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CAPITAL MOBILITY AND PAYMENTS EQUILIBRIUM

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IN HER recent survey article, Anne Krueger notes that "the first problem of balance-of-payments theory is to formulate the nature of the external constraint. Since theory allows for, and countries are, running deficits (however defined) it is not sufficient to say that the external constraint means there can be no deficits."[1] Also, "any balance-of-payments model which precisely formulated the external constraint would, of necessity, be intertemporal. Since most models to date are static, the issue of the nature of the constraint is avoided by focusing upon current-account transactions and assuming that deficits must eventually be corrected."[2] Krueger states that growth models, with increasing asset demand and changing flows, hardly exist.[3] This paper represents an effort to develop such a model for the fixed exchange-rate case; a model in which the external constraint is endogenously determined from demand and debt-servicing requirements. (Table 1 provides a listing of symbols employed therein.)

In the real world the liquidity constraint, or the constraint upon the amount deficit countries can borrow, is imposed for at least three reasons: (1) countries do not wish to lend their savings in more than limited amounts; (2) countries are fearful of imported inflation; and (3) we all recognize intuitively that even if unlimited lending were available to offset imbalances, a system of fixed exchange rates would

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[1] Anne O. Krueger, "Balance-of-Payments Theory," *Journal of Economic Literature*, March, 1969, p. 2.

[2] *Ibid.*

[3] *Ibid.*, p. 23.

TABLE 1

List of Symbols

Stocks and flows in real units of domestic goods:

- B The current-account balance. $B \equiv X - M - (r - p)D$.
- D Net external indebtedness of the region. A negative D value indicates that the region is a creditor. $D_n \equiv \sum_{j=1}^{n-1} B_j$.
- I Physical investment in the region.
- K The capital stock physically located in the region. $K_n \equiv \sum_{j=1}^{n-1} I_j$.
- M Imports expressed in terms of equivalent units of domestic goods at the current price ratio.
- T The current account minus net external investment earnings. In the model this is identical to the trade balance. $T \equiv X - M$.
- W Income. Output minus the interest burden. $W \equiv Y - (r - p)D$.
- X Exports.
- Y Output.
- Y^* Full capacity output.

Ratios, coefficients, and rates:

- d D/K.
- d^* The equilibrium d ratio.
- e Elasticity of demand for exports.
- e' Elasticity of demand for imports.
- f The rate of growth of export demand in the absence of different rates of inflation between regions.
- g The rate of growth of K and of capacity.
- k The output-to-capital ratio.
- n The natural growth rate of the region's capacity; n can be interpreted as the growth rate of labor with no innovation, or the rate of growth of labor plus the rate of increase in capacity output per laborer if labor-saving innovation is assumed to exist.
- p The rate of increase in the price of goods produced in the region.
- p' The rate of increase in the price of imports.
- r The nominal rate of interest. The region's real rate of interest is $(r - p)$.
- s The average propensity to save. The saving function is assumed to be linearly homogeneous, but s need not be constant with respect to short-run changes in income or the growth rate.

still restrict a country's ability to use expansionary fiscal policy. With regard to the third point, the ultimate constraint of fixed exchange rates is not the liquidity constraint; it is the constraint imposed by the growing debt and deteriorating trade balance of any nation, or region, that expands faster than is warranted by world demand for her goods. But because of the theoretical gap that Krueger notes, we have not been able to specify what sort of limitations the latter constraint imposes on a region, and this makes it difficult to determine what the liquidity constraint should be—and whether, indeed, it is necessary.

An initial step in bridging this gap was taken by Robert A. Mundell in his analysis of the short-run characteristics of a payments system involving fixed exchange rates, perfect interregional mobility of capital (funds), and separate regional fiscal programs.[4] The liquidity constraint is effectively relieved by capital mobility in this case—except that the region must maintain the same interest rate as that existing elsewhere. Although this prevents monetary policy from being used for internal balance, fiscal policy can be used for this purpose, while capital flows are induced that offset any resultant current-account imbalance. This gets rid of the liquidity constraint, and that is a necessary step if a model is to be developed in which the balance-of-payments constraint is to be an endogenously determined part of the analysis, rather than being an arbitrary limit upon the current account that is imposed exogenously at the outset. It remains to find out what happens in the long run in this Mundellian world—to determine what happens to the debt and the trade balance once the region is freed of the liquidity constraint.[5]

Interregional differences in interest rates or credit constraints do not play a major role in maintaining balance-of-payments equilibrium between regions of, say, the United States. Nevertheless, demand forces, acting through the multiplier and accelerator, evidently limit inflation or expansion in a region to a rate warranted by demand for the region's goods, but this demand relationship does not insure a balance-of-payments equilibrium in the conventional static sense. A re-

[4] Robert A. Mundell, "Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates." *Canadian Journal of Economics and Political Science*, November, 1963, pp. 475–485.

[5] Krueger, *Journal of Economic Literature*, March, 1969, pp. 20–21.

gion may run a current-account deficit indefinitely, but not a deficit of unlimited size.[6] The indebtedness of the region may also grow for an indefinite time, but both the deficit and the debt remain in some sort of reasonable proportion to the output capabilities of the region.

The preceding arguments suggest the direction that might be taken by an analysis in which the external constraint is endogenously determined. A dynamic model will be presented in which perfect capital mobility relieves the liquidity constraint à la Mundell, and the only remaining payments-equilibrating force is the demand effect of changes in the interregional interest burden and the trade balance. It is well known that the demand effects of balance-of-payments changes do not insure an equilibrium within the static Keynesian framework. But considered within an intertemporal framework, they do lead to something that can be called a dynamic equilibrium—an equilibrium in which the level of external debt and the current-account imbalance *grow* at a rate that is compatible with the growth rate of the region. After the characteristics of this equilibrium are described, the model will be used to determine the nature of the external constraint imposed by this ultimate requirement that the debt level or trade imbalance remain in proportion to the economic size of the region.

The analysis presented here is based upon several versions of a rather complex difference-equation model, a variant of which is shown in the Appendix. The text of the paper uses a more intuitive presentation. This analysis will be presented in two steps. First, the concept of an equilibrium ratio of regional external debt to capital, labeled d^*, will be discussed. A determinate d^* value will be shown to exist for any set of values of the following coefficients:

1. The rate of capital formation: g.
2. The real interest rate: $(r - p)$.[7] The nominal rate is r, and p is the rate of price increase of domestically produced goods.

[6] Richard G. Davis and Lois Banks, "Interregional Interest Rate Differentials." *Federal Reserve Bank of New York Monthly Review*, August, 1965, pp. 165–174.

[7] Actually, $(r - p)$ is only an approximation of the real rate of interest, which is more accurately stated as $(r - p)/(1 + p)$. An inaccuracy also results from the fact that p is the rate of increase in the price of domestically produced goods, and what is actually needed is an expression for the rate of increase in the price of domestically consumed goods.

3. The output to capital ratio: k.
4. The saving to income ratio: s.

It will be shown that if these values remain constant, the debt-level to capital ratio, d, will approach the equilibrium level d^*. This is not to imply that the values of all of these coefficients will, in fact, remain constant during the adjustment process.

In the second part of the analysis it is affirmed that a change in the trade-balance to capital ratio, T/K (or, in one version, the export to capital ratio, X/K), must be accompanied by changes in g, k, s, and/or p. This is definitional. Consequently, a change in T/K will alter d^*. But it is argued that any change in T/K will be self-limiting. A worsening of T/K (increase of the deficit relative to the capital stock) will depress demand relative to capacity to produce, and this deflationary effect will increase until the deterioration of T/K is halted. By a similar process, any increase in T/K is eventually self-limiting. Therefore, an approach to a dynamic balance-of-payments equilibrium involves an approach of T/K to its limiting, or equilibrium, value at the same time as d approaches an equilibrium value. Then both the external-debt level and the current-account imbalance of the region will tend to grow at the same rate as the region's capital stock or capacity to produce.

The deflationary or inflationary process through which changes in T/K are self-limiting can involve long-run price, and/or income, changes.[8] If labor, as well as capital, is highly mobile between regions, the adjustment will come primarily through income changes; but if labor is not mobile, price changes will play the primary role. In considering the effect of changes in T/K, therefore, two limiting cases will be considered: the case of perfect interregional mobility of labor, and that of perfectly immobile labor. In both cases, of course, capital is assumed to be perfectly mobile, so that the liquidity constraint in the usual sense does not exist.[9]

[8] This analysis is related to export-based growth models and a number of other long-run theories. A complete bibliography cannot be provided here; see Marina von Neumann Whitman, "International and Interregional Payments Adjustment: A Synthetic View." *Princeton Studies in International Finance*, No. 19, 1967.

[9] Space will not permit a detailed response to discussants. However, extreme or limiting-case assumptions are used by the theorist not because they are encountered in reality, but because they are a useful starting point in attempting to understand reality. Perfect competition and perfect monopoly are examples; the assumptions are never fulfilled, but

While this paper is too brief to describe completely the dynamic adjustment process following a variety of disturbances, I will use the model to analyze the options that might have been open to France in 1968 and 1969 had not that country been faced by a limit on reserves and borrowing. Symbols will be defined as they are introduced, but they are also listed for quick reference in Table 1 above.

1 THE EQUILIBRIUM RATIO OF EXTERNAL DEBT TO CAPITAL

THE following assumptions will apply throughout the remainder of this discourse:

1. The world consists of small region A and large region F. Region A is sufficiently small so that foreign repercussions of changes within A can be ignored.
2. The balance-of-payments adjustment process in region A will be considered, while the rest of the world (region F) grows at a constant rate.
3. Region F maintains a constant money rate of interest (r).
4. No change of exchange rates is possible and capital is perfectly mobile between regions in the Mundellian sense. An infinitesimal deviation of region A's interest rate from the rate in F will induce a flow of funds of whatever size is needed to make up the difference between internal investment and saving and so offset an existing current-account imbalance. As Mundell has pointed out, this means that region A's nominal interest rate cannot deviate from the rate r existing in F. All investment takes the form of riskless bonds with the nominal yield

the models have provided a norm with which to compare reality and a background for the construction of models of oligopoly and monopolistic competition. In balance-of-payments analysis, the limiting case of zero factor mobility with fixed exchange rates has been well developed in the specie-flow and open-economy multiplier models. The assumptions (i.e., zero capital mobility) are not realistic, but the models have provided a background for the consideration of more realistic cases. In contrast to studies in microeconomics, the opposite extreme of perfect capital mobility has not been adequately developed. An automatic adjustment process is at work in that case, as in the specie-flow case, and examining it provides a different perspective. In addition, many of the conclusions reached are surprisingly unaffected by changes in assumptions.

r. The debt (D) of region A will always mean the net debtor position of region A vis-á-vis region F. A negative D value means that A is a creditor.

5. No assumption is necessary concerning the exact institutional arrangement that facilitates the perfect mobility of capital. With a unified currency, a well-developed banking system can facilitate the transfer of savings. With separate currencies and a highly developed capital market, open-market operations by region A's monetary authorities can produce the transfer, as has been explained by Mundell. An agreement involving a uniform interregional interest rate and a commitment by each region's central bank to establish interbank lending to offset any current-account imbalance will also do it. Any of these three arrangements will make the excess saving of the surplus region available, at the world rate of interest, in an amount sufficient to cover the excess investment of the deficit region.

Region A will run a deficit on current account whenever the investment needs of firms within that region exceed the saving done by residents. With the assumptions just specified, the needed additional saving will be provided by residents of F, and A will accumulate a net indebtedness (positive D value). Considered within a static model, the accumulating debt appears to be a cause for concern; the debt and the interest burden grow over time. But with a given rate of saving, the debt only results from the expansion of the region's capital stock and capacity at a rate which cannot be accommodated by domestic saving. Given certain parameters, a particular relationship between the growth of the debt and the growth of the capital stock will exist, and the debt-to-capital ratio (d) of the region will tend to approach an equilibrium value (d^*).

One way to express this equilibrium ratio is[10]

$$d^* = 1 - \frac{S}{I}. \qquad (1)$$

Thus, if saving is 90 per cent of net investment, there will be one unit addition to the debt for each 10 units addition to capital, for that por-

[10] Mathematical derivations are omitted throughout the paper to conserve space. They are available from the author.

tion of investment funds must come from another region. The d ratio will tend to approach 10 per cent.

It will be more useful to express d^* in terms of the growth rate of the region's capital stock (g), the average propensity to save (s), the output-to-capital ratio (k), and the real rate of interest ($r - p$). Since these parameters imply a particular relationship between S and I, the d^* value can be expressed in these terms by a simple translation of equation (1):

$$d^* = \frac{g - sk}{g - s(r - p)}. \tag{2}$$

If the d ratio is at this value, it will remain unchanged as long as the values on the right do not change. It is easy to show that equation (2) represents a stable equilibrium in the sense that should the values on the right be constant and within the relevant range, any existing d value will approach d^*. But the adjustment process is not likely to involve an approach of d to d^* while the values on the right side of equation (2) remain constant. In fact, any change in the trade balance of a region must affect investment and/or saving; hence it must affect s, g, and/or k. It may also affect p. Now it must be shown how the trade balance of the region will tend to approach some limiting magnitude relative to the size of the region, and how it will influence s, g, k, and/or p in the process. When this is done, we will have an equilibrium model of the balance of payments that does not depend upon liquidity constraints.

2 THE ADJUSTMENT PROCESS — PERFECTLY MOBILE LABOR

WITH liquidity constraints removed, trade imbalances are limited only through price and income effects. The open-economy multiplier and price relationships do not insure an equilibrium in the conventional static sense, but they obviously do limit the relative size to which a trade imbalance can grow. A long-run change in the trade balance of region A may affect the region through income, and/or price, changes.

Given perfect mobility of capital, the degree of mobility of labor is crucial in determining which will be the primary effect. In this section the limiting case of perfect mobility of labor will be considered. In order to do this, the assumptions stated at the beginning of the preceding section will be expanded as follows:

1. Labor (as well as capital) is perfectly mobile between regions. Thus the wage rate in region *A* must conform to the constant rate assumed to exist in *F*. Labor and capital are the only two factors of production.

2. There is no technological change. Because of this and the constant factor prices, the ratio of full-capacity output to capital will remain constant. There is no assumption, however, that capital will always be used to capacity.

3. The rate of price inflation in region *A* cannot deviate from the zero rate existing in *F* for the reasons just mentioned: constant factor prices and no technological change. Because of perfect factor mobility, region *A* can expand capacity sufficiently to produce, at a constant price, any quantity of goods demanded.

4. Interregional commerce consists of goods traded, interest payments on outstanding bonds, and the sale of bonds. The "trade balance" includes the first category of transaction only, while the "current-account balance" includes the first and second.

5. The consumption and import functions of the region are linearly homogeneous with respect to its long-run growth. The homogeneous consumption function means that there is no secular tendency for s to increase. This does not imply that s is unaffected by short-run demand changes or even by changes in the *rate* of growth.

6. The investment function, likewise, is linearly homogeneous with respect to long-run growth. The rate of investment (g value) is assumed to be determined by, and to vary directly with, the ratio of demand to capital.[11]

Since labor is instantaneously mobile, the only short-run restriction upon the size of the region is K, its capital stock. K is therefore used as a proxy for the size of the region. In conventional static multi-

[11] James S. Duesenberry, *Business Cycles and Economic Growth*. New York, 1958, pp. 179–276.

plier-analysis, given the consumption, investment, and import functions, there is an equilibrium income level and an equilibrium rate of investment corresponding to each level of exports. This reasoning is familiar. To convert it to a dynamic framework, we can say that given the same three functions, there is an equilibrium ratio of demand to capital and an equilibrium rate of investment, or g value, corresponding to any given ratio of exports to capital. This result is obtained by dividing all values by K. With the homogeneity assumption, a doubling of exports and of capital should leave the demand-to-capital ratio, and the g rate, unaffected. Demand is twice as great, but so is capacity, and the same rate of investment is induced as before. Thus g is directly related to X/K:

$$g = g(X/K). \tag{3}$$

An expansion of exports relative to capital results in an expansion of total demand relative to capital (capacity) through the usual multiplier relationship. This induces a higher rate of investment; that is, a higher g value. Because of the homogeneity assumption, the relationship between X/K and g remains constant over time.

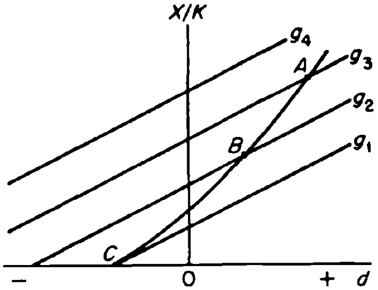
Changes in the debt level of the region also affect demand. An increase in debt increases the interest burden of the region and reduces income relative to output. This reduces the level of domestic consumption. An increase in D, therefore, affects g in the same direction as a decrease in X. Following the same reasoning as before, an increase in D/K, or d, decreases g, while a decrease in d increases g. Thus, both d and X/K affect g, and function (3) must be rewritten as

$$g = g(X/K, -d). \tag{4}$$

Equation (4) is expressed graphically in Figure 1 by the growth contours g_1 through g_4. The slowest growth rate represented is g_1, and the fastest is g_4. Each growth contour depicts the various X/K and d combinations that generate sufficient demand, relative to the capital stock, to produce that particular rate of growth. An increase in X/K, or a decrease in d, will increase the growth rate. Thus, the contours slope upward to the right.

Region F grows at the exogenously determined rate f, and the demand for A's exports is also assumed to grow at that rate. Since region

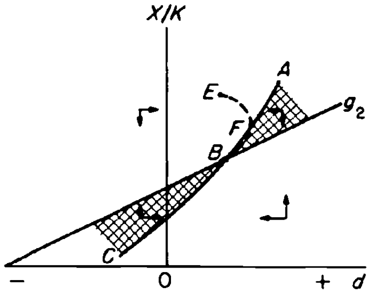
FIGURE 1



A can, in the long run, supply any quantity of exports demanded, supply considerations do not limit the growth rate of exports. With f, the growth rate of X, exogenously determined; the X/K ratio, which appears in the demand equation (4), can remain constant only when the growth rate of the region's capital stock (g) has adjusted to equal the growth rate of exports (f). This adjustment of g will, in fact, be induced by the demand effects of the changes in X/K, as expressed in equation (4). If g exceeds f, K grows faster than X, and X/K will decline. This is deflationary, reducing total demand relative to capital or capacity. A reduction in investment is induced and g declines. The adjustment mechanism will continue to operate, and the export-induced reduction in the ratio of demand to capacity will become progressively greater, as long as K continues to grow faster than X; that is, as long as g exceeds f. Once X/K has decreased sufficiently to cause g to equal f, that particular X/K ratio will tend to be sustained. The vertical arrows in Figure 2 represent the demand pressure exerted by changes in X/K when f is equal to g_2. Thus, with the factor mobility and homogeneity assumptions, the growth rate of the region must adjust to that of exports. Even if the homogeneity assumption is discarded, a given f value, along with specific consumption, investment, and import functions, will imply a particular equilibrium g value, although the identity of the two values will be lost. This occurs simply because a region cannot forever outrun the level of world demand for its goods, nor can its capacity forever lag behind demand. And with factors mobile, it is g, not f, that will adjust.

It has been shown that region A will adjust vertically in Figure 1

FIGURE 2



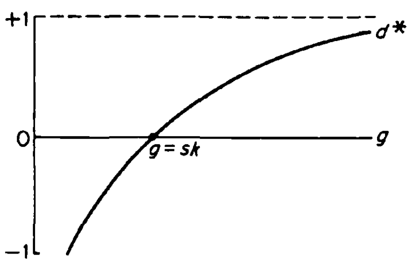
or 2 to approach the g contour at which g equals f. In Figure 2 this g value was arbitrarily assumed to be g_2. What will happen to the debt-to-capital ratio d, and how the region moves horizontally in the diagram, have not yet been indicated. The equilibrium d value, d^*, was expressed in equation (2). If the growth rate of export demand (f) is altered, it must affect the coefficients in this equation. It has already been shown that g will be altered; s and k may be also. Export-induced *short-run* changes in demand may affect s considerably, but in most developed countries the average propensity to consume has shown considerable stability over the long run. In a long-run analysis of developed regions it seems realistic to assume that export-induced changes in g do not affect s or k greatly, and that the change in g, itself, will be the predominant effect in equation (2).

The assumption that changes in g will predominate in equation (2) is not crucial to the argument. The dynamic equilibrium will occur anyway. However, this is not an innocent assumption as far as the nature of the adjustment path is concerned. If s and k do not respond greatly to export-induced g changes, then an increase in the growth rate of exports, in expanding total demand, will increase investment more than saving. A larger investment inflow will be needed. The expansion will cause imports to rise more than the original rise in exports, facilitating a real transfer of resources. With mobile capital, the capital account will adjust to the current account, and an investment inflow will be induced. A relatively greater proportion of investment must be financed by outside saving, and d will rise. Thus, with s and k relatively unresponsive to demand-induced g changes, an increase in the growth rate of export demand and the resulting increase in g will lead to a deterioration of the current account and a rise in d^*.

That effect of a change in exports upon the current account is just the opposite of what we would expect from the conventional static model; an increase in exports is generally assumed to increase saving more than investment, thereby improving the current account. This is the familiar "stability in isolation" requirement that demand changes affect saving more than investment. But the condition for stability in isolation is not likely to obtain where factors are highly mobile; investment will be too responsive. All regions of a mobile-factor area can be "unstable in isolation," that is, dependent upon export demand for stability; while the area as a whole, because factor supply is limited, may be perfectly stable. Consequently, it will be assumed that an increase in f affects I more than S, although this assumption is not crucial to the establishment of the dynamic equilibrium.

We shall now examine how the value of d^* is related to the demand-determined value of g, as illustrated in Figure 3. Note that in equation (2), since k is the output-to-capital ratio, it can be expected to be numerically larger than $(r - p)$, the interest rate. This means that sk in the numerator of (2) is larger than $s(r - p)$ in the denominator. In the extreme case of an unrealistically rapid growth-rate of capital, $(g - sk)$ will be almost as large as $[g - s(r - p)]$, and d^* will have a value of almost unity. If the growth rate of a region creates such a demand for investment funds that only a small portion of such funds can be obtained internally, then the external debt will be nearly as large as the capital stock. Because the rapid growth rate of exports has induced a high internal growth rate, investment is high relative to saving, the

FIGURE 3



trade balance is passive, capital flows in, and a high positive d^* value results. Of course, more realistic g values will produce d^* values considerably less than unity, and d^* will equal zero when g is as small as sk, since the numerator on the right side of equation (2) will be zero at this point; but with sk greater than $s(r - p)$ the denominator will still be positive. When g is smaller than sk but larger than $s(r - p)$, the expression assumes a negative value; the region will be a net lender.

We also see that d^* is nearly minus infinity if g is only slightly above $s(r - p)$. It turns out, however, that the growth rate of the region will always be driven up to well above $s(r - p)$. If the growth rate approaches a level as low as $s(r - p)$, this will cause the d^* ratio to grow to a large negative value. Thus, interest income will grow in relation to the capital stock, causing domestic demand to increase relative to K. This relative expansion in demand will continue as long as $(-d^*)$ increases. It will induce an increase in investment and push the growth rate up long before d^* approaches minus infinity. (Due to this the growth rate of capital may remain permanently above the growth rate of exports – an exceptional case to be considered below.) Thus, it appears that reasonable values for the parameters s, k, p, r, and g will produce an equilibrium ratio of debt to capital that is between a positive value of considerably less than unity and a relatively small negative value; d^* will vary with g, as shown in Figure 3.

Since a unique d^* value corresponds to each g value, there is some d^* value corresponding to each growth contour in Figure 1. Whenever the region is on that particular growth contour, the d ratio will tend to approach this equilibrium value. Point A in Figure 1 is assumed to be the equilibrium d point on contour g_3. Only at point A on that contour will d remain constant. If the region is on the g_3 contour above and to the right of point A, the increase in the debt which results from the current-account deficit will cause D to grow at a slower rate than g_3 (the rate of growth of K), and therefore d will decline toward d^*. Conversely, if the region is on the g_3 contour to the left and below point A, the d ratio will rise.

Of course, there is an equilibrium d ratio for every other growth rate. At slower growth rates the lower g value will bring about a smaller value of d^*, for less investment is required, and a larger proportion of it can be obtained from internal saving. Thus, B and C in Figure 1 can be assumed to represent points at which the d ratio is in equilibrium when the growth rates of the region are g_2 and g_1, respectively. The ABC line is a nexus of all points at which the growth rate of capital, as determined by the demand factors d and X/K, coincides with the growth rate of the debt, as determined by the current-account imbalance. If the region's position falls below and to the right of this line, the d ratio will decline; if it lies above and to the left, the d ratio will rise. Point C should be noted. Here the d ratio is in equilibrium with no commodity exports whatever, the value of $(-d)$ being sufficiently high for interest income to replace export income completely. But more on that later.

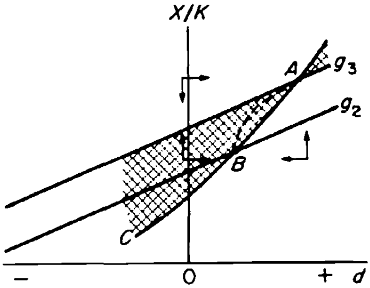
The ABC line also appears in Figure 2. The horizontal arrows pointing toward the ABC line indicate the movement of the d ratio toward its equilibrium value. If this is combined with the changes in the X/K ratio that are represented by the vertical arrows, the adjustment path of the region toward equilibrium can be traced. To illustrate, assume that the growth rate of exports is equal to g_2, but that the initial X/K and d ratios put the region at point E in Figure 2. Demand conditions (equation (4)) generated by the existing X/K and d ratios cause the region's capital stock to grow faster than g_2, as is indicated by the fact that the region is above the g_2 line. This means that the growth rate of capital will be greater than the growth rate of exports, and that the X/K ratio will decline. As it does so, the total demand for the region's goods relative to capital will decrease. This is the familiar foreign-trade multiplier relationship. The relative decrease in demand causes a decrease in g, which is represented by the movement of the region to lower growth contours as it moves down the X/K axis. The X/K ratio will continue to decline and to depress the growth rate until the g_2 contour is reached, for f is assumed to be equal to g_2. Given the homogeneity of the demand functions, this must occur. As noted earlier, the vertical arrows in Figure 2 indicate the change in the X/K ratio that pushes the region toward the contour at which g will equal f.

Of course, the region will not move directly downward to the g_2 contour, for changes in d will occur. Note that an essential difference between the present analysis and the static multiplier model is already evident. In the latter analysis, a decrease in the demand for exports also induces downward pressure on aggregate demand; but once this pressure is spent, it is assumed that no further automatic corrective forces are available. Thus, there is no assurance of a current-account equilibrium. On the other hand, if the multiplier analysis is considered within a growth framework, it is assured that there will be an increasing downward pressure on demand as long as the growth rate of the economy is greater than that of exports. Thus, unless exports become negligible first, the corrective forces continue to lower the growth rate of capital until it is the same as that of exports. This is not necessarily a current-account equilibrium, but it is a dynamic equilibrium in the sense that the tendency for the region to outgrow the demand for its exports has been eliminated.

Now consider the d ratio. At point E in Figure 2 the region is above the ABC line. This means that the d ratio is below the equilibrium ratio (equation (2)) for the existing growth rate of capital. The increments to the debt (which are relatively large owing to the high g value and the resultant large current-account deficit) cause it to increase more rapidly than the capital stock does, and d rises toward d^*. The path of adjustment for the region is, therefore, in the direction of the broken line moving away from E. Its direction is a combination of the vertical vectors, propelling the region toward the g_2 line where X/K will be in equilibrium; and the horizontal vectors, propelling the region toward the ABC line where d will be in equilibrium. Only where both lines intersect at B will the growth rate of the region remain constant, for only there will both ratios remain unchanged. The path of adjustment is not directly to point B, for the force vectors initially cause d to rise. As soon as the growth rate has slowed sufficiently, however, the d ratio will reach a temporary equilibrium at point F on the ABC line. The growth rate of capital at that point is still above the growth rate of exports, and X/K will continue to decline, pushing the growth rate below the ABC line. As soon as this happens, the debt level is above the equilibrium position, and both X/K and d decline toward the equilibrium point B, at which X, K, and D are all growing at the rate f.

For an additional example, consider the adjustment from point B to a new equilibrium following a change in f, as illustrated in Figure 4. Point B is initially the equilibrium position, for f is equal to g_2. K and D are growing at the same rate as X. Now the growth rate of export demand (f) increases to a value equal to that of g_3. An adjustment must

FIGURE 4



occur to a new equilibrium at point A. For a time, K continues to grow at the rate g_2, but X is growing at the rate g_3, and X/K rises. This is expansionary. The region shifts upward in the diagram to a higher g value. The resulting increase in demand for investment funds causes imports to increase more than exports, the trade balance deteriorates, and d starts rising, shifting the region to the right in the diagram and back to the ABC line. The new equilibrium is reached at point A, with a faster growth rate, a larger current-account deficit and d value, and K and D once again growing at the same rate as X.

In general, the adjustment process from any point in the diagram is as dèscribed here. As long as the region is outside the shaded area, the force vectors will take it to that area. Once within the area, the vectors take it directly toward the equilibrium point, which is the intersection of the ABC line and whichever g contour happens to equal the value of f. A high value of f leads to a correspondingly high g value, a current-account deficit, and a positive d^* value, while a low f value will lead to a surplus and a negative d^*. In either case, however, an equilibrium will normally result in which the debt level, current-account imbalance, and capital stock will grow at the same rate as export demand. While the relaxation of the homogeneity assumption would destroy the exact equality of these growth rates, the nature of the adjustment process and the self-limiting nature of excessive changes in the relative size of the current-account imbalance and the relative size of the debt level would not be affected.

There is an exception to the above conclusions. As noted earlier, point C in Figure 1 involves the complete substitution of external investment earnings for exports, for X/K is zero. This equilibrium may be approached asymptotically if f is equal to, or less than, g_1, which is a very slow rate of growth. In this case, the low rate of investment causes the region to achieve a considerable current-account surplus during the adjustment process, and the gradually rising $(-d)$ value causes investment earnings to replace export income eventually. The region's growth rate will then continue to outrun the growth rate of exports, and X will eventually become insignificant relative to K. Then the region is close to point C, which is the equilibrium point. K and $(-D)$ will grow at the same rate, but X (now insignificant) may grow at a slower rate; that is, a rate less than g_1. This type of equilibrium will always come about if f is as low as the value of $s(r-p)$. (I believe that the zero X/K equilibrium is unlikely to occur in reality because of the sustained low level of f that is required to bring it about.)

Further description of the adjustment process and the dynamic equilibrium will be postponed until after the presentation of the immobile-labor case, for that case is surprisingly similar to the case of mobile labor.

3 THE ADJUSTMENT PROCESS—CAPITAL COMPLETELY MOBILE AND LABOR COMPLETELY IMMOBILE

IN THE preceding analysis, the growth rate of the region's output could respond to changes in the long-run growth rate of demand without affecting factor costs. Both factors were available from the other region. Thus, an unlimited-supply and constant-price analysis seemed appropriate. In such a case, the rate of growth of the region's capacity eventually adjusted to the growth rate of export demand. The equilibrium growth path involved growth of both the region's capital stock and its debt at the same rate as the growth of export demand. The fact that region A was small, and the lack of induced differences in the rates of inflation between regions, made it reasonable to assume that the growth of export demand was exogenously determined. If labor is immobile, on the other hand, g cannot adjust to f, at least not at constant prices.

Considering the opposite extreme, it is apparent that if labor is immobile and factor proportions cannot be varied, then the region's capacity can be expanded only as fast as the growth rate of the labor force, or the natural growth rate of the region. But if the homogeneity assumption is retained, there must still be an adjustment to equalize g and the rate of growth of externally generated demand. (Even with specific nonhomogeneous functions, some given relationship between the two rates is indicated.) This adjustment is likely to occur through the establishment of a rate of inflation in region A that will cause the rate of growth of demand (and the rate of growth of the trade imbalance) to adjust to the unresponsive g value. This is just the opposite of the previous case, in which g did all the adjusting, but many of the characteristics of the two examples are similar. To consider this limiting case, we may discard the assumptions specified at the beginning of Part 2 and assume the following:

1. Labor is immobile between regions, and region A's labor force grows at an exogenously determined and constant rate. Capital, as before, is completely mobile. With the supply of one factor limited, the assumption of unlimited capacity must be discarded. If demand tends to exceed that which can be supplied with the existing labor force, wages and prices will be driven up. Conversely, if a low level of demand causes a sufficiently high level of unemployment, and some downward wage and price flexibility exists, wages and prices will decline. With the present assumptions of immobile labor, therefore, the previous assumption of constant prices will be replaced by the assumption of a Phillips Curve kind of relationship between the rate of unemployment and the rate of demand-induced inflation. Since there is some evidence that the long-run Phillips Curve might be vertical, it may seem more appropriate to assume that the rate of change in the rate of inflation is a function of the rate of unemployment. This, however, would insure that fiscal policy was ineffective in altering the long-run rate of unemployment, and since the same conclusion can be reached on other grounds, the latter assumption will not be used here.

2. All terms in the following analysis will be expressed in real units of domestic goods. Imports will be expressed in terms of the equivalent number of units of domestic goods at the then-existing price ratio. The import term, therefore, is actually the total real amount

spent on imports. To avoid an index-number problem, it is assumed that all investment goods are domestically produced. Thus, a change in the price level in region A will not alter K. The symbol p is defined as the rate of increase in region A's wages and prices per time period. Region F's prices, and the price of region A's imports, increase at the constant and exogenously determined rate p'. Since capital is mobile, the money rate of interest is exogenously determined. The real rate of interest $(r - p)$, however, varies inversely with the rate of price inflation. Although the real interest rate to a resident of A is likely to be different from the real rate to a resident of F, the real rate to a resident of a given region will not be affected by where he invests; it is the rate of price inflation in his own region that determines his real return.

3. No technological change occurs and factor proportions cannot be varied, so that the region's natural growth rate (n) is equal to the growth rate of the labor force. This places an absolute limit on the rate of expansion of capacity and makes the present case precisely the opposite of the mobile labor case. Incidentally, an alternative assumption that would not alter the analysis is to postulate that exogenously determined technical progress increases the efficiency of labor at a specific rate, increasing the ratio of output to labor while not affecting the ratio of output to capital. Then n would become the sum of the rate of growth of labor and the rate of technical progress, but the rate of growth of capacity would still be absolutely limited by the value of n. (However, since the assumption of no technological change will tax my explanatory ability less, that is the one which I shall use.[12])

4. The difference-equation models that have been used to develop this analysis have made the rate of investment a function of the ratio of demand to capital, with allowances for the effects of changes in the real interest rate.[13] With such an investment function and with stability conditions met, the growth rate of capital, g, will not vary long from the growth rate of labor, n. For g to remain above n, demand must grow faster than labor. But if capital and demand grow faster than labor, unemployment will fall, $(p - p')$ will rise (an increase in the rate of

[12] Professor Lanyi suggests in his discussion that n can also be interpreted as the target growth rate of the region. This is correct.

[13] Duesenberry, pp. 179–276.

domestic inflation relative to foreign inflation), foreign goods will be substituted for domestic goods, and in this way the inflation will lower the rate of growth of demand in region *A*. The rate of inflation can only cease to increase when g and n are equal, for only then will the rate of unemployment cease to decline. For a similar reason, g will not long lie below n. The rate of unemployment will rise until $(p - p')$ is decreased sufficiently to cause the rate of growth of demand, and of capital, to rise to equal the rate of growth of labor capacity. Given the fact that g automatically adjusts to equal n in the model, it will be assumed in the presentation that follows that g always equals n as a long-run approximation, and that the capital-to-labor ratio is always at a level such that the full employment of capital and of labor occur simultaneously. Although this assumption is not explicit in the mathematical model, it is used here because it reduces the number of variables and allows the use of K as a proxy for the size of the entire region, including the labor force. In spite of the short-run inaccuracy of the "g equals n" assumption, from a long-run perspective it is in keeping with the assumptions of immobile labor and mobile capital; the ultimate restriction on the growth rate of the region is not capital, which has unlimited availability, but labor, which does not.

5. A change in p is assumed to have no effect upon s. With g constant, the effect of g upon s that was possible in the analysis of mobile labor does not occur here. Therefore, s can be assumed constant. As before, however, an increase in demand relative to capital will result in more complete utilization of capital at the same time as it raises p. An increase in p, therefore, is correlated with an increase in the effective value of k, as well as with a decrease in the rate of unemployment. Of course, such a change in k is due to a change in the utilization of capacity, not to a change in the ratio of *full-capacity* output to capital.

6. All other assumptions, including the linear homogeneity of all internal relationships with respect to long-run changes in the economic capacity of the region, are the same as in the mobile-labor analysis. As before, the growth rate of foreign demand for exports, in the absence of different rates of inflation, is f. That is, X increases at the rate f per time period if $(p - p')$ is zero. Price changes, of course, will now

enter the picture, and both the exogenously induced tendency for export demand to grow and the endogenously determined rate of inflation affect the actual growth rate of export demand.

In the case of mobile labor, the growth rate of exports was constant throughout and g adjusted to it. Such an adjustment of the growth rate can no longer take place. That equilibrating force no longer exists. But with labor immobile, and different regional rates of inflation possible, adjustment will be brought about by the rate of price inflation. The adjustment will, in a sense, be the opposite of the earlier one; the rate of growth of the trade imbalance will now adjust to the natural growth rate that is imposed upon the region by the immobility of labor, again without liquidity constraints.

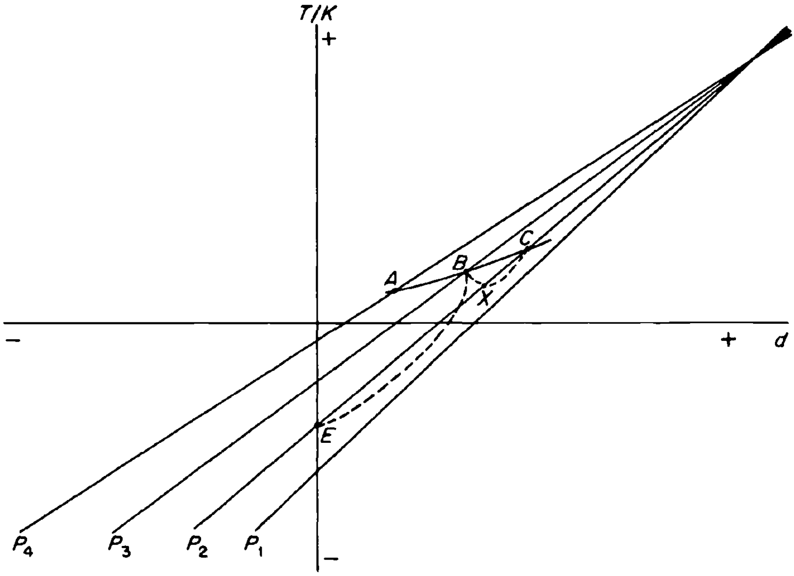
The adjustment process can be described with the aid of modified versions of demand equation (4) and the diagrams used earlier. Of course, g no longer responds to demand, but p does, for this is implied by the Phillips Curve. With consumption, import, and investment functions given and linearly homogeneous, as before, the two factors determining the ratio of demand to capital are the ratio of the interest burden to capital and the ratio of the trade balance to capital (T/K). An increase in d increases the interest burden, decreases income and demand relative to capacity, and therefore decreases p. This effect is intensified because the lower p value itself increases the real interest burden for residents of A, for it increases the real interest rate $(r-p)$. In a similar way, a decrease in T/K reduces total demand relative to capacity, hence reducing p. Thus, a function for p can be expressed in the form

$$p = p(T/K, -d). \tag{5}$$

This is similar to the demand function (4) except that now p, not g, is affected. Also, in the constant-price version the average propensity to import could be assumed constant, and X/K, rather than T/K, could be used. With price changes, however, imports and exports will both be affected during the adjustment process, and T/K must be adopted.

Now consider Figure 5, which is similar to Figure 1 except that T/K replaces X/K, and the two demand factors T/K and d influence p rather than g. Each p contour represents the various T/K and d combinations that will generate a particular rate of inflation. The lowest

FIGURE 5



rate is p_1, and the highest p_4. An increase in T/K, or a decrease in d, is inflationary, involving a movement to a higher p contour. With g predetermined and s unresponsive to demand changes, a relatively small change in T/K or d is likely to produce a large change in p, resulting in p contours that are relatively close together. As a result, all of the contours of reasonable p values *may* fall on one side or the other of the zero T/K axis. If this is the case, it simply means that the internal investment and savings relationship (g and s) is such that a zero T/K value will involve an unrealistically severe inflationary or deflationary condition; the dynamic equilibrium must involve a current-account imbalance in that case.

Higher p contours are more horizontal than lower ones, because a higher p value results in a lower real interest rate, so that changes in the debt level have less effect on demand. The p contours may even intersect on the right side of the diagram. If investment is very high relative to internal saving, the equilibrium may fall in the area to the right of the intersection of the p contours, and price instability may result. This possibility will be discussed below. For the time being, we shall assume that the equilibrium does not fall in this unstable range of high d^* values.

It has been shown how T/K and d influence demand relative to capacity, hence altering p. The contours in Figure 5 illustrate this. It will now be shown how changes in p react upon the trade balance, alter T/K, and hence alter demand relative to capacity. In this way, changes in T/K and p will tend to be self-limiting.

It is assumed, as before, that exports tend to grow at an exogenous rate (f) if prices in region A are constant. But prices affect both imports and exports, in accord with the usual elasticity relationship. Assuming that the influences of price and income are additive, it can be shown that T/K will be in equilibrium (constant) when

$$p = \frac{\left(\frac{M}{T} + 1\right)(f - g)}{e - \frac{M}{T}(1 - e - e')} + p'. \qquad (6)$$

M/T is the ratio of imports to trade balance, f is the rate that exports would tend to grow in the absence of price effects, e' is the elasticity of demand for imports, and e for exports. The right side of this equation reduces to $(f - g + ep')/e$ if e' is unity, or to approximately $(f - g + ep' + e'p' - p')/(e + e' - 1)$ if trade is nearly balanced.

Equation (6) is not difficult to interpret. If f exceeds g, the region's exports, in the absence of price effects, tend to grow faster than the region's capacity. With the import function linearly homogeneous, the trade balance therefore tends to improve relative to capacity. And if T/K tends to improve when $(p - p')$ is zero, there is some value of p higher than p' that will exactly offset this tendency and will hold T/K constant. Equation (6) states that p value. With the sum of the two elasticities greater than unity, p will exceed p' if f exceeds g, and p will be less than p' if f is less than g. The equilibrium p value may change slowly over time, for a nonzero $(p - p')$ value together with a nonunitary elasticity of demand for imports may cause M/T in equation (6) to change gradually. This effect did not occur in the difference-equation model because of the nature of the import function, but other equally plausible functions would have caused it. The change in the equilibrium value of p will, however, be so slow that it can be ignored in the description of the adjustment process.

Let us assume that p_3 in Figure 5 happens to be the p value that will cause T/K to remain constant, as expressed in equation (6). When the region is above the p_3 contour, the existing T/K and d ratios will generate a level of demand relative to capacity that will cause a greater inflation than p_3 (demand equation (5)). Then the high level of p relative to p' will cause the trade balance to deteriorate relative to capacity, although not necessarily in absolute value. This will cause the usual multiple reduction in demand relative to capacity, and the region will shift downward toward p_3. T/K declines, demand decreases, the rate of inflation also decreases; the decrease in the rate of inflation, in turn, reduces the decline in T/K. Eventually p_3 is reached, and the value of $(p_3 - p')$ is just enough to offset whatever tendency would have otherwise existed for T to grow at a rate different from that of K. On that contour, T will grow at the same rate as K, and T/K will remain constant. The tendency for demand to grow at the same rate as capacity will then sustain the existing rate of inflation.

Now turn once again to equation (2) and consider the adjustment of d to its equilibrium. Since labor is immobile, the values of g, s, and r are now given, and it is p that responds to demand changes. Because capital tends to be better utilized when demand is great, the effective value of k will be related to p. As long as the nature of this relationship is known, an equilibrium d value, d^*, can be calculated for each p contour in Figure 5, and as before, the ABC line can represent the nexus of such points. As in the earlier analysis, this line represents all points at which the existing current-account imbalance will cause the debt to grow at the same rate as capital, thus holding d constant. In the case of mobile labor it seemed likely that the ABC line would slope upward to the right; a higher f value would increase g and this would result in a shift in the ratio of the current account to capital toward a deficit, and thus an increase in d^*. In the present case the ABC line may have almost any slope; it may fall in any of the four quadrants of Figure 5, or it may pass through several of them. In the next section it will be shown that the equilibrium will fall in the upper right quadrant if $sk < g < r - p$, in the lower right quadrant if $sk < g$ and $r - p < g$, in the lower left quadrant if $g < sk$ and $g < r - p$, or in the upper left quadrant if $r - p < g < sk$.

To summarize, each p contour in Figure 5 represents the various combinations of T/K and d that will generate the amount of demand necessary to create that particular rate of price change (equation (5)). The p value that will cause T to grow at the same rate as K (equation (6)) is assumed to be p_3 in the diagram. The d^* value corresponding to each p contour is determined from equation (2), and these d^* values result in the ABC line. The intersection of p_3 and ABC is the equilibrium point where both T/K and d will tend to remain constant. This point (B) happens to fall in the upper right-hand quadrant, but different parameter values could cause it to fall in any of the other quadrants.

Let the region initially be at point E. At that point, region A has a trade deficit that results in the rate of inflation p_2, which falls short of the equilibrium rate p_3. In other words, the existing rate of inflation is less than the rate that would cause the trade deficit to grow at the same rate as the capital stock. Thus, $(-T/K)$ becomes smaller, causing the region to shift upward in the diagram. The improvement in the ratio of the trade balance to capital is inflationary; a movement directly up from E leads to higher p contours, but offsetting changes in d will occur in this particular case. The d value cannot remain at zero, for a trade deficit exists. Thus d rises. This increases the interest burden, lowers domestic income relative to capacity, and is therefore deflationary. In the illustration, the deflationary effect of the rightward shift in d is initially greater than the inflationary effect of the upward shift in T/K, so that the region drops below p_2. The decrease in p further contributes to the improvement in T/K. Eventually T/K becomes positive. In spite of this, d continues to increase in value, for the interest burden creates a current-account deficit in spite of the favorable trade balance. The trade balance continues to improve until a rate of inflation is reached that will cause T to grow no faster than K. This is p_3. Similarly, D will grow faster than K until d reaches a stable value on the ABC line (equation (2)). Both conditions are met only when point B is reached.

Although the direction of change in d and T/K will be different, depending upon the location of the equilibrium point and upon the initial T/K and d values, the preceding case does illustrate the nature of the adjustment forces that push the region toward the intersection of the line ABC and the equilibrium p contour; the intersection of those two lines is the only point at which T/K and d will both remain constant. However, as in the case of mobile labor, there is an instance in which the equilibrium just described will not result. This may occur if the natural growth rate of the region is slow enough to cause the numerator in equation (2) to approach zero or to assume a negative value. In other words, it may occur if $s(r - p)$ is almost as large as g or larger. In this case, the internal demand for investment funds is so small that $(-d)$ will grow very large. The increasing investment earnings may compensate for the deteriorating trade balance, and the dynamic equilibrium as described here may never be reached, or it may be reached with such a large $(-d)$ value as to make the result unrealistic.

Another kind of problem may occur if internal saving is very small relative to investment; the resulting high d^* value may fall to the right of the intersection of the p contours in Figure 5, which might cause price instability. To consider this possibility, suppose that the region is in equilibrium with a very high d^* value, perhaps .50 or so. If p for any reason rises above the equilibrium point, the real rate of interest, $(r - p)$, will be reduced. Because of the large external debt, this reduces the real interest burden, which result means an increase in real income. Thus, an increase in p produces an inflationary influence that may cause an even further increase in p should this inflationary effect be strong enough to offset the deflationary influence of the increase in p upon the trade balance.

There are a number of reasons why this possible instability does not seem likely to be a problem in reality. First, a relatively high level of d^* is required in the model to produce that result. In addition, it is assumed that a change in the real rate of interest is immediately recognized by debtors as a change in their real income, and the introduction of a lag in this relationship would appear to add stability.

Before leaving the analysis of the adjustment process in the case of immobile labor, the reader may wish to consider the adjustment from point B in Figure 5 to a new equilibrium, following a change in f. With the region initially in equilibrium at B, let f decrease. With the lower f value, T can be made to grow as fast as K only with a p value of less than p_3. Let us say that the new equilibrium p value is p_2. The existing rate of price inflation, p_3, causes T to deteriorate relative to

K, and T/K declines. This deterioration of the trade balance involves an increase in the increments to the debt each time period, and d rises. Thus the region moves along the dotted line. The deterioration of T/K ends as soon as the contour p_2 is reached at point x, for p_2 is now the rate of inflation that will cause T to grow exactly as fast as K. But the T/K value at point x is too low for the debt to grow at the same rate as capital, and d continues to rise. The region moves to the right, and since an increase in d is deflationary, this involves a drop in p below p_2. Then T/K rises. As p_2 is approached a second time, the increase in T/K slows to a stop, and this time the region also approaches ABC, for now the value of T/K is high enough for D to grow as slowly as K. The new equilibrium is reached at C.

4 THE EXTERNAL CONSTRAINT AND THE CHARACTERISTICS OF THE EQUILIBRIUM

THE preceding material has been an attempt to describe the forces that bring about a dynamic equilibrium in several variants of an open-economy model, a version of which is in the Appendix. In both cases, with mobile labor and with immobile labor, a dynamic equilibrium generally comes about in which the region's debt level, current-account balance, and capital stock grow at the same rate. Capital mobility removes the short-run liquidity constraint of limited reserves, but the analysis describes other external constraints operative in the long run. With both factors mobile, the constraint is upon the growth rate of the region, which with linearly homogeneous functions must equal the growth rate of exports. (Of course, with both factors mobile the rate of price inflation and the rate of unemployment are controlled by factor mobility.) At the other extreme, with immobile labor and fixed factor proportions, the growth rate of the region is constrained internally and the external constraint is upon the rate of inflation; $(p - p')$ must assume a value that will keep the trade balance growing at the same rate as the region.

Now consider the characteristics of the dynamic equilibrium.

These characteristics are not dependent upon the more restrictive assumptions of the model, but merely follow from the fact that changes in T/K and D/K will influence the ratio of demand to capacity in such a way that the T/K and D/K changes will be self-limiting. Given values of certain parameters, only one balance-of-payments configuration can result, for there will be only one configuration that is compatible with the stability of the T/K and D/K ratios. It is not even necessary to assume a fixed exchange rate to reach the conclusions that follow in this section, and they apply to both the mobile, and immobile, labor cases.

Since it is the current-account balance (B) that keeps D growing at the same rate as K in equilibrium, the equilibrium relationship of B/K to D/K, or d, must be

$$\frac{B}{K} = -gd^*. \tag{7}$$

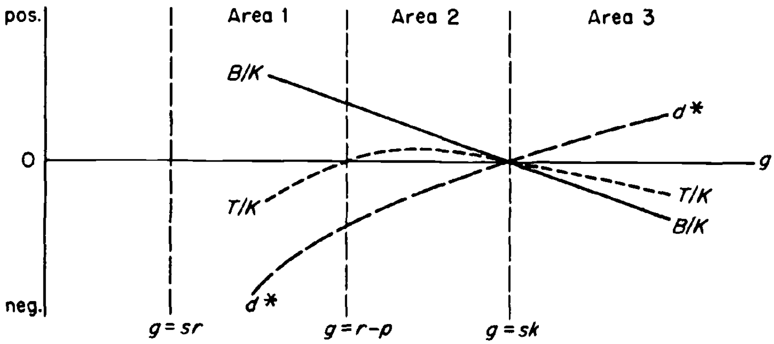
Thus, the current-account balance and the debt level must have opposite signs in equilibrium. But T may have a different sign from B. The relationship of the equilibrium T/K value to the d^* value can be determined by considering that the current-account balance $[B = X - (r - p)D - M]$ must be equal to the increase in the stock of external investments ($-\Delta D$) in the stipulated time period. Since the debt grows at the rate g in equilibrium, $[X - (r - p)D - M]$ must equal ($-gD$) in equilibrium. Rearranging this equality, dividing by K, and substituting d^* for D/K and T for ($X - M$) produces

$$\frac{T}{K} = (r - p - g)d^*. \tag{8}$$

The relationships expressed in equations (7) and (8) result from the fact that B, T, D, and K all must grow at the same rate in equilibrium.

Thus we relate the equilibrium B/K and T/K values to d^*; d^* was previously related to g in equation (2). It can now be shown how the values of B/K, T/K, and d^* relate to each other in equilibrium at different growth rates. First, whether the growth rate that equals the real rate of interest is greater or less than the growth rate that equals sk must be known. Figure 6 shows the former case. In area (1) of that diagram, the slow growth rate g, measured along the horizontal axis, produces the conditions ($g < sk$, $g < r - p$). The ($g < sk$) condition

FIGURE 6



is another way of saying that domestic investment is less than domestic saving; the slow growth rate implies a low level of investment demand and excess savings. A current-account (B) surplus must exist. It was explained earlier that if export demand tends to be incompatible with this required B value, either g will change through induced investment (if labor is mobile), or export demand will change through induced price changes (if labor is immobile). In either case, a current-account surplus must come about or the region must shift to a g value greater than sk, which means a shift out of area (1) in the diagram.

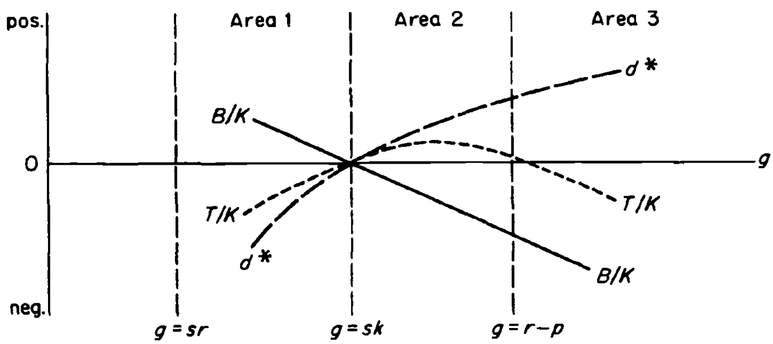
With the region's growth rate in area (1), therefore, a current-account surplus must exist. Since capital is perfectly mobile, this is offset by a capital outflow, and a negative D/K value accompanies the positive B/K value, as is expressed in equation (7). Equation (8) states that this equilibrium, with g less than $(r-p)$, must involve a negative T balance along with the positive B balance. Interest payments, of course, make up the difference. To see why T must be negative, assume for a moment that T equals zero. $(-D)$ will grow at the interest rate $(r-p)$. But the diagram shows g (the growth rate of K) to be less than $(r-p)$, and if D grows at the rate $(r-p)$ the value of $(-D/K)$ will rise. This increase in demand relative to capacity, acting through the usual relationships, will cause the trade balance to deteriorate. D/K will continue to increase until T/K has established a sufficiently negative value to drain away some of the external interest income and reduce the growth rate of $(-D)$ from $(r-p)$ to g. Then $(-D/K)$ can remain constant and a dynamic equilibrium can exist. The negative T/K ratio must accompany the positive B/K ratio, because with g less than $(r-p)$, the value of $(-D/K)$ would otherwise grow without limit.

In area (2) of Figure 6 the growth rate exceeds sk, so that insufficient internal saving is available, d^* (equation (2)) is positive, and B/K (equation (7)) is negative. Since g is less than $(r-p)$, the value of T/K expressed in equation (8) is positive; its sign has changed because the sign of d^* has changed. T/K must be positive for D to grow at the rate g, for a zero T/K value would cause D to grow at the faster rate $(r-p)$. If g is faster than both $(r-p)$ and sk, the debt grows faster than the interest rate, and T/K must assume a negative value to cause D to grow that fast, as is stated in equation (8).

Figure 7 is like Figure 6, except that in Figure 7 it is assumed that the growth rate that will exceed $(r-p)$ is less than the growth rate that will exceed sk. The curves are determined from equations (2), (7), and (8) as before.

Borts and Kopecky, in a paper appearing in this volume, present empirical results that support the conclusions stated here. They examine data from OECD countries in an attempt to explain the value of the ratio of external interest income to GNP for each country. (With constant k and $(r-p)$ values, this is, of course, the same as attempting to explain the value of D/K.) Their findings imply that the D/K ratio is strongly influenced, as expected, by the growth rate, the savings ratio, the capital coefficient, and the government-spending rate.

FIGURE 7



5 THE EXTERNAL CONSTRAINT AND FISCAL POLICY

EVERYONE is familiar with the way in which liquidity requirements restrict a nation's ability to use fiscal policy within today's international monetary structure. As noted earlier, the liquidity constraint exists for at least three reasons: (1) countries wish to limit the amount of their saving that they lend to others, (2) countries fear inflation, and (3), as we all recognize intuitively, even if unlimited lending were available to offset imbalances, a system of fixed exchange rates would still restrict a country's ability to use expansionary policy.

But we have only the vaguest notion of what the external constraint should be, for balance-of-payments theory has taken for granted that the constraint exists. In this paper, instead of following that course, an attempt has been made to describe the type of equilibrium that tends to develop when liquidity is not constrained and the only external constraint is demand for the region's goods. It now remains to determine how much this constraint of external *demand* limits the usefulness of regional fiscal policy. In doing so, we may get a clearer view of what is, and what is not, possible with fixed exchange rates.

A region's capacity or price level cannot indefinitely outrun the level warranted by world demand for the region's goods. Hence the ultimate determinant of the rate of growth or rate of price inflation in the region must be the value of f. If one accepts the assumption that f is exogenously determined, then it follows that fiscal policy cannot indefinitely keep a region's rate of growth or rate of inflation above the equilibrium level. If fiscal expansion temporarily raises g or p above the equilibrium rate, a deterioration in T/K will be induced which will offset the expansion, and g or p will drop back to equilibrium. If labor is mobile, this fall in g or p will occur because the rate of growth of K exceeds that of exports; if labor is immobile, the excessive p value will reduce T relative to K. Thus, g or p can be maintained above the equilibrium level only so long as the fiscal deficit can be continually increased relative to the size of the region, for this is what is required to offset the deterioration in T/K. Since an increasing fiscal deficit means that less internal saving is available for investment, this expansionary effort will be accompanied by a rising d level.

The above is not the only limitation on the effectiveness of fiscal policy. Serious balance-of-payments problems may result even from using fiscal policy to prevent fluctuations in g or p around the equilibrium value. It will be shown that the debt level, current-account balance, and the required fiscal imbalance are all likely to explode if the fiscal goal is to maintain a given p or g value, even if that value is the equilibrium one. Specifically, such instability will occur if the growth rate of the region is less than the real rate of return on interregional investment. This conclusion (as far as I can determine) is a very general one and is not dependent upon the more specialized assumptions of the model.

Assume that region A, a small part of an area in which capital is mobile, has the fiscal goal of preventing economic fluctuations around the dynamic equilibrium. If labor is mobile, the region will attempt to keep g exactly at its long-run equilibrium value; in other words, at the value warranted by the rate of increase in export demand. If labor is immobile, the goal will be to keep unemployment continuously at a level that will cause p to remain at its equilibrium value, which is the p value that will cause T to increase at a rate compatible with the natural growth rate of the region. In either case, the effect of fiscal policy will be to keep T/K at its equilibrium value. However, part of the process through which the d level is stabilized involves the adjustment of T/K through the demand effects of changes in the interest burden, and the d value may be unstable if its influence upon T/K is eliminated by using stabilizing fiscal policy. This can be easily shown.

Consider first the case in which g is less than $(r - p)$. For illustrative purposes, assume a positive debt and a current-account deficit. If T/K is zero, the debt will grow at the real rate of interest. The equilibrium must involve a positive T/K value of the size needed to reduce the rate of growth of D from $(r - p)$ to g. Now assume that for some unexplained reason an increment is added to D to cause it to exceed its equilibrium value, and consider the growth of that increment separately from the growth of the rest of D. The T/K ratio will still be of the correct amount to cause the rest of the debt to grow at the same rate as K, but the increment will grow at the rate $(r - p)$ because of compounding interest. It will become larger and larger relative to K, which is only growing at the rate g. Normally, the deflationary effects of this would increase T/K, reduce the rate at which the debt accumulates, and bring

D/K back to equilibrium. But the commitment of the region to offset income or price fluctuations prevents the adjustment. D/K explodes.

On the other hand, if g exceeds $(r - p)$, the use of fiscal policy to prevent income or price fluctuations around the equilibrium path poses no problem. Any increment to D above or below its equilibrium value grows at the rate $(r - p)$; but since K is growing at the faster rate g, the increment becomes less and less significant, and D/K reapproaches its equilibrium value, even though fiscal policy offsets the tendency for the change in D/K to influence price or income.

The above argument was framed in terms of a positive debt, but the case of a negative debt is analogous. The debt may explode either positively or negatively when g is less than $(r - p)$ and stabilizing fiscal policy is employed.

To summarize, it has been found that fiscal policy within a system of fixed exchange rates has two major limitations. First, while it can effectively prevent large deviations of p or g from the equilibrium value, it cannot permanently alter the value of p or g unless it affects f or causes a continuous substitution of domestic for imported goods. In addition, if g is less than $(r - p)$, those small fluctuations in p or g around the equilibrium value which are necessary to stabilize d must be permitted.

The above analysis of fiscal policy has been applied to a particular policy problem. In 1968, France was faced with an exceptional increase in wages and prices following a round of strikes in May through June. This led to a balance-of-payments problem and an eventual devaluation. The model was used to examine the policy alternatives that might have been open to France if that country (1) had been forced to maintain a permanently fixed exchange rate (as with a monetary union), and (2) had not been faced with a liquidity limit.

It was found that even with unlimited lending, a readjustment of prices was inevitable following the disturbance. The rate of employment and the rate of inflation had to fall temporarily below their long-run equilibrium values.[14] Moreover, any given increase in the ratio of fiscal deficit to income would offset this adjustment only temporarily. Efforts to use fiscal policy to postpone the required adjustment of

[14] With fixed exchange rates there is nothing peculiar about a large autonomous increase in prices leading to a subsequent lowering of the rate of inflation; even the specie-flow model produced this result.

prices indefinitely would require an ever increasing ratio of fiscal deficit to income; both that ratio and the ratio of debt to capital would explode.

As noted above, this situation resulted from the fact that the rate of growth in France was less than the rate of return on international investment; g was less than $(r - p)$. It should be observed, however, that fiscal policy could be effectively used to spread the adjustment process over a greater number of years, thus reducing the amount of price adjustment and unemployment occurring in any one year.

The application of the model to this particular policy problem produced some other interesting findings. For example, it became evident that the imposition of a liquidity constraint considerably complicated the adjustment process by necessitating policy actions that moved the region further away from its equilibrium path, thus creating a need for offsetting actions in the future. To generalize, it appears that the requirements for a balance-of-payments equilibrium in the liquidity sense may often conflict with the requirements for a long-run, or dynamic, equilibrium. When this happens, policies that necessitate offsetting policy actions at some future date must be pursued for liquidity reasons.[15]

6 CONCLUSION

THE simple specie-flow analysis endogenously generates a type of balance-of-payments equilibrium—the zero current-account balance. The liquidity constraint is the modus operandi which produces that equilibrium. More recent analysis has begun with the assumption of some particular equilibrium concept; the nature of the constraint is assumed at the outset rather than being generated by the analysis. This trend has evolved because the ultimate external constraint, which involves demand rather than liquidity, cannot be endogenously determined within a static model.

The external-demand constraint, like the liquidity constraint, can bring about a condition that can be called a balance-of-payments equilibrium—but an equilibrium in a dynamic sense, not in a static one. The

[15] Duesenberry, pp. 179–276.

static open-economy multiplier model analyzes demand forces, but a static model cannot describe the intertemporal equilibrium that those demand forces tend to produce. Inevitably, the equilibrium concepts that have been assumed have not been greatly different from the equilibrium generated by the specie-flow analysis. Efforts to modify the equilibrium concept have generally involved distinguishing between different kinds of capital flows, but the liquidity constraint remains the central focus. Thus, static balance-of-payments analysis has not been able to determine what sort of liquidity limits should be imposed upon a nation.

The present effort to develop a model in which the external constraint is endogenously determined initially employed the same static assumptions as did Mundell in his analysis of perfect mobility of capital with fixed exchange rates. This procedure eliminated the liquidity constraint and permitted the examination of the long-run adjustment process of the balance of payments where demand remained as the only constraint upon the expansion of the region. The resulting adjustment process and dynamic equilibrium were then analyzed. Certain inadequacies of the current analysis are evident. Only a few types of disturbances have been considered. Many details of the adjustment process and the equilibrium remain to be explored. Alternative assumptions need to be evaluated. Nonetheless, a number of conclusions have been reached:

1. The demand constraint limits the size, relative to capacity and output, of a region's current-account imbalance and of its net debtor or creditor position. The result can be described as a dynamic balance-of-payments equilibrium.

2. If both capital and labor are mobile between regions, the demand equilibrium tends to be established by the adjustment of the growth rate of the region's capacity and output to a rate that is compatible with the growth of the demand for its exports.

3. Capital formation within a region is likely to be highly responsive to demand changes when capital and labor are both mobile between regions. In this case it seems unlikely that the individual region will meet the familiar "stability in isolation" postulate that an increase in demand increases saving more than investment. An increase in the growth rate of the demand for exports is therefore likely to cause a

deterioration of the current-account and an increase in the relative size of the debt.

4. If labor is immobile between regions and the marginal factor-proportions ratio is unresponsive to demand influences, the region's growth rate cannot adjust to suit export demand. The equilibrium then comes about through the establishment of an induced rate of price change that will cause the trade imbalance to expand at a rate that is compatible with the growth rate of the region.

5. With reasonable long-run stability of the ratio of output to capital, the propensity to save, and the growth rate, the dynamic equilibrium will approximate the characteristics shown in Figure 6 and Figure 7. One of the most interesting features is that the T balance (current account minus net investment earnings) will tend to adjust to a positive value with an intermediate growth rate, but to a negative value if the growth rate is either fast or slow.

6. Regional fiscal policy cannot have a sustained influence upon demand unless it can influence export demand or cause domestic goods to be substituted for imports. A current-account deterioration will otherwise offset any given expansionary effort. The new dynamic equilibrium resulting from a fiscal expansion will involve an increased equilibrium ratio of debt to capacity and a more negative equilibrium ratio of current-account balance to capacity.

7. A rapid growth rate appears to have a definite stabilizing influence upon the region's balance of payments, for it makes d more stable. In fact, if the growth rate of the region is less than the real rate of return on interregional investment, the stability of d depends upon induced changes in T/K. In this case, efforts to use fiscal policy to prevent fluctuations around the long-run trend line of prices or growth will produce an unstable d ratio.

8. A region can prevent the adjustment to the dynamic equilibrium only by an ever increasing ratio of fiscal deficit to capital (and capacity). A secular rise in this ratio is a signal that the region cannot sustain the existing rate of expansion (g or p); it is a warning that the equilibrating forces are being thwarted.

9. A tendency to approach an equilibrium with zero exports may occur if a low equilibrium g value severely limits internal demand for investment funds. (Due to limited space, this equilibrium was not discussed in detail.)

APPENDIX

THE analysis is based upon several versions of a difference equation model. One of the more useful variants is presented here. The reader should refer to Table 1 for the definition of terms. The subscript t indicates the time period.

First, the immobile labor case. The Phillips Curve assumption is

$$p_t = a_7 \frac{Y_t}{Y_t^*} - a_8. \qquad \text{(A-1)}$$

Full-capacity output is limited by the labor supply and grows at the natural rate

$$Y_{t+1}^* = Y_t^*(1 + n). \qquad \text{(A-2)}$$

Consumption is a function of income

$$C_{t+1} = a_1 W_{t+1} = a_1[Y_{t+1} - (r - p_{t+1})D_{t+1}]. \qquad \text{(A-3}a\text{)}$$

An alternative version of (A-3a) can be used to make C less responsive to short-run income changes. This involves reducing the value of a and adding $a_{14}K_{t+1}$, where K_{t+1} is a proxy for the long-run income level of the region

$$C_{t+1} = a_1[Y_{t+1} - (r - p_{t+1})D_{t+1}] + a_{14}K_{t+1}. \qquad \text{(A-3}b\text{)}$$

Investment is a function of the ratio of income to capital and of the real rate of interest [16]

$$I_{t+1} = a_3 Y_{t+1} - a_4 K_{t+1} - a_5(r - p_{t+1})K_{t+1}. \qquad \text{(A-4)}$$

For the export and import functions, the income and price effects are added together to obtain

$$X_{t+1} = X_t(1 + f - ep_t + ep'), \qquad \text{(A-5)}$$

and

$$M_{t+1} = a_2(C_{t+1} - C_t) + M_t[1 + (e' - 1)(p_t - p')]. \qquad \text{(A-6)}$$

The price effect on M takes the form $[1 + (e' - 1)(p_t - p')]$ because M

[16] *Ibid.*

is actually the value of imports expressed in real units of domestic goods.

The system is completed with the following definitions:

$$D_{t+1} = M_t + D_t(1 + r - p_t) - X_t, \tag{A-7}$$

$$K_{t+1} = K_t + I_t, \tag{A-8}$$

and

$$Y_t = C_t - M_t + I_t + X_t. \tag{A-9}$$

The mobile-labor model is identical except that equation (A-1) is replaced by ($p - p' = 0$) and equation (A-2) is deleted.

A general solution could be obtained only in a simplified version of the model. Instead, a variety of parameter values were selected and computer simulations were run.[17]

COMMENTS

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The capital-market problems analyzed by Professors Howle and Floyd in terms of portfolio-balance models can be examined in the context of a new and imaginary state, the Kingdom of Brookings. This kingdom is initially part of a unified-currency area, Howledom. Later it joins a multiple-currency area known as Floyddom. Both Howledom and Floyddom are parts of a Mundellian world. One aspect of this world is the extremely high sensitivity of financial capital to small differences in interest rates offered in different parts of the world.

My comments on the two papers under discussion are organized into three sections. First, the papers will be reviewed briefly. Then, the models of national economies in the world will be compared with the problems of a firm in an exclusively national economy. Finally, concluding comments will be directed to the relevance of these papers to the policy problems of the international economy.

[17] Details are available from the author.

The major problem for the Kingdom of Brookings in Howledom is how much to borrow from foreign sources, knowing that increasing current expenditure relative to current income means that future expenditure must fall relative to future income. The tradeoff is between the present balance-of-payments constraint and the future balance-of-payments constraint. The kingdom has an equilibrium debt-to-capital ratio. Deviations from this path induce variations in the growth rate, movements in factors, or changes in relative prices. The interest rate paid on a loan is independent of the amount borrowed.

Certain theorems, both formal and informal, are derived from this model. Some of these theorems have Fisherian properties—increases in the yield on capital and reductions in the interest rate lead to more borrowing. Several other theorems relate to the impact on the amount borrowed abroad of changes in the growth of foreign demand for domestic goods. Thus, a decline in the growth of export demand leads to a reduction in the growth of debt; apparently the impact of the reduction in export demand on the growth rate dominates its impact on the supply of foreign exchange. The model shows the limitations on the use of fiscal policy, for the trade effects of induced changes in income cause a payments imbalance that will necessitate an offsetting change in the fiscal balance. This model is useful in its demonstration of which variables adjust under a variety of assumptions about factor mobility and fiscal policy.

The Floyd world differs from the Howle world in having more policy variables and fewer real variables. The Kingdom of Brookings issues and operates an exchange-stabilization fund, a monetary policy, a fiscal policy, and a commercial policy. Floyd is concerned with changes in the distribution of the ownership claims of additions to this stock in response to imbalance in the trade accounts. Redistributions of these claims between the residents of the small country and the rest of the world reflect the necessity of getting the trade deficits financed. These ownership claims appear to be denominated in the same currency—if they are denominated in any currency. Yields on this claim are necessarily identical, regardless of whether the issuers are in the country with the trade deficit or in the one with the trade surplus.

This model leads to the usual proportionality theorems under floating exchange rates. Thus, an increase in the money supply leads to an increase in the price of local goods and in the price of foreign exchange; the distribution of ownership claims among residents of the several countries does not change.

In a world of pegged exchange rates, however, disturbances have different consequences. An increase in money supply in the small country leads to an increase in the demand for imports and in the demand for ownership claims. The price of ownership claims increases. This price increase has a real-balance effect, which leads to a shift in the demand-function for goods. This conclusion depends on several assumptions, one of which is explicit. The explicit assumption is that no wealth effects are attached to the ownership of officially held international reserves, so that when the demand for foreign exchange rises, the resulting loss of reserves does not raise the unit value of the reduced holdings. If it did, owners of these reserves might realize a capital gain as the demand for foreign exchange increased. An implicit assumption is that the increase in the money supply has no wealth effect vis-à-vis goods, while it has a wealth effect vis-à-vis ownership claims. One inference from Floyd's model is that the difference in the conclusion about adjustment paths with pegged and floating rates reflects the assumptions about the differential wealth effects of the ownership of different financial assets, including the exchange-stabilization fund.

A comparison between the Kingdom of Brookings and the Brookings Clothespin Company (BCC) illustrates the international dimensions of the worlds of Howle and Floyd, and the relevance of their use of portfolio-balance models. Within the international economy, adjustment occurs through trade in goods, bonds, and money. A country adjusts to changes in the external demand for its goods by changes in the selling prices for its goods, bonds, or money. Within a domestic economy, a company adjusts to changes in the demand for its goods by changes in its issue of bonds and by changes in its money-holdings. Adjustments in the bond and money markets reflect changes in the goods market. BCC issues liabilities in the domestic capital market—a unified-currency area—to finance excesses of expenditures over incomes. Within the domestic economy the theory of portfolio balance suggests that the more debt BCC issues, the higher the interest rates on its marginal debt issues. Buyers of Monday's bonds require that

Tuesday's bonds be given inferior claims on the BCC. The theory of portfolio balance focuses on the relations between the prices of different financial assets in the bond market and the money market.

Countries in the worlds of Floyd and Howle face simpler problems than does BCC in a domestic economy, when the introduction of an international component might be expected to complicate the portfolio problem. The worlds of Howle and Floyd are domestic worlds in the sense that all financial assets are denominated in the same currency; their worlds have only one money and only one nonmoney financial asset. The lenders in these worlds passively adjust their demands for supplies generated by borrowers without any allowance for risk. Changing the name of the borrower from a company to a country does not automatically make the problem international.

The uniqueness of the world of international finance is the division of the world into currency areas. Each country has its own currency. The market applies different prices to securities denominated in these several currencies. The differences in these prices reflect expected exchange rates and the prices demanded by investors for bearing exchange risk. Howle intentionally sidesteps this problem. Floyd operates in a pseudo-multiple-currency world—*pseudo* in the sense that the ownership claims issued by borrowers in different countries do not differ in terms of currency denomination.

Papers on the international mobility of capital which fail to acknowledge the division of the world into currency areas and the consequences of that division for asset pricing may be excellent papers, but they are in the wrong ball park. Portfolio analysis appears well designed to deal with the pricing of assets denominated in different currencies. Instead, these papers caricature international finance and portfolio balance. They caricature international finance because they operate within a unified-currency area, and they caricature portfolio balance because the yield on financial assets appears independent of their value relative to other assets, and to the chain of prior claims on the borrower.

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An important piece of unfinished business in international economics is the development of an economically meaningful and operational concept of external balance or external constraint. For an age of special drawing rights and greater flexibility of exchange rates, it will be of limited usefulness to define imbalances in terms of institutionally imposed constraints on international liquidity and on the frequency of changes in exchange rates. External balance should no longer be thought of as an end in itself but as a means toward the achievement of national and international economic goals. The latter must then be incorporated into our definition of external balance, with necessary account being taken of international economic interdependence and the likely incompatibility of different nations' economic objectives. As yet, we have not come very far along these lines.[1]

In view of this hiatus in the literature, and in our thinking, Howle's contribution is suggestive. His definition of external constraint is endogenously determined in a long-run model whose crucial variables are the long-run equilibrium ratio of foreign debt to capital stock, an endogenously determined rate of interest, the saving rate, the capital-output ratio, and the rate of growth of foreign demand for the country's exports. In the case of internationally immobile labor, an additional determining factor is the "natural rate of growth," given by exogenously determined rates of growth of the labor force and technical change. It is argued that fiscal policy cannot evade this constraint for more than a temporary period of time, and this argument is supported by a numerical illustration purporting to describe French economic problems following the *événements* of May, 1968. In the limited space available, I should like to mention what I believe are the major difficulties with this approach.

First, I doubt that it is appropriate to define external constraint in terms of a small region unable to affect the rest of the world. In fact, the world is made up of many such regions. The interest rate is exoge-

[1] However, several writers—including Richard Cooper, John Letiche, and Tibor Scitovsky—have argued that our criteria of external balance should incorporate the notion of stabilization policy on an international scale.

nously determined in Howle's model but is not so in the real world; the same is true of the rate of growth of foreign demand. To ignore international economic interdependence in such a model is to beg some major questions inherent in the present international monetary dilemma. The real situation presents a multiplicity of possible solutions and, therefore, a far greater range of policy choice than Howle's model would suggest. The real problem is not to find a theoretical equilibrium but to define tradeoffs and to use welfare criteria to find the best feasible position.

Long-run equilibrium analysis tends to be irrelevant to the mainstream of policy concerns, not only because there is in reality no unique solution to the system, but also because such analysis is nonoperational. Howle never defines the appropriate time horizon for defining an external constraint—unless, by implication, the time horizon is infinity. However, for periods shorter than the long run in which we are all dead, once-for-all changes of an unpredictable nature are likely to dominate putative equilibrium magnitudes.[2] Even if this were not so, there would still be the problem of translating long-run equilibrium values into guidelines based on short-run statistics. How can policymakers identify Howle's external constraint when they see it?

Finally, I am uneasy about some of the variables around which Howle has chosen to construct his analysis. I wonder why the ratio of foreign debt to physical capital is more appropriate than the ratio of foreign debt to total financial assets: Raymond Goldsmith's recent work shows that these two ratios do not change in tandem. Moreover, the "natural rate of growth" is a fictional magnitude; Edward Denison's empirical studies have certainly shown this. I suggest that n might be interpreted as a *desired* rate of growth, in which case Howle's model depicts the tradeoff between the rate of growth and the rate of price inflation. An interesting extension of this model would be to assume floating exchange rates, in which case a fall in the exchange rate could be substituted for some, or all, of the price inflation, depending on one's assumptions about the relationship between the two.

[2] This fact does not disturb Howle, who, in discussing the French case, is able to ignore an initial price *rise* of six per cent and analyze ensuing developments on the assumption of an initial rate of price *deflation* of one per cent. Such, however, is the ineluctable logic of long-run equilibrium analysis.

While Howle's problem springs from the application of a model of long-run equilibrium to the issues of short-run policy, Floyd's lies in extending a comparative-static model to explain long-run changes. The strength of Floyd's model is its inclusion of portfolio adjustment, a consideration omitted from Howle's analysis. This difference in assumptions produces at least one interesting difference in results, namely that in Floyddom the ratio of foreign debt to real national wealth depends on monetary as well as real variables; while in Howledom, it depends on real variables alone. On the other hand, Floyd's model as it now stands is inadequate for the exploration of long-run relationships. One reason for this is the assumption of constant output, which is not only inconsistent with an annual nonzero flow of new domestic investment, but also entails the omission of a most important variable from the analysis of portfolio adjustment over time. Another reason is the curious assumption that the expected rate of price inflation is independent of the actual rate. Although the author has mentioned verbally that the expected rate might adjust to the actual rate, this point of view is not incorporated into the mathematical model, which consequently enjoys a somewhat deceptive aura of dynamic stability.

A further oversight in the specification of Floyd's model is the assumption that the domestic *real* rate of interest is determined by the *real* rate of interest prevailing abroad. In fact, foreign investors compare the *nominal* rate of interest in their countries (i^f_n) with the *nominal* rate of interest in the home country (i_n) *minus* the expected rate of depreciation of the home-country currency (R^*_r). In a world of perfect capital mobility, then, we would expect that

$$i^f_n = i_n - R^*_r.$$

Only when exchange rates are flexible *and* the expected rate of depreciation of the home-country currency is exactly equal to the difference between the expected rates of price inflation at home and abroad will the *real* interest rates be equated. Incorporating this correction into Floyd's model produces significant changes. For instance, Floyd predicts that under fixed exchange rates, a foreign inflation will raise aggregate demand in the domestic economy, thereby inducing domestic price inflation and a sale of domestic assets to foreigners. In fact, if foreign inflation drives up nominal interest rates abroad, one would expect foreigners to wish to sell *their* holdings of domestic assets as well. The adjustment process then becomes considerably more complicated—and more realistic—than the one Floyd describes.

In Figure 2 of his paper, Floyd neatly exhibits the process by which simultaneous equilibrium is achieved in the markets for assets, goods, and foreign exchange through changes in the exchange rate and the price level. Once long-run rates of change of variables are incorporated into the analysis, however, the result is somewhat confusing. In one place we are told that the price level is unaffected by monetary policy under fixed exchange rates, since an increase in the *rates* of monetary expansion and price inflation will have no effect on the *levels* of the money supply and prices during the present period. Elsewhere, it is asserted that higher rates *do* have an effect on the levels by the end of the period during which they are changed. This confusion apparently stems from the author's interpretation of the short run as a period whose length asymptotically approaches zero—a concept corresponding to the time derivatives in Floyd's model. But in such a short run, the rates of change *also* approach zero asymptotically. The author should have taken greater care to distinguish between a verbal description of his mathematical model and the way terms like short run are commonly understood in policy analysis.

Thus, while Howle's analysis of the short run suffers from paying excessive attention to the near-infinite *long* run, Floyd concentrates inordinately on the near-infinite *short* run. Needless to say, neither of these periods is of much interest to the makers of economic policy. That neither of these papers has much to say about the short or medium runs, as commonly understood, implies criticism either of the models employed or of the way in which interpretations have been drawn (or have *not* been drawn) from them. There is a lesson in this. Just as mathematics is a way of checking the logical validity of our economic analysis, so must economic analysis be used to check the economic validity and relevance of our mathematical models. We must be careful to avoid the bad (and increasingly widespread) habit of letting mathematical models do our economic thinking for us.