Practice Question #3

Course 14.454 – Macro IV, Fall 2004

Monetary Policy via the Lending Channel & Credit Shocks

This question is based on the model developed by Bernanke and Blinder and will ask you to prove some of the results stated in their paper. Similar to their paper, begin with the following market clearing conditions:

$$L\underset{- + +}{\left(\rho, i, y\right)} = \lambda\underset{+ -}{\left(\rho, i\right)} D\left(1-\tau\right) \tag{1}$$

$$D\underset{- +}{\left(i, y\right)} = m\underset{+}{\left(i\right)} R \tag{2}$$

$$y = Y\underset{- -}{\left(i, \rho\right)} \tag{3}$$

Equation (1) gives us the market clearing condition in the loan market. $L(\,)$ is the demand for loans, and the RHS is the supply of loans. D is the deposits held by banks, τ is the fraction of deposits required to be held in reserves by banks to back up their deposits, $\lambda(\,)$ is the fraction of non-required reserves that are supplied as loans, i is the interest rate on bonds, and ρ is the interest rate on bank loans.. The plus and minus symbols below each variable indicate the sign of their partial derivative. Equation (2) is our money market clearance condition (LM curve), where $D(\,)$ is the demand for deposits (money), m is the money multiplier, and R is the reserves of the banking system. Finally, equation (3) is our goods market clearance condition where $Y(\,)$ represents planned expenditures.

(a) Please explain in words why the derivatives in equations (1) - (3) have the signs we've assumed. [This is to help refresh your memory of the IS-LM model].

First, let's begin with equation (1). On the LHS we have the demand for loans by individuals given by the function $L(\,)$. Clearly, if the interest rate for the loan, ρ, is higher, the demand for loans will be reduced. If bonds require a higher interest rate i, borrowers will increase their demand for loans as an alternative form of financing. Demand for loans is also a positive function of the income level. With more income, we assume there will be more transactions in the economy and more demands for loans for liquidity, etc. Now consider the RHS of equation (1). The fraction non-required reserves supplied as loans by banks, $\lambda(\,)$, is an increasing function of the interest rate they receive on loans which makes perfect sense. Additionally, a rise in the interest rate banks can receive by buying bonds will induce them to supply fewer loans.

Now let's look at equation (2). On the LHS we have the demand for holding deposits (money) in a bank. The demand is negatively related to the bond interest rate since a higher return to holding bonds will certainly reduce the demand of holding deposits in banks (which we implicitly assume have a zero return). Additionally, the demand for deposits is an increasing function of income. The assumption that an economy with

more income will have more money (deposits) is very plausible. On the RHS, we have the supply of money. The money multiplier $m(i)$, is an increasing function of the interest rate for the following reason. At higher interest rates, the bank will face a higher opportunity cost of holding unnecessary excess reserves because it could instead be purchasing bonds. So an increase in the interest rate will reduce the amount of excess reserves held by banks which increases the multiplier effect. The multiplier effect is simply the idea that for every unit of money deposited in the bank, a fraction of it is then loaned out to new investors thus creating new money.

Finally, let's look at equation (3). The function $Y(\ )$ is the amount of expenditures in the economy. An increase in either interest rate will increase the cost of purchasing items that require the person to borrow. Thus, planned expenditures will fall for any increase in interest rates.

(b) If we wanted to return to the standard IS-LM framework we are familiar with, how could we modify the above market clearing conditions? In other words, what have Bernanke and Blinder added to our standard IS-LM model?

To do this, we simply drop equation (1) and the interest rate ρ for loans found in equation (3). In the standard IS-LM model, all forms of financial instruments are considered perfect substitutes. Thus, there is no need to differentiate between loans and bonds, and there will only be one interest rate in the economy. Bernanke and Blinder have simply added the assumption that bonds and loans from banks are not perfect substitutes. Thus, in their model we must keep track of both interest rates and ensure that the market for loans clears.

In the standard IS-LM model, we just need to clear the three markets for money, bonds (and all other financial instruments), and goods. The intersection of the IS-LM curves of equations (2) and (3) clears the money and goods market. By Walras' Law, we have then cleared the market for bonds. There is no need to clear a separate loan market in the standard IS-LM model.

(c) Use equations (1) and (2) to find an implicit function of ρ in terms of $i, y,$ and R. Define this function as $\rho = \phi(i, y, R)$. Use the implicit function theorem to prove $\partial\rho/\partial y > 0$ and $\partial\rho/\partial R < 0$. Explain in words the intuition of each of these results.

Plugging (2) into (1), we have the following function (which I will call F) that implicitly defines ρ as a function of $i, y,$ and R.

$$F(i, y, R, \rho) = L(i, y, \rho) - \lambda(\rho, i)(1-\tau)m(i)R = 0 \qquad (4)$$

By, the implicit function theorem, we have:

$$\frac{\partial \rho}{\partial y} = -\frac{F_y}{F_\rho} = -\frac{L_y}{L_\rho - \lambda_\rho (1-\tau) m(i) R} > 0$$

$$\frac{\partial \rho}{\partial R} = -\frac{F_R}{F_\rho} = -\frac{-\lambda(\rho, i)(1-\tau) m(i)}{L_\rho - \lambda_\rho (1-\tau) m(i) R} < 0$$

If you think about it, these results should make sense. A higher income level, y, increases the demand for loans, all else equal. If nothing else were to change, it must be that the interest rate of loans must rise in order to increase the supply of loans enough to meet this demand. A higher amount of reserves, R, increases the amount of money and deposits in the economy. Since banks lend out a fraction of their deposits, this causes an increase in the supply of loans. All else equal, this increase in supply should drive down the interest rate of loans.

Note: for the remainder of this question, I assume $\partial \rho / \partial i > 0$, so we have $\rho = \phi\underset{+\ +\ -}{(i, y, R)}$.

Substituting ρ out of equation (3), we now have our CC curve that describes the relationship between output and bond interest rates such that both the credit and commodity markets clear. The intersection of the LM and CC curves will determine the equilibrium of this economy by ensuring that all markets clear at the given interest rates and output level.

Now consider a country where it has just been announced that a very prominent and large firm in the country has just gone bankrupt. Stories of corruption arise, and banks now fear the corruption of managers in the economy may be widespread. Hence, they perceive the extension of loans in the economy to be much riskier now.

(d) How will this new perception of risk affect the credit supply of the economy? In particular, which function in our initial setup changes? How will this shift the LM and CC curves? How do output, money, credit and the interest rate change?

This perception of greater risk to providing loans implies that for any given level of interest rates, a bank will be less willing to supply loans. This is seen as a reduction in the fraction of deposits, $\lambda(\rho, i)$, used to create loans for any given level of interest rates ρ and i. I.e. we have a contraction in the supply of credit to the economy. Holding i and ρ constant, it must be that y falls to ensure the credit market clearance equation (4) still holds. This implies that our CC curve must shift to the left. The money market clearance condition is unaffected and so the LM curve remains unchanged. See figure 1 below.

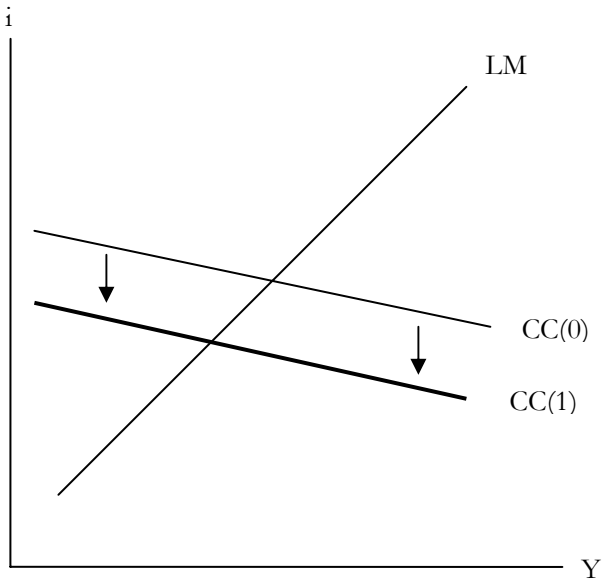

Figure 1

As shown in figure 1, output and the interest rate for bonds will fall. The fall in i reduces the money multiplier, $m(i)$, and the hence the supply of money will fall. Using the goods market clearance condition, we see that a decrease in i and y means that ρ must rise. But, a rise in ρ and fall in i and y means the overall credit demand of the economy has fallen. Thus, credit must be lower now. Overall, we find that output, money and credit (via loans) all contract!

(e) What monetary policy would you recommend to return the economy to its original output level? How does this policy shift the LM and CC curves? ***[Hint: we assume monetary policy is conducted by direct changes in the reserves,*** R ***, held by banks.]***

Clearly, we should recommend an expansionary monetary policy! This would take the form of increasing the reserves held by banks. The expansionary money supply clearly moves the LM curve to the right. This is the usual effect of monetary policy in the IS-LM framework. [Mathematically, we see this shift as follows: Equation (2) captures our LM curve. An increase in reserves implies that for a given interest rate i, it must be that output is higher to ensure the condition still holds].

However, in the Bernanke-Blinder model, we also have another expansionary effect of the monetary policy through the lending channel. . The expansion of reserves also increases the amount of credit supplied to the economy for any given level of i and y. This will be seen as a shift to the right in our CC curve. [To see this mathematically, recall that our CC curve is given by $y = Y[i, \phi(i, y, R)]$ and $Y_R > 0$. Holding y constant, it must be that i rises since $Y_i < 0$ for any increase in R.]

(f) Now suppose that banks realize that the failure of the firm was just a one time incident and that their loans are no more risky than before. However, they aren't so sure depositors know this, and the banks fear there may be a bank run. To bolster confidence in the banking system and to prevent a bank run, banks decide to lend a smaller fraction of their deposits. How does this response to a fear of a bank run affect output of the economy?

The response of banks has exactly the same effect as we saw in part (d). They will reduce the amount of credit supplied to the economy. Everything is the same as before in that output, credit and money will all contract. The mere fear of a bank run can lead to an economic contraction in this model.