
14.02 Principles of Macroeconomics

Problem Set 3 Solutions

Spring 2003

Part 1. True and False

- a) One of the reasons why the original Phillips curve vanished is that the U.S. was hit twice in the 70s by a large increase in oil prices. **True**
- b) One of the reasons why the original Phillips curve vanished in the U.S. is that the wage setters changed the way they form their expectations. **True**
- c) The natural rate of unemployment is also called NAIRU because it is the rate of unemployment required to keep output constant. **False**
- d) The modified Phillips curve captures well the aggregate supply relation in the U.S. today. **True**
- e) The modified Phillips curve captures well the aggregate demand relation in the U.S. today. **False**
- f) If expected inflation is well approximated by last year's inflation then unemployment above its natural rate leads to an increase in inflation. **False**
- g) Changes in the rate of growth of money have no effect on output or unemployment in the medium run, but are reflected one for one in changes in the rate of inflation. **True**
- h) Disinflations typically lead to higher unemployment for some time. **True**
- i) Faster disinflations are associated with smaller sacrifice ratios.
False (in the model) True (empirically)

Part 2. Macronesia After the War

In the last problem set, (PS2), Macronesia embarked into conquering half of the rest of the world. Well, it didn't work.

A. Phillips Curve

The wage is set following $W = P^e(1 - 0.5u)$.

Macronesia's economy is based on coconut production (it is also the only consumption good of macronesians). Firms charge a price per coconut which is equal to one plus a markup times the cost of paying a macnesian to climb up a tree and collect a coconut. Let the markup be 1.

But, even after being tricked by their government into war, macnesian people are still very naïve. They believe the government will stop inflation every year, and expect an inflation rate of zero percent.

1) Derive the original Phillips curve for Macronesia (Hint : use the approximation that $\log(1+x)=x$ for x small or a Taylor approximation)

The Wage Setting equation:

$$W = P^e(1 - 0.5u)$$

Substituting into the Price Setting equation:

$$P = 2 P^e(1 - 0.5u)$$

Here you could do many things.. This is one way of getting the Phillips curve:

$$\log(P_t/P_{t-1}) = \log 2 + \log P_t^e/P_{t-1} + \log(1-0.5u_t)$$

Now, $P_t/P_{t-1} = 1 + \pi_t$ and $P_t^e/P_{t-1} = 1 + \pi_t^e$. Using the approximation $\log(1+x)=x$ and the fact that for the original Phillips Curve $\pi_t^e = 0$ we get :

$$\pi_t = \log 2 - 0.5 u_t$$

As of today, to be able to finance its expenses and the reconstruction of the military, the macnesian government is printing money at a rate of 50% a year.

2) Do you expect the original Phillips curve to still hold for Macronesia? Explain.

No, inflation expectations won't be zero anymore. The systematic increases in the money supply will generate persistent inflation, and hence macnesians will adjust their expectations once they see that inflation is constantly different from what they had expected (i.e. zero).

Suppose that Macnesians finally understand (to their surprise) that inflation is not always zero. From this insight, they start to expect prices to increase in the future at the same rate they increased in the past.

3) Derive the modified Phillips curve for Macronesia.

Proceeding as in part 1 we have that

$$\log (P_t/P_{t-1}) = \log 2 + \log P_t^e/P_{t-1} + \log(1-0.5u_t)$$

Now, we assume that $\pi_t^e = \pi_{t-1}$ and we obtain the modified Phillips Curve :

$$\pi_t - \pi_{t-1} = \log 2 - 0.5 u_t$$

4) What is the NAIRU rate for Macronesia? Why is it called NAIRU?

The NAIRU is given by $0 = \log 2 - 0.5 u_n \Rightarrow u_n = 2 \log 2$

It's called NAIRU because it is the unemployment rate at which inflation does not change. Notice that we can rewrite the modified Phillips curve as :

$$\pi_t - \pi_{t-1} = \log 2 - 0.5 u_t = 0.5 u_n - 0.5 u_t$$

$$\pi_t - \pi_{t-1} = -0.5 (u_t - u_n)$$

So when $\pi_t - \pi_{t-1} = 0$ we have $u_t = u_n$.

B . Inflation and Money Growth

1) What is the medium run unemployment rate?

Medium run unemployment is u_n . Remember that the medium run is characterized when expectations coincide with actual realizations, in our case is when $\pi_t^e = \pi_t$. Using the Phillips curve we have that unemployment is at the NAIRU (or at its natural rate).

Finally, after observing the bad state of their economy, macronesians decide to elect a new government. The new government wants to reduce the inflation rate from the current medium run level of 50% to 0% over 10 years, starting in year 1. (They want to reduce inflation by equal amounts every year).

2) Start from the desired path of inflation and find the required path of unemployment.

Desired path of inflation

Year	0	1	2	3	4	5	6	7	8	9	10	11	12
<i>π path</i>	50	45	40	35	30	25	20	15	10	5	0	0	0
<i>U path</i>	u_n	$u_n + 10$	$u_n + 10$	$u_n + 10$	$u_n + 10$	$u_n + 10$	$u_n + 10$	$u_n + 10$	$u_n + 10$	$u_n + 10$	$u_n + 10$	u_n	u_n

To compute the unemployment path we have that

$$\pi_t - \pi_{t-1} = -0.5 (u_t - u_n)$$

Solving out for unemployment:

$$u_t = u_n + 2 (\pi_{t-1} - \pi_t)$$

Once we have the desired inflation path, we can easily compute the associated unemployment rate.

3) What is the total unemployment cost of the disinflation experience (in terms of the number of point-years of excess of unemployment)?

$$\text{Point-years of excess} = \text{Sum over all years of } (u_t - u_n) = 100.$$

$$\text{Sacrifice ratio} = \text{point-years of excess} / \text{total change in inflation} = 100/50 = 2$$

4) Can you find a desired inflation path that does better in achieving a lower total unemployment cost with the same reduction in inflation? (you don't need to answer with math).

No, they will all add up to the same point-years of excess unemployment.

Suppose now that 10% of macronesian firms are indexing their workers' contracts to inflation. Now, the wages of these workers increase one by one with inflation; while the rest of the workers set their wages as before.

5) What is the new Phillips curve? What would be the total unemployment cost of the disinflation experience previously exposed?

The new Phillips curve is

$$\pi_t = [.10 \pi_t + .9 \pi_{t-1}] - 0.5 (u_t - u_n)$$

$$\pi_t - \pi_{t-1} = -0.5/.9 (u_t - u_n)$$

$$\pi_t - \pi_{t-1} = -0.555 (u_t - u_n)$$

$$\text{Sacrifice ratio} = 1/0.555 = 1.8$$

$$\text{Point-years of excess unemployment} = \text{Sacrifice ratio} * \text{total change in inflation} = 90$$