

## Final Answers

You have two hours. This is a closed book/closed notes exam. No cell phones or calculators are allowed. Please write all your answers on the exam paper. There is 400 points in total. Good luck!

Your name: .....(5 points)

### 1 Multiple Choice (6 pts each).

There is only one correct answer for each question.

1. The Fisher relationship may be described by the following equation in which  $R$  is the nominal rate of interest,  $r$  is the real rate of interest, and  $i$  is the inflation rate.
  - A)  $i = r + R$
  - B)  $1 + i = \frac{1+r}{1+R}$
  - C)  $1 + r = \frac{1+i}{1+R}$
  - D)  $1 + r = \frac{1+R}{1+i}$
2. Banks in the Diamond-Dybvig model can offer depositors increased liquidity because
  - A) both individual depositors' liquidity needs and average depositor liquidity needs are predictable.
  - B) while individual depositors' liquidity needs are unpredictable, average depositor liquidity needs are predictable.**
  - C) while individual depositors' liquidity needs are predictable, average depositor liquidity needs are unpredictable.
  - D) neither individual depositors' liquidity needs nor average depositor liquidity needs are predictable.

3. The Diamond-Dybvig model provides a rationale for the phenomenon of
  - A) undercapitalized banks.
  - B) banks making overly risky loans.
  - C) bank runs.**
  - D) deflation.
4. Of the following four decades, the average U.S. inflation rate was highest in the
  - A) 1960s.
  - B) 1970s.**
  - C) 1980s.
  - D) 1990s.
5. In a two-period model with international trade, a temporary increase in domestic government spending
  - A) increases domestic output and increases the current account surplus.
  - B) increases domestic output and decreases the current account surplus.**
  - C) decreases domestic output and increases the current account surplus.
  - D) decreases domestic output and decreases the current account surplus.
6. Ricardian equivalence suggests that government budget deficits generated by decreases in current taxes
  - A) increase the current account surplus.
  - B) decrease the current account surplus.
  - C) have no effect on the current account surplus.**
  - D) have unpredictable effects on the current account surplus.
7. Twin deficits are
  - A) the current account deficit and the trade deficit.
  - B) the current account deficit and the government budget deficit.**
  - C) the current account deficit and the private saving deficit.
  - D) the current account deficit and the future account deficit.

8. If price level doubles then money demand
- A) **doubles as well.**
  - B) more than doubles.
  - C) increases, but less than doubles.
  - C) does not change.
9. If the monetary authority is not fully dominant then budget deficits
- A) can produce deflation.
  - B) cannot increase GDP.
  - C) cannot be sustainable.
  - D) **can produce inflation.**
10. If taxes are distortionary,
- A) **it is optimal to smooth tax rates over time**
  - B) it is optimal to decrease tax rates over time
  - C) it is optimal to increase tax rates over time
  - D) Ricardian equivalence holds
11. According to Prescott, differences between US and European GDP per person can be explained
- A) by differences in unemployment.
  - B) by differences in union power.
  - C) **by differences in tax rates.**
  - D) by different attitudes toward work and leisure.
12. Temporary decrease in government spending
- A) temporarily decreases the interest rate.
  - B) has no effect on the interest rate.
  - C) **temporarily increases the interest rate.**
  - D) permanently decreases the interest rate.

13. Investment and savings of an open country will be positively correlated
- A) **if productivity shocks are persistent.**
  - B) if productivity shocks are temporary.
  - C) if there are shocks to the terms of trade.
  - D) will never be positively correlated.
14. If currency to deposit ratio increases,
- A) money multiplier increases.
  - B) **money multiplier decreases.**
  - C) money multiplier does not change.
  - D) reserve to deposit ratio increases as well.
15. Central bank's commitment to a particular monetary policy is critical in obtaining
- A) low unemployment.
  - B) **low inflation.**
  - C) high GDP.
  - D) positive current account balance.

## 2 Current Account (135 points)

Assume that preferences of households in a given country are described by the following utility function

$$\ln C_1 + \ln C_2,$$

where  $C_1$  and  $C_2$  denote consumption in periods 1 and 2, respectively. The production function is given by

$$Y_t = A_t \sqrt{K_t}, \quad t = 1, 2,$$

where  $K$  is capital stock,  $Y$  is output and  $A$  is productivity. It is assumed that there is 100% depreciation of capital, and so  $K_2 = I_1$ , where  $I_1$  is investment in period 1. The initial capital  $K_1$  is given by  $K_1 = 1$ , and so  $Y_1 = A_1$ .

1. Assume that the economy is closed. Write down the production possibility frontier in this economy. (10 pts)

$$C_2 = A_2\sqrt{K_2} = A_2\sqrt{I_1} = A_2\sqrt{A_1\sqrt{K_1} - C_1} = A_2\sqrt{A_1 - C_1}.$$

2. Determine the equilibrium consumption, investment and interest rate in the closed economy (as a function of  $A_1$  and  $A_2$ ). (20 pts)

The social planner's problem is

$$\begin{aligned} \max_{C_1} \ln C_1 + \ln A_2\sqrt{A_1 - C_1} &= \ln C_1 + \frac{1}{2} \ln(A_1 - C_1) + \ln A_2 \\ \frac{1}{C_1} &= \frac{1}{2} \frac{1}{A_1 - C_1} \\ C_1 &= \frac{2}{3}A_1 \end{aligned}$$

Investment and second period consumption are given by

$$\begin{aligned} I_1 &= 1 - C_1 = \frac{1}{3}A_1 \\ C_2 &= A_2\sqrt{I_1} = \frac{A_2\sqrt{A_1}}{\sqrt{3}}. \end{aligned}$$

The interest rate is equal to the marginal product of capital:

$$1 + r = \frac{A_2}{2} \frac{1}{\sqrt{I_1}} = \frac{\sqrt{3}}{2} \frac{A_2}{\sqrt{A_1}}.$$

Alternatively, the interest rate can be obtained from the Euler equation.

3. How does consumption, investment and interest rate respond to a temporary increase in productivity (i.e. increase in  $A_1$ )? (10 pts)

Consumption in both periods and investment all increase. The interest rate decreases because higher investment leads to a decrease in the marginal product of capital.

4. How does consumption, investment and interest rate respond to a permanent increase in productivity (i.e. increase in both  $A_1$  and  $A_2$  by the same amount)? Hint: To get the effects of a permanent increase in productivity, set  $A_1 = A_2 = A$  and compute the effects of an increase in  $A$ . (10 pts)

Then  $C_1 = \frac{2}{3}A$ ,  $I_1 = \frac{1}{3}A$ ,  $C_2 = \frac{A_2^{\frac{3}{2}}}{\sqrt{3}}$  and  $1 + r = \frac{\sqrt{3}}{2}\sqrt{A}$ . All those variables now increase.

5. Now assume that the economy is open, with initial net international investment position  $B_0 = 0$ , and faces an exogenously given interest rate  $r$ . Write down the present value budget constraint for the economy. (15 pts)

$$C_1 + \frac{C_2}{1+r} = A_1 + \frac{A_2\sqrt{I_1}}{1+r} - I_1,$$

since first period production is given by  $Y_1 = A_1\sqrt{K_1} = A_1$ .

6. Determine the equilibrium investment  $I_1$  (as a function of the world interest rate  $r$ ). (15 pts)

The equilibrium investment equates marginal product of capital to  $1 + r$

$$\begin{aligned} \frac{A_2}{2} \frac{1}{\sqrt{I_1}} &= 1 + r \\ I_1 &= \frac{1}{4} \left( \frac{A_2}{1+r} \right)^2 \end{aligned}$$

7. Determine the equilibrium consumption in both periods (as a function of  $r$ ,  $A_1$  and  $A_2$ ). (20 pts)

The households solve

$$\begin{aligned} &\max \ln C_1 + \ln C_2 \\ &s.t. \\ C_1 + \frac{C_2}{1+r} &= A_1 + \frac{A_2\sqrt{I_1}}{1+r} - I_1 = A_1 + \frac{1}{4} \left( \frac{A_2}{1+r} \right)^2 \end{aligned}$$

The solution is given by

$$\begin{aligned} C_1 &= \frac{1}{2} \left[ A_1 + \frac{1}{4} \left( \frac{A_2}{1+r} \right)^2 \right] \\ C_2 &= \frac{1+r}{2} \left[ A_1 + \frac{1}{4} \left( \frac{A_2}{1+r} \right)^2 \right] \end{aligned}$$

8. Determine the current account balance in the first period (as a function of  $r$ ,  $A_1$  and  $A_2$ ). (15 pts)

Since  $B_0 = 0$ , the current account balance is equal to

$$\begin{aligned} CA_1 &= A_1 - C_1 - I_1 \\ &= A_1 - \frac{1}{2} \left[ A_1 + \frac{1}{4} \left( \frac{A_2}{1+r} \right)^2 \right] - \frac{1}{4} \left( \frac{A_2}{1+r} \right)^2 \\ &= \frac{1}{2} A_1 - \frac{3}{8} \left( \frac{A_2}{1+r} \right)^2 \end{aligned}$$

9. How does current account respond to a temporary increase in productivity and why? (10 pts)

If  $A_1$  increases, Current Account balance increases. This is so because of consumption smoothing. A fraction of the extra income is saved for the future.

10. How does current account respond to a permanent increase in productivity and why? (10 pts)

Set  $A_1 = A_2 = A$ . Then

$$CA_1 = \frac{1}{2}A - \frac{3}{8} \left( \frac{A}{1+r} \right)^2$$

Depending on  $A$  and  $1+r$ , it may either increase or decrease. If  $A > \frac{2}{3}(1+r)^2$  then a permanent increase in  $A$  leads to a decline in current account. Otherwise, the investment effect is too low and the current account still increases in response to an increase in productivity shock.

### 3 The Fed and Money Supply (90 points)

Assume that Federal Reserve issues \$3000 in currency and holds Treasury Bonds (T-Bonds) in the same amount. Individuals have preferences regarding the amount of currency and deposits they want to hold. Assume we can express those preferences as a ratio of currency to deposits  $c$ . Let  $c = 0.5$ . Banks are required to keep reserves in, at least, the amount of 25% of total deposits in order to meet possible withdrawals. Assume that banks hold exactly the required amount of reserves so that the reserve deposit ratio  $r = 0.25$ .

1. Calculate the Money Multiplier and M1 Money Supply. (15 pts)

From definition of  $M0$  and  $M1$ ,

$$M1 = \frac{C + D}{C + R} \cdot M0 = \frac{c + 1}{c + r} \cdot M0 = \frac{1.5}{0.5 + 0.25} \cdot M0 = 2 \cdot M0 = \$6000.$$

2. Find the amount (in dollars) of Currency, Reserves, Loans and Deposits. (Hint: Since assets and liabilities of a commercial bank must be equal, Reserves plus Loans equals to Deposits,  $R + L = D$ ). (20 pts)

Since

$$M1 = C + D = (c + 1) \cdot D = 1.5 \cdot D,$$

we have  $D = \$4000$ . Thus,  $C = \$2000$  and  $R = \$3000 - C = \$1000$ . Loans are then given by  $L = D - R = \$3000$ . The balance sheet of the bank is thus given by

ASSETS		LIABILITIES	
<i>Reserves</i>	<i>1000</i>	<i>Deposits</i>	<i>4000</i>
<i>Loans</i>	<i>3000</i>		
<i>Total</i>	<i>4000</i>	<i>Total</i>	<i>4000</i>

3. Suppose banks purchase a \$1000 Treasury bond from the Fed. What happens to the Money Multiplier and to M1 money supply as a result of the bond's purchase? (20 pts)

The money multiplier is unchanged. Let  $B$  stand for Treasury bonds. Because the monetary base is reduced by  $B$  to \$2000,  $M1$  is given by \$4000.

4. What Happens to Currency, Reserves, Loans and Deposits? (Hint: Treasury bond is now one of the commercial bank's assets) (20 pts)

Deposits are given by  $\frac{M1}{c+1} = \frac{2}{3} * \$4000 = \$2667$ . Currency is  $\frac{1}{3} * \$4000 = \$1333$  and Reserves are \$667. Bonds enter the balance sheet of the banks, which is now given by  $R + L + B = D$ . Thus,  $L = \$920$ . The balance sheet of a commercial bank changes to

ASSETS		LIABILITIES	
<i>Reserves</i>	<i>667</i>	<i>Deposits</i>	<i>2667</i>
<i>Loans</i>	<i>1000</i>		
<i>T-Bonds</i>	<i>1000</i>		
<i>Total</i>	<i>2667</i>	<i>Total</i>	<i>2667</i>

5. Assume that government decreases the reserve ratio to zero How does the money multiplier and M1 change? (15 pts)

The money multiplier is now  $\frac{1.5}{0.5+0} = 3$ . Since the monetary base is \$2000, the money supply increases back to \$6000.

## 4 Optimal Monetary Policy (80 points)

Assume that the government has preferences over inflation  $\pi$  and unemployment  $u$  given by

$$V^g(u, \pi) = -ku^2 - \pi^2.$$

The relationship between inflation, expected inflation, and unemployment is given by the Phillips curve:

$$u = u^* - \pi + \pi^e$$

1. Assume that inflationary expectations are fixed at  $\pi^e$ . Find the optimal inflation rate choice of the government,  $\pi_0(k)$  (20 pts)

$$\begin{aligned} \max_{\pi} -k(u^* - \pi + \pi^e)^2 - \pi^2 \\ k(u^* - \pi + \pi^e) &= \pi \\ \pi_0(k) &= \frac{k}{1+k}(u^* + \pi^e) \end{aligned}$$

2. For the fixed expectations, find the corresponding choice of unemployment rate  $u_0(k)$  (20 pts)

$$\begin{aligned} u_0(k) &= u^* - \pi_0(k) + \pi^e \\ &= \frac{1}{1+k}(u^* + \pi^e) \end{aligned}$$

3. Now assume that the private sector is aware of the government's maximization problem and knows  $k$  perfectly. Find the inflation rate  $\pi_1(k)$  at which the expectations are met. What is the associated unemployment rate  $u_1(k)$ ? (20 pts)

$$\begin{aligned} \pi^e &= \frac{k}{1+k}(u^* + \pi^e) \\ \pi^e &= ku^* \end{aligned}$$

The unemployment rate is given by  $u^*$

4. Would you prefer to live in a country whose government has a high value of  $k$  or a low value of  $k$ ? (20 pts)

Lower values of  $k$  deliver lower inflation, but unemployment is always the same. Thus, low  $k$  is always better.