Macroeconomics

Question 4 (Macroeconomics, 30 minutes).   This question asks you to interpret various theories about the current recession using the IS-LM model, the Phillips Curve, and the data below. The first two parts of the question, (a) and (b), ask you to evaluate two potential theories for why the crisis began. These two theories are not necessarily mutually exclusive — both may be true.
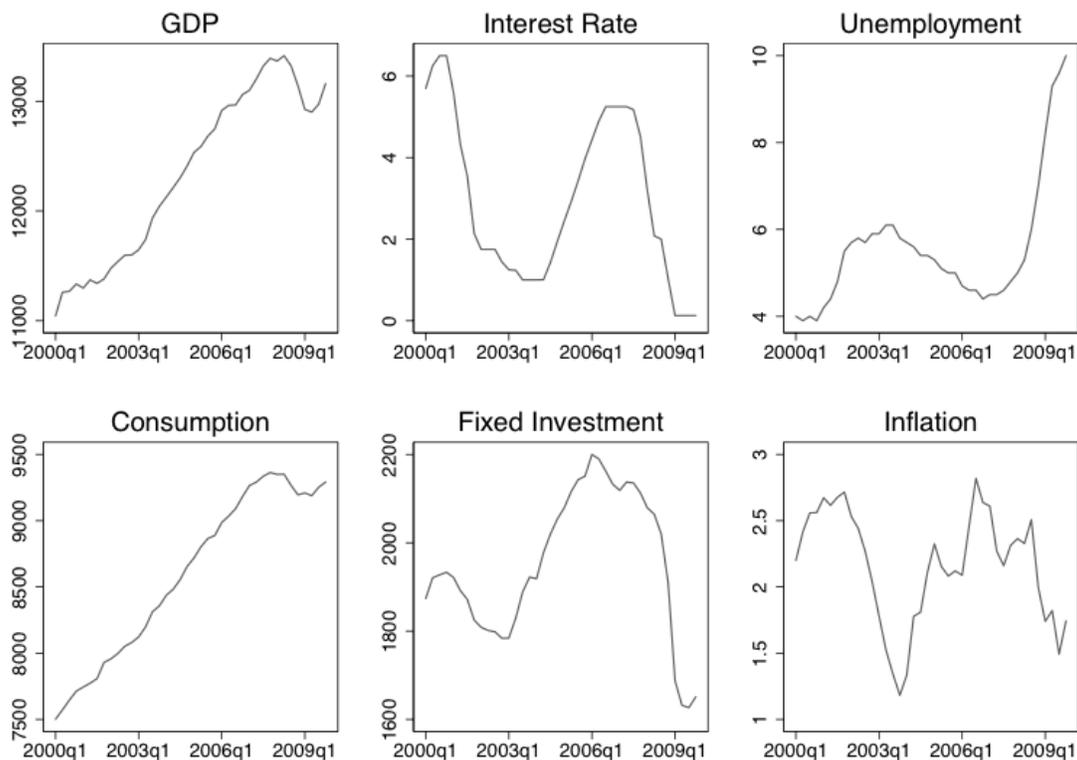

Figure 1: **Selected U.S. Macroeconomic Data: 2000:Q1 to 2009:Q4.** In the graphs above, GDP, fixed investment, and consumption are all measured in constant (2005) dollars. Unemployment, the interest rate, and the inflation rate are all measured as percentages. The interest rate is the Fed's target for the federal funds rate. The inflation rate is the 12-month percent change in the core Consumer Price Index.

a. (**5 points**) Economist A argues that the recession was caused by a steep drop

1

in "animal spirits." In other words, this economist believes that firms became less optimistic about the future, so they stopped adding to their capital stocks. What features of the data could the economist point to in order to prove her theory? What other data would be useful in shedding light on it?

Answer:
The IS-LM model assumes that investment is determined by real interest rates $I = I(r)$. Economist A argues that it was not higher interest rates that caused investment to collapse in the current recession, but a decline in "animal spirits." The data are consistent with that interpretation. We see that investment fell in the current recession, but this was not because interest rates rose. Rather, interest rates fell. If investment is determined by the equation $I = \phi - d \cdot r$, where ϕ is animal spirits and r is the real interest rate, then the only way that I can fall if interest rates fall is if ϕ declines. Also, in the IS-LM model, a combination of falling investment, falling output, and falling interest rates is consistent with an inward shift of the IS curve that is caused by a drop in animal spirits.

Points: This is worth 5 points
To get full credit for the question, you need to point out that the behavior of interest rates is consistent with Economist A's theory about a decline in animal spirits and explain the reasons. (3 points)

You also needed to suggest at least one other variable that would help verify Economist A's theory. These might have included stock prices (which are the present discounted value of future profits), or some other interest rate, such as corporate bond rates (which are closer to the true opportunity cost of investment for firms). (2 points)

Partial credit at the grader's own judgement.

b. (**5 points**) Economist B argues that the recession was caused by a steep drop in "autonomous consumption." In other words, this economist believes that consumers reduced their spending because of an increased desire to save for the future. What features of the data could the economist point to in order to prove her theory? What other data would be useful in shedding light on it?

Answer:
The data are consistent with Economist B's theory, because consumption did fall. However, the crucial difference between this theory and that of Economist A is that we would expect consumption to decline as income fell, even if consumers did

2

not want to save more at any given level of disposable income. To see this, let the functional form for consumption be $C = a + MPC \cdot (Y - T)$. We see that Y fell, so it is harder to know whether autonomous consumption a also fell just by looking at consumption.

Points: This is worth 5 points
You get partial credit for noting that higher unemployment might cause people to be concerned about their jobs, and thus save more for the future. (2 points)

However, more appropriate data to test Economist B's idea would be some component of wealth that would operate on autonomous consumption directly, like stock prices or housing prices. Alternatively, a graph that showed the average propensity to consume, of the marginal propensity to consume, would speak more directly to Economist B's theory that simply noting that consumption and output fell in the current recession. (3 points)

Partial credit at the grader's own judgement.

c. (**5 points**) As the recession took hold, many economists argued that fiscal policy, rather than monetary policy, would be most effective in fighting the recession. Draw two IS-LM diagrams. The first one assumes that both Economist A and B's theories are correct and illustrates these theories in IS-LM. The second graph will depict the situation in which monetary policy is less effective in boosting output than fiscal policy. Draw your IS-LM diagrams with the nominal interest rate on the vertical axis and real GDP on the horizontal axis.

Answer:
The graph depicting Economist A and B's theories will show inward shifts of the IS curve. For the second graph, note that the fact that the interest rate has fallen to zero indicates that the U.S. is very likely in a liquidity trap, in which traditional monetary policy is ineffective. However, it is not enough to simply draw a regular LM curve that does not shift out very much.

Points: This is worth 5 points
2 points for drawing the first graph.
3 points for drawing the second graph.
In order to get full credit for the equation, you need to point out that at very low interest rates, the LM curve becomes flat. When this occurs, increases in the money supply do not lower interest rates; the LM curve essentially shifts sideways across itself. In this situation, however, expansionary fiscal policy is very effective.

3

Outward shifts in the IS curve result in very large increases in output, because there is essentially now crowding out of investment from higher from interest rates.

Partial credit at the grader's own judgement.

d. (**5 points**) Are the data for unemployment and inflation during the 2000s in general agreement with the Phillips Curve? Does the behavior of inflation and unemployment during this period suggest a value (or range of values) for the natural rate of unemployment, UR^*? Explain your reasoning.

Answer:

The behavior of inflation and unemployment during the 2000s is consistent with predictions from the Phillips Curve, in that inflation fell when unemployment rose. More accurately, the data seem to imply a natural rate of unemployment UR^* somewhere between 4 and 6 percent. The Phillips Curve predicts falling inflation when $UR > UR^*$. Thus, the declines in inflation in 2003 and 2008-2009 provide suggestive evidence that unemployment exceeded the natural rate in those periods.

Points: This is worth 5 points

2 points for noting that the behavior of inflation and unemployment during the 2000s is consistent with predictions from the Phillips Curve.

To get full credit for the question, you do not have to give the "right" number for the natural rate (that is, either 5 percent or 6 percent). Rather, you have to make clear that the way to infer the natural rate from these data is to find periods when inflation is either rising or falling, which indicate that unemployment is either below or above the natural rate. (3 points)

Partial credit at the grader's own judgement.

e. (**5 points**) The data above indicate that inflation has fallen during the past few years. Assume that consumers and firms expect inflation to continue falling in 2010 and become negative in 2011. How would this *expected future deflation* affect the IS-LM diagram that you drew in part (c) above, which is relevant for the current time period?

Answer:

Holding nominal interest rates constant, an expected future deflation would raise real interest rates, depressing investment. When the IS-LM diagram is drawn with the nominal interest rate on the vertical axis, an expected deflation shifts IS to the left, reducing output.

4

Points: This is worth 5 points

To get full credit for this question, you have to explain that an expected deflation raises real interest rates and portray this effect correctly in the IS-LM diagram. You get partial credit for noting that $r = i - \pi^e$, so that an expected deflation raises real rates.

Partial credit at the grader's own judgement.

f. (**5 points**) Your answer in part (d) might suggest a way in which the Federal Reserve could fight the recession. What is it? What are some advantages and disadvantages to this approach?

Answer:

Just as an expected <u>deflation</u> raises real interest rates, an expected <u>inflation</u> would reduce them. In an IS-LM diagram with i on the vertical axis, this would shift the IS curve out and to the right, raising output. The Federal Reserve could potentially bring this about by committing to raise inflation during the next several years, perhaps by announcing a price level target for 10 years from now that is 30% higher than the price level today. An advantage of this approach is that we would not need to raise the national debt in order to pay for fiscal stimulus. Additionally, private firms would be deciding where to invest as real interest rates fell. The resulting increase in output might therefore be provided more efficiently. A disadvantage to this approach is that a commitment to future inflation could undermine the inflation-fighting credibility of the Federal Reserve System. Just as importantly, it might not work — people may not find the central bank's commitment to higher inflation credible. If so, π^e would not rise and real interest rates would not fall.

Points: This is worth 5 points

2 points for noting that the solution is an expected inflation.
3 points for enumerating relevant advantages and disadvantages of the method.
Partial credit at the grader's own judgement.

Question 5 (Macroeconomics, 30 points).   Consider a version of the Solow Model where households require a subsistence level of consumption. The production function is standard:

$$Y = K^\alpha E L^{1-\alpha}, \tag{1}$$

as is the equation of motion for the aggregate capital stock,

$$\Delta K = sY - \delta K. \tag{2}$$

Labor (L) grows at a constant rate n. Labor-augmenting technical progress (E) is constant at 1. Unlike the standard Solow Model, savings is not a constant, but depends on per-capita income $y = \frac{Y}{L}$. If y is lower than a threshold level $\overline{y}$, then the representative household does not save. Of the income above $\overline{y}$, the household saves a constant fraction $\overline{s}$. Per-capita saving is therefore given by $sy = 0$ if $y < \overline{y}$ and

$$sy = \overline{s}(y - \overline{y}) \tag{3}$$

if $y > \overline{y}$.

a. (**6 points**) Graph the saving rate $s(= \frac{sy}{y})$ as a function of y.

Answer:
Dividing Equation (3) by y, and realizing that the savings rate cannot be zero, gives $s = max(0, \overline{s}(1 - \frac{\overline{y}}{y}))$. This function is graphed in Figure 2 (scales of the axes do not matter).

Points: This is worth 8 points
To get full credit, you had to show that $s = 0$ below $\overline{y}$ (4 points) and that it asymptotes to $\overline{s}$ as y gets large (4 points).
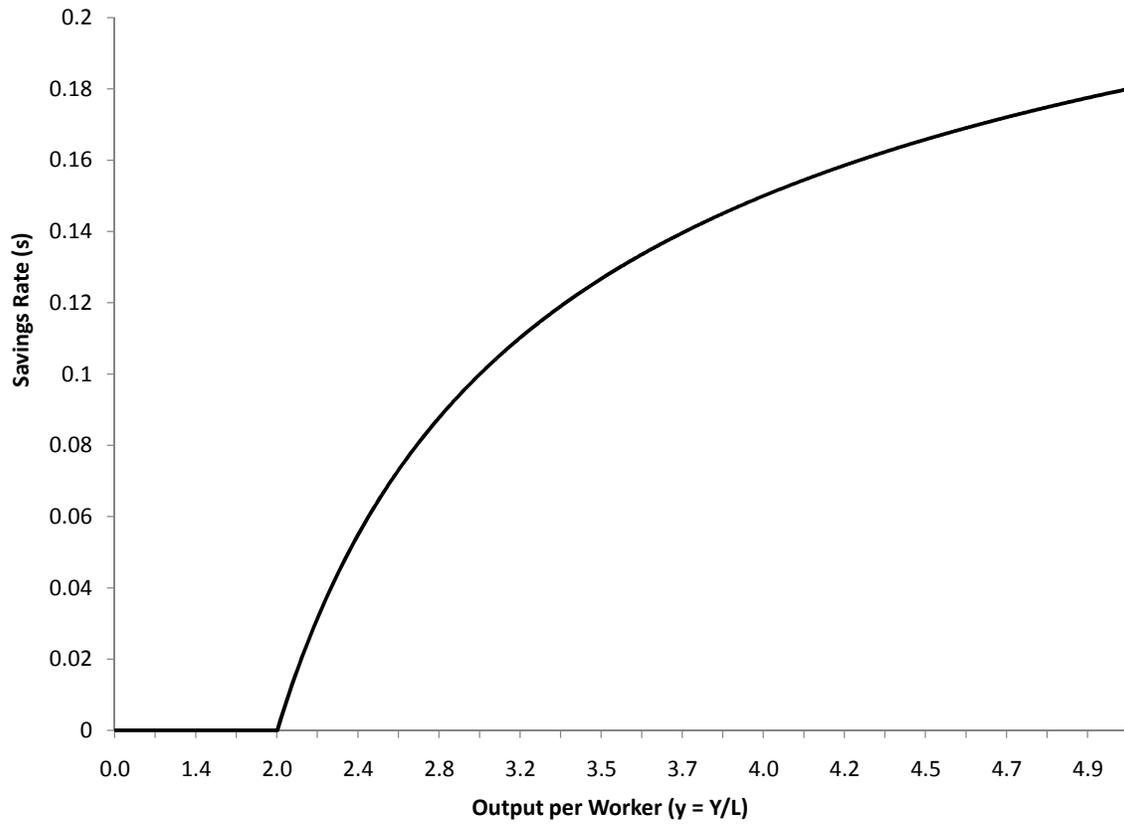Partial credit at the grader's own judgement.

Figure 2: **The Savings Schedule Under a Subsistence Minimum:** $\overline{s} = .3$ **and** $\overline{y} = 2$**.** This graph shows the savings rate s for various values of output-per-worker y. Savings are determined by the equation $sy = \overline{s}(y - \overline{y})$. Thus, the savings rate s is zero until $\overline{y}$ and thereafter asymptotes to the value of $\overline{s}$.

7

b. (**6 points**) Draw the Solow diagram for this model. In other words, draw a diagram depicting sy and $(n + \delta)k$. Be sure to label your lines.

Answer:

See Figure 3. This figure resembles the standard Solow graph, with the sy curve "shifted down."
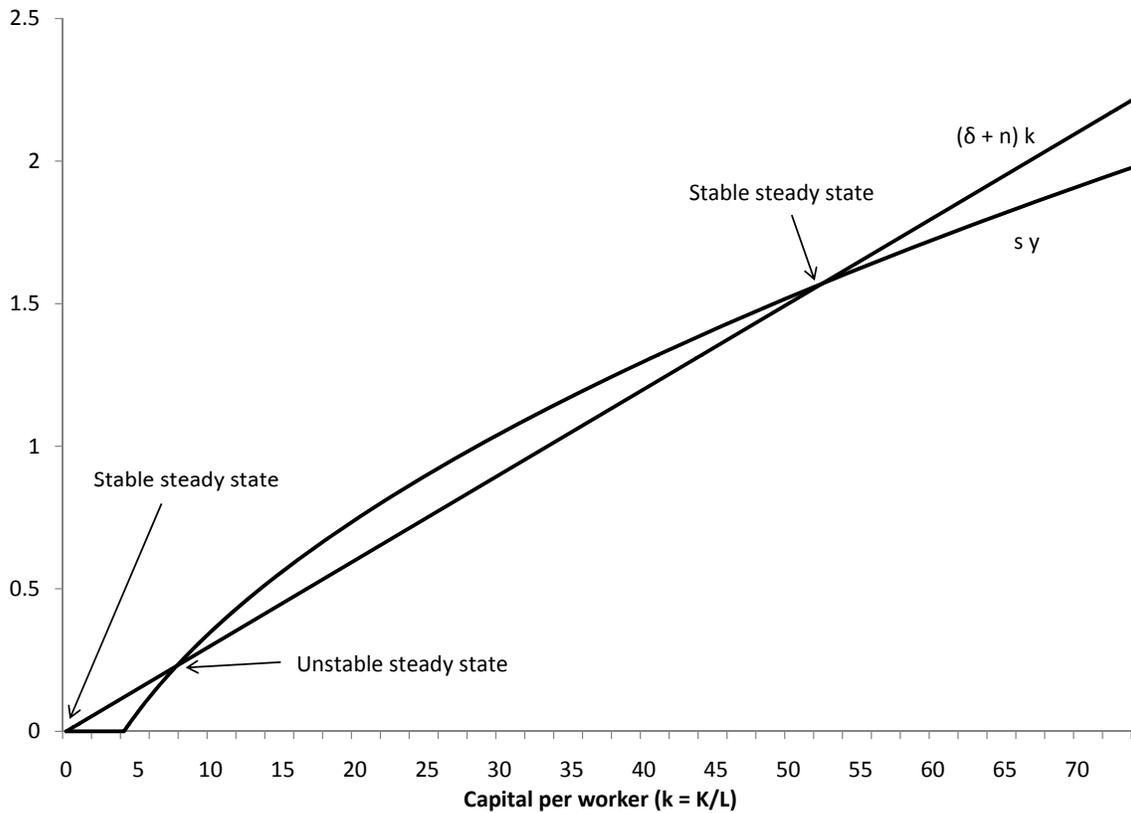

Figure 3: **The Solow Model Under a Subsistence Minimum.** With the non-standard savings behavior of Figure 2, there are two stable steady states in the Solow graph. One stable steady state is at zero and the other resembles the stable steady state from the standard Solow model. Model parameters are $\alpha = 0.5$, $\delta = .02$, and $n = .02$.

Points: This is worth 6 points

2 points for drawing and labeling the sy curve correctly.

4 points for drawing and labeling the $(n + \delta)k$ curve correctly.

8

The students do not have to label the steady states to get full credit

Partial credit at the grader's own judgement.

c. (**4 points**) How many steady-states does the model have? (Assume that $\bar{y}$ is not too large. Otherwise the economy has no steady states with $k > 0$.)

Answer:

There are now three steady states in the model, two of which are stable.

Points: This is worth 6 points

The students do not have to distinguish between stable and unstable steady states to get full credit).

Partial credit at the grader's own judgement.

d. (**6 points**) For various values of initial capital, characterize which steady states the economy may converge to.

Answer:

If initial capital-per-worker lies to the right of the unstable steady state, the model will converge to the typical steady state. However, if initial capital lies to the left of the unstable steady state, the model will converge to the steady state at zero.

Points: This is worth 6 points

3 points for getting the first part correct.

3 points for getting the second part correct.

Partial credit at the grader's own judgement.

e. (**6 points**) This formulation of the Solow Model is sometimes called a "poverty trap" model. Why?

Answer:

If the initial capital stock is too small, so that k_0 lies to the left of the unstable steady state, then the economy will converge to the zero steady state. Intuitively, the economy is not producing enough to meet the subsistence needs of the population, so the population does not save enough to replace worn-out capital, and capital-per-worker contracts. The initially poor economy becomes "trapped" at the zero steady state.

Points: This is worth 6 points

Partial credit at the grader's own judgement.

9