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The Assignment Problem for
a Large Country

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The Assignment Problem for a Large Country*

by

Don E. Roper

Since the publication of James Meade's famous work [8], the concept of a dilemma case -- a situation in which a country's desire to achieve internal stability and balance of payments equilibrium appears to require contradictory use of macroeconomic policy instruments -- has become very familiar to international economists. Consequently, considerable importance was attached to Robert Mundell's argument [10] that Meade's financial policies could be split into monetary and fiscal instruments which in turn, since they have different relative impacts upon internal and external balance, could be used to achieve domestic stability and external equilibrium simultaneously.

Mundell's suggestion for the mix of macroeconomic policies has been frequently discussed for the case of the United States. As an indication of the importance which was widely attributed to his conclusions for United States macroeconomic policies, we should note that Ott and Ott [14] and Willett and Forte [18] performed rough

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empirical tests to determine the viability of this assignment of policies to the U.S. The Otts' observation that "since 1961 monetary and fiscal policy measures, by design or accident, have tended to conform to the mix prescribed by Mundell" (p. 313 in [14]) is a further indication that his 1962 article may have influenced U.S. policymaking.

However, it is surprising that Mundell's conclusions would have been unhesitatingly regarded as relevant to a large country like the United States when Mundell explicitly assumed that the country in question was small relative to the rest of the world. In his own words (p. 234 in [10]) "it is assumed that all foreign policies [which includes the foreign interest rate] and export demand are given, ..." To this author's knowledge, no one has asked whether the internal and external balance schedules still retain their same relative slopes when feedback from the rest of the world is incorporated into the theoretical model. The primary purpose of this paper is to re-derive the internal-external-balance diagram for a non-small country using the same Keynesian framework of analysis which Mundell employed.[1/]

1/ Actually, Mundell [10] used a model in which the level of imports depended upon the level of expenditures, whereas we will use a model in which imports depend upon the level of income. The latter variant of the income-expenditure model has been given a formal statement in several publications (e.g., Dernberg [3], Kemp [5], Mundell [11] chs. 15, 17 and 18 and Roper [15]). We will use this version of the model in order to avoid a restatement of all the mathematics here.

Since Mundell's original article appeared in 1962, professional opinion (including Mundell's) has shifted from the use of the interest rate to a monetary aggregate as the proper instrument of monetary policy. The complete Keynesian income-expenditure model attributes an important role to the quantity of money such that we can define monetary policy in terms of the money supply without abandoning the Keynesian model. Although some economists (e.g., Jay Levin [7], John Morton [9], and Robert Stern [16]) have derived the internal and external balance schedules using the money supply in the IS-LM model, it has not yet been done in the context of a two-country analysis.

Although the removal of the small-country assumption and the introduction of the money supply as the monetary control variable constitute, I believe, much needed improvements in the model, there are other criticisms which have been directed against the analysis. For instance, there is substantial agreement that the flow theory of capital movements (which had some degree of currency when Mundell wrote his paper) is theoretically indefensible and that Mundell's use of this theory undermined his conclusions. In the last part of this paper I will argue that the theoretical deficiency of this capital flow function does not affect Mundell's conclusions. Some discussion will also be given to other short-comings of the analysis which do restrict the conclusions.

A Two-Country Model

In this section we will develop a graphical portrayal of the two-country model which depicts the impact of monetary and fiscal policies upon internal and external balance and the international adjustment mechanism. From this graph we can easily generate the internal-external-balance diagram.

The income-expenditure model is usually cast in terms of the Hicksian IS and LM curves which represent the equilibrium conditions for the goods and money markets, respectively.[1/] Our procedure is to rewrite the usual equilibrium conditions for goods such that interest rates appear as explicit functions of the other variables and then to substitute these functions into equilibrium conditions for domestic and foreign cash balances. The resulting equations depend only upon domestic and foreign income (Y and Y') and can be plotted in income space. This graph will allow us to trace out the impacts of monetary and fiscal policies and will facilitate the derivation of the internal-external-balance diagram.

Consider first the equation for domestic goods and services, $Y = E(Y, r) + I'(Y') - I(Y) + G$, where Y = real domestic output, E = real domestic expenditures, I = imports, r = "the" interest rate, and G = government expenditures. Taxes are assumed constant such that a

1/ The assumptions of the model will be discussed in the last section of the paper.

change in G represents a change in the budgetary deficit. Primed variables represent the foreign counterparts to domestic variables. By assuming monotonic functions, we can rewrite the equilibrium condition such that r is an explicit function of Y, Y', and G, viz., $r = r(Y,Y',G)$. By similar reasoning the equilibrium condition for foreign goods and services can be written as $r' = r'(Y',Y,G')$.

We can now turn to the conditions for monetary equilibrium. We will assume that residents of each country hold only those cash balances supplied by their own central banks and that the supply of money is completely determined by central bank policy.[1/] Using the symbols L and M to represent the demand and supply of money, the equilibrium conditions can be written as

$$L(Y, r) = M \qquad \text{and} \qquad L'(Y', r') = M'.$$

By substituting the functions for r and r' into the monetary equilibrium conditions we obtain

$$(1) \quad L[\, Y, r(Y, Y', G)] = M$$

$$(2) \quad L'[\, Y', r'(Y', Y, G')] = M'.$$

Equations (1) and (2) contain only two endogenous variables, Y and Y' and can be plotted in income space. If we assume the functions are linear, (1) and (2) can be drawn as shown in Figure I.

1/ Throughout the paper, "money" will be used for "high-powered money."

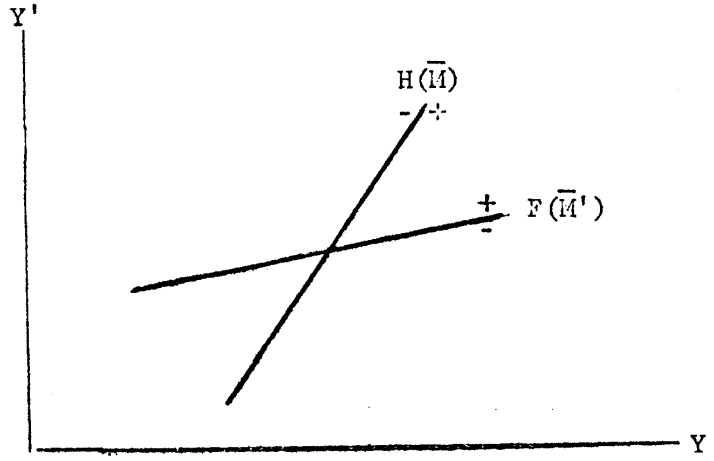

Figure I: Equilibrium in the Home and Foreign Countries

In Figure I, H and F represent the equilibrium conditions for money and goods in the home and foreign countries, respectively. An intuitive explanation for their relative slopes will be given here and a mathematical derivation can be found in [15]. H and F slope upwards because Y and Y' have opposite effects upon the excess demands for money. For instance, for a given level of Y', an increase in Y raises the domestic demand for cash balances and lowers the demand for cash balances in the rest of the world by placing upward pressure on foreign expenditures and output and therefore, upon the foreign interest rate. Consequently, a plus sign is placed on the right side of H and a minus sign on the right side of F. Analogous reasoning explains why an increase in Y' (given the value of Y) increases the excess demand for foreign cash balances while decreasing the demand for domestic cash balances. However, the "own" effect of income on money outweighs the cross relation between domestic (foreign) money and foreign (domestic) income. Consequently, H is steeper (with respect to the Y-axis) than F.

The H and F lines in Figure I are drawn for given values of M and M', respectively. We can use these schedules to construct another curve which represents the values of Y and Y' corresponding to a constant world money supply, W. Suppose we increase the domestic money supply and decrease the foreign money supply by the same amounts. This shifts both F and H southeast such that their new intersection is at point a', as shown in Figure II. If we go through other equal-but-opposite changes in M and M', we can generate a locus of points or an iso-liquidity line for the world, LL.[1/]

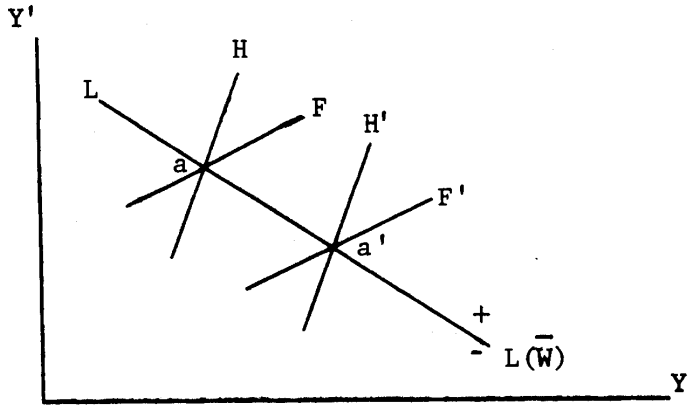

Figure II: Construction of the Iso-World Money Supply Line

1/ Mathematically, the iso-liquidity line for the world, LL, is found by adding equations (1) and (2) to obtain L + L' - (M+M') = 0. Since the sum of the two excess demands, (L-M) + (L'-M') is identical to the excess demand for the world money supply (that is, (L-M) + (L'-M') = L+L' - W is an identity in Y and Y'), the three curves must intersect at the same point.

The LL curve is useful primarily as a means of tracing out the effect of a balance of payments disequilibrium upon the distribution of the world money supply and, consequently, upon Y and Y'. When authorities intervene in the foreign exchange market to stabilize the exchange rate, they increase the supply of one currency and decrease the supply of the other.[1/] This changes the composition of the world money supply. Under our assumption that residents of each country only hold cash balances which are denominated in the currency of their respective countries, this change in the composition also implies a change in the distribution of W from the deficit to the surplus country.[2/] Consequently, a balance of payments deficit for, say, the home country, will (if the authorities do not engage in sterilization operations) move the system northwest along the LL curve.

To complete our graph, we need to determine the combinations of Y and Y' which represent balance of payments equilibrium. Suppose

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1/ The amount that one currency is increased relative to the other depends upon the reserve policies of the central banks. We will assume that the central banks do not allow their holdings of foreign exchange to go up or down (except temporarily) as a result of stabilizing their exchange rates. This implies that, if we take exchange rates as unity, the increase in one country's monetary base will equal the decrease in the other country's monetary base.

2/ A change in the composition implies a change in the distribution of the world money supply from the deficit to the surplus country whenever the ratio of domestic to foreign currency held by domestic residents is greater than the ratio of domestic to foreign currency held by foreign residents.

the balance of payments depends upon four variables, viz., $b = b(Y,Y',r,r')$. We will assume that the function is linear and that the partial derivatives have the following signs: $\partial b/\partial Y < 0, \partial b/\partial Y' > 0, \partial b/\partial r = -\partial b/\partial r' < 0$. If we substitute the functions we found earlier for r and r', we obtain $b = b[Y,Y',r(Y,Y',G), r'(Y',Y,G')]$. The condition for payments equilibrium, $b[\ldots] = 0$, is plotted as the β-line in Figure III.[1/] Since G and G' are the only parameters in $b[\ldots]$, β shifts only when there is a change in domestic or foreign fiscal policy.

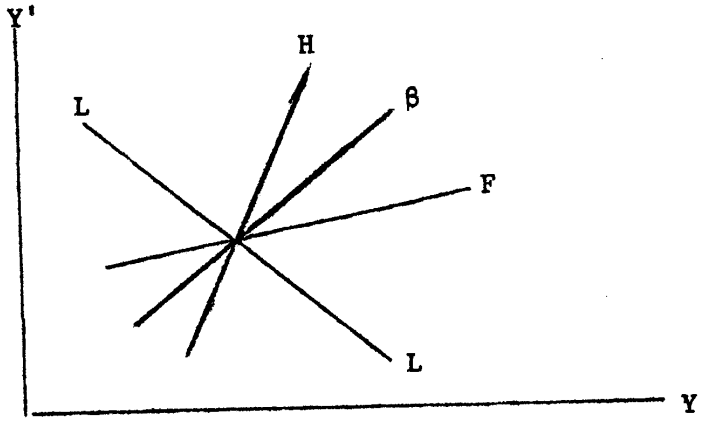

Figure III: The Complete Graph With External Balance

Monetary and Fiscal Policies

We can now use the graph to show the impacts of monetary and fiscal policies upon internal and external balance. We will begin with monetary policy.

1/ The fact that H is steeper than β which is steeper than F is demonstrated in [15]. The intuitive reason for their relative slopes should become clear in the subsequent discussion. We will assume that the equilibrium exchange rate is such that β passes through the intersection common to H, F, and LL.

The model has been deliberately constructed such that monetary policy is defined in terms of the money supply rather than the interest rate. That is, M is an autonomous parameter of H (and, therefore, LL) and r is an endogenous variable. If there is an expansionary monetary policy in the home country, the H curve will shift southeast and the LL curve will (since the world money supply has been increased) shift northeast such that Y and Y' will slide along F. Consequently, a domestic expansion in the quantity of money (that increases the world money supply from W_o to W_1) will drive the system from Q to R as shown in Figure IV. This leaves the home country with an increase in income, $Y_1 - Y_o$, and an external deficit (indicated by the minus sign below β) which we will measure by the length of the line, RS. If the balance of payments disequilibrium is allowed to redistribute the world

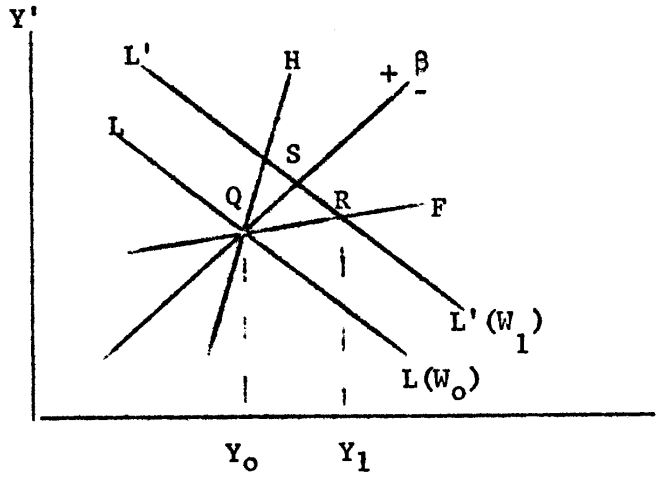

Figure IV: Domestic Monetary Expansion

money supply, the system will slide along L'L' from R to S. If both monetary authorities offset the impact of the external imbalance upon their money supplies, the system will remain at point R.

A change in fiscal policy also shifts the LL curve and induces a movement of Y and Y' along F or H depending upon whether the change in fiscal policy occurred in the home or foreign country, respectively. For instance, an increase in either country's budgetary deficit increases domestic and foreign interest rates and lowers the demand for cash balances for given income levels. This releases money which accommodates increases in incomes and allows the liquidity line to shift northeast (from LL to L'L') as shown in Figure V. As can be seen by inspecting equation (1), a domestic fiscal expansion will shift H (not shown) and move the system along F from T to U.

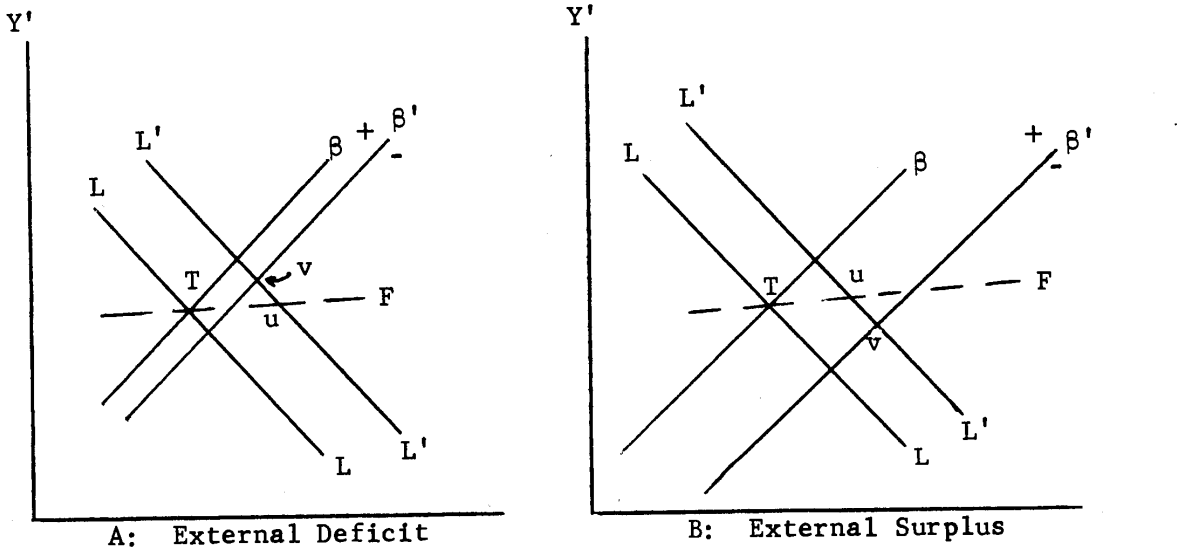

Figure V: Domestic Fiscal Expansion

Unlike monetary policy, fiscal policy induces a shift in the β-line. A change in debt-financed expenditures alters the relation between interest rates and incomes such that a given point in income space will correspond to a different interest rate differential than before. In particular, for any given values of income and, therefore, the trade balance, a greater budgetary deficit will increase domestic relative to foreign interest rates and thereby improve the country's capital account and balance of payments. As a result the β-line will shift southeast (from β to β') when domestic fiscal policy is expansionary.

Whether β' will lie above or below U depends upon whether fiscal policy has a negative or positive impact upon the movement of international reserves. The reason that fiscal policy and the balance of payments are ambiguously related is that budgetary deficits affect the capital account and trade balance in different ways. By raising domestic interest rates, an expansionary domestic fiscal policy attracts capital, and by raising domestic income it worsens the trade balance. Its impact upon foreign income and interest rates works in the opposite direction: By driving up foreign income through the foreign trade multiplier, domestic exports rise. By driving foreign interest rates up, less capital is attracted to the domestic economy than otherwise. When these four effects are added, the net impact upon the balance of payments can be either negative or positive.[1/] Figure VA was drawn

1/ A formula which relates budgetary policy to the movement of international reserves is given in [15].

to reflect a negative impact, and in VB β' has been moved southeast of U to reflect a positive relation between fiscal policy and the balance of payments.

Internal-External Balance Diagram

Before constructing internal and external balance diagrams from Figures IIIA and IIIB we need to introduce several symbols to represent different multipliers. We shall let

Y_G = impact of domestic fiscal policy upon domestic output and employment > 0

Y_M = impact of domestic monetary policy upon domestic output > 0

b_G = impact of domestic fiscal policy upon the balance of payments $\lesseqgtr 0$

b_M = impact of domestic monetary policy upon the balance of payments < 0

Y_G and Y_M are clearly positive as indicated by the preceding graphs. b_M is negative and this is indicated by the fact that point R (associated with a domestic monetary expansion) is below β' in Figure IV. In Figure VA β' is drawn above U which indicates that $b_G < 0$; in Figure VB, U is above β' such that $b_G > 0$.

The relative slopes of the external and internal balance curves can be derived from an analysis of the comparative advantages of our two macroeconomic policies upon external and internal stability. Comparative advantages can be obtained from our two-country graphs as follows: First, set the magnitude of a monetary and a fiscal expansion

such that both have the same impact upon domestic income -- such that QR in Figure IV equals TU in Figures VA and VB. Then simple inspection reveals that RS > UV in VA. Although the size of RS relative to UV appears ambiguous in Figure VB, a complete mathematical formulation would indicate that RS > UV except under very unusual conditions.[1/]

1/ For RS < UV (when QR = TU), it is necessary that the structure of the demand for money functions in the two countries be very different. In particular, the foreign demand for money must be relatively more sensitive to interest rates than to income (by a factor of something like four times as much) when compared to the domestic demand for money. In graphical terms, this means that the domestic LM curve must be much steeper than the foreign LM curve (when domestic variables and their foreign counterparts are measured in the same dimensions). These conditions must be fulfilled in order for the fiscal expansion to improve the domestic balance of payments to such an extent that UV > RS when QR = TU. The economic reason why these conditions tend to lead to such a strong positive relation between fiscal policy and the balance of payments is as follows: If there is a domestic budgetary expansion, the domestic balance of payments is improved the more the interest rate rises to attract international capital and the less income rises to increase imports. The interest rate will rise more and income rise less the less (more) sensitive the domestic demand for money with respect to interest rates (income). The domestic fiscal expansion also increases the demand for foreign goods and places upward pressure on foreign interest rates. The domestic balance of payments is improved the more foreign income rises relative to the foreign interest rate (i.e., the less steep the foreign LM schedule) such that their imports are greater and the incentive to invest in the foreign country is less.

As hard as it would be for this condition to be obtained, it is only necessary and not sufficient. The dissimilarity of demand-for-money functions in conjunction with a very high degree of capital mobility would constitute a sufficient condition. If we apply the model to the United States and the rest of the world, not only would it be unlikely that the structure of the demand for money functions would be so entirely different, but, even if they were, the usual empirical estimates of capital mobility (see [18] for a statement of the general magnitude of the numbers found in empirical studies on capital flows are much too small to imply that RS < UV when QR = TU.

(Footnote continues on next page)

Consequently, barring extreme conditions, money has a comparative advantage in maintaining external balance, and this advantage can be stated algebraically as $|b_M/Y_M| > |b_G/Y_G|$ (where vertical bars indicate absolute values).

To construct the internal external balance diagram from the preceding analysis, we must first note that the ratios Y_G/Y_M and b_G/b_M represent the slopes (disregarding signs) of iso-income and iso-payments curves, respectively. These ratios are found by cross multiplying the inequality $|b_M/Y_M| > |b_G/Y_G|$ to obtain $|Y_G/Y_M| > |b_G/b_M|$. This last inequality states that the internal balance schedule, II, is (absolutely) steeper than the external balance schedule, EE, when plotted in policy space with fiscal policy on the horizontal axis.

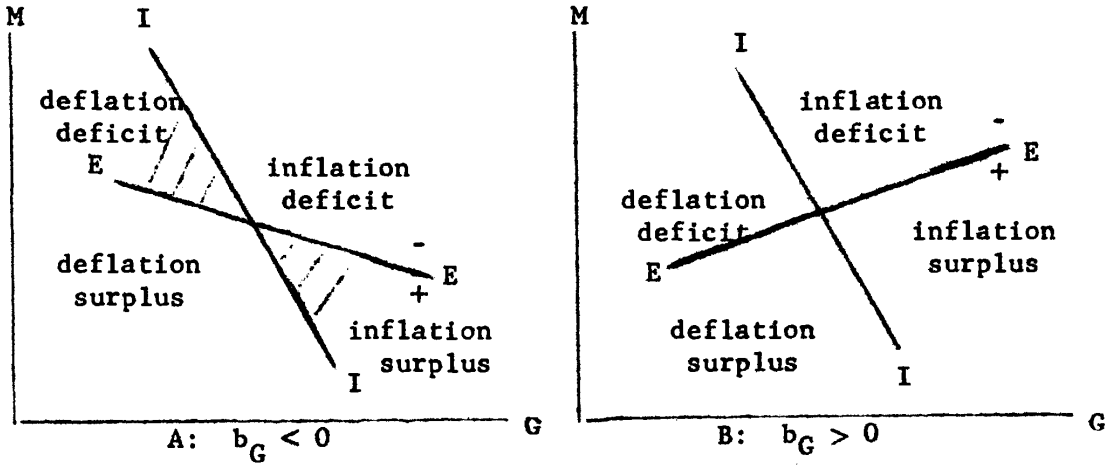

Figure VI: Internal-External-Balance Diagrams

It is interesting to note that a reversal of comparative advantages of our two financial policies is much more difficult to obtain (in this Keynesian environment) in our two-country analysis than when the country is small compared to the rest of the world. For a statement of the conditions under which the fiscal policy of a small country will have a comparative advantage maintaining external balance see Levin [7] or Morton [8].

The inflation, deflation, deficit, and surplus areas marked in Figures VIA and VIB are determined from the signs of the multipliers. For instance, since $b_G < 0$ in Figure VIA, an increase in fiscal policy causes a deficit when the money supply is held constant. In Figure VIB the upward sloping EE curve indicates that the positive impact of a budgetary expansion on the capital account outweighs the negative impact on the current account.

The cross-hatched areas in Figure VIA represents those combinations of internal and external imbalance for which the Meadean dilemma exists. If either policy is used to get the economy from a point in a cross-hatched area to a point nearer one target line, it will drag the economy further from the other target line.

The situation presented in Figure VIB is, however, quite different. In all four combinations of external and internal imbalances, only one of the two policies will face a dilemma. For instance, suppose there is a deflation and a deficit -- that we are west of the intersection of the EE and II curves in Figure VIB. In that situation monetary policy faces a dilemma because, if the money supply is changed to alleviate either the deflation or the deficit, it will worsen the other. On the other hand <u>both</u> the deficit and the deflation call for an expansionary fiscal policy. Similarly, in the other three cases, one of the policies will face a dilemma and the requirements for the other policy will be clear cut. Consequently, <u>if</u> Figure VIB is a more apt representation of

the real world than Figure VIA, the traditional notion that there are two cases that confront both policymakers with a dilemma is incorrect. More generally, the trend toward the use of monetary aggregates rather than interest rates as the proper tool for monetary policy has created the possibility that the deficit-deflation and surplus-inflation situations pose no more of a dilemma than the surplus-deflation and deficit-inflation situations. However, our purpose is to determine if there is a single decentralized assignment of policies which can be properly followed regardless of whether a dilemma confronts one policymaker or both simultaneously.

Mundell's assignment of monetary policy to external balance and fiscal policy to domestic stability is an implication of his principle of effective market classification[1/] when applied to the internal-external balance problem. According to this principle, if each policymaker assumes responsibility for only one target, then they should split assignments according to their comparative advantage. If we begin in a dilemma situation or cross-hatched area in Figure VIA, the attempt by either policymaker to influence one of the economic targets has a large counterproductive impact upon the other target such that the system is unstable unless the assignment is made according to comparative advantage.[2/]

1/ This principle was first suggested by Mundell in a 1960 publication which is reprinted in [11] chapter 11.

When both curves slope in the opposite directions as in Figure VIB, the system is stable regardless of the assignment. However, the use of Mundell's principle or the criterion of comparative advantage implies the assignment which has the greater probability of direct (i.e., non-cyclical) adjustment to the desired values of the economic goals.[1/] As we have argued above, monetary policy retains its comparative advantage in influencing the external balance except under extreme conditions. Consequently, whether fiscal policy has a negative or positive impact upon the balance of payments, the two-country analysis supports the proposition that monetary policy should be assigned to the maintenance of external balance and fiscal policy to internal stability.

Qualifications and Limitations

Having explicitly derived the internal-external-balance diagram from a short-run Keynesian model, it is clear that the policy conclusion is relevant only for the short-run. The short-run character of the model which lay behind Mundell's original internal-external-balance diagram was not emphasized in his 1962 article. He did give one important reason for restricting his policy conclusion to the short run, namely, his assumption that there is no "concern about the precise composition of the balance of payments" (p. 71 in [10]). Generally, however, economists initially accepted his policy prescription with fewer qualifiactions and regarded it as applicable to a longer time period

1/ See the appendix.

than was warranted. In this section we will review some of the criticisms that have been or could be levied against Mundell's solution to the assignment problem.

One major criticism of Mundell's analysis is that he employed a flow rather than a stock theory of capital movements. Probably the first to make this criticism was Herbert Grubel [4]:

> Our [portfolio] model suggests that at the international interest rate differential initially chosen, there will be a stock adjustment flow of a size that cannot be sustained beyond the attainment of the new stock equilibrium. If the external deficit on current account persists beyond this point of new stock equilibrium, then the interest rate differential has to be raised again to finance the deficit in the next period and so on until it is eliminated by some other policies. (p. 1313)

While it may be theoretically correct to argue that the domestic interest rate must be repeatedly raised each period (relatively to the foreign rate) to induce a continuing capital flow,[1/] the amount that interest rates must be changed is an empirical question.[2/] For

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1/ If we ignore the initial stock adjustment, the portfolio-balance theory does imply that a continuing capital flow is possible after the initial shift of stocks. According to this theory, the rate of change of interest rates influences the allocation of existing stocks of international financial capital, and the level of interest rates influences the allocation of new additions to portfolios between countries. For a detailed explanation of a capital-flow function based upon portfolio-balance considerations, see Bryant and Hendershott [7].

2/ Since the criticism has been cast in terms of interest rates rather than monetary aggregates, our counterargument is also given in terms of interest rates. However, both sides of the argument could be carried out in terms of the money supply -- a change in r is equivalent (in our non-growth model) to some discrete change in M.

instance, if the stock of internationally mobile capital is sufficiently sensitive to the level of interest rates in different countries, the interest differential would have to be changed very slowly to keep from "overfinancing" a substantial deficit. From the length of the time period and the size of the external imbalance, one can not infer the amount which the interest rate differential must be changed each period to continuously correct the imbalance.

The emphasis in this criticism on obtaining a continuous capital flow is misplaced. In Mundell's analysis of the assignment problem, the importance of raising the interest rate to attract capital funds is to increase foreign exchange reserves. It is irrelevant whether the increase in reserves takes place during the first quarter (or day or hour, etc.) or evenly over the period for which the analysis is intended.[1/] In the present context it is the integral of the balance of payments rather than its time path that is important.

1/ Of course, if one is interested in a sufficiently long time period, the initial shift of capital following an interest rate change will be small relative to the continuing flow effect. For example, Willett and Forte [18] argue that with the U.S. and foreign portfolio growing at 10% annually

> ...it would require a high stock shift of $5 billion to improve the U.S. short term capital account by a half billion ... (p. 251)

for each year thereafter. If the model were relevant for, say, a two year period, the capital account should be regarded as having improved by an average of $3.0 (= 5/2 + .5) billion per year. Willett and Forte are justified in omitting the initial $5 billion shift in determining the difference between the EE and II slopes if they are concerned with a time horizon of n years in which 5/n is small relative to .5. Although such a value of n is too large for their analysis to be relevant for determining the relative slopes of the short or intermediate-run internal-external-balance schedules, their analysis does indicate that Mundell's policy mix cannot be taken as a long-run policy prescription.

For any given time period, parameters for a flow model can be found which will yield the same balance of payments integral as found under a stock model. Consequently, a flow model can always be substituted for a stock model without altering the conclusions.1/

We were motivated to use a flow model in the preceding analysis since it is much easier to handle in a general equilibrium framework. The stock model is difficult to handle because, when the flow of financial capital is determined by the time derivative of the interest rate differential, the β-curve moves over time as the rate of change of the differential assumes new values over time.2/ For instance, a domestic fiscal expansion might shift the β-curve far past point U in Figure V as the domestic rate is moving upward relative to the foreign interest rate. As the interest rate differential ceases to move, β shifts back to its original position (which goes through point T in Figure V). If we tried to construct the EE curve from this moving β-line, the slope of EE would rotate over time. When the differential is not changing, EE is parallel

1/ There are other problems for which the different behavior of capital movements implied by the stock and flow models is crucial. For instance, I have argued in another context [15] that the case for sterilization policy depends, in part, upon whether capital movements behave according to the flow or stock theory.

2/ In [15] the β-curve does not assume different positions for different values of the time derivative of the interest rate differential. The reason that β does not depend upon the time derivative of the interest differential in the earlier paper is that it was defined there as the locus of points representing external balance when the system is not moving over time.

with II. When the interest differential is moving in favor of the domestic country the slope of EE is steeper than II. The relevant external balance curve would not be found at the beginning of the stock adjustment nor at the end of the adjustment period; it would be an average of all the curves weighted by the time over which they existed. The flow model provided us with the correct external balance curve without or having to go through the complicated averaging process. In short, the flow model was adopted because of its simplicity.

Another criticism of Mundell's 1962 policy recommendation concerns the consequences that might result when, in the midst of a general shortage of international liquidity, all countries followed this policy mix. If most countries contracted their monetary policies in order to improve their payments position, the result might be a world wide escalation of interest rates with little or no change in the world's payments pattern.1/

Even if one countered this argument with the Monetarist view that the attempt to drive interest rates up will ultimately bring them down lower than before, we are still left with the possibility of a competitive monetary contraction around the world. Although the analysis of this paper has included a second country, the fact that we did not

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1/ This argument has been made by James Tobin (see for instance, [17]) and Richard Cooper (see [2]). The increase in interest rates in Europe and the United States during the mid-1960's is sometimes regarded (although not by this author) as an example of interest rate escalation.

incorporate the reactions of other policy authorities must be regarded as an important problem.

Mundell's theoretical breakthrough has been tempered by the empirical observation that the differential impact of monetary and fiscal policies may be so slight that the policies would reach boundary conditions before both targets can be obtained. After examining the empirical evidence for the United States, Ott and Ott [14] have also questioned the feasibility of using these two macroeconomic policies for achieving internal and external balance in a dilemma situation. Mundell has also recognized this empirical limitation. In his words, "the correct mixture of monetary and fiscal policy . . . might necessitate larger changes in interest rates and budget deficits than are politically feasible" (p. 16 in [12]).

However, Mundell and the Otts defined monetary policy in terms of the interest rate. When a monetary aggregate is used as the policy instrument, there may be a greater differenee in the slopes of the two curves. An expansionary budgetary policy no longer has a purely negative impact on the external balance through the increase in imports, but it tends to raise the interest rate and attract financial capital. This ambiguous effect of fiscal policy upon the balance of payments has created the possibility that the internal and external balance curves could have opposite slopes (as in Figure VIB). An empirical investigation of the scope for differentiation between the two policies has yet to be made using a monetary aggregate as the monetary instrument.

Several other limitations of the analysis will be dealt with only briefly here. Willett and Forte [18] have argued that, after the initial reallocation of portfolios, the increased interest payments to foreigners plus the diminished interest receipts from abroad may outweigh the continuing capital inflow induced by the increase in the domestic relative to the foreign interest rate.[1/] This implies that Mundell's solution must be limited to a time period in which the reallocation of stocks is comparable in magnitude to the (integral of) the continuing capital flow plus interest payments caused by an interest rate change.

The linearity assumption imposes further restrictions upon policy conclusions generated from the model. Since the iso-target curves in Figure VI are linear, the comparative advantages of monetary and fiscal policies do not change for different values of the policy and target variables. Jurg Niehans [13] has pointed out that if we introduce nonlinearities, we might find that continual doses of monetary policy to improve the payments position and repeated additions of fiscal policy to improve the domestic situation will erode and eventually reverse the comparative advantages of the policies. At such a point we could no longer (as our linear model unrealistically suggests) improve both our domestic and external positions -- one could be gained only at the

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1/ For a complete statement of the conditions under which a change in the domestic interest rate improves the country's reserve position over the long run, see John Morton [8].

expense of the other. Niehans's work not only suggests a fruitful approach for subsequent research, but it also implies that Mundell's policy mix may only be applicable to small disequilibria for which the linearity assumption is more realistic.

There are several shortcomings of the Keynesian model itself. The assumption of a constant price level has some justification in the short-run if initial changes in nominal income occur in real output rather than in prices. However, this precludes the incorporation of inflationary expectations and the important distinction between real and nominal interest rates. When the country is small and must take prices as given by the outside world, we have an additional rationale for the assumption of a fixed price level. Consequently, the assumption of constant price levels is less justified in our two-country version of the Keynesian model. However, on balance, I shall think that the incorporation of a second country is a much needed improvement. The absence of portfolio-balance considerations with regard to the public's holdings of securities is an important and well-recognized defect of the model. The neglect of the bond market, the constant price level, and the assumption that investment does not appreciably alter the capital stock can only be justified when we limit our conclusions to the short-run.[1/] Although the appropriate mix of policies in the long-run is an interesting problem, Mundell's conclusions and our extension of his analysis to the case of a large country are only relevant to a short time period and, only then, with the qualifications mentioned above.

1/ For an extensive evaluation of the income-expenditure model, see Axel Leijonhufvud [6].

Appendix

In Chapter 11 of [11] Mundell showed that when the curves slope in opposite directions, the decentralized assignment of policies according to their comparative advantage will reduce the likelihood of cyclical adjustment in the extreme cases when one curve approaches a vertical or horizontal position. The purpose of this appendix is to demonstrate this conclusion for the general case when the curves can assume any slopes with opposite signs.

Consider the two decentralized assignments,

(i) $\dot{p} = Kdy = KAdp$ and (ii) $\dot{p} = Hdy = HAdp$

where $dy = y - y^* = \begin{vmatrix} Y - Y^* \\ b - b^* \end{vmatrix}$, $dp = \begin{vmatrix} dG \\ dM \end{vmatrix}$, $\dot{p} = \frac{dp}{dt}$,

$$K = \begin{vmatrix} k_1 & 0 \\ 0 & k_2 \end{vmatrix}, \qquad H = \begin{vmatrix} 0 & h_1 \\ h_2 & 0 \end{vmatrix}, \qquad A = \begin{vmatrix} Y_G & Y_M \\ b_G & b_M \end{vmatrix},$$

and y^* is the target vector. Assignment (i) directs fiscal policy toward internal stability and monetary policy toward external balance. With the substitution of the H for the K matrix, assignment (ii) requires monetary policy to be determined by internal considerations and fiscal policy be oriented toward balance of payments problems.

The stability conditions for (i) and (ii) depend upon the responsiveness of policy authorities to target disequilibria or, mathematically, upon the k_j's and h_j's. It is difficult if not

impossible to compare the stability conditions of (i) and (ii) if there is no relation between the K and H matrices.

Fortunately, K and H can be linked by a simple economic consideration. Suppose that we think one policy instrument, say monetary policy, is more flexible and responds with greater speed and under fewer constraints than the other instrument, fiscal policy. We would not expect this difference in responsiveness to be altered when we go from one assignment to the other (i.e., from an assignment like (i) to (ii) or vice versa). The difference in the responsiveness of the policy tools to target disequilibria is an interesting problem but one which we want to separate from the problem of the policy mix under decentralization. If we maintain an invariance of relative policy responses under alternative decentralized assignments, then the determinants of the two matrices must be equal. This condition would imply that, if monetary policy reacts, say, three times as quickly to dY in (ii) as fiscal policy responds to dY in (i), then monetary policy must also react three times as quickly to db in (i) as fiscal policy responds to db in (ii). In the subsequent discussion we will assume that the relative policy responses are invariant under alternative assignments such that $|K| = |H|$.

The stability properties of the two-by-two case are found from the investigation of a second order characteristic equation of the form $f(\lambda) = \lambda^2 + b\lambda + c$. It is widely known that, when the internal

and external balance curves both slope upwards or both slope downwards, the system is stable if the assignment is made on the basis of comparative advantage and unstable if the opposite assignment is made. It is also well known that when EE and II have opposite slopes, both decentralized assignments are stable.[1/] Our concern is whether the policymakers reach their objectives directly or in an oscillatory manner. The approach to equilibrium will be cyclical if and only if the discriminant of the roots (of the equation $f = 0$), $D = b^2-4c$, is negative. Although assignments (i) and (ii) are both stable when EE and II slope in the opposite directions, the policymakers may reach their objectives directly or in an oscillatory manner. Our objective is to examine the link between the comparative advantages of the policies and the directness of the approach to equilibrium.

1/ This is demonstrated, for instance, in chapter 11 of Mundell [11]. The fact that both (i) and (ii) are stable when EE and II slope in opposite directions presupposes that the signs of the k_i's and h_j's are properly chosen. For instance, if monetary policy is directed toward external balance, monetary conditions should be eased when there is payments surplus and tightened when there is a payments deficit. The condition that the signs be properly chosen can be interpreted graphically as the requirement that, when the system is off the target curves in Figure VI, M and G be moved in the direction of the curves to which they have been assigned (rather than in the opposite direction).

To determine whether assignment (i) or (ii) will be more likely to approach equilibrium directly, we can write the discriminant of the roots in terms of the system parameters as follows:

$$D_i = b_i - 4c_i = (k_1Y_G + k_2b_M)^2 - 4k_1k_2(Y_Gb_M - Y_Mb_G)$$

$$D_{ii} = b_{ii}-4c_{ii} = (h_1b_G + h_2Y_M)^2 - 4h_1h_2(Y_Mb_G - Y_Gb_M).$$

Since we assumed that the relative responsiveness of policies was invariant to alternative assignments, $k_1k_2 = -h_1h_2$ and $c_i = c_{ii}$. Consequently, the difference between D_i and D_{ii} is found as

$$D_i - D_{ii} = b_i^2 - b_{ii}^2 = (k_1Y_G+k_2b_M)^2 - (h_1b_G+ h_2Y_M)^2$$

$$= [(k_1Y_G)^2+(k_2b_M)^2 - (h_1b_G)^2 - (h_2Y_M)^2] + 2(k_1k_2-h_1h_2)(Y_Gb_M+Y_Mb_G). \tag{3}$$

Assuming that the signs of the reaction coefficients are properly chosen (as explained in the previous footnote), $2(k_1k_2-h_1h_2) = 4k_1k_2 < 0$ and equation (3) can be rewritten as

$$D_i - D_{ii} = [. . .] + 4k_1k_2(\overset{+\ -}{Y_Gb_M} + \overset{+\ +}{Y_Mb_G}). \tag{4}$$

The comparative advantages of the policies is determined by the expression in parenthesis, $\Delta = Y_Gb_M + Y_Mb_G$. If the II curve is (absolutely) steeper than the EE curve in Figure VIB, then $\Delta < 0$ and monetary policy has a comparative advantage in maintaining external balance. If EE is steeper than II, $\Delta > 0$ and fiscal policy has a

comparative advantage in maintaining external balance. In other words, the sign of the second term in (4) is completely determined by the relative slopes of the EE and II curves. If, as was argued in the text, monetary policy has a comparative advantage in achieving payments balance, the second term in (4) will be positive ($4k_1k_2\Delta > 0$) which will tend to make $D_i > D_{ii}$. Neglecting the term in brackets in (4), we can say that the assignment based upon the relative slopes of the curves will, through its influence upon Δ and $D_i - D_{ii}$, have a greater likelihood of a direct approach to equilibrium than the opposite assignment.

When one examines the terms in the bracketed expression in equation (4), there appears to be a tendency for [...] and $k_1k_2\Delta$ to have the same sign and be positively related. One could postulate some assumption about the mean values and distributions of the terms in [...] such that [...] and $k_1k_2\Delta$ would, with a such-and-such probability, have the same sign. Such an approach, however, would seem unduely complicated. If we merely regarded the value of [...] to be normally distributed independently of the value of $k_1k_2\Delta$ and with a mean of zero, then the bracketed term in equation (4) would not be expected to influence our choice between assignments. Consequently, it seems reasonable to expect the relative slopes of the curves, or the value of Δ, to determine the difference between D_i and D_{ii} in the majority, if not the great majority, of cases.

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