Elements of Macroeconomics TA
Session 7:
Midterm Exam *3*

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Slides on https://github.com/Haruki-Shibuya/TA

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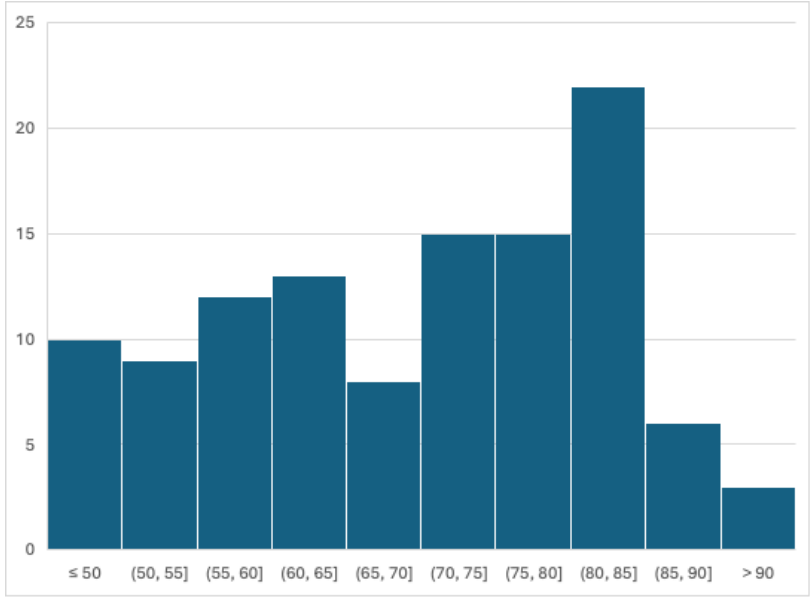
Grading allocation

- Section 1,3,4: Qingyuan qfang6@jh.edu
- Section 2: Shiqi h.q@jh.edu

- Midterm Exam 3 was graded by Qingyuan and Shiqi only.
- I will (probably) grade most of the final exam.

Basic stats



	Q1	Q2	Q3	Q4	Total
Full points	28.00	22.00	36.00	14.00	100.00
25% Percentile	23.00	15.00	17.00	0.50	58.50
Median	25.00	17.00	24.00	9.00	71.50
75% Percentile	26.00	20.00	27.00	9.50	80.50
Mean	24.42	16.71	22.04	5.94	69.12
Stand. Dev.	2.83	4.03	7.04	4.29	13.85
Highest	28.00	22.00	33.00	12.00	92.50

Section 1

Fixed Income Security	Yield	issue date	issue price
1-year U.S. treasury	6.0%	1/1/2028	$3,000
5-year U.S. treasury	4.0%	1/1/2028	$3,000
10-year U.S. treasury	5.0%	1/1/2028	$3,000
10-year TIPS	2.6%	1/1/2028	$3,000
10-year IBM bond	7.0%	1/1/2028	$3,000
10-year GameStop bond	11.0%	1/1/2028	$3,000

1. A buyer of a GameStop bond would pay ___$3000___and expect to receive _$330_ per year for __10__years.
2. At the beginning of 2038, the buyer of the GameStop bond will receive her last interest payment plus a check for __$3000__.

↑Principal

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3. According to the expectations theory of interest rates, investors believe that, on average, 1-year treasury rates, over the years 2029 through 2038 will equal ___4.89%___? ↵ (ignore term premium) ↵

- $(1 + y_1) \times (1 + f_{1,2029}) \times \cdots (1 + f_{1,2038}) = (1 + y_{10})^{10}$
- $(1 + f_{1,average})^9 = (1 + f_{1,2029}) \times \cdots (1 + f_{1,2038}) = \frac{1.05^{10}}{1.06}$

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5. Based on the data given, what is the average expectation for inflation, 2028-2038?

2.42%↵

- $1 + f_{1,\,average} = \left(\frac{1.05^{10}}{1.06}\right)^{1/9} = 1.048894\ldots.$
- Or log-approximate as $1+ (1+10 \times 0.05\text{-}1.06)/9 \approx 1.048888\ldots$

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4. Why is the 10-yr GameStop rate higher than the 10-yr rate on the IBM debt instrument?↵
   GameStop corporate bond is riskier than IBM corporate bond/↵
   GameStop has a higher probability of default than IBM.↵

Credit ratings (Source: S&P Global Ratings)

IBM: A-
GameStop: BB-

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5. Based on the data given, what is the average expectation for inflation, 2028-2038?

- $E\pi = i - r$
- 10-year US treasury yield - 10-year TIPS yield = 5% - 2.6% = 2.4%

Section 1

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6. Based on the data above, on average, what do investors in the IBM bond expect the real yield to be?

- $r = i - E\pi$
- 10-year IBM bond yield – expected inflation rate over 10 year
- $= 7\% - 2.4\% = 4.6\%$

Section 1

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7. If you expect inflation to average 5% per year over the next 10 years, would you prefer to hold 10-yr TIPS or Treasuries? Briefly explain.

- $r = i - E_{yours}\pi$
- 10-year US treasury yield – your expected inflation rate over 10 year
- = 5% - 5% = 0% (you expect 0% real yield from US treasury)
- But you get 2.6% real yield by investing in TIPS, so TIPS is preferred

Section 2

Long-term sustainable real growth (Y)	2.5%
NAIRU (Non-Accelerating Inflation Rate of Unemployment)	4%
π* (Target inflation rate)	2%
Neutral real short rate	2%
Unemployment rate	6%
Inflation rate	2%
10-year historical performance of velocity of money	Highly volatile
Taylor Equation parameter (α)	0.5
Taylor Equation parameter (β)	1

- Fed Chair Judy Shelton follows Friedman during 2032 Jan-June

Section 2

1. Write down the equation that is associated with Milton Friedman's guidance on conducting monetary policy. (3 points)

- Milton Friedman's guidance on conducting monetary policy is often associated with the equation of the Quantity Theory of Money:
- MV=PY, where
- M = Money supply
- V = Velocity of money (often assumed to be constant)
- P = Price level
- Y = Real GDP

Section 2

- MV=PY
- $\Rightarrow \frac{\dot{M}}{M} = \frac{\dot{P}}{P} + \frac{\dot{Y}}{Y} - \frac{\dot{V}}{V}$ *or* $\Delta M\% = \Delta P\% + \Delta Y\% - \Delta V\%$
- If V is constant (i.e., $\Delta V\%=0$), then $\Delta M\% = \Delta P\% + \Delta Y\%$
- "Increase money supply in proportion to the nominal GDP growth"
- So, under assumption $\Delta P\%=2\%$, $\Delta Y\%=2.5\%$, $\Delta V\% = 0$,
- we have $\Delta M\% = 2\% + 2.5\% = 4.5\%$

2. What assumption—contradicted by information provided above—must Chair Shelton make to feel confident about following this rule? (3 points)↵

V is constant↵

3. The N.Y. Fed, following Chair Shelton dictates, conducts open market operations. They will buy and sell t-bills in an effort to do what? (4 points)↵

a) Target a growth rate of 4.5% for Money↵

Section 2

Over the two quarters Chair Shelton embraces this strategy, the following unfolds:

	Jan.	Feb.	Mar.	Apr.	May.	Jun.
M1 (annualized growth rate)	5.8%	4.3%	5.2%	5.9%	6.1%	4.9%
fed funds rate	8%	4%	6%	2%	9%	3%
CPI (annualized growth rate)	2%	2%	2%	1.5%	1.5%	1.5%
Unemployment rate	6%	6.20%	6.40%	6.80%	6.90%	7.00%

4. Chair Shelton, in July Congressional testimony, heard major complaints about her strategy from Congressmen and Congresswomen. They would most likely complain about? (4 points)
   a) The risk of accelerating inflation in the near future
   b) The sharp rise for unemployment over the six-month period
   c) The wild volatility for interest rates
   d) The volatility exhibited for monetary growth
   e) Both a and d
   f) Both b and c

Section 2

5. President DeSantis, in July of 2028, replaces Chair Shelton with Stanford economist John Taylor. Which famous equation will this new Fed Chair likely use, as he leads monetary policy discussions? Write down the equation. (4 points)

- $i = \pi + r^* + \alpha(\pi - \pi^*) + \beta(u^* - u)$, where
- r^* = natural rate of interest
- u^* = natural unemployment rate or NAIRU
- π^* = target inflation rate

Section 2

6. Taylor sets policy according to the equation you highlighted in question 5. What target rate will result? (Use the June 2028 economic data, and the star values and parameters provided at the top of page 3) (4 points)

- $i = \pi + r^* + \alpha(\pi - \pi^*) + \beta(u^* - u)$
- $= 1.5\%+2\%+0.5 \times (1.5\%-2\%)+1 \times (4\%-7\%) = 0.25\%$

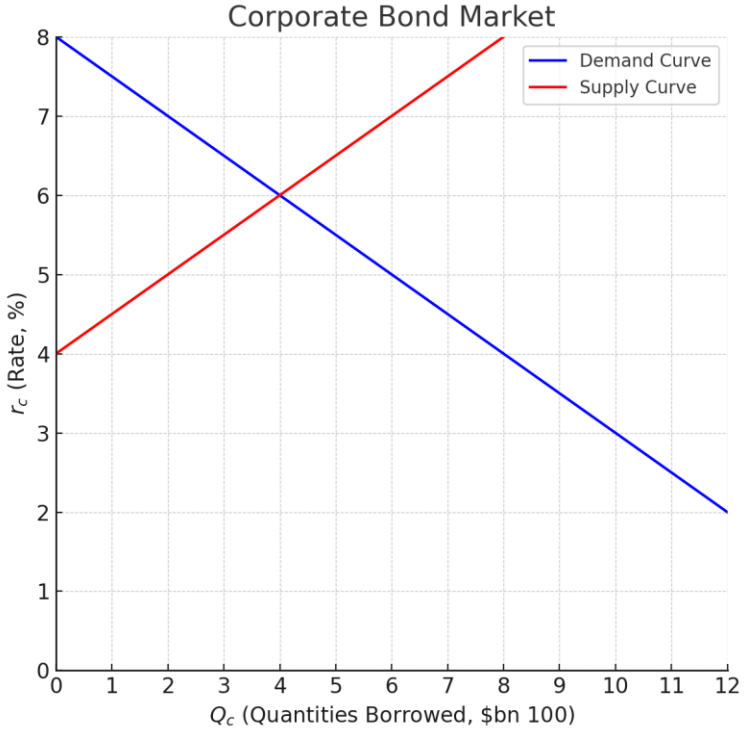
Section 3

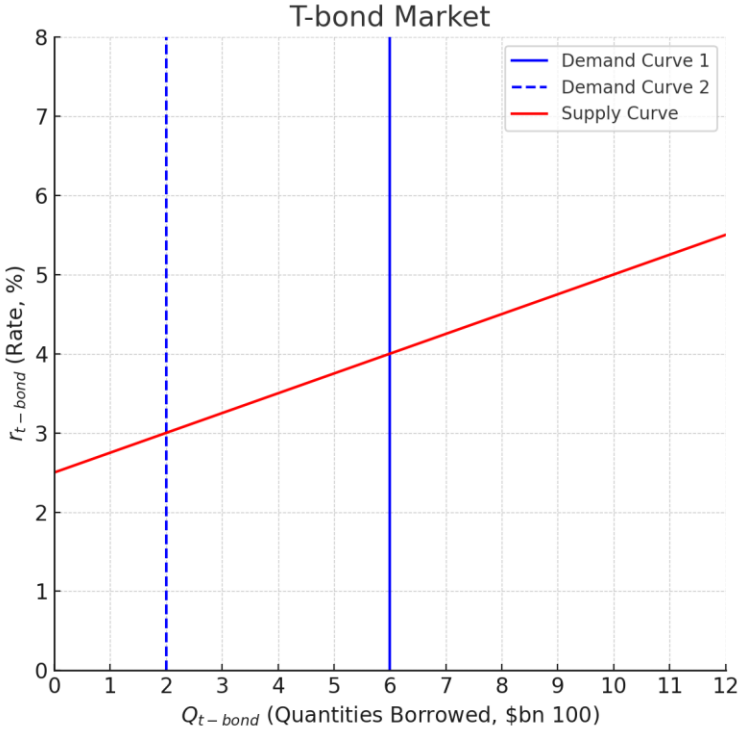
The FOMC of the U.S. Federal Reserve, December of 2030, provides the following median forecast for year-end 2031:

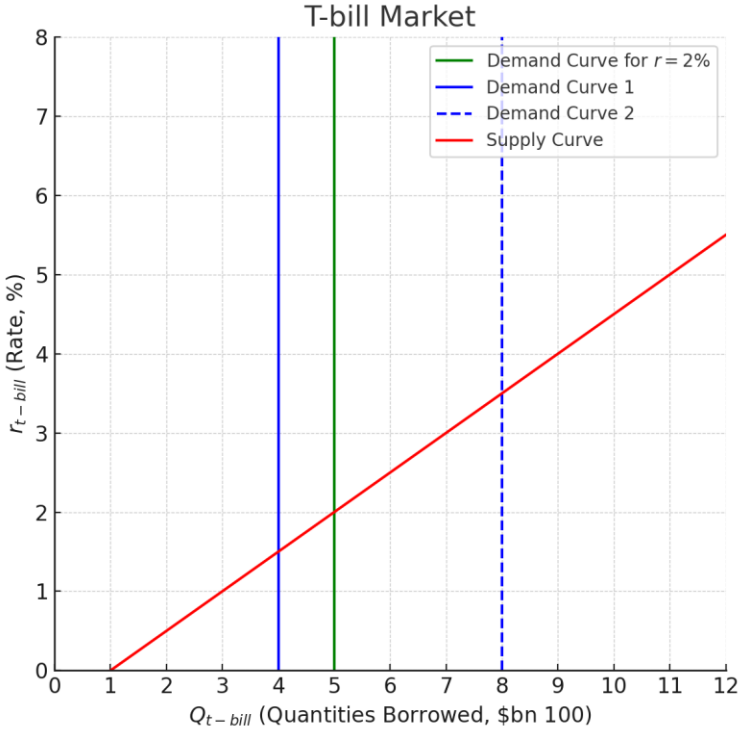
FOMC Expectations		FOMC Parameters	
Inflation	2.0%	α for Taylor Rule:	0.5
Unemployment	4.25%	U*	4.25%
r*	2.0%	π*	2%
Budget Deficit	$1 trillion	Deficit Financing Plan	40% t-bills, the rest t-bonds
Risky/Risk-Free Bond Spread	2%	β for Taylor Rule:	1

Section 3

1. Label each of the panels' curves. Add the curves that depict the government's funding plans. In addition, based on the information above, draw in the missing curve, being careful to have it reflect the equilibrium rate dictated by the information provided.







Section 3

- Loanable funds model (LFM) vs money market model (MMM)

- Interest Rates: LFM deals with the real interest rate, while the MMM deals with the nominal interest rate.
- Purpose: The LFM is primarily used for analyzing long-term capital investment and saving behavior, while the MMM is used for understanding short-term monetary policy and liquidity.
- Determinants: The supply of money in the MMM is set by the central bank, whereas in the LFM, the supply of loanable funds is determined by the saving behavior of households and external capital inflows.

Section 3

- Applications:
- LFM: Useful for studying long-term trends in economic growth, interest rate impacts on investment, and the effects of fiscal policy on savings and investment.
- MMM: Central to understanding how monetary policy impacts interest rates, inflation, and overall liquidity in the economy.

Section 3

2. Embracing the frame offered by Stanford economist John Taylor, calculate the target rate the FOMC of the Federal Reserve will set, given the information above.

- $i = \pi + r^* + \alpha(\pi - \pi^*) + \beta(u^* - u)$
- $= 2\%+2\%+0.5 \times (2\%-2\%)+1 \times (4.25\%-4.5\%) = 4\%$

Section 3

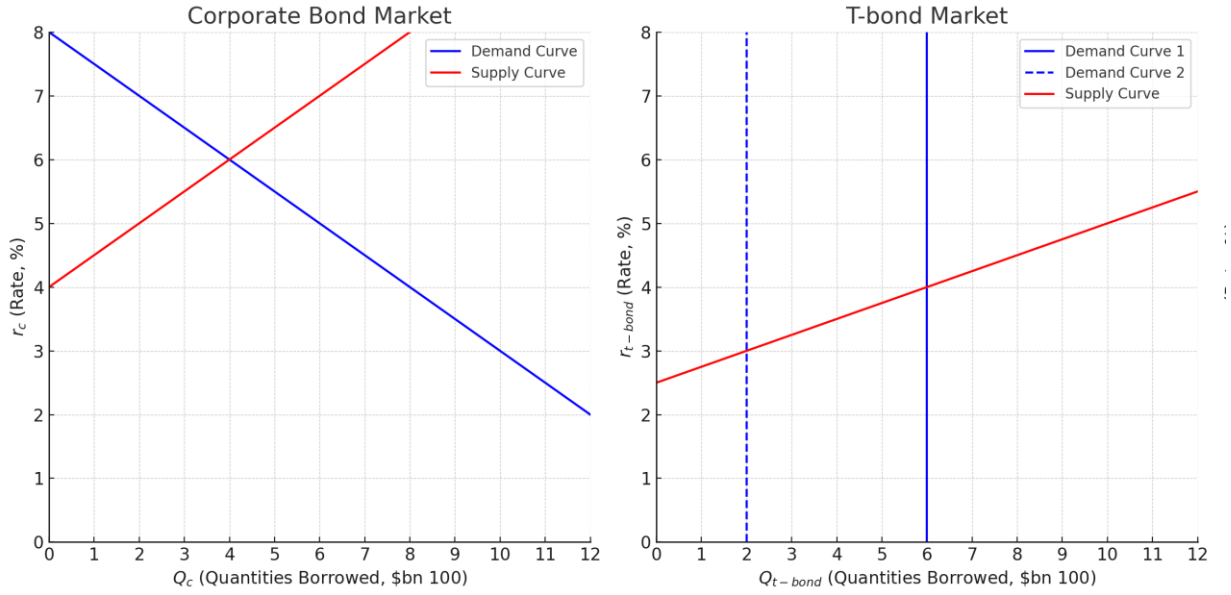
3. State the name of the operation the Fed will perform, to achieve its target, and represent this operation in the diagram above.

- Open market operations
- If target rate<actual FF rate, Fed buys gov. securities to decrease FF rate
- If target rate>actual FF rate, Fed sells gov. securities to increase FF rate

Section 3

4. **Assume the government and corporate bond markets already have accounted for the Federal Reserve Actions**. What is the equilibrium **real** corporate bond rate, and what is the equilibrium quantity borrowed?

- r_c = r_{t-bond} + risky/risk-free bond spread
- = 4%+2% = 6%
- Q_c = $bn 400



Section 3

5. If we check a Bloomberg screen, what rate will corporations be offering?

- This question is asking for a nominal yield of the corporate bond
- $i\_c = r\_c + \pi = 6\% + 2\% = 8\%$

Section 3

6. Is Fed policy easy, tight or neutral, and why? Briefly explain.

- r=2% and r*=2%. Fed is setting the real rate at the neutral level.
- i.e., Fed policy stance is neutral.
- This is neutral in that the real interest rate is consistent with u=u*, π=π*

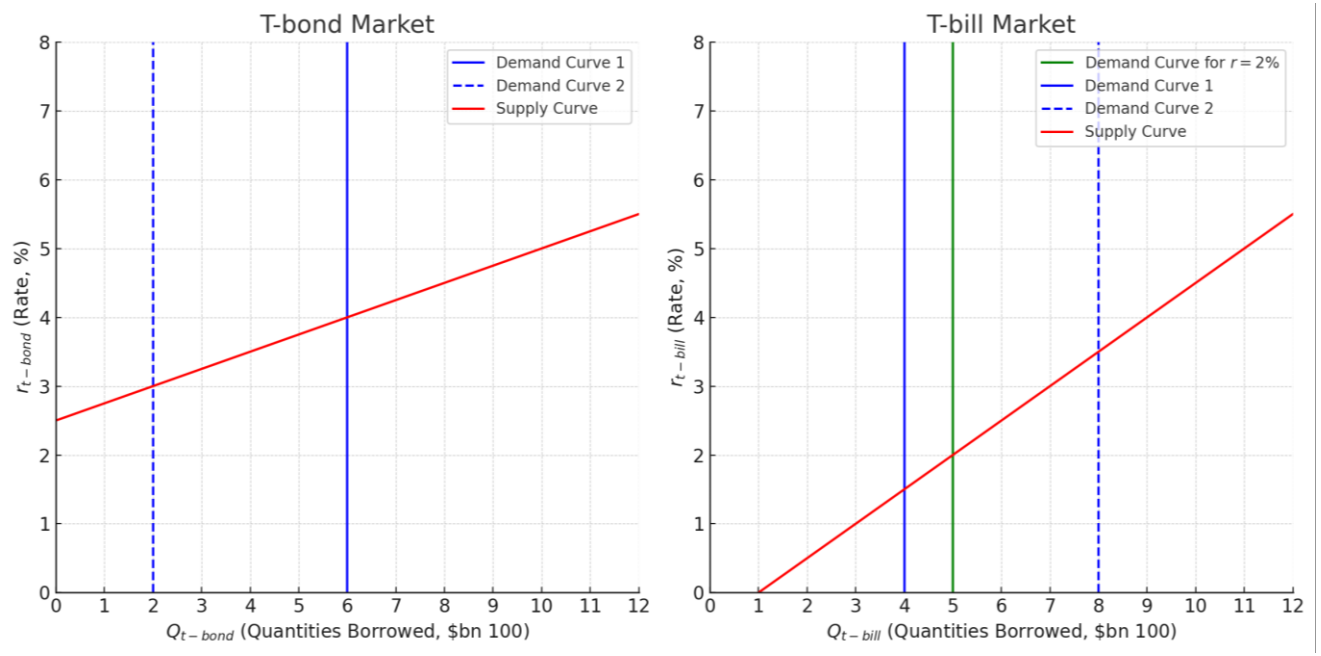
- (Recall Taylor rule $r = r^* + \alpha(\pi - \pi^*) + \beta(u^* - u)$.)

Section 3

7. A White House economist, advising the President, has an idea to deliver much faster growth. He knows that the Fed uses the Taylor equation, and he knows the target value for their policy rate. He recommends radically changing the treasury borrowing plans. He proposes that the treasury fund 80% of its deficit in the t-bill market.

a. Draw the change in the composition of borrowing, in the appropriate panels.

- Solid demand curves shift to dashed ones.

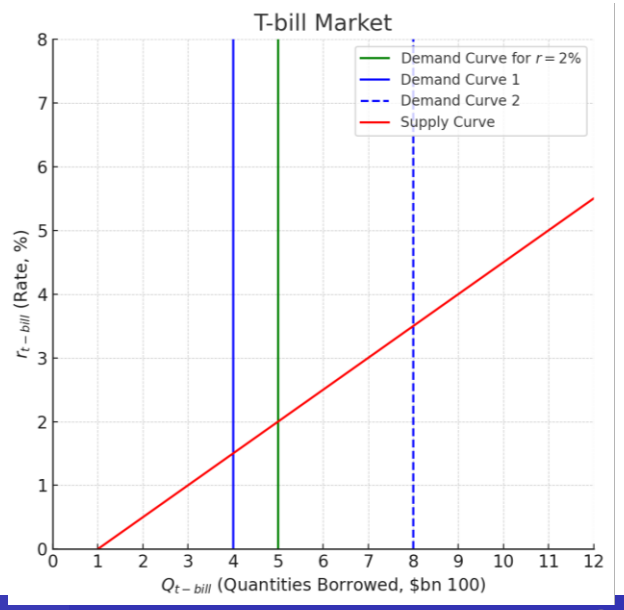


Section 3

b. Based on your answer to question 2, what does the Fed have to do, now, to meet its target rate. ↵

- Now the equilibrium T-bill rate is higher than 2% (with S and D2)
- Fed has to buy t-bills (lends money to the gov.) to reduce the rate to 2%
- As the gov. borrows from Fed, the demand of funds borrowed from the private market (households, city banks, etc.)

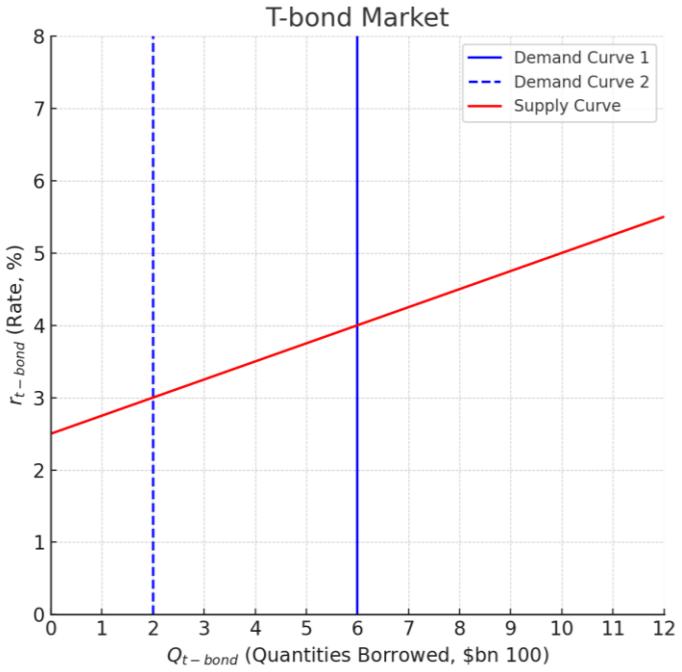
  decreases
- demand shifts from dashed blue line→green line
- Get a targeted real rate, r=2%
- (targeted r = i(4%) – π(2%) = 2%)



Section 3

b. What happens to the real borrowing cost in the government bond market?

- r_{t-bond} falls from 4% to 3%.



Section 3

c. Assume the spread between treasury long rates and corporate rates stays the same. What happens to the real borrowing cost for corporations and what does this do to corporate borrowing?

- r_c = r_{t-bond} + risky/risk-free bond spread
- = 3%+2% = 5%
- Q_c = $bn 600

Section 3

d. Fed officials now no longer believe they have the right target for their policy rate. Briefly explain?

- Because of the gov.'s new financing plan, we are now seeing
- Q_c=$bn 600 instead of Q_c=$bn 400, meaning more investment, lower unemployment, leading to a higher inflation.
- Now Fed thinks i=4% is too low and the target policy should be higher.

Section 3

e. Assume the new spread between the t-bill and government bond, that resulted from the change in treasury funding, will remain the same if the Fed takes action. Modify an input to the Taylor equation, so that Fed policy delivers the economy the Fed wants to deliver.

- Assume Fed wants to keep r_c = 6%, not to stimulate inflation.
- To achieve this,
- r_{t-bond} = r_c - risky/risk-free bond spread = 6% - 2% = 4% is necessary
- $\therefore$ r_{t-bill} = r_{t-bond} – t-bill/t-bond spread = 4% - 1% = 3% is necessary
- $\therefore$ $i \approx$ r_{t-bill} + π = 3%+2%=5% is necessary
- From Taylor equation $i = \pi + r^* + \alpha(\pi - \pi^*) + \beta(u^* - u)$,
- $5\% = 2\% + r^* + 0.5 \times (2\% - 2\%) + 1 \times (4.25\% - 4.25\%) \Rightarrow r^* = 3\%$

Section 4.1.

- Bank can lend (i) \$1m to gov. with 3% rate or (ii)\$1k each to 1000 small businesses with 8% rate
- If a SB defaults, 33% of the principal is collected.
- EMH:
- Total return on SBs = Return on Gov. bond + RP

- $1.08 \times \$1k \times (1000\text{-}D) + 0.33 \times \$1k \times D = 1.05 \times \$1m$
- $\Rightarrow D = 40$ SBs default for EMH to hold.

Section 4.2.

- The Bank now believes D=80 and charges 12% from SB loans.
- RP stays at 2%
- Under this new condition, only 80 (instead of 1000) SBs borrow $1k.
- Fewer SBs expand businesses → more unemployment.
- Q. What can Fed do against this?
- A. (i) To restore healthy borrowing, the Fed needs to ease supply more funds by buying gov. securities and lower the 1-year t-bill rate

Section 4.2.

- Q. What can Fed do against this?

- A. (i) To restore healthy borrowing, the Fed needs to supply more funds by buying gov. securities and lower the 1-year t-bill rate to x%.
- (ii) To calculate x%, we first need to calculate the default rate the bank expects, now that they are charging 12%:
- $1.12 \times \$1k \times (1000-D)+0.33 \times \$1k \times D=\$1.05m \Rightarrow D=80$
- (iii) How low should x% be when bank expects 80 defaults to make it charge only 8%?
- $1.08 \times \$1k \times (1000-80)+0.33 \times \$1k \times 80 = \$1m \times (1+x+0.02) \Rightarrow x=0$
- Fed should set the 1-year T-bill rate at 0%