Class Outlines
October 23 and October 25, 2001

October 23, 2001

I. Review

II. The relationship between prices and unemployment.

a. Recall, in chapter 7 we learned that if an economy is operating below full employment, monetary authorities can increase the money supply. We saw that although there was no impact on output relative to what we would see in the medium run, the immediate affects were higher output and higher prices. Recall that if output increases, unemployment decreases. This suggests that there may a tradeoff between higher prices and unemployment. We explore this relationship in chapter 8.

b. Recall that the aggregate supply relationship was given as follows:
   i. $P_t=P_t^e(1+\phi)f(u_t,z)$.
   ii. If we let $f(u_t,z)=1-\alpha u_t+z$, then the aggregate supply relationship becomes:
      1. $P_t=P_t^e(1+\phi)(1-\alpha u_t+z)$.
   iii. Our goal is to compare inflation to unemployment. Inflation is the growth rate of prices, $(P_t-P_{t-1})/P_{t-1}$. With some math (and the use of the appendix at the end of chapter 8), we can rearrange the above aggregate supply relationship to yield the following:
      1. $\pi_t= \pi_t^e+(\phi+z)-\alpha u_t$
      2. The above is also known as the modern view of the Phillips curve. It has the following implications.
         a. A higher expected inflation rate leads to higher inflation. As expected prices increase, expected inflation increases. Similarly for actual inflation. We know that as expected prices rise, wages increase. As wages increase, employers increase the price of their products. This implies that as expected inflation increases actual inflation increases.
         b. Given expected inflation, as the markup over costs increase (or as z increases) inflation increases.
         c. Given expected inflation, a higher rate of unemployment causes inflation to decline.

c. Some background (the Traditional view of the Phillips curve).

1. The Phillips curve was originally developed by A.W. Phillips in 1958. Phillips noticed an inverse relationship between inflation and unemployment in the United Kingdom from 1861 to 1957. In the United States, a similar relationship existed up until the 1960's. Prior to 1955, it was not uncommon to observe an inflation rate that was negative. In some periods inflation was positive and in some periods it was negative. In general, the average inflation rate was around 0. A rational assumption, then, is that during this period, expected inflation is equal to zero. If this is true, then the modern view of the Phillips curve can be written as follows:
2. $\pi_t = \pi_t^e + (\phi + z) - \alpha u_t$, and since $\pi_t^e = 0$,
    a. Traditional View: $\pi_t = (\phi + z) - \alpha u_t$
    b. *The wage price spiral*: As unemployment falls, employees demand higher wages. As wages increase, employers increase the price of their products. As the price of goods and services increase, expected prices increase, and employees demand higher wages. As employees demand higher wages employers increase their prices, and so on and on…..

d. The break down of the Phillips curve.
    i. As alluded to above, the relationship between inflation and unemployment held very well up until the 1960's. Since 1970, however, the relationship has completely fallen apart. In other words, during some periods, inflation and unemployment may both be high, or during other periods inflation and unemployment may both be low. Since 1970, there has not been a discernable relationship between inflation and unemployment.
        1. Why?
            a. From the traditional view of the Phillips curve, if the markup over prices increases (such as it did during the 1970's) then it is not clear that an increase in inflation will be associated with a decrease in unemployment. In fact, it could be possible for inflation to increase without any decline in unemployment if markup over costs increase.
            b. Since 1955, annual inflation has been positive for each and every year. The assumption of a zero inflation rate is non-sensical. It is more

likely, the people base their expectations on previous inflation. We write:

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

c. The modern view of the Phillips curve (replacing expected inflation with our expression above) becomes,
   i. $\pi_t=\theta\pi_{t-1}+(\phi+z)-\alpha u_t$
      1. If $\theta=0$, we get the traditional view of the Phillips curve.
      2. If $\theta=1$, we get the following Phillips curve:
         a. $\pi_t=\pi_{t-1}+(\phi+z)-\alpha u_t$

e. The modern view of the Phillips curve and the natural rate of unemployment.
   i. If we are at full employment, then the expected inflation rate and actual inflation rate are equal. The modern view of the Phillips curve becomes:
      1. $\pi_t=\pi_t+(\phi+z)-\alpha u_N$, where u_N is the natural rate of unemployment. Thus, $(\phi+z)-\alpha u_N=0$. Thus, $(\phi+z)=\alpha u_N$. This implies that the natural rate of unemployment is determined by markup over costs and z. We can replace $(\phi+z)$ with αu_N in the modern view of the Phillips curve to yield the following:
         a. $\pi_t=\pi_{t-1}+\alpha u_N-\alpha u_t$. This implies,
         b. $\pi_t-\pi_{t-1}=-\alpha(u_t-u_N)$.
            i. Case 1: if $u_t>u_N$ since $\alpha>0$, the current rate of inflation must be lower than inflation last period.
            ii. Case 2: if $u_t<u_N$ since $\alpha>0$, the current rate of inflation must be greater than inflation last period.
            iii. Case 3: if $u_t=u_N$ the current rate of inflation must be equal to inflation last period. Since inflation is not increasing (or accelerating) at this unemployment rate, we call the natural rate of unemployment the non-accelerating inflation rate of unemployment.

October 25, 2001

I. Review

II. Limitations of Phillips curve analysis.

a. Although the aggregate supply relationship can be captured rather well by Phillips curve methodology, there are several warnings.
    i. How are expectations formed? We have assumed that the expected inflation rate is simply equal to last period's inflation rate. This is fine when inflation is relatively constant. Consider the implications of your problem set. (Question 3b). If done correctly, you get the following inflation path.
        1. Year 0: $\pi_0^e=0$, $\pi_0=0$.
        2. Year 1: $\pi_1^e=0$, $\pi_1=4\%$
        3. Year 2: $\pi_2^e=4\%$, $\pi_2=8\%$
        4. Year 3: $\pi_3^e=8\%$, $\pi_3=12\%$
        5. Year 100: $\pi_{100}^e=396\%$, $\pi_{100}=400\%$
            a. The above implies that agents consistently underestimate inflation. Agents that use last period's inflation rate as the expected inflation rate are said to have *adaptive expectations.* Agents that possess adaptive expectations will consistently underestimate inflation during inflationary periods.
    ii. Rational expectations. Agents are said to possess *rational expectations,* if on average, they correctly anticipate the inflation rate. In other words, if agents possess rational expectations, $\pi_t^e=\pi_t$. Notice, from the modern view of the Phillips curve, that we can not impact unemployment by changing inflation.
    iii. The assumption that consumers possess either adaptive expectations or rational expectations is too restrictive. Likely, it is something in between these views. What is important to realize, is that the only thing that causes a decline in unemployment is a positive difference between the actual inflation rate and the expected inflation rate. Thus, if a policy objective is a decrease in unemployment, then policy makers face the incentive of increasing inflation beyond what agents anticipated.

b. Wage contracting.
    i. To this point, we have assumed that all wage contracts are determined by the wage setting equation in which wages are a function of the expected price level. We know that employers gain when actual prices exceed expected prices (since employers pay employees based on expected prices). We also know that employers lose when actual prices are below expected prices. Because employees and employers can be harmed by inflation rates that differ from expected inflation rates, there may be a desire to base pay on the actual inflation rate rather than expected inflation.

1. Wage indexing. Suppose a proportion of all wage contracts are based on current inflation (nominal wages are adjusted in light of changing prices). Denote this proportion by λ. Note, only $(1-\lambda)$ percent of all contracts are based on the expected inflation rate. The wage index adjusted Phillips curve becomes:
    a. $\pi_t=[\lambda\pi_t+(1-\lambda)\pi_t^e]-\alpha(u_t-u_N)$.
        i. or, $\pi_t-\lambda\pi_t=(1-\lambda)\pi_t^e-\alpha(u_t-u_N)$
        ii. or, $(1-\lambda)\pi_t=(1-\lambda)\pi_t^e-\alpha(u_t-u_N)$
        iii. or, $\pi_t=\pi_t^e-[\alpha/(1-\lambda)](u_t-u_N)$.
        iv. if $\pi_t^e=\pi_{\tau-1}$, we get the following:
            1. $\pi_t-\pi_{t-1}=-[\alpha/(1-\lambda)](u_t-u_N)$
    b. The above implies that for a given decrease in unemployment (below the natural rate), we must increase inflation by an even larger amount than we would need to under the no-indexing case. We must increase inflation by even more, because only a fraction of all wage contracts are subject to differences in expected inflation and actual inflation.

c. Changes in the natural rate of unemployment over time and across country.
    i. Above, we replaced (ϕ+z) with αu_N. This implies that $u_N=(\phi+z)/\alpha$. We have treated the natural rate of unemployment as though it were constant across countries and time. However, this is unlikely to hold true. Recall that during the 1970's oil prices ballooned and as a result the firm's markup over cost increased. This caused the natural rate of unemployment to climb. In addition, the factors that constitute z (such as unemployment compensation and skill levels) are likely to be different across countries. Thus, when talking about the natural rate of unemployment, it is more precise to recognize that it likely changes over time and across countries.