

Money Market I: Money Supply and the Banking System

Chapter 11

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Money Supply

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Questions Unanswered by Classical Model

- Questions left unanswered by Classical model
 - What is the role of the Fed?
 - What determines the price level?
 - Why do we have inflation?
- To address these questions, we need to understand the role of money in the economy

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What Is Money?

- Money is an asset that is widely accepted in payments for goods and services
 - E.g. coins and bills, but also checks and checking cards, and perhaps even some savings accounts



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Important Distinction

- Money is *not* the same thing as wealth
- Money is part of wealth which can be quickly used to make payments without a significant loss of value
 - Is your house money?
 - Is your car money?
 - Is checking card money?
 - Is \$100 bill money?

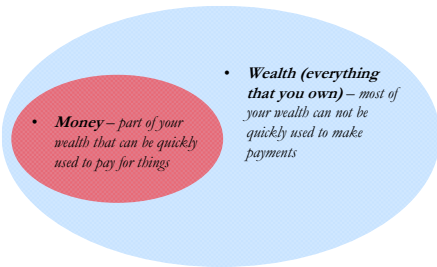
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Important Distinction

- Money is *not* the same thing as wealth
- Money is part of wealth which can be quickly used to make payments without a significant loss of value
 - Is your house money? **No**
 - Is your car money? **No**
 - Is checking card money? **Yes**
 - Is \$100 bill money? **Yes**

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Wealth and Money



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Measuring Stock of Money

- *Operational* definitions of money range from narrow to broad depending on the ease at which a given asset (part of wealth) can be converted into cash or used in transactions directly
 - The ease at which it can be done is referred to as **liquidity**
 - House is a very illiquid asset (especially nowadays)
 - \$100 bill is an extremely liquid asset

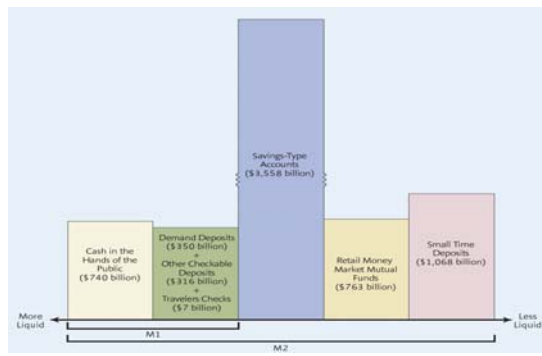
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Monetary Aggregates in the US

- *Operational* definitions of money in the US
 - M1 = cash in the hands of public + demand deposits + other checking accounts + travelers checks
 - M2 = M1 + some types of saving accounts that can be accessed quickly
- M0 refers to the *stock of all bills and coins in circulation*; considered too narrow to serve as a notion of money

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Comparison of M1 and M2 in the US



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Careful: Credit Cards Are Not Money

- Right to borrow is not an assets, and thus it is not money
 - C-cards do not settle the payment; they only allow to defer payments
 - To settle c-card balance one needs to come up with money eventually
 - It is true, however, that c-cards significantly reduce the need for money by allowing people to time transactions differently and pool them

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Why Do We Have Money?

- Money should be thought of as a *technological innovation* that allows to use resources more efficiently
 - Key role of money is to facilitate trade and exchange, which are fundamental to specialization and division of labor
 - *With* money, only *unilateral* coincidence of wants is required for trade to take place
 - *Without* money, *bilateral* coincidence is required

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Miracle of Modern Times

- In 70s, a so called fiat money system has been set in place
 - In this system, *money* is intrinsically worthless, but valuable by government declaration
- A self-fulfilling prophecy makes it work!
 - Since others believe a \$20 bill has a certain value, I also think it has this value...

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Money Creation: Why $M1 > M0$?

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Recall

- **M0** = all bill and coins in circulation = bills and coins in the hands of the public + bills and coins in the vaults of the banks
- **M1** = only bills and coins in the hands of the public + demand deposits + other checking accounts + traveler's checks
- Typically, $M1 > M0$... Why?

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Key Idea

- Suppose $M0 = \$100$
- Ask yourself:
 - Can it be that *cash in the hands of the public + demand deposits* $> \$100$?

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Key Idea

- Suppose $M0 = \$100$
- Ask yourself:
 - Can it be that *cash in the hands of the public + demand deposits* $> \$100$?
 - Yes, it can!

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Key Idea

- **Example:** Suppose Mr. X holds the \$100 bill, and he decides to deposit it in his checking account
 - Typical bank will keep, say, \$50 in the vault, and loan out the rest to some Mr. Y
 - **Result:** Mr. X has \$100 in his checking account, and Mr. Y gets \$50 in cash as a loan
 - $M0 = \$100$
 - $M1 = (\text{cash holdings of Mr. Y}) + (\text{demand deposit of Mr. X}) = \150

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Money Creation

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Key Players

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Key Players

- Banks (and other depository institutions) that operate checking accounts
- Federal Reserve System that prints high powered money (bills and coins)

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Banks

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Banks

- Core business of banks
 - Banks accept deposits and give loans
 - Profit on spread between interest accrued on deposits and interest charged on loans
- Main player: commercial bank
 - A private corporation owned by the stockholders
 - As a private corporation, its primary objective is to maximize profits for its owners

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Balance Sheet of a Bank

- Easiest way to understand operations of a bank is to look at its **balance sheet**
- Balance sheet provides information on
 - **Assets** = what the bank owns
 - **Liabilities** = what the bank owes
 - **Net worth** = Total assets - Total liabilities

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Balance Sheet of a Bank

- A balance sheet always balances
 - By definition: $\text{Assets} = \text{Liabilities} + \text{Net Worth}$
- It gives a useful snapshot of the financial standing of virtually any entity

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Analogy to a Balance of a Student

- Typical items on a balance sheet of a student would be
 - Assets – what the student owns: notebook, watch, moped, car, etc...
 - Liabilities - what student owes: student loan, credit card debt, etc...
 - $\text{Net worth} = \text{Total assets} - \text{Total liabilities} = \text{what student owns} - \text{what student owes}$

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A Sample Balance Sheet of a Bank

Assets		Liabilities	
Property and buildings	\$5 million	Demand deposit liability	\$100 million
Government and Corporate Bonds	\$25 million	Net Worth	\$ 5 million
Loans	\$65 million		
Cash in vault	\$2 million		
Cash in accounts with Fed	\$8 million		
Total assets	\$ 105 million	Total liabilities plus Net Worth	\$105 million

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Understanding Business of Banking

- Banks accept deposits from the public
- Deposits are the main source of funds for the bank
 - Because the bank owes the customers, deposits are its liability

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A Sample Balance Sheet of a Bank

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Total assets	\$ 105 million	Total liabilities plus Net Worth	\$105 million

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Understanding Business of Banking

- Typically, bank pays interest on deposits
- If the bank does not put deposits into good use, it will start losing money!

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Understanding Business of Banking

- To make profits, the banks must invest deposits in loans or other interest earning financial assets
 - These assets must pay interest higher than the one the bank pays on deposits
 - The spread between the interest rate accrued on deposits and charged on loans is what the bank lives off

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A Sample Balance Sheet of a Bank

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Property and buildings	\$5 million	Demand deposit liability	\$100 million
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Cash in vault	\$2 million		
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Understanding Business of Banking

- Banks also need to hold some reserves to stay afloat on a daily basis
 - Holding reserves is costly for the bank because they do not earn any interest
 - Banks try to keep as small reserves as possible to stay afloat

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A Sample Balance Sheet of a Bank

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Cash in vault	\$2 million		
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Total assets	\$ 105 million	Total liabilities plus Net Worth	\$105 million

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Required Reserves

- Some reserves are required by law
 - Reserves = Vault cash plus balances held at the Fed
 - Required reserves = Minimum amount of reserves a bank must hold
- Required reserves depend on the amount of deposit liabilities
- Bank must comply with the so called **required reserve ratio (RRR) = required reserves/deposits**

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A Sample Balance Sheet of a Bank

Assets		Liabilities	
Property and buildings	\$5 million	Demand deposit liability	\$100 million
Government and Corporate Bonds	\$25 million	Net Worth	\$ 5 million
Loans	\$65 million	Reserves to deposit ratio of this bank is $(\$2+\$8)/\$100=10\%$	
Cash in vault	\$2 million		
Cash in accounts with Fed	\$8 million		
Total assets	\$ 105 million	Total liabilities plus Net Worth	\$105 million

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Key Take Aways So Far

- Banks exploit the fact that it is highly unlikely for all depositors to withdraw their money at the same time
- This way, reserves of a bank can be *much* lower than its total deposit liabilities, and the rest of the funds can be safely loaned out to make profits

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The Federal Reserve System

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The Federal Reserve System

- The Federal Reserve System
 - A nation's principal monetary authority created by Congress in 1913
 - Responsible for managing the money supply and regulating banking industry
 - Has direct control over the stock of high powered money (bills and coins) in circulation
 - Not a part of any branch of government!

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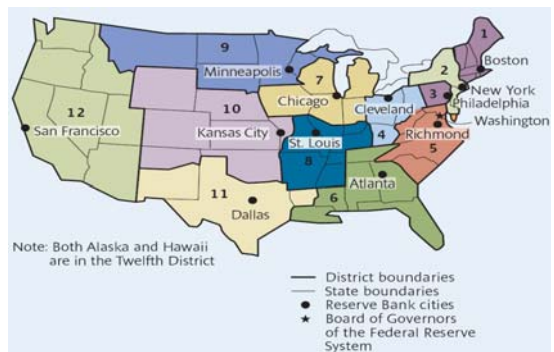
The Federal Reserve System



- Fed = Twelve Federal Reserve District Banks + Board of Governors
 - Federal Reserve District Banks
 - Fed's agencies that represent Fed in a given part of the country
 - Gather local information on the economy, represent local interests at the Board
 - Board of Governors = main managing body of the Federal Reserve System (the brain)

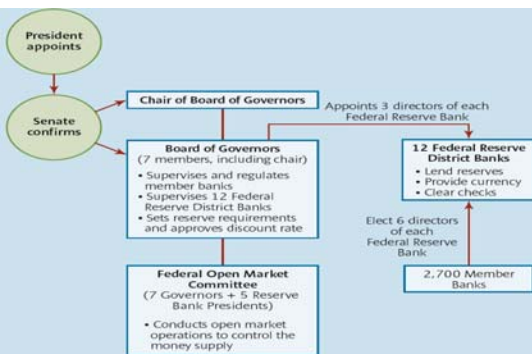
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Geography of the Fed



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Internal Structure of the Fed



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Idea Underlying the Structure of Fed

- Fed is a non-profit, publicly chartered organization; its structure reflects two major goals
 - Independence from the government and day-to-day political goals the government might have
 - Balance between regional interests and federal interests

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Mechanics Behind Money Creation

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Mechanics Behind Money Creation

- How does the Fed inject new bills and coins into the monetary system?
- How the stock of bills and coins (monetary base) that the Fed injects into circulation translates into money supply M1?

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Monetary Base and Fed's Policy

- Fed uses so called **open market operations** to **directly** control (change) monetary base M0

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Open Market Operations

- **Open market operation** is a sale or a purchase of bonds by the Fed in the open market
 - Bonds are assets that promise future payment – issued by the government or corporations

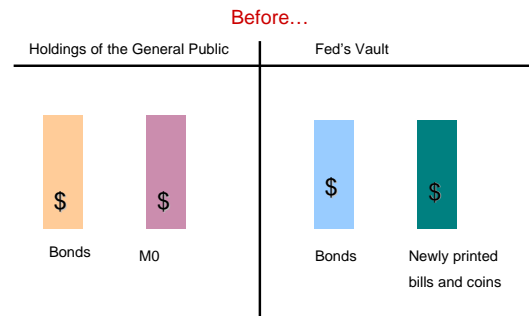
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Open Market Operations

- When Fed **sells bonds** in the open market, it **decreases** the stock of M0
 - Such policy is called **monetary contraction**
- When Fed **buys bonds** in the open market, it **increases** the stock of M0
 - Such policy is called **monetary expansion**

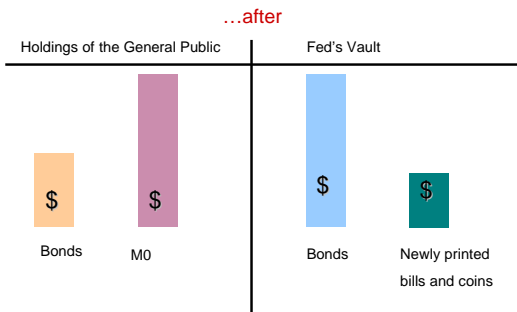
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Open Market Purchase by the Fed



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Open Market Purchase by the Fed



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Effect on Money Supply

- Say the FED buys \$1000 worth of bonds in the open market
- **What happens to M0 and M1?**
 - Simplifying assumptions:
 - Households and businesses – do not hold cash – all money is held in checking accounts
 - Banks hold no excess reserves (reserves in excess of the required reserves)

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Hypothetical Scenario

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A Hypothetical Scenario

- FED writes a \$1000 check to pay the dealer of bonds
- Dealer deposits the check in their bank, say First National, and gives the FED \$1000 of bonds
- First National cashes the check at the FED, and deposits the money in its account with the FED
 - This way \$1000 of monetary base (M0) is injected into the system, but it does not end here due to money creation by banks...

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Balance Sheet of First National

Assets		Liabilities	
Property and buildings	unchanged	Demand deposit liability	+\$1000
Government and Corporate Bonds	unchanged	Net Worth	unchanged
Loans	unchanged		
Cash in vault	unchanged		
Cash in accounts with Fed	+\$1000		
Total assets	+\$1000	Total liabilities plus Net Worth	+\$1000

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First Round of Money Creation

- Assuming RRR=10%, First National has \$900 in excess reserves
 - i.e. reserves in excess of required reserves of $RRR * \$1000$
- To maximize profits, First National will seek to loan out excess reserves of \$900 to someone, say, Paula's Pizza...

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Balance Sheet of First National

Assets		Liabilities	
Property and buildings	unchanged	Demand deposit liability	+\$1000
Government and Corporate Bonds	unchanged	Net Worth	unchanged
Loans	+\$900		
Cash in vault	unchanged		
Cash in accounts with Fed	+\$1000-\$900		
Total assets	+\$1000	Total liabilities plus Net Worth	+\$1000

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- ...Paula's Pizza will deposit the check from First National in, say, Second United...

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Paula's Pizza Gets a Loan

First United

Assets		Liabilities	
Property and buildings	unchanged	Demand deposit liability	+\$1000
Government and Corporate Bonds	unchanged	Net Worth	unchanged
Loans	+\$900		
Cash in vault	unchanged		
Cash in accounts with Fed	+\$1000-\$900		
Total assets	+\$1000	Total liabilities plus Net Worth	+\$1000

Second United

Assets		Liabilities	
Property and buildings	unchanged	Demand deposit liability	+\$900
Government and Corporate Bonds	unchanged	Net Worth	unchanged
Loans	unchanged		
Cash in vault	unchanged		
Cash in accounts with Fed	+\$900		
Total assets	+\$900	Total liabilities plus Net Worth	+\$900

Paula's Pizza
(deposit of \$900)

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Balance Sheet of Second United

Assets		Liabilities	
Property and buildings	unchanged	Demand deposit liability	+\$900
Government and Corporate Bonds	unchanged	Net Worth	unchanged
Loans	unchanged		
Cash in vault	unchanged		
Cash in accounts with Fed	+\$900		
Total assets	+\$900	Total liabilities plus Net Worth	+\$900

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Second Round of Money Creation

- Assuming RRR=10%, Second United has $(1 - \text{RRR}) * \$900 = \810 in excess reserves
- Second United will seek to loan out excess reserves of \$900 to someone, say, John's Burgers...

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Balance Sheet of Second United

Assets		Liabilities	
Property and buildings	unchanged	Demand deposit liability	+\$900
Government and Corporate Bonds	unchanged	Net Worth	unchanged
Loans	+\$810		
Cash in vault	unchanged		
Cash in accounts with Fed	+\$900-\$810		
Total assets	+\$900	Total liabilities plus Net Worth	+\$900

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- ...John's Burgers deposits the check from Second United in, say, Third State Bank...

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John's Burgers Gets a Loan

Second United				Third State			
Assets		Liabilities		Assets		Liabilities	
Property and buildings	unchanged	Demand deposit liability	+\$900	Property and buildings	unchanged	Demand deposit liability	+\$810
Government and Corporate Bonds	unchanged	Net Worth	unchanged	Government and Corporate Bonds	unchanged	Net Worth	unchanged
Loans	+\$810			Loans	unchanged		
Cash in vault	unchanged			Cash in vault	unchanged		
Cash in accounts with Fed	+\$900-\$810			Cash in accounts with Fed	\$810		
Total assets	+\$900	Total liabilities plus Net Worth	+\$900	Total assets	+\$900	Total liabilities plus Net Worth	+\$900

John's Burgers

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John's Burgers Gets a Loan

First United				Second United				Third State			
Assets		Liabilities		Assets		Liabilities		Assets		Liabilities	
Property and buildings	unchanged	Demand deposit liability	+\$1000	Property and buildings	unchanged	Demand deposit liability	+\$900	Property and buildings	unchanged	Demand deposit liability	+\$810
Government and Corporate Bonds	unchanged	Net Worth	unchanged	Government and Corporate Bonds	unchanged	Net Worth	unchanged	Government and Corporate Bonds	unchanged	Net Worth	unchanged
Cash in vault	unchanged			Cash in vault	unchanged			Cash in vault	unchanged		
Cash in accounts with Fed	+\$1000			Cash in accounts with Fed	+\$900-\$810			Cash in accounts with Fed	\$810		
Total assets	+\$1000	Total liabilities plus Net Worth	+\$1000	Total assets	+\$900	Total liabilities plus Net Worth	+\$900	Total assets	+\$900	Total liabilities plus Net Worth	+\$900

Initial \$1000 deposit by Lehman Brothers

Paula's Pizza (deposit of \$900)

John's Burgers (deposit of \$810)

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- ...the process continues...

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Overall Result

Cumulative Increases in Demand Deposits

Round	Additional Demand Deposits Created by Each Bank	Additional Demand Deposits Created by All Banks
First National Bank	\$1,000	\$1,000
Second United	\$ 900	\$1,900
Third State	\$ 810	\$2,710
Bank 4	\$ 729	\$3,439
Bank 5	\$ 656	\$4,095
Bank 6	\$ 590	\$4,685
...		
Bank 10	\$ 387	\$6,511
...		
Bank 20	\$ 135	\$8,784
...		
Bank 50	very close to zero	very close to \$10,000

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Overall Result

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Bank 50	very close to zero	very close to \$10,000

Excess reserves of First National that are loaned out...

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...		
Bank 10	\$ 387	\$6,511
...		
Bank 20	\$ 135	\$8,784
...		
Bank 50	very close to zero	very close to \$10,000

Excess reserves of Second United that are loaned out...

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Overall Result

Cumulative Increases in Demand Deposits

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...		
Bank 10	\$ 387	\$6,511
...		
Bank 20	\$ 135	\$8,784
...		
Bank 50	very close to zero	very close to \$10,000

Excess reserves of Third State that are loaned out...

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Overall Result

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...		
Bank 10	\$ 387	\$6,511
...		
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...		
Bank 50	very close to zero	very close to \$10,000

At one point there are almost no excess reserves left, and the process gradually dies out

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Overall Result

Cumulative Increases in Demand Deposits

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First National Bank	\$1,000	\$1,000
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Bank 6	\$ 590	\$4,685
...		
Bank 10	\$ 387	\$6,511
...		
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...		
Bank 50	very close to zero	very close to \$10,000

\$10,000 is created as a result (in new demand deposits)

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Why M1 Increases by \$10,000?

- Due to the fact that banks retain some reserves as required reserves at each stage of money creation, the process dies out eventually
- The \$1000 in additional reserves injected by the Fed, ends up being held as required reserves only in the banking system

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Why M1 Increases by \$10,000?

- We can calculate it, by summing up additional deposits created at each stage
- Increase in money supply
 $\Delta M = \$1000+$
 $+(1-RRR)*\$1000+$
 $+(1-RRR)*(1-RRR)*\$1000+$
 $+(1-RRR)*(1-RRR)*(1-RRR)*\$1000+...$
- How to calculate such sum?

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Why M1 Increases by \$10,000?

- **Step 1:** Pull out (1-RRR) in front of the bracket starting from the second term on
 $\Delta M = \$1000+$
 $+(1-RRR)*\$1000+$
 $+(1-RRR)*(1-RRR)*\$1000+$
 $+(1-RRR)*(1-RRR)*(1-RRR)*\$1000+...$

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Why M1 Increases by \$10,000?

- **Step 1:** Pull out (1-RRR) in front of the bracket starting from the second term on
 $\Delta M = \$1000+$
 $+(1-RRR)*[\$1000+$
 $+(1-RRR)*\$1000+$
 $+(1-RRR)*(1-RRR)*\$1000+...]$

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Why M1 Increases by \$10,000?

- **Step 2:** Note that the expression in the red bracket [...] is exactly analogous to the original formula for ΔM in step 1
 $\Delta M = \$1000+$
 $+(1-RRR)*[\$1000+$
 $+(1-RRR)*\$1000+$
 $+(1-RRR)*(1-RRR)*\$1000+...]$

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Why M1 Increases by \$10,000?

- **Step 2:** Note that the expression in the red bracket [...] is exactly analogous to the original formula for ΔM in step 1
 $\Delta M = \$1000+$
 $+(1-RRR)*\Delta M$

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Why M1 Increases by \$10,000?

- **Step 3: Calculate ΔM**
 $\Delta M = \$1000 + (1 - RRR) * \Delta M$,
 $\Delta M = \$1000 + \Delta M - RRR * \Delta M$,
 $RRR * \Delta M = \$1000$, and so
 $\Delta M = \$1000 / RRR$

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Recap

- Open market purchase of bonds
 - The Fed purchases government bonds
 - Injection of reserves (positive change in reserves)
 - Increase in the money supply

$$\Delta M = \left(\frac{1}{RRR} \right) \times \Delta \text{Reserves}$$

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Open Market Sales?

- Open market **sales** of bonds (has the opposite effect)
 - The Fed **sells** government bonds
 - **Withdrawal** of M0 (**negative** change in reserves of banking system)
 - **Decrease** in the money supply M1

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Other Tools of the Fed

- **Open market operations OMO are not the only tool** used by the Fed to change money supply
- Fed sets the interest rate at which it lends funds to the banks 'in urgent need' – so called **discount rate DW**
- Fed also sets **required reserve ratio RRR**
- In practice, Fed uses OMO to conduct monetary policy – but recently started to use DW actively

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Other Tools of the Fed

- **Lower** discount rate or lower RRR is another way to conduct monetary **expansion**
 - Likely to result in **increase in monetary base**
- **Higher** discount rate or higher RRR is another way to conduct monetary **contraction**
 - Likely to result in **decrease in monetary base**

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How Does Discount Window Work?

$$M = \left(\frac{1}{RRR} \right) \times \text{Reserves}$$

- When Banks borrow from Fed, and lower discount rate encourages them to do so, reserves go up in the banking system (Reserves \uparrow)
- When RRR \downarrow , more money is created from the same amount of reserves

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