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Can the Policy Trilemma Be Exposed in the Mundell-Fleming Framework?

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February 3, 2006

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“Can the Policy Trilemma be Exposed in the Mundell-Fleming Framework?”

Abstract: There is a general recognition that there are deficiencies in the Mundell-Fleming model. Nonetheless, Rose [2000] has stated that Mundell was the first to expose the Policy Trilemma, which identifies an intrinsic incompatibility among: high capital mobility, fixed exchange rates, and monetary autonomy. We look for the source of Rose’s claim.

All of Mundell’s formal modeling after 1964 assumes that capital mobility is zero, so we look to earlier work for verification. The paper in *Kyklos* states clearly that in comparing equilibrium positions, the impotence of monetary policy is independent of the degree of capital mobility.

Two further claims deriving from that model are explored using a analysis which portrays the asset markets consistently: that both the short- and the long-run equilibria are independent of capital mobility; and that the speed of adjustment is higher the greater is capital mobility. We find that in every case these results are overturned in the portfolio balance model.

I. Introduction

Even in today's globalized world, monetary policy continues to play a large role in macroeconomic stabilization, despite some Central Banks' managing their exchange rates. Such activity seems to run counter to the dictum of the Policy Trilemma (Obstfeld et al [2004]), that autonomy of monetary actions is incompatible with such conditions. The reason such policy is rendered ineffective is that in such a setting foreign exchange market operations are very close substitutes for open market operations in domestic market instruments. The foreign exchange market operations needed to stabilize the exchange rate offset the effects of the monetary initiative.

This paper investigates the connection between the degree of capital mobility and the effects of monetary policy, both in the context of the Mundell-Fleming model, and using a simple portfolio balance framework. One's intuition is supported most closely in the portfolio balance framework, which is comfortable with the notion of substitutability between market instruments. Nonetheless Andrew Rose [2000] has said that Mundell was the first to exposit the Incompatible Trinity, and we undertake to analyze this claim.

Mundell's modeling of capital mobility has had an unusual arc, which we delineate in the second section of this paper, showing that after 1964 all his formal analysis assumed that capital mobility is zero. Nonetheless his earlier work did emphasize capital movements, and we look at it in order to attempt to find the source of Rose's allusion.

The Mundell-Fleming model remarkably finds that in both the short- and the long-run, capital mobility has no impact on the equilibrium generated by an open market operation, as is confirmed by the analysis of Swoboda [1972], among others. The speed with which the economy moves between these equilibria, the argument continues, is positively related to the degree of capital mobility, with the speed becoming indefinitely large as the degree of capital mobility goes to perfection.

Not only do the results of a portfolio balance model conform to one's informed intuition, they also contradict those of the Mundell-Fleming model on every point. Thus, short- and long-run equilibria depend on the degree of capital mobility, but so too does the speed of adjustment. Counter to one's unaided intuition, the speed of adjustment tends to depend inversely on the degree of capital mobility, contrary to what the earlier model concludes.

One case in which the speed is independent of the degree of capital mobility is that for a sterilization regime. Such a regime, and the possibility of its instability, is analyzed below. Far from being a "disequilibrium system" (Mundell [1961a]), such a regime is in many ways analogous to other, more familiar regimes, such as those employing unsterilized foreign exchange market operations.

The paper concludes by emphasizing the importance of using a consistent specification of asset markets, including the recognition of a wealth constraint. It is argued that as Mundell and Company rushed on to the Monetary Approach to the Balance of Payments

(Frenkel and Johnson [1976]), and the introduction of rational expectations into the macromodel (Dornbusch [1976]), many problems were left unsolved. It seems appropriate to look at those problems again, and to return to the solutions generated by the Mundell-Fleming model, because those solutions too deserved to be reconsidered in the context of a consistent model of an open economy.

II. The Evolution of Mundell's Modeling of Capital Mobility

Mundell's work is noted for analyzing the effects of capital movements on the economies which place no restrictions on the mobility of capital across their borders. The Nobel Committee writes of Mundell that he did his most important work in "...the interesting special case with perfect capital mobility." (Persson [2000, xii]) Dornbusch has succinctly characterized this contribution as dealing with "...the functioning of an economy with an open capital account." (Dornbusch [2000, 199]) While it is true that Mundell did write such a paper, (Mundell [1963], as well as a follow up to it (Mundell [1964]), the fact is that these are the only places in which he makes this assumption. A convincing argument can be made, that the inspiration for adopting such an assumption was the noteworthy results which Fleming [1962] had identified in his article which was written about two years and more before Mundell's capital mobility papers were published. Despite Mundell's being immediately under Fleming in the Special Studies Division of the Research Department at the Fund at the time, Mundell did not cite his boss's work.

Previous to this Mundell had introduced capital mobility into the analysis, but the argument was that while the dynamics might be modified by its presence, the equilibria were not. And any modifications of the dynamics were quite minor, so that Humean or Keynesian adjustment mechanisms continued to play a role in a recognizable way. In the paper where this argument first appears (Mundell [1961a]) there is no claim as to the degree of capital mobility. Ironically, it is the low capital mobility case that is portrayed in the figures in the article, in which the FF locus is steeper than LL (as we repeat in Figure 1 below).

Also relevant to this point is the extent of capital mobility in other early papers (Mundell [1960], [1961b], and [1962]). It is true that in all these papers capital mobility has a role, and that in the first of these the role is central. But the key point about capital mobility in such papers is that the analysis is inconsistent unless mobility is less than perfect. The term that is used in one of these paper is that capital can range up to being "almost completely mobile" (Mundell [1960, 237]), but it can not be perfectly mobile.

Perfect capital mobility, which one finds in Mundell [1963], seems like the natural destination for this assumption, and that once one had reached it he would deviate from it only with a clarifying explanation. This is clear from the observations that one finds in that paper. Namely, that the assumption "...will overstate the case, but it has the merit of posing a stereotype towards which international financial relations seem to be heading." (Mundell [1963, 475]). The conclusion from this analysis is enunciated in breath-taking fashion: "perfect capital mobility implies different concepts of stabilization

policy from those to which we have become accustomed in the post-war world.” (Mundell [1963, 484])

It is therefore very striking that in all subsequent modeling Mundell assumes that capital mobility is zero. This is a conscious choice made in at least one case involving the argument about Growth and the Balance of Payments: “The conclusions do not depend on capital mobility, but they remain valid when such mobility exists, so we shall assume capital is completely immobile.” (Mundell [1965, 135])¹ Every chapter in Mundell’s second theory book, *Monetary Theory*, takes capital mobility to be zero.

There is a persuasive argument that capital mobility has little to do with some of the subjects covered in Mundell’s later work: Growth and the Balance of Payments, and the Monetary Approach to the Balance of Payments. But the same cannot be said about “Uncommon Arguments for Common Currencies,” (Johnson and Swoboda [1973]) in which the absence of a non-monetary financial instrument is precisely what causes consumption to fluctuate in step with output in the flexible exchange rate case. In a fixed rate regime, in contrast, money is tradable. It follows that fluctuations in consumption need not mimic those in output, since money balances can be run down or accumulated, depending on whether the consumer wishes to consume more or less than her income (output).

To put this in perspective, just seven years after Mundell was writing that it is was “...not far from the truth...” that Brussels could not sustain an interest rate differential with Amsterdam and Zurich (Mundell [1963, 475]), he was making the assumption that such a differential among the same financial centers can be maintained at any level, because capital movements are absent. It is extraordinary to think that Europe embarked on the path that led them to monetary union on the basis of a model that said that capital markets between the various countries did not exist.

III. Policy Trilemma

The Policy Trilemma is the observation that there is an “...intrinsic incompatibility of perfect capital mobility. (b) fixed exchange rates and (c) domestic monetary autonomy.” (Rose [2000, 215]) Rose claims that Mundell was the first to exposit this “incompatible trinity.”

If Mundell were the first to exposit this idea, then it would have to be in his early papers, since after 1964 all his models assumed that capital mobility was zero. Therefore the most likely source for such an exposition is in the work that was done in the early sixties, when capital mobility was positive, and especially in the checkerboard square papers (Boyer and Young [2006]) which deal with both fixed and flexible exchange rates and both monetary and fiscal policy. These papers include Mundell [1961b] and [1963] (as

¹ This paper was first presented at a lecture at Princeton University in 1965. In addition, Mundell’s most famous zero capital mobility paper [1968b] was presented at a seminar in the Research Department of the IMF in 1962 or 1963. This shows that even in the early sixties Mundell was willing to assume capital immobility.

well as Fleming [1962]). Also, the paper in *Kyklos* looks promising because it takes an extended look at the consequences of an contractionary monetary initiative.

By looking at this set, we are ruling out other papers mentioned above (Mundell [1960], and [1962]). We do this because these papers have an “unacceptable” definition of monetary policy as Mundell realized soon after writing them (Mundell and Swoboda [1969, 262]). If the Trilemma means anything, it is that all of the elements which go into it are necessary. Notably, one needs to have a well-defined view of what monetary autonomy means, and this requires a suitable definition of monetary policy. In Mundell [1960] monetary policy is not even defined, whereas in Mundell [1961b] it is portrayed in a way which Mundell soon after “...no longer liked or accepted.” (Mundell and Swoboda [1969, 262]) The argument is that using the interest rate as a gauge of monetary policy is inappropriate, especially as capital mobility becomes high.

Mundell is consistent in his claim that with flexible exchange rates monetary policy can function effectively, even in the perfect capital mobility case. Therefore we do not need look exclusively at papers which treat both exchange rate regimes, that is, only at the checkerboard square papers. But to look just at Mundell’s most famous paper does not provide a basis for the Trilemma. Since that paper deals only with the perfect capital mobility case, it can not establish that such an assumption is necessary for the inefficacy of monetary policy. It could be that perfect capital mobility is just one case, perhaps of an infinity, for which monetary policy is impotent.

A far better approach would have been to have capital mobility captured as a parameter which is permitted to go to zero or infinity. This is precisely what Fleming [1962] does, which supports our view that that paper is an outstanding contribution to the literature.

The Mundell paper to which we should look is *Kyklos* (Mundell [1961a]), for it shows that under fixed exchange rates monetary policy has an impact on output and employment which is independent of the degree of capital mobility in the short run. And has no impact on these variables in the long run, even if prices are sticky. It demonstrates quite clearly that the key concern is whether the policies of the central bank are such as to let the economy attain its long-run equilibrium. But given that it is attained, monetary policy has no impact on output and employment, no matter what the degree of capital mobility, including even zero (Mundell [1961a, 165]) or infinity.

The argument in this paper is worth repeating, so we do so in the next section.

IV. The Inefficacy of Monetary Policy in the Mundell-Fleming Model

This diagrammatic framework is so familiar, it is standard tool for teaching open economy macro at the intermediate level. This discussion is based on Figure 1 in the *Kyklos* paper.

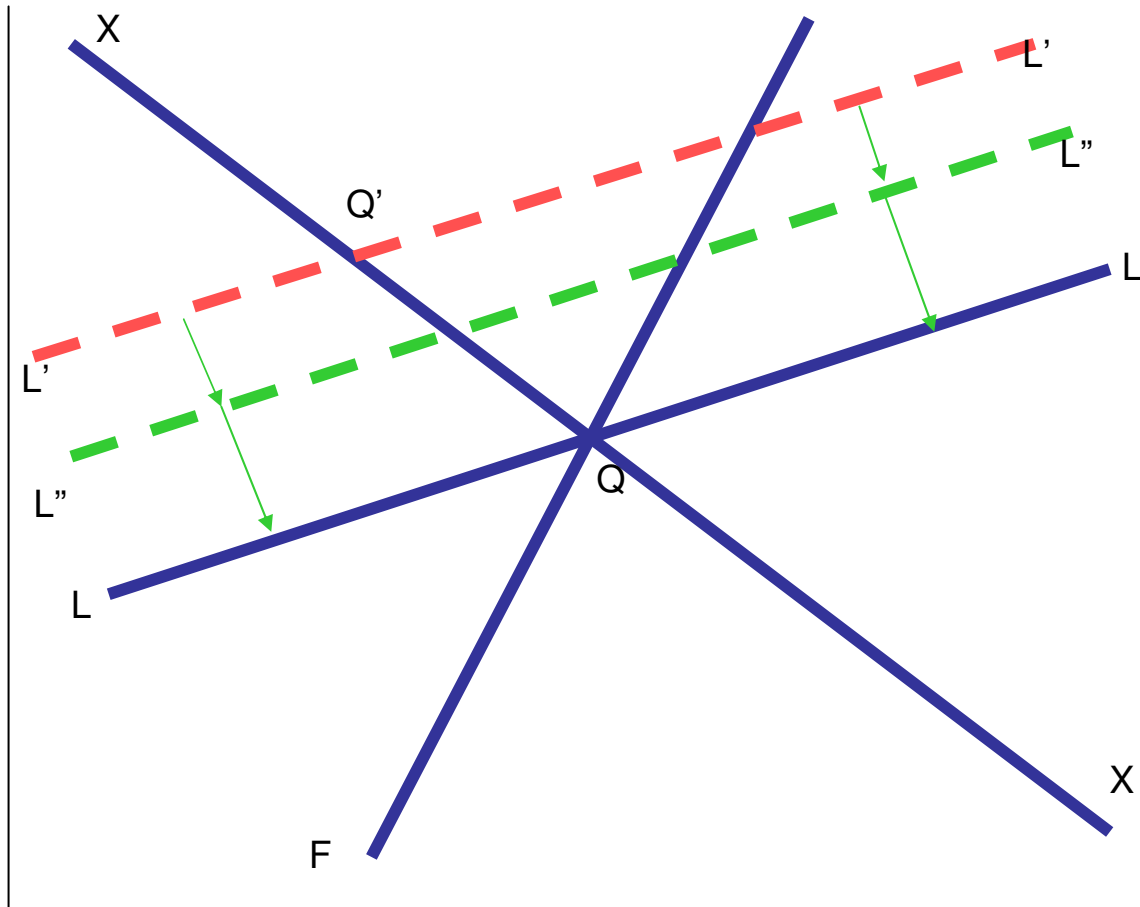


Figure 1: Adapted from Mundell [1961a].

This is an “internationalized IS-LM framework,” in which XX is the locus of points of equilibrium in the goods market, LL is the equilibrium locus in the money market, and FF is balance in the foreign exchange market. This framework is used for an analysis of the consequences of

“...a Hume-type experiment in which a fraction of the money supply is ‘annihilated overnight.’ From an initial equilibrium position passing through Q the LL curve shifts upward and to the left to, say $L'L'$, raising interest rates and lowering money income, generating a new equilibrium in the markets for goods and money at Q' . But Q' cannot be a position of overall equilibrium... The LL curve thus begins a gradual shift back to its original position, the only one which permits equilibrium at the point Q .” (Mundell [1961, 157])

We should note that this Hume-Polak conclusion about monetary neutrality in the open economy does not depend on the degree of capital mobility. The curves shown in this figure present the low-capital-mobility case, in which FF is steeper than LL . But the argument in the high-capital-mobility case would be identical. Since the LL locus is the only curve which is shifting both in the short run and as the economy returns to the full

equilibrium, its relative slope with respect to FF is not germane to the process that is laid out here. So long as we are considering only equilibrium positions, the results presented here should hold no matter what the degree of capital mobility.

The ineffectiveness result for monetary policy under fixed exchange rates shown in this analysis could not have been considered a novel one, as the discussion in *Kyklos* makes clear. This conclusion had been in the modern literature since 1957, as is shown by the following quotation from Polak [1957, 10]:

“...A temporary expansion of credit (terminated, but not reversed, after the end of, say, one year) will, by itself, bring about
 (1) a temporary increase in money income and the stock of money;
 (2) a temporary increase in imports and a permanent reduction of reserves equal in size to the credit expansion.”

Since the mechanism that lies behind this result is of quite ancient origin, as is widely recognized, this conclusion can validly be attributed to Hume [1752], even if his statement is highly stylized, and entirely in a verbal form.

A. The Short-Run ‘Equilibrium’ Is Independent of Capital Mobility

The equations which lie behind these curves are worth presenting because they reveal a number of further observations about the model. Most notably, that the short-run ‘equilibrium’ in the model is independent of the degree of capital mobility. The appendix to Fleming’s [1962, 378-79] points this out clearly, and is likely the reason that he did not take the limit as capital mobility becomes indefinitely large in the fixed exchange rate regime.

This model is captured by the following equations:

$$X(e/P, Y, r) = 0 \quad (1)$$

$$L(Y, r) = M/P \quad (2)$$

$$\Delta M = k \cdot \{ T(Y, e/P) + K(r) \} \quad (3)$$

For this system we have: equilibrium in the goods and services market (1) (where X is the excess demand for domestic goods); equilibrium in the money market (2) (where L the demand function for real money balances); and possible disequilibrium in the balance of payments (3), in which case the money supply is changing in a no-sterilization fixed exchange rate regime. In this equation, k is taken to be a constant, reflecting the fact that in modern financial systems, there isn’t a one-for-one relationship between the loss in international reserves and the change in the money supply. T stands for the trade account surplus, and K for the capital account surplus. In all cases, the effects on the values of the functions of the variables is shown by the signs which appear beneath them.

In this system: P is the domestic price level; e is the exchange rates, measured as the price of foreign exchange in terms of domestic currency; Y is domestic output (income); r is the domestic interest rate; and M is the domestic money supply.

What this system portrays is the short-run equilibrium in which there is the possibility of “external disequilibrium.” In that timeframe the quantity of money may be changing even though its level may be given. The movement to the long run relies on the argument that eventually the money supply must adjust to a level which generates balance in transactions with the rest of the world.

In the world of Keynesian aggregate supply for which P is constant, but Y may vary, the first two equations, representing the XX and LL loci, determine the equilibrium values of r and Y in the short run. Since capital mobility does not have any influence on the positions or slopes of XX and LL , it cannot have any impact on their point of intersection. Furthermore that point gives the values of Y and r in the short run, and therefore capital mobility can not be a determinant of the values of these variables.

B. The Long-Run Equilibrium Shows Inefficacy, No Matter What Degree of Capital Mobility

The same argument shows that the long run equilibrium is independent of the degree of capital mobility. In that timeframe the change in the money supply is driven to zero. Equation (3) in the model above then becomes one in two variables for the fixed exchange rate case (if we continue with the Keynesian assumption that P is given). Combined with the goods market condition, we again have two equations in two unknowns.

In general the degree of capital mobility will be an important influence on the long-run equilibrium, but in this case the shock is entirely monetary, so only equation (2) is affected, and only in the short run. Since the long-run equilibrium takes place at the intersection of XX and FF , and since neither of those loci has shifted, it is clear the long-run equilibrium is independent of the degree of capital mobility.

This result, while not as startling as our short-run conclusion, certainly merits further attention for non-monetary shocks. But in the present case we are faced with the conclusion that nothing depends on capital mobility, contrary to the big fuss which Mundell made about it in 1963.

C. The Speed of Adjustment Is Higher the Greater Is Capital Mobility

The results reported above have been spelled out in admirable detail in Swoboda [1972]. He further points out that it is the speed of adjustment between these two equilibria which is the important influence of the capital mobility parameter in the Mundell-Fleming model for the fixed exchange rate case.

This conclusion can be seen clearly from the diagram above. If we take the short run equilibrium after the “monetary annihilation” as given, but we permit the degree of capital mobility to increase, this has two effects on the diagram. Most clearly, the slope of the FF locus falls in value, so that line comes closer to a horizontal position. But the second point is that any position off the FF locus now represents a greater imbalance in international payments than had existed previously.

In particular, at point Q’ the balance is now in greater surplus than it was in the low capital mobility case. The trade account has the same value as before, but now the higher interest rate value at Q’ means that more capital is drawn into the economy, and that the money supply is augmented more rapidly. Since the adjustment mechanism relies on the movement of the money supply, this more rapid change means that the speed of adjustment to the equilibrium is more rapid.

V. A Consistent Model of a Small Open Economy

Now all the results that we noted above, may be plausible, but they are hardly intuitive. One would think that the degree of substitutability between domestic and foreign assets would be a crucial parameter in determining the nature of the short run equilibrium. On the other hand, if one focuses attention on monetary neutrality, and if the exchange rate is indeed fixed, then there is not much flexibility to the position of the long-run equilibrium.

But it is the result about the speed of adjustment that is the most counterintuitive. What does the degree of substitutability have to do with the speed of movement from one equilibrium to another? Indeed, isn’t the more plausible argument that the speed of adjustment should be slower for the high capital mobility case, because the short-run equilibrium is such that quantities and yields are brought into closer conformity with their long-run values. This leaves less need and less pressure for adjustment, and therefore a lower speed of adjustment of the economy. These conclusions are precisely what we derive below.

The model we now present is a variant of portfolio balance models which were popular during the period 1960-85. They never held center stage because so much attention was given instead to models expounding the Monetary Approach to the Balance of Payments, or which focused on the nature of expectations in the international financial markets, such as we see in Dornbusch’s [1976] celebrated “overshooting” model. While this model does not have that glamour, it does provide consistency in thinking about open economy macro problems, because it accommodates the wealth constraint that is a key ingredient in thinking about asset markets.

This model can be found in Boyer [1975], Branson [196??], Branson and Henderson [1985], Dornbusch [1980??], McKinnon [1966], Marston [1985].

The diagrammatic framework, shown in Figure 2, is very similar to that of the Mundell-Fleming model, but the crucial difference revolves around the third locus: FF in Mundell, but BB in many other portrayals. What the portfolio balance models contend is that the

position of this locus must depend upon asset supplies. With this change it is still the case that the money supply, when pegging of the exchange rate is carried out through non-sterilized foreign exchange market operations, is such as to shift the LL locus so as to slot through the intersection of the other two curves.

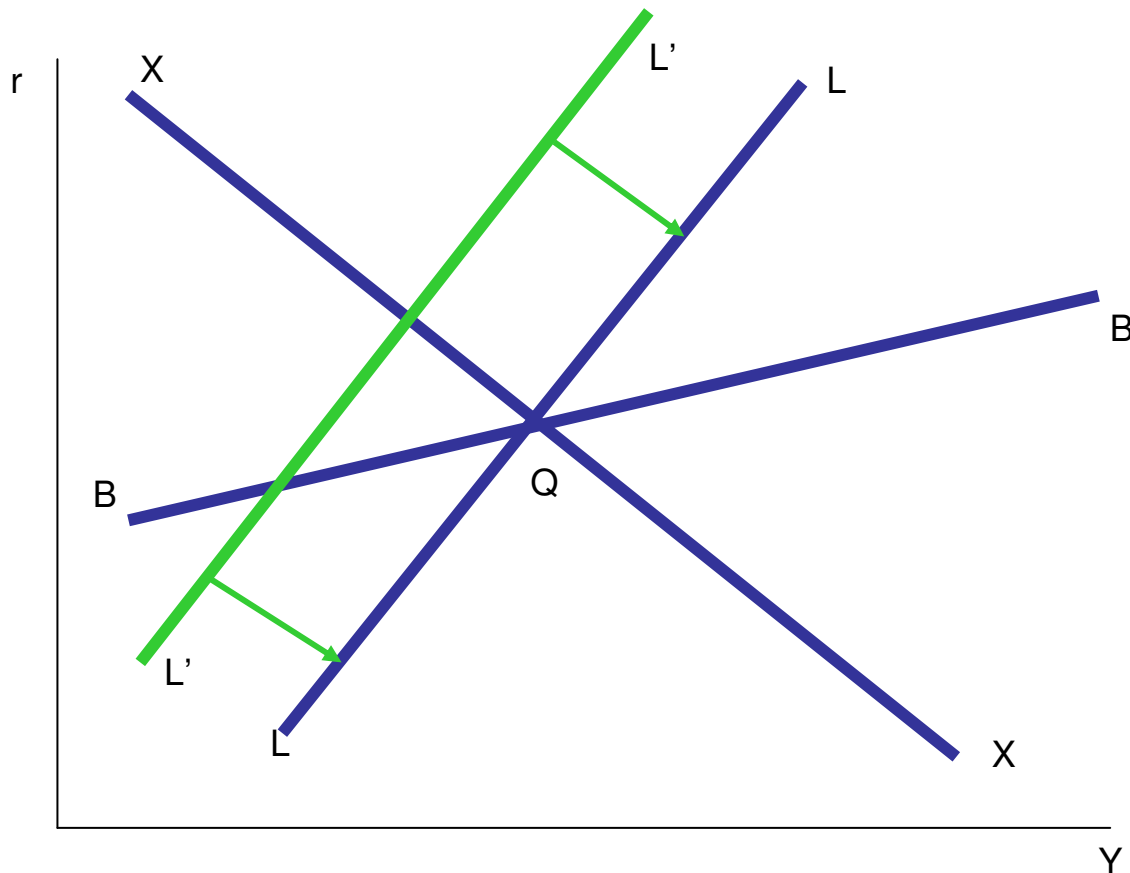


Figure 2: A Portfolio Balance Model

This can be shown most easily using Marston portrayal of an open market operation. Two of the three curves which he considers are familiar: XX represents equilibrium in the goods market, and LL represents equilibrium in the money market. The difference now is that the third curve captures the points where demand for the domestic bond (whose rate of return is shown on the vertical axis of the figure) is equal to an exogenously given quantity supplied of them, and this quantity is typically portrayed as being zero.

As Dornbusch [1980???, ???] has emphasized, the LL locus in essence does not exist, in the sense that to draw it one must postulate a given value for the money supply and for the price level. Since the very point of the discussion of fixed exchange rates during the 1960s was that the money supply is an endogenous value for an open economy, the

function of the LL locus is not to determine equilibrium, but rather to serve as a gauge to see how much the money supply must change (thereby shifting the LL locus by a commensurate amount) so as to get LL to slot through the intersection of the XX and BB loci.

Another striking similarity with the Mundell-Fleming literature is that the slope of the BB loci depends precisely as indicated on the degree of capital mobility, where that parameter is captured in the notion of the degree of substitutability between domestic bonds and foreign bonds (which are called, synecdochally, foreign exchange). Namely, with high substitutability, the BB locus is close to horizontal, whereas with low substitutability there is an upper bound on its slope, namely to equaling that of the LL locus. That is, the wealth constraint says that BB can not get steeper than LL.

VI. Short-Run Effects of an Open Market Operation Depend on Capital Mobility

In this diagrammatic framework it is easy to show that the equilibrium in the short run (for a given level of nominal wealth, when portfolio readjustments have been accomplished) depends in an intuitive way on the degree of substitutability between domestic bonds and foreign exchange.

The diagram captures the effects of an open market operation by using a two-step procedure. The first step portrays the size of the disequilibrium which the open market operation creates, while the second step shows the manner in which the disequilibrium is eliminated through portfolio rebalancing. This is shown in Figure 3.

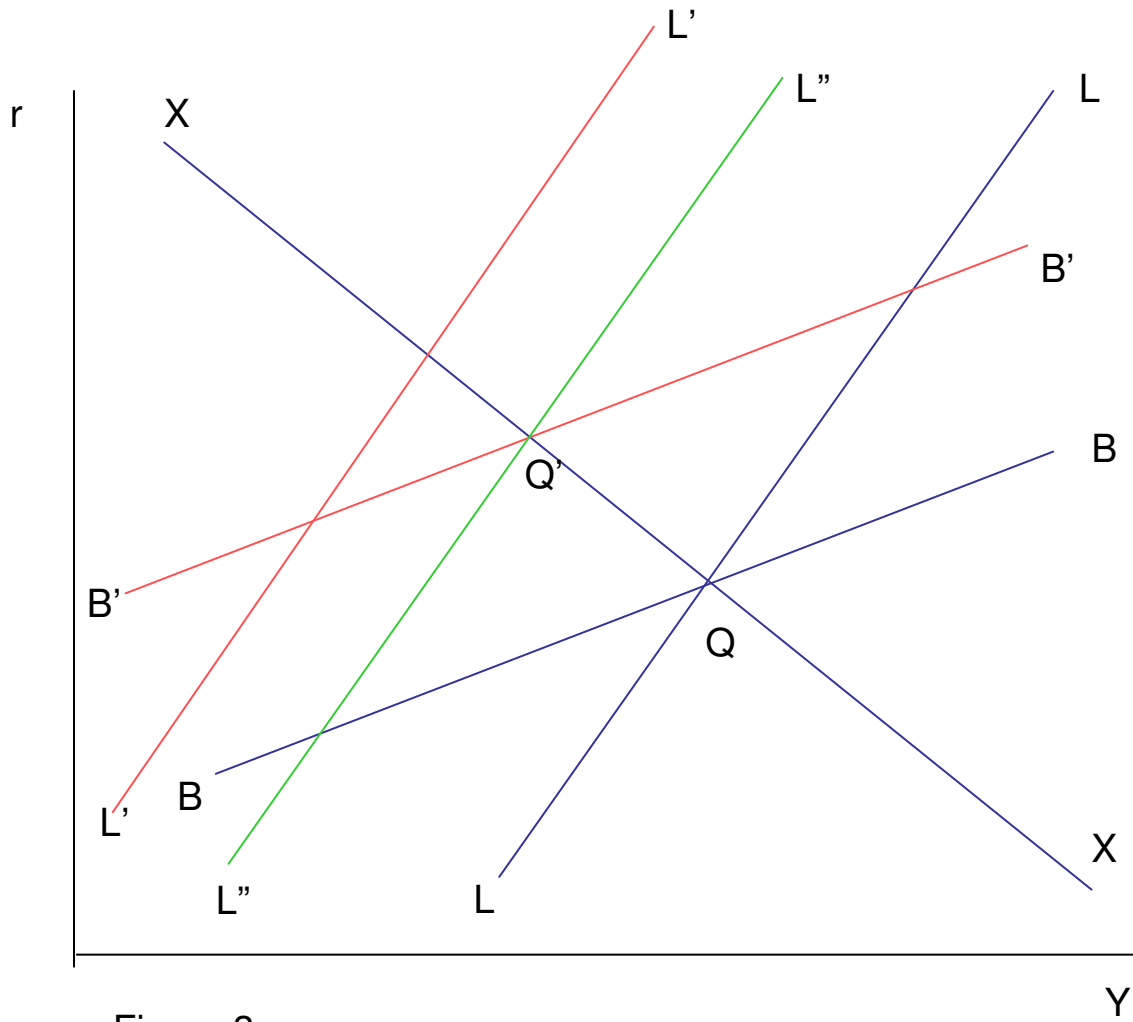


Figure 3

The economy is assumed to start in equilibrium, which is denoted by point Q. At that point the loci for the three markets, shown in blue, intersect each other. The contractionary open market operation represents a shock to two of these markets, and the loci for them are therefore displaced to the positions shown in red. The leftward, upward shift in LL was shown previously in the Mundell-Fleming analysis. In contrast, the similar movement in the domestic bond market equilibrium locus represents a divergence from the previous analysis. The argument is that the increased quantity of domestic bonds which is now present in the open market will be voluntarily held only if the yield on those bonds is higher than previously. Alternatively, at a given value of that yield, equilibrium will hold in this market only if the level of output is lower, reflecting the fact that demand for bonds is assumed to be negatively related to the level of output. (This is consistent with the wealth constraint in that with fixed nominal wealth, a higher level of output increases demand for money (as is conventional in the literature), which must imply that demand for other financial assets is reduced.) (A similar argument with respect to foreign exchange justifies the left shift of LL being greater than that of BB, so that their intersection moves in a northwesterly direction.) Since we are assuming that capital mobility is high, the movement of the intersection between LL and BB is closer to horizontal than is XX. That is, that intersection now lies to the left and below that locus.

This shows the disequilibrium which is created by the open market operation. The resolution of this disequilibrium, if foreign exchange market operations are used to peg the exchange rate, is to permit the money supply to rise somewhat, as the Central Bank purchases foreign exchange in the open market to counter the pressure on the exchange rate to fall. Since there is no further change in the quantity of domestic bonds in the open market, its locus does not adjust further. Therefore given that we have specified the position of BB, that locus together with the XX locus determine the position of the new equilibrium. It is shown in the figure as point Q'. In order to have the money market clearing as well, the quantity of money must rise, but by less than its initial decrease, and that is shown by the rightward shift in LL, taking it back partway to its initial position.

The various colors of the curves that generate the new equilibrium are explained as follows: since XX is not shifted, it is shown in blue. BB is at the position to which it was displaced by an exogenous shock, and therefore it is shown in red. And LL is the endogenous response, dictated by the policy regime which is in place (namely, fixed exchange rate, with pegging effected by foreign exchange market operations), and is shown in green.

The question immediately arises as to how capital mobility influences the comparative statics of this shock. Once again, the answer can be seen in the two steps which we have distinguished above. The slope of the LL locus, and its displacement due to a decrease in the money supply are both independent of the degree of capital mobility. In contrast, for the BB locus, only its leftward displacement is independent of the degree of capital mobility. But since higher capital mobility causes BB to become closer to horizontal, the displacement of the intersection between LL and BB moves more in a westerly direction, and moves less in a northerly direction.

The immediate conclusion is that both output and interest rates move by less the higher is the degree of capital mobility, as is obvious from the intersection along an unshifted XX locus being closer to the initial equilibrium than otherwise. But it should also be noted that the adjustment of the money supply after the initial open market operation is larger the greater is the degree of capital mobility. In the limit of perfect capital mobility, the only variables whose values change as a result of an open market operation are domestic credit and international reserves, a result which we associate with Polak and Mundell.

The focus here has been on the short run. An extension to this analysis would look also at the long run. Of particular interest would be equilibria under a whole array to exchange rate regimes which satisfy monetary neutrality. Since that criterion includes that the value of the interest rate must be the same as it was originally, it is likely that capital mobility has little impact on the long-run equilibrium in that case.

VII. The Effect on the Current Account

We do not analyze the complete path of adjustment for this economy as it moves from the short-run equilibrium to its new steady state, but the tools which we have developed permit us to see whether the speed of adjustment depends positively on the degree of capital mobility, as the Mundell-Fleming model contends. The presumption is that only the attainment of the target level of real wealth is the mechanism at work. There is no analysis of the way in which changing values of interest rates in the short run may alter the level of investment and therefore the capital stock which the economy has in its productive resources. But since these would depend positively on the degree of movement of yields due to the shock, it is hard to see how the speed would be increased when higher capital mobility puts a limit on the extent to which the yields actually move.

The key to seeing how capital mobility influences the speed of adjustment resides in noting that the open market operation had no influence on the position of the XX locus. The short-run equilibria that we are comparing are along the same such curve, and therefore we can identify how the balance between income and expenditure is changing as we move from one to the other.

Since the XX locus represents the set of points for which the domestic goods market clears, we can identify those points with the equilibration of a very familiar equation:

$$S + T - I - G = CA.$$

Moving in a northwesterly direction along XX moves us to points of lower values of Y and higher values for r. Any conventional specification of CA would argue that these are points for which the value of the current account is higher than its value previously.

If we started in a steady state for which the value of CA is zero, then after the contractionary open market operation, this country is experiencing a current account surplus. That is, its expenditure is less than its income, so its nominal wealth in the form of credits against the rest of the world is increasing.

In thinking about the movement to the long run, it is natural to envisage the full-employment variant of this model, because in that timeframe the aggregate supply curve is likely to be much less elastic than it is in the short run. This variant of the model supposes that nominal income varies because the price level does. It is therefore natural to place the price level as the endogenous variable on the horizontal axis of our diagram. This change is made in Figures 4 and 5.

The question arises as to the consequences which the increase in nominal wealth which we deduced from our previous diagram will have on the system. Will it cause the economy to move away from its long run equilibrium, because the increase in wealth will cause income to exceed expenditure by even more? Or will it cause the economy to move back towards its long-run equilibrium, because the increase in wealth will cause expenditure to exceed income, so that the extra wealth will eventually be dissipated? We will see that the conclusion depends on the exchange rate regime which we portray.

VIII. Speed of Adjustment to the Long Run

The framework which we have used above can be augmented with a single curve, in order to provide us with the tools we need to identify the speed of adjustment to the long run. Namely we need to identify the position of the locus of points for which the current account is equal to zero. In the initial, long-run equilibrium which we have identified this curve must have passed through the point of intersection of the loci shown, since by the very nature of that term, if the current account were different from zero, the position would not be one of a steady state. The fact that credits or debits with the rest of the world were accruing, means that further adjustments would be needed in order to allow the system to settle down and reach a position that can be sustained indefinitely.

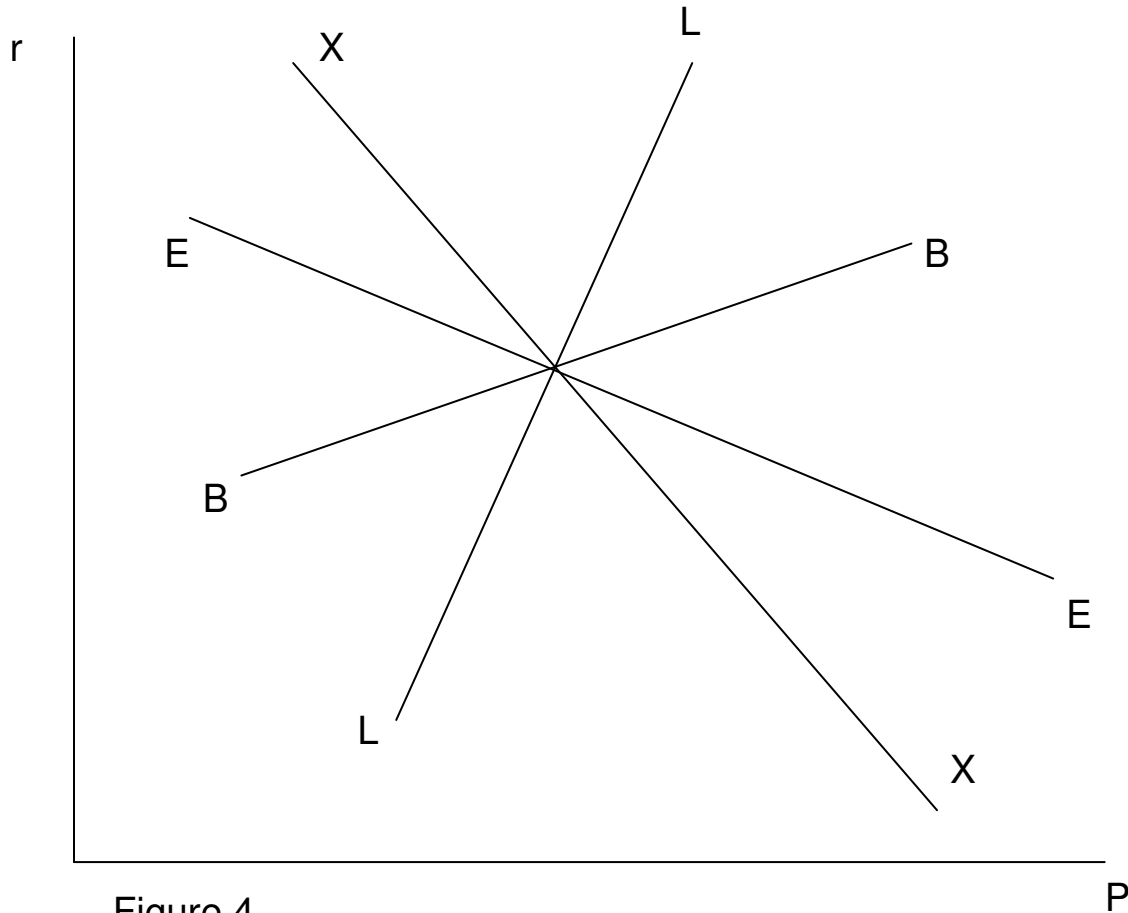


Figure 4

Identifying a point on this locus is just the beginning. What is the sign of the slope of this locus? To answer this question we need to be more specific about the nature of the determinants of the current account. For simplicity we assume that the level of expenditure in this economy is dependent on the level of wealth and on the value of the domestic rate of interest. Specifically, we assume that total expenditure does not depend on the real or nominal values of the exchange rate.

If expenditure depends positively on real wealth and negatively on the value of the interest rate, then it can be shown that not only is the locus of points for which expenditure is equal to income negatively sloped, but that it is closer to horizontal than is the XX locus. The initial equilibrium, with this curve drawn in, is shown in Figure 4.

Of equal importance is the displacement of this locus as nominal wealth increases. This is easy to characterize, since we are portraying the simple specification outlined above. In Figure 5 the initial equilibrium is denoted by Q . The horizontal displacement of EE is equal, in percentage terms, to the increase in wealth. The reason is that at a given interest rate, if real wealth is restored to its previous value, then expenditure should be the same as previously. Real wealth has the same value as before when the increase in nominal wealth is paired with an equal percentage increase in the value of the price index.

The increase in nominal wealth shifts the other curves in the diagram in ways that easily understood, specifically we hold constant the values of: the quantities of domestic bonds, and money; and the value of the exchange rate. An increase in nominal wealth due to an increase in foreign exchange causes the displacements of these curves which are shown in Figure 5.

For convenience of exposition we assume that nominal wealth increases by ten percent, and the price level initially is equal to one.

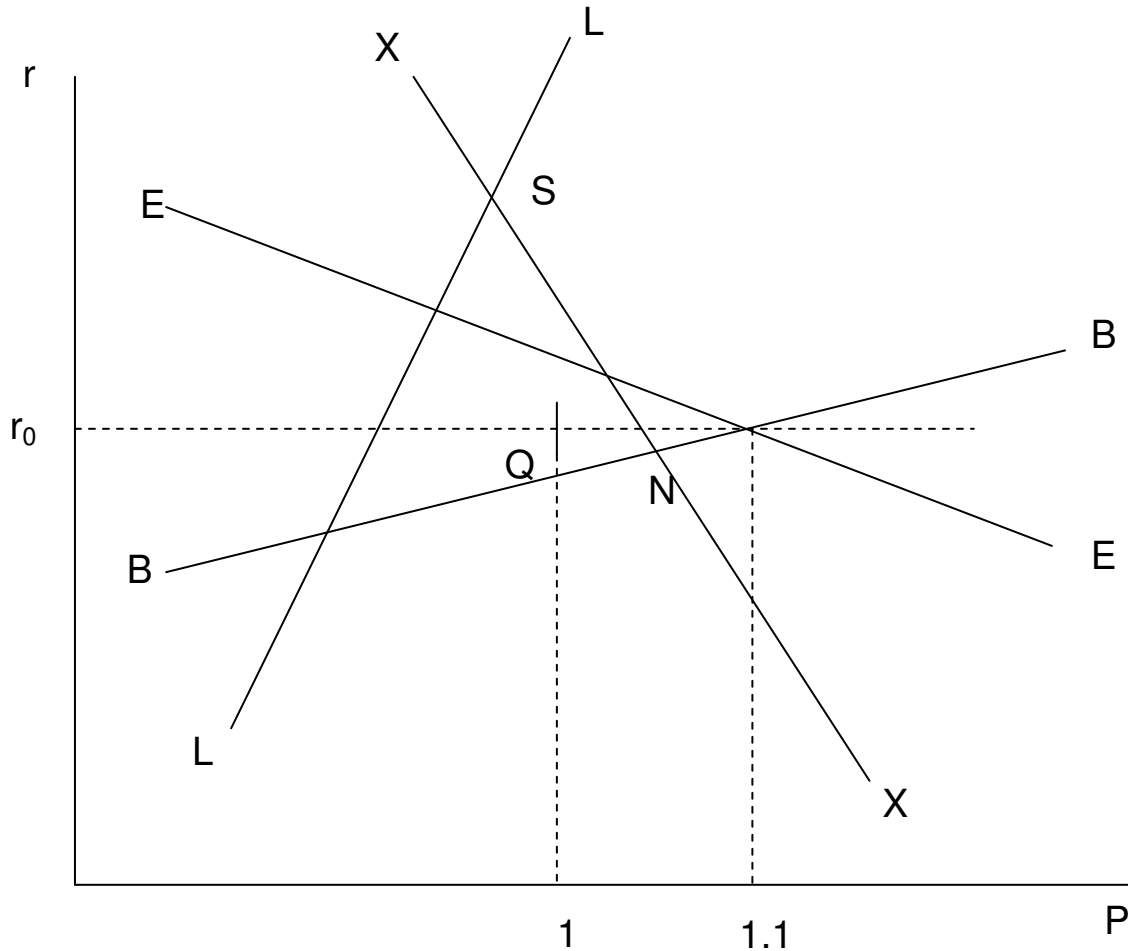


Figure 5

The shifts in the other curves in the figure are straightforward. If the quantity of domestic bonds is initially zero, then the argument above applies to the BB locus as well. Namely, an increase in nominal wealth combined with an equiproportionate increase in the price index restores equilibrium to this market. That is, a ten percent increase in the quantity of nominal wealth, combined with a ten percent increase in the price level keeps the quantity of real wealth unchanged. Since the quantity of domestic bonds is zero, the same value of interest rate should cause the domestic bond market to clear. Thus, the horizontal displacement of BB , due to a ten percent rise in nominal wealth, is rightward by ten percent.

It can be shown that XX , too, shifts right as a result of an increase in nominal wealth, but its displacement is less than ten percent. The reason is that the exchange rate is held constant in drawing this locus. As a result, a ten percent increase in the domestic price level has two effects on the goods market: it decreases real wealth by ten percent; and it increases the relative price of domestic goods by ten percent. An increase in nominal

wealth of ten percent offsets that first effect, but fails to offset the change in relative price, thereby leaving an excess supply in this market. Only if the increase in domestic prices is somewhat less than ten percent is equilibrium restored in this market when nominal wealth is increased by ten percent. Thus the horizontal displacement of XX is less than ten percent.

Finally, the LL locus is displaced to the left as a result of an increase in nominal wealth, specifically in the form of an increase in foreign exchange. That increase creates an excess demand for real money balances, since it is a normal asset. To raise the quantity of real money to match the demand for it, the price level must be reduced. In the process the quantity of real wealth will rise, but the price index effect will more than offset that, and equilibrium will be restored to the money market.

This analysis of the displacement of these curves due to an increase in nominal wealth can now be put to a useful purpose. Namely, this same analysis shows the disequilibrium that results from an exogenous increase in nominal wealth. What we wish to focus on here is the size of the imbalance between expenditure and income in two cases: when the Central Bank follows a policy of pegging the value of the exchange rate by using unsterilized foreign exchange market operations, and when it pegs using sterilized foreign exchange market operations. For the remainder of this section we shall assume that the Central Bank does not sterilize.

For the unsterilized case, the analysis proceeds just as it did before. Pegging of the exchange rate means that the XX locus has the position shown, since it is drawn for a given value of the exchange rate, and we have assumed the current value in setting the position of that locus. BB, too, is portrayed appropriately, as the quantity of domestic bonds, set as zero, is held constant through this exercise. It is the LL locus which must shift because the quantity of money is an endogenous variable in this exchange rate regime. Therefore, as in the analysis in the previous section, the new equilibrium is shown appropriately, as the intersection of XX and BB, with LL shifting downward and to the right to slot through that point. This point is denoted by N.

Since the EE locus is the set of points for which expenditure is equal to income, it follows that the amount of distance between any particular point in the figure and that locus represents the size of the difference between expenditure and income. For example, since the point N is below the EE locus, it is a situation in which expenditure is greater than income. This is stabilizing influence, as the increased nominal wealth is being reduced in size over time. Had N been further to the south and/or to the west of the position shown, the difference between expenditure and income would have been even greater, as the distance from the EE locus would have been larger.

We can now deal with the question of the effects of capital mobility on the speed of adjustment when the exchange rate is pegged using non-sterilized foreign exchange market operations. We are thinking about how the distance between point N and the EE locus is influenced by the degree of capital mobility. The only curve in this figure whose slope depends on capital mobility is that of BB. Note as well that the horizontal distance

between point Q in the figure, and the horizontal displacement of BB is ten percent, independent of the degree of capital mobility. It follows that the precise point of intersection between BB and XX depends on capital mobility only to the extent that it affects the slope of BB.

As capital mobility increase, BB becomes closer to horizontal, and its intersection with XX moves into greater proximity with EE. It follows that the speed of adjustment is reduced as the degree of capital mobility increases. This can be understood intuitively as being the result of the fact that higher mobility constrains yields to move less than they would have otherwise. This means that there is less pressure for adjustment coming from this source. As a result the speed of adjustment is diminished.

(We have noted above that the money supply also moves back towards its previous value in the portfolio readjustment we portrayed above. It is true that foreign exchange holdings change by a greater amount the higher is the degree of capital mobility. But since foreign exchange and domestic bonds are better substitutes the higher is the degree of capital mobility, this mechanism also can be seen as a way of moving the economy back towards its long run equilibrium.)

IX Sterilization Reconsidered

This framework allows us to investigate more fully the process of sterilizing the balance of payments. We have a framework which portrays explicitly the tools which the authorities would use in order to carry out this process.

The consequences of sterilizing a balance of payments surplus is shown in the figure above. The idea is that the economy has increased its holdings of foreign exchange by running a current account surplus. One possible response on the part of the Central Bank is to buy some (or all, or even more) of that foreign exchange, but not in terms of money, instead to trade it for domestic bonds, keeping the quantity of money circulating in the system constant.

With a higher level of domestic bonds available, yields on those bonds would have to be higher in order to convince agents to hold them. This higher yield would make holding money less attractive. But since nominal wealth is higher, there is greater than previous desired money holdings. A yield higher by just the required amount would offset this wealth effect, and leave money holdings precisely where they were before. In terms of targets and instruments, we are thinking about a situation in which the Central Bank is using two instruments: open market operations and foreign exchange market operations. To hit two goals: a given quantity of money, and a given value for the exchange rate. (Alternatively, if one takes as given that only sterilized foreign exchange market operations are to be used, there is that one instrument, but only one remaining goal, to fix the value of the exchange rate, since we have taken as given that the money supply will not change, in light of the single instrument that is being employed.)

Now perhaps the most remarkable aspect about this observation is merely that it asserts that sterilization can have some identifiable effects, on a par with those that arise in other forms of exchange rate pegging (using non-sterilized foreign exchange market operations, or open market operations). It is not a disequilibrium system, contrary to what Mundell has called it. It does not generate a partial equilibrium or an external disequilibrium. In every way it is comparable with more familiar policy regimes. (It does however require ever larger foreign exchange reserves to maintain a given equilibrium, as capital mobility goes to infinity.)

What is also true about sterilization is that it has the potential to lead to instability. This is apparent from the figure we have employed above. For this model in order to be stable an increase in nominal wealth must lead to a current account deficit. This was demonstrated in the case of exchange rates being pegged through the use of unsterilized foreign exchange market transactions, as in shown by position N in the figure. In contrast, for a sterilization regime the new equilibrium is at point S. Since that point will lie on either side of the EE locus, this regime potentially is unstable. This possibility will arise when the interest elasticity of money demand is small, and the interest elasticity of saving and investment is very large. This is the case shown in the diagram, which is the unstable case.

What is interesting about this criterion is that the slope of the BB locus, reflecting the degree of capital mobility, is not a factor influencing the possibility of instability. Thus the degree of capital mobility will not determine whether the system is unstable. This is contrary to some conventional wisdom on the subject.

X. Conclusion

The Policy Trilemma is a deduction of portfolio balance models of an open economy, for the simple reason that the foreign exchange market operations that are needed to peg the exchange rate are more similar to the open market operations that are used in the policy initiative. As has been noted many times in the past, the reduction in domestic credit that a contractionary open market operation entails is just matched by an expansion in the holding of international reserves, as intervention is undertaken to hold down the value of domestic currency.

But for other models of the open economy this process is derived in a system that fails to distinguish between portfolio rebalancing and asset accumulation. As a general conclusion from the Hume-Polak-Mundell-Fleming view, it is clear that monetary policy is ineffective no matter what the degree of capital mobility. Since this is true, high capital mobility is not an essential element. It follows that the Policy Trilemma can not be explicated in the Mundell-Fleming framework.

Perhaps the next question which arises concerning the term Policy Trilemma is, Who was the coiner of this term? That must wait until another paper.

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