Economics 435
The Financial System
(11/14/2016)

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UW Madison
Fall 2016

Outline

- What is the Fed? What is the ECB?
- IS-LM: Textbook monetary policy (pre-2008)
- IS-LM: monetary policy in practice (pre-2008)
- Where does a central bank fit in the economy?
- Taylor Rules

Federal Reserve System: Organization

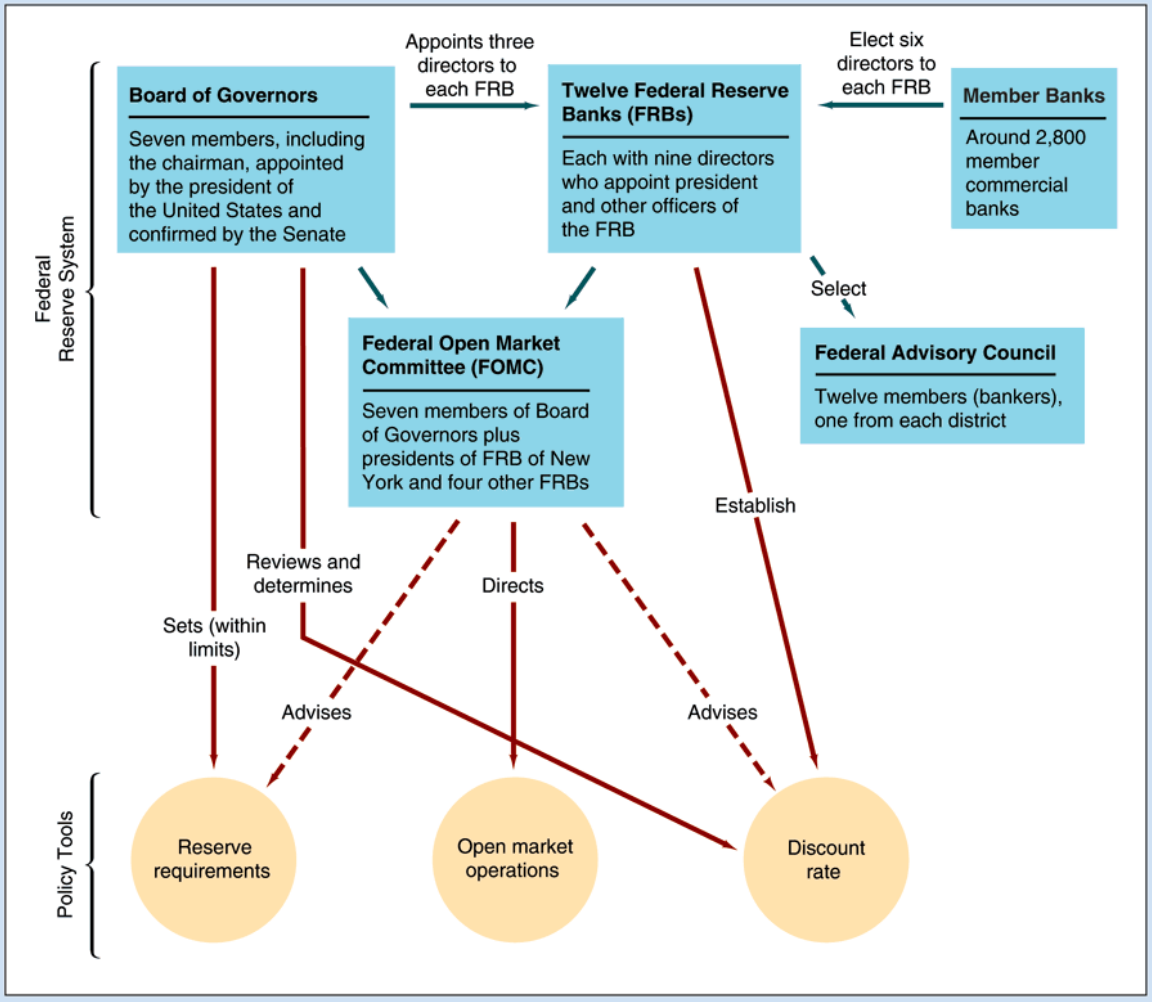
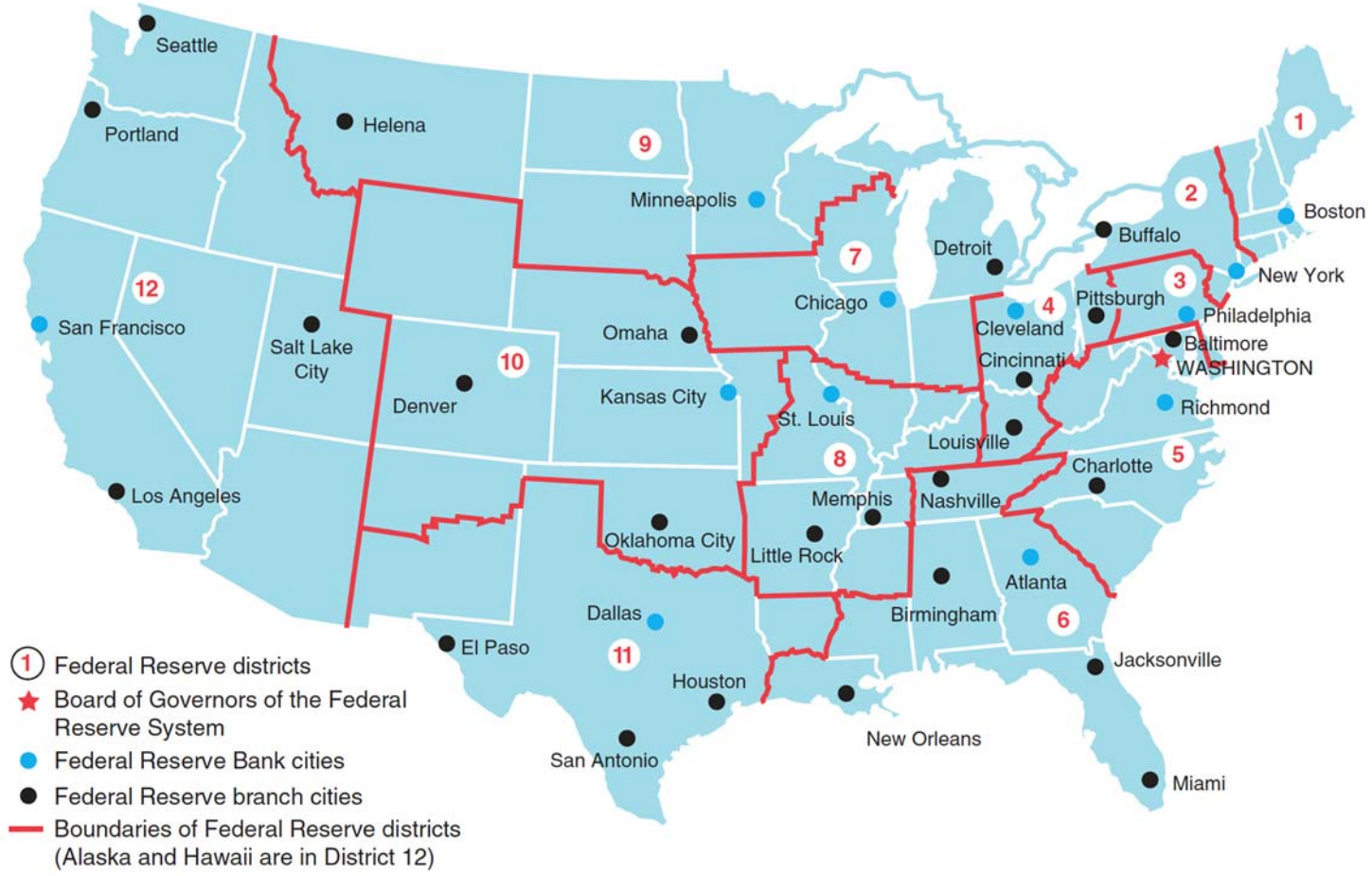


FIGURE 1 **Structure and Responsibility for Policy Tools in the Federal Reserve System**

Source: Mishkin

Federal Reserve System: Regional Distribution



Comparing Organizational Structure

Federal Reserve Banks =>

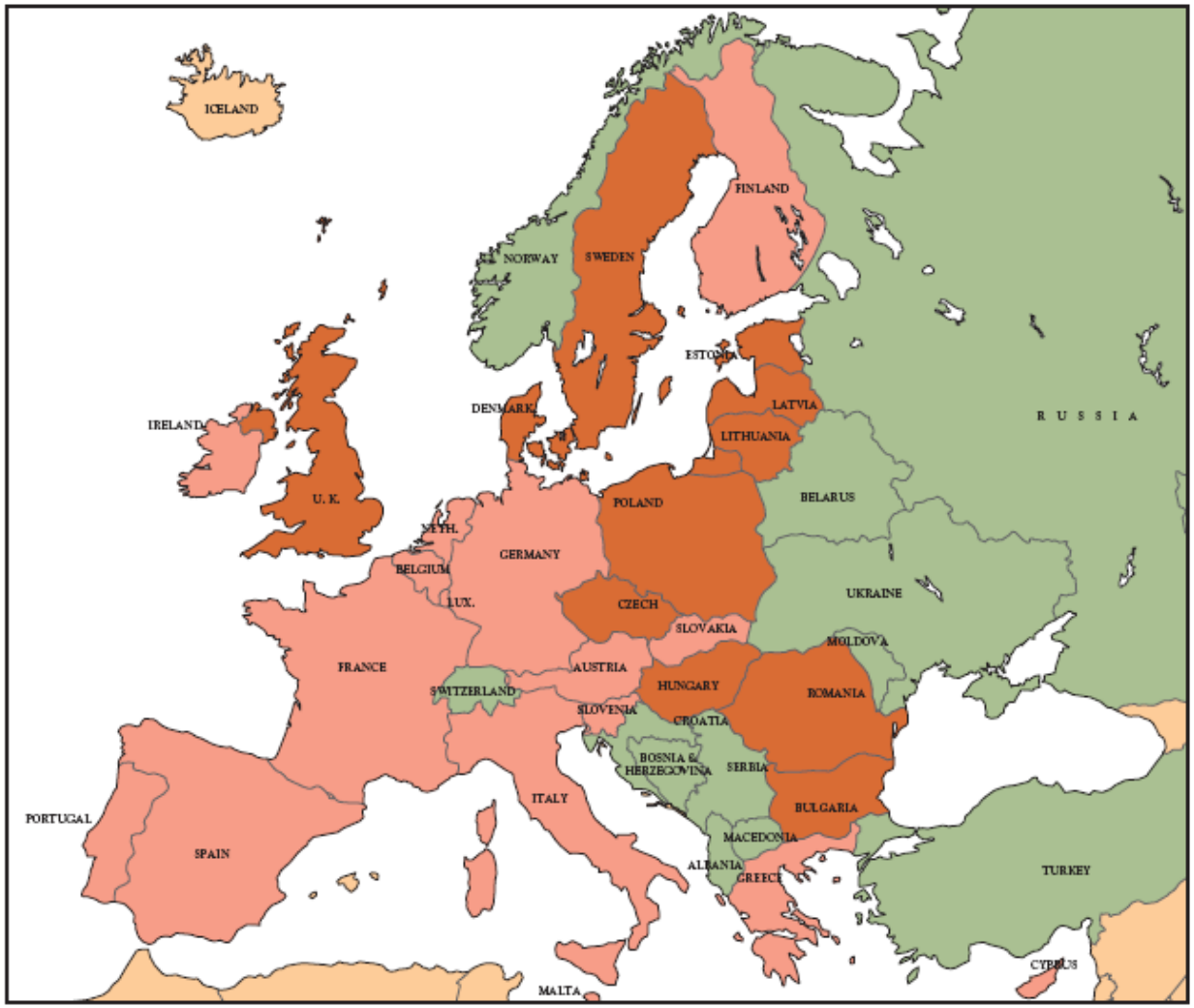
Board of Governors ===>

FOMC ========== >

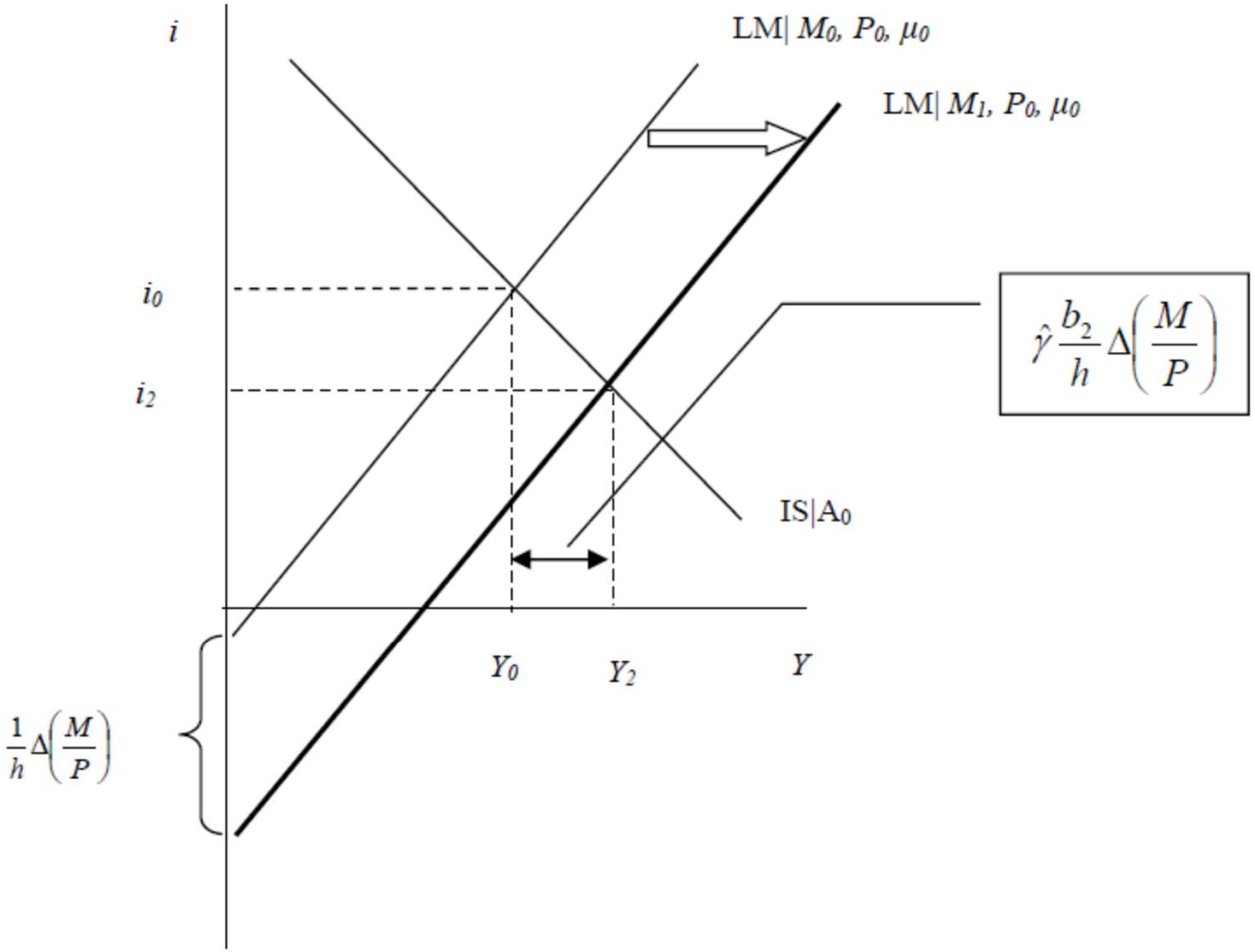
Table 16.2 Key Aspects of the European Central Bank

European Central Bank (ECB)	The central authority in Frankfurt, Germany, that oversees monetary policy in the common currency area. (Established July 1, 1998.)
National Central Banks (NCBs)	The central banks of the countries that belong to the European Union.
European System of Central Banks (ESCB)	The ECB plus the NCBs of all the countries in the European Union, including those that do not participate in the monetary union.
Eurosystem	The ECB plus the NCBs of participating countries; together, they carry out the tasks of central banking in the euro area.
ECB Executive Board	The six-member body in Frankfurt that oversees the operation of the ECB and the Eurosystem.
Governing Council	The (currently) 22-member committee that makes monetary policy in the common currency area.
Euro	The currency used in the countries of the European Monetary Union.
Euro area	The countries that use the euro as their currency.

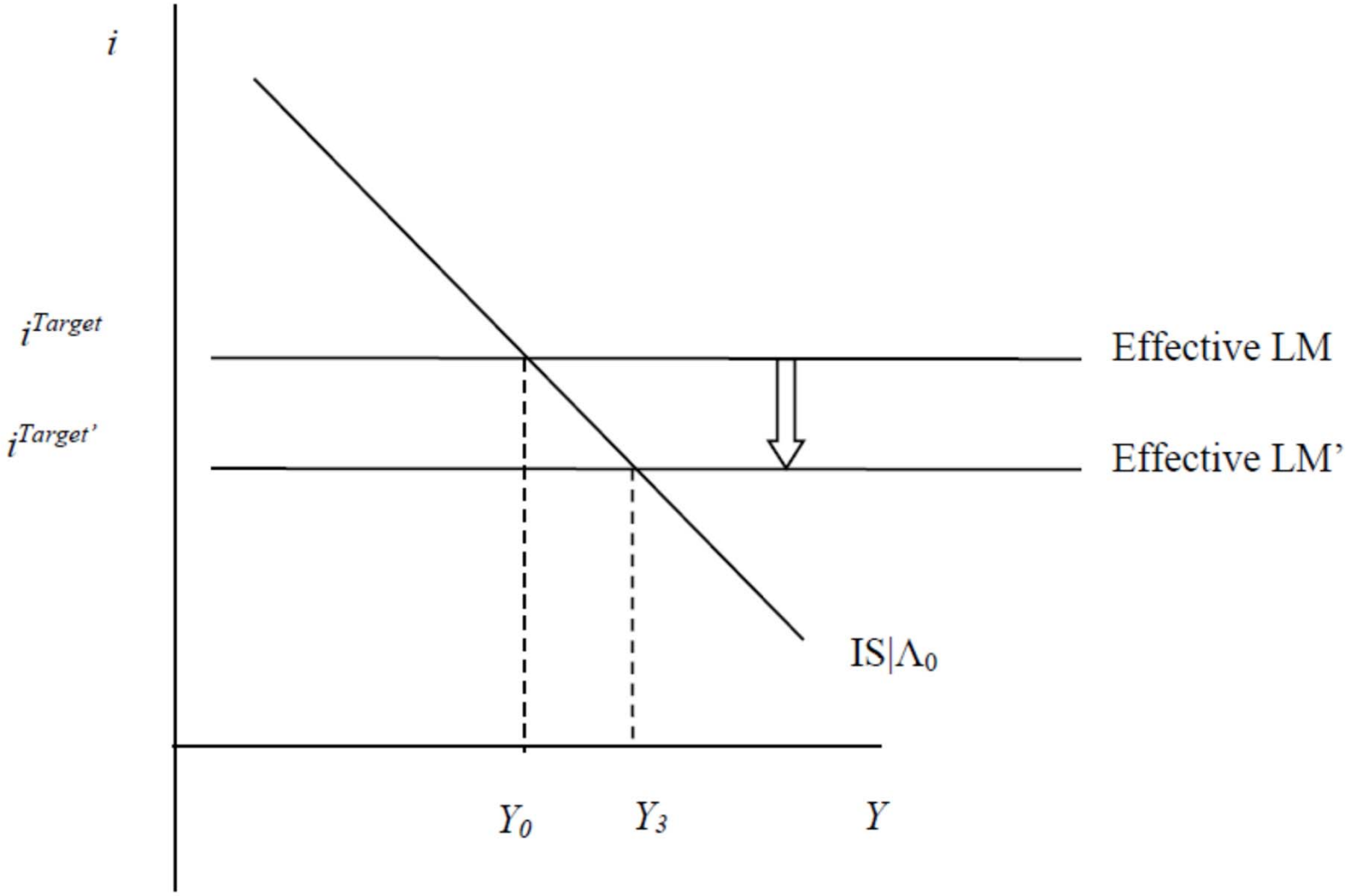
Figure 16.3 The European System of Central Banks



Textbook Monetary Policy (pre-2008)



Monetary Policy in Practice (pre-2008)



Central Banks in the Financial System

TABLE 14.1 FINANCIAL RELATIONSHIPS (BALANCE SHEETS) BETWEEN THE BANKS, THE FED, THE GOVERNMENT, AND THE PRIVATE SECTOR

PRIVATE NONFINANCIAL		BANKS		FED		GOVERNMENT	
ASSETS	LIABILITIES	ASSETS	LIABILITIES	ASSETS	LIABILITIES	ASSETS	LIABILITIES
Currency (CU)					Currency (CU)		
Deposits (D)			Deposits (D)				
Bonds (B)		Bonds (B)		Bonds (B)			Bonds (B)
		Reserves (RE)			Reserves (RE)		
	Loans	Loans					

Macroeconomics, 6th Edition

The Fed's Balance Sheet

Federal Reserve System	
Assets	Liabilities
Securities	Currency in circulation
Loans to Financial Institutions	Reserves

- **Liabilities**
  - Currency in circulation: in the hands of the public
  - Reserves: bank deposits at the Fed and vault cash
- **Assets**
  - Government securities: holdings by the Fed that affect money supply and earn interest
  - Discount loans: provide reserves to banks and earn the discount rate

Control of the Monetary Base

High-powered money

$$MB = C + R$$

C = currency in circulation

R = total reserves in the banking system

Open Market Purchase from a Bank

Banking System			
Assets		Liabilities	
Securities	-$100m		
Reserves	+$100m		

Federal Reserve System			
Assets		Liabilities	
Securities	+$100m	Reserves	+$100m

- Net result is that reserves have increased by $100
- No change in currency
- Monetary base has risen by $100

Open Market Purchase from the Nonbank Public

Banking System	
Assets	Liabilities
Reserves +$100m	Checkable deposits +$100m

Federal Reserve System	
Assets	Liabilities
Securities +$100m	Reserves +$100m

- Person selling bonds to the Fed deposits the Fed's check in the bank
- Identical result as the purchase from a bank

Open Market Purchase from the Nonbank Public

Nonbank Public	
Assets	Liabilities
Securities -$100m	
Currency +$100m	

Federal Reserve System	
Assets	Liabilities
Securities +$100m	Currency in circulation +$100m

- The person selling the bonds cashes the Fed's check
- Reserves are unchanged
- Currency in circulation increases by the amount of the open market purchase
- Monetary base increases by the amount of the open market purchase

Open Market Purchase: Summary

- The effect of an open market purchase on reserves depends on whether the seller of the bonds keeps the proceeds from the sale in currency or in deposits.
- The effect of an open market purchase on the monetary base always increases the monetary base by the amount of the purchase.

Open Market Sale

Nonbank Public	
Assets	Liabilities
Securities +$100m	
Currency -$100m	

Federal Reserve System	
Assets	Liabilities
Securities -$100m	Currency in circulation -$100m

- Reduces the monetary base by the amount of the sale
- Reserves remain unchanged
- The effect of open market operations on the monetary base is much more certain than the effect on reserves.

Overview of The Fed's Ability to Control the Monetary Base

- Open market operations are controlled by the Fed.
- The Fed cannot determine the amount of borrowing by banks from the Fed.
- Split the monetary base into two components:

$$MB_n = MB - BR$$

- The money supply is positively related to both the non-borrowed monetary base MB_n and to the level of borrowed reserves, *BR,* from the Fed.

Multiple Deposit Creation: A Simple Model

Deposit Creation: Single Bank

First National Bank	
Assets	Liabilities
Securities -$100m	
Reserves +$100m	

First National Bank	
Assets	Liabilities
Securities -$100m	Checkable deposits +$100m
Reserves +$100m	
Loans +$100m	

- Excess reserves increase
- Bank loans out the excess reserves
- Creates a checking account
- Borrower makes purchases
- The Money supply has increased

First National Bank	
Assets	Liabilities
Securities -$100m	
Loans +$100m	

Multiple Deposit Creation: A Simple Model

Deposit Creation: The Banking System

Bank A		Bank A	
Assets	Liabilities	Assets	Liabilities
Reserves +$100 m	Checkable deposits +$100 m	Reserves +$10	Checkable deposits +$100 m
		Loans +$90	

Bank B		Bank B	
Assets	Liabilities	Assets	Liabilities
Reserves +$90	Checkable deposits +$90	Reserves +$9	Checkable deposits +$90
		Loans +$81	

Table 1 Creation of Deposits (assuming 10% reserve requirement and a $100 increase in reserves)

TABLE 1 Creation of Deposits (assuming 10% reserve requirement and a $100 million increase in reserves)

Bank	Increase in Deposits ($)	Increase in Loans ($)	Increase in Reserves ($)
First National	0.00	100.00 m	0.00
A	100.00 m	90.00 m	10.00 m
B	90.00 m	81.00 m	9.00 m
C	81.00 m	72.90 m	8.10 m
D	72.90 m	65.61 m	7.29 m
E	65.61 m	59.05 m	6.56 m
F	59.05 m	53.14 m	5.91 m
.	.	.	.
.	.	.	.
.	.	.	.
.	.	.	.
Total for all banks	1,000.00 m	1,000.00 m	100.00 m

Deriving The Formula for Multiple Deposit Creation

Assuming banks do not hold excess reserves

Required Reserves (RR) = Total Reserves (R)

RR = Required Reserve Ratio (r) times the total amount of checkable deposits (D)

Substituting

$$r \times D = R$$

Dividing both sides by r

$$D = \frac{1}{r} \times R$$

Taking the change in both sides yields

$$\Delta D = \frac{1}{r} \times \Delta R$$

The Money Multiplier

- Define money as currency plus checkable deposits: M1
- Link the money supply (*M*) to the monetary base (*MB*) and let *m* be the money multiplier

$$M = m \times MB$$

Deriving the Money Multiplier

- Assume that the desired holdings of currency *C* and excess reserves *ER* grow proportionally with checkable deposits *D*.
- Then,

  $c = \{C/D\}$ = currency ratio

  $e = \{ER/D\}$ = excess reserves ratio

Deriving the Money Multiplier

The total amount of reserves (R) equals the sum of required reserves (RR) and excess reserves (ER).

$$R = RR + ER$$

The total amount of required reserves equals the required reserve ratio times the amount of checkable deposits

$$RR = r \times D$$

Subsituting for RR in the first equation

$$R = (r \times D) + ER$$

The Fed sets r to less than 1

Deriving the Money Multiplier

- The monetary base *MB* equals currency *(C)* plus reserves *(R)*:

$$MB = C + R = C + (r \times D) + ER$$

- Equation reveals the amount of the monetary base needed to support the existing amounts of checkable deposits, currency and excess reserves.

Deriving the Money Multiplier

$$c = \{C / D\} \Rightarrow C = c \times D \text{ and}$$

$$e = \{ER / D\} \Rightarrow ER = e \times D$$

Substituting in the previous equation

$$MB = (r \times D) + (e \times D) + (c \times D) = (r + e + c) \times D$$

Divide both sides by the term in parentheses

$$D = \frac{1}{r + e + c} \times MB$$

$$M = D + C \text{ and } C = c \times D$$

$$M = D + (c \times D) = (1 + c) \times D$$

Substituting again

$$M = \frac{1 + c}{r + e + c} \times MB$$

The money multiplier is then

$$m = \frac{1 + c}{r + e + c}$$

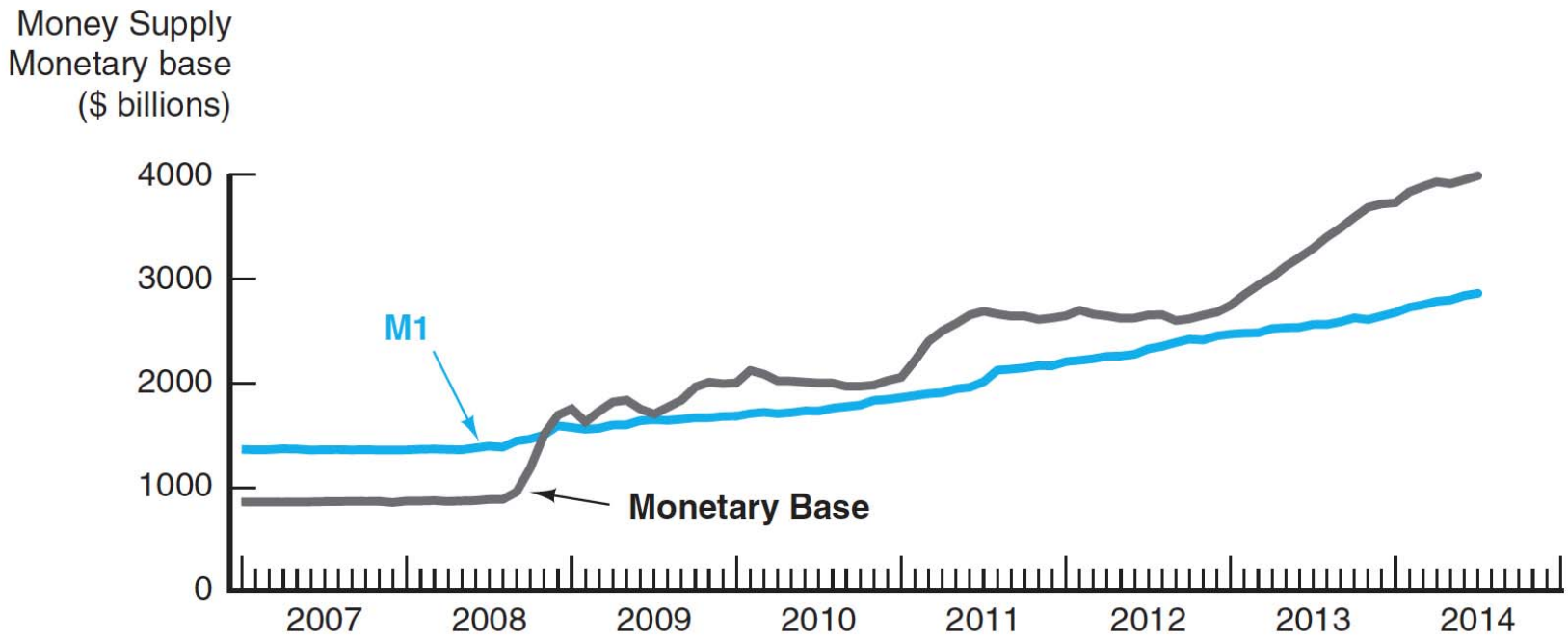
Quantitative Easing and the Money Supply, 2007-2014

- When the global financial crisis began in the fall of 2007, the Fed initiated lending programs and large-scale asset-purchase programs in an attempt to bolster the economy.
- By June 2014, these purchases of securities had led to a quintupling of the Fed's balance sheet and a 377% increase in the monetary base.

Quantitative Easing and the Money Supply, 2007-2014

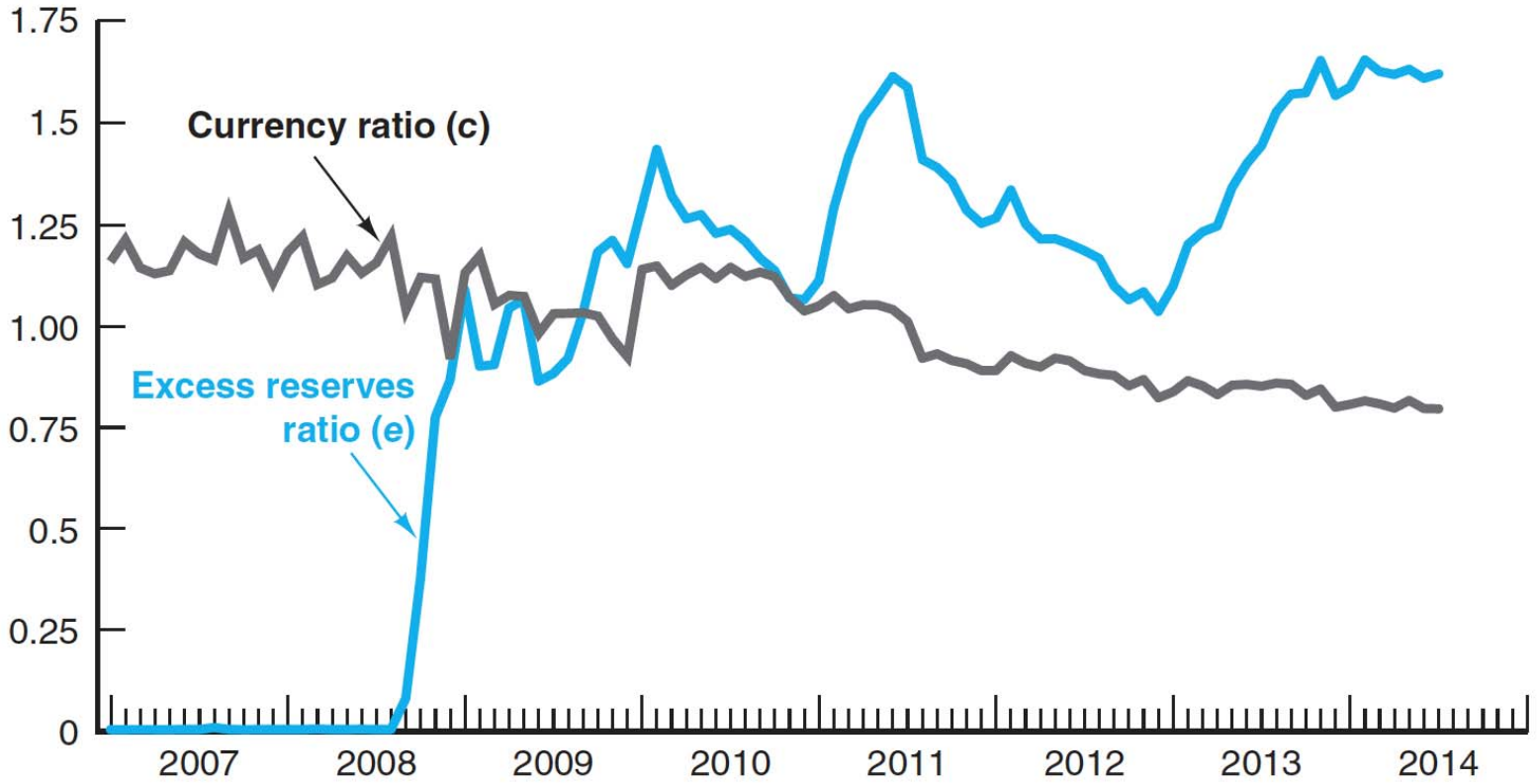
- These lending and asset-purchase programs resulted in a huge expansion of the monetary base and have been given the name "quantitative easing."
- This increase in the monetary base did not lead to an equivalent change in the money supply because excess reserves rose dramatically.

Figure 1 M1 and the Monetary Base, 2007-2014



Source: Federal Reserve Bank of St. Louis, FRED database: http://research.stlouisfed.org/fred2/.

Figure 2 Excess Reserves Ratio and Currency Ratio, 2007-2014



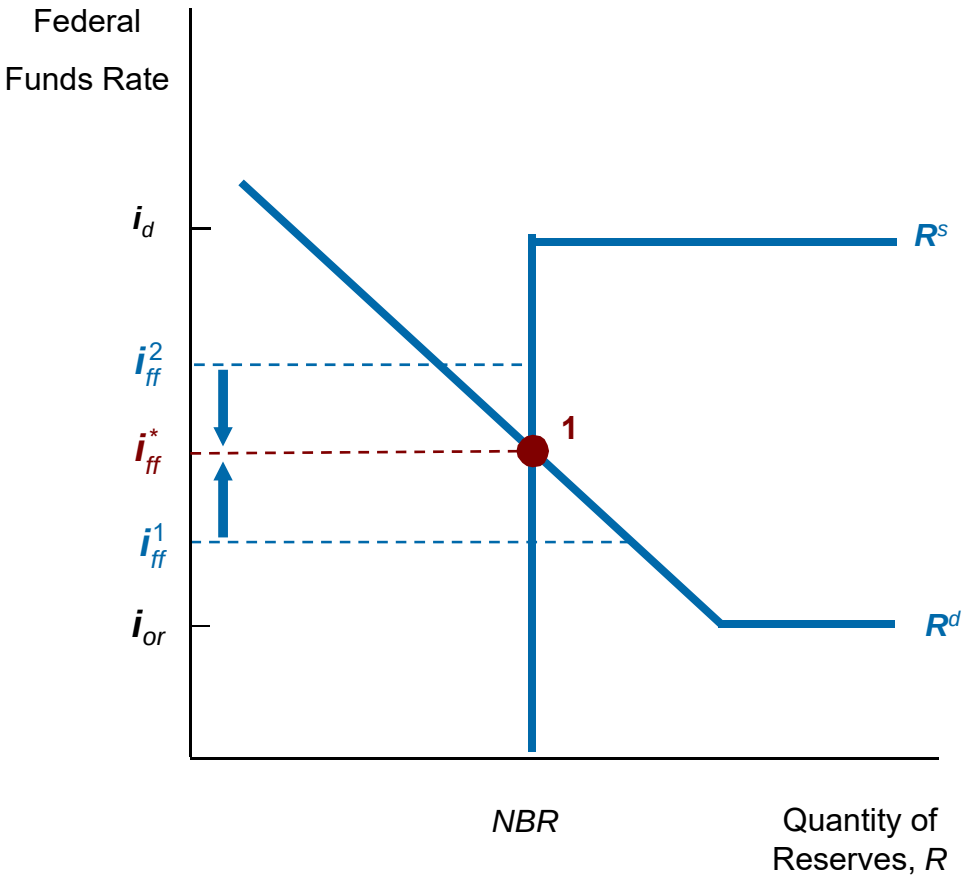
Source: Federal Reserve Bank of St. Louis, FRED database: http://research.stlouisfed.org/fred2/.

The Fed's Conventional Policy Toolbox

Table 18.1 The Tools of U.S. Monetary Policy

	What Is It?	How Is It Controlled?	What Is Its Impact?
Target Federal Funds Rate	Interest rate charged on overnight loans between banks.	Supply of reserves adjusted through open market operations to meet expected demand at the target rate.	Changes interest rates throughout the economy.
Discount Rate	Interest rate charged by the Federal Reserve on loans to commercial banks.	Set at a premium over the target federal funds rate.	Ceiling on market federal funds rate. Means to provide liquidity to banks in times of crisis.
Deposit Rate	Interest rate paid by the Federal Reserve on excess reserves held by banks.	Set at a spread below the target funds rate.	Sets a floor under the market federal funds rate.
Reserve Requirement	Fraction of deposits that banks must keep either on deposit at the Federal Reserve or as cash in their vaults.	Set by the Federal Reserve Board within a legally imposed range.	Stabilizes the demand for reserves.

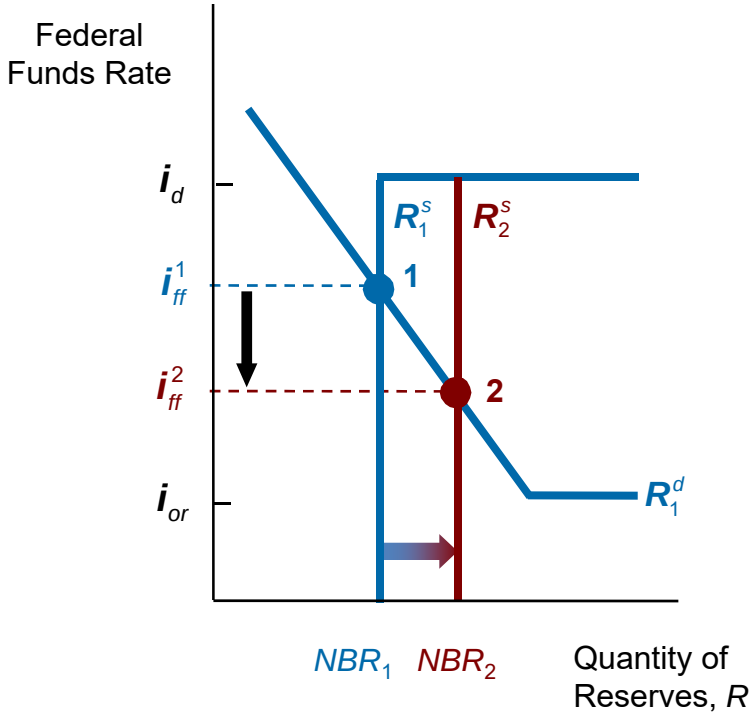
Equilibrium in the Market for Reserves



With excess supply of reserves, the federal funds rate falls to i_{ff}^*.

With excess demand for reserves, the federal funds rate rises to i_{ff}^*.

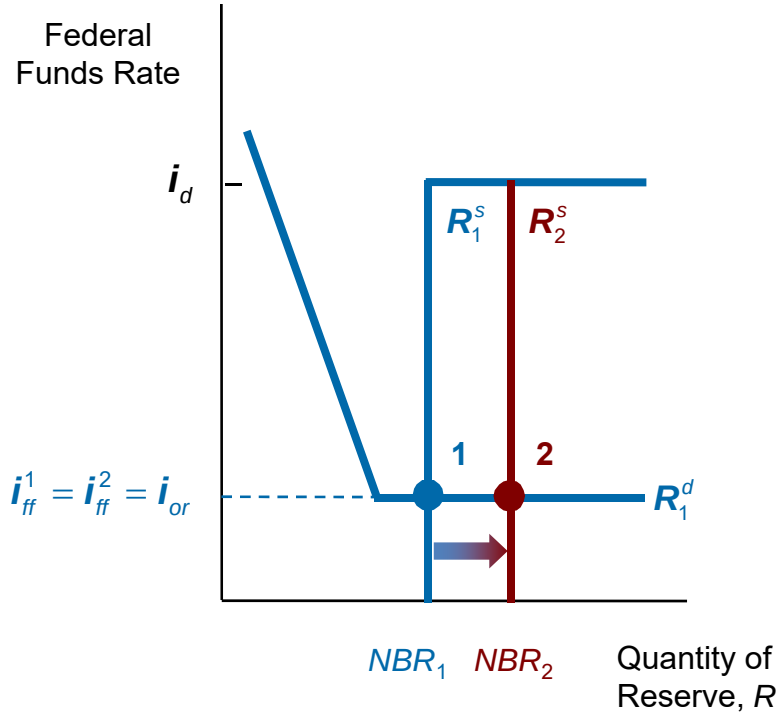
Response to an Open Market Operation



Step 1. An open market purchase shifts the supply curve to the right …

Step 2. causing the federal funds rate to fall.

(a) Supply curve initially intersects demand curve in its downward-sloping section

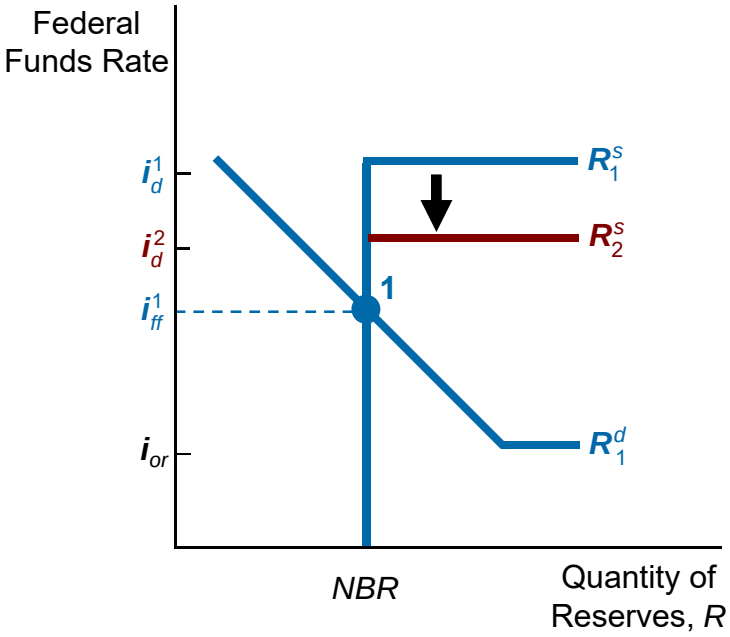


Step 1. An open market purchase shifts the supply curve to the right …

Step 2. but the federal funds rate cannot fall below the interest rate paid on reserves.

(b) Supply curve initially intersects demand curve in its flat section

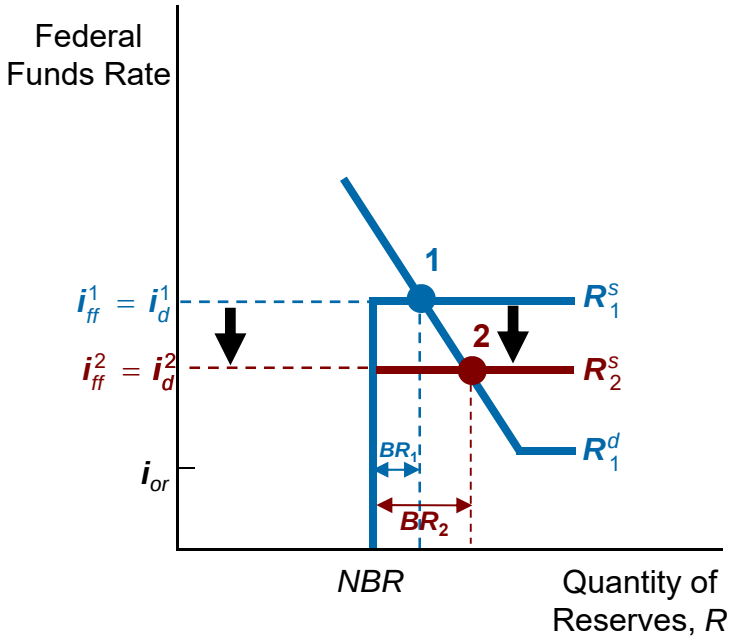
Response to a Change in Discount Rate



Step 1. Lowering the discount rate shifts the supply curve down…

Step 2. but does not lower the federal funds rate.

(a) No discount lending (*BR* = 0)

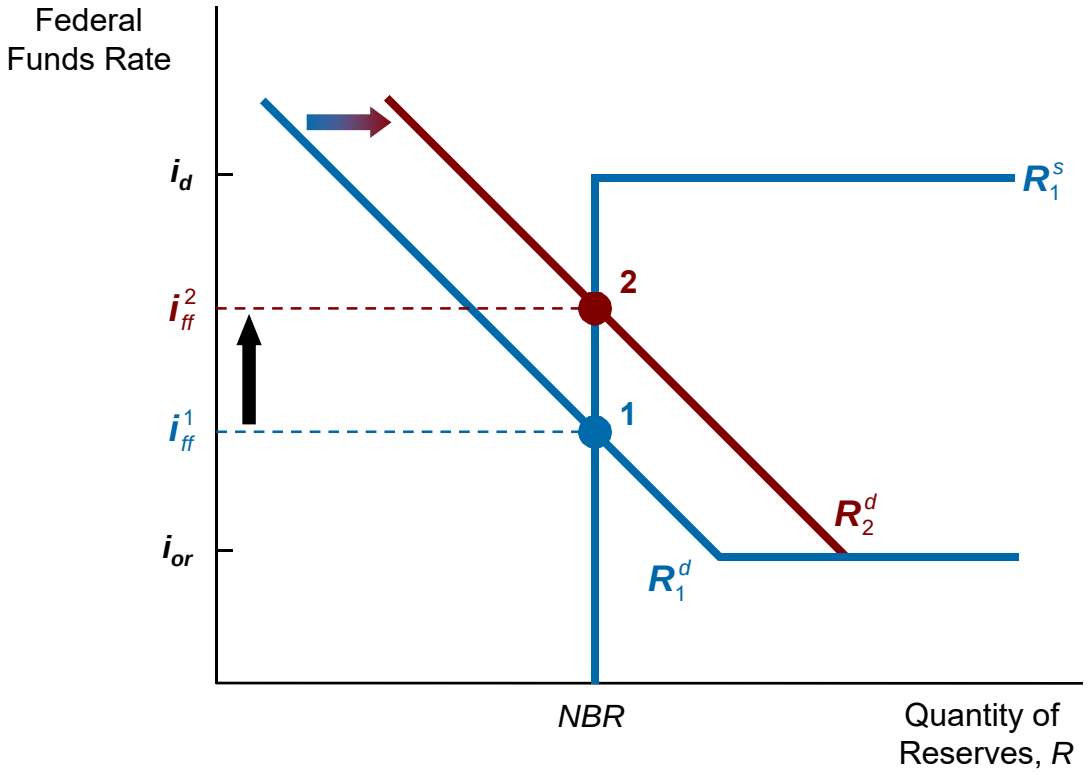


Step 1. Lowering the discount rate shifts the supply curve down…

Step 2. and lowers the federal funds rate.

(b) Some discount lending (*BR* > 0)

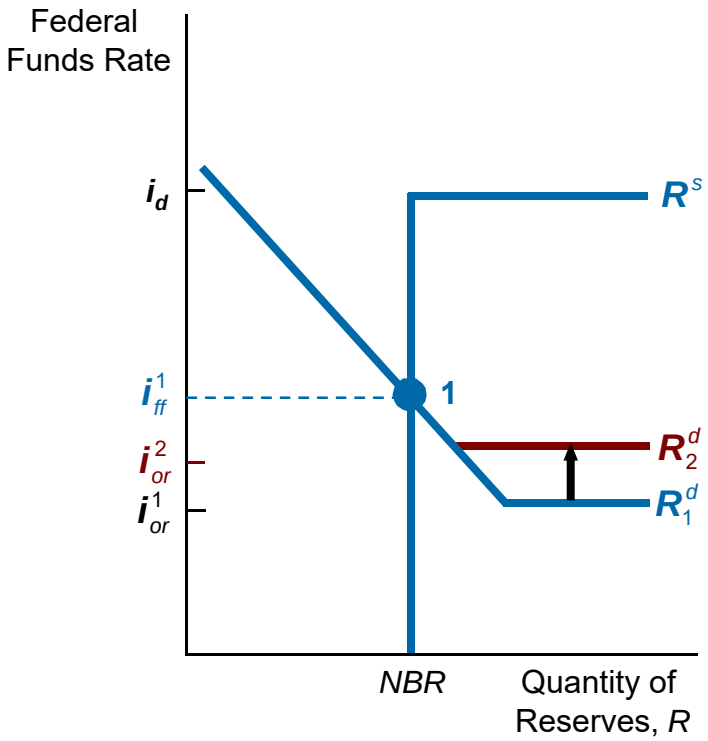
Response to a Change in Required Reserves



Step 1. Increasing the reserve requirement causes the demand curve to shift to the right . . .

Step 2. and the federal funds rate rises.

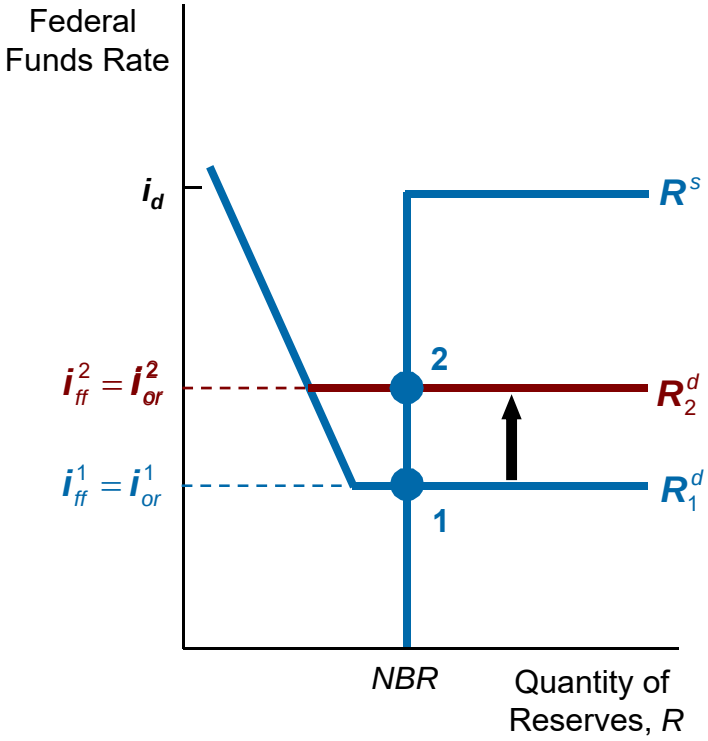
Response to a Change in the IRoR



Step 1. A rise in the interest rate on reserves from i_{or}^1 to i_{or}^2 ...

Step 2. leaves the federal funds rate unchanged.

(a) initial $i_{ff}^1 > i_{or}^1$

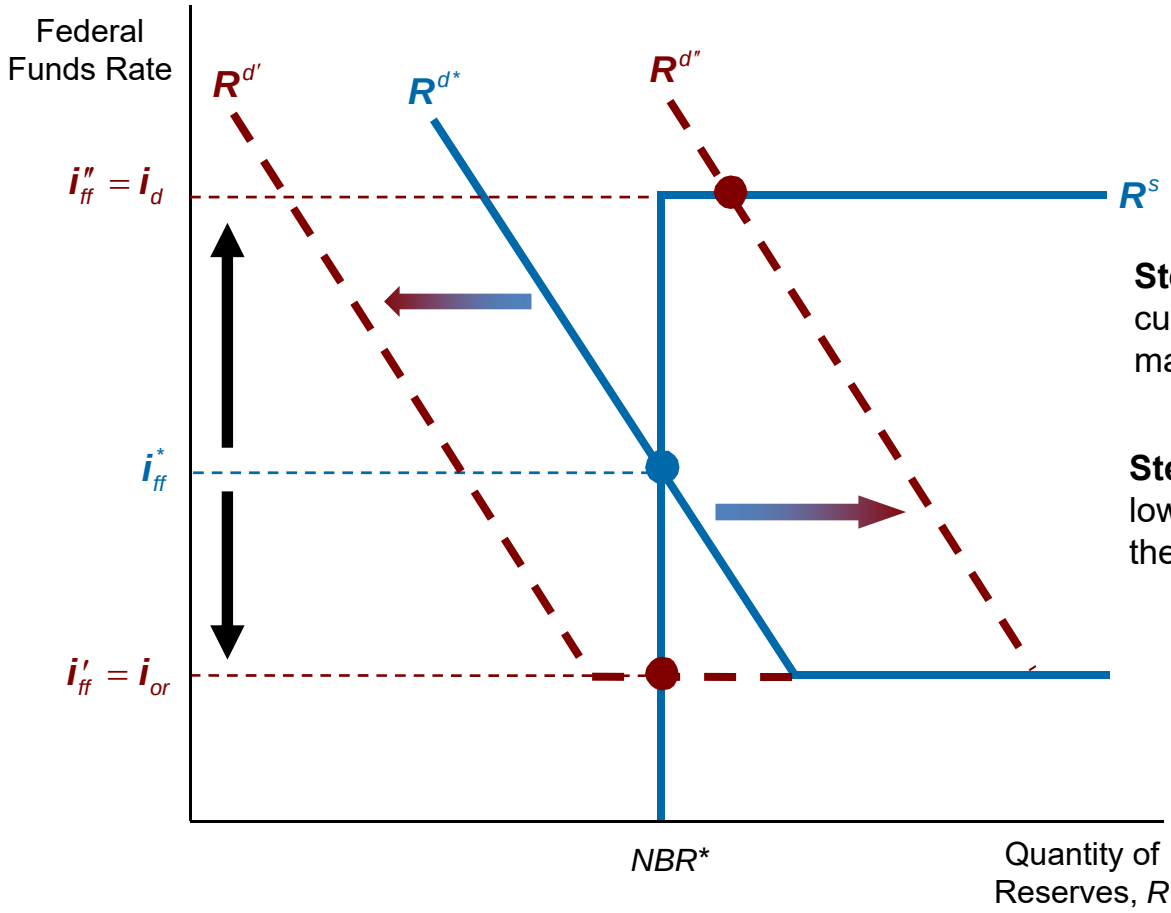


Step 1. A rise in the interest rate on reserves from i_{or}^1 to i_{or}^2 ...

Step 2. raises the federal funds rate to $i_{ff}^2 = i_{or}^2$.

(b) initial $i_{ff}^1 = i_{or}^1$

How the Federal Reserve's Operating Procedures Limit Fluctuations in the Federal Funds Rate

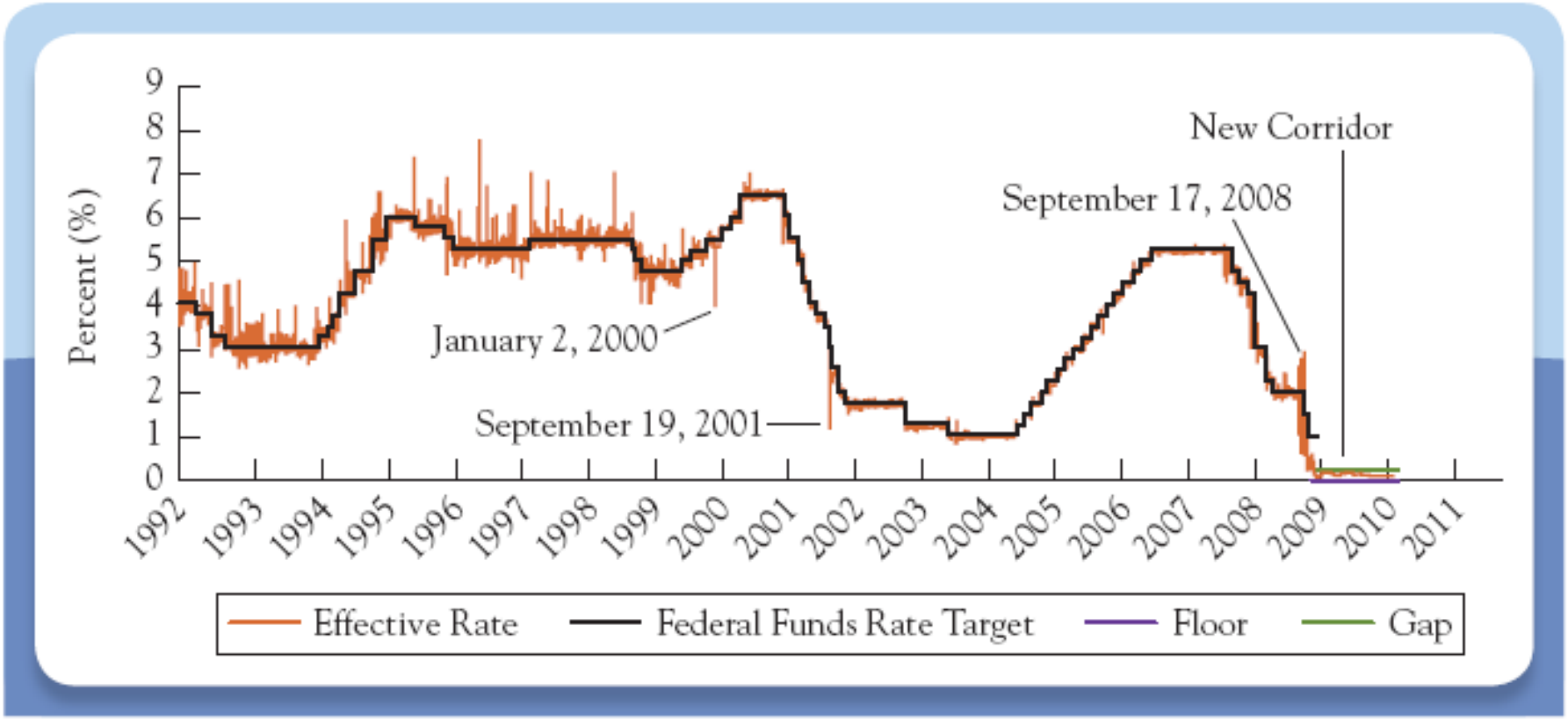


Step 1. A rightward shift of the demand curve raises the federal funds rate to a maximum of the discount rate.

Step 2. A leftward shift of the demand curve lowers the Ederal funds rate to a minimum of the interest rate on reserves.

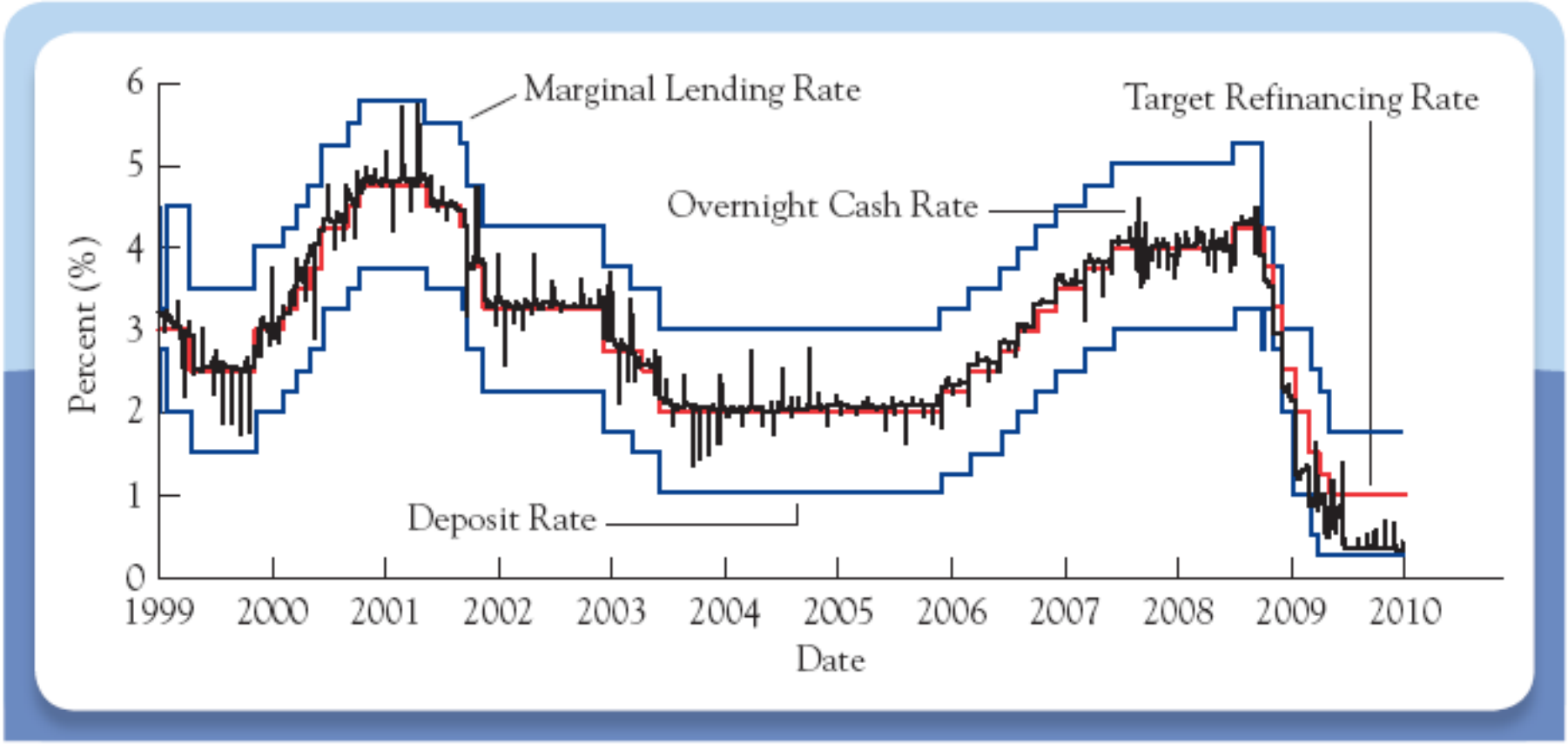
The Target Fed Funds Rate

Figure 18.4 Target Federal Funds Rate and Daily Market Rate, 1992–2009



ECB Hitting Target Refi Rate

Figure 18.6 Euro-Area Overnight Cash Rate and ECB Interest Rates, 1999–2009



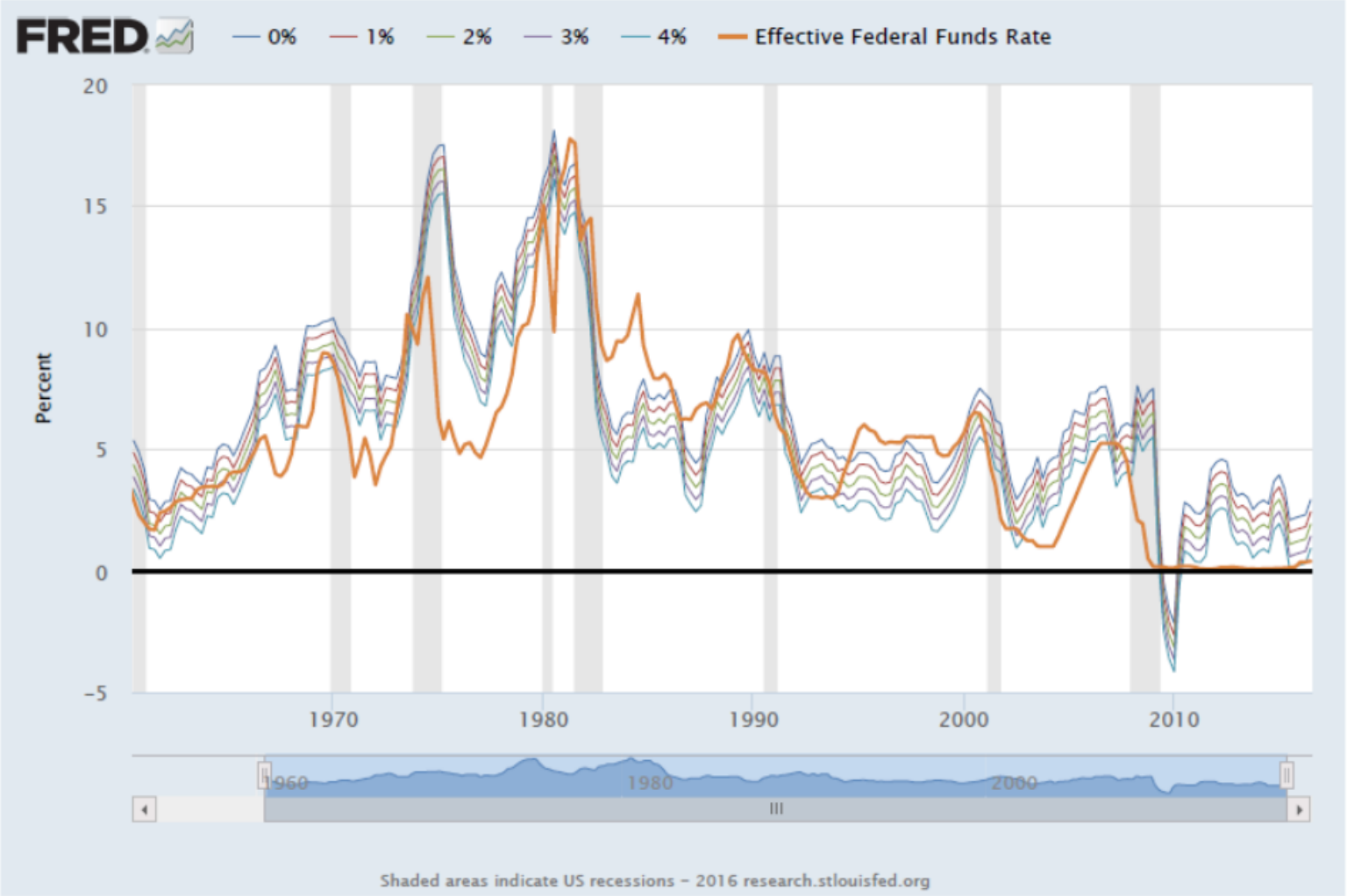
Taylor Rules

$$i_t^{FedFunds} = \pi_t + \beta(y_t - y_t^*) + \delta\,(\pi_t - \pi_t^*) + r_t^*$$

$$i_t^{FedFunds} = (1+\delta)\pi_t + \beta(y_t - y_t^*) + r_t^* - \delta\pi_t^*$$

- Positive statement? Is this how central banks behave?
- Or normative statement? Is this how central banks *should* behave?

Federal Funds Rate and Inflation Targets

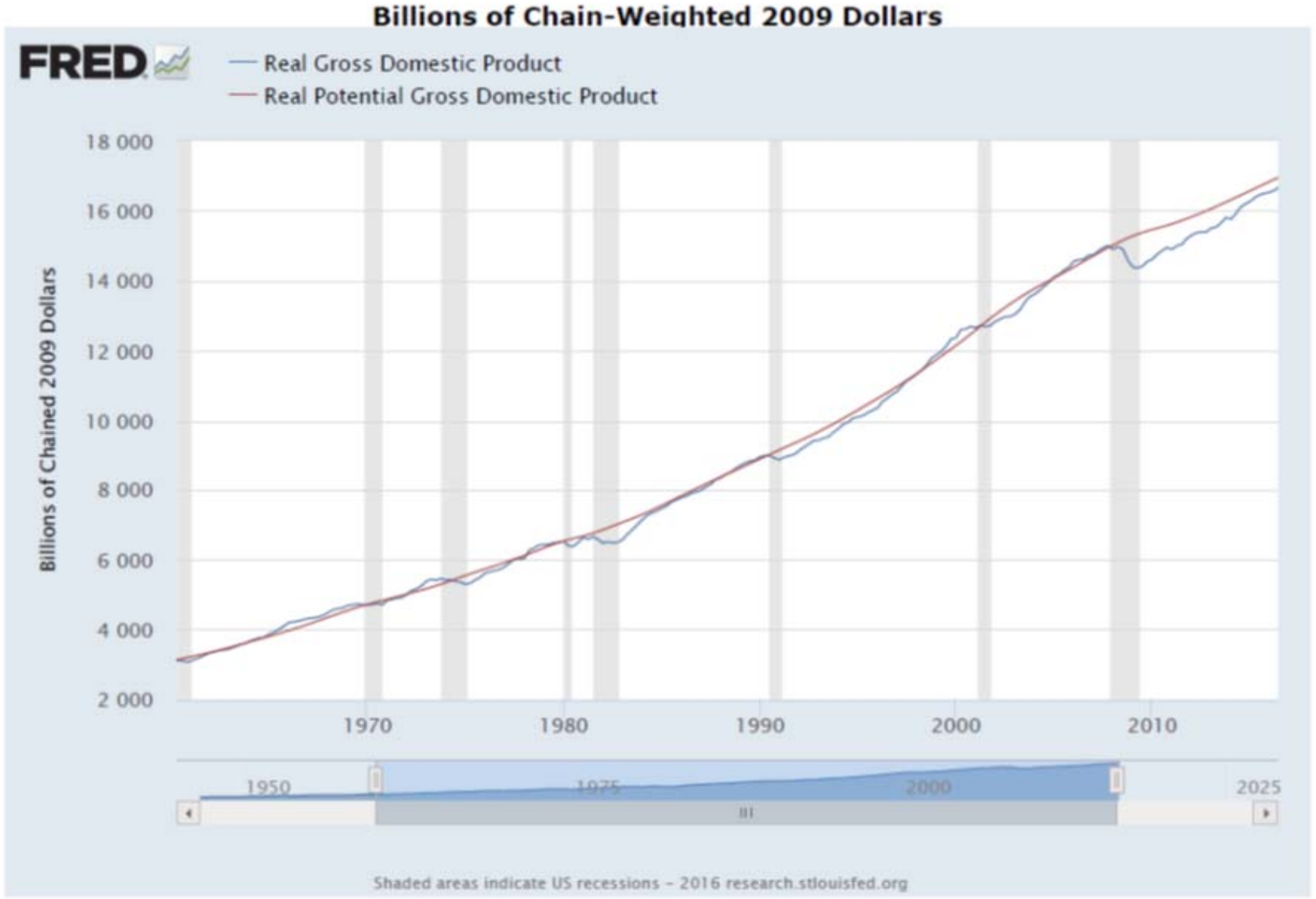


Federal Funds Rate and Inflation Targets shows the observed federal funds rate, quarterly, and the level of the funds rate implied by applying Taylor's (1993) equation to five alternative target inflation rates, π= 0, 1, 2, 3, 4 percent, where ft* is the implied federal funds rate, πt−1 is the previous period's inflation rate (PCE) measured on a year-over-year basis, yt−1 is the log of the previous period's level of real gross domestic product (GDP), and yt−1P is the log of an estimate of the previous period's level of potential output.

$$ft^* = 2.5 + \pi t-1 + (\pi t-1 - \pi)/2 + 100 \times (yt-1 - yt-1P)/2$$

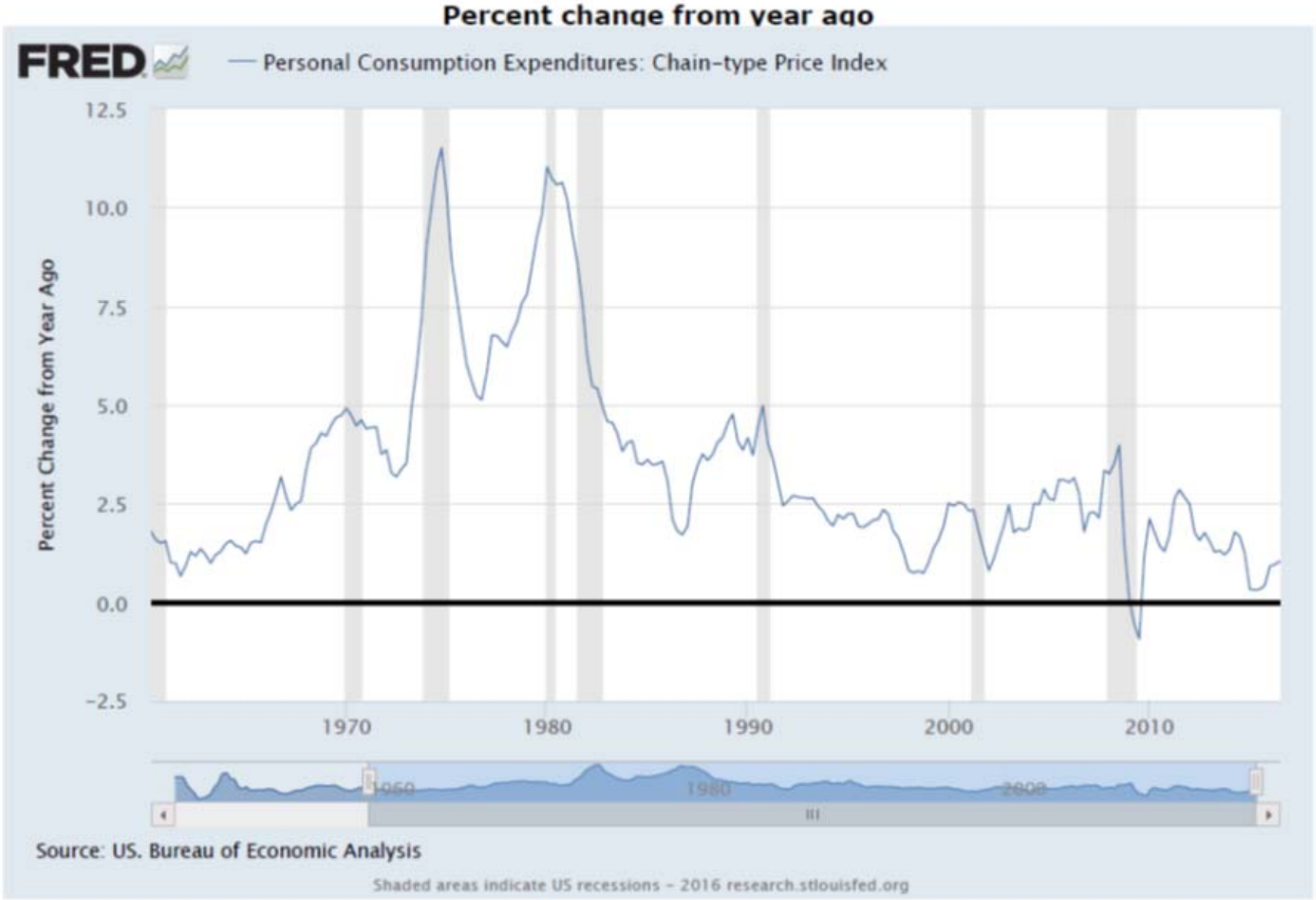
Source: St. Louis Fed, https://research.stlouisfed.org/datatrends/mt/page10.php

Actual and Potential Real GDP



Potential Real GDP is estimated by the Congressional Budget Office (CBO).

PCE Inflation



FRB St. Louis Interpretation of the Taylor Rule

Page 10: **Federal Funds Rate and Inflation Targets** shows the observed federal funds rate, quarterly, and the level of the funds rate implied by applying Taylor's (1993) equation

$$f_t^* = 2.5 + \pi_{t-1} + (\pi_{t-1} - \pi^*)/2 + 100 \times (y_{t-1} - y_{t-1}^P)/2$$

to five alternative target inflation rates, $\pi^* = 0, 1, 2, 3, 4$ percent, where f_t^* is the implied federal funds rate, π_{t-1} is the previous period's inflation rate (PCE) measured on a year-over-year basis, y_{t-1} is the log of the previous period's level of real gross domestic product (GDP), and y_{t-1}^P is the log of an estimate of the previous period's level of potential output. **Potential Real GDP** is estimated by the Congressional Budget Office (CBO).

“Your Name Here” Interpretation of the Taylor Rule

Baseline Taylor Rule Estimates of the Fed Funds Rate
(1987-2012)

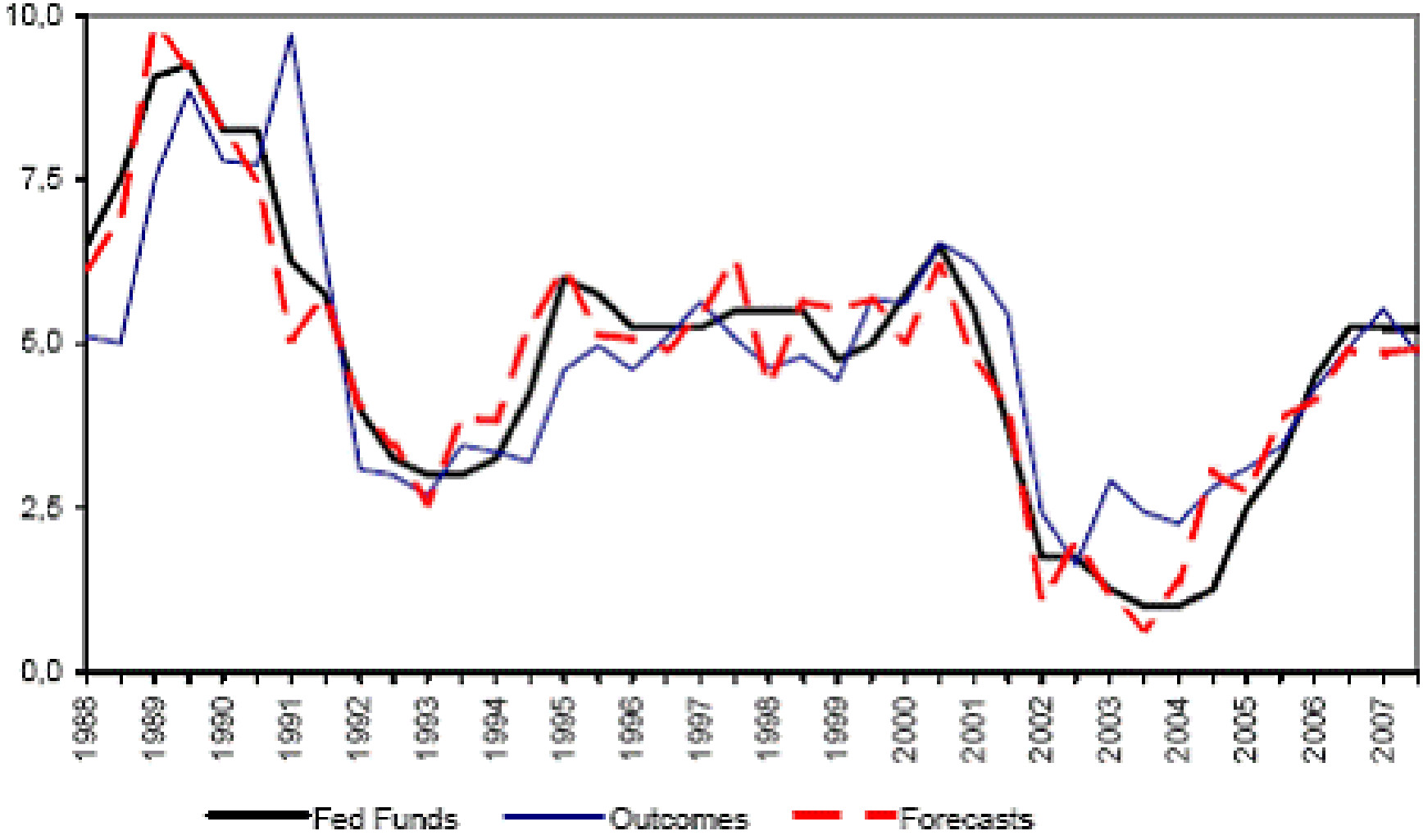
Source: Bloomberg; {TAYL <go>}

Bloomberg Financial Conditions Watch (Dec. 12, 2012)

Issues (within the framework)

- Which activity variable (output, unemployment)?
- Which inflation measure (CPI, PCE deflator, or respective core measures; 12 month, 3 month, etc.)
- What is the “natural” rate of real interest rate?
- Should it be forecasted output and inflation that matters?
- How to deal with data revisions?

Using Forecasted Values of y, π



Source: Orphanides and Wieland (2007)

Taylor Rules and Inflation Targeting

$$i_t^{FedFunds} = \pi_t + \beta(y_t - y_t^*) + \delta\,(\pi_t - \pi_t^*) + r_t^*$$

$$i_t^{FedFunds} = (1+\delta)\pi_t + \beta(y_t - y_t^*) + r_t^* - \delta\pi_t^*$$

- Question of interpretation: Why does the output gap enter? Is it determinant of future inflation (via Phillips Curve)? If so, Taylor rule is inflation targeting.
- More explicit: Set β=0, δ=1.