

Final Exam : 14.02

Fall 1999

Basic Answers

Part 1. This part consists of one question: question 1.

Question 1. (35 points)

Consider a country characterized by the following relations:

$$C = 4 + 0.6(Y - T) \quad (1)$$

$$I = 5 - 0.4i \quad (2)$$

$$G = 5 \quad (3)$$

$$T = 5 \quad (4)$$

$$M^d = P \left(Y - \frac{1}{3}i \right) \quad (5)$$

$$M^s = 1 \quad (6)$$

$$W = P^e \left(2 - \frac{32}{3}u \right) \quad (7)$$

$$P = (1 + 0.5)W \quad (8)$$

$$L = 16 \quad (9)$$

$$P_0^e = P_0, \quad P_t^e = P_{t-1} \quad (10)$$

a) (3 points) Derive and graph the equilibrium condition for the goods market. Describe the equilibrium in words. What is the most important feedback effect?

Answer. The equilibrium condition is from $Y = C + I + G$. It means that demand for goods (Z) is equal to the supply of goods. The relevant graph is in the Z - Y space, the 45° line and the ZZ line. In our current version of the model, the only feedback is via $C(Y)$.

b) (2 points) Derive and graph the equilibrium condition for financial markets. Describe the equilibrium in words.

Answer. This is from $M^s = P(Y - i/3)$. The relevant picture is in the M^s - i space. It corresponds to equilibria in the money and the bonds market, determined by the transaction need for liquidity.

c) (3 points) Derive and graph the IS and LM curves. What is responsible for the relationship between output and the interest rate in those curves? Can you think of any further connections between output and the interest rate?

Answer. Solving for Y as a function of i or the other way around from a and b gives the IS and LM. The relevant picture is in the i - Y space. In terms of the IS, the relationship is via investment (from the interest rate to output). In the LM, it is via an increased transactions, thus higher need for liquidity (from output to the interest rate). Another channel could be via NX in an open economy, or assume $C(Y-T, i)$ because of the marginal propensity to consume might depend on the interest rate.

d) (4 points) Describe equilibrium in the labor market. Solve for the natural rate of unemployment.

Answer. It comes from PS , WS and the assumption that $P = P^e$. Combining these three things easily yields $u = 0.125$.

e) (6 points) Derive, graph and interpret in words the aggregate supply and the aggregate demand curves.

Answer. The AD is coming from equating IS with LM, thus getting Y as a function of prices. It should be a negative relationship: higher prices, lower real money supply, thus higher interest rates, thus lower output. (I am not doing the algebra here, but you were supposed to do it.)

The AS is from WS and PS , without the $P = P^e$ assumption. It is in terms of price as a function of output, so you need to use $u = \frac{16-Y}{16}$. It is upward sloping: higher output means lower unemployment, hence higher contracted wages (WS). That leads to higher prices (PS).

The relevant picture is in the P - Y schedule.

f) (10 points) Assume that investor confidence suddenly shoots up, so the investment equation becomes

$$I = 6 - 0.4i.$$

Analyze the immediate and dynamic changes, both graphically and in words. Show the changes in all the underlying curves.

Answer. This means an outward shift of the IS curve, which means that the AD also shifts out. In the short run, it means an output and a price increase (with this price increase, the LM shifts in a bit, partly offsetting the output increase, but not fully: this shift of the LM is incorporated into the shift of the AD already, so AD does not shift back!!).

This means that $P > P^e$, and that starts the dynamics of adjustment: the AS shifts up, pulling the LM together, thus output declines, prices rise further (the AD or the IS does not move). We are still above the natural rate, so $P > P^e$, so this process continues.

In the long run, we are back to the natural rate, but a permanently higher price level. Also, in terms of the IS-LM, the LM is permanently higher, thus the interest rate is permanently higher. In fact, the rise in i must be exactly such that investment returns to its normal level: from $Y = C + I + G$, if Y , C , G are the same, then I cannot change either.

In principle, you should have also drawn the Z - Y and $M^s - M^d$ shifts, but you were not penalized for missing that (but you were for missing the LM).

g) (7 points) Answer part f under the assumption that people have very good price information (hence $P_t^e = P_t$). Explain the differences between the two cases.

Answer. In this case, you can argue in two ways. First: with $P = P^e$, $Y = Y_n$, so the AS is vertical (not horizontal!!!) at Y_n . Thus the shift of the AD (same shift) will immediately lead to the final price rise, in one single period. The long-run is the same as before, but no transition: with (perfect) price information, there is no temporary fooling of workers, hence no temporary boom. Only supply side changes can matter.

Second way: the AS immediately jumps up to match the rise of AD, thus the intersection stays at Y_n . The jump is again coming from P^e adjusting quickly (immediately). This also shows that the LM jumps up to its final level within the same first period.

Part 2. This part consist of one question: question 2.

Question 2. (20 points) Suppose that government expenditure on domestic goods in an open economy is given by

$$G = G(i^*ED),$$

where i^* is the world interest rate, E is the nominal exchange rate, and D is some parameter. Assume that G is decreasing with respect to its argument. (You can think of D as foreign debt, so i^*ED is the annual debt service obligation of the government.) Work with

$$G = \bar{G} - i^*ED$$

as a particular choice of this function. The rest of our standard assumptions remains the same, so

$$\begin{aligned} Y &= C(Y - T) + I(Y, i) + G(i^*ED) + NX(Y, Y^*, E) \\ M/P &= YL(i) \\ i &= i^* + \frac{E^e - E}{E} \end{aligned}$$

The exchange rate is flexible.

a) (4 points) Suppose first that $D = 0$ (the government has no foreign obligations). Graph and describe the effects of a monetary expansion on the interest rate, the exchange rate and output. What happens to the components of aggregate demand?

Answer: standard effects of a monetary expansion. Meaning that output up, interest rate down, hence the exchange rate up (depreciation). Investment up (both Y up and i down), consumption up (Y up), NX ambiguous (Y up, E up).

b) (10 points) An earthquake hits the country and causes a significant damage. Everything is immediately reconstructed, with the help of foreign loans. Thus D becomes positive (but \bar{G} stays unchanged). What happens to the IS curve? What happens to the interest rate, the exchange rate, output and its components? Can you think of a policy intervention that would have had similar effects (meaning that the signs of changes are the same, but not necessarily the sizes)? Interpret.

Answer. The IS curve shifts in and rotates: the extra term i^*ED introduces an extra dependence on the interest rate (via the interest parity condition), but it has the opposite sign as the other two i - Y links (more

at part c). Other than that, it is like a standard fiscal contraction: Y down, i down, E up. hence C down, G down, I ambiguous (Y down, i down), NX up (Y down, E up).

c) (6 points) Does the presence of a positive debt D make monetary policy more or less effective? (In the following sense: in order to implement the same output change, does the central bank have to shift the LM curve more or less?) Explain.

Answer. Since the IS curve is steeper (the same interest rate change introduces less of an output change, since the channel through G is exactly offsetting the NX and the I channels), the same LM shift leads to a smaller effect on output. Intuitively: a monetary expansion (M up) leads to lower interest rates (i down), that depreciates the currency (E up), which makes debt servicing more expensive, hence acts as a fiscal contraction, partly offsetting the monetary expansion.

Part 3. This part consists of two questions: question 3 and question 4.

Question 3. (ESSAY QUESTION – 15 points)

In response to a proposal in Congress to use the current budget surplus as an opportunity to cut taxes, some economists have argued that now is poor timing for a tax cut. Assume the tax cut is lump-sum, and use the tools developed in class to discuss why or why not this argument is correct. Limit yourself to two pages in your blue book.

Grading notes and answers. I was looking for three things: I was unhappy if you disregarded instructions and did not write an essay or relied on graphs and equations to make your point, but did not deduct any points specifically for this. You should be much more careful in the future.

5 points for correctly identifying the current economic situation and policy of the central bank (why timing is important). Currently unemployment is below the natural rate and the central bank has increased interest rates three times in the last year to ward off inflationary pressures. Partial credit also awarded for noting the large trade deficit and large government debt. The question is about timing, so simply talking about evaluation is incomplete.

5 points for correct evaluation of the tax cut on policy. Net exports fall in both short and long run due to higher y (in the short-run) and an appreciation. Investment falls in long-run, short-run ambiguous due to higher r and y . Inflation increases as unemployment stays low (fiscal expansion works AGAINST the central bank's policy).

5 points for tying it all together. Tax cut causes both good and bad things, how do you balance them? The question was trying to really get you to think about the trade-offs in policy, in particular what is the argument for higher unemployment in the United States today?

My answer: Output is higher and unemployment lower, but inflation increases and the trade deficit worsens. Inflation is costly by creating uncertainty and distortions while affecting income distribution, while disinflation is costly through the need for excess unemployment in the future. Investment also falls, potentially affecting capital accumulation.

Partial credit for other answers IN THE CONTEXT OF TYING IT ALL TOGETHER. You did not receive full credit if you did not explain how you balanced these different issues.

ASIDE Several of you may have been disturbed by this strong "keynesian" view of policy. Things which have been ignored here are potential supply-side effects of the tax cut (which are probably small and unimportant) and the future course of productivity growth, which is of course deflationary, explaining how inflation and unemployment could have remained so low for so long. The FED is betting that productivity growth will slow in the near future so that the low unemployment rate will translate into higher inflation. A more optimistic view of how productivity growth will evolve would justify a less contractionary policy. There are other issues, but most beyond the scope of this course.

Question 4. (10 points)

This question draws from the attached short article that was recently published in the Financial Times. It talks about policy measures in Australia.

a) (3 points) Based on the information given in the article, can you say which exchange rate regime Australia has (fixed, flexible; or insufficient information to tell)?

b) (4 points) What would the Central Bank do if the economy starts growing at 6% per year? What would happen to the interest rate and the exchange rate as a consequence of this policy action?

c) (3 points) During the 1997 East Asian crisis, although Australia did much better than its neighbors (Australia is very close geographically to the crisis countries), but it clearly suffered. What do you think the channel was through which the crisis affected Australia?

Grading notes and answers. 3 points for flexible exchange rate. Since the bank is changing interest rates, it is engaging in active monetary policy, which is impossible with fixed exchange rates due to uncovered interest parity. Some of you were confused by "the neutral stance" of the central bank, which just means they are as likely to increase as decrease interest rates, not that monetary policy has a neutral effect.

4 points for identifying contractionary monetary policy which increases interest rates and causes an appreciation. If you were confused by the fixed exchange rate regime above, I tried to give partial credit. Many of you said strong growth shifts the IS curve right, increasing interest rates and causing an appreciation, and lost 2 points for having the wrong mechanism.

3 points for net exports, driving by an appreciation of Australia's currency relative to Asian countries and reduction in Y^* of those countries, both which cause net exports to deteriorate. Partial credit for some other creative things, none correct enough to merit any mention.

Part 4. This part consists of one question: question 5.

Question 5. (20 points)

(This question follows current debate in economics about increasing wage inequality in the US over the last 3 decades)

Consider an economy with heterogeneous population. Suppose there are workers with just high school education and with college education. Productivity of high school graduates is 1, that of college graduates is $A > 1$. In the rest of the question, superscript H (mnemonic from *high*) refers to college graduates with high productivity, L (for *low*) to high school graduates. Thus, if the employment of the former is N_H , and of the latter is N_L , the production functions are

$$\begin{aligned} Y_H &= AN_H \\ Y_L &= N_L \end{aligned}$$

These two distinct subpopulations of workers are called types in what follows.

We assume that college graduates and high school graduates are not substitutable in production. Consequently, they are employed by two different types of firms. So, the wage setting equations for each type depend only on their respective unemployment rate:

$$\begin{aligned} w_H &= p^e F(z, u_H) = \frac{p^e z}{u_H} \\ w_L &= p^e F(z, u_L) = \frac{p^e z}{u_L} \end{aligned}$$

a) (3 points) Write down *two* price setting equations for firms employing either H or L workers, assuming a constant markup μ .

Answer. The *two* price setting equations for each type of firm (employing either H or L workers), assuming a constant markup μ :

$$\begin{aligned} p &= (1 + \mu) \frac{w_H}{A} \\ p &= (1 + \mu) w_L \end{aligned}$$

b) (3 points) (Combine the wage-setting and price-setting relations to get 2 aggregate supply equations.

Answer. Combine the wage-setting and price-setting relations to get 2 aggregate supply equations.

$$\begin{aligned} p &= \frac{p^e (1 + \mu) z}{u_H A} \\ p &= \frac{p^e (1 + \mu) z}{u_L} \end{aligned}$$

If we want them in terms of output, use $u_L = (1 - \frac{Y_L}{500})$, $u_H = (1 - \frac{Y_H}{500A})$ (using the fact that there are 500 workers of each type):

$$\begin{aligned} p &= \frac{p^e (1 + \mu) z}{A - \frac{Y_H}{500}} \\ p &= \frac{p^e (1 + \mu) z}{1 - \frac{Y_L}{500}} \end{aligned}$$

c) (6 points) Compute the natural rates of unemployment *for each type*. Which type will suffer relatively higher unemployment in the long run equilibrium? Compute the ratio of real wages w_H/p and w_L/p which will prevail in the long run. Can this ratio serve as an inequality indicator?

Answer. The natural rates of unemployment *for each type* are computed by setting $p = p^e$:

$$\begin{aligned} 1 &= \frac{(1+\mu)z}{u_H A} \\ 1 &= \frac{(1+\mu)z}{u_L} \\ u_H &= \frac{z(1+\mu)}{A} \\ u_L &= z(1+\mu) \end{aligned}$$

Thus lower productivity types (high school graduates) suffer relatively higher unemployment in the long run.

To compute the real wages we do not even need the preceding equations. From a),

$$\begin{aligned} \frac{w_H}{p} &= \frac{A}{1+\mu} \\ \frac{w_L}{p} &= \frac{1}{1+\mu} \\ \frac{w_H}{w_L} &= A \end{aligned}$$

The wage ratio serves as a useful unit-free indicator of wage inequality. College graduates earn higher wages in equilibrium due to higher productivity.

d) (4 points) Now suppose that the proportions of type H and L workers are half and half. Find the aggregate natural rate of unemployment in the economy (Optional hint: compute the total number of the unemployed of both types and divide by the total number of workers in the economy. You may take this total number to be 1000). Find the long run average real wage

$$\bar{w}/p = \frac{1}{2} \frac{w_H}{p} + \frac{1}{2} \frac{w_L}{p}$$

in the economy.

Answer. Since the proportions of type H and L workers are half and half, the aggregate natural rate of unemployment in the economy

$$u = \frac{u_H L + u_L L}{2L} = 1/2(u_H + u_L) = \frac{z(1+\mu)}{2A} + \frac{z(1+\mu)}{2} = \frac{1}{2} \frac{(1+\mu)z(1+A)}{A}$$

For average wage we must take into account that proportions of employed workers of either type are not $1/2$ due to differential unemployment incidence. The proportion of high school graduates in the labor force is $\frac{1-u_L}{(1-u_L)+(1-u_H)}$, that of college graduates $\frac{1-u_H}{(1-u_L)+(1-u_H)}$. Thus,

$$\begin{aligned} \bar{w}/p &= \frac{1-u_L}{(1-u_L)+(1-u_H)} \frac{1}{1+\mu} + \frac{1-u_H}{(1-u_L)+(1-u_H)} \frac{A}{1+\mu} \\ &= A \frac{z(1+\mu)-1}{z(1+\mu)(A+1)-2A} \frac{1}{1+\mu} + \frac{z(1+\mu)-A}{z(1+\mu)(A+1)-2A} \frac{A}{1+\mu} \\ &= \frac{A}{1+\mu} \frac{2z(1+\mu)-A-1}{z(1+\mu)(A+1)-2A} \end{aligned}$$

However, full credit was given if average wage was computed with the same weights as the unemployment rate, $1/2$ and $1/2$:

$$\begin{aligned} \bar{w}/p &= \frac{1}{2} w_H/p + \frac{1}{2} w_L/p \\ &= \frac{A+1}{2(1+\mu)} \end{aligned}$$

e) (4 points) What happens if productivity of college graduates (A) goes up? Specifically, discuss the effect on the natural rate of unemployment, the average wage, and the inequality indicator (ratio of real wages of the two types).

Answer. If productivity of college graduates A goes up, the natural aggregate unemployment rate $\frac{1}{2} \frac{(1+\mu)z(1+A)}{A}$ goes down, average wage $\frac{A+1}{2(1+\mu)}$ goes up, and the inequality widens as indicated by the wage ratio A . This happens because with higher productivity, employers are now more active in hiring college graduates than before, which pushes their wage up (but less than by the amount of the increase ΔA), and reduces unemployment. Nothing happens to labor market outcomes of high-school graduates.