PART I – TRUE/FALSE/UNCERTAIN (5 points each)

1. Like expansionary monetary policy, expansionary fiscal policy returns output in the medium run to its natural level, and increases prices. Therefore, fiscal policy is also neutral.

False. A policy is neutral if it only affects nominal variables (prices, nominal wages, nominal money supply) in the medium run, but does not affect real variables (output, the components of output, interest rates, etc.). Although fiscal policy does not, in the medium run, affect the natural level of output, it does alter the composition of output (an expansionary fiscal policy will, for instance, decrease investment in the medium run). So it does affect real variables, even though a cursory examination of the AS-AD diagram might give the impression that it does not.

2. If investment is completely insensitive to the interest rate (i.e. in the Investment function I = aY – bi, b is equal to zero), then the AD curve will be vertical.

True. The reason that the AD curve is usually downward sloping is that an increase in prices reduces the real money supply, which increases interest rates, which in turn reduces investment and therefore output. So if investment is insensitive to changes in the interest rate, then one of the links in the above argument is broken, and changes in prices no longer affect the output level. So the AD curve will be vertical.

3. A politician faced with a steeper AS curve is more likely to embark on a given disinflation program than one faced with a flatter AS curve (assume that the steeper slope is due to a higher sensitivity of nominal wages to the unemployment rate).

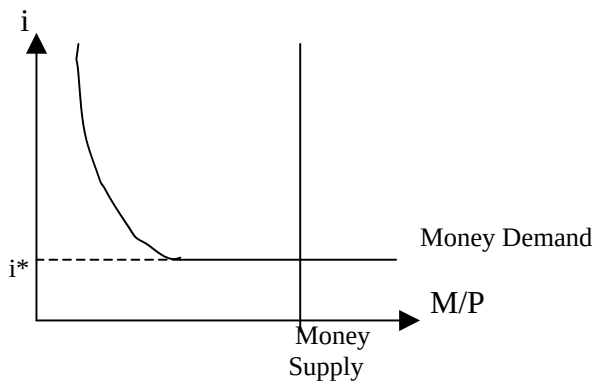
True. A steeper AS curve (resulting from a higher sensitivity of nominal wages to the unemployment rate) is equivalent to a steeper Phillips curve. The unemployment costs of a disinflation program will be lower with a steeper Phillips curve than with a flatter Phillips curve.

4. Money cannot be neutral in the short-run – the neutrality of money is exclusively a medium run phenomenon.

False. If workers have rational expectations, then an increase in money will lead the workers to at once revise their expected price to be equal to the new medium run equilibrium price (assuming that workers can revise their expectations as soon as the increase in money takes place). The economy will merely jump from one medium run equilibrium to another, with none of the usual gradual shifts in the AS curve. If workers can only adjust expectations after a lag, then the economy moves to a short run equilibrium, where the new AD curve intersects the old AS curve, but thereafter it jumps to the new medium run equilibrium with none of the usual gradual shifts in the AS curve. Consequently, money will be neutral in both the short run and the medium run.

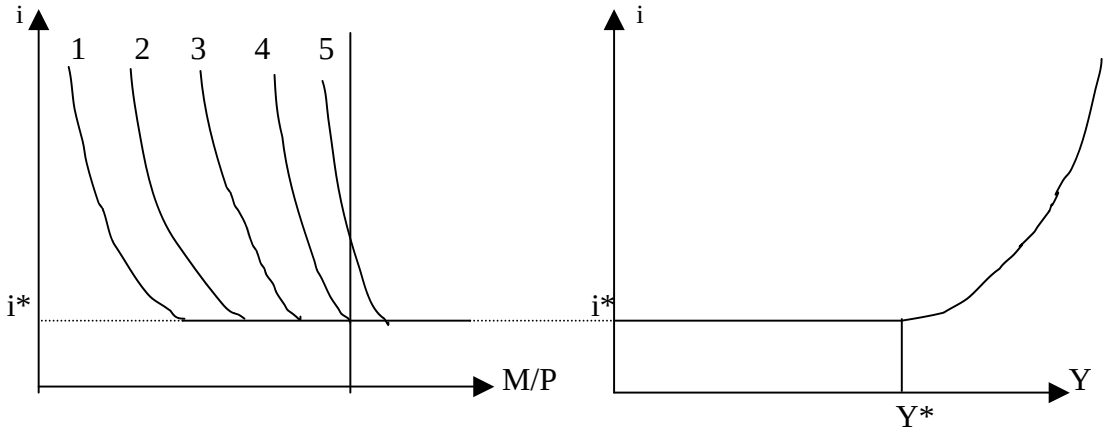
PART II – IS/LM and AS/AD – A special case (10 points each)

1. Consider the following diagram for the money market



Note carefully what this means. Money demand is completely unresponsive to the interest rate if interest rate falls below i*. In other words, the interest rate must ordinarily fall in order to convince people to hold more money, but once it has fallen to i*, no further drop is required for individuals to hold more money, regardless of what their income level is. They will be willing to hold any amount of money at this interest rate. Derive the LM curve **graphically** for this economy (i.e. consider changes in Y and what it does to the Money Demand function, and translate this information into (i, Y) space; show both the money market diagram and the IS-LM diagram when you do this). Explain intuitively its shape. (**Hint** : Changes in Y will **NOT** shift the **entire** money demand curve up)

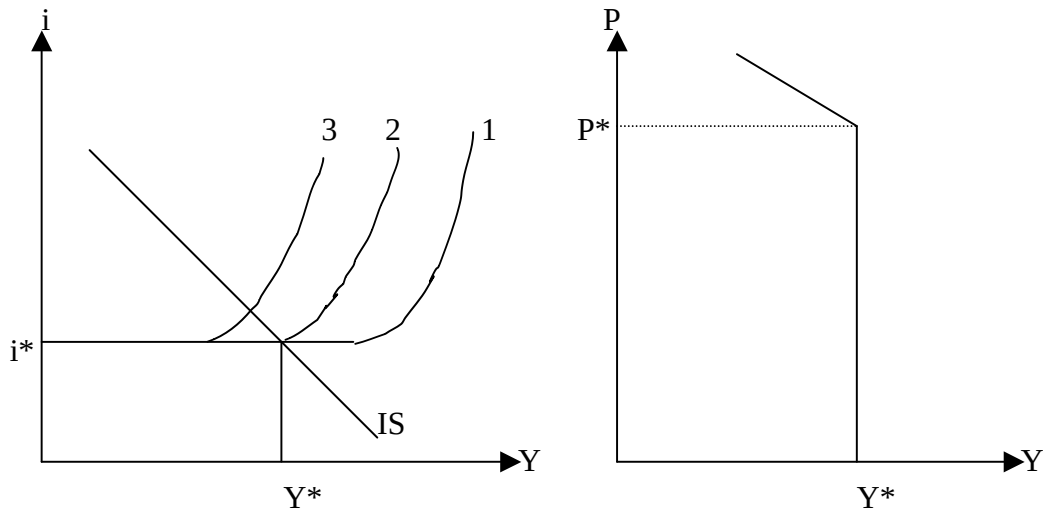
Answer :



Consider the curve labeled 1 as the initial money demand curve. As Y is increased, the money demand curve shifts out to the right (as indicated by 2,3,4,5 etc), but only the downward sloping part of the money demand curve is seen to shift out. At i*, each of the new curves must become flat, so the horizontal portions of the money demand curves do not shift "out". Denote the income level for which curve 4 is drawn as Y*. Then as long as Y<Y*, the shifts in the money demand curve do not change the equilibrium interest rate. So the LM curve is flat in this range. Increases in Y do not increase the interest rate. But for Y>Y*, the downward sloping parts of the money demand curves intersect the money supply curve, so we get a regular upward sloping LM curve for Y>Y*.

2. Suppose the IS curve has the usual negative slope. Derive **graphically** the AD curve in this economy (ie, consider changes in P and how it affects the IS-LM diagram and translate this information into a diagram in (Y,P) space; show both the IS-LM diagram and the AS-AD diagram when you do this). Explain intuitively why it has the slope it does.

Answer :



Consider the LM curve 2 as the initial LM curve. Denote the price level corresponding to this LM curve as P*. Now increase prices. The real money supply falls and the LM curve starts shifting to the left (to a position such as 3). But only the upward sloping part of the LM curve shifts to the left, since the curve flattens out at i*. With every increase in prices above P*, the new LM curve intersects the IS curve at a lower output and a higher interest rate. Translated into (Y,P) space, this corresponds to the regularly downward sloped AD curve seen above P* on the right hand side diagram above. But now consider decreases in P below P*. Starting from curve 2, the LM now begins to shift to the right, but because with each shift, the IS curve always intersects the flat portion of the LM curve, the output level remains at Y*. This corresponds to the vertical section of the AD curve on the right hand side. The intuitive explanation for the downward sloping part of the AD curve is the regular explanation. The intuitive explanation for the vertical part of the AD curve is that as prices fall below P*, money supply increases, but because

individuals are willing to hold any money at the interest rate i*, this increase in money supply is willingly held by individuals without necessitating a fall in the interest rate, and if the interest rate does not fall, then investment cannot increase and neither can output. So output remains at Y* even as prices fall below P*.

3. Suppose the AS curve has its regular upward slope, and it intersects the AD curve you just derived at some initial point. The government then increases the money supply. Does the AD curve shift? Is monetary policy effective, at least in the short run?

Answer : The vertical part of the AD curve will not shift, but the downward sloping part will shift up, so the price at which the curve becomes vertical increases from P* to some higher level of P. With the vertical part not having shifted, equilibrium output remains at Y*. Monetary policy is usually effective in the short run since an increase in money reduces interest rates, and this increases investment and therefore output. But if the economy is at equilibrium along the vertical part of the AD curve to start with, it is, in the IS-LM diagram, already at the interest rate i*. Any increase in money will not reduce the interest rate and so there is no increase in output even in the short run. If, however, the economy is at equilibrium along the downward sloping part of the AD curve to start with, then monetary policy will be effective in the short run for the usual reasons.

PART III – THE PHILLIPS CURVE (10 points each)

Consider the following set of equations :

Phillips Curve : $\pi_t = {}_{t-1}\pi_t^e + 5 - u_t$

Okun's Law : $u_t - u_{t-1} = -g_{yt}$

Aggregate Demand (in terms of growth rates) : $g_{yt} = g_{mt} - \pi_t$

We have used the following notation :

t – a time subscript denoting year
π_t – the inflation rate in year t (the rate of change of prices between t-1 and t)
${}_{t-1}\pi_t^e$ – the inflation expected by workers for year t formed at the end of year t-1
u_t – the unemployment rate in year t
g_{yt} – the growth rate of output between year t and year t-1
g_{mt} – the growth rate of nominal money between year t and year t-1

Assume that u_t, g_{yt}, and π_t are all determined in the middle of the year, while g_{mt} is set at the beginning of the year by the government. As described above, workers form expectations about next year's inflation rate at the end of the current year, ie, after the current year's inflation rate, unemployment rate and output growth have all been determined.

1. What is the natural rate of unemployment in this economy?

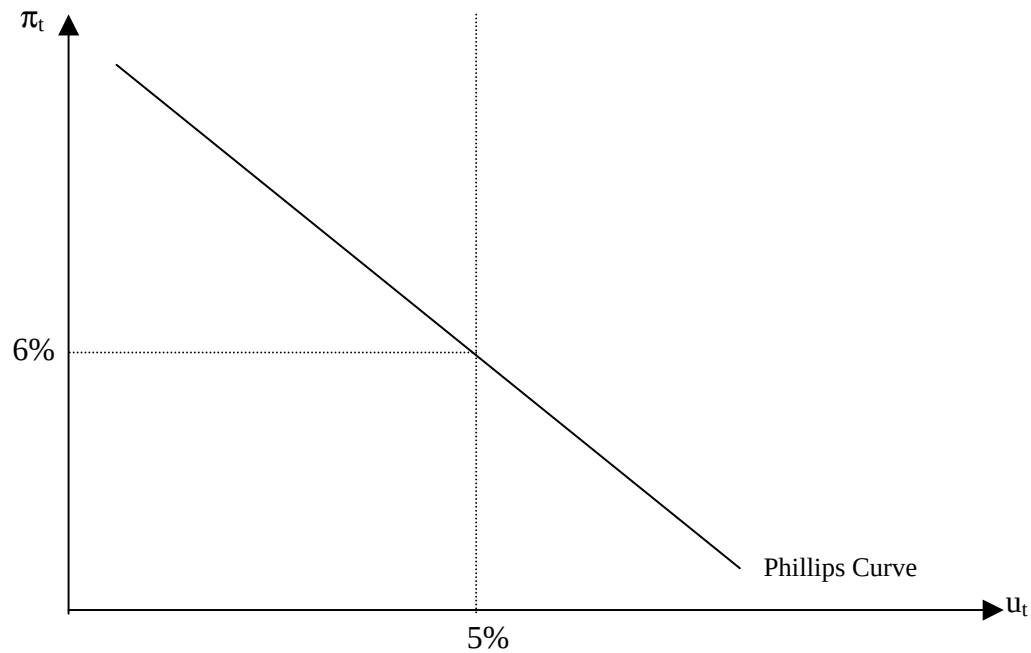
Answer : Setting π_t equal to ${}_{t-1}\pi_t^e$ in the Phillips curve relation, we get u_n to be equal to 5%.

2. Suppose we start in the year 1990 with the government having set the growth rate of money at 6% for all years. Suppose also that the economy is in a medium run equilibrium. What is g_{yt} and π_t?

Answer : In the medium run, we know that $u_t=u_n$ and that the growth rate of output is equal to its normal growth rate. As is evident from the Okun's Law relation provided above, the normal growth rate is 0. So $g_{yt}=0$. The AD relation then tells us what the inflation rate should be. With $g_{yt} = 0$ and $g_{mt} = 6\%$, π_t must equal 6% as well.

3. Draw a Phillips curve in (u, π) space to describe the information provided so far. In your diagram, show the natural rate of unemployment and the corresponding inflation rate.

Answer :



4. Suppose the government maintains the growth rate of money at 6% each year till 1995. But in 1995, the government increases this growth rate to 10% every year from then on. Suppose also that workers use adaptive expectations, and expect the next year's inflation rate to be equal to the inflation rate in the current year. Calculate the values of the unemployment rate and the inflation rate for 1995. Show these values on the diagram you drew for part 3.

Answer :

So g_{mt} = 10% for all t from 1995 onwards

To get u_{1995} and $\pi_{1995,}$ we have to solve the three equations provided simultaneously for 1995. These 3 equations are

Phillips Curve for 1995 : $\pi_{1995} = {}_{1994}\pi_{1995}^{e} + 5 - u_{1995}$

Okun's Law : $u_{1995} - u_{1994} = -g_{y1995}$

Aggregate Demand (in terms of growth rates) : $g_{y1995} = 10\% - \pi_{1995}$

We know that in 1994, the economy is still at the old medium run equilibrium (the one we calculated in part 1). And since the values of the inflation rate, unemployment rate and growth rate of output are determined in the middle of the year, before expectations have had a chance to adjust to the new growth rate of money, we have

${}_{1994}\pi_{1995}^{e} = \pi_{1994} = 6\%$

$u_{1994} = 5\%$

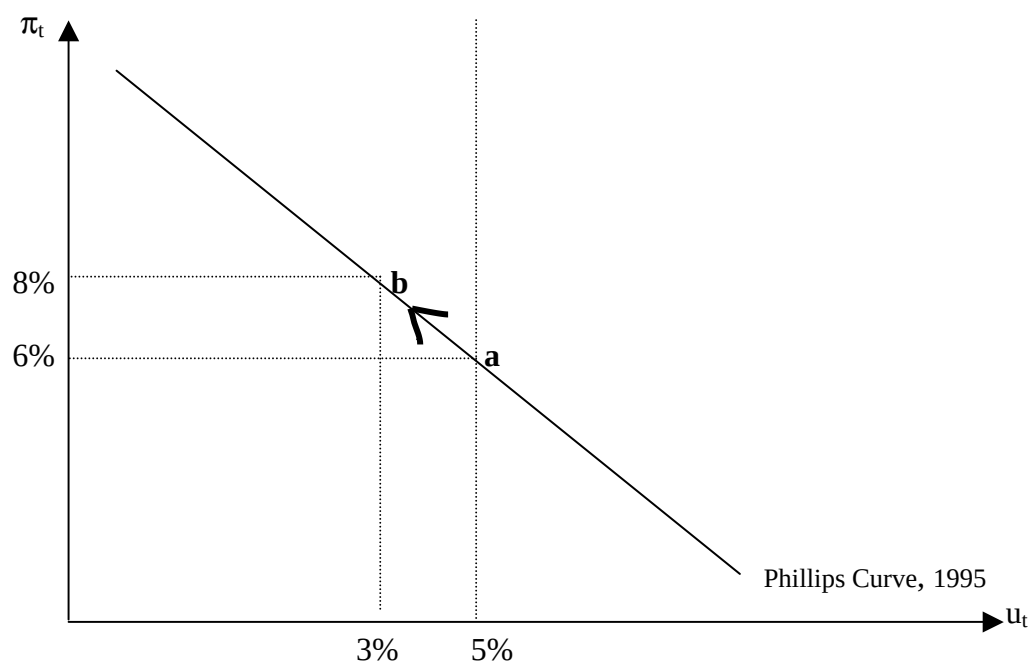
Putting these values into the above equations and solving we get

$\pi_{1995} = 8\%$

$u_{1995} = 3\%$

$g_{y1995} = 2\%$

So unemployment falls below the natural rate and inflation increases. Note carefully that the 1995 Phillips curve for the economy is the same as the 1994 Phillips curve. So the economy moves along this Phillips curve from **a** to **b**.



5. What are the unemployment and inflation rates in 1996? Show on the diagram where the economy is in the middle of 1996.

At the end of 1995, workers have a chance to revise their expectations. They had expected the 1995 inflation rate to be 6% but it turned out to be 8%. Since they have adaptive expectations they therefore set the expected inflation rate for 1996 to be 8%. This has the effect of **shifting up the Phillips curve**. The new Phillips curve is

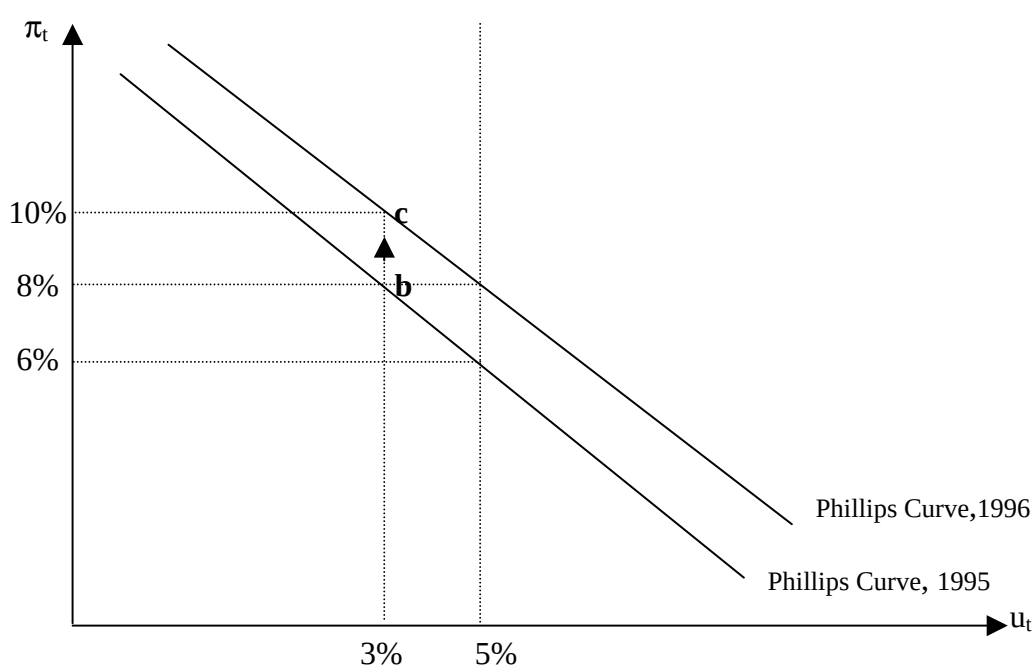
$\pi_{1996} = {}_{1995}\pi_{1996}^{e} + 5 - u_{1996} = 8 + 5 - u_{1996}$

Okun's Law is : $u_{1996} - 3 = -g_{y1996}$

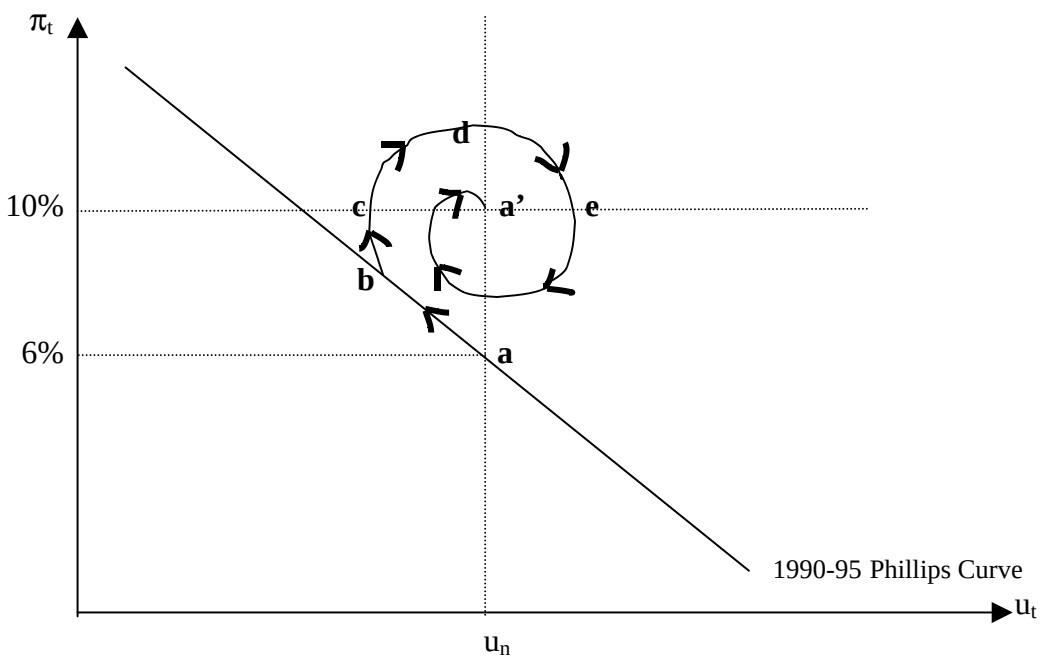
And the AD relation is the same as before. Solving these three equations simultaneously, we get

$\pi_{1996} = 10\%$
$u_{1996} = 3\%$
$g_{y1996} = 0\%$

So the inflation rate increases but the unemployment rate stays at its 1995 level. In the diagram below, the point (3,10) lies on a new Phillips curve. This new Phillips curve passes through (5,8) since if actual inflation is equal to expected inflation (which is 8% along this curve), then the corresponding unemployment rate must be the natural rate. Earlier the economy had moved from **a** to **b**. In 1996 it moves from **b** to **c**.



6. **(No math is required for this part – just provide word answers)** If you trace the evolution of the economy, you will find that the values (u_t, π_t) trace out the following **approximate** path from 1995 onwards.



The economy starts at **a** and moves along the path **abcdea'**. The new medium run equilibrium is at **a'**

(a) Consider the path **abc**. Along this path u_t is falling while π_t is rising. Intuitively why is u_t following this path?
(b) Consider the path **cde**. Along this path u_t is rising while π_t is first rising and then falling. Why does u_t continue to rise along this path? Why does π_t first rise and then fall?

(**Hint** : Think about what is happening to the real money supply along these paths)

Answer :

The reason the economy follows the path shown is that over time the Phillips curve keeps shifting, sometimes up and sometimes down, depending on what the actual inflation rate is, relative to the expected inflation rate.

(a) Along the path **abc**, the inflation rate is always less than the money growth rate which is 10% after the change. Therefore along **abc**, the real money supply is growing. Therefore output is growing (by the AD relations), and therefore the unemployment rate is falling (by Okun's law). As the unemployment rate falls, the inflation rate rises due to the Phillips curve relation but stays below 10% till the economy reaches point **c**.
(b) At point **c**, the inflation rate is equal to the money growth rate, but unemployment is still below its natural rate, so the inflation rate continues to rise. But now the inflation rate outstrips the money growth rate, so the real money supply is falling. Along **cd**, the real money supply falls, therefore output growth falls (by the AD relation), and the unemployment rate increases (by Okun's Law). At **d**, the unemployment rate is back to the natural rate, but inflation continues to be higher than the money growth rate. So the real money supply continues to fall, output growth continues to fall, and the unemployment rate continues to increase. But as soon as we are past **d**, the unemployment rate is greater than the natural rate, so now the inflation rate starts falling as well, and along the path **de**, the inflation rate, though falling, continues to be higher than the money growth rate, so output growth continues to fall, and the unemployment rate continues to increase.

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