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INTERNATIONAL FINANCE DISCUSSION PAPERS

A NOTE ON THE MIX OF POLICIES AND THE THEORY OF CAPITAL MOVEMENTS

by

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Discussion Paper No. 10, March 1, 1972

Division of International Finance

Board of Governors of the Federal Reserve System

March 1, 1972

A Note on the Mix of Policies and the Theory of Capital Movements

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Beginning with Robert Mundell's [8] well known article in 1962, there has been widespread interest and debate over the policy mix or assignment problem. If financial capital movements between countries are sensitive to interest rates, then, according to Mundell

> in countries where employment and balance-of-payments policies are restricted to monetary and fiscal instruments, monetary policy should be reserved for attaining the desired level of the balance of payments and fiscal policy for preserving internal stability. (p.239)

Although initially well received, Mundell's analysis has been questioned on several grounds. Perhaps the most frequent criticism is that the flow theory of capital movements (which was being used by many investigators when Mundell wrote his paper) is theoretically indefensible and that Mundell's use of this theory undermined his conclusions.[1/] In this note I would like to argue that the viability of Mundell's policy mix is contingent upon the mobility of capital (an empirical question) but is unaffected by the fact that capital flows depend upon the rate of change of interest rates rather than the level of interest rates (a theoretical question).

1/ Probably the first to make this particular criticism was Herbert Grubel [1]. The criticism (expressed in various forms) has been a major focus in the articles by Willett and Forte [17], John Patrick [13], and Jay Levin [7]. The criticism has been summarized in Marina Whitman's survey (on pp. 23-24 in [18] which draws upon Levin's work for the point) and by Robert Dunn [2]. The point was reiterated in several discussions during the NBER-Brookings Conference on International Mobility and Movement of Capital, January, 1970. Perhaps Levin's statement is the most complete (from a theoretical viewpoint) since he used a general equilibrium model with an explicit analysis of the stability conditions that include the stock model of capital movements.

The Model

The model that lay behind Mundell's original analysis was the well known IS-LM model with an external sector.[1/] Graphical and mathematical derivations of the internal-external-balance diagram from the underlying IS-LM model have been presented in several publications[2/] and, therefore, should not occupy our attention here. Instead, we will start with a popular version of the internal-external-balance diagram and try to cast the argument in graphical terms as much as possible.

If we let M (= quantity of money or monetary policy)[3/] and G (= government budgetary deficit or fiscal policy) represent the two macro-economic policy instruments, the combinations of M and G that produce balance of payments equilibrium (EE) and internal stability (II) can be plotted in Figure I.

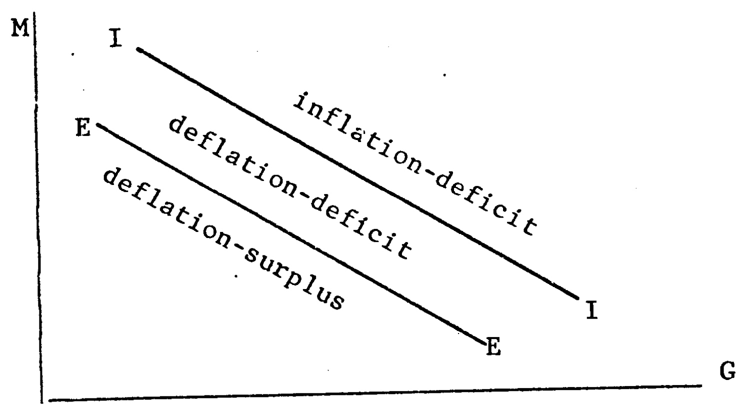

Figure I: Internal and External Balance

1/ Mundell's analysis was based upon the assumption, which we will follow here, that the country in question was small relative to the rest of the world such that foreign incomes and interest rates could be taken as fixed. This assumption has been removed and the assignment problem re-examined in Roper [15].

2/ The relationship was probably first stated by Anne Krueger (footnote 6 in [5]) and later by Michael Michaely [8] and Krueger [6]. Complete expositions are given by Dale Henderson [4], Jay Levin [7], John Morton [9], and Dwayne Wrightsman [19]. The most extensive discussion is found in the text by Robert Stern [16].

3/ Since Mundell's 1962 article, professional opinion has, to a significant degree, moved from the use of the interest rate to a monetary aggregate as the appropriate indicator of monetary policy. I have used the money supply in this paper to reflect this change in opinion. However, since there is a unique relation between the interest rate and the money supply for a given fiscal policy in the static income-expenditure model, the entire argument could be carried out using the interest rate without affecting the conclusions in any way.

The reason for the negative slope of II is clear: if one policy is increased, the other must be decreased in order to stabilize domestic employment. The EE schedule is drawn, at this point, to exclude the capital account. It must have a negative slope since both monetary and fiscal policies, when they expand, "worsen" the trade account in the short run by driving up income and imports. As Mundell pointed out, if capital is immobile (or, if we omit the capital account) the two target lines will be parallel.[1/] Since the argument for the case is which EE lies above II is formally identical to the argument for the case in which EE lies below II, we have chosed to concentrate on the latter argument alone. When EE and II coincide both goals can be achieved with only one policy.

When we add the capital account, the external balance curve, EE, is affected in different ways depending upon our specification of the capital flow function. A general statement of capital flows that includes both stock and flow movements of interest-sensitive capital is

(1) $K = K_s(\dot{r}) + K_f(r).$

Mundell used a flow model which means, in our notation, that $k_s = 0$ and $k_f > 0.$[2/] If k_f were positive, the EE schedule would rotate counterclockwise in Figure I such that EE and II would intersect. Mundell demonstrated that in such a world, monetary and fiscal policies have different relative impacts upon the two targets so that they can be used to achieve both goals.[3/]

1/ The lines are uniformly parallel since we have taken linear approximations. Consequently, the analysis is more realistic for small policy changes.

2/ The small letters are used to denote derivatives: viz., $k_s = \partial K/\partial \dot{r}$ and $k_f = \partial K/\partial r$.

3/ Of course, Mundell defined monetary policy in terms of the interest rate, but Henderson [4], Levin [7], Morton [9], and Stern [15] have verified the stability of Mundell's policy mix when monetary policy is defined in terms of the money supply and other characteristics of the model remain the same.

If we switch from a flow to a stock model such that $k_f = 0$ and $k_s > 0$, the EE schedule retains its slope (parallel to II) but the curve is no longer stationary -- it moves whenever M and G are changing. Specifically, the rates of change of monetary and fiscal policies, $\dot{M}$ and $\dot{G}$, determine (since other parameters and exogenous influences are assumed constant) $\dot{r}$ which, in turn, affects K and the balance of payments. Consequently, $\dot{M}$ and $\dot{G}$ must be parameters in the EE schedule. If we specify the (reduced-form) relation between $\dot{r}$ and the policy changes with the equation $\dot{r} = f(\dot{M},\dot{G})$, we can substitute this relation into equation (1) to obtain

$$K = K_s[\dot{r}] = K_s[f(\dot{M},\dot{G})].$$

Clearly, the interest rate is increased when monetary policy contracts (i.e., $f_1 < 0$)[1/] or when fiscal policy expands (i.e., $f_2 > 0$). Consequently, $\partial K/\partial \dot{M} = k_s f_1 < 0$ and $\partial K/\partial \dot{G} = k_s f_2 > 0$ where $k_s = \partial K/\partial f > 0$. Graphically, this means that EE shifts upward during times that M is contracting and G is expanding.

Policy Rules, Stability and Paths of Adjustment

In this section we will examine the path of adjustment toward the desired economic target values when capital flows behave as stock adjustments and monetary policy is aimed at external balance and fiscal policy at internal stability. The policy rules can be written as

$$\dot{M} = c_1(T + K) \qquad \text{(R1)}$$

$$\dot{G} = c_2(N - N_f) \qquad \text{(R2)}$$

1/ f_1 and f_2 are defined as $\partial f/\partial \dot{M}$ and $\partial f/\partial \dot{G}$, respectively.

where T = trade account (positive values indicate surplus)[1/]

N = level of employment (N_f = full employment)[2/]

c_i = speed of adjustment; $c_1 > 0$, $c_2 < 0$.

Along the II schedule, $N = N_f$ and along the EE schedule, $(T+K) = 0$.

Before tracing out the paths of adjustment for monetary and fiscal policies, we need to introduce the distinction between the trade-equilibrium, TT, and external balance, EE, schedules as shown in Figure III. Whenever the system is at rest such that $\dot{r} = 0$ or whenever

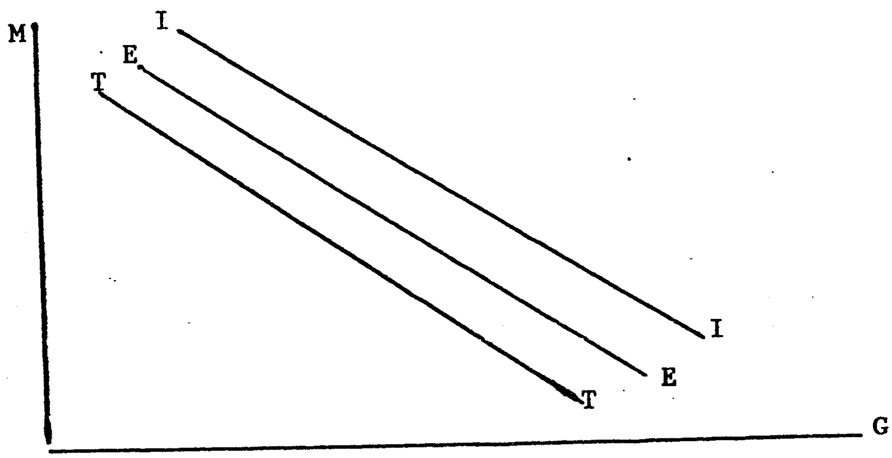

Figure II: Trade Equibibrium and External Balance

capital is immobile such that $K = 0$, then there exists overall payments equilibrium $(T + K = 0)$ at the same policy combinations that yield trade balance $(T = 0)$ such that the TT and EE schedules coincide. When there are capital flows induced by movements in the domestic interest rate, the EE schedule moves away from the stationary TT schedules. For instance, a net capital inflow caused by an increasing interest rate shifts the EE schedule above TT as shown in Figure II:

1/ The difference between the current account and the merchandise trade balance includes interest and dividend payments. The reason for this omission will be discussed at the end of the paper. In order for T+K to measure the overall balance of payments (which is probably best thought of as the official settlements balance) we will assume that the invisibles account is continuously in balance.

2/ In the static IS-LM model, income and employment are uniquely related such that either employment or output can be used as a target variable.

The location of the EE schedule is found by linearizing the balance of payments equations, $T + K[f(\dot{M},\dot{G})] = 0$, to obtain

(2) $$T + k_s f_1 \dot{M} + k_s f_2 c_2 (N-N_f) = 0$$

where $c_2(N-N_f)$ has been substituted for $\dot{G}$. Of the infinite number of possible positions of EE, there is only one EE curve that the system can actually cross. According to the monetary policy rule, (R1), $\dot{M}$ is nonzero if and only if the system is not on the EE schedule. Hence, if the system _is_ in external balance such that $\dot{M} = 0$, the location of the EE schedule is given by

(3) $$T + k_s f_2 c_2 (N-N_f) = 0.$$

This particular EE schedule, call it RR, will be important for tracing the paths of adjustment. Since the coefficient preceding $(N-N_f)$ in (3) is negative ($k_s f_2 c_2 < 0$), the RR schedule must lie between TT and II where T and $(N-N_f)$ will have the same sign.

The mnemonic reason for labeling the curve "RR" is that it traces out the values of M and G at which monetary policy reverses itself. To demonstrate this, we can examine the monetary policy equation,

$$\dot{M} = c_1[T + k_s f_1 \dot{M} + k_s f_2 \dot{G}],$$

which, when combined with rule (R2), yields

(4) $$(1-k_s c_1 f_1)\dot{M} = c_1[T + k_s f_2 c_2 (N-N_f)].$$

Since the expression in the brackets in equation (4) is identical to the left hand side of equation (3), equation (4) demonstrates that $\dot{M}$ is proportional to the (perpendicular) distance from the (M,G) point to the RR line. Consequently, monetary policy will always be expansionary when (M,G) is below RR and contractionary when (M,G) is above RR. Whenever (M,G) crosses RR, monetary policy will reverse itself.

We can now demonstrate that regardless of the position in which policymakers initially find themselves, the path of adjustment will ultimately fall between RR and II when policies are assigned according to (R1)-(R2). Given that TT is below II, there are three possible situations from which policymakers can begin; these are denoted by point a, b, and c in Figure III.

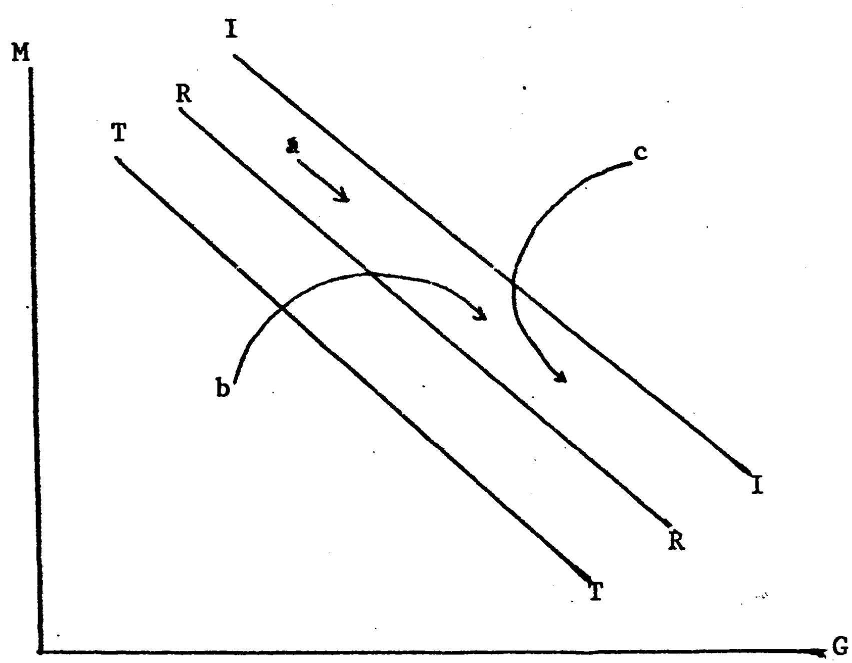

Figure III: Adjustment Paths and Initial Conditions

We will first consider the case in which the policy authorities begin with a deficit and a deflation denoted by point <u>a</u>.[1/] According to the fiscal policy rule, the budgetary deficit should expand and this expansionary force pulls the system to the right toward II. Monetary policy must contract because (M,G) is above RR. We can demonstrate that the path of adjustment will not go outside the RR-II boundary by examining the forces that would exist if the system did reach either II or RR. Suppose that fiscal policy were sufficiently more powerful than or responded faster than monetary policy such that the system were drawn over to the II schedule. If (M,G) were on the II line, $\dot{G}$ would be zero and monetary policy would pull the system to the south. Thus, once to the left of II, the system must stay to the left of II. Similarly, if the system were to reach the RR schedule, monetary policy would be neutral ($\dot{M} = 0$) and fiscal policy would be moving the system to the right. Consequently, once the authorities enter a deficit-deflation region, (R1)-(R2) implies that they continue in this area between RR and II in a southeasterly direction.[2/]

1/ There is a balance of payments deficit whenever the (M,G) point lies above RR because the EE schedule will always lie between RR and the (m,G) point. To prove that EE lies between (M,G) and RR, we can rewrite the equation for the EE schedule, equation (2), as

$$(2') \qquad T(M,G) + k_s f_2 c_2 (N - M_f) = -k_s f_1 \dot{M},$$

where the left-hand sides of (2') and (3) are identical. If (M,G) lies above RR, equation (4) implies that $\dot{M} < 0$. If $\dot{M} < 0$, then the right-hand side of (2') is negative such that the value of T that satisfies (2') must be more negative than the value of T that satisfies (3). Such combinations of values of M and G are only found above RR. Thus, if $\dot{M} < 0$, then EE must lie above RR. But, if $\dot{M} < 0$, EE must lie below (M,G) according to rule (R1). Consequently, EE must lie between RR and (M,G) whenever (M,G) is <u>above</u> RR. An analogous argument will show that EE lies between RR and (M,G) whenever (M,G) is <u>below</u> RR.

2/ If we had drawn the TT schedule above II, then the authorities would have been in a surplus-inflation region as they followed an adjustment path between RR and II in a northwest direction.

Having shown that the system will stay between RR and II once it gets inside this area, the paths of adjustment starting from points b and c can be easily described. Starting from point b, both policies must expand (as fiscal policy pulls horizontally toward the II schedule and monetary policy pulls vertically toward the RR schedule) and the system moves northeast. As the economy crosses the RR line, monetary policy will reverse itself and the system will again slide between RR and II. If the system begins at point c, both policies will contract and the adjustment will initially begin in a southwesterly direction. Once the economy reaches internal balance, fiscal policy will have to reverse itself as monetary policy carries the economy into the deficit-deflation zone. Hence, all adjustment paths will ultimately fall between RR and II as shown in Figure III.

Having found the location of the adjustment paths, we can now determine how close the adjustment paths will be to internal and external balance, or the II and EE schedules. Since EE always lies between RR and the (M,G) point, then the distance between EE and II will be smaller than the distance between RR and II as the system slides between RR and II. By inspection of equation (3), it is clear that the larger k_s the more weight given to $(N-N_f)$ relative to T (which has a "weight" of unity) such that RR will lie nearer II. In fact, RR can be made arbitrarily close to II by increasing the value of k_s. Consequently, given any degree of proximity to the targets that policymakers find satisfactory, if capital is sufficiently mobile, 1/ they can achieve <u>both</u> targets.

According to Herbert Grubel [1], however,

> 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)

Although Grubel did not cast his argument in a general equilibrium context in which both policies are used to achieve the two targets, we can interpret his criticism within our framework as follows: Policymakers can achieve their targets in each period but, over the longer run, they will run into cumlative policy constraints. As time goes to infinity, the successful maintenance of both target objectives requires the cumulative policy dosages to approach (plus or minus) infinity as the system continues an unending

1/ The influence of capital mobility upon the value of k_s is conceptually distinguishable from the effect of the relative size of the country in question. The value of k_s is (implicitly) scaled relative to the size of the world as a whole (see p.129 in Roper [14]). If we take the economic size of the world and the degree of capital mobility as given, a decline in the relative size of the country in question will lower the parameters c_1, c_2, f_1, and f_2 relative to k_s. Consequently, as one can see from inspection to equations (2) and (3), a decline in the relative country size has, from an analytical viewpoint, the same effect upon the relative positions of EE and RR as an increase in the mobility of capital.

unstable[1/] and is not viable in the long run.

Over any finite time period, however, the cumulative policy dosages are finite and are determined by the definite integrals of $\dot{M}$ and $\dot{G}$. The magnitudes of $\dot{M}$ and $\dot{G}$ are determined by the distance of the point, (M,G), from EE and II. If RR and II (and, therefore, EE and II) are sufficiently close together, the policies will continue to move between RR and II at

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1/ The graphical demonstration of instability is rigorous. However, it might be useful to summarize the source of the instability from a mathematical viewpoint.

The solution to the differential equation system takes the form dp(t) = VE(t)K + Ft where dp is the vector [dM dG], VEK is the complementary solution to the homogeneous system (V is a normalized matrix of characteristic vectors, $E(t) = \{e^{\lambda_i t} s_{ij}\}$ is a diagonal matrix of exponential terms, and K is a vector of arbitrary constants), and Ft is the particular integral of the non-homogeneous system (Ft is a vector of constants multiplied by time, t).

When the EE and II curves are parallel, one of the roots is zero and the other is negative. If the curves coincide, the system is homogeneous such that F = 0 and the system will be stable. If the curves do not coincide, the system is not homogeneous. A second-order non-homogeneous system with one zero root will force the particular integral to include the time variable (as explained on p. 290 of Baumol [1]. Thus, as time approaches infinity, VE(t)K approaches a vector of constants while Ft approaches [$-\infty$ $+\infty$] or [$+\infty$ $-\infty$] depending upon whether II lies above or below RR. Thus, instability does not arise from a positive root but from the lack of homogeneity produced when the curves are parallel but not coincident. (Column vectors have been denoted by brackets in this footnote.)

a very slow speed[1/] such that the system can remain near internal and external balance for a long period of time without requireing large cumulative changes in policies. Thus, we get the final conclusion that, if the allocation of the stock of financial capital is sufficiently sensitive to interest rates, policymakers can achieve both targets to <u>any</u> degree of closeness for <u>any</u> finite length of time without hitting <u>any</u> finite, cumulative policy constraints.

Conclusions and Qualifications

We have demonstrated, in the context of the Keynesian income-expenditure model[2/] that incorporates a stock model of capital movements, that policymakers can achieve both internal and external targets to any degree of closeness for any finite period of time <u>if</u> capital is sufficiently mobile.

1/ The speed at which monetary policy changes is given by equation (4), namely $(1-c_1k_sf_1)\dot{M} = c_1(T + k_sf_2\dot{G})$. In the limit (when capital is sufficiently mobile and the country is sufficiently small) $\dot{M} = (c_1T + c_1k_sf_2\dot{G})/(1-c_1k_sf_1)$ approaches $(f_2/f_1)\ \dot{G}$ as k_s approaches infinity. The resulting expression, $\dot{M}/\dot{G} = -(f_2/f_1) > 0$, requires that both policies expand or both contract at speeds compatible with a constant interest rate. Thus, the adjustment paths from points like <u>b</u> and <u>c</u> would be straight lines with the slope $-(f_2/f_1)$. Once the adjustment paths reached RR or II they would terminate because RR and II coincide in the limit. Getting between the schedules where one policy contracts and the other policy expands (such that the interest rate moves) is precluded. Of course, if k_s is any finite number there does exist some distance between RR and II such that, once the system gets between the two schedules, there are some movements in the policies and the interest rate, however, small.

2/ There are several well known shortcomings with the IS-LM model. For our purposes the most bothersome problem is that, except for our specification of the capital account as a stock adjustment, the rest of the model ignores portfolio balance considerations. However, the results of the paper are not just limited to this model. Given our specification of the balance of payments equation, the results hold for any model from which internal and external schedules can be generated that are not analytically dissimilar from those with which we began the analysis in Figure I. That is, the schedules would have to be parallel (or the external balance schedule would have to be relatively steeper with respect to the monetary policy axis) as well as stationary whenever monetary and fiscal policies (however defined) were not changing.

But this is the same situation that prevails when the flow model is used. With the flow model, the difference in the relative slopes of EE and II and the amount that the cumulative policy dosages required to achieve the desired goals depends upon the value of k_f. Thus, whether the capital account is specified as a continuous flow or a stock adjustment is except for asymtotic stability analysis, irrelevant; the important concern is the magnitude of k_f or k_s. 1/

We must recognize the several factors that limit Mundell's policy mix to the short run. The short-run character of the income-expenditure model is well known although this characteristic was not emphasized in Mundell's 1962 article. He did give one 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. 234 in [8]). Generally, however, economists initially accepted his policy prescription with fewer qualifications and regarded it as applicable to a longer time period than was warranted.

1/ Of course, there has been empirical as well as a theoretical criticism of Mundell's policy prescription. After examining the empirical evidence for the United States, Ott and Ott [12] questioned the feasibility of using monetary and fiscal policies for achieving internal and external balance in a dilemma situation. Mundell has also recognized the possibility of an 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 [11]).

Another reason for confining Mundell's policy prescription to the short run is that the reallocation of portfolios or the stock adjustment of capital is, in the short-run, overwhelmingly larger than changes in interest payments on capital indebtedness and the flow of capital due to portfolio growth.[1/] Jay Levin [5] has formally introduced interest payments along with a stock model of capital movements and found this to produce another source of instability for Mundell's policy mix.[2/] For long run analysis a growth model must be employed, the capital account must be specified to include the effect of portfolio growth, and interest payments must be explicitly considered.[3/]

1/ If one is interested in a sufficiently long time period, theinitial shift of capital following an interest rate change will be small relative to the continuing flow effect. For example, Willett and Forte [17] argue that with the U.S. and foreign portfolio growing at 10% annually

> ...it would require a huge 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.

2/ We have already found the policy-endogenous model to be unstable in the long run when we switch from a flow to a stock model of the capital account. Levin has found "another source of instability" in the sense that, with the inclusion of interest payments, he obtains a positive root for the characteristic equation. Had he omitted interest payments he would nothave found a positive root and the source of instability would have arisen only from the nonhomogeneous terms discussed earlier.

3/ For a good analysis of the assignment problem in the context of growth see John Morton [9].

References

[1] Baumol, W. J. Economic Dynamics, New York: Macmillan, 1959.

[2] Dunn, R.M., International Payments Adjustment Problems Arising from Economic Integration," U.S. Foreign Economic Policy for the 1970's, National Planning Association, 1971.

[3] Grubel, H.G., "Internationally Diversified Portfolios: Welfare Gains and Capital Flows," American Economic Review. LVIII (December 1968), 1299-1344.

[4] Henderson, D., "Macroeconomic Policymaking in Open Economies," Ph.D. Thesis, Yale University, (forthcoming).

[5] Krueger, A.O., "The Impact of Alternative Government Policies Under Varying Exchange Systems," Quarterly Journal of Economics, LXXIX (May 1965), 195-208.

[6] ____________, "Reply," Quarterly Journal of Economics, LXXXII (August 1968), 511-513

[7] Levin, J.H., "International Capital Mobility and the Assignment Problem," Oxford Economic Papers, (forthcoming).

[8] Michaely, Michael, "Impact of Alternative Government Policies Under Varying Exchange Systems: Comment," Quarterly Journal of Economics, LXXXII (August 1968), 508-510.

[9] Morton, J.E., "Portfolio Balance, Growth, and Long-Run Balance-of-Payments Adjustment." University of Michigan, Discussion Paper No. 22, (June 1970).

[10] Mundell, R.A., "The Appropriate Use of Monetary and Fiscal Policy Under Fixed Exchange Rates," IMF Staff Papers, IX (March 1962), 70-79, reprinted as chapter 16 in International Economics. New York: Macmillan, 1968.

[11] ____________, "On the Selection of a Program of Economic Policy with an Application to the Current Situation in the United States," Banca Nazionale Del Lavoro Quarterly Review, No. 66, (September 1963).

[12] Ott, D.J. and Ott, A.F., "Monetary and Fiscal Policy: Goals and the Choice of Instruments," Quarterly Journal of Economics, LXXVI (May 1968), 313-325.

[13] Patrick, D., "The Balance of Payments, Full Employment and Growth: Study of Convergence and Consistency of International Economic Policy," unpublished Ph.D. thesis, Columbia University, 1968.

[14] Roper, D.E., "Macroeconomic Policies and the Distribution of the World Money Supply," Quarterly Journal of Economics, LXXXV (February 1971).

[15] __________, "The Assignment Problem for a Large Country," Review of Foreign Developments, #667, Federal Reserve Board, April, 1971.

[16] Stern, R.M., The Balance of Payments; Theory and Economic Policy. Chicago: Aldine Publishing Co., 1972.

[17] Willett, T.D. and Forte, F., "Interest Rate Policy and External Balance," Quarterly Journal of Economics, LXXXIII (May 1969), 242-262.

[18] Whitman, Marina, "Policies for Internal and External Balance," Princeton Special Paper in Economics No. 9, December, 1970.

[19] Wrightsman, Dwayne, "IS, LM, and External Equilibrium: A Graphical Analysis," American Economic Review, LX (March, 1970), 203-209.