Traders normally share in the profits from good investments, but the bank pays for the losses.
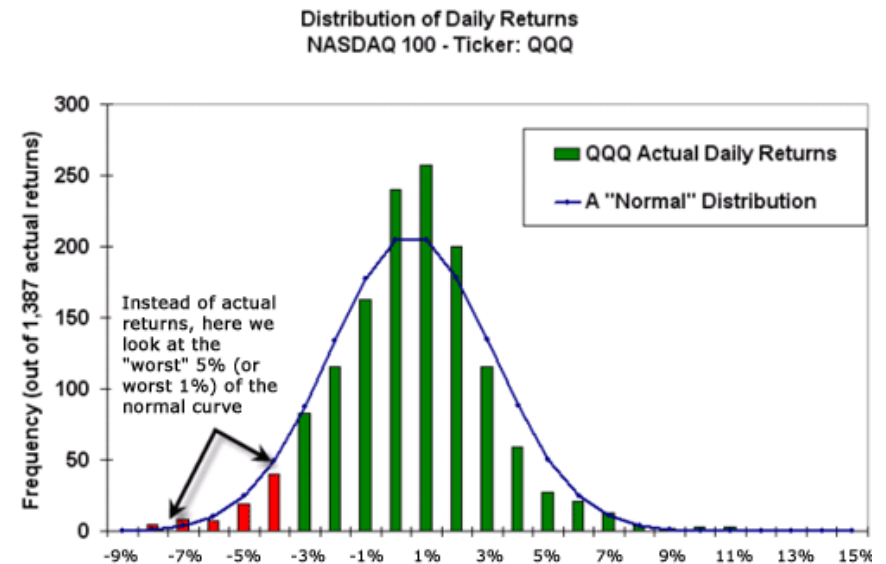 - This creates moral hazard - traders take more risk than the banks would like.
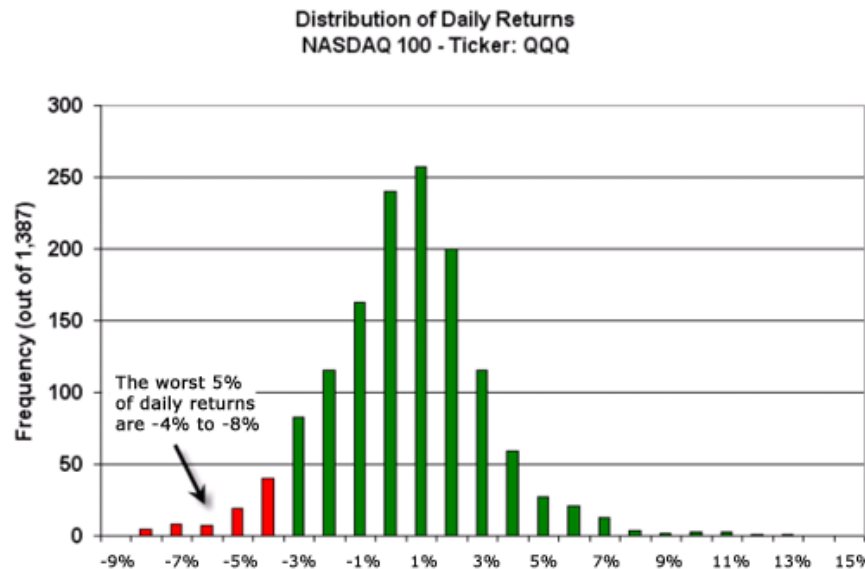
Trading Risk

- The solution to the moral hazard problem is to compute the risk the traders generate.

  – Use standard deviation and value at risk.

- The bank's risk manager limits the amount of risk any individual trader is allowed to assume and monitors closely.

- The higher the inherent risk in the bank's portfolio, the more capital the bank will need to hold.

Value at Risk (VaR)

A methodology that answers: What is the most I can - with a 95% or 99% level of confidence - expect to lose in dollars over the next month (or quarter or year)?

E.g. daily stock returns, historical, variance-covariance,(monte carlo)

Distribution of Daily Returns
NASDAQ 100 - Ticker: QQQ

The worst 5% of daily returns are -4% to -8%

Distribution of Daily Returns
NASDAQ 100 - Ticker: QQQ

QQQ Actual Daily Returns
A "Normal" Distribution

Instead of actual returns, here we look at the "worst" 5% (or worst 1%) of the normal curve

Caveats

- Variance-Covariance approach requires assumption of Normal or mixture of Normal distributions (first two moments summarize all information)
- Potentially many parameters need to be estimated
- Need to assume stability of parameters
- What if different distributions apply (jump-diffusion)
- Or much more non-Normal (Taleb and "black swan"