Economics 105 Professor K. Kletzer
UCSC Spring 2011

First Midterm
Sample Answers

My answers are inserted after each question. I did not insert diagrams, but instead describe what happens in them.

1. Answer each of the following:

a. Define the natural rate of interest and explain how a fiscal expansion affects it.

The natural rate of interest, r_n, is the medium-run real rate of interest. At the natural rate of interest, aggregate demand equals potential output. A permanent fiscal expansion raises r_n because an increase in G or decrease in T increases aggregate demand. The real rate of interest rises to reduce investment demand so that aggregate demand returns to equal potential output. A temporary fiscal expansion has no effect on the medium run, so it has no effect on r_n.

b. Why might current inflation depend on expected future inflation?

Expected future inflation affects current inflation when prices and wages are set in a forward-looking way. If firms set prices (and/or wages) for a period of time, they realize that their prices will fall in real terms with inflation. Firms will balance the cost of setting nominal prices too high initially against having these prices become too low before it is optimal to reset prices. Higher inflation leads firms to raise nominal prices further each time they set prices and to set them more often.

c. How are long-term interest rates related to short-term and expected future short-term interest rates?

The long-term interest rate is an average of current and expected future short-term interest rates. A two-year bond can be held for one year and then sold for its remaining maturity. At the end of one year, the bond is the same as a new one-year bond. In equilibrium, it provides the same yield. When the bond is issued, the short-term (one-year bond) interest rate one year hence is not known. It is the expected future short-term interest rate. The two-year bond interest rate is given by $\left(1+i_t^{\ell}\right)=\left(1+i_t\right)\left(1+i_{t+1}^{e}\right)$. ($i_t^{\ell}$ is the two-year bond, issued at t, annual interest rate and i_t is the one-year bond, issued at t, annual interest rate.)

d. How are real and nominal interest rates related?

The nominal interest rate is paid in dollars at current prices, and the real interest rate is paid at constant prices. The real interest rate is corrected for inflation. The Fisher equation summarizes this relationship: $1+i=\left(1+r\right)\left(1+\pi\right)$ which is approximated by $i=r+\pi$.

2. Some economists suggest that monetary policy in the 1970s targeted the short-term interest rate but that the response of the interest rate to inflation was too small. Follow these steps to explain this argument:

a. Write down a Taylor rule and note how inflation affects the interest rate set by the Fed.

The Taylor rule is given by the equation $i^T = r_n + \phi_\pi \pi + \phi_y \tilde{y}$. This tells us how the Fed adjusts the short-term nominal interest rate in response to inflation and the output gap. The parameter, ϕ_π, measures how much the interest rate is increased in response to inflation. If ϕ_π is larger than one, then the Fed raises the Fed Funds rate by more than the rise in inflation so that the real rate of interest increases. If ϕ_π is less than one, then the Fed raises the Fed Funds rate by less than the rise in inflation and the real rate of interest decreases.

b. Suppose expected inflation suddenly rises. How does this affect current inflation?

The Phillips curve includes expected inflation. We can use either the backward, $\pi_t = \pi_t^e + \lambda \tilde{y}_t$ or forward looking $\pi_t = \pi_{t+1}^e + \lambda \tilde{y}_t$ version. An increase in expected inflation raises inflation because firms and workers care about real prices and wages when they set nominal prices and wages. If expected inflation is higher, newly set prices and wages will be higher.

c. Use the IS-MP diagram to show how the short-term real interest rate responds to this shock (you may use equations if you like). If the Fed's response to inflation is small, does the real interest rate rise or fall?

In an IS-MP diagram, the MP curve moves down if just inflation rises (the real interest rate is on the y-axis). If the Fed raises the Fed Funds rate by more than inflation, then the MP curve (on net) rises. This reduces the output gap (that is, output falls). If the Fed raises the Fed Funds rate by less than the increase in inflation, then the MP curve (on net) shifts down and the output gap rises.

d. If the real interest rate falls, does the inflation rate continue to rise? Why?

The real interest rate falls, so that output rises above potential output. The Phillips curve (equivalently, the AS relation) indicates that inflation rises above expected inflation because unemployment is now below the natural rate. As the inflation rate rises, the Fed continues to increase the Fed Funds rate – but by not as much as inflation. As inflation rises, real interest rates continue to fall and expected inflation continues to rise. Actual inflation keeps rising until the output gap goes to zero and then inflation stays high.

In the next two questions, we compare two ways to think about how OPEC price increases affect the US economy.

3. For this question, assume an oil price rise increases the mark-up of prices over wages. The economy starts in medium-run equilibrium.

a. Does the natural rate of unemployment change? Does potential output change?

The natural rate of unemployment rises and potential output falls. The reason is that as the mark-up increases, real wages fall. In the medium run, this means that workers and firms negotiate lower real wages which requires a slacker labor market – that is, higher unemployment leads to a lower real wage. Higher unemployment means fewer people are employed so less output is produced.

b. Does the natural rate of interest change?

Aggregate demand for goods and services (the IS curve) does not change. When potential output falls, medium-run GDP must be lower. The real interest rate rises in the medium run to reduce aggregate demand. Thus, the natural rate of interest rises.

c. How do output and inflation change in the short run if the Fed keeps the money supply growth rate constant?

You want to use both the AD and AS relations for this answer. As Y_n decreases, the AD curve does not shift. The AS, given by the Phillips curve, $\pi_t = \pi^e_{t+1} + \lambda\tilde{y}_t$, shifts back and up. Why? Because the output gap rises (Y_n falls but Y_t does not yet). Inflation is higher, so M/P begins decreasing. Output falls as inflation rises and M/P falls.

Not asked, but in the adjustment to the medium run, expected inflation rises and the AS curve continues to shift up until it intersects the AD curve at Y_n. Output falls until it reaches Y_n and the inflation rate rises then falls back to its original value in the new medium run.

If you used growth rates instead of output in your answer, you would have that g_y falls as inflation and unemployment rise, then g_y returns to the medium-run growth rate, $\overline{g}_y$ and inflation returns to its medium-run rate $\overline{\pi} = g_m - \overline{g}_y$ at the higher natural rate of unemployment.

d. How do output and inflation change in the short run if the Fed instead uses a Taylor rule?

Under a Taylor rule, the short-term interest rate increases with the natural rate of interest and output gap: $i^T = r_n + \phi_\pi\pi + \phi_y\tilde{y}$. The output gap rises because Y_n falls unless Y_t also falls. But the IS-MP diagram tells us that if the short-run interest rate rises by just the increase in r_n, then output falls to just potential output. The Phillips curve, $\pi_t = \pi^e_{t+1} + \lambda\tilde{y}_t$, then tells you that inflation does not change. Under the Taylor rule, the economy immediately adjusts to the new medium run with unemployment rising exactly with u_n and the interest rate rising exactly with r_n and no change in inflation or the output gap (gap, not output – output falls immediately to the new Y_n).

4. For this question, assume the oil price increase does not change the mark-up but affects the economy by increasing the value of US imports.

a. Show how the increase in imports affects the IS curve and explain. Does potential output change in this case? Does the natural rate of interest change?

The IS curve shifts back because the increase in expenditures on imports reduces aggregate demand for US goods and services. There is no change in the natural rate of unemployment, hence potential output, because the mark-up does not change. Because the IS shifts inward and Y_n does not change, r_n must decrease. You can see this in a diagram – it means that for aggregate demand to equal potential output again, the real interest rate must fall so that investment demand rises to make up for the drop in net export demand for US goods.

b. How does aggregate demand change with the oil shock?

The AD curve shifts inward when the IS curve shifts inward. That is, aggregate demand contracts in both diagrams.

c. How do output and inflation change in the short run if the Fed keeps money supply growth constant?

If money supply growth is constant, the real interest rate falls as the IS shifts inward (the LM curve does not shift). The shift of the AD curve lowers the output gap (it becomes negative) and inflation starts to fall. (You can draw and AD-AS diagram to show this.)

d. How do output and inflation change in the short run if the Fed uses a Taylor rule?

Using the Taylor rule, $i^T = r_n + \phi_\pi \pi + \phi_y \tilde{y}$, again, since r_n falls, the Fed Funds rate falls by just as much. When the interest rate falls to the new value of r_n, output equals potential. The output gap is zero and inflation is the same as it was before the oil price increase.

5. The economy is in the medium run, and productivity growth suddenly rises.

a. Does potential output rise? Do consumption and investment demand rise?

Start with the short-run production function $Y = AN$. Productivity growth increases A which increases Y_n. Consumption and investment demand must rise because output rises in the short run (real income goes up, consumption goes up).

b. Does the natural rate of interest change? Show how aggregate demand shifts.

In the medium run, the AD and AS curves shift by exactly the amount that Y_n rises by. Consumption and investment go up by exactly the percentage increase in potential output. This means the natural rate of interest does not change. For this answer, it's really important to

remember that r_n is the medium-run interest rate (the short-run interest rate change can be ambiguous.)

c. At constant inflation, how does the productivity increase affect the output gap?

At constant inflation, expected inflation equals actual inflation, so the output gap is zero. If inflation is constant, output rises exactly one for one with potential output. The AD curve shifts out by the amount Y_n rises.

d. The central bank targets the inflation rate at 2%. How does short-run output respond to the productivity rise under this policy.

If the central bank keeps inflation at 2%, then output rises by exactly the amount Y_n does. The central bank keeps the short-term nominal and real interest rates constant because r_n does not change, the output gap remains at zero and inflation is constant. The Taylor rule works great in this case.

e. (tough question) Explain why your answer to d. does not depend on whether the productivity increase is expected or unexpected.

The tough part is thinking through what happens in the short run if expected productivity does not equal actual productivity, $A^e \neq A$. If $A^e < A$, then u_n falls and Y_n rises more than if $A^e = A$. In the AD-AS diagram, the AD curve shifts out more than the AS curve. The output gap becomes negative as Y_t does not increase by as much as Y_n. If the money supply growth rate is held constant, the real interest rate rises and inflation falls below 2%. With a constant money supply growth rate, the inflation rate would need to remain lower so that output could grow faster and catch up to Y_n over time. Under the inflation target, the central bank increases the money supply growth rate to keep the real interest rate and inflation from changing. This expands output to Y_n even though people underestimate how fast productivity is rising.