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THE IMPACT OF UNCERTAINTY ON THE CHOICE OF MONETARY POLICY INSTRUMENT

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Economists concerned with aggregative policy spend a great deal of their time discussing the implications of various structural changes of the effectiveness of economic policy. Generally it is accepted of suppose that the consequences of a structural change for the effectiveness of policy should be related to how it affects the policy-maker's performance in meeting his objectives. Let us suppose, for instance, that the policy-maker wishes to maximize a utility function which depends on the volumes of "target" variables. If, after some structural change, policy-maker finds he is able to score higher on his utility function, then presumably the structural change has improved the effectiveness of policy and vice versa. One of the implication of the "theory of policy" in a world of certainty or "certainty equivalance" is that structural chanes which simply alter the magnitude of the response to policy do not alter the attainable utility level. Another feature of the theory of policy in a world of certainty is that a policy-maker with more instruments than the targets is free to discard the excess instruments, and it makes no difference to his performance which ones he discards. These results are crucially dependent on the assumption that the response of target variables to policy instruments is known for certain. This assumption seems to be quite unrealistic, since it is difficult to imagine a real world policy-maker in such an enviable position. With our incomplete understanding of the economy and our inability to predict accurately the occurance of disturbing factors such as strikes, wars, and foreign exchange crises we cannot expect to hit policy goals exactly. For this reason, many economists seem to have agreed on the fact that some periods of inflation or unemployment are unavoidable. The evitable lack of precision in reaching policy

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(1) Certainty equivalance may be defined, in short, as the situation in which the policy-maker knows the expected values precisely as if they would actually occur. See. W. Brainard, "Uncertainty and the Effectiveness of Policy", **The American Economic Review Papers and Proceedings**, May 1967.

goals is sometimes recognized by saying that the goals are "reasonably" stable prices and "reasonably" full employment.

To illustrate this point in a formal way suppose that the policy-maker is concerned with a target variable (y). Assume that y depends linearly on a policy instrument (p) - for example, government expenditures- and various exogenous variables-for example, autonomous investment demand. For our present purpose the impact of exogenous variables may be summarized in a single variable (u). We can write

$$y = ap + u$$

where "a" determines the response of y to policy action.

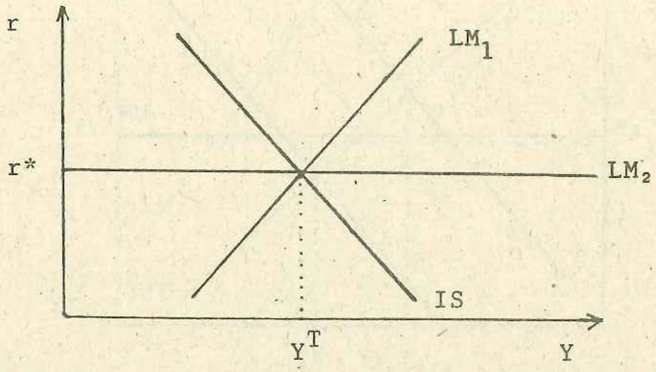
Here the policy-maker faces two kinds of uncertainty. First, at the time he must make a policy decision he is uncertain about the impact of the exogenous variables (u) which affect y. This may reflect his inability to forecast perfectly either the volume of exogenous variables or the response of y to them. Second, the policy-maker is uncertain about the response of y to any given policy action. He may have an estimate "â" of the expected value of the response coefficiet "a" in the above equation, but he is aware that the actual response of y to policy action may differ substantially from the expected value. Both types of uncertainy imply that the policy-maker cannot guarantee that y will asume its target value (y*).

With these ideas in mind we can state two important points. First, policy should aim at minimizing the average size of errors. Second, policy can be judged only by the average size of errors over a period of time and not by individual episodes.

Having had a quick look at the issue of uncertainty and its importance in economic policy in general we can now turn to a more particular subject, namely the impact of uncertainty on the choice of monetary policy instrument. The effect of uncertainty for monetary policy may be examined within the contex of Hicksian IS-LM model. In this simple model we have two sectors, the expenditure sector and the monetary sector. It is assumed that the price level is fixed in the short run. Consumption, investment, and governmet expenditures functions are combined to produce the IS function. The LM function is produced by combining the demand and supply of money functions. In figure - 1, Y^T is some target income level which the monetary authority wishes to achieve through monetary policy. If monetary policy fixes the interest rate at r* then the resulting LM function is LM_2 while if policy fixes the stock of money, say at M* then the resulting function is LM_1.

If the positions of all the functions could be predicted with no errors, our model would gain a deterministic nature (or the properties of the certainty equivalence case) in which it would obviously make no difference whatsoever whether the policy prescripton is in terms of setting the inverest rate at r* or in terms of setting the money stock at the level M* that makes LM function cut the IS function at Y^T.

Figure - 1



In reality the positions of the functions are never precisely known. Let us first consider Figure-2 in which the IS function is randomly shocked (uncertainty over the position of the IS function). This uncertainty may result from instability in the underlying consumption and investment functions. What is known about the IS function is that it will lie between the extremes of IS_1 and IS_2. On the assumption that the money demand function is stable, if the money stock is set at M* the LM function will be LM_1 and income may end up anywhere between Y_1 and Y_2, with a fixed interest rate policy the LM will become LM_2 and the range of income is greater than the money stock policy's range. Hence we can say that the money stock policy is superior to the interest rate policy, since an unpredictable disturbance in the IS function will affect the interest rate, which in turn will produce spending changes that partly offset the initial disturbance.

Figure - 2

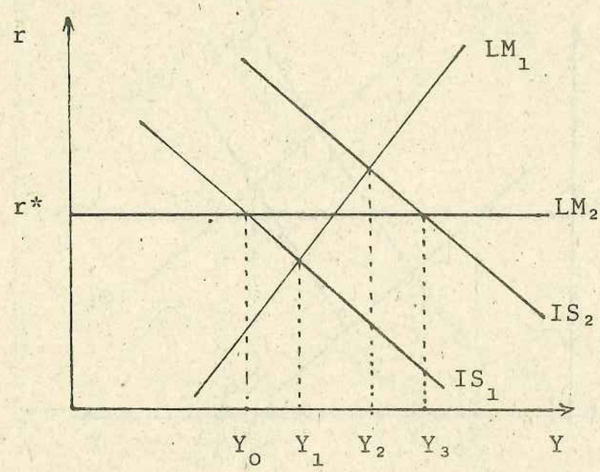
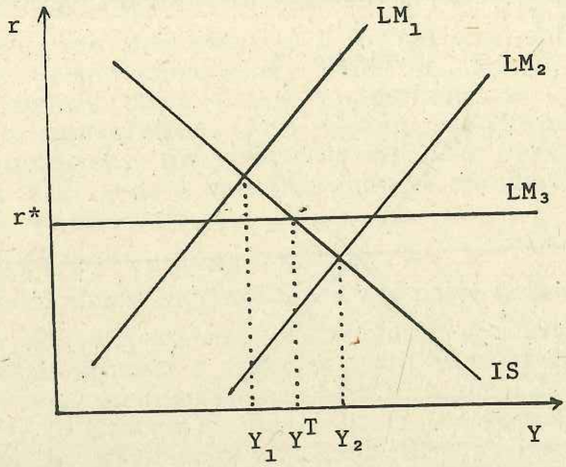


Figure - 3



In Figure - 3 the opposite polar case is analyzed. Here it is assumed that the IS function is stable i.e. it is known with certainty but the money demand function is randomly shocked, that is unpredictable shifts in the demand for money cause unpredictable shifts in the LM function if a money stock policy is followed. Setting the money stock at M* will lead to an LM function between LM_1 and LM_2 and income between Y_1 and Y_2, while setting the interest rate at r* will lead to LM_3 and Y^T. The interest is the proper instrument in this case.

In practice, of course it is necessary to cope with uncertainty in both the IS and LM functions. This situation is shown in Figure - 4, where the unpredictable disturbances are larger in the IS function, and Figure - 5 where the unpredictable disturbances are larger in the LM function.

Figure - 4

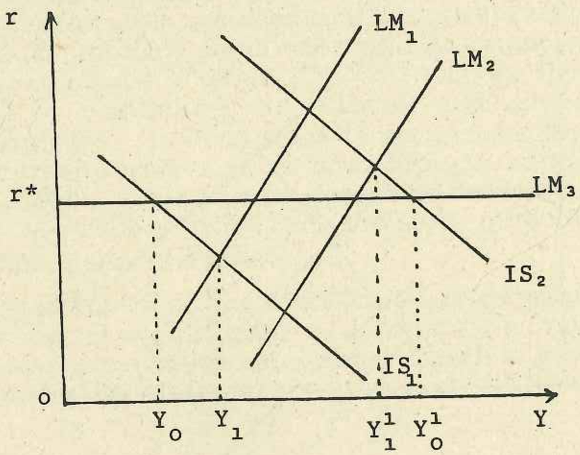
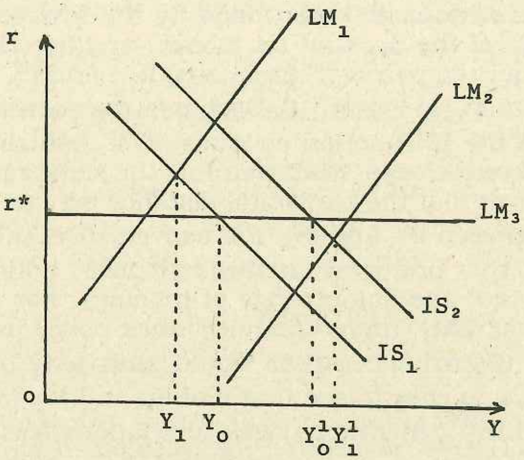
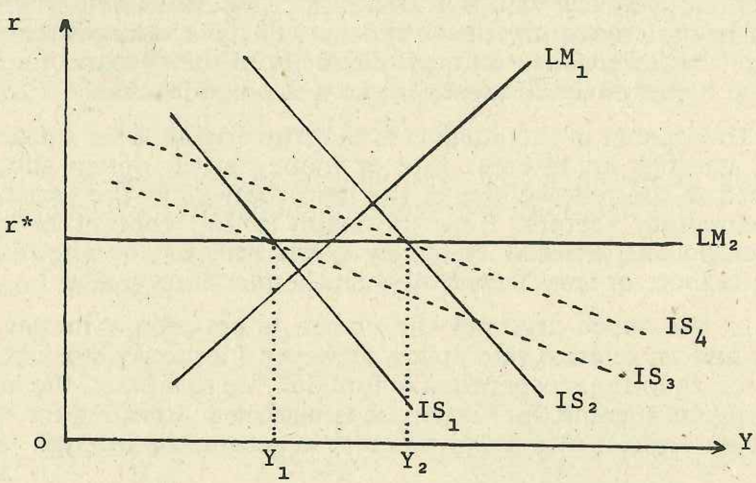


Figure - 5



If the disturbances in two functions are not independent the situation becomes more complicated. For example consider Firgure-5 in which the interest rate policy is superior to the money stock policy if the disturbances are independent. Suppose that the disturbances on LM_1 side of the average LM were always accompanied by disturbances on the IS_2 side of the average IS function. This would mean that income would never as low as Y_1, but rather only as low as the intersection of the LM_1 and IS_2, an income not as low as Y_0 unter the interest rate policy. Similarly, the highest income would be given by the intersection of LM_2 and IS_1 an income not so high as $Y_0{}^1$.

Figure-6



In addition consider the effects of the relative sizes of random elements in the IS and LM functions, we need to take into acount the slopes of the functions as determined by the interest elasticities of investment and of the demand for money, and by other parameters as well. Consider the pair of IS functions, IS_1 and IS_2, as opposed to the pair, IS_3 and IS_4 in Figure - 6. Each pair represents the upper and lower limits of the IS function as a result of disturbances, but the pairs have different slopes. Each pair has the same random shock as shown by the fact that the horizontal distance between IS_1 and IS_2 is the same as between IS_3 and IS_4. For convenience, the function have been drawn so that under an intereşt rate policy both pairs of the IS functions produce the same range of incomes. For simplicity only one LM function, LM_1, under a money stock policy has been drawn. Now consider disturbances that would shift LM_1 back and forth. From Figure-6 it is easy to see that if shifts in LM_1 would, given the pair of IS_1 and IS_2, generate income fluctuations less than Y_1 to Y_2 (fluctuations under an interest rate policy) then with the pair IS_3 and IS_4 income fluctuations would also be less than Y_1 to Y_2. In this case a money stock policy would, therefore, be preferred regardless of which IS pair obtains.

The above argument can be made more precise by saying that if variability of the LM function is small enough relative to the IS function, then a money stock policy will be preferred to an interest rate policy regardles of the interest elasticities of the expenditures and the money demand function. How small is "small enough" depends on the income elasticity of the demand for money. When the variability of the LM relative to IS is not "small enough" then a money stock policy will be preffered forthe relatively high values of theratio of the interest elasticity of the demand for money to the interest elasticity of expenditures; an interest rate policy preffered for the relatively low values of this ratio. The intutive reason for this result is that monetary disturbances will have a larger impact on income the lower is the interest elasticity of the demand for money and the higher is the interest elasticity of expenditures.

The upshot of this analyis is that the crucial issue for deciding upon whether an interest rate or money stock policy should be followed is the relative size of the disturbances in the expenditure and monetary sectors. Here the issue is not whether te interest elasticity of the demand for money is relatively low or whether fiscal policy is more or less "powerful" then the monetary policy.

In the above argumet the choice is between a money stock policy and an interest rate policy. However if a money stock policy is superior, than the steeper the LM function, up to a point, the larger is the range of income fluctuation. It is also clear from Figure - 6 that under an interest rate policy an error in setting the interest rate will lead to a larger error in hitting the income target if the IS function is relatively flat than if it is relatively steep. But these facts do not affect the choice between an interest rate and a money stock policies.

We can also express the above argument in an algeabric way in the contex of o formal model. Suppose that we have a static linear IS-LM structure with independent normally distributed errors and known coefficients:

(1) $Y = a_0 + a_1 r + u \,,\; a_1 < o$

(2) $M = b_0 + b_1 Y + b_2 r + v \,,\; b_1 > 0 \,,\; b_2 < o$

Where $E[u] = E[v] = o$

$$E[u^2] = \sigma_u^2 ;\; E[v^2] = \sigma_v^2$$

$$E[uv] = \sigma_{uv} = \rho_{uv} \sigma_u \sigma_v$$

Equation (1), the IS function, is obtained by combining linear consumption and investment equations with the equilibrium condition Y + C + I. In equation (2), the LM function, the left hand side is the stock of money and the right hand side is the demand for money. The parameters are not necessarily constant for all time. The model has two equations and three veriables, Y, M, and r. Monetary policy selects either M or r as the policy instrument so that there are two endegenous variables and one exogenous variable, the policy instrument. In this model the level of income is a random variable, and in general its probability distribution will depend on whether the money stock or the interest rate is selected as the policy instrument.

While in the deterministic model where u = v = o the policies namely the money stock policy and interest rate policy are equivalent in every way, therefore, the choice of a policy instrument can be a matter of convenience, preferrence or prejudice, in the stochastic model the selection of the instrument depends on which instrument minimizes the expected loss from failure of the level of income to equal the desired level. For that reason, let us assume a quadratic loss function so that expected loss, L, given by

(3) $L = E\left[(Y - Y^*)^2\right]$

where Y* is some target income level which monetary authority wishes to achive through an optimum monetary policy.

From equations (1) and (2) we obtain reduced forms for interest rate and money stock policies, respectively.

(4) $Y = a_0 + a_1 r + u$

$= Y^* + u$ when $r = r^*$

$Y = (a_1 b_1 + b_2)^{-1} \left[a_a b_2 + a_1 (M - b_o) + b_2 u - a_1 v\right]$

5) $= Y^* + (a_1 b_1 + b_2)^{-2} \; (b_2 u - a_1 v)$ when $M = M^*$

As can be seen clearly from equations (4) and (5) in the stochastic model the two policies are not equivalent as they were in the detereministic model since the stochastic terms of the reduced form equations will depend on which instrument is selected.

By substituting (4) into loss function (equation 3), we obtain the minimum expected loss, L_r, under an interest rate policy, and by substituting (5) into the loss function, we obtain the minimum expected loss, L_M, under a money stock policy, as given by equations (6) and (7).

(6) $$L_r = \sigma_u^2$$

(7) $$L_M = (a_1 b_1 + b_2)^{-2} \; (a_1^2 \sigma_v^2 - 2 \rho_{uv} a_1 b_2 \sigma_u \sigma_v + b_2^2 \sigma_u^2$$

By comparing the two expected loss function, a policy-maker makes his decision about which instrument he is going to choose in order to achive the target level as close as possible. Obviously the policy which has the smaller loss will be chosen. It should be reemphasized that the magnitudes of the expected loss from different policies depend also on the values of the parameters.

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