Econ 340: Money, Banking and Financial Markets
Midterm Exam KEY, Spring 2002

1. The U.S. Federal Reserve has been cutting its fed funds rate target for more than a year. The Fed funds rate has declined from 6.5% in November of 2000 to 1.75% today. The Fed's primary goal has been to stimulate the economy so as to avoid a recession. Today, most economists believe the economy has reached the trough of the business cycle and will resume substantial growth over the **next several years**.

   (a) *(15 points)* Using a supply and demand for fed funds (supply and demand for very short term bonds) model, illustrate and explain how the central bank is able to reduce the fed funds rate.

   The Federal Reserve sets a target for the Fed funds rate at its semi-monthly Federal Open Market Committee meeting. To insure that the market interest rate banks charge each other for loans of Fed funds (bank reserves held at the Fed) is close to it's target, the Fed buys or sells bonds from banks in exchange for reserves. If the Fed lowers it's target rate, as it has steadily since November of 2000, it enters the bond market to purchase bonds with reserves. That is, the Fed creates an excess supply of reserves. This excess supply of reserves drives down the interest rate banks charge each other for loans. If we treat fed funds (loans) as if they were very short term bonds, we can use a supply and demand for bonds model to illustrate the Fed's action. In the graph below, the demand for bonds curve (Dbonds) shifts to the right as the Federal Open Market desk purchases short term bonds. At the original equilbrium price for these bonds, \$590, there is an excess demand for bonds measured by the distance between Q*(1) and Q$\prime$. The excess demand for bonds drives up bond prices. Bond prices continue to rise until the excess demand is eliminated at the new equilibrium quantity Q*(2) and price \$690. This new equilibrium is labeled **B** in the graph. Because bond prices and yields move in opposite directions, we know that the Fed has been sucessful in lowering interest rates on these short term bonds (Fed funds). Note that declining interest rates due to expansionary monetary policy is often refered to as the Liquidity Effect.

   (b) *(15 points)* Based on the theory of Asset Demand, and using a supply and demand for T-bills model, illustrate and explain what you think will happen to short term interest rates as the economy enters the expansion phase of the business cycle.

   The theory of asset demand tells us the impact on interest rates of changes in relative risk, return, liquidity, and wealth. During a business cycle expansion a number of factors are likely to affect the yields on T-bills, however risk and liquidity are not likely to change. When the economy is expanding after more than a year of monetary easing, income will increase (by definition), and inflation is likely to rise as well. The theory of asset demand tells us that an increase in income (resulting in rising wealth) will lead to an *increase in the demand* for all assets, including T-bills. Meanwhile, the Fisher equation,

$$r_t^e = i_t - \pi_t^e, \tag{1}$$

tells us that an increase in expected inflation lowers the expected real return from holding T-bills, where r_e is the expected real return on T-bills, i_t is the nominal yield, and π^e is the expected rate of inflation. An increase in expected inflation, therefore, leads to a decline in the expected real return from holding bonds, and a decrease in the **demand for bonds**.

Because T-bills are issued by the US Treasury, there is generally no reason to expect that there will be an increase in the supply of T-bills as the economy expands or because of the decline in the real cost of borrowing for the US government. (In contrast, an increase in the supply of commerical paper is likely as businesses increase their borrowing to meet the liquidity needs of their expanding operations. Similarly, business tend to sell additional bonds when the real cost of borrowing is lower.)

If the expected effect of a business cycle expansion is to both increase (due to rising wealth) and decrease (due to higher expected inflation) the demand for T-bills, it is not possible to say definitively which effect will dominate. However, the stylized facts of business cycles (see Fig. 8, pg 99 of text) tell us that interest rates tend to rise during business cycle expansions and fall during contractions. Based on this evidence we can predict that the expected inflation effect must dominate the effect of rising wealth, and the demand for bonds must decline. In other words, investors who expect rising inflation will demand fewer T-bills as they seek out higher yielding inflation hedges. The decline in demand leads to an excess supply of T-bills, falling bill prices, and rising yields on T-bills for the next few years. Graphically, the downward shift in demand is just the reverse of the increase in bond demand demonstrated in the answer to question (a).

(c) *(15 points)* Write down an equation representing the expectations hypothesis for the term-structure of interest rates. (Three years is long enough.) Given your answer to part (b) above, draw and explain the shape of a yield curve for bonds with terms to maturity from 1 to 3 three years?

The expectations hypothesis states that investors are indifferent between bonds of different maturity. Therefore, the yield to maturity on a three year note should be identical to the expectd yield on a portfolio of three sucessive one year bills as indicated by the following expression

$$i_{3,t} = \frac{i_{1,t} + i^e_{1,t+1} + i^e_{1,t+2}}{3}. \tag{2}$$

Because interest rates are very low today, the one-year bill rate is 2.6%, and interest rates are expected to rise over the next two years due to increasing inflation (and Fed tightening), I expect the yield curve to be relatively steeply upward sloping.

(d) *(10 points)* Use the data below on T-bill yields to calculate the **expected** 1-year tbill rate one year from now (in year t+1) and two years from now (year t+2). Compare your results with your answer in part (c) above.

Term to maturity	Yield To Maturity as of today (t)
1-year	2.57
2-year	3.56
3-year	4.14

Rewrite equation (2) above (for a two year horizon) as:

$$i_{2,t} = \frac{i_{1,t} + i^e_{1,t+1}}{2}. \tag{3}$$

Now, solve for the expected one-year T-bill in period $t+1$.

$$i^e_{1,t+1} = 2 \times i_{2,t} - i_{1,t} = 2 \times 3.56\% - 2.57\% = 4.55\% \tag{4}$$

We can use today's one-year bill rate, next year's expected one-year bill rate (we just solved for that), and equation (2) to find the one year bill rate expected two years from now.

$$i^e_{1,t+2} = 3 \times i_{3,t} - i_{1,t} - i^e_{1,t+1} = 3 \times 4.14\% - 2.57 - 4.55\% = 5.3\% \tag{5}$$

Clearly, the answer I gave in part (c) above is consistent with the predictions of rising short term rates given by the current yield curve and the expectations hypothesis.

(e) *(15 points)* Write down an equation for the Security Market Line (CAPM equation). If you are considering purchasing Cisco System, which has $\beta = 2.0$, calculate the impact on your required rate of return if the risk free rate changes as you predicted in your answer to part (d). Explain your results.

The security market line for Cisco systems is given by:

$$R_i - R_f = \beta[R_m - R_f] \tag{6}$$

or

$$R_i = R_f + 2.0[R_m - R_f] \tag{7}$$

an increase in the risk free rate of return (other things constant) should lead to an increase in both the required return on the market and the required return on Cisco. In other words, assuming the systematic risk of the market has not changed, the market risk premium $(R_m - R_f)$ should remain relatively constant. Therefore, an increase in the risk free rate should result in an increase in R_m by the same amount, so the right hand side of (6) remains remains unchanged, while the right hand side of (7) increases by the change in the risk free rate. The idea is that if the risk free rate is increasing, the market return must increase to compensate investors for the risk of holding the market portfolio. The same is true of Cisco stock (at least according to the prediction of the CAPM), and the required return on Cisco should increase by the same amount as the increase in the risk free rate.