PART II

PROBLEM 2

THE OPTIMAL CHOICE OF THE EXCHANGE RATE REGIME: FIXED VS FLEXIBLE

As discussed in class the choice of the exchange rate system can have important consequences for macroeconomic stability. For instance, it is commonly believed that Germany contributed to the slowdown in economic activity in the rest of Europe in the early 90s through the fixed regime in place (the EMS.
Suppose that a country's nominal exchange rate, q(t), is determined by the following equation

(1) $q(t) = a0 + a1*i(t) + a2*i'(t) + e(t)$

That is, the current spot rate is influenced by, among other things, the domestic -i(t)- and the foreign -i'(t)- nominal interest rates. e(t) is a random error capturing other influences on the exchange rate (relative riskiness of domestic assets, productivity growth and so on).
The level of output, y(t), is determined according to equation (2)

(2) $y(t) = b0 + b1*i(t) + b2*q(t) + u(t)$

where u(t) captures the influence of other factors (for instance, fiscal and monetary policy). According to (1), changes in either the exchange rate or the domestic nominal interest rate affect output. Equation (2) is a version of the IS curve.
Consider now two exchange rate regimes, a fixed one and a flexible one. Under a **fixed regime** and in the face of on changes in foreign interest rates as well as other disturbances, the Central Bank is assumed to adjust the domestic interest rate in order to maintain a constant exchange rate. We will assume that the desired fixed rate is q(t) = 2 in each period.
Under a **flexible exchange** rate system, on the other hand, the Central Bank lets the exchange rate be determined freely by market forces.
You are asked to determine which exchange rate system will produce greater output stability in the period 1985:1 to 1994:4.
Proceed as follows: First estimate equations (1) and (2) for the period 1970:1-1984:4 and store the coefficients. For the flexible regime, simply use the supplied values of i(t), i'(t), e(t) and u(t) to calculate y(t) from 1985:1 to 1994:4. Plot the resulting series and calculate its variance.
For the fixed exchange rate system, use the supplied values of i'(t) and e(t) in equation (1) to calculate the value of i(1985:1) that is required in order to have q(1985:1) =2. Then in equation (2) use the fixed value of the exchange rate, the calculated value of i(1985:1) and the value of u(1985:1) in order to calculate y(1985:1). Continue until you have constructed the full output series (from 1985:1 to 1994:4). Plot the y(t) series and compute its variance. Is output more stable under a fixed or a flexible regime? Under what conditions? Why?

Bonus:
a) Now suppose that e(t) is given by a new series, e1(t). Redo your analysis. Which regime is now preferable? Why? How do your findings differ from those obtained above for e(t)?

PROBLEM 3

<u>INTEREST VS MONEY TARGETING</u>
(Poole, 1970)

Suppose that the IS curve takes the form

(1) $y(t) = a0 + a1*i(t) + a2*G(t) + e(t)$

where y is output, i is the interest rate, G is the government expenditure deficit and e(t) captures all other influences (taxes, exports, exogenous changes in investment and so on). Let the LM curve take the form

(2) $m(t) = b0 - b1*i(t) + b2*y(t) + u(t)$

where m is the supply of money and u(t) captures all other factors that affect the position of the LM curve (velocity, financial sophistication...).
Estimate equations (1) and (2) using the y, i, G, e and u series supplied for the period 1970:1 to 1984:4. Then compare two alternative targeting rules in terms of the associated output stability: A **money supply** rule that sets m(t) = 1.7 in all periods. And an **interest rate** rule that perfectly stabilizes the nominal interest rate at the level i(t) = 0.10 in all periods. Do your comparisons for the period 1985:1-1994:4
Calculate the path of output as follows:
Solve (2) for i(t); substitute the resulting expression for i(t) in equation (1) and solve for y(t). Then use the values supplied for i, G, e, and u in order to compute y. Calculate similarly the path of output under a fixed interest rate targeting rule. This is simply equation (1) with i = 0.10. Note that under interest rate targeting we select m(t) in each period in such a way that the interest rate remains constant at its targeted level, i(t) =0.10 no matter what is happening to the exogenous variables in the system, G(t), e(t) and u(t).

Which procedure results in greater output stability? Why?

Bonus: Redo the analysis using u(t) in place of u(t). Which procedure is more successful now? Why?

PROBLEM 4

DOES MONEY MATTER?
(Barro)

According to the imperfect information, rational expectations theory of the business cycle, unanticipated changes in the supply of money do affect real economic activity, while anticipated changes do not. We now describe how to test this theory (following Barro, AER, 1977).
We first decompose changes in the money supply into anticipated and unanticipated changes. We postulate that the growth rate of money depends on its own lagged values, that it responds positively to increases in government expenditure (financing the deficit by printing money) and also positively to a slow down in economic activity (countercyclical policy). In particular, the money supply follows the process

(1) m(t) = a0 + a1*m(t-1) +a2*m(t-2) +a3*g(t) +a4*y(t) + e(t)

where m(t) = [M(t)-M(t-1)]/M(t-1), M(t) = M1 in period t

y(t) = [Y(t)-Y(t-1)]/Y(t-1), Y(t) = real GDP in period t

and g(t) = [G(t)-G(t-1)]/G(t-1), G(t) = real government expenditure in period.

The systematic -anticipated- component of money (anticipated as of period t-1) -call it f(t)- is given by

(2) f(t) = a0 + a1*m(t-1) +a2*m(t-2) +a3*g(t) +a4*y(t)

Now estimate equation (1) . The residuals from this regression -call them r(t)- represent the unanticipated change in the growth rate of the money supply, while the fitted values are the f(t) series (the anticipated component of the supply of money).
Now run the regression

(3) y(t) = c0 + c1*r(t) +c2*r(t-1) +c3*g(t) + u(t)

where u(t) is the residual of equation (3). Equation (3) says that output depends on unanticipated money and on current government expenditure. If unanticipated money matters for the reasons given by Lucas, Sargent and Barro then one should expect to find that c1 and c2 are positive and statistically significant. Note that c1 and c2 give the slope of the famous Philipps curve.
Now run the regression

(4) y(t) = b0 + b1*f(t) +b2*f(t-1) +b3*g(t) + v(t)

where v(t) is the residual. If anticipated money does not matter (as postulated by the rational expectations model) then one should expect to find that b1 and b2 are statistically insignificant.
Interpret your results.

PROBLEM 5

PRICE STABILITY WHEN THE CENTRAL BANK USES THE WRONG MODEL

Suppose that the research department of the Central Bank has estimated the following equation over the period 1970:1-1983:4

(1) $p(t) = c0 + c1*p(t-1) + c2*m(t-1) + e(t)$

where p(t) is the inflation rate and m(t) is the growth rate of the supply of money (M1).

Suppose that the Bank does not control directly m(t) but uses the monetary base to influence it. Suppose that this is done through the relationship

(2) $m(t) = b0 + k*MB(t) +u(t)$

where MB(t) is the growth rate of the monetary base and e(t) captures other influences on the supply of money (for instance, unpredicted changes in the money multiplier and so).

Assume that the Bank has an inflation target of 0.05 (5%).
a) Estimate equation (2) and then using the values of e and u supplied calculate the optimal path of the money supply and of the resulting inflation for the period 1984:1-1994:4. This can be done as follows: Let e and u be serially uncorrelated and also on average equal to zero. Given the value of inflation in period t-1, the Bank can form a forecast of inflation, pe(t), for the following period t as a function of its current policy, m(t-1), using equation (1) (that is, pe(t) = c0 + c1*p(t-1) + c2*m(t-1)). It can then chose a value of MB using equation (2) that will make the predicted value of inflation in the following period equal to the target level.
(Hint: Substitute for m(t) from (2) in (1) and solve for the appropriate value of MB)

b) Now assume that as a result of developments in the financial markets at the end of 1979 (the introduction of money market instruments), the relationship between the monetary base and M1 also changes. Moreover, let the new true coefficient k = 0.2 but suppose that the Central Bank is not aware of this change and continues to base its monetary policy on the estimated value of k from (2).

Using the values of e and u calculate the path of the inflation rate when the Bank uses the wrong model. Is the inflation outcome (in terms of the average distance from the inflation target and the variability of inflation) superior compared to the case where the Bank knows the true model?

c) Now suppose that the Bank fixes the growth of MB at a particular value for the entire period without knowing the right model, that is, using the estimated k instead of the true k=0.2)? The MB rule is set in such a way that it gives, on average, an inflation rate of 0.05. That is, the constant growth of the monetary base is determined as $MB(t) =[0.05-c0-c2*b0 - c1*0.05]/(k*c2)$. How does the inflation outcome compare to the previous 2 cases?

d) Now redo parts (b-c) assuming that the true coefficient is k= 1.4.

PROBLEM 6

EXCHANGE RATE OVERSHOOTING

The overshooting theory of Dornbusch occupies a prominent position among the theories of exchange rate determination. Its popularity is due to the fact that it can account for both the high volatility of nominal exchange rates and the fact that nominal and real exchange rates move closely together.

This exercise asks you to determine the degree of nominal exchange rate overshooting that arises from a change in the money supply.

The standard Dornbusch model consists of the following equations

(1) $m(t) - p(t) = A - bI(t)$ $\quad\quad A > 0$

(2) $I(t) - I^*(t) = e(t+1) - e(t)$

(3) $p(t) - p(t-1) = k[p(t-1) - p']$ $\quad\quad k < 0$

(4) $p' = e' = (p^*)'$

The first equation is the demand for money, the second is the uncovered interest rate parity, the third is the price adjustment equation (prices adjust slowly towards their long term equilibrium value) and the last one is the long term purchasing power parity condition (PPP holds in the long run); m, p, I and e are the supply of money, nominal price level, nominal interest rate and nominal exchange rate respectively (a * represents foreign variables and a ' long run equilibrium values).

The parameter values are: A = 1, b = 5, I* = 0.2 (20%), k = -0.2, (p*)' = 0.

Let initially m = 10 in each and every period. In the long run, equations (1)-(4) then imply that e(t) = e(t+1) = e', p(t) = p' and I = I*. In particular, p'= 10 = e'.

Suppose now that the money supply increases unexpectedly to m = 11 and stays at this higher level indefinitely. Calculate the resulting path of prices, interest rates and the exchange rate (plot them).

Hint: To the new value of money m=11 there correspond new long term equilibrium values for prices and the exchange rate, namely, p' = 11 and e' = 11. As explained in class, the nominal exchange rate must jump at the time of the change in the money supply by such an amount that, following (2) from that point on, it should approach eventually its new long term value, e' = 11.

Use (3) to calculate p(t) where p(t-1)= old-p =10 (the starting point before the increase in the money supply) and p' = 11 is the new price in the long run. Use this value of p(t) in (1) to calculate I(t) and then calculate the change in the exchange rate from (3). Knowing the ending point for e (e' = 11) as well as the cumulative change along the path to that point allows you to calculate the starting point for e.

PROBLEM 7

THE PHILLIPS CURVE

Consider two economies. In both economies the labor unions seek salary raises that match the expected inflation rate (in order to protect their purchasing power. That is, w(t) = pe(t), where pe(t) is the expected inflation rate and w(t) is the percentage change in the nominal wage.
The unemployment rate depends on the cost of labor. It is given by the equation

(1) $u(t) = u - k[p(t)-w(t)] + e(t) = u - k[p(t) - pe(t)] + e(t)$

where u is the natural rate of unemployment, p(t) is the actual rate of inftation in period t, pe(t) is the inflation expected by the labor unions when they negotiated wage contracts for period t and e(t) is an iid supply shock. Let the inflation rate evolve according to

(2) $p(t) = s\, p(t-1) + z(t) \qquad s = 1.02$

where z(t) is a random, unobserved shock with an average value of zero.
Suppose that in one of these two countries, labor unions are knowledgeable enough to have figured out the true process that governs the inflation rate. They thus form expectations and set nominal wages according to

(3) $w(t) = pe(t) = s\, p(t-1)$

Using (3) in (1) gives the unemployment rate in that country. Let us call this rate u1(t).

In the other country, labor unions are less knowledgeable about the inflation process and simply extrapolate from present experience. In other words, in that country,

(4) $w(t) = pe(t) = p(t-1)$

Using (4) in (1) gives the unemployment rate in that country. Let us call this rate u2(t).
Which of these two countries will have a vertical long term Phillips curve? If a country has a vertical Phillips curve, will it also have a vertical short term Phillips curve?
Hint: By running a regression of u1(t) and u2(t) on p(t) you can determine whether there is a long term relationship (a non-vertical Phillips curve). Once you have identified the country in which the unions have rational expectations you can construct the series of expected inflation in that country, pe(t). Then by running a regression of ut) on p(t) -pe(t) you can determine the slope of the short term Phillips curve.