

## PROBLEM SET NINE SOLUTIONS

1.

- a. The natural rate of unemployment for this economy is described by the modified Phillips Curve when the change in inflation is zero, thus  $0 = -1(u-0.06)$  implies the natural rate is 0.06.
- b. The long-run growth rate of the economy is recovered from Okun's law when the change in unemployment is zero, so  $0 = -0.4(dY/Y-0.03)$  implies  $dY/Y = 0.03$ . Give the growth rate of output and the rate of inflation, the growth rate of money is simply the sum of these two parts, or  $dM/M = dY/Y + dP/P = 3\% + 10\% = 13\%$ .
- c. Construct the following table,

	0	1	2	3	4	
<b>inflation</b>	10%	7.5%	5%	5%	5%	target deflation
<b>d(inf)</b>	0%	-2.5%	-2.5%	0%	0%	differences
<b>u</b>	6%	8.5%	8.5%	6%	6%	$u = 0.06-d(\text{inf})$
<b>d(u)</b>	0%	2.5%	2.5%	-2.5%	0%	differences
<b>dY/Y</b>	3%	-3.25%	3%	9.25%	3%	$dY/Y = 0.03-du/0.4$
<b>dM/M</b>	13%	4.25%	8%	14.25%	8%	$dM/M = \text{inflation} + dY/Y$

2.

The equation of interest is  $i = r + \text{expected inflation}$ . In the long run, expected inflation = actual inflation, which we know by the aggregate demand equation is simply the difference between growth in the money supply and growth in output. This implies  $i = r + dM/M - dY/Y$ .

The only question is where the real interest rate comes from. Growth shifts the long-run AS curve to the right, and probably won't affect the AD curve, implying prices must fall. The fall in prices translates into a shift right in the LM curve. Since growth does not shift the IS curve, and the level of output is determined from the AS-AD graph, the IS curve uniquely determines the position of the real interest rate. The LM curve must shift far right enough to intersect with the IS curve at the level of output determined by the new long-run AS curve. A higher growth rate of money will not affect where the LM curve must intersect the IS curve, so higher rates of money growth simply reduce the amount of deflation necessary to restore goods market equilibrium. The central bank could increase the money supply enough so that prices don't change, shifting the AD curve, but the position of the LM curve is the same, trading off price decreases for money increases.

Given that money growth can't affect the real rate of interest, and the long-run growth rate of the economy is determined by technology and population growth, it holds then that the Fisher hypothesis stands in the sense that a 1% increase in money growth translates into a 1% higher nominal interest rate.

Convince yourself this is true even if the IS curve shifts right (and consequently the AD curve shifts right) for some reason associated with growth.

3.

In the short run, seignorage is calculated as follows,

$$S = (dM/M)M/P = (dM/M)*1000*[1-0.10-0.25] = (dM/M)*650$$

(dM/M)	S
25%	162.5
50%	325
75%	487.5

In the long run, expected inflation equals actual inflation (equal money growth), so seignorage is calculated as follows

$$S = (dM/M)M/P = (dM/M)*1000*[1-0.10-dM/M]$$

(dM/M)	S
25%	162.5
50%	200
75%	112.5

4.

In a flexible exchange rate regime firms face transaction costs when doing business overseas. This occurs due to costs when exchanging currencies or costs associated with selling currency forward to hedge currency risk. Transition to a fixed exchange rate regime reduces the need to hedge and consequently reduces costs for firms, interpreted as a reduction in the markup, which we know reduces the natural rate of unemployment.

5.

An incorrect answer is to repeat part d with opposite signs, and gets 10/15 bonus points,

This policy is not sustainable. The shift in the AS curve increases prices, which shifts the LM curve to the left, increasing the interest rate. The central bank must react by increasing the money supply, which shifts both the LM and AD curves to the right. This increases both output and prices.

A nominal interest rate target, given the IS curve, translates into a real output target. Aggregate demand is consequently the IS curve evaluated at the target interest rate. Note this quantity does not demand on price, so AD is vertical. The decrease in AS causes prices to increase this period, but output is fixed by the nominal interest rate peg. Next period, price expectations are updated and AS shifts left again, further increasing prices, but again not changing output. This process will continue until prices increase to infinity or the central bank abandons its peg.

The problem with this answer is that the economy is now open, so the IS curve is described by the following equation,

$$Y = C(Y-T)+I(Y,r)+G+NX(Y, Y^*, EP^*/P)$$

Which clearly depends on the price level. Higher prices shift the IS curve to the left, complicating the analysis above. Correct answer given next week. Graders give up to 5 more bonus points for good answers, but please don't give any grades higher than 100/100.

6.

Many different answers are possible here.

Technological discoveries are not a measure of productivity growth. Many of the important technological discoveries in the United States over this period may not have translated into high productivity and the pace of Japanese growth could correspond to an increase in the saving rate in the early 1950s.

More importantly (and realistically), Japan started from a much lower productivity to start off with. Convergence in technological differences between the two countries through the diffusion of technology across borders implies that Japan would have to have faster productivity growth than the U.S. just to catch up to U.S. productivity levels by the end of the period.