Elements of Macroeconomics TA Session 6-2: Assignment 5

Haruki Shibuya

hshibuy1@jh.edu

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

10/21/2024

Q1-1

The following data were obtained on Oct 23, 2030.

Fixed Income Security	Yield at issuance	issue date	issue price
5-year U.S. treasury note	5.0%	1/1/2025	$20,000
10-year U.S. treasury note	4.5%	1/1/2025	$20,000
5-year U.S. TIPS note	2.0%	1/1/2025	$20,000
10-year U.S. TIPS note	2.0%	1/1/2025	$20,000
10-year Ford Motor Co. note	8%	1/1/2025	$20,000

1. The 2025 data tell us that an individual buying a Ford Motor Co. note, on the day it was issued, would pay $20k and expect to receive $20k×8%=$1.6k per year for 10 years. At the beginning of 2035, the buyer of the Ford Motor Co. note will receive her last interest payment plus a check for $20k, reflecting the return of principal.

Q1-2

The following data were obtained on Oct 23, 2030.

Fixed Income Security	Yield at issuance	issue date	issue price
5-year U.S. treasury note	5.0%	1/1/2025	$20,000
10-year U.S. treasury note	4.5%	1/1/2025	$20,000
5-year U.S. TIPS note	2.0%	1/1/2025	$20,000
10-year U.S. TIPS note	2.0%	1/1/2025	$20,000
10-year Ford Motor Co. note	8%	1/1/2025	$20,000

2. According to **the expectations theory of interest rates**, investors believe that a 5-year treasury note, issued in January of 2030, will offer a yield of approx. 4 %.

- **The expectations hypothesis** of the term structure of interest rates:

$$(1+i_{lt})^n = (1+i_{st}^{\text{year 1}})(1+i_{st}^{\text{year 2}})\cdots(1+i_{st}^{\text{year n}})$$

(short-term rates are expected values)

Q1-2

The following data were obtained on Oct 23, 2030.

Fixed Income Security	Yield at issuance	issue date	issue price
5-year U.S. treasury note	5.0%	1/1/2025	$20,000
10-year U.S. treasury note	4.5%	1/1/2025	$20,000
5-year U.S. TIPS note	2.0%	1/1/2025	$20,000
10-year U.S. TIPS note	2.0%	1/1/2025	$20,000
10-year Ford Motor Co. note	8%	1/1/2025	$20,000

$$(1+y_{10})^{10} = (1+y_5)^5 \times (1+f_5)^5$$

- y_10: 10-year treasury yield (2025), 4.5%
- y_5: 5-year treasury yield (2025), 5.0%
- f_5: expected 5-year yield in 2030
- $\Rightarrow$ 1.045^2=1.05*(1+f_5) $\Rightarrow$ f_5≈0.04 or 4%

Q1-3

The following data were obtained on Oct 23, 2030.

Fixed Income Security	Yield at issuance	issue date	issue price
5-year U.S. treasury note	5.0%	1/1/2025	$20,000
10-year U.S. treasury note	4.5%	1/1/2025	$20,000
5-year U.S. TIPS note	2.0%	1/1/2025	$20,000
10-year U.S. TIPS note	2.0%	1/1/2025	$20,000
10-year Ford Motor Co. note	8%	1/1/2025	$20,000

3. Why is the 10-yr Treasury rate lower than the 10-yr rate on the Ford Motor Co. note?

INVESTORS DEMAND A RISK PREMIUM, GIVEN FORD MAY DEFAULT

Q1-4

The following data were obtained on Oct 23, 2030.

Fixed Income Security	Yield at issuance	issue date	issue price
5-year U.S. treasury note	5.0%	1/1/2025	$20,000
10-year U.S. treasury note	4.5%	1/1/2025	$20,000
5-year U.S. TIPS note	2.0%	1/1/2025	$20,000
10-year U.S. TIPS note	2.0%	1/1/2025	$20,000
10-year Ford Motor Co. note	8%	1/1/2025	$20,000

4. What do investors expect for the average inflation rate, in years 2030 through 2035?

- Remember: f_5(expected 5-year nominal yield in 2030)=4%
- Note also: expected 5-year real yield in 2030 = 2% (solve 1.02^2=1.02x)
- $E\pi = i - r$
- Expected average inflation 2030-2035 = 4% - 2% = 2%

Q1-5

The following data were obtained on Oct 23, 2030.

Fixed Income Security	Yield at issuance	issue date	issue price
5-year U.S. treasury note	5.0%	1/1/2025	$20,000
10-year U.S. treasury note	4.5%	1/1/2025	$20,000
5-year U.S. TIPS note	2.0%	1/1/2025	$20,000
10-year U.S. TIPS note	2.0%	1/1/2025	$20,000
10-year Ford Motor Co. note	8%	1/1/2025	$20,000

5. Based on the data above, on average, what do investors in the Ford Motor company note expect the real yield to be?

- Expected inflation over 10y = 4.5% - 2.0% = 2.5%
- $r = i - E\pi$
- Real yield of Ford Co. note over 10y = 8% - 2.5% = 5.5%

Q2

- Bank can lend for a year (i) $1m to the government at a 3.25% rate or
- (ii) $1m in total to 100 small businesses at a 9% rate
- 2% risk premium required for (ii) to compensate potential defaults
- No default of government
- When a small business loan defaults, no interest is collected and 60% of the principal is lost (only 40% is recovered)

Q2-1

1. Each corporation borrows $10,000. At the end of the term of its debt, (1-year), a corporation that honors its debt will send how many dollars to the bank?

- A small business that doesn't default repays $\$10k \times 1.09 = \$10.9k$

Q2-2

2. Each corporation borrows $10,000. At the end of the term of its debt, (1 year), a corporation that defaults on its debt will send how many dollars to the bank?

- Remember: When a small business loan defaults, no interest is collected and 60% of the principal is lost (only 40% is recovered)

- If a small business defaults, only $\$10k \times 0.4 = \$4k$ is sent to the bank

Q2-3

3. The government borrows, $1,000,000. At the end of the term of its debt, (1 year), the government will send how many dollars to the bank?

- The government sends $\$1\text{m} \times 1.0325 = \$1.0325\text{m}$ to the bank

Q2-4

4. Now the question that requires some effort. If we assume the EMH, and recognize the lender will demand the stated risk premium, how many small business loans are expected to default? (show your work)↵

- Let D be the number of small businesses that default out of 100
- Then, lending to the small businesses yields \$10.9k*(100-D)+\$4k*D
- Lending to the government yields + RP \$1m*(1.0325+0.02)
- EMH requires :

  expected return from SB = expected return from Gov + RP
- So, \$10.9k*(100-D)+\$4k*D = \$1m*1.0525
- Solving this results in D≈5.4.

Q3

Section 3. The Phillips curve

The economy is hit with a shock, as food prices leap amid a drought. The CPI rises by 6% in 2030, with a rise of 3.5% for the core inflation rate.

One economist believes inflation expectations exclusively reflect last year's overall inflation rate.

He uses a Phillips curve equation, assumes the natural rate of unemployment is 4%, and α =1.25

- Phillips curve equation: $\pi = E\pi - \alpha(u - u\_n)$
- u: unemployment rate, u_n: natural unemployment rate

Q3-1

1. What level must unemployment rise to in 2031, to get inflation back to 2.25%? show work

- $\pi = E\pi - \alpha(u - u\_n)$
- Assume π=2.25%, $E\pi$=6.0% (CPI in 2030), α=1.25, u_n=4%
- 2.25%=6.0%-1.25*(u-4%)
- u=7%

Q3-2

- Another economist thinks inflation in 2030 was temporarily high due to food prices
- So, she thinks the core inflation rate in 2030 is a better expectation

- $\pi = E\pi - \alpha(u - u\_n)$
- Assume π=2.25%, $E\pi$=3.5% (core CPI in 2030), α=1.25, u_n=4%
- 2.25%=3.5%-1.25*(u-4%)
- u=5%

Q3-3

3. Fed Chair Jerome Powell justified the Fed's aggressive tightening in 2022-2023, he noted that it was essential to preserve anchored inflation expectations. How do the answers to your two previous calculations support this point?

- "preserve anchored inflation expectations" here means making people believe that inflation will go down
- From Q3-1 and Q3-2, we can tell that a lower inflation expectation leads to a lower unemployment rate given the current inflation.
- Chairman Powell's comment points out that he tried to lower the expected inflation by increasing the interest rate to keep the unemployment rate relatively lower than what it otherwise would be