14.02 Principles of Macroeconomics, Spring 2000
3 pages

Problem Set 1
Answers

Question 1. (5 points each) True, false or uncertain? Give a brief but careful explanation.

a) Economic models can be used both for forecasting and for choosing optimal policy instruments.

True: if we know or can predict the exogenous variables, then the model "will" tell what happens to the endogenous variables. Plus, if we want to implement a certain (optimal) allocation, one can choose the exogenous (policy) variables accordingly. Note that in general, we need as many policy instruments as targets to be able to implement any outcome.

b) There is a consensus today that high current US stock prices reflect bright future fundamentals (e.g., productivity growth)

False: many people, including the Chairman of the FED, believe that it is due to excess optimism of financial investors (a "bubble").

c) The relationship between output per capita and growth varies a lot among different regions of the world.

True: for example, there is a negative relationship within the OECD countries, within Asia, but no clear negative relationship within Africa.

d) An endogenous variable in a macro model is dependent on the value of other variables in the model.

True: endogenous variables are functions of the exogenous variables and other coefficients of the model.

e) The high unemployment rate has been causing trouble for Europe since as early as the 1960s.

False: look at figure 1-4 of the textbook. It clearly shows that Europe had an extremely low unemployment rate in the 60s-early 70s, then it shot up steadily in a decade and stayed quite high ever since.

Question 2. (35 points) A model of wage and price inflation.

a) (10 points) Assume that wage inflation (i.e., the relative change of wages from year to year) is given by

$$\frac{W_t - W_{t-1}}{W_{t-1}} = \frac{P_{t-1} - P_{t-2}}{P_{t-2}} + A_0 - A_1(U_t - U_{voluntary}),$$

where W_t is the level of wages at time t, P_t is the price level, U_t is the actual level of unemployment, $U_{voluntary}$ is the level of voluntary unemployment.

Interpret the three terms on the right hand side. Can you relate this equation to a labor supply relation?

The first term is past price inflation: this reflects that workers care for their real wages, and they use past price inflation to predict present price inflation. The second can capture productivity growth for example. The third says that if unemployment is high (employment is low), then wages will fall – this is in

fact like a labor supply relation: low wages low employment thus high unemployment.

b) (10 points) Prices are set by

$$P_t = K_t W_t,$$

where K_t is called a *markup.* Give at least two factors that might be captured by this term and explain how. Derive the rate of change form

$$\pi_t = \frac{P_t - P_{t-1}}{P_{t-1}} = \frac{K_t - K_{t-1}}{K_{t-1}} + \frac{W_t - W_{t-1}}{W_{t-1}}$$

from the above specification (*Hint: use the approximation* $(1+a)(1+b) = 1+a+b$ *if* ab *is small).*

Assume that

$$\frac{K_t - K_{t-1}}{K_{t-1}} = B_0 - B_1(U_t - U_{voluntary}).$$

Interpret this relationship with the determinants of the markup you listed earlier.

The markup might reflect the level of competition (market power) in the industry/country: more competitive environment, smaller margin between prices and wages (costs); or capital costs, or energy prices etc.

$\frac{P_t - P_{t-1}}{P_{t-1}} = \frac{K_t W_t}{K_{t-1} W_{t-1}} - 1 = \left(\frac{K_t - K_{t-1}}{K_{t-1}} + 1\right)\left(\frac{W_t - W_{t-1}}{W_{t-1}} + 1\right) - 1 = \frac{K_t - K_{t-1}}{K_{t-1}} + \frac{W_t - W_{t-1}}{W_{t-1}}$.

The markup condition says that if U_t is high, then the markup will decrease. In terms of competition: with high unemployment, it should imply tougher competition (might or might not hold in reality). In terms of energy, capital costs: with high U_t, hence depressed production, capital (and energy) might become relatively cheaper, thus the price-wage margin decreases.

c) (5 points) Solve for $\pi_t - \pi_{t-1}$ as a function of $U_t - U_{voluntary}$ (and the A, B coefficients). Interpret the tradeoff described by your results.

$\pi_t = B_0 - B_1 (U_t - U_{vol}) + \frac{W_t - W_{t-1}}{W_{t-1}} = B_0 - B_1 (U_t - U_{vol}) + \pi_{t-1} + A_0 - A_1 (U_t - U_{vol})$

$\pi_t - \pi_{t-1} = B_0 + A_0 - (B_1 + A_1)(U_t - U_{vol})$

It describes a negative relationship between unemployment and changes in inflation: when unemployment is low (below the voluntary level), the change in inflation is high and vice versa. So there is a tradeoff between low unemployment and accelerating inflation.

d) (10 points) How can you reconcile the relationship you established in part c with actual US data (using figures 8-2, 8-3 and 8-5 of the textbook)?

As 8-5 shows, this relationship holds quite nicely since the 1970s. Before that, however, the unemployment rate was related with the *level,* and not the *change* of inflation.

Question 3. (40 points) A model of output determination.

a) (5 points) Consumption is determined by

$$C = c_0 + c_1(Y - T) - c_2 i.$$

Here Y is output, T is the level of taxes and i is the interest rate. Interpret this equation: what determines the sign of the effect of Y, T and i on C?

There is an autonomous component of consumption: $c_0 - c_2 i$. The higher the interest rate, the more people save thus the less they spend, but even without any (current) income, there is a minimal level of spending. As disposable income goes up, so does spending, but not necessarily one by one.

b) (5 points) Investment is given by

$$I = b_1 + b_2 Y - b_3 i.$$

Interpret the equation (in the same manner as in part a).

Again, there is an autonomous component – b_1, which is invested even for zero output and interest rate; I increases if Y increases: higher production today might indicate more profitable projects today, hence higher investment. An increase in the interest rate suppresses investment: i is basically the (opportunity) cost of investment – foregone interest, or interest on bank loans used for financing the investment project.

c) (10 points) Assuming that there are no exports or imports ($M = X = 0$), the equilibrium condition becomes

$$Y = C + I + G,$$

with G denoting government spending. What does this condition mean? Assume that $b_2 + c_1 < 1$. Solve for Y, C, and I as a function of G, T, i (and the coefficients).

The equilibrium condition says that whatever is demanded ($C + I + G$) is also produced.

The solution is

$$\begin{aligned} Y &= \frac{c_0 - c_2 i + b_1 - b_3 i}{1 - c_1 - b_2} - \frac{c_1}{1 - c_1 - b_2} T + \frac{1}{1 - c_1 - b_2} G \\ C &= c_0 - c_1 T - c_2 i + c_1 Y \\ I &= b_1 - b_3 i + b_2 Y \end{aligned}$$

d) (10 points) Suppose that G increases by ΔG. Calculate the effect on output, consumption and investment. Is the effect on output smaller or larger than ΔG? Explain why.

$\Delta Y = \frac{1}{1 - c_1 - b_2} \Delta G$, $\Delta C = c_1 \Delta Y$, $\Delta I = b_2 \Delta Y$. The increase of output is greater than the increase in G: this is the multiplier effect. Higher G – higher demand – higher production – higher consumption and investment – *feedback:* higher demand and production again – etc.

e) (10 points) Suppose that i increases by Δi. What happens to output and its components (C and I)? Explain the channels through which Y, C and I are affected.

$\Delta Y = -\frac{c_2 + b_3}{1 - c_1 - b_2} \Delta i$, $\Delta C = c_1 \Delta Y - c_2 \Delta i$, $\Delta I = b_2 \Delta Y - b_3 \Delta i$. Higher interest rates induce higher consumer savings thus lower spending, which lowers demand. Higher interest rates also depress investment, that further decreases demand. This decrease then feeds back again into both consumption and investment (through production, income), depressing all three variables further and further.