



Central banking and monetary policy

Chapter 15 - 17

Learning Objectives

1. Central banking and goals of central bank
2. Monetary policy and the Structure of central bank
3. Central bank balance sheets and controlling money supply

CENTRAL BANKING AND GOALS OF CENTRAL BANK

The Functions of a Modern Central Bank

1. *The Government's Bank*

- a. Executes financial transactions for the government.
- b. Through interest rates, controls the availability of money and credit.

2. *The Bankers' Bank*

- a. Guarantees that sound intermediaries can do business by *lending* to them, even during crises.
- b. Operates a *payments system* for interbank payments.
- c. Oversees financial institutions to ensure confidence in their soundness.

Stability: The Primary Objective of All Central Banks

- Government involvement is justified by the presence of externalities or **public goods**.
- Economic and financial systems, when left on their own, are **prone to episodes of extreme volatility**.

Stability: The Primary Objective of All Central Banks

We can easily see examples of failure:

1. The Great Depression of the 1930's when the banking system collapsed.
 - Economic historians state that the Fed failed to provide adequate money and credit.
2. The crisis of 2007-2009
 - The Fed was largely passive as intermediaries took on increasing risk amid the housing bubble.
 - It also allowed the crisis to intensify for more than a year after it had begun.

Stability: The Primary Objective of All Central Banks

Modern central bankers work to **reduce the volatility** of the economic and financial systems by pursuing five specific objectives:

1. Low and stable inflation
2. High and stable real growth, together with high employment
3. Stable financial market and institutions
4. Stable interest rates
5. A stable exchange rate

Stability: The Primary Objective of All Central Banks

- ***The job of the central bank is to improve general economic welfare by managing and reducing systematic risk.***
- Instability in any of these five objectives poses a systematic or economy-wide risk.
- It is probably impossible to achieve all five of their objectives simultaneously.
 - Tradeoffs must be made.

Low, Stable Inflation

- Many central banks take their primary job as the maintenance of **price stability**.
 - They strive to eliminate inflation.
 - The consensus is that when inflation rises too high or falls too low for an extended period, the central bank is at fault.
- The purchasing power of one dollar, one yen, or one euro should remain stable over long periods of time.
- Maintaining price stability enhances money's usefulness both as a unit of account and as a store of value.

Low, Stable Inflation

- Prices provide the information individuals and firms need to ensure that resources are allocated to their most productive uses.
- But volatile inflation degrades the information content of prices.
- If the economy is to run efficiently, we need to be able to tell the reason why prices are changing.

Low, Stable Inflation

- The higher inflation is, the less predictable it is, and the more systematic risk it creates.
- High inflation is also bad for growth.
- In cases of **hyperinflation**,
 - Prices contain virtually no information, and
 - People use all their energy just coping with the crisis so growth plummets.

Low, Stable Inflation

- Most people agree that low inflation should be the primary objective of monetary policy.
- Zero inflation is probably too low.
 - There would be a risk of deflation.
 - This makes debts more difficult to repay, increasing default, affecting the health of banks.
- Zero inflation would also be difficult for companies.
 - If an employer wished to cut labor costs, it would need to cut nominal wages which is difficult to do.
- So, a small amount of inflation makes labor markets work better, at least from an employer's point of view.



YOUR FINANCIAL WORLD

Why Inflation Is Bad for You

- High inflation is more volatile than low inflation.
- Volatile inflation means more risk which requires compensation.
- High inflation means a higher risk premium, so loan rates are higher.
- Volatile inflation makes long-term planning even more difficult.

High & Stable Real Growth

- To foster maximum sustainable growth in output and employment has been one of the goals of central banks.
 - This means working to dampen the fluctuations of the business cycle.
- By adjusting interest rates, central bankers work to moderate these cycles and stabilize growth and employment.

High & Stable Real Growth

- The idea is that there is some long-run *normal* level of production called **potential output**, which depends on things like
 - Technology
 - The size of the capital stock
 - The number of people who can work
 - Usual working hours.
- Growth in these *inputs* leads to growth in *potential output* -- **sustainable growth**.

High & Stable Real Growth

- A period of above-average growth has to be followed by a period of below-average growth.
- The job of the central bank during such periods is to change interest rates to adjust growth.
- In the long run, stability leads to higher growth.
 - The greater the uncertainty about future business conditions, the more cautious people will be in making investments of all kinds.

High & Stable Real Growth

- Fluctuations in general business conditions are the primary source of systematic risk, so stability is important.
- Uncertainty about the future make planning more difficult, so less uncertainty makes everyone better off.

Financial System Stability

- **Financial system stability** is an integral part of every modern central banker's job.
- If people lose faith in financial institutions and markets, they will rush to low-risk alternatives.
 - Intermediation will stop.
- The possibility of a severe disruption in the financial markets is a type of **systematic risk**.
 - Central banks must control this risk.

Interest-Rate and Exchange-Rate Stability

- In the hierarchy, *interest-rate stability* and *exchange-rate stability* are means for achieving the ultimate goal of stabilizing the economy.
 - They are not ends unto themselves.

Interest-Rate and Exchange-Rate Stability

Why is interest-rate volatility a problem?

1. Most people respond to low interest rates by borrowing and spending more and vice versa.
 - Interest-rate volatility makes output unstable.
2. Interest-rate volatility means higher risk and therefore a higher risk premium.
 - Risk makes financial decisions more difficult, lower productivity, and lessen efficiency.

Interest-Rate and Exchange-Rate Stability

- The value of a country's currency affects the cost of imports to domestic consumers and the cost of exports to foreign buyers.
- When the exchange rate is stable, the dollar price of goods is predictable and planning ahead is easier for everyone.
- For emerging market countries, exports and imports are central to the structure of the economy.
 - Stable exchange rates are very important.

The Objectives of a Modern Central Bank

- | | |
|--------------------------------------|---|
| 1. <i>Low, stable inflation</i> | Inflation creates confusion and makes planning difficult. When inflation is high, growth is low. |
| 2. <i>High, stable growth</i> | Stable, predictable growth is higher than unstable, unpredictable growth. |
| 3. <i>Financial system stability</i> | Stable financial markets and institutions are a necessity for an economy to operate efficiently. |
| 4. <i>Stable interest rates</i> | Interest-rate volatility creates risk for both lenders and borrowers. |
| 5. <i>Stable exchange rates</i> | Variable exchange rates make the revenues from foreign sales and the cost of purchasing imported goods hard to predict. |

Creating a Successful Central Bank

- Prior to the global financial crisis of 2007-2009, inflation was low and stable for over 25 years
- Technology sparked a boom just as central banks became better at their jobs.
 1. Monetary policymakers realized that sustainable growth had gone up, so they could keep interest rates low without worrying about inflation.
 2. Central banks were redesigned.

Creating a Successful Central Bank

- To be successful, a central bank must:
 1. Be independent of political pressure.
 2. Be accountable to the public and transparent in communicating its policy actions.
 3. Operate within an explicit framework that clearly states its goals and makes clear the trade-offs among them.
 4. Make decisions by committee.

The Need for Independence

- The idea of **central bank independence**, that central banks should be independent of **political pressure**, is a new one.
- Independence has two operational components:
 1. Monetary policymakers must be free to control their own budgets.
 2. The bank's policies must not be reversible by people outside the central bank.
 - The Committee's decisions cannot be overridden by the President, Congress or the Supreme Court.

The Need for Independence

- Successful monetary policy requires a long time horizon.
 - The temptation to forsake long-term goals for short-term gains is impossible for most politicians to resist, i.e. politically-driven business cycle
- Knowing these tendencies, governments have moved responsibility for monetary policy into a separate, largely apolitical, institution.



APPLYING THE CONCEPT

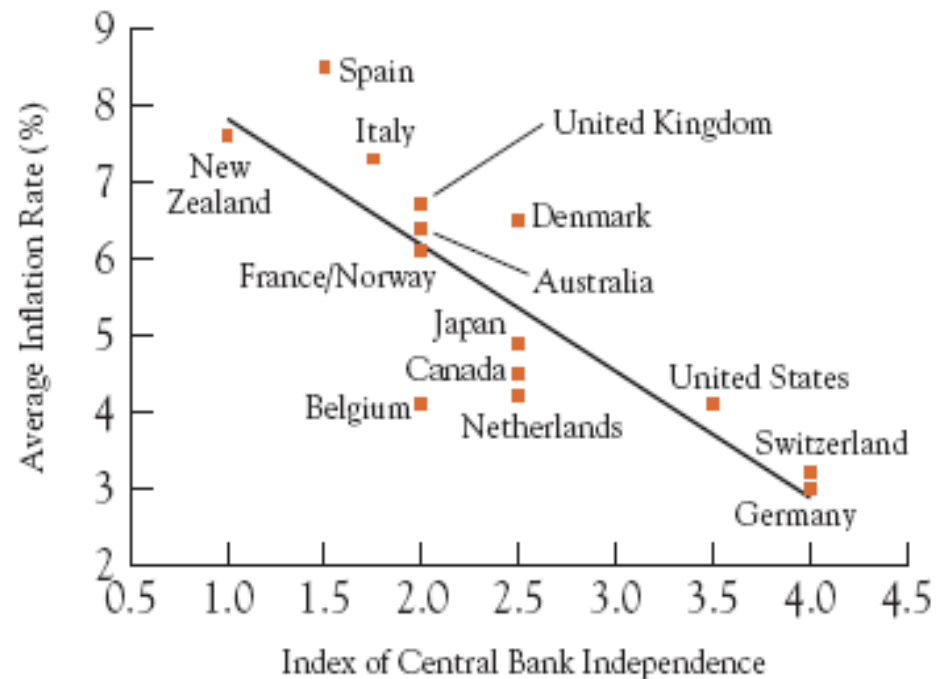
INDEPENDENT
CENTRAL BANKS
DELIVER LOWER
INFLATION

What drove politicians to give up control over monetary policy?

Realization that independent central bankers would deliver lower inflation than they themselves could.

Figure 15.1

Inflation and Central Bank Independence 1973-1988



The Need for Accountability and Transparency

1. Politicians would establish a set of goals.
2. The policymakers would publicly report their progress in pursuing those goals.
 - Explicit goals foster **accountability** and disclosure requirements create **transparency**.
 - Legislatures usually grant central banks **instrument independence** not **goal independence**
 - The institutional means for assuring accountability and transparency differ from one country to the next.

The Need for Accountability and Transparency

- Today every central bank announces its policy actions almost immediately.
 - However the extent of the statements that accompany the announcement and the willingness to answer questions vary.
- Central bank statements are far more informative today than they were in the early 1990s.
 - Secrecy is now understood to damage both the policymakers and the economies they are trying to manage.

The Need for Accountability and Transparency

- The economy and financial markets should respond to information that everyone received, not to speculation about what policymakers are doing.
 - Policy makers need to be as clear as possible.
- Transparency can help counter the uncertainties and anxieties that feed liquidity and deleveraging spirals.

The Policy Framework, Policy Tradeoffs, and Credibility

- To meet these objectives, central bankers must be independent, accountable, and good communicators.
- These qualities make up the **monetary policy framework**.
 - This exists to resolve ambiguities that arise in the course of the central bank's work.
 - Officials have told us what they are going to do.
 - This helps people plan and keeps officials accountable to the public.

The Policy Framework, Policy Tradeoffs, and Credibility

- The monetary policy framework also clarifies the likely responses when goals conflict with one another.
- All objectives cannot be reached at the same time, and often the Fed only has one instrument.
 - It is impossible to use a single instrument to achieve a long list of objectives.
- The goal of keeping inflation low and stable, then, can be inconsistent with the goal of avoiding a recession.

The Policy Framework, Policy Tradeoffs, and Credibility

- Central bankers face the tradeoff between inflation and growth on a daily basis.
 - In 2008 the FOMC judged that it was more important to cut the policy rate in an effort to halt the financial contagion that has resulted from the run on Bear Stearns.
 - Policymakers were forced to choose among competing objectives amid great uncertainty.

The Policy Framework, Policy Tradeoffs, and Credibility

- Because policy goals often conflict, central bankers must make their priorities clear.
- The public needs to know:
 - What policymakers are focusing on and what they are willing to allow to change, and
 - The roles that interest-rate and exchange-rate stability play in policy deliberations.
- This limits the discretionary authority of the central bankers, ensuring that they will do the job with which they have been entrusted.

The Policy Framework, Policy Tradeoffs, and Credibility

- Finally, a well designed policy framework helps policy makers establish **credibility**.
 - For central bankers to achieve their objectives, everyone must trust them to do what they say they are going to do.
- Expected inflation creates inflation.
 - Successful monetary policy, then, requires that inflation expectations be kept under control.

Decision Making by Committee

- During normal operations, it is better to rely on a committee than an individual.
- Pooling the knowledge, experience, and opinions of a group of people reduces the risk that policy will be dictated by an individual's quirks.
 - Vesting so much power in one individual also poses a legitimacy problem.
- Therefore, monetary policy decisions are made by committee in all major central banks in the world.

The Principle of Central Bank Design

1. *Independence*

To keep inflation low, monetary decisions must be made free of political influence.

2. *Accountability and transparency*

Policymakers must be held accountable to the public they serve and clearly communicate their objectives, decisions, and methods.

3. *Policy framework*

Policymakers must clearly state their policy goals and the tradeoffs among them.

4. *Decision making by committee*

Pooling the knowledge of a number of people yields better decisions than decision making by an individual. But effective crisis response requires a clear chain of command.

CENTRAL BANK BALANCE SHEET AND MONEY SUPPLY CONTROL

The Central Bank's Balance Sheet

Figure 17.1

The Central Bank's Balance Sheet

Assets		Liabilities
Government's bank	Securities	Currency
	Foreign exchange reserves	Government's account
Bankers' bank	Loans	Accounts of the commercial banks (reserves)

The Central Bank's Balance Sheet

- The central bank's balance sheet shows three basic assets:
 - Securities,
 - Foreign exchange reserves, and
 - Loans.
- The first two are needed so that the central bank can perform its role as the government's bank.
- The loans are a service to commercial banks.

Assets

1. *Securities* are the primary asset of most central banks.
 - Traditionally, the Fed exclusively held Treasury securities, which are virtually free of default risk.
 - During the 2007-2009 crisis, the central bank chose to acquire a variety of risky assets.
 - The quantity of securities it holds is controlled through purchases and sales known as ***open market operations***.

Assets

2. **Foreign exchange reserves** are the central bank's and government's balances of foreign currency.
 - These are held in the form of bonds issued by foreign governments.
 - These reserves are used in **foreign exchange interventions**, when officials attempt to change the market values of various currencies.

Assets

3. *Loans* are usually extended to commercial banks.
 - In 2008 and 2009, the Fed made substantial loans to nonbanks as well.
 - **Discount loans** are the loans the Fed makes when commercial banks need short-term cash.
 - Through its liquid securities holdings, the Fed controls the federal funds rate and the availability of money and credit.

Liabilities

- On the liabilities side of the central bank's balance sheet, we see three major entries:
 - Currency,
 - The government's deposit account
 - The deposit accounts of the commercial banks
- The first two items allow the central bank to perform its role as the government's bank, while the third allows it to fulfill its role as the bankers' bank.

Liabilities

1. *Currency.* Nearly all central banks have a monopoly on the issuance of the currency used in everyday transactions.
 - Currency circulating in the hands of the nonbank public is the principal liability of most central banks.

Liabilities

2. *Government's account.* Governments need a bank account like the rest of us.
- The central bank provides the government with an account into which the government deposits funds (mostly tax revenue) and from which the government makes payments.
 - By shifting funds between its accounts at commercial banks and the Fed, the Treasury usually keeps its account balance at the Fed fairly constant.

Liabilities

3. *Commercial Bank accounts (reserves).*
- Commercial bank reserves are the sum of two parts: Deposits at the central bank, *plus* the cash in the bank's own vault.
 - In the same way that you can take cash out of a commercial bank, the bank can withdraw its deposits at the central bank.
 - **Vault cash** is part of reserves.
 - Reserves are assets of the commercial banking system and liabilities of the central bank.

Liabilities

- Of the central bank's liabilities, bank reserves are the most important in determining the quantity of money and credit in the economy
- Central banks run their monetary policy operations through changes in these reserves.
- There are two types of reserves.
 - **Required reserves** that banks must hold
 - **Excess reserves**, which banks hold voluntarily.

The Monetary Base

- Together, currency in the hands of the public and reserves in the banking system make up the **monetary base**.
 - This is the privately held liabilities of the central bank.
 - It is also called **high-powered money**.
- The central bank can control the size of the monetary base.
 - When the monetary base increases by a dollar, the quantity of money typically rises by several dollars.

Changing the Size and Composition of the Balance Sheet

- Policymakers can enlarge or reduce their assets and liabilities at will, without asking anyone.
- What is the difference between a purchase you make and one the central bank makes?
 - To pay for the bond, the central bank writes a \$1 million check payable to the bond dealer.
 - The dealer's commercial bank account is credited with \$1 million when the check is deposited.
 - The commercial bank then sends the check back to the central banks.
 - The central bank credits the reserve account of the bank presenting the \$1 million.

Changing the Size and Composition of the Balance Sheet

- The central bank can simply buy things and then create liabilities to pay for them.
 - It can increase the size of its balance sheet as much as it wants.
- We will look at four types of transactions taken by the central bank.
 - Each of these have an impact on both the central bank's balance sheet and the banking system's balance sheet.

Changing the Size and Composition of the Balance Sheet

1. Open Market Operation
 - Buying or selling a security initiated by the central bank.
2. Foreign Exchange Intervention
 - Buy or sell foreign exchange reserves initiated by the central bank.
3. Extend a discount loan
 - Initiated by commercial banks.
4. Decision by an individual to withdraw cash from their bank
 - Initiated by the nonbank public.

Changing the Size and Composition of the Balance Sheet

- When the value of an asset on the balance sheet increases, one of two things happens so that the net change is zero:
 - The value of another asset decreases, or
 - The value of a liability rises by the same amount.
- What's true for assets is also true for liabilities.
- Remember that the securities and foreign exchange transactions are managed by the Federal Reserve Bank of New York, while the discount loans are extended by all 12 Reserve Banks.



YOUR FINANCIAL WORLD

Has Paper Money Outlived Its Purpose?

- Why hasn't cash been replaced by electronic money?
 - There is an enormous amount of currency in circulation worldwide
 - To avoid criminality, all other countries would have to switch to electronic money
- Benefits of paper currency
 - Governments receive seignorage (the ability to acquire real goods and services in exchange for fiat currency) for issuing notes and coin
 - Anonymity

Open Market Operations

- When the Fed buys or sells securities in financial markets, it engages in **open market operations**.
- To see how the process works, we can track the purchase of \$1 billion in U.S. Treasury bonds from a commercial bank.

Open Market Operations

Figure 17.2

Balance Sheet Changes after the Federal Reserve Purchases a U.S. Treasury Bond

A. Federal Reserve's Balance Sheet		B. Banking System's Balance Sheet	
Assets	Liabilities	Assets	Liabilities
Securities (U.S. Treasury bond) +\$1 billion	Reserves +\$1 billion	Reserves +\$1 billion	
		Securities -\$1 billion (U.S. Treasury bond)	

- The Fed transfers \$1 billion into the reserve account of the seller, called a **T-account**.
- The Fed's assets and liabilities both go up \$1 billion, increasing the monetary base by the same amount.
- Both the \$1 billion in securities and in reserves are banking system assets.

Open Market Operations

- Notice that the reserves are an asset to the banking system but a liability to the Fed.
 - This is similar to the balance in your bank account is your asset, but it is your bank's liability.
- If the Fed sells a U.S. Treasury bond through an **open market sale**, the impact on everyone's balance sheet is reversed.

Foreign Exchange Intervention

- What if the U.S. Treasury instructs the Fed to buy \$1 billion worth of euros.
 - They buy German government bonds, denominated in euros, from foreign exchange departments of large commercial banks and pay for them with dollars.
- The \$1 billion payment is credited directly to the reserve account of the bank from which the bonds were bought.
 - This has a similar effect on the balance sheet as the open market operation.

Foreign Exchange Intervention

Figure 17.3

Balance Sheet Changes after the Federal Reserve Purchases a German Government Bond

A. Federal Reserve's Balance Sheet		B. Banking System's Balance Sheet	
Assets	Liabilities	Assets	Liabilities
Foreign exchange reserves +\$1 billion (German government bonds in euros)	Reserves +\$1 billion	Reserves +\$1 billion Securities -\$1 billion (German government bonds)	

- The Fed's assets and liabilities both rise by \$1 billion, and the monetary base expands with them.
- In both cases, the banking system's securities portfolio falls by \$1 billion and reserves balances rise by an equal amount.

Discount Loans

- Commercial banks ask for loans, the Fed does not force them.
- A borrowing bank must provide collateral.
 - This usually takes the form of U.S. Treasury bonds, but the Fed has been willing to accept a broad range of securities and loans as collateral.
- This changes the balance sheet of both institutions.

Discount Loans

Figure 17.4

Balance Sheet Changes after the Federal Reserve Makes a Discount Loan

A. Federal Reserve's Balance Sheet		B. Banking System's Balance Sheet	
Assets	Liabilities	Assets	Liabilities
Discount loans +\$100 million	Reserves +\$100 million	Reserves +\$100 million	Discount loans +\$100 million

- For the borrowing bank, it is a liability matched by an offsetting increase in the level of its reserve account.
- For the Fed, the loan is an asset that is created in exchange for a credit to the borrower's reserve account.
- The extension of credit to the banking system raises the level of reserves and expands the monetary base.

Cash Withdrawal

- The Fed can always shift its holdings of various assets.
 - But the same is not true of its liabilities.
- Because the Fed stands ready to exchange reserves for currency on demand, it does not control the mix between the two.
 - The nonbank public, those who hold cash, controls that.

Cash Withdrawal

- When you take cash from an ATM, you are changing the Fed's balance sheet.
 - By moving your own assets out of your bank and into currency, you force a shift from reserves to currency on the Fed's balance sheet.
- The transaction involves three balance sheets:
 - The nonbank public
 - The banking system
 - The central bank

Cash Withdrawal

- Your assets shift from checkable deposits to cash with no change in liabilities.
- Cash inside the bank, vault cash, counts as bank reserves.
 - By withdrawing cash from your bank, you decreased the banking system's reserves.
 - This is a change in the bank's T-account.
- For the Fed, the change comes in the composition of the Fed's liabilities.

Cash Withdrawal

Figure 17.5

Balance Sheet Changes after a Private Person Withdraws Cash from His or Her Bank Account

A. Nonbank Public's Balance Sheet

Assets		Liabilities
Currency	+\$100	
Checkable deposits	-\$100	

B. Federal Reserve's Balance Sheet

Assets	Liabilities	
	Currency	+\$100
	Reserves	-\$100

C. Banking System's Balance Sheet

Assets		Liabilities	
Reserves	-\$100	Checkable deposits	-\$100

Changing the Size and Composition of the Balance Sheet

- Open market operations and foreign exchange interventions are both done at the discretion of the central bank.
- The level of discount borrowing is decided by the commercial banks.
- The nonbank public decides how much currency to hold.

The Central Bank's Balance Sheet: Summary

Table 17.2

Changes in the Size and Composition of the Federal Reserve's Balance Sheet and the Monetary Base

Transaction	Initiated by	Typical Action	Impact
Open market operation	Central bank	Purchase of Treasury bond	Increases reserves, the size of the Fed's balance sheet, and the monetary base
Foreign exchange intervention	Central bank	Purchase of German government bond	Increases reserves, the size of the Fed's balance sheet, and the monetary base
Discount loan	Commercial bank	Extension of loan to commercial bank	Increases reserves, the size of the Fed's balance sheet, and the monetary base
Cash withdrawal	Nonbank public	Withdrawal of cash from ATM	Decreases reserves and increases currency, leaving the size of the Fed's balance sheet and the monetary base unchanged

The Monetary base and The Money supply

- Central bank liabilities form the base on which the supplies of money and credit are built.
 - This is why they are called the ***monetary base***.
 - The central bank controls the monetary base.
- Our primary interest, however, is in the broader measure of money which are multiples of the monetary base.
 - M1.
 - M2.

The Deposit Expansion Multiplier

- M1 and M2 are the *money* we think of as available for transactions.
- **What is the relationship between the central bank's liabilities and these broader measure of money?**
- How do reserves become bank deposits?
- This happens in a process called **multiple deposit creation**.

Figure 17.8

Multiple Deposit Creation

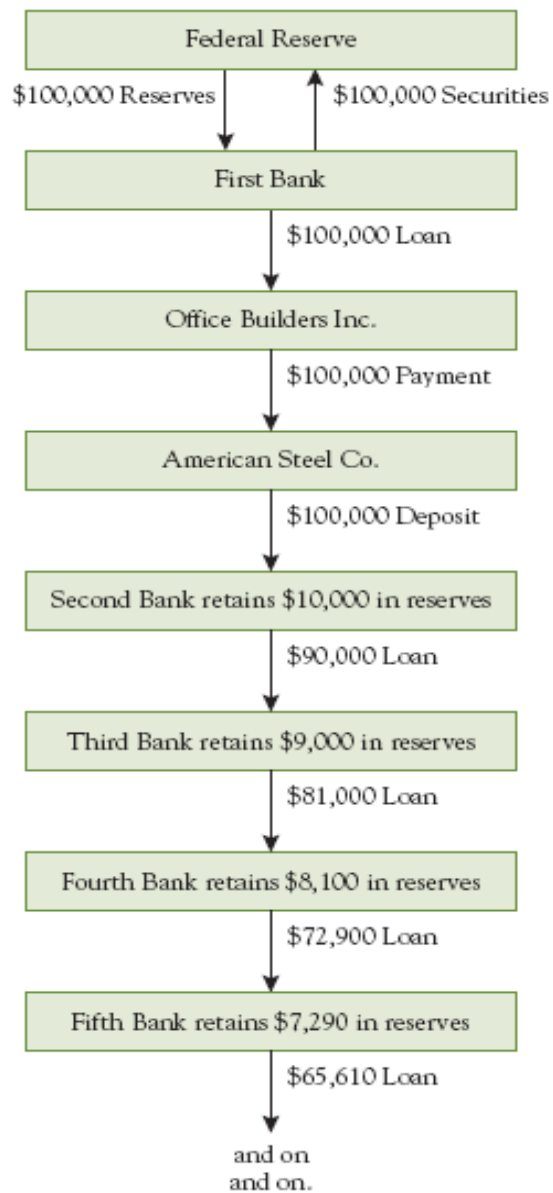


Table 17.3

Multiple Deposit Expansion following a \$100,000 Open Market Purchase
Assuming a 10% Reserve Requirement

Bank	Increase in Deposits	Increase in Loans	Increase in Reserves
First Bank	\$ 0	\$ 100,000	\$ 0
Second Bank	\$ 100,000	\$ 90,000	\$ 10,000
Third Bank	\$ 90,000	\$ 81,000	\$ 9,000
Fourth Bank	\$ 81,000	\$ 72,900	\$ 8,100
Fifth Bank	\$ 72,900	\$ 65,610	\$ 7,290
Sixth Bank	\$ 65,610	\$ 59,049	\$ 6,561
.	.	.	.
.	.	.	.
.	.	.	.
The Banking System	\$1,000,000	\$1,000,000	\$100,000

$$\begin{aligned}
 RR &= r_D D. \\
 \Delta RR &= r_D \Delta D
 \end{aligned}
 \quad \Rightarrow \quad
 \Delta D = \frac{1}{r_D} \Delta RR$$

The Monetary Base and the Money Supply

- The simple deposit expansion multiplier is too simple.
- In deriving it, we ignored a few details:
 1. We assumed banks lend out all their excess reserves, but banks do hold some of their excess reserves.
 2. We ignored the fact that the nonbank public holds cash.
 - As people's account balances rise, they tend to hold more cash.
- Both of these affect the relationship among reserves, the monetary base, and the money supply.

The Arithmetic of the Money Multiplier

- The *money multiplier* shows how the quantity of money is related to the monetary base.
- If we label the quantity of money M and the monetary base MB , the money multiplier m is defined as:

$$M = m \times MB$$

The Arithmetic of the Money Multiplier

- We will start with the following relationships:
 - Money equals currency, C , plus checkable deposits, D ,
 - The monetary base MB equals currency plus reserves in the banking system R , and
 - Reserves equal required reserves RR plus excess reserves ER .

$$M = C + D$$

$$MB = C + R$$

$$R = RR + ER$$

The Arithmetic of the Money Multiplier

- We know that banks holdings of required reserves depends on the required reserve ratio r_D .
- The amount of excess reserve a bank holds depends on the costs and benefits of holding them.
 - The higher the interest rate on loans, the lower banks' excess reserves, and
 - The greater banks' concern over the possibility of deposit withdrawals, the higher their excess reserves.

The Arithmetic of the Money Multiplier

- Labeling the **excess reserve-to-deposit ratio** $\{ER/D\}$, we can rewrite the reserve equation as:

$$\begin{aligned} R &= RR + ER \\ &= r_D D + \{ER/D\}D \\ &= (r_D + \{ER/D\})D \end{aligned}$$

- Banks hold reserves as a proportion of their deposits.

The Arithmetic of the Money Multiplier

- The **currency-to-deposit ratio**, $\{C/D\}$, is the fraction of deposits that people hold as currency.

$$C = \{C/D\}D$$

- The decision of how much currency to hold depends on the costs and benefits as well.
 - The cost of currency is the interest it would earn on deposit.
 - The benefit is its lower risk and greater liquidity.

The Arithmetic of the Money Multiplier

- Putting this all together, we can see to following.

$$\begin{aligned} MB &= C + R \\ &= \{C/D\}D + (r_D + \{ER/D\})D \\ &= (\{C/D\} + r_D + \{ER/D\})D \end{aligned}$$

- The monetary base has three uses:
 - Required reserves
 - Excess Reserves
 - Cash in the hands of the nonbank public

The Arithmetic of the Money Multiplier

- We can do the same with the equation for money.

$$\begin{aligned}M &= C + D \\&= \{C/D\}D + D \\&= (\{C/D\} + 1)D\end{aligned}$$

The Arithmetic of the Money Multiplier

- We can use the equation for MB to solve for deposits:

$$D = \frac{1}{\{C/D\} + r_D + \{ER/D\}} \times MB$$

- And substituting D into the money equation:

$$M = \frac{\{C/D\} + 1}{\{C/D\} + r_D + \{ER/D\}} \times MB$$

The Arithmetic of the Money Multiplier

The quantity of money in the economy depends on:

1. The monetary base, which is controlled by Fed,
2. The reserve requirement,
3. The bank's desire to hold excess reserves, and
4. The nonbank public's demand for currency.

The Arithmetic of the Money Multiplier

What is the impact of each of these?

1. If the monetary base increases, the quantity of money increases.
2. An increase in either the reserve requirement or banks' excess reserve holding reduces money.
3. When an individual withdraws cash, he or she increases the currency in the public and decreases reserves.
 - The decline in reserves creates a multiple deposit contraction.
 - The money supply contracts.

Factors Affecting the Quantity of Money

Table 17.4

Factors Affecting the Quantity of Money

Factor	Who Controls It	Change	Impact on M
Monetary base	Central bank	Increase	Increase
Required reserve-to-deposit ratio	Central bank	Increase	Decrease
Excess reserve-to-deposit ratio	Commercial banks	Increase	Decrease
Currency-to-deposit ratio	Nonbank public	Increase	Decrease



LESSONS FROM THE CRISIS

THE IMPACT ON MONEY SUPPLY

- The central bank supplies the monetary base, but it is banks and the banking system that supply money.
- When the crisis peaked in September 2008, the deposit expansion multiplier plummeted to a fraction of its normal value.
- The standard process of deposit expansion assumes that banks will lend out most of additional dollar reserves supplied by the Fed.
- However, banks panicked and sought to hold more excess reserves collapsing the deposit expansion multiplier.
- Money supply did not grow as much as they had anticipated.

The Limits on the Central Bank's Ability to Control the Quantity of Money

- The various factors affecting the quantity of money change over time.
 - Market interest rates affect the cost of holding both excess reserves and currency.
 - As interest rates increase, we expect to see $\{ER/D\}$ and $\{C/D\}$ fall.
 - This increases the money multiplier and the quantity of money.

The Limits on the Central Bank's Ability to Control the Quantity of Money

- If these changes in the money multiplier were predictable, the central bank might choose to exploit this link in its policymaking.
- In countries like the U.S., Europe, and Japan, the link has become too weak and unpredictable to be exploited.

The Limits on the Central Bank's Ability to Control the Quantity of Money

- The money multiplier is just too variable.
- The relationship between the monetary base and the quantity of money is not something that a central bank can exploit for short-run policy purposes.
- **Interest rates have become the monetary policy tool of choice.**
- In a financial crisis, other balance-sheet tools help address liquidity needs and market disruptions more directly.

The Limits on the Central Bank's Ability to Control the Quantity of Money

Figure 17.10

The M1 and M2 Money Multipliers, 1980–2016

