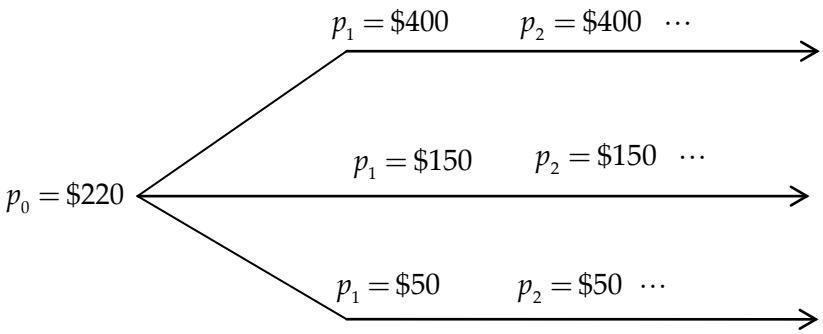
Problem Set #4
Due: beginning of class December 3

1. A venture capital fund is considering a project that costs \$1200 and would pay off \$220 if started this period. Thereafter, it can have three payoffs that repeat in each subsequent period:
   $(p_L, p_M, p_H) = (\$50, \$150, \$400)$
   The fund assigns probabilities to these three outcomes: $(q_L, q_M, q_H) = (0.3, 0.3, 0.4)$
   The discount rate is 10 percent. The fund has the option to wait for one period before deciding.



   a. Compute the standard deviation of this investment project (2 points).

$$\sigma^2 = 0.3(50-220)^2 + 0.3(150-220)^2 + 0.4(400-220)^2 = 23100$$
$$\sigma = 151.99$$

   b. Compute the net present value (NPV) of investing in period 0 (2 points).

$$NPV = -1200 + 220 + 0.3\sum_{t=1}^{\infty}\frac{50}{(1.10)^t} + 0.3\sum_{t=1}^{\infty}\frac{150}{(1.10)^t} + 0.4\sum_{t=1}^{\infty}\frac{400}{(1.10)^t} = 1220$$

   c. Compute the NPV of investing in period 1 if the project is a high-return investment (1 point).

$$NPV = 0.4\times\left(\frac{-1200}{1.1} + \sum_{t=1}^{\infty}\frac{400}{(1.10)^t}\right) = 1163.6$$

   d. Compute the NPV of investing in period 1 if the project is a medium-return investment (1 point).

$$NPV = 0.3\times\left(\frac{-1200}{1.1} + \sum_{t=1}^{\infty}\frac{150}{(1.10)^t}\right) = 122.7$$

   e. Compute the NPV of investing in period 1 if the project is a low-return investment (1 point).

$$NPV = 0.3\times\left(\frac{-1200}{1.1} + \sum_{t=1}^{\infty}\frac{50}{(1.10)^t}\right) = -177.3$$

f. What is the value of waiting one period to invest in the project (2 points)?

$$1163.6 + 122.7 - 1220 = 66.4$$

g. As the economic outlook improves, the worst-case scenario becomes less likely and less damaging, but competition also increases. The probabilities are now: $(q_L, q_M, q_H) = (0.25, 0.4, 0.35)$.

The returns are now: $(p_L, p_M, p_H) = (\$80, \$150, \$400)$

What is the standard deviation of the project (2 points)?

$$\sigma^2 = 0.25(80 - 220)^2 + 0.4(150 - 220)^2 + 0.35(400 - 220)^2 = 18200$$

$$\sigma = 134.91$$

h. What is the value of waiting to invest now (5 points)?

$$NPV = -1200 + 220 + 0.25\sum_{t=1}^{\infty}\frac{80}{(1.10)^t} + 0.4\sum_{t=1}^{\infty}\frac{150}{(1.10)^t} + 0.35\sum_{t=1}^{\infty}\frac{400}{(1.10)^t} = 1220$$

$$NPV = 0.35 \times \left(\frac{-1200}{1.1} + \sum_{t=1}^{\infty}\frac{400}{(1.10)^t}\right) = 1018.2$$

$$NPV = 0.4 \times \left(\frac{-1200}{1.1} + \sum_{t=1}^{\infty}\frac{150}{(1.10)^t}\right) = 163.6$$

$$NPV = 0.25 \times \left(\frac{-1200}{1.1} + \sum_{t=1}^{\infty}\frac{80}{(1.10)^t}\right) = -72.7$$

$$1018.2 + 163.6 - 1220 = -38.2$$

The firm would now prefer to invest in period 0, rather than wait, because the downside risk has declined (both in probability and cost).

i. What impact does a decline in uncertainty have on aggregate demand (2 points)?

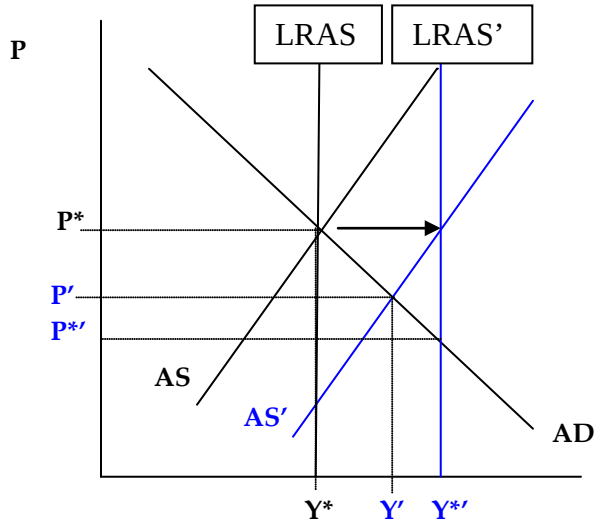
The increase in investment demand boosts aggregate demand, shifting the AD curve to the right.

2. In a paragraph, describe how fiscal deficits can cause hyperinflations. Use the quantity theory to help frame your discussion. (10 points)

When a country runs a fiscal deficit, it must either issue debt, or print money to finance the deficit. Most countries cannot issue debt indefinitely (for now, the U.S. seems to be an exception) and eventually must print money to finance the debt. The quantity theory ties together the growth rate of the money supply and the inflation rate. If the growth rate of output stays constant (it is more a function of institutions, labor and capital supplies, and productivity than the price level) then the inflation rate is equal to the growth rate of money over the long run. As the government prints more money to finance the deficit, it increases the inflation rate, and can lead to a hyperinflation. Importantly, as the money declines in value compared to goods and services, it also declines in value compared to other currencies.

3. In the 1990s, the U.S. experienced a period of high output growth and low inflation, contrary to the "Philips Curve" view of the economy. In a couple of sentences, give a likely explanation. In an AS/AD framework, how this might have occurred? (10 points)

The 1990s were a period of rapid technological improvement in the United States. These productivity gains shifted the supply curve outward—the economy could produce more goods at lower prices—and generated low rates of inflation and high rates of growth.



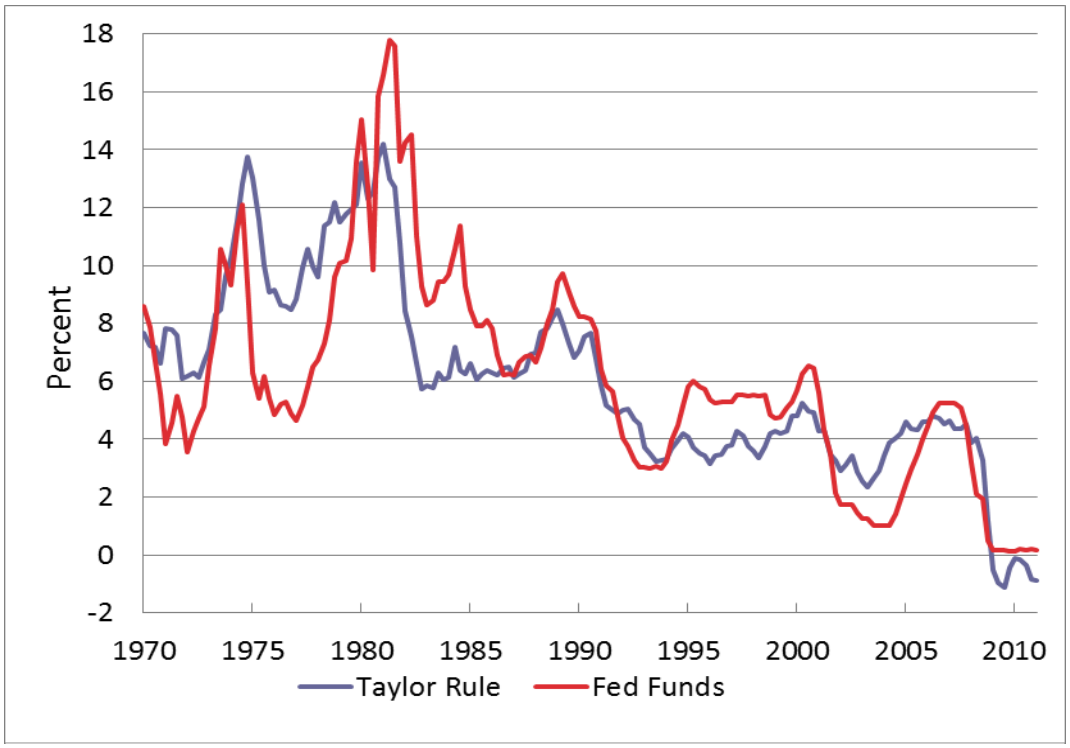
4. Classify the following developments as shocks to aggregate supply (AS) or aggregate demand (AD) and show in table whether they are stimulative (+) or restrictive (-) with respect to output and, separately, with respect to prices. (10 points)

Oil price surge
Equity market crash
Heightened fear of job losses
Deregulation of airlines, finance and telecommunications
Sales tax holiday
Fed increases interest rate paid on reserves
Improved inventory control
Government limits workweek
New information technology
Fed embarks on quantitative easing

Shock	Type	Output	Prices
Oil Price Surge	AS	-	+
Equity Crash	AD	-	-
Heightened Fear of Job Losses	AD	-	-
Deregulation	AS	+	-
Sales tax holiday	AD	+	+
Fed increases interest paid on reserves	AD	-	-
Improved inventory control	AS	+	-
Government limits workweek	AS	-	+
New information technology	AS	+	-
Fed embarks on quantitative easing	AD	+	+

5. You have been asked by your boss to explain the Taylor Rule and how it can be a helpful guide to the Fed in making monetary policy.

   a. Using the Taylor Rule workbook data on Blackboard, plot a Taylor rule and the federal funds rate on a graph from 1970 to 2011. (5 points)



   See Taylor Rule Workbook key for calculations

   b. What was the impact of keeping the federal funds rate well below the Taylor rule rate for much of the 1970s? Why might the Fed have chosen this policy? (5 points)

   Inflation became high and volatile, and real GDP also became more volatile. Several factors may have influenced the Fed's choice: (1) It overestimated the economy's supply capacity when productivity slowed after 1973; (2) It underestimated the impact of Fed caution on inflation expectations; (3) It was highly sensitive to unemployment; and (4) it feared that the level of unemployment needed to lower inflation would be intolerably high. In the end, inflation fell persistently only after a long and deep recession in the early 1980s.

   c. Fed deviations from a Taylor rule were smaller and less persistent after 1985. What was the impact on output and inflation? (5 points)

   Inflation remained low and stable. From 1985 to 2007, the volatility of real GDP also plunged, resulting in a period known as the Great Moderation. Many economists believe that the improvement of monetary policy contributed to this stability.

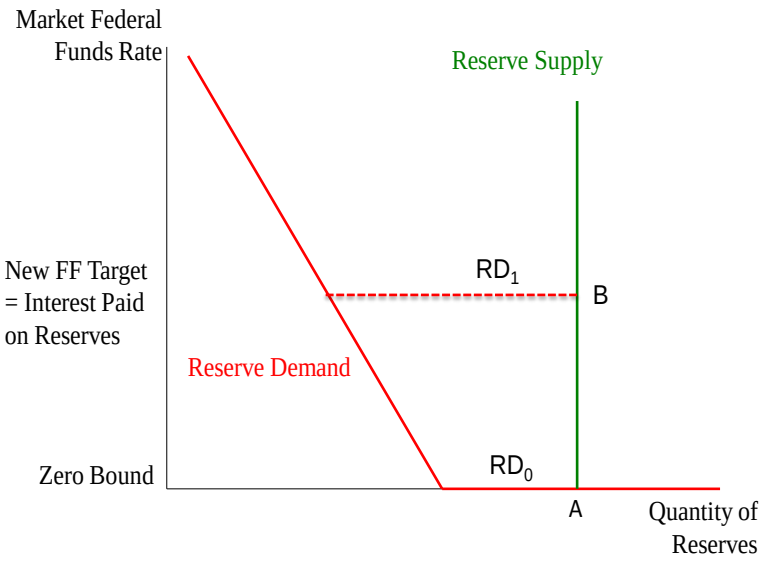
d. Why can't the Fed lower the federal funds rate sustainably below zero? (2 points)

The federal funds rate cannot decline sustainably below zero because banks would prefer to hold cash (or reserves at the central bank) that pay zero rather than lend in the interbank market at a rate below zero.

e. What can the Fed do to stimulate aggregate demand if the Taylor rule rate is below zero? (5 points)

In order to stimulate aggregate demand at the zero bound for the federal funds rate, the Fed would need to introduce unconventional monetary policies. These could include a commitment to keep the policy target rate low in the future, an expansion of reserve supply beyond the level needed to keep the funds rate at zero ("quantitative easing") or a change in the mix of assets on the balance sheet toward riskier assets ("credit easing").

f. The figure below shows an initial equilibrium in the market for reserves at a zero interest rate (point A). Show graphically how the Fed can exit from quantitative easing *without* selling assets. (You should be able to click inside the graph object and edit it.) Label any changes in the reserve supply and reserve demand curves, along with the new target federal funds rate. Label the equilibrium where demand and supply meet as point B. (3 points).



g. Using the graph in question f, explain the mechanism by which the Fed can set an interest rate target without adjusting the level of reserves? (5 points)

Since October 2008, the Fed has the authority to pay interest on reserves held by banks at the Fed. By hiking that "deposit interest rate", the Fed can incentivize banks to hold excess reserves rather than lend the funds out to private borrowers. In this way, the Fed can achieve any interest rate target (by adjusting the rate paid on reserves) without altering the size or mix of its assets.

6. This question focuses on the slope of the aggregate supply curve.

a. Why does the short run aggregate supply curve have a positive slope? (5 points)

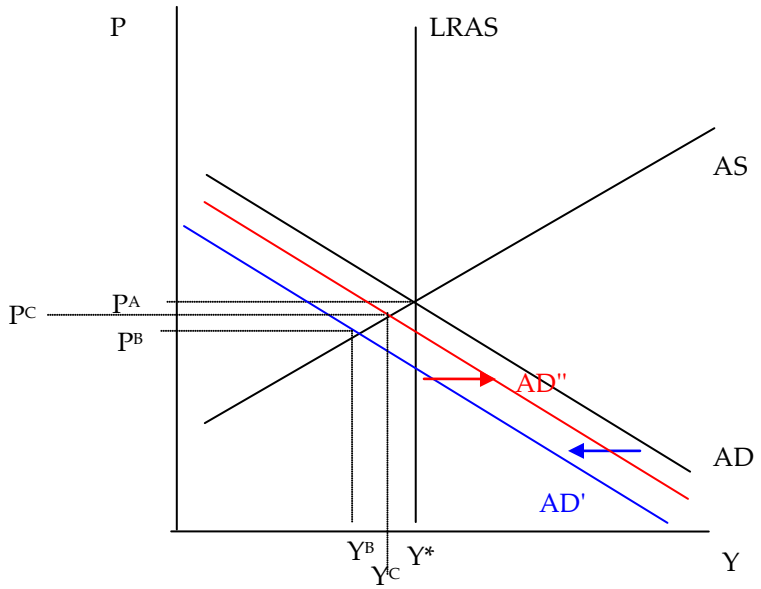
Short run aggregate supply has a positive slope because prices are sticky in the short run. For example: if the wage is stuck, an increase in the price level lowers real wages (w/p) making workers cheaper to hire. Firms hire more workers and produce more output. A higher price level leads to an increase in output: a positive relation between the output of goods and the price level.

b. Why is the long run aggregate supply curve vertical? Explain why it differs from short run aggregate supply. (5 points)

In the long run, all prices (including wages) are flexible. In this setting, supply is no longer sensitive to price, since an increase in price will no longer boost labor demand (in contrast to the short run when wages are sticky). At any price level p, the price of labor (w) and the price of capital (r) will adjust to ensure that the real wage and the real interest rate equal the marginal product of labor and capital. In equilibrium, capital and labor will be fully utilized. The equilibrium level of output (Y*) will depend only on technology and the level of capital and labor available as inputs into the production process.

7. Deflation—broad and persistent decreases in the price level—can be troublesome. Falling prices raise the expected real rate of interest, helping to discourage spending. For example, if consumers expect deflation to continue, they will postpone purchases and try to save more, lowering their demand at any current price level.

   The economy is initially at the long run equilibrium, as shown in the figure below.



   a. How does the figure above change when consumers expect deflation in the future? Label the new short run equilibrium (Y^B, P^B). Are the consumers' expectations correct? (6 points)

      The consumers' expectations are correct. The price level is falling. (This is the "deflationary spiral you may read about. Consumers think the price level is falling, so they wait to spend, by waiting, demand falls and prices fall, then some consumers wait again, …)

   b. What can the Federal Reserve do to counteract this deflationary cycle? Show the Fed's response on the figure above. Label the new short run equilibrium (Y^C, P^C). (6 points)

      The Fed can use expansionary policy (decrease the interest rate, increase the money supply) to shift AD back to the right.

      The AD curve is shifted back to the right in the figure above. I haven't shifted if all the way back to the LRAS, although that is what the FED would be trying to do. In reality, it is very difficult to know exactly where the economy is, and what the effect of a stimulus will be. It's a lot like the 3 bears: sometimes the stimulus will be too much, sometimes not enough, and sometimes … just right.