14.02 Principles of Macroeconomics
Problem Set 4 Solutions

Fall 2017

Question 1 (Chapter 7)

Using the information in Chapter 7 or the slides from Lecture 7, label each of the following statements as True, False, or Uncertain and briefly explain (max 1 paragraph each).

(a)

Since 1950, the participation rate in the US has remained roughly constant at 60%.
  Solution: FALSE
  The participation rate has steadily increased in the US over the past 70 years, mostly reflecting the entry of women in the labor force.

(b)

Each month, the flows into and out of employment are very small (less than 1%) compared to the size of the labor force.
  Solution: FALSE
  The flows of workers in and out of employment are rather large each month (see figure 7-2 in the book)

(c)

Fewer than 10% of all unemployed workers exit the unemployment pool each year, either to become employed or to exit the labor force.
  Solution: FALSE
  The average duration of unemployment is between 2-3 months in the US, so most workers flow out of unemployment within the year.

(d)

The unemployment rate tends to be high in recessions and low in expansions.
  Solution: TRUE/UNCERTAIN both acceptable.
  While a high unemployment rate during a recession is rather frequently observed, there may be prolonged times of relatively high unemployment a few after a recession, due to the generally slow recovery of the unemployment rate.

(e)

Most workers are typically paid their reservation wage.
  Solution: FALSE/UNCERTAIN both acceptable.
  Most workers are paid a salary above their reservation wage. Nevertheless, it is empirically very hard to observe and quantify a reservation wage so it is acceptable to be agnostic about this.

(f)

Workers who do not belong to unions have no bargaining power.
Solution: UNCERTAIN
The idea is that, individually, a worker may have bargaining power if her skills are highly valued by the firm. Of course, this is not the case for many workers, especially the least qualified ones.

(g)

It may be in the best interest of employers to pay workers above their reservation wage.
Solution: TRUE
This is the so-called theory of efficiency wages, stating that employers find it more profitable to retain a worker and avoid frequently resorting to posting a vacancy and having high workers turnover. This might be also to spur higher productivity from employees.

(h)

The natural rate of unemployment is invariant to any policy interventions.
Solution: FALSE
Policies affecting the labor market will impact its efficiency and functioning (captured in the model by the variable z) will generally affect the natural unemployment rate, while other will not (such as temporary changes in government spending.

Question 2 (Chapter 8)

Suppose the Phillips Curve is given by:

$$\pi_t - \pi_t^e = .1 - 2u_t$$

where:

$$\pi_t^e = \pi_{t-1}$$

Suppose that inflation in year $t - 1$ is zero. In year t, the Central Bank decides to keep the unemployment rate at 4% forever.

[Hint: here the assumption is that wages are not indexed. This explains why we assume $\pi_t^e = \pi_{t-1}$.]

(a)

Compute the inflation rates for years t, $t + 1$, $t + 2$, and $t + 3$.

Solution:

$$\pi_t = \pi_{t-1} + .1 - 2u_t = 0 + .1 - 2(.04) = 2\%$$

$$\pi_{t+1} = \pi_t + .1 - 2u_{t+1} = .02 + .1 - 2(.04) = 4\%$$

$$\pi_{t+2} = \pi_{t+1} + .1 - 2u_{t+2} = .04 + .1 - 2(.04) = 6\%$$

$$\pi_{t+3} = \pi_{t+2} + .1 - 2u_{t+3} = .06 + .1 - 2(.04) = 8\%$$

(b)

Now suppose that half of the workers have indexed labor contracts. Nominal wages in those contracts move one-for-one with variations in the actual price level. What is the new equation for the Phillips Curve?

Solution: The reason π_t^e shows up in our PC equation is because wage contracts are set before actual inflation is known. For those contracts that are indexed, then, wages will depend on actual, rather than expected, inflation. We can modify the PC equation as follows:

$$\pi_t = .5\pi_t + .5\pi_t^e + .1 - 2u_t$$

which becomes:

$$\pi_t - \pi_t^e = .2 - 4u_t$$

(c)

Based on your answer to subpoint (b), compute the inflation rates for years t, $t + 1$, $t + 2$, and $t + 3$.

Solution:

$$\pi_t = \pi_{t-1} + .2 - 4u_t = 0 + .2 - 4(.04) = 4\%$$

$$\pi_{t+1} = \pi_t + .2 - 4u_{t+1} = .04 + .2 - 4(.04) = 8\%$$

$$\pi_{t+2} = \pi_{t+1} + .2 - 4u_{t+2} = .08 + .2 - 4(.04) = 12\%$$

$$\pi_{t+3} = \pi_{t+2} + .2 - 4u_{t+3} = .12 + .2 - 4(.04) = 16\%$$

(d)

Discuss briefly the impact of wage indexation on the relation between π and u and compare your answers to (a) and (c) above.

Solution: Wage indexation leads to a stronger response of inflation to unemployment. The intuition is as follows. Without wage indexation, lower unemployment increases wages, which in turn leads to higher prices. But because wages don't respond to prices right away, there are no further changes to prices within the year. With wage indexation, an increase in prices leads to a further increase in wages within the year, which leads to a further increase in prices, and so on.

Question 3 (Chapter 8)

For this question, refer to the data in Table 1.

Table 1 The Nominal Interest Rate, Inflation, and the Real Interest Rate, 1929–2033

Year	Unemployment Rate (%)	Output Growth Rate (%)	One-Year Nominal Interest Rate (%), i	Inflation Rate (%), π	One-Year Real Interest Rate (%), r
1929	3.2	−9.8	5.3	0.0	5.3
1930	8.7	−7.6	4.4	−2.5	6.9
1931	15.9	−14.7	3.1	−9.2	12.3
1932	23.6	−1.8	4.0	−10.8	14.8
1933	24.9	9.1	2.6	−5.2	7.8

Assume there is a constant Phillips Curve

$$\pi_t - \pi_t^e = -\alpha \left(u_t - u_n \right)$$

throughout the period.

(a)

If inflation expectations are always equal to zero, what would the natural rate of unemployment be using data from 1929?

Solution:

$$u_{1929} = 3.2\%$$

$$\pi_{1929} = 0\%$$

Hence:

$$u_n = 3.2\%$$

Note that this holds irrespectively of the value of α!

(b)

Is setting $\pi_t^e = 0$ for all years between 1929 and 1933 consistent with the data we observe? In other words, does it seem like a plausible assumption?

Solution: No, clearly inflation expectations cannot be systematically wrong, and are usually formed looking at recent realizations of inflation. Therefore, a more cogent assumption would be that π^e were on average negative at least starting from 1930.

(c)

Assume $\pi_{1929}^e = 0$ and $\pi_{1930}^e = -1\%$. What is u_n? What is the value of α?

Solution: from subpoint (a) we know that it must be $u_n = 3.2\%$, irrespectively of α, if $\pi_{1929}^e = 0$. Given that, we can easily compute a value for α using the Phillips Curve in 1930:

$$-2.5\% - (-1\%) = -\alpha \left(8.7\% - 3.2\% \right)$$

Which gives us:

$$\alpha = \frac{2.5\% - 1\%}{8.7\% - 3.2\%} \approx 0.27$$

(d)

Using the Phillips Curve you derived in (c) above, find the levels of expected inflation in 1931, 1932, 1933. What does this lead you to conclude about the assumption that the natural rate of unemployment remained constant throughout the Great Depression?

Solution: Consider the PC and rearrange it as follows:

$$\pi_t^e = \alpha \left(u_t - u_n \right) + \pi_t$$

Therefore:

$$\pi_{1931}^e \approx 0.27 \left(15.9\% - 3.2\% \right) + \left(-9.2\% \right) \approx -5.77\%$$

$$\pi_{1932}^e \approx 0.27 \left(23.6\% - 3.2\% \right) + \left(-10.8\% \right) \approx -5.29\%$$

$$\pi_{1933}^e \approx 0.27 \left(24.9\% - 3.2\% \right) + \left(-5.2\% \right) \approx 0.66\%$$

Clearly, as the expected inflation is consistently way above the realized inflation, we conclude that the natural rate of unemployment must have been **higher** *than what it was in 1929.*

(e)

If the expected level of inflation had remained anchored at the actual value of inflation in 1929, would the Great Depression have been more or less severe? Using the same Phillips Curve you derived in c, write down the unemployment rates for all the years from 1929 to 1933 for the case in which inflation expectations were always equal to π_{1929}.

Solution: Consider the PC and rearrange it as follows:

$$u_t = u_n + \frac{\pi_t^e - \pi_t}{\alpha}$$

Therefore:

$$u_{1929} \approx 3.2\% + \frac{0\% - 0\%}{0.27} = 3.2\%$$

$$u_{1930} \approx 3.2\% + \frac{0\% - (-2.5\%)}{0.27} \approx 12.5\%$$

$$u_{1931} \approx 3.2\% + \frac{0\% - (-9.2\%)}{0.27} \approx 37.3\%$$

$$u_{1932} \approx 3.2\% + \frac{0\% - (-10.8\%)}{0.27} \approx 43.2\%$$

$$u_{1933} \approx 3.2\% + \frac{0\% - (-5.2\%)}{0.27} \approx 22.5\%$$

The Great Depression would have been **more severe** *in all years but 1933. This is because the expected inflation would have been much higher than realized inflation compared to the previous subpoint, so that the inflation surprise would in turn have been more negative, and this would have pushed unemployment even higher.*