Class Outlines
November 13 and November 15, 2001

November 13, 2001

I. Review: Discussion of economic relationships relevant to disinflation policy:

a. Okun's Law: $u_t-u_{t-1}=-\beta(\Delta Y_t-\Delta Y^*)$
   i. For United States: $u_t-u_{t-1}= -.4(\Delta Y_t-3\%)$
b. Phillip's Curve: $\pi_t-\pi_{t-1}= -\alpha(u_t-u_N)$
   i. For United States: $\pi_t-\pi_{t-1}= -(u_t-6.5\%)$
c. Aggregate Demand Relationship: $\Delta Y_t=\Delta M_t-\pi_t$

II. A disinflation policy continued:

a. Suppose that the United States has an inflation rate equal to 20% in 2000, and monetary authorities decide to lower it to 5%. From the Phillip's curve, we know that the only way this can be done is through a higher unemployment rate (relative to the natural rate of unemployment). To achieve a higher than natural unemployment rate, monetary authorities will slow down the growth rate of the money supply. This will cause interest rates to increase, thereby slowing down investment in homes, cars, etc. As such output growth declines we move into a recession. The recession is associated with lower prices and lower output. Let's see exactly how a disinflation policy works according to our assumptions:
   i. The sacrifice ratio gives us the number of point years of excess unemployment that must be endured to decrease inflation by 1%. This is given by $1/\alpha$. This is equal to 1/1 in our case, and thus for each percentage decrease in inflation, we must endure 1 point year of excess unemployment. For a 15 pt drop in inflation, we must endure 15 point years of excess unemployment. Suppose we decide to do this evenly over 5 years bearing 3 point years of excess unemployment per year.
   ii. **2000**: (these are given):
      1. $\pi_t=20\%$
      2. $\pi_t^e=\pi_{t-1}=20\%$
      3. $u_t=6.5\%$
      4. $\Delta y_t=3\%$.
      5. From AD relationship: $\Delta M_t=\Delta Y_t+\pi_t=20\%+3\%=23\%$
   iii. **2001**: We want to decrease inflation by 3% to 17%.
      1. **Phillip's Curve:**
         a. $\pi_{2001}=\pi_{2000}-(u_{2001}-6.5\%)=>$
            $17\%=20\%-(u_{2001}-6.5\%)=>$
            $u_{2001}=9.5\%$

2. **Okun's Law:**
    a. $u_{2001}-u_{2000}=-.4(\Delta Y_{2001}-3\%)=>$
       $9.5\%-6.5\%=-.4\Delta Y_{2001}+1.2\%=>$
       $1.8\%=-.4\ \Delta Y_{2001}=>\ \Delta Y_{2001}=-4.5\%$
3. **Aggregate demand Relationship**:
    a. $\Delta Y_{2001}=\Delta M_{2001}-\pi_{2001}=>$
       $-4.5\%=\Delta M_{2001}-17\%=>\Delta M_{2001}=12.5\%$
4. Description of 2001:
    a. First, from the Phillip's curve relationship, we want to decrease inflation by 3% in 2001. To do this, we must increase the unemployment rate by 3% above the natural rate.
    b. In 2000, the unemployment rate was at 6.5%. Now in 2001, we desire an unemployment rate of 9.5%. This represents a change of 3% from 2000 to 2001. To increase unemployment by 3%, we need output to fall. Thus, output growth falls by 4.5%.
    c. All of the above is accomplished by slowing down the growth rate in the money supply. Given negative economic growth and less inflation, money growth contracts to 12.5%.

iv. 2002:
1. **Phillip's Curve:**
    a. $\pi_{2002}=\pi_{2001}-(u_{2002}-6.5\%)=>$
       $14\%=17\%-(\ u_{2002}-6.5\%)=>$
       $u_{2001}=9.5\%$
2. **Okun's Law:**
    a. $u_{2002}-u_{2001}=-.4(\Delta Y_{2002}-3\%)=>$
       $9.5\%-9.5=-.4(\Delta Y_{2002}-3\%)=>$
       $\Delta Y_{2002}=3\%\%$
3. **Aggregate demand Relationship**:
    a. $\Delta Y_{2002}=\Delta M_{2002}-\pi_{2002}=>$
       $3\%=\Delta M_{2002}-14\%=>\Delta M_{2002}=17\%$
4. Description of 2002:
    a. Again, the same that was true for the Phillip's curve relationship in 2001 is true in 2002.
    b. Notice in 2002, the unemployment rate has not changed relative to 2001. You should recall that we defined the normal growth rate of output as the output rate at which unemployment was not growing. Thus, it makes since that the growth rate of output in 2002 is equal to 3%, the normal growth rate of output.
    c. Notice our desire is an increase in output growth and a decrease in inflation. We want output

growth to increase from –4.5% to 3% or by 7.5%. We want inflation to fall by 3%. We must allow money growth to increase, but only by the difference between the increase in output growth and the decline in inflation. Thus, we allow money growth to increase by 4.5% from 12.5% to 17%.

v. **2003**

1. **Phillip's Curve:**
   a. $\pi_{2003}=\pi_{2002}-(u_{2003}-6.5\%)=>$
      $11\%=14\%-(u_{2003}-6.5\%)=>$
      $u_{2003}=9.5\%$
2. **Okun's Law:**
   a. $u_{2003}-u_{2002}=-.4(\Delta Y_{2003}-3\%)=>$
      $9.5\%-9.5=-.4(\Delta Y_{2003}-3\%)=>$
      $\Delta Y_{2003}=3\%$
3. **Aggregate demand Relationship**:
   a. $\Delta Y_{2003}=\Delta M_{2003}-\pi_{2003}=>$
      $3\%=\Delta M_{2003}-11\%=>\Delta M_{2003}=14\%$
4. Description of 2003.
   a. The same interpretation holds for the Phillip's curve.
   b. The same interpretation hold for Okun's law.
   c. In 2003, output growth remains constant. Thus, there will be no need to increase money growth to allow for an increase in the transactions necessitated when output grows at a faster rate. Since we want inflation to fall, we allow the growth rate in the money supply to drop from 14% to 11%.

vi. 2004:

1. **Phillip's Curve:**
   a. $\pi_{2004}=\pi_{2003}-(u_{2004}-6.5\%)=>$
      $8\%=11\%-(u_{2004}-6.5\%)=>$
      $u_{2004}=9.5\%$
2. **Okun's Law:**
   a. $u_{2004}-u_{2003}=-.4(\Delta Y_{2004}-3\%)=>$
      $9.5\%-9.5=-.4(\Delta Y_{2004}-3\%)=>$
      $\Delta Y_{2004}=3\%$
3. **Aggregate demand Relationship**:
   a. $\Delta Y_{2004}=\Delta M_{2004}-\pi_{2004}=>$
      $3\%=\Delta M_{2004}-8\%=>\Delta M_{2004}=11\%$
4. Description of 2004.
   a. The same interpretation holds for the Phillip's curve.
   b. The same interpretation hold for Okun's law.

c. The same interpretation as above holds for the aggregate demand relationship. For example, in 2004 we want inflation to fall by 3% with no associated increase in output growth. Thus, we must allow money growth to fall by 3%.

vii. 2005:

1. **Phillip's Curve:**
   a. $\pi_{2005}=\pi_{2004}-(u_{2005}-6.5\%)=>$
      $5\%=8\%-(u_{2005}-6.5\%)=>$
      $u_{2005}=9.5\%$
2. **Okun's Law:**
   a. $u_{2005}-u_{2004}=-.4(\Delta Y_{2005}-3\%)=>$
      $9.5\%-9.5=-.4(\Delta Y_{2005}-3\%)=>$
      $\Delta Y_{2005}=3\%$
3. **Aggregate demand Relationship**:
   a. $\Delta Y_{2005}=\Delta M_{2005}-\pi_{2005}=>$
   $3\%=\Delta M_{2005}-5\%=>\Delta M_{2005}=8\%$
4. Description of 2005.
   a. The same interpretation holds for the Phillip's curve.
   b. The same interpretation hold for Okun's law.
   c. The same interpretation as above holds for the aggregate demand relationship. For example, in 2005 we want inflation to fall by 3% with no associated increase in output growth. Thus, we must allow money growth to fall by 3%.

viii. 2006.

1. **Phillip's Curve**
   a. $\pi_{2006}=\pi_{2005}-(u_{2006}-6.5\%)=>$
      $5\%=5\%-(u_{2006}-6.5\%)=>$
      $u_{2005}=6.5\%$
2. **Okun's Law:**
   b. $u_{2006}-u_{2005}=-.4(\Delta Y_{2006}-3\%)=>$
      $6.5\%-9.5=-.4(\Delta Y_{2006}-3\%)=>$
      $-3\%=-.4(\Delta Y_{2006}-3\%)=>$
      $7.5\%=\Delta Y_{2006}-3\%=>\Delta Y_{2006}=10.5\%$
3. **Aggregate demand Relationship**:
   a. $\Delta Y_{2006}=\Delta M_{2006}-\pi_{2006}=>$
   $10.5\%=\Delta M_{2006}-5\%=>\Delta M_{2006}=15.5\%$

4. Description of 2006:
   a. Phillip's Curve: We have now accomplished our goal of decreasing inflation to 5%. Thus, there is no need to allow inflation to decrease any longer. Since inflation does not decrease,

we return to full employment. Thus, the unemployment becomes the natural rate of unemployment.

b. Okun's Law: The unemployment rate has declined from 9.5% to 6.5%. For unemployment to decline, output must expand. Thus, output growth increases above the normal rate to allow expansion.

c. Aggregate demand: Because we desire output growth to expand, without any accompanying decline in inflation, we must allow money growth to increase.

ix. 2007:

1. Phillip's Curve

a. $\pi_{2007}=\pi_{2006}-(u_{2007}-6.5\%)=>$
$5\%=5\%-(u_{2007}-6.5\%)=>$
$u_{2007}=6.5\%$

2. Okun's Law

a. $u_{2007}-u_{2006}=-.4(\Delta Y_{2007}-3\%)=>$
$6.5\%-6.5\%=-.4(\Delta Y_{2007}-3\%)=>$
$0\%=-.4(\Delta Y_{2007}-3\%)=>$
$0\%=\Delta Y_{2007}-3\%=>\Delta Y_{2007}=3\%$

3. **Aggregate demand Relationship**:

a. $\Delta Y_{2007}=\Delta M_{2007}-\pi_{2007}=>$
$3\%=\Delta M_{2007}-5\%=>\Delta M_{2007}=8\%$

4. Description of 2007:

a. Phillip's curve: Same explanation as above.

b. Okun's Law: Now the unemployment rate does not change between 2006 and 2007, and we are able to return to the normal growth rate of output.

c. Aggregate demand relationship: Output growth again slows from 10.5% to 3%. Less money growth is needed, and hence money growth declines as well. We are now back in the medium run. The economy has had a chance to adjust to all policy decisions, and we arrive at a situation where the growth rate in the money supply is equal to 8%. Compare this to the picture when we were previously in the medium run. Then, money growth stood at 23%. The analysis indicates that a decline in inflation (relative to the medium run) is accomplished by a policy that effectively decreases the growth rate in the money supply.

III. Challenges to the traditional view:

a. The above indicates that the unemployment rate must be increased (by a factor given to us through the constant sacrifice ratio) by a constant amount to decrease inflation. There are at least two schools of thought that would challenge the "traditional approach".

b. The Lucas critique: Above, we have held economic relationships constant over time. Notice that we have exactly the same Phillip's curve relationship in 2000 (when no policy has been implemented) as we do in 2004 (when the Federal Reserve pursues a disinflationary policy). The Lucas critique contends that economic relationships can and do change in the face of changing policy. Let's look at this more in depth.
    a. Suppose the Federal Reserve announces a disinflation policy in which they indicate they will decrease inflation by 3% over the next 5 years. Inflation will fall each and every year relative to the previous year. In spite of this, agents in the economy will expect an inflation rate equal to last year's inflation rate. They will overestimate inflation every year, although they have information that inflation will fall. Lucas would contend that this is foolish. Notice, that if agents were perfectly rational, and correctly predicted the decline in the inflation each and every period, then the unemployment rate would not need to increase at all. This is a simplistic view, but generally, people in the economy will probably be more accurate in their assessment of inflation than the view above (also known as adaptive expectations) would imply. What is really important is credibility:
        i. Credibility. Recall, that expectations are crucial to our analysis. When the expected inflation rate is lower than the actual inflation rate, unemployment declines. The Federal Reserve can accomplish such a feat by convincing people that money growth will be relatively small. Then, the Fed can increase money growth and catch people off guard. There is some incentive for the Federal Reserve to "trick" people. Notice what happens then, when the Federal Reserve announces a disinflation policy. It is unlikely people will believe them and will continue to expect abnormally high inflation rates. The tradeoff we have described above (where unemployment must be held above the natural rate) continues. However, if the Federal Reserve maintained some credibility, then less unemployment would be needed for a given disinflation policy.

c. The possibility of nominal rigidities (Stanley Fischer) - The above contends that expected inflation controls all contracts, and that when expected inflation changes, prices can quickly change. However, this is unlikely to always be true. There can be "nominal rigidities" in the economy meaning that even when expectations of inflation change, some contracts are intact for several periods. Consider a policy in which the Federal Reserve decides to disinflate. They immediately slow down the growth rate in the money supply. Eventually prices will fall, but they may not fall by a large amount if some prices are predetermined via contracts. Thus the only effect of a slow down in money growth is unemployment. The theory that nominal rigidities can impact any policy aimed at disinflation implies that policy makers must carefully announce any maneuver so as to allow agents in the economy time to adjust both their expectations and contracts expressed in nominal terms.

d. The theory and empirical evidence. The textbook offers the following evidence with respect to the policies we have discussed in class (based on a study by Laurence Ball. See reference in text):

    a. Disinflations are typically associated with higher sacrifice ratios (meaning there appears to be a tradeoff between money growth and unemployment in the short run).
    b. Faster disinflations are associated with smaller sacrifice ratios. This supports Lucas' view and suggests that credibility is a key issue in the Federal Reserve's decision to pursue a disinflation policy.
    c. Sacrifice ratios are smaller is country's that have shorter wage contracts. This gives credibility to the analysis of Fischer (nominal rigidities). Since less unemployment is needed for a given decline in inflation (a smaller sacrifice ratio) in countries where wage contracts are more easily adjusted, the implication is that wage contracting (and its duration) can play a large role in disinflation policies.

November 15, 2001

I. The Long Run: Economic Growth

a. The following facts are based on table 10-1 on page 191 in the text.
    i. For each of the 5 OECD countries pictured, economic growth has been outstanding since 1950 when measured in per capita terms (we use per capita as a measure of economic welfare to control for countries that have higher population than others).
    ii. Economic growth has slowed down since 1973.

iii. The countries with less per capita output than the United States appear to be catching up or "converging."

II. A broader picture of economic growth.

a. The facts above apply to the major industrial countries of the world since 1950. One of the major implications of table 10-1 is that countries with low per capita income in 1950 experience high economic growth converging (in per capita terms) to the United States. A broader picture would answer the following questions:
   i. Why has economic growth slowed since 1973? Is this out of the ordinary?
   ii. Has the United States always maintained control as the leading economic power in the world? What has per capita income looked like over time?
   iii. Does low per capita income always lead to higher economic growth? What is the experience aside from developed countries?

b. The answers?
   i. Economic growth has not been a historical reality. From 1500 to 1700 economic growth (measured in output per capita terms) averaged about .1% per year. From 1700 to 1820 this number barely increased from .1% to .2%. During the Industrial Revolution, and leading up to 1950, output per capita growth stood at 1.5% in the United States. Thus, in the context of history, it is not the period from 1973 to present that stands out as the odd period. In fact, it is the unprecedented growth from 1950 to 1973 that is anomalous.
   ii. Historically speaking, the United States has been the leading economic power for about 125 years. Prior to this, the United Kingdom stood as the leading power. Historically, output growth has been characterized using the term "leapfrogging." It is true that countries can either develop new technologies or mimic existing technologies. One would certainly expect that is easier to clone successful economies. Thus, throughout history we have observed alternating periods of economic supremacy in which one country has high output per capita, and then other countries catch and surpass.
   iii. A low per capita output in 1950 has been associated with high per capita output in 1998 for the following:
      1. OECD countries such as the United States, France, Germany, etc (see page 15 for a full list).
      2. Asian economies known as the "four tigers." This list includes Singapore, Taiwan, Hong Kong, and South Korea (these statistics were taken before the collapse of

many of the economies of Southeastern Asia during the "Asian Crisis." In spite of the Asian crisis, we can successfully say that these countries have experienced phenomenal growth since 1950).

Unlike the above economies, most African nations have experienced little or no growth in spite of very low per capita output in 1950. As an example, both Chad and Madagascar have experienced negative economic growth since 1960.

III. A step toward explaining economic growth: The aggregate production function.

a. To date, we have assumed that production is only a function of labor/employment. This is an unrealistic assumption, particularly from the standpoint of economic growth. In particular, physical capital such as machines and factories are likely to be an important determinant of output. We now take this into account, and write the aggregate production function as follows:
   i. $Y_t=f(K_t,N_t)$, where K_t stands for the capital stock at time t. There are several types of aggregate production functions:
      1. increasing returns to scale – a production function is said to exhibit increasing returns to scale if output increases by a multiple more than 2 when all factors of production are doubled.
      2. decreasing returns to scale – a production function is said to exhibit decreasing returns to scale if output increases by a multiple less than 2 when all factors of production are doubled.
      3. constant returns to scale – a production function is said to exhibit constant returns to scale if output doubles when all factors of production double. More specifically, if we multiply all factors of production by some constant c, then output increase by c. e.g.
         a. $cY_t=f(cK_t,cN_t)$.
   ii. Specific functional forms of production functions: The Cobb-Douglass Production Function:
      1. The Cobb Douglass Production function takes on the following form:
         a. $Y_t=K_t^{a}N_t^{b}$
            i. Increasing returns to scale. The Cobb-Douglass production function has increasing returns to scale if a+b>1.
            ii. Decreasing returns to scale: a+b<1.
            iii. Constant returns to scale: a+b=1=>b=1-a. Thus, if the Cobb Douglass Production function exerts constant

returns to scale, then it can be written as follows:

1. $Y_t=K_t^aN_t^{1-a}$ Example:
2. Consider a Cobb-Douglass Production function with constant returns to scale. Suppose a=1/2 (and hence 1-a=1/2). Suppose the initial capital stock is 9 units while initial employment is 100 units. Then output is given by:
    a. $Y_t=9^{1/2}100^{1/2}=3*10=30$ units
3. Suppose that all factors of production doubled (such that capital increased to 18 and labor to 200). Then it is easy to verify output increases to 60 units (simply plug in the numbers and take square roots). Thus, doubling all inputs does indeed double output for production functions that exhibit constant returns to scale.

iii. Our aggregate production function:

1. The above expresses output as a function of capital and labor. We are trying to explain per capita output, not simply output. Recall that if a production function exhibits constant returns to scale then we can multiply through by any constant. Let us multiply the general form of our production function by $1/N_t$. This yields:
    a. $Y_t/N_t=f(K_t/N_t,N_t/N_t)=f(K_t/N_t,1)$.