

**Problem Solving / Essay Questions. (75 points)**

#11. (60 pts) Assume that currency ( $C$ ) is \$10 billion and reserves ( $R$ ) are \$20 billion, the reserve-deposit ratio ( $rr$ ) is 0.1, and the currency-deposit ratio ( $cr$ ) is 0.05.

(a) (10 pts) What is the amount of demand deposits? What is the money supply? Show your work.

**Since the reserve-deposit ratio is 0.1, demand deposits must satisfy  $D = \frac{\$20}{0.1} = \$200$  billion.**

**The money supply ( $M$ ) is given by  $M = m \times B$ , where  $m = \frac{cr+1}{cr+rr} = \frac{1.05}{0.15} = 7$  and  $B = C + R = \$10 + \$20 = \$30$  billion. Therefore,  $M = 7 \times \$30 = \$210$  billion.**

(b) (10 pts) Just for part (b), assume the monetary base increases by \$1 billion through an injection of new reserves. How much will this increase the money supply? Show how much the money supply will increase through the first two rounds of fractional-reserve lending.

**The change in the money supply is  $\Delta M = m \times \Delta B = 7 \times \$1 \text{ billion} = \$7 \text{ billion}$ . In the first round, the bank will take the new reserves and loan it all out. Therefore, \$1 billion is loaned out, but the recipient of the loan will retain 5% (or \$50 million) in currency. This implies that the second bank will receive \$950 million in new demand deposits, keeping 10% (\$95 million) in reserves, and loaning out \$855. This process continues until the total increase in the money supply is \$7 billion.**

(c) (10 pts) Assume that the velocity of money is constant and real GDP growth is 2.5%. Janet Yellen and the Fed are targeting a 2% inflation rate. What is the target growth rate in the money supply? How much new money needs to be injected in the coming year to meet the target? Explain.

**Using the quantity equation in percentage changes, the money supply needs to have a growth rate of 4.5%. Because the money supply is \$210 billion, this means that the new injection of money must be  $\Delta M = 0.045 \times \$210 \text{ billion} = \$9.45 \text{ billion}$ .**

- (d) (10 pts) National savings is 200 and investment demand is  $I = 250 - 10r$ , where  $r$  is the real interest rate. Assuming the Fed hits the target inflation rate, what is the nominal interest rate?  
**BONUS** (5 pts): The government wishes to target a 3% nominal interest rate. All else equal, how much do they need to change government spending?

**In equilibrium,  $S = I$  so the real interest rate is  $r = 5\%$ . If the Fed hits the 2% inflation target, then the Fisher equation implies that the nominal interest rate will be  $i = r + \pi = 5 + 2 = 7\%$ .**

**BONUS: To target a 3% nominal interest rate with a 2% inflation rate, the real interest rate must be  $r = 1\%$ . This can be achieved by increasing national savings to 240. Therefore, all else equal, the government must reduce spending by 40.**

- (e) (10 pts) The economy suddenly falls into recession and real GDP growth falls to -1%. How should the Fed change the money growth rate to maintain the 2% target for inflation? Describe how the Fed would implement this change in practice and provide some intuition for the results.

**Using the quantity equation in percentage changes, the Fed must target a growth rate of money equal to 1%. The lower growth rate of the money makes sense because real GDP has fallen and less money is necessary to carry out transactions. The Fed would continue to purchase government securities and inject reserves into the banking system, but the growth in the reserves is lower now that the economy is in a recession.**

- (f) (10 pts) Nominal GDP is \$2.1 trillion. Using the numbers in part (a), what is the velocity of money? More merchants start accepting credit cards, what will happen to the velocity of money? Explain.

**To answer this question, you can use the quantity equation  $MV = PY$ . We know  $PY = \$2.1$  trillion and  $M = \$210$  billion. Therefore, the velocity of money is 10. If merchants start accepting more credit cards, people need to hold less cash. This means the dollars that are circulating will turn over more times and the velocity of money will increase.**

**Problem Solving / Essay Questions. (75 points)**

#11. (60 pts) Consider a macroeconomy that only produces two goods, A and B. The base year is 2015 and all quantities are measured in billions. Round all your answers to the nearest tenth.

Product	Quantity		Prices	
	2015	2016	2015	2016
A	100	105	\$20	\$20
B	50	52	\$100	\$105

(a) (10 pts) Calculate the real GDP (Y) growth rate in 2016.

**SOLUTION:**

- **2015 Nominal GDP** =  $(100 \times \$20) + (50 \times \$100) = \$7000$
- **2016 Nominal GDP** =  $(105 \times \$20) + (52 \times \$105) = \$7560$
- **2015 Real GDP** =  $\$7000$
- **2016 Real GDP** =  $(105 \times \$20) + (52 \times \$100) = \$7300$
- **2016 Growth Rate in Real GDP** =  $\frac{\$7300 - \$7000}{\$7000} \times 100 = 4.3\%$

(b) (10 pts) Calculate the inflation rate ( $\pi$ ) in 2016 using the GDP deflator.

**SOLUTION:**

- **2015 GDP Deflator** =  $100$
- **2016 GDP Deflator** =  $\frac{\text{Nominal GDP}}{\text{Real GDP}} \times 100 = \frac{\$7560}{\$7300} \times 100 = 103.6$
- $\pi = \frac{103.6 - 100}{100} \times 100 = 3.6\%$

- (c) (10 pts) The money supply ( $M$ ) is \$1000 in 2016. What is the velocity of money? Now assume the Fed wishes to target a  $\pi = 2\%$  inflation rate in 2017. If the growth in real GDP is expected to be the same in 2017 as in 2016, what money supply growth rate is necessary? How much new money must the Fed inject into the economy?

**SOLUTION:**

- The 2016 velocity of money is  $V = \frac{PY}{M} = \frac{\$7560}{\$1000} = 7.6$ .
- Using the quantity theory in percentage changes, we have  $\pi = \% \Delta M - \% \Delta Y$ . Substituting the 2% inflation target and the growth rate of  $Y$ , we have  $\% \Delta M = 2 + 4.3 = 6.3\%$ . The Fed must target a 6.3% growth rate in money.
- Therefore, the Fed would need to inject \$63 billion into the economy.

- (d) (10 pts) Assume households hold 10% of deposits as currency and banks are required to keep 10% of deposits in reserve. Explain how the Federal Open Market Committee (FOMC), in practice, would hit the  $M$  target in part (c).

**SOLUTION:**

- The money multiplier is  $m = \frac{1+cr}{cr+rr} = \frac{1+0.1}{0.1+0.1} = \frac{1.1}{0.2} = 5.5$ .
- The FOMC would need to buy  $\$63/5.5 = \$11.3$  billion of government securities. Given the multiplier effect, the \$11.5 billion of new reserves would eventually lead to \$63 billion in new  $M$ .

- (e) (10 pts) Assume that  $G = T = 500$ ;  $C = 1000 + 0.9(Y - T)$ ; and  $I = 200 - 125r$ . Calculate the equilibrium real interest rate ( $r_*$ ) that clears the 2016 goods market. Show the equilibrium in a graph. What is the nominal interest rate ( $i$ )?

**SOLUTION:**

- The equilibrium condition is:  $Y = C + I + G$ .

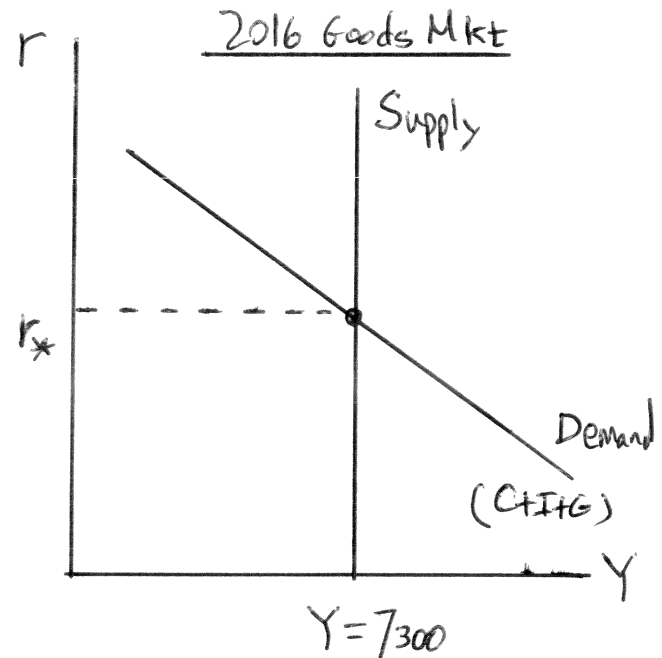
Substitution gives...

$$7300 = 1000 + 0.9(7300 - 500) + 200 - 125r + 500$$

$$7300 = 7820 - 125r$$

$$r_* = 4.2\%$$

- The nominal interest rate is given by the Fisher equation:  $i = r_* + \pi = 4.2 + 3.6 = 7.8\%$ .



- (f) (10 pts) Prove that  $r_*$  also clears the loanable funds market in 2016. Show the equilibrium in a graph.

- The equilibrium condition is:  $S = I$ .

$$S_{pr} + S_{pu} = I$$

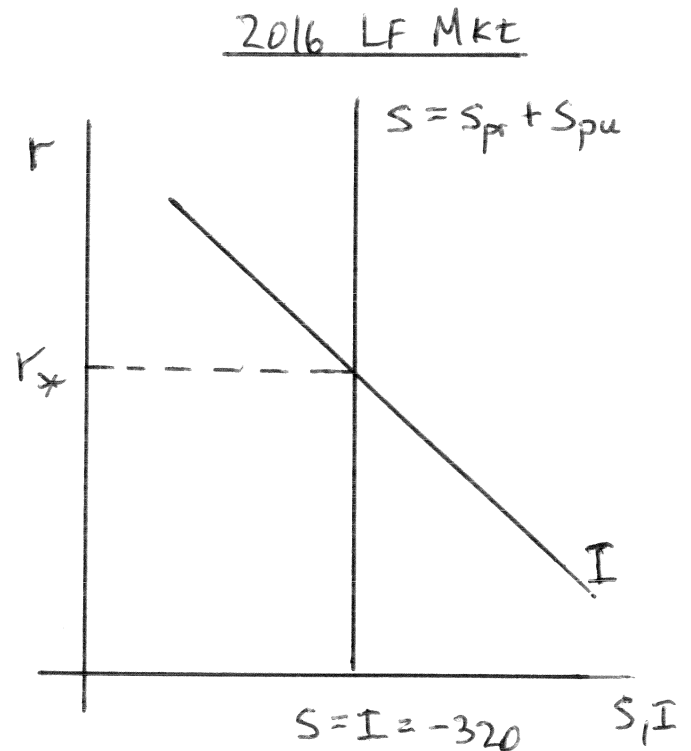
$$Y - C - G = I$$

$$7300 - 7120 - 500 = 200 - 125r$$

$$-320 = 200 - 125r$$

$$125r = 520$$

$$r_* = 4.2\%$$



#22. (30 pts) Assume the current U.S. adult population ( $N$ ) is 250 million. The labor force is 157 million and the number of employed workers ( $E$ ) is 148 million.

(a) (10 pts) How many people are unemployed? What is the unemployment rate? How does it compare to the reported U.S. unemployment rate for April 2015? What is the labor force participation rate?

**The number of unemployed workers is 9 million, which is the difference between the total labor force (157 million) and the number of employed workers (148 million). The unemployment rate is  $u = \frac{9}{157} = 5.7\%$ . The U.S. unemployment rate for April was 5.4%, so it is a little higher than the April rate. The labor force participation rate is  $\frac{157}{250} = 63\%$ .**

(b) (10 pts) The U.S. labor force (LF) participation rate in 2000 was 67%. Give three reasons why the current LF participation rate might be different than the rate in 2000. Also, state two possible policy recommendations that might bring the LF participation rate closer to the 2000 level.

**The current rate may have fallen due to (1) more people retiring, (2) more people going to college, or (3) workers becoming discouraged and dropping out of the labor force. In terms of policy, policymakers could (1) discourage retirement by increasing the age at which individuals are eligible to receive social security payments or (2) discourage students from going to college by lowering subsidies to higher education (e.g., Pell grants or low-interest student loans).**

(c) (10 pts) The rate of job separation ( $s$ ) is 0.01 and the rate of job finding ( $f$ ) is 0.19. What is the natural rate of unemployment? Find the number of people that will become separated from their job, the number that will find a job, and the new unemployment rate. Is the rate moving toward its natural level?

**The natural rate of unemployment is  $u_n = \frac{s}{s+f} = \frac{0.01}{0.01+0.19} = 5\%$ . The number of people becoming separated from their job will be  $s \times E = 0.01 \times 148 = 1.48$  million. The number of people finding a job will be  $f \times U = 0.19 \times 9 = 1.71$  million. The new employment and unemployment numbers will be  $E = 148 + 1.71 - 1.48 = 148.23$  and  $U = 9 - 1.71 + 1.48 = 8.77$ . The new unemployment rate is  $u = \frac{8.77}{148.23+8.77} = 5.6\%$ , which is closer to the natural rate.**

#23. (30 pts) Consider the following short-run, open-economy model of the economy.

Goods Market	Money Market
$C = 100 + 0.9(Y - T)$	$M = 2000$
$I = 190 - 10r; NX = -200$	$P = 5$
$G = 200; T = 100$	$L(Y, r) = Y - 100r$

(a) (10 pts) Graph the IS and LM equations and find the equilibrium values of  $r$  and  $Y$ .

**IS Equation**

$$Y = C + I + G + NX$$

$$Y = 100 + 0.9(Y - 100) + 190 - 10r + 200 - 200$$

$$0.1Y = 200 - 10r$$

$$Y = 2000 - 100r$$

**LM Equation**

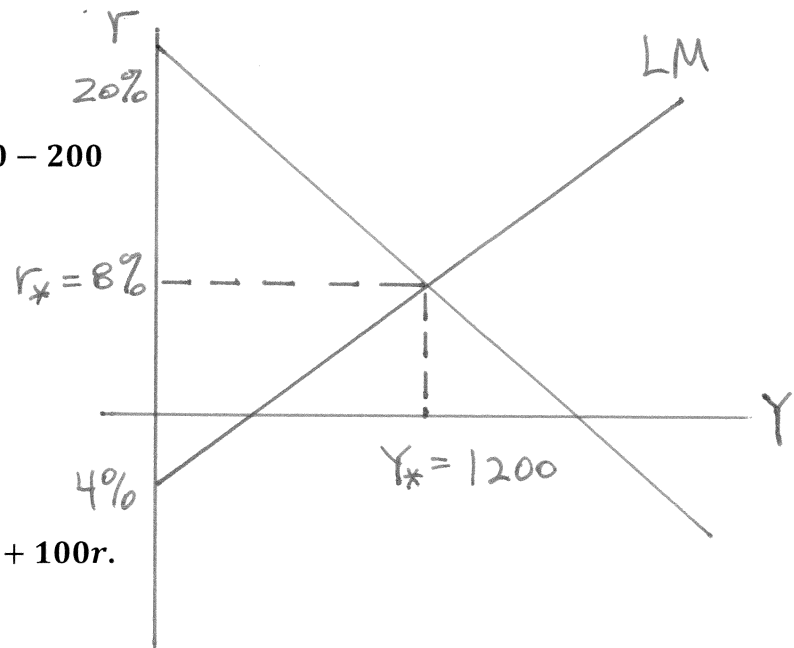
$$M/P = L(Y, r)$$

$$400 = Y - 100r$$

$$Y = 400 + 100r$$

Setting IS equal to LM:  $2000 - 100r = 400 + 100r$ .

Solving for  $r$  gives  $r_* = 8$  and  $Y_* = 1200$ .



(b) (10 pts) Policymakers plan to balance the budget and are debating whether to decrease  $G$  or increase  $T$ . Which is preferable in terms of sacrificing GDP?

The new equilibrium with  $G = 100$  is  $r_* = 3$  and  $Y_* = 700$ . The new equilibrium with  $T = 200$  is  $r_* = 3.5$  and  $Y_* = 750$ . Therefore, an increase in taxes is preferable because less GDP is sacrificed.

(c) (10 pts) At equilibrium in part (a), what is the value of national saving? Investment? Net capital outflows? Show the results in a diagram.

The value of national saving is  $S = Y - C - G = 1200 - 1090 - 200 = -90$ . Investment is  $I = 110$ . Net capital outflows are  $S - I = -90 - 110 = -200$ , so the economy is a net borrower.

To show the equilibrium, you can use either a loanable funds diagram or a foreign exchange diagram.

