

A blue-tinted background image featuring a close-up of a calculator's keypad on the left, a stack of coins on the right, and a line graph with fluctuating data points in the center. The overall theme is finance and economics.

Bond price and interest rate determination

EE431 (Sem 1/2017)

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Reading

- Chapter 5 Mishkin

Previously....

- Established the relationship between bond price and YTM, known under the Bond Pricing **Formula**
 - **As emphasized**, the formula does not explain anything about causation. (what causes what!)
- Question: **“How does the market set price and interest rate of bond?”**
- **Answer:** Price is determined by **“demand”** and **“supply”**

Framework for bond price/interest rate determination.

- Model 1: **Bond price determination “Bond demand and Bond Supply”** (or also known loanable fund framework model)
- Model 2: Liquidity preference of Keynes

Topics

- Demand & Supply for Bond
- Liquidity Preference Model

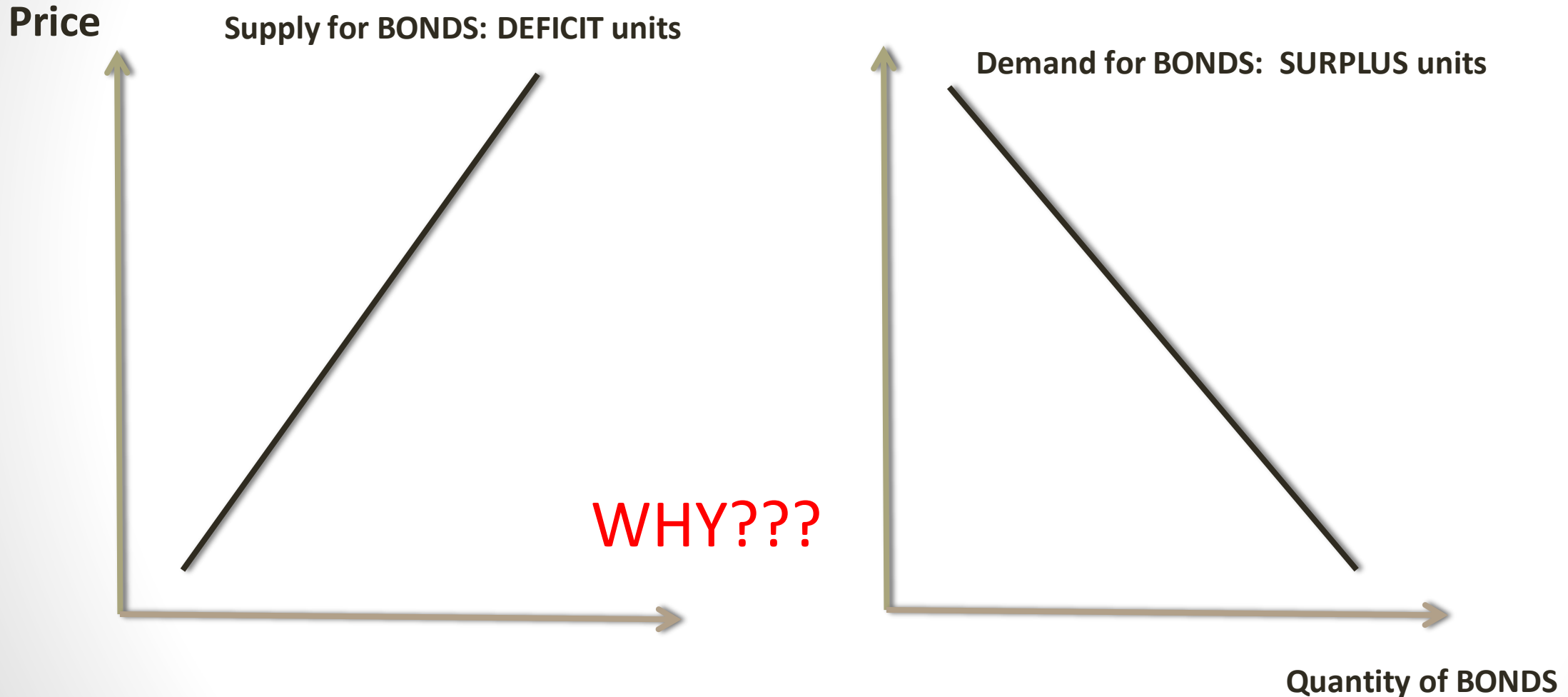
Assumptions

- Locally-issued Bonds: e.g. government bond + corporate bond
 - Later on, we will distinguish these two.
 - As you will be seeing later, we can create **interest rate differentials** for the two types of bonds.
- For simplicity, we consider only zero-coupon (discount) bond.
 - By principle of valuation II, understanding the determination of price and interest rate of zero-coupon bond is sufficient to help us understand everything about price's and interest rate's determination of coupon bond

Analytical framework using demand and Supply for BONDS

- Given everything else fixed, an increase in price of BONDS will
 - Lower quantity demanded for BONDS. (demand for BONDS is negatively related to bonds' price: downward sloping in price)
 - Increase quantity supply for BONDS. (supply for BONDS is positively related to bonds' price: upward sloping in price)

Bond demand and supply: graphical illustration



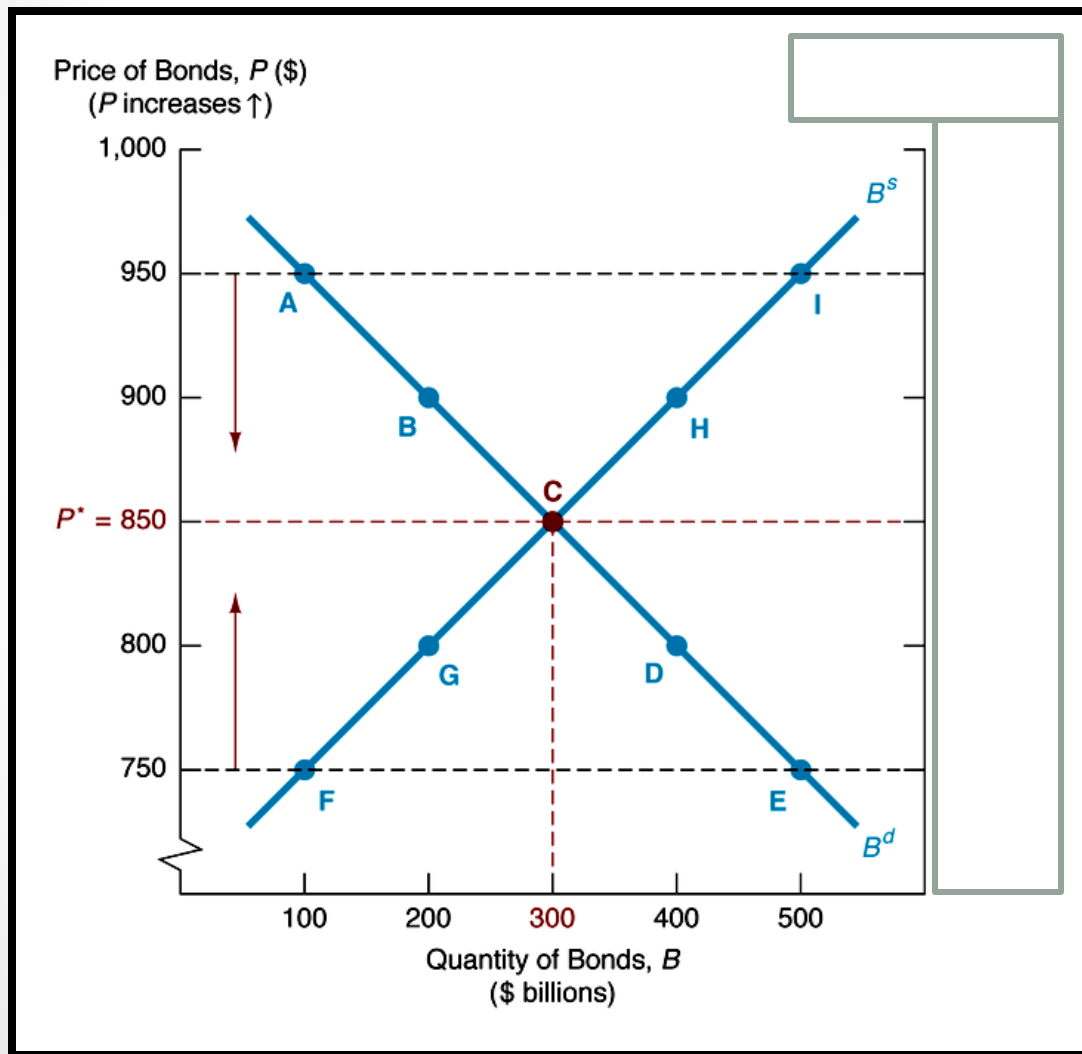
Demand for Bonds as a downward sloping relationship

- Price of bonds increases, **surplus units** would demand for less amount of bond holding because.....
 - As price increases, **yield to maturity of bond decreases**.
 - YTM represents the **return** for holding a discount bond.
 - Using our standard theory of asset demand, as return of an asset decreases, quantity demanded for that asset would be lowered accordingly!
 - **So, when price increases, associated with lower yield, quantity demand for bonds drop.**

Supply for Bonds as an upward sloping relationship

- Price of bonds increases, **deficit units** would supply for more amount of bond because...
 - As price increases, **yield to maturity of bond decreases**. (the same as before)
 - YTM represents the **cost of the borrowing** to bond issuers.
 - As cost of borrowing decreases, deficit units would be willing to borrow more, and hence issuing for more quantity
 - **So, when price increases, associated with lower yield, quantity supplied for bonds increase.**

Equilibrium price occurs when Bond demand = Bond Supply



Market Equilibrium = Point C

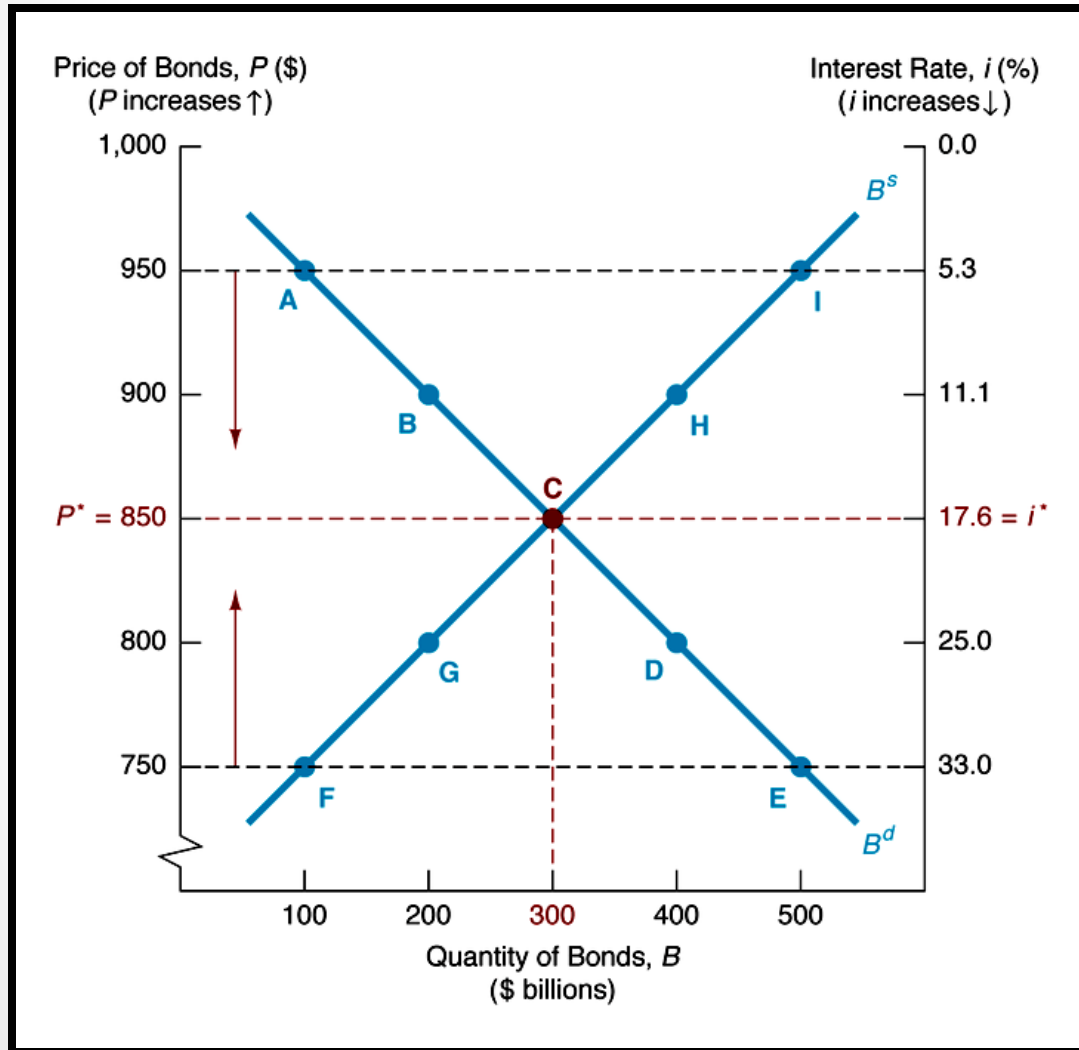
$$P^* = 850; Q^* = 300$$

Suppose a one-year discount bond with $FV = 1,000$
implied equilibrium interest rate can be then determined.

Market Equilibrium = Point C

$$P^* = 850; Q^* = 300$$

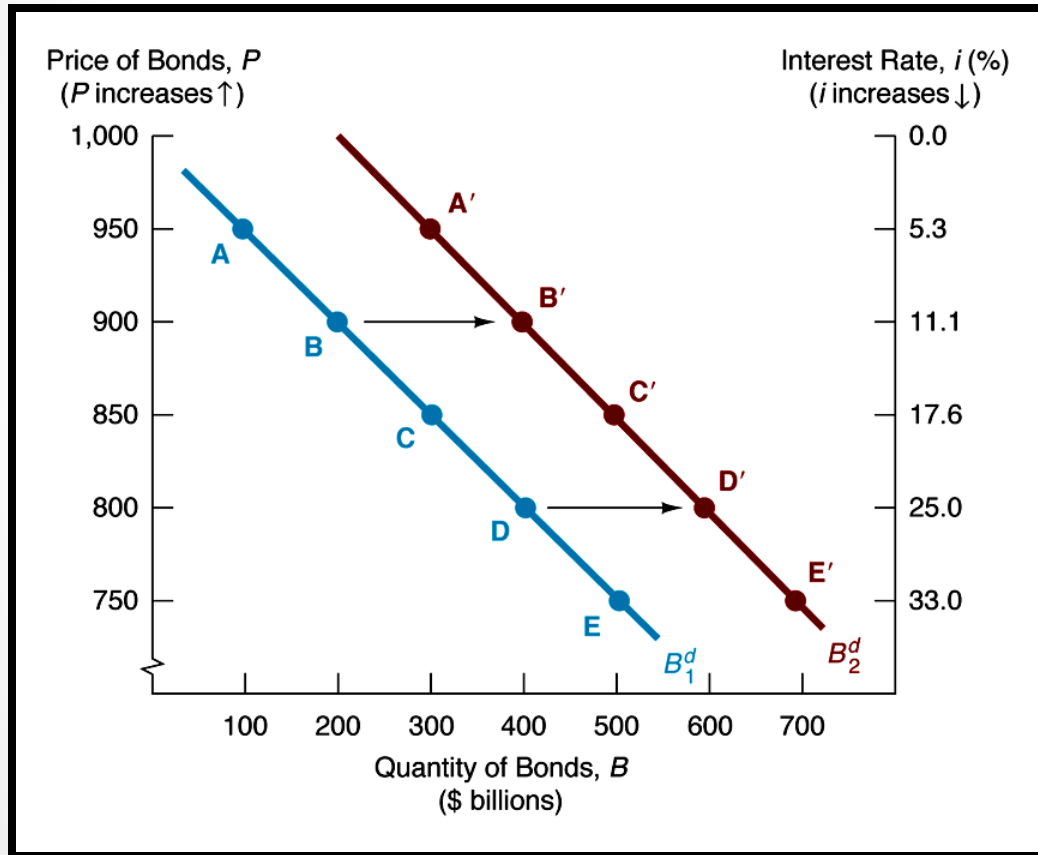
When price is set → the
implied market YTM can be
determined.



Fluctuation in the price and interest rate are the two key features in market.

- Price and interest rate always move over time.
- Why? → change in the equilibrium..
- This occurs because of changing conditions in demand and supply for BONDS, i.e. making the two curves shifted.
- **Question: what drives/causes the change in demand and supply for BONDS.**

Following the investment theory, factors that affect demand for BONDS include



- Relative return
- Liquidity
- Risk
- Wealth

Relative (expected) return

- Excess return of bonds (relative returns)
 - Defined as: expected return on bond – expected return on other assets
- Relative returns can increase under the followings:
 - expected return on other assets drops → switch to hold more on bonds.
 - expected return on BONDS increases
 - An anticipation in the rise of BONDS price → Expected Capital Gain
 - Lower expected inflation → real YTM increases (for any given level of nominal YTM)

Level of relative risk

- *Risky* and *riskier* assets → relative level of riskiness.
 - Overall level of riskiness in BONDS decreases.
 - Overall level of riskiness of alternative assets increases.
- Bond risks: Price Volatility, Credit Risk or Default Risk, Interest Rate Risk, etc.

Liquidity

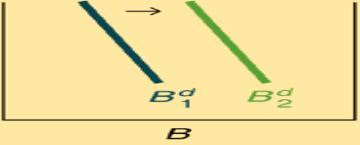
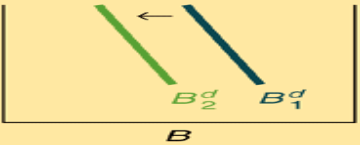
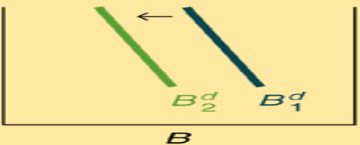
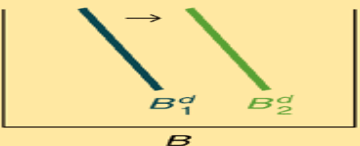
- Liquidity is referred to how ease an asset can be converted into cash:
 - Stock and house? Which one takes a shorter duration for the sell process?
- Typically, highly liquid asset is more preferable to illiquid asset.
- Bond price could increase if investor believes that it is easier to sell bond in the market.
 - More active buyer and sellers attracted to bond market.
 - Making the trading process easier.

Wealth

- Wealth causes an increase in Bonds Demand.
- Why? Empirically, we find that investors have constant relative risk aversion.
- As wealth increases, the investing amount on a particular asset would grow in the same proportion so that the fraction of investment on that particular asset is constant.

Factors affect demand for BONDS.

SUMMARY Table 2 Factors That Shift the Demand Curve for Bonds

Variable	Change in Variable	Change in Quantity Demanded	Shift in Demand Curve	
Wealth	↑	↑	(increases ↑)	 (increases ↓)
Expected interest rate	↑	↓	(increases ↑)	 (increases ↓)
Expected inflation	↑	↓	(increases ↑)	 (increases ↓)
Riskiness of bonds relative to other assets	↑	↓	(increases ↑)	 (increases ↓)
Liquidity of bonds relative to other assets	↑	↑	(increases ↑)	 (increases ↓)

Note: P and i increase in opposite directions: P on the left vertical axis increases as we go up the axis, while i on the right vertical axis increases as we go down the axis. Only increases in the variables are shown. The effect of decreases in the variables on the change in demand would be the opposite of those indicated in the remaining columns.

Factors that affect supply for BONDS.

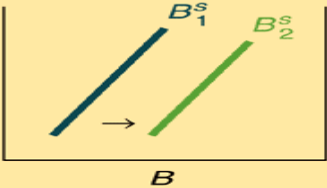
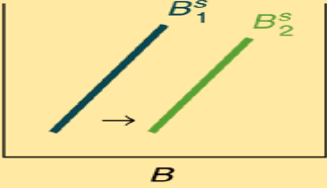
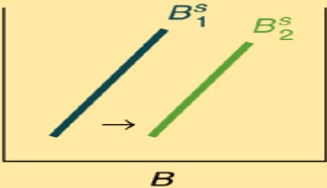
- What are the factors that **cause deficit units to issue more bonds**, i.e. why they borrow more?
- Three possible reasons:
 - Profitability of business
 - Inflation expectation
 - Government activities

Three possible reasons:

- Good business prospects $\rightarrow$ invest more $\rightarrow$ Borrow more $\rightarrow$ issue more bond $\rightarrow B^s \uparrow$
- *Anticipating that inflation is going to rise, $\pi^e \uparrow \rightarrow$ lowered borrowing cost, in real term $\rightarrow B^s \uparrow$*
- Larger scale of budget deficit $\rightarrow$ debt-financing $\rightarrow$ more bonds issued.

Factors that affect supply for BONDS.

SUMMARY Table 3 Factors That Shift the Supply of Bonds

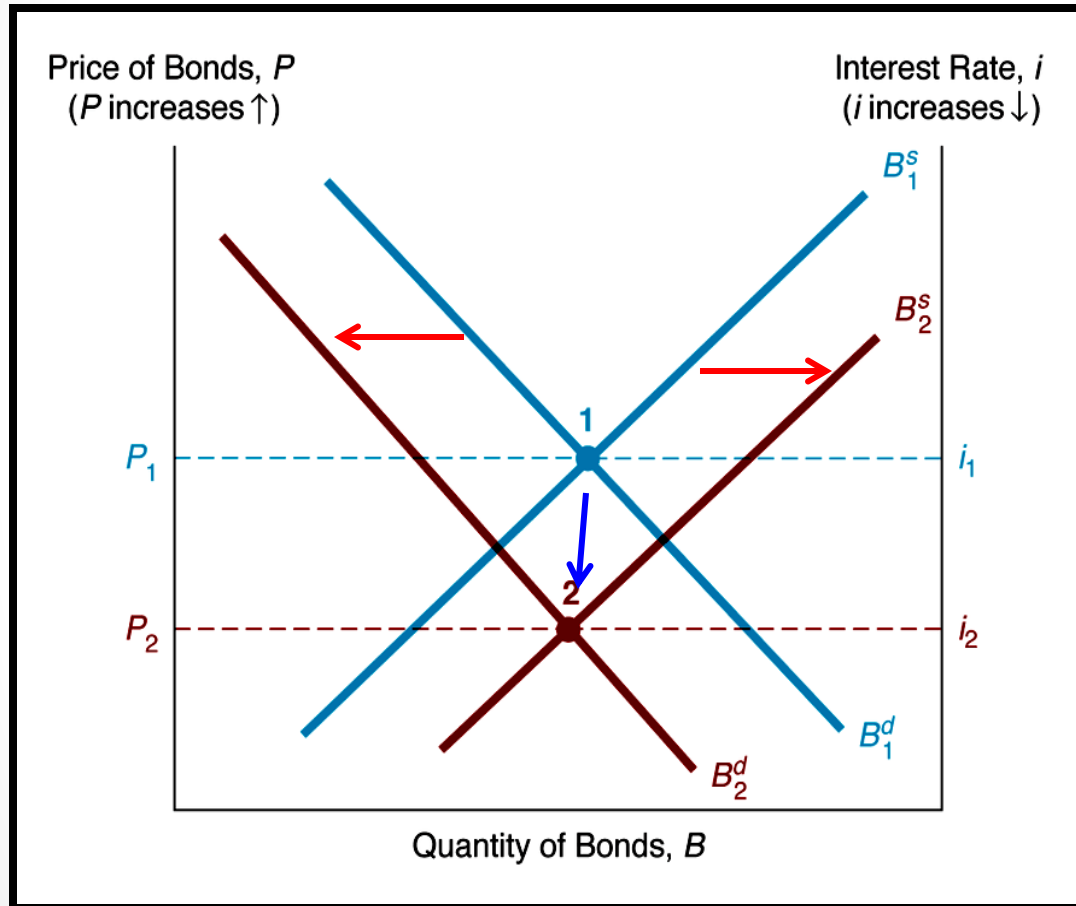
Variable	Change in Variable	Change in Quantity Supplied	Shift in Supply Curve
Profitability of investments	↑	↑	P (increases ↑)  i (increases ↓)
Expected inflation	↑	↑	P (increases ↑)  i (increases ↓)
Government deficit	↑	↑	P (increases ↑)  i (increases ↓)

Note: P and i increase in opposite directions: P on the left vertical axis increases as we go up the axis, while i on the right vertical axis increases as we go down the axis. Only increases in the variables are shown. The effect of decreases in the variables on the change in supply would be the opposite of those indicated in the remaining columns.

What we have seen so far

- Framework for the determination of BOND price and interest rate.
 - Knowing price → knowing market-implied yield (interest rate)
- Factors that causes a variation in price and interest rate.
 - Factors that shift demand and supply for BONDS.
- Next, **some applications** of the model to explain what happened in the world.

1. What is the effect of inflation?



- Inflation Expectation
 - Bond Demand drops
 - Bond Supply increases

$$i_1 - \pi_1^e = i_2 - \pi_2^e$$

Fischer Effect
(no money illusion)

Empirically, does the Fisher effect hold?

- Plenty of work have tested the theory.
 - Short-run the effect doesn't hold
 - Correlation between inflation and interest rate is moderate.
 - Long-run the effect holds.
 - Correlation is higher.
 - International comparison suggests that high inflation economy is typically associated with high level of interest rate.
- So, it's a *matter of time horizon*:
 - people *may* be slow to adjust, and hence having a money illusion in the short-run.

2. How does the interest rate behave over the course of business cycles?

FRED 

— 3-Month Treasury Bill: Secondary Market Rate



Source: Board of Governors of the Federal Reserve System (US)
research.stlouisfed.org

Recession: area shaded in grey

1. Procyclical Behavior

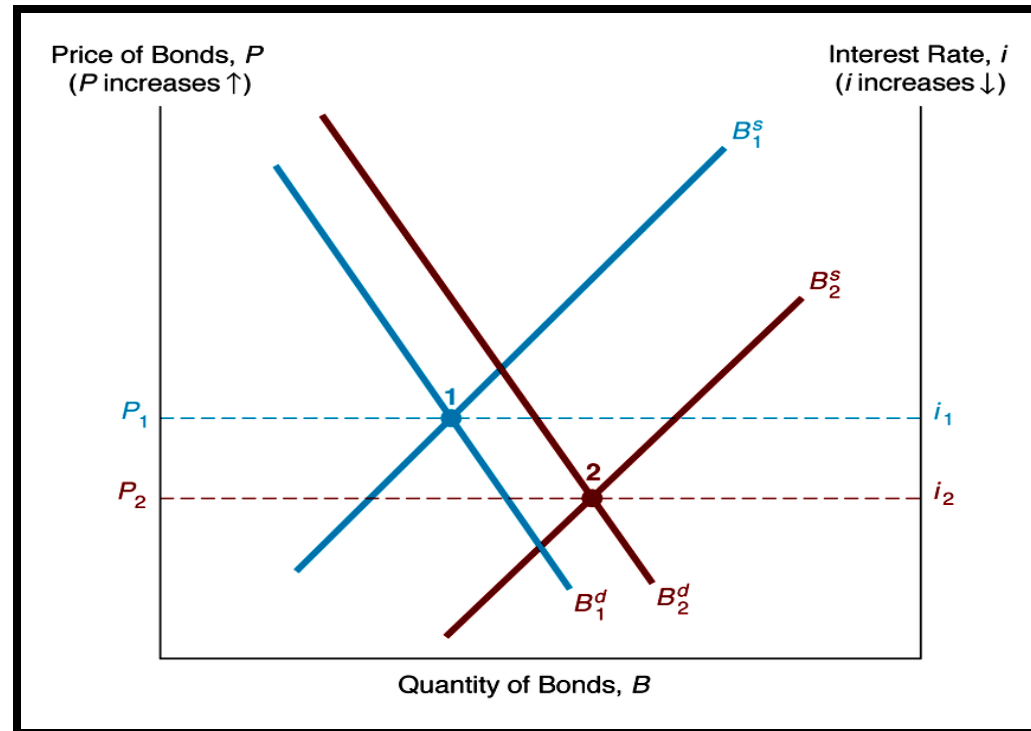
2. Leading indicator

2. The Explanation using our framework

Booming economy

more demand for
bond (more
saving)

More demand for
investment



Demand shift right

- Price rises
- **YTM drops**

Supply shift right

- Price drops
- **YTM increases**

As interest rate is procyclical
variable, **supply factor must
dominate demand factor.**

Agenda

- Demand & Supply for Bond

- Liquidity Preference Model

Demand for money

- Motives of demand for money
 - Transaction
 - Precautionary
 - Speculative

Determinants

- The first two motives: income / financial technology
- The last: relative return on money.

Short-term interest rate / money demand

- Higher interest rate represents higher opportunity cost of money holding, i.e. foregone amount of interest that could have been earned.
- Demand curve for money → Downward slope

Supply for money

- Central bank can control money supply, and then set the stock of money supply to the targeted level.

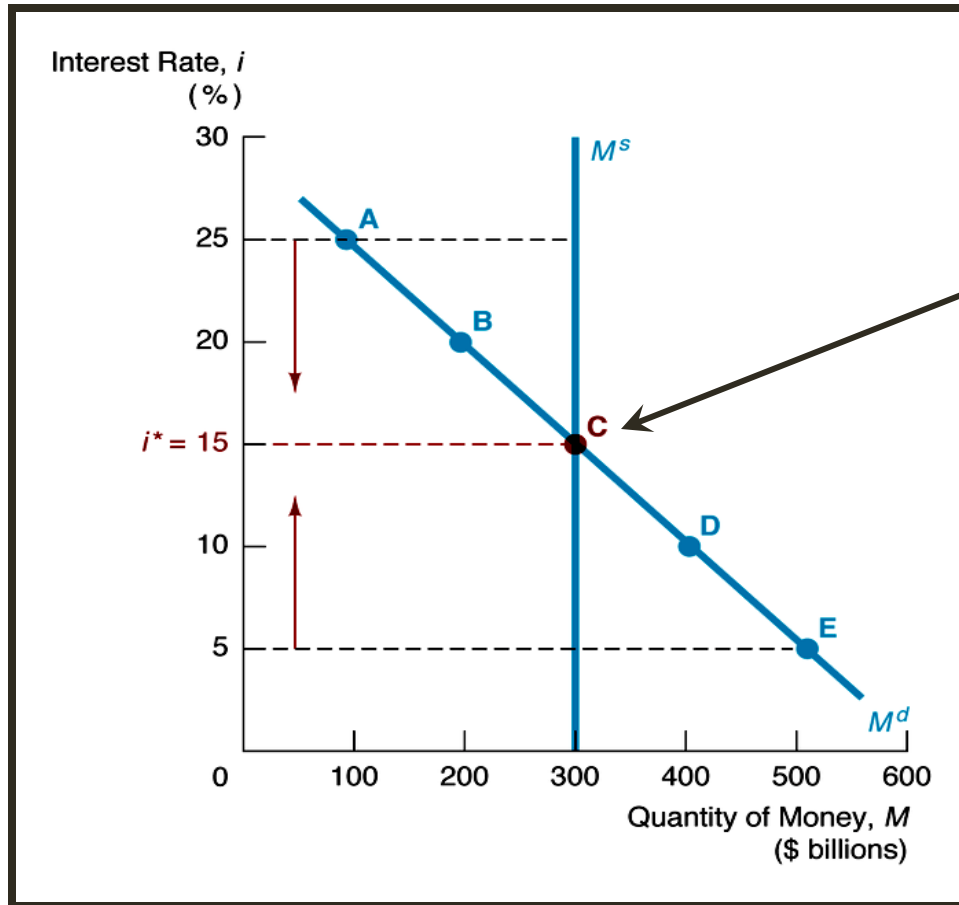
M^s is vertical line.

- How does the central bank adjust money supply?

Equilibrium in money market

- If $M^s > M^d$ (excess supply): eliminate the excess by **purchasing more of** Bond
- If $M^d > M^s$ (excess demand): compensate the deficit by **liquidating** Bond
- Equilibrium arises when $M^d = M^s$

Equilibrium in money market

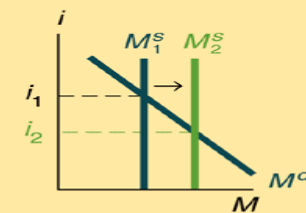
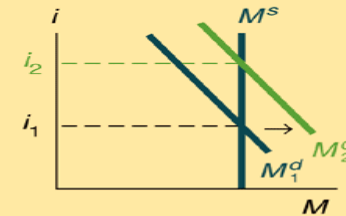
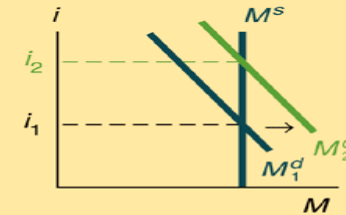


Money market equilibrium

What does the model prediction?

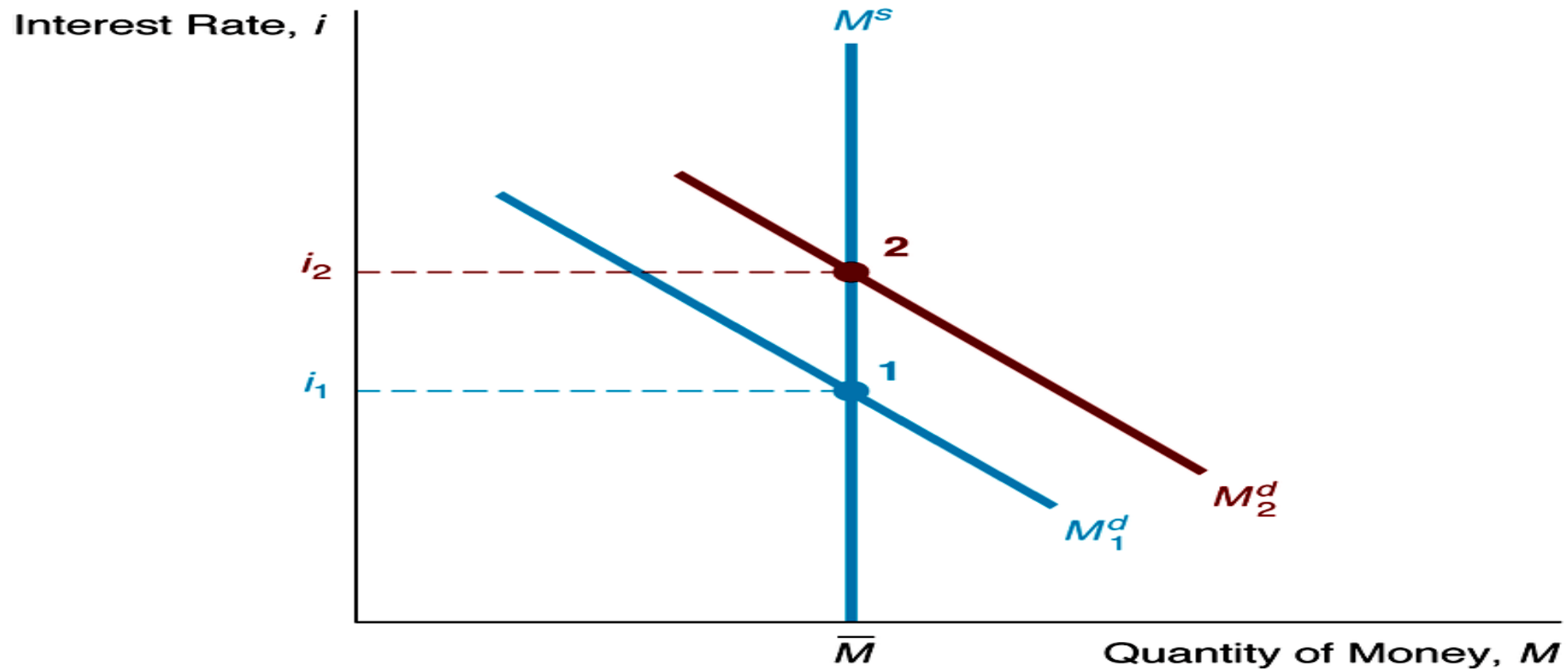
SUMMARY Table 4 Factors That Shift the Demand for and Supply of Money

Variable	Change in Variable	Change in Money Demand (M^d) or Supply (M^s)	Change in Interest Rate
Income	↑	M^d ↑	↑
Price level	↑	M^d ↑	↑
Money supply	↑	M^s ↑	↓



Note: Only increases in the variables are shown. The effect of decreases in the variables on the change in demand would be the opposite of those indicated in the remaining columns.

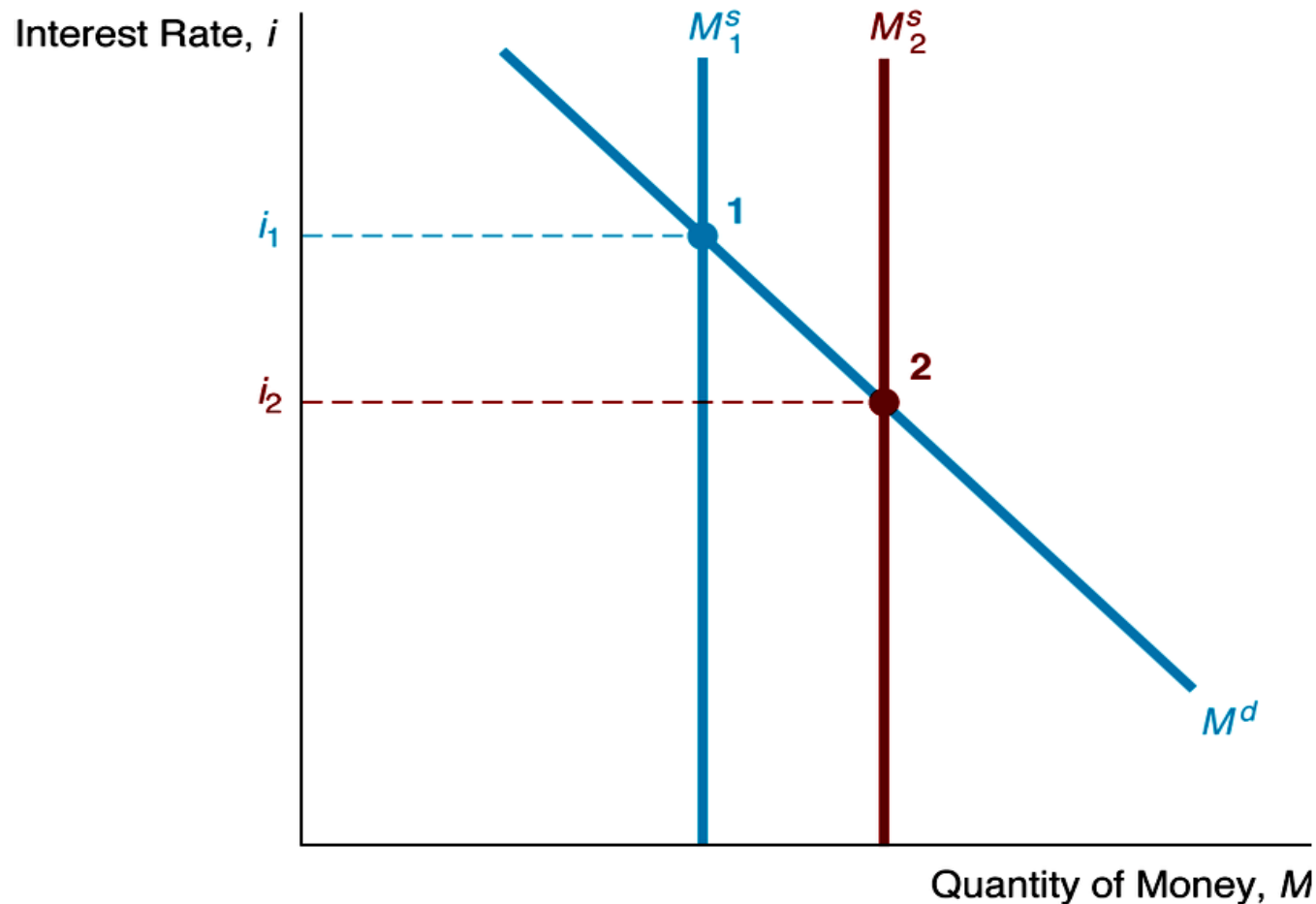
Model predicts that interest rate is a procyclical variable.



Application: Does money expansion permanently cause a lower interest rate?

- Yes, following Keynes..
 - Lowered interest rate stimulates growth
 - Monetary economists call the *Liquidity effect of money*.
- As it generates a stimulative impact, is it logically sensible to keep the interest rate low so that country can keep growing?

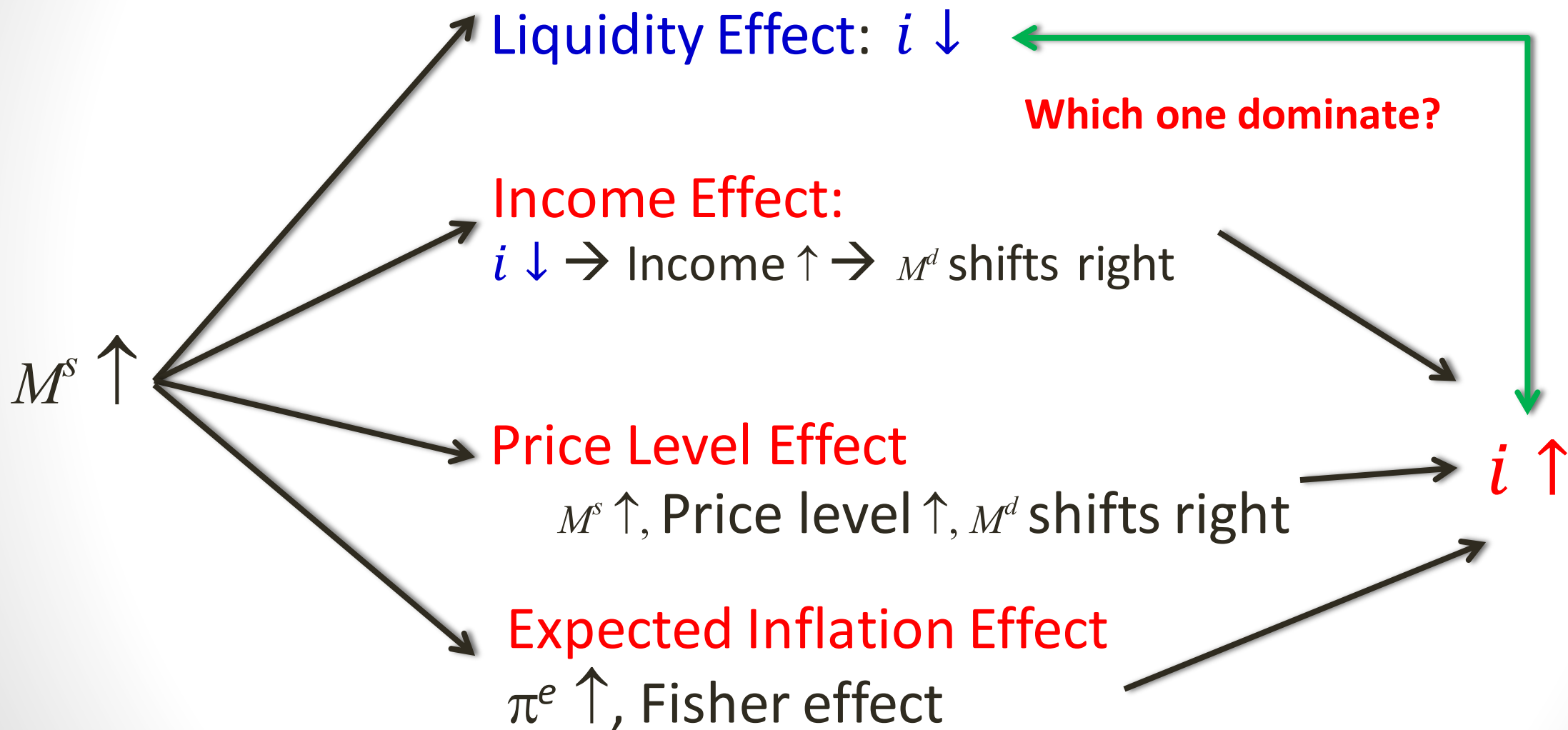
Model predicts that expansionary monetary policy will cause an decrease in market interest rate



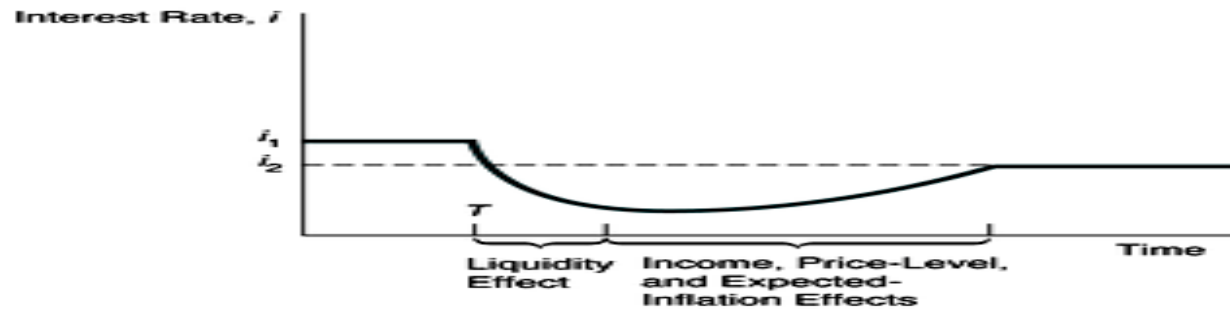
Monetarism Argument and Debate

- Milton Friedman: “NO” Keynes’s analysis is based on partial effect, i.e. incomplete.
- In the reality, changes in money supply generates chain reactions, and cause some adverse feedback effects that might offset the effect produced initially.
 - General equilibrium

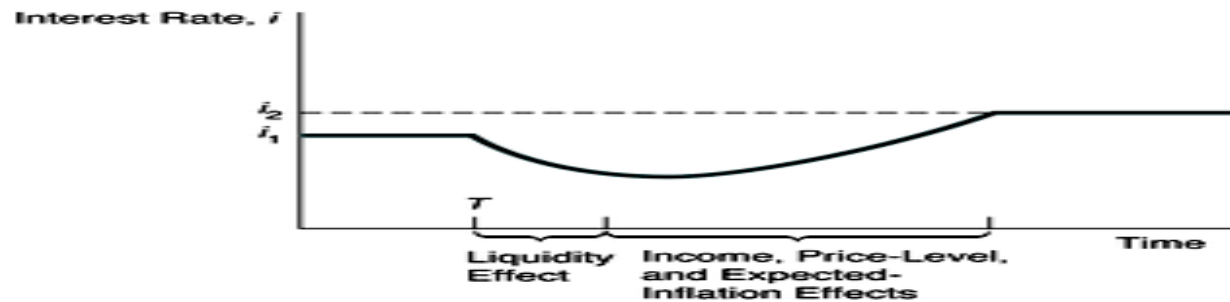
Effects **counteract** to Liquidity Channel



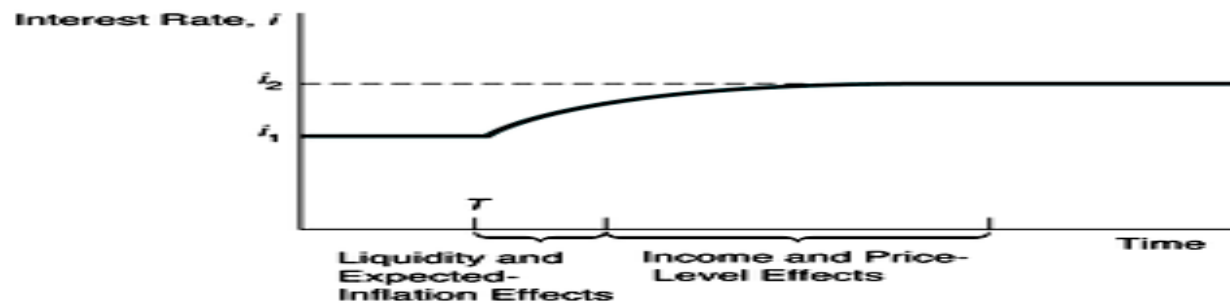
Interest rate dynamics



(a) Liquidity effect larger than other effects



(b) Liquidity effect smaller than other effects and slow adjustment of expected inflation



(c) Liquidity effect smaller than expected-inflation effect and fast adjustment of expected inflation

Empirical evidences

- Short-run: A temporary increase in money supply causes a lower interest rate. Price is slow to adjust in the short-run.
- Long-run: when inflation starts to kick in, liquidity effect will be offset, either “partially” or “completely”.

Implications: principle of monetary policy

- Friedman argues that targeting low interest rate does not make sense
- In the long-run, the attempt to keep interest rate low must be accompanied with higher level of money growth. This causes higher *Inflation Expectation* (anticipation) which eventually will lead to a rise of market rate.
- Price stability as the primary goal of monetary policy

Friedman (1968) “The role of monetary policy” American Economic Review

Implications: Financial imbalances and Bubble

- New generation of monetary policy has shifted their concerns over the perils of low interest rate; it might instead impair the financial stability.
- What has lead the US economy to the Subprime is a clear example.
- After the 2001 crisis, FED had kept their FED fund rate for too extended periods of time. (Worried about the full recovery of the US economy, from the Dot-com bust.)
- Even no sign of the inflation threat, this sows the seeds of next financial bubble (financial stability) through the risk-taking and the search-for-high-yield behavior.