

International Economics

INTERNATIONAL ECONOMICS

Robert A. Mundell

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Preface

This book brings together, and to a certain extent integrates, my theoretical writings on international economics over the past decade. All the major topics are touched on, and I have organized them into a pattern that seemed to me to make them most useful to the student. Part I analyzes the classical theory and covers such topics as the terms of trade, income transfers, productivity changes, tariffs, consumption taxes, production taxes, transport costs, tariff preferences, factor mobility, and policy analysis in the context of general equilibrium systems. Part II introduces monetary-dynamic elements into the theory of exchange and develops the theory of adjustment, the balance of payments, growth, the distribution of the burden of adjustment, optimum currency areas, monetary standards, and fixed and flexible exchange rate systems. Part III treats international macroeconomic theory from the standpoint of the theory of policy and develops the principle of effective market classification, the appropriate mix of monetary and fiscal policy under fixed and flexible exchange systems, capital mobility, the international transmission of cycles, commercial policy, the welfare cost of exchange crises, the crisis problem, and multiple-currency systems.

The book, looked upon as a text, is perhaps most suitable in courses of international economics for graduate students, or, in those institutions where undergraduates receive substantial instruction in theory and money, for seniors. But just as international economics cannot be studied independently of value and monetary theory, so value theory and monetary theory cannot be divorced from the subject matter that is studied in trade theory. The theory of exchange and general equilibrium, treated in Part I of this book and in the final chapter, are as much a part of general theory as optimum currency area theory and the monetary-fiscal policy mix are part of the theory of money. For this reason some teachers may find various chapters useful as supplementary reading for students of courses in general theory or in monetary theory.

Many of the topics covered in this book have a bearing on the great controversies that have raged in the economics profession since the publication of Keynes' *General Theory*. Keynes' attempt to integrate real and monetary phenomena was only partially successful, but he gave new scope to economic thinking about theory and policy. Just as theorists in the nineteenth century eventually settled their differences over which blade of the scissors did the cutting, so economists today are becoming increasingly impatient

with analysis based solely on multiplier or on velocity approaches to income determination. What emerges is a richer and more useful theory based on general equilibrium analysis. To accelerate this end, in the field of international economics, I trust this book makes a contribution.

A complete list of acknowledgments to teachers, friends, students, and colleagues would be too long and would detract from the special indebtedness I owe to select individuals. My earliest indebtedness is to two great teachers at the University of British Columbia, Joseph A. Crumb in the Economics Department and William J. Rose of the Slavonic Studies Department. I owe a general debt in 1953-54 to members of the Economics Department at the University of Washington and especially to Donald F. Gordon.

I had the good fortune in the three years from 1954 to 1957 to benefit from personal association with C. P. Kindleberger, P. A. Samuelson, J. E. Meade, S. A. Ozga, L. Robbins, H. G. Johnson, M. Friedman, A. C. Harberger, and L. A. Metzler. Their influence on my work will, it is hoped, not have escaped detection. Subsequently, K. J. Arrow greatly encouraged my interest in general equilibrium theory.

In the preparation of this volume I have exploited the advice of friends and students. H. G. Johnson, to whom I owe numerous debts incurred over the past decade, made many suggestions. Lawrence Krause, Walter Salant, Alexander Swoboda, and Bernard Munk made helpful comments. Kishori Lal, Houston Stokes, Michael Mussa, and Rudiger Dornbusch (who prepared the bibliography) contributed at various stages. Paulette Lundgren and Judith Kidd provided valuable assistance.

For permission to reprint material from which, in whole or in part, material has been adapted, I am happy to acknowledge the *American Economic Review*, *The Quarterly Journal of Economics*, *Econometrica*, the *National Banking Review*, *Kyklos*, *The Canadian Journal of Economics and Political Science*, the *Manchester School of Social Studies*, the *IMF Staff Papers*, the *Banca Nazionale del Lavoro Quarterly Review*, and the *International Encyclopaedia for the Social Sciences*.

R. A. M.

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International Economics

Part I

THE THEORY OF
EXCHANGE

Chapter 1 / *The Classical System*

The distinction, vital to the classical system of international trade theory, between the short-run mechanism of balance-of-payments adjustment and the static theory of barter was an important dimension of the classical dichotomy between monetary theory and value theory. This dichotomy was a powerful tool of analytical abstraction that enabled a separation of long-run static analysis from short-run dynamics. In dynamical, short-run, disequilibrium theory, monetary elements assume a role of first-order importance in the adjustment process. But after the adjustment process is completed money is shown in its true light as a mere veil, with no influence upon the nature or position of long-run equilibrium. A major task of exposition in classical theory, therefore, was to demonstrate the automaticity of equilibrium through examination of the monetary adjustment process, and through this demonstration, the unimportance, in the long run, of monetary phenomena.

The demonstration of the automaticity of balance-of-payments adjustment in the field of international trade theory was a companion to, although it anteceded, the demonstration of a different kind of automaticity in value theory. In the theory of a closed economy the classical economists assumed the system tended automatically toward a full-employment equilibrium, on the premise that money wages were flexible, and it was an equilibrium not affected, in any fundamental way, by the amount of *money* in the system. Whatever the temporary effects of a change in central bank policy, the money supply had no influence upon the equilibrium rate of interest, which was identified with the rate of profit, or the real wage. Instead, money exerted its influence merely upon the price level and the level of money wages. Since money could not alter either the level of real wages or the rate of interest, it could not affect the equilibrium level of any real magnitude in the economic system, and the path was cleared for long-run analysis and abstraction from purely monetary phenomena.

In an open economy linked to the rest of the world by international trade

and the gold standard, on the other hand, the central bank could not even affect the nominal quantity of money in the system unless the country was large enough to influence, by itself, the world price level. Whereas in a closed economy the central bank could determine the *nominal* quantity of money, and the public, through spending or hoarding it, could determine its *real* value, in an open economy any excess of new money creation over desired hoarding would escape down the foreign drain. An overissue of money by the banking system would quickly bring its own corrective: Specie would flow out and force the banks to take back the redundant currency, or else suffer a depreciation of the gold value of bank notes. The nominal quantity of money was thus determined in a single economy by international considerations, and the barter terms of trade could not be affected permanently by purely monetary disturbances.

To have perceived the validity of these propositions, which even today exhibit a fundamental truth, was the supreme intellectual achievement of classical economic analysis. Through this theory mercantilist fallacies could be refuted and the way paved for the emphasis on the doctrine of free trade and on other real phenomena, the only considerations that were supposed to matter in the long run. Ricardo's love was not the short-run dynamic mechanism but the long-run static theory of international barter.

We know today that this separation of static, barter theory from dynamical, monetary theory was carried too far, in the sense that it cannot be maintained, as the classical school seemed to hold it could, that the trade equilibrium established under conditions in which money is used and the trade equilibrium reached under conditions of barter are identical. Indeed, it is difficult to conceive of a way in which the assertion can be given an operational meaning. What is valid in the separation is not the identical nature of the equilibrium that is achieved, but rather the universality of the principles established in the process of reaching trade equilibrium. The principles established would not be different and it is this that provides the justification for an extended treatment of the classical barter model.

The barter model is indeed the source of many propositions that form the body of modern international trade theory. Despite severe criticism of other aspects of classical theory the barter model has stood the test of time. Its survival can be attributed partly to its applicability to current policy issues in the country in which it originated, and partly to its internal consistency. It was logically immune to criticisms of general equilibrium and macroeconomic methods and was aggregative in scope.

The classical school was interested in establishing the direction in which the terms of trade would move as a result of exogenous disturbances to equilibrium such as would arise from tariffs, hoarding, harvest failures, income transfers (or other remittances) and productivity changes. More powerful methods today make it possible to derive additional implications from the

model and to deduce, in cases where the relevant data are available, the probable magnitude of changes in the terms of trade. The purpose of this and the following two chapters¹ is to show how these results may most simply be obtained. The main focus of our attention will be on comparative statics rather than dynamics or monetary considerations.

Analytical Procedure

The nature of comparative statics analysis is a contrast between two positions, usually positions of equilibrium, distinguished from one another by a shift in some parameter such as that which would be brought about by a change in economic policy. The policy change disturbs the initial equilibrium by causing excess demand for one commodity and excess supply of another commodity. The disequilibrium must then be eliminated, if a new equilibrium is to be reached, by an adjustment in some other variable. The adjusting or equilibrating variable may be another policy change, or a process of adjustment that is sufficiently predictable to be considered automatic.

In classical international trade theory the adjustment mechanism was presumed to be automatic. A policy change would disturb balance-of-payments equilibrium, induce a gold flow and, through a change in relative price levels, a change in the terms of trade. Today this mechanism is not so automatic in the sense that central bank and government reaction to disequilibrium in the balance of payments is predictable. Besides the traditional inflation-deflation method of the gold standard, a disequilibrium may be corrected by borrowing (in the short run), trade controls, tax changes, technological changes (in the long run), or the exchange-rate adjustment. Most of these methods have been used² by one country or another since the breakdown of the gold standard system to resolve balance-of-payments crises.

Because of this change in institutional response to disequilibrium, any analysis of policy change necessarily involves elements of taxonomy. Such questions as: "Do tariffs improve the balance of trade?" cannot be given an equivocal reply; the answer depends on the other policies followed by the government. A tariff disturbs the initial equilibrium and therefore requires, for a new equilibrium to be reached, a change in some other policy; it may involve changes in any or all of the policies listed above.

But exploring all conceivable policy alternatives would be tedious and unrewarding pedantry. For that reason it is convenient to assume that, for analytical purposes, the classical mechanism is operative, that the terms of

¹ Adapted from: *Amer. Econ. Rev.*, 50, 68–110 (March, 1960).

² Often, perhaps usually, to the detriment of economic efficiency. We are concerned now, however, with "positive," rather than "normative," aspects of international trade theory.

trade “automatically” adjust to correct disequilibrium. The first step in the comparative-static analysis is therefore to determine the effect of policy changes on the terms of trade or domestic price ratios. It will be shown later that results thus obtained can be used to demonstrate the working of any alternative mechanisms of adjustment.

The Method of Comparative Statics

The most direct way to derive the effect of a policy change on the terms of trade is to differentiate a balance-of-payments equation with respect to the change in policy, and to substitute in the result the conditions necessary to satisfy the other conditions of equilibrium. A more intuitive way of getting the criterion, however, is to employ a device implicit in all comparative-statics analysis. This is to compute the excess demand caused by the policy change *on the assumption that the adjusting variable is constant*, and to equate this excess demand to the excess supply created by the actual change in the adjusting variable. If, for example, we wish to find the criterion for the effects of a tax on the terms of trade, we first determine the excess demand caused by the tax at constant terms of trade and translate the excess demand, which is the coefficient of the tax change, into the appropriate income or price elasticity; we then compute the excess supply of the same good created by a change in the terms of trade, translating its coefficient into the relevant elasticities. By equating the excess demand and the excess supply the criterion is established.

This procedure, which may be called *the method of comparative statics*, can be illustrated by two familiar—almost trivial—examples drawn from economic theory. In the Marshallian demand-supply system, with mnemonic terminology, we have at equilibrium the condition that demand equals supply:

$$D(p; \alpha) = S(p) \quad (1)$$

where α is a parameter representing the position of the demand schedule. To determine the effect on price of a shift in the demand schedule, first determine the excess demand caused by the shift at constant price; this equals

$$\frac{\partial D}{\partial \alpha} d\alpha. \quad (2)$$

The excess supply caused by an increase in price is equal to

$$\left(\frac{\partial S}{\partial p} - \frac{\partial D}{\partial p} \right) dp. \quad (3)$$

At the new equilibrium the excess demand must be offset by an equal excess supply, so we get

$$\frac{dp}{d\alpha} = \frac{\partial D / \partial \alpha}{(\partial S / \partial p) - (\partial D / \partial p)} \quad (4)$$

which is the criterion we set out to find.

In the naive Keynesian system we have, at equilibrium, equality of saving (S) and investment (I), that is,

$$I(\alpha) = S(y) \quad (5)$$

where y is income and α is a parameter representing the level of autonomous investment. To find the effects of a shift in the investment schedule on income, first consider the excess demand for goods at constant income, that is,

$$d(I - s) = \frac{\partial I}{\partial \alpha} d\alpha \quad (6)$$

and then the excess supply induced by a change in income, that is,

$$d(S - I) = \frac{\partial S}{\partial y} dy = s' dy \quad (7)$$

where s' is the marginal propensity to save. At the new equilibrium the excess demand caused by the shift in investment and the excess supply created by the change in income must be equal. Equating (6) and (7) and rearranging terms, we get the familiar multiplier

$$\frac{dy}{d\alpha} = \frac{\partial I / \partial \alpha}{s'} \quad (8)$$

A second step in analysis is to utilize information from knowledge of stability. Any adjustment mechanism implies a type of dynamic behavior and thus a condition of dynamic stability—convergence to equilibrium over time. If an equilibrium is unstable, the system would not tend to approach the new equilibrium given by the comparative-statics analysis, and there would be little point in pursuing the comparative-statics analysis. On the other hand, if the system is stable, a useful clue may be obtained from the stability conditions about the sign of the elasticity coefficient of the adjusting variable, the terms of trade. The first step, then, is to examine the conditions of dynamic stability.

This procedure is an application of the correspondence principle. Thus in the demand-supply example just given, on the dynamic hypothesis that excess

demand induces an increase in price, say, according to the law

$$\frac{dp}{dt} = k(D - S)$$

stability requires that

$$\frac{\partial S}{\partial p} - \frac{\partial D}{\partial p} > 0.$$

Therefore the change in demand has the same sign as the resulting change in price.

In the second example, on the dynamic hypothesis that income rises when there is excess demand for goods, stability requires that

$$s' > 0$$

so an increase in investment induces an increase in income.

The Free-Trade Model

Let us now construct a simplified classical trade model and examine its stability conditions. Assume two countries, A and B , in full employment, producing two commodities— X , which is exported by A , and Y , which is exported by B . Let capital letters denote production, small letters consumption, and subscripts countries. Let T represent the capital exports (lending) of country A expressed in terms of X ; let P denote the terms of trade, the price of Y in terms of X ; and let D represent domestic expenditure.

The system can then be described by the following equations:

Domestic expenditure in A (in terms of X) equals national income minus net capital exports:

$$D_a \equiv x_a + Py_a = X_a + PY_a - T. \quad (9)$$

Domestic expenditure in B (in terms of Y) equals national income plus net capital imports:

$$D_b \equiv \frac{x_b}{P} + y_b = \frac{x_b}{P} + y_b + \frac{T}{P}. \quad (10)$$

The demand for Y in A depends on domestic expenditure and the terms of trade:

$$Y_a = y_a(D_a, P). \quad (11)$$

The demand for X in B depends on domestic expenditure and the terms of trade:

$$x_b = x_b(D_b, 1/P), \quad (12)$$

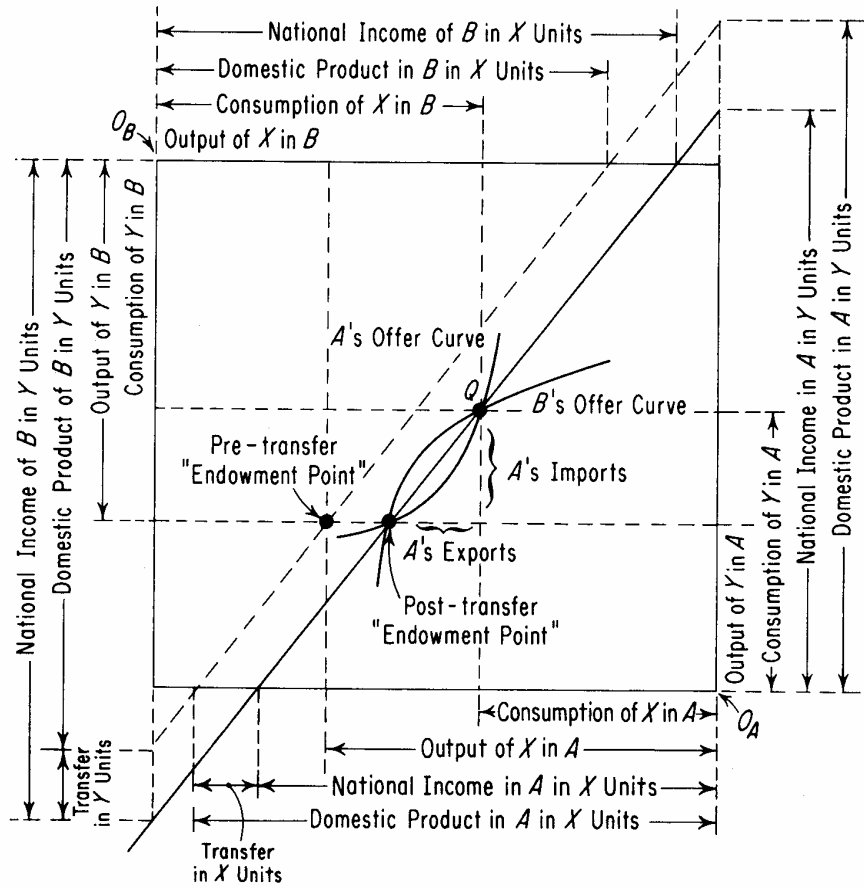


Figure 1-1.

The dimensions of the box represent world output of the two goods. The endowment point shows how production is distributed between the two countries before trade or transfers. The point Q illustrates post-trade equilibrium on that assumption that country A makes a transfer to country B and that there is free trade.

It is left for the reader to translate the symbols used in the text into distances in the diagram, to develop an alternative statement of the equilibrium conditions using community indifference curves and the contract locus, and to show that, in the variable production case, A 's and B 's production possibility curves, referred to origins O_A and O_B respectively, would be tangent to one another at the pre-transfer point.

In subsequent diagrams the endowment point will be regarded as the origin for trade.

The production of X and Y in A depends on the terms of trade:

$$X_a = X_a(1/P) \quad Y_a = Y_a(P). \quad (13)$$

The production of X and Y in B depends on the terms of trade:

$$X_b = X_b(1/P) \quad Y_b = Y_b(P). \quad (14)$$

The net capital exports of country A equal the balance of trade of country A :

$$T = X_b - X_b - P(y_a - Y_a). \quad (15)$$

Variations in domestic expenditure in each country are assumed to depend on changes in policy. In the free-trade case the system is completed by the following equations:

$$D_a = D_a(T) \quad \text{and} \quad D_b = D_b(T/P).$$

We then have eleven independent equations in the twelve unknowns x_a , x_b , y_a , y_b , X_a , X_b , Y_a , Y_b , D_a , D_b , P , and T , so there is 1 degree of freedom. Knowing the rate at which A is lending to B (that is, T), we can solve for the equilibrium terms of trade (P); or, assuming that the terms of trade are fixed, we can find the rate of lending that will establish equilibrium.

There are other, equivalent ways of writing the equilibrium conditions of the system. equations (9) and (10) could be replaced by conditions stating that world production and world consumption of each good must be equal—these alternatives imply each other when combined with equation (15), expressing balance-of-payments equilibrium. equations (11) and (12), the demand functions for the good that is imported in each country, could be replaced by the demand functions for the good that is exported, since all income is spent; the part of domestic expenditure that is not spent on one good must be spent on the other good.

It will be convenient to define an import demand function for each country. The demand for imports is the difference between the quantities of the imported good demanded and supplied, that is, $I_a = y_a - Y_a$ and $I_b = x_b - X_b$, where I_a and I_b , are, respectively, the demands for imports in A and B . Then, because the demand and supply functions depend only on domestic expenditure and the terms of trade, the import demand functions must also depend on these variables. Thus we have two more equations and two more unknowns:

$$I_a = I_a(D_a, P) \quad \text{and} \quad I_b = I_b(D_b, 1/P). \quad (16)$$

If we now substitute (16) in the balance-of-payments equation (15) we obtain

$$T = I_b(D_b 1/P) - PI_a(D_a, P). \quad (17)$$

Conditions of Stability

Now let us consider the question of stability. An equilibrium is stable if a small displacement of a variable from its equilibrium level is followed by a return to equilibrium. In the context of the classical trade model, the equilibrium is stable if a displacement of the terms of trade from equilibrium sets in motion forces inducing a return to that equilibrium. The system is stable only if a fall in the price level or exchange rate of the deficit country causes an improvement in its balance of payments. To find the criterion for stability we have to compute the excess supply caused by a change in the terms of trade. This criterion will then give us the coefficient of a change in the terms of trade for use in the comparative-statics analysis.

The balance of trade surplus of country *A*, expressed in terms of home goods, can be written, given the level of domestic expenditure in each country, as

$$B = I_b(1/P) - PI_a(P). \quad (18)$$

Differentiating with respect to *P* we get

$$\begin{aligned} \frac{dB}{dP} &= \frac{\partial I_b}{\partial(1/P)} \frac{d(1/P)}{dP} - P \frac{\partial I_a}{\partial P} - I_a \\ &= -\left(\frac{1/P}{I_b} \frac{\partial I_b}{\partial(1/P)}\right) \frac{I_b}{P} - \left(\frac{P}{I_a} \frac{\partial I_a}{\partial P}\right) I_a - I_a. \end{aligned}$$

The terms in parentheses are the elasticities of demand for imports in *A* and *B*, respectively. Write these terms, with a change of sign, as η_a and η_b . Then we have

$$\begin{aligned} \frac{dB}{dP} &= \eta_b \frac{I_b}{P} + \eta_a I_a - I_a \\ &= I_a \left(\eta_a + \eta_b \frac{I_b}{PI_a} - 1 \right). \end{aligned} \quad (19a)$$

If trade is initially in balance, $I_b = PI_a$, so that a fall in *A*'s terms of trade (an increase in *P*) will improve or worsen *A*'s trade balance, depending on whether

$$\frac{dB}{dP} = I(\eta_a + \eta_b - 1) \lessgtr 0 \quad (19b)$$

depending on whether the sum of the elasticities of demand for imports is greater or less than 1.

This criterion can be derived directly from the dynamic behavior of the system along the lines that Samuelson, writing in the early 1940s, made famous.

Let us approximate the dynamic behavior of the system by the following differential equation:

$$\frac{dP}{dt} = k[PI_a(P) - I_b(1/P)] \quad (20)$$

which states that the speed of the change in the terms of trade is proportional to the discrepancy between foreign exchange payments and receipts. Expanding this equation in a Taylor series in the neighborhood of equilibrium, omitting nonlinear terms, and choosing time units to make the “speed of adjustment” $k = 1$, we obtain

$$\frac{dP}{dt} = I(1 - \eta_a - \eta_b)(P - P^0) \quad (21)$$

where P^0 denotes the terms of trade at equilibrium. This equation has a solution

$$P = P^0 + Ae^{-I(\eta_a + \eta_b - 1)t} . \quad (22)$$

The equilibrium point is stable only if $P \rightarrow P^0$ as $t \rightarrow \infty$; this can be the case only if the exponential term disappears, that is, only if $\eta_a + \eta_b - 1 > 0$.³

This discussion has been restricted to the stability of an *equilibrium* rather than to the stability of a *system*. John Stuart Mill recognized the possibility of multiple equilibria without reference to stability ([66], pp. 154–63), but his treatment was in error in certain respects. Marshall, in 1879, was aware ([52], pp. 24–25) that a point of unstable equilibrium must be flanked by points of stable equilibria, that the number of equilibria must be odd, and that (therefore) if an equilibrium were unique it would be stable.

There are alternative ways of expressing the stability condition. For example, it can be expressed in terms of one good only. To see this, recall

³ The elasticity criterion just derived was first developed by Alfred Marshall. It is important, however, to notice that Marshall’s dynamic postulates differ from that described in (20) above. The latter assumes that the budget equations in each country are satisfied (each country is always at a point on its offer curve) but that markets are not necessarily cleared. Marshall’s postulates are based on adjustments of offers toward the budget equations (offer curves). Marshall’s adjustment process, which can be justified on the basis of varying profitability of export industries, admits richer solutions, including the possibility of complex roots and an oscillatory path to equilibrium (see Samuelson [90], pp. 266–268).

equation (1), which expresses the equality of income (plus borrowing) and expenditure in country A . With lending zero this equation can be written

$$X_a - x_a = P(y_a - Y_a) = PI_a.$$

That is, offers of exports equal the value of imports demanded. Substituting in (18) and making a similar substitution for I_b , we can write the balance of payments (with no lending) as

$$B = (x_b - X_b) - (X_a - x_a).$$

Differentiating and rearranging terms we get

$$\frac{dB}{dP} = \left[\frac{d(x_a + x_b)}{dP} \frac{P}{x_a + x_b} - \frac{d(X_a + X_b)}{dP} \frac{P}{X_a + X_b} \right] \frac{X}{P}$$

where X is world production and consumption at equilibrium, and the arguments in the bracket are, respectively, the world elasticity of demand for X and the world elasticity of supply of X :

$$\eta_x = - \frac{d(x_a + x_b)}{d(1/P)} \frac{1/P}{x_a + x_b}$$

$$\varepsilon_x = \frac{d(X_a + X_b)}{d(1/P)} \frac{1/P}{X_a + X_b}.$$

Hence

$$\frac{dB}{dP} = X(\eta_x + \varepsilon_x), \quad (23a)$$

where units are chosen so that P is, at equilibrium, equal to unity. By similar reasoning from the balance-of-payments equation,

$$\frac{B}{P} = (Y_b - y_b) - (y_a - Y_a)$$

we find that

$$\frac{dB}{dP} = Y(\eta_y + \varepsilon_y), \quad (23b)$$

where η_y and ε_y are the elasticities of world demand for, and supply of, Y .⁴

⁴ Mosak ([68], chap. 4) derived stability conditions in terms of one good only; see also Johnson ([30], p. 98). See Hirschman [25] for a development of the stability criterion when trade is not initially in balance.

The elasticities of demand for X and Y are defined to be positive provided these goods are not Giffen goods; and the elasticities of supply of X and Y are defined to be positive provided opportunity costs are not decreasing. It may then be seen that the system is necessarily stable if neither good is a Giffen good in world consumption and opportunity costs are not decreasing. But even if the goods are Giffen goods, positive supply elasticities may yet make the system stable.

The task of Chapter 2 is to introduce into the balance-of-payments equation various parameters representing economic policies, and to show how the equilibrium values of the variables are affected by changes in these policies. Unless it is explicitly stated to the contrary, the equilibrium point will be assumed to be stable.⁵

Price and Income Effects

Before going on to a consideration of changes in economic policies, it will be useful to introduce a relationship between income propensities and price elasticities based on Slutsky's separation of price effects into income and substitution effects. A price elasticity of demand can always be written as the sum of a compensated (pure substitution) price elasticity and an income propensity. Consider any demand function of the form $I = I(D, P)$ and differentiate with respect to P . This yields

$$\frac{P}{I} \frac{dI}{dP} = P \frac{\partial I}{\partial D} \frac{dD}{IdP} + \frac{P}{I} \frac{\partial I}{\partial P}$$

after multiplying by P/I . Now $-(P/I) \partial I/\partial P$ is the (money-income constant) elasticity of demand, η , and $P \partial I/\partial D$ is the marginal propensity to spend, m . Thus

$$\frac{P}{I} \frac{dI}{dP} = m \frac{dD}{IdP} - \eta.$$

A change in price can be associated with a change in real income approximately equal to the change in cost of the initial amount bought, IdP . If expenditure is adjusted to compensate for this change in real income, that is, if $dD = IdP$, then $-(P/I)(dI/dP)$ becomes the compensated elasticity of demand, η' , and we get $\eta = m + \eta'$.⁶ If indifference curves are convex, all

⁵With respect to instability Marshall ([51], p. 354) wrote: "...it is not inconceivable but it is absolutely impossible," a statement I find understandable if not comprehensible! More complicated aspects of stability in the classical system are explored in Chapters 3 and 7.

⁶Meade [54] has made extensive use of this relation; his stability condition is split into income and substitution effects and, in my notation, is $\eta'_a + \eta'_b + m_a + m_b - 1 > 0$.

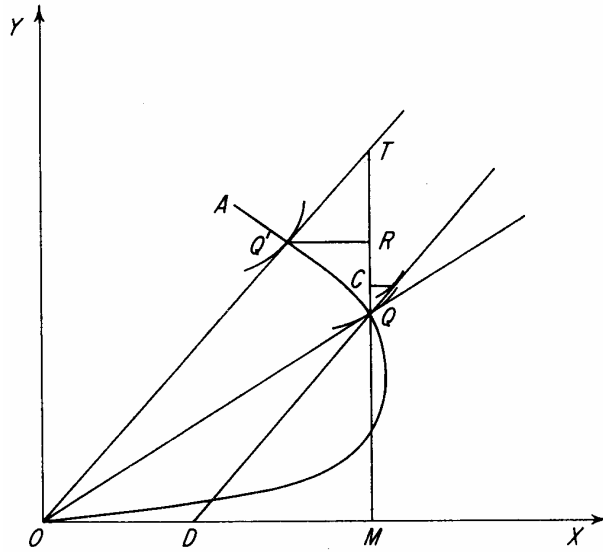


Figure 1-3.

Initial equilibrium is at Q on A 's offer curve OA . Suppose that the terms of trade change in the proportion TQ/QM , and that at the new terms of trade A trades at the point Q' . The effect on income of this change in the terms of trade can be approximated by OD in terms of X or TQ in terms of Y , where DQ is drawn parallel to OT .

To prove the relation between compensated and ordinary elasticities: Define the elasticity of demand for imports in A , by

$$\eta_a = \frac{RQ}{QM} \bigg/ \frac{TQ}{QM}, \text{ and the marginal propensity to import in } A, \text{ by } m_a = \frac{RC}{TQ}.$$

Then

$$\eta_a - m_a = \frac{RQ}{TQ} - \frac{RC}{TQ} = \frac{CQ}{TQ}.$$

But

$$\frac{CQ}{TQ} = \frac{CQ}{QM} \bigg/ \frac{TQ}{QM},$$

which is the elasticity of demand for imports with the income effect removed, i.e., the compensated elasticity of demand for imports, η'_a .

substitution effects in the two-good case under consideration are positive, so $\eta > 0$. From this it follows that the elasticity of demand for imports is always greater than the marginal propensity to import. A fortiori the sum of the elasticities of demand for imports is greater than the sum of the marginal propensities to import, so that if $m_a + m_b$ is equal to, or exceeds, 1, the exchange market is necessarily stable. Conversely, an unstable exchange market implies that the sum of the marginal propensities to import is less than unity.

Chapter 2 / *Transfers, Productivity, and Taxes*¹

The Transfer Problem

The first policy change we shall consider is a unilateral payment from one country to the other. This involves two parts: a *financial* transfer and a *real* transfer. The financial transfer refers to the accumulation and liquidation of debt on the part of individuals or governments in each country, while the real transfer refers to the induced movement of goods. Assume that *A* is the transferring country.

In the case of a private flow of capital lenders in *A* buy the debt of borrowers in *B*, the former financing the purchase out of an excess of saving over investment, the latter disposing of the proceeds by an excess of investment over saving.² Because of the identity of income-less-lending and expenditure [equations (9) and (10) of Chapter 1], the excess of investment over saving in *B* and saving over investment in *A* must each equal the transfer.

In the case of intergovernmental transfers such as reparations payments or foreign aid, the government in *A* (the paying country) grants credits to *B*, the former financing the credits by means of, say, an income tax, the latter disposing of the proceeds by means of, say, an income subsidy. Again, because of the identity of income-less-lending and expenditure, the budget surplus in *A* and the budget deficit in *B* are each equal to the transfer.

Whatever the type of transfer and however it is financed and disposed of, domestic expenditure in *A* is reduced, and in *B* is increased, by the amount of the transfer. These changes in expenditure induce changes in demand that, at constant terms of trade, create disequilibrium in the balance of payments. The transfer problem may then be posed as the problem of determining the

¹ Adapted from: *Amer. Econ. Rev.*, **50**, 68–110 (March 1960).

² The conventions in the literature usually ignore the problems associated with interest payments, despite the fact that, from a conceptual standpoint, they involve wealth effects that cannot be legitimately ignored. For this reason it is perhaps preferable to restrict the applicability of the model to remittances of interest or gifts.

direction and extent of the change in the terms of trade required to eliminate the balance-of-payments disequilibrium.

The Terms of Trade. To find the effects of a transfer on the terms of trade we first determine the excess demand created by the expenditure changes at constant terms of trade. This can be done in terms of either good, as an excess demand for one good implies an excess supply of the other good.

The reduction in domestic expenditure in A decreases the demand for Y in A at constant terms of trade by

$$P \frac{\partial y_a}{\partial D_a} dD_a = m_a dD_a$$

where m_a is the marginal propensity to spend on imports in A . The increase in domestic expenditure in B increases the demand for Y in B by

$$\frac{\partial y_b}{\partial D_b} dD_b = c_b dD_b$$

where c_b is the marginal propensity to spend on home goods in B . The excess demand at constant terms of trade is therefore the sum of these changes, or

$$m_a dD_a + c_b dD_b = (c_b - m_a) dT,$$

noting that the changes in expenditure in each country are equal to the change in lending, that is, $-dD_a = dD_b = dT$. Now expenditure in each country is divided between home goods and imports, so that the sum of the marginal propensities to spend on home goods and imports is unity; thus $c_b + m_b = 1 = c_a + m_a$.³ We could make use of this result to translate the above expression into a number of equivalent forms. The most convenient for our purposes is the familiar one,

$$(1 - m_a - m_b) dT, \quad (1)$$

which states that transfer creates an excess demand for, or excess supply of, the good of the transferring country depending on whether the sum of the marginal propensities to spend on imports is greater or less than 1. Only in the

³ Differentiation of $D_a = x_a + P y_a$ and $D_b = x_b/P + y_b$ with respect to D_a and D_b yields

$$1 = \frac{\partial x_a}{\partial D_a} + P \frac{\partial y_a}{\partial D_a} = c_a + m_a$$

$$1 = \frac{1}{P} \frac{\partial x_b}{\partial D_b} + P \frac{\partial y_b}{\partial D_b} = m_b + c_b$$

special case where the receiving country increases its consumption of the two goods in the same proportion that the paying country does without them ($1 - m_a - m_b = 0$) will no change in the terms of trade be required. If $m_a + m_b > 1$, the receiving country experiences a deficit; if $m_a + m_b < 1$, the paying country suffers a deficit.

To correct the disequilibrium, equal to $(1 - m_a - m_b) dT$, a change in the terms of trade is required. But we already know from the stability condition that a change in the terms of trade causes an excess supply of B 's good (or an excess demand for A 's good, or improves A 's balance, or worsens B 's balance) by an amount equal to

$$(\eta_a + \eta_b - 1)I dP. \quad (2)$$

The excess demand for B 's good at constant terms of trade must, at the new equilibrium, be equal to the excess supply of B 's good caused by the actual change in the terms of trade. Equating of (1) and (2) therefore provides the general criterion for the change in the terms of trade:

$$\frac{dP}{dT} = \frac{1 - m_a - m_b}{I(\eta_a + \eta_b - 1)}. \quad (3)$$

It may be seen that the higher the price elasticities of demand for imports are, the smaller will be the change in the terms of trade (a small price change relieves a large excess demand). In the limiting case where one of the elasticities is infinite, no change in the terms of trade is required. Similarly, the closer to 1 is the sum of the marginal propensities to import, the smaller is the excess demand to be eliminated by a change in the terms of trade, and so the smaller is the actual change in the terms of trade.⁴

Real Income. How is real income affected by a grant or gift from one country to the other? In the reparations discussions of the interwar period, the view was widely held that the terms of trade of the paying country must

⁴ To obtain the criterion directly, differentiate the balance-of-payments equation:

$$T = I_b(D_b, 1/P) - P I_a(D_a, P)$$

with respect to T . This yields

$$1 - m_b \frac{dD_b}{dT} + m_a \frac{dD_a}{dT} = \frac{\partial I_b}{\partial (1/P)} \frac{d(1/P)}{dT} - P \frac{\partial I_a}{\partial P} \frac{dP}{dT} - I_a \frac{dP}{dT}.$$

Expenditure changes are equal in absolute value to the transfer, so

$$\frac{dD_b}{dT} = -\frac{dD_a}{dT} = 1.$$

Then by forming elasticities and taking P initially equal to unity, we get (3).

For a sample of recent literature on the transfer problem see Mosak ([68], Chap. 4), Meade [54], [57], Samuelson [90], and Johnson [32]; and for a survey of earlier literature see Viner ([103], pp. 290–377).

fall, thus imposing an additional burden. The change in real income implicit within the change in the terms of trade was called the *transfer burden*.

The change in real income due to transfer is composed of two effects—the direct effect of the change in expenditure, and the income effect implicit within the change in the terms of trade. Thus the real income of the receiving country improves by more or less than the transfer itself, depending on whether the terms of trade improve or worsen. For small changes we can approximate the income effect of a change in the terms of trade by the change in cost of the initial volume of imports, that is, by $I dP$. The change in real income as a result of the transfer is therefore approximately

$$\frac{dU_b}{dT} = -\frac{dU_a}{dT} = 1 + I \frac{dP}{dT} \quad (4)$$

where U_a and U_b are, respectively, the real incomes of A and B . Substituting for dP/dT from (3) we obtain an approximate quantitative measure of the change in the real income evaluated at pretransfer prices

$$\frac{dU_b}{dT} = -\frac{dU_a}{dT} = 1 + \frac{1 - m_a - m_b}{\eta_a + \eta_b - 1} \quad (5)$$

Using the relationship between income elasticities and marginal propensities developed in Chapter 1, we can manipulate (5) to get

$$\frac{dU_b}{dT} = -\frac{dU_a}{dT} = \frac{\eta_a - m_a + \eta_b - m_b}{\eta_a + \eta_b - 1} = \frac{\eta'_a + \eta'_b}{\eta_a + \eta_b - 1} \quad (6)$$

From this criterion it can be seen that the real income of the receiving country will be lower following a transfer, only if the system is unstable.⁵ Assuming stability, the higher m_a and m_b (the marginal propensities to import) are, the smaller is the increase in real income of the receiving country, since income effects enter only in the denominator of (6).⁶

⁵ Leontief [40] discovered an example consistent with convex indifference curves, where the change in the terms of trade in favor of the paying country is so great that its real income *improves* as a result of the transfer. Equation (6) proves that this cannot happen unless the system is unstable. The identification of this *Leontief effect* with instability was first made by Samuelson ([88], p. 29).

⁶ Transfer analysis has many applications in economic theory. It applies to any redistribution of income between sectors, individuals, or groups within a country. In the Keynesian problem of income redistribution a gift of tax-cum-subsidy from the rich to the poor increases or decreases effective demand depending on whether the marginal propensity to spend (MPS) of the rich is less or greater than that of the poor. In public finance theory an increase in government spending financed by new taxes stimulates effective demand if the MPS of the government is greater than that of the public. And in monetary theory a fall in the price level stimulates effective demand if the MPS of creditors is greater than that of debtors (including governments and central banks).

Productivity Changes

Assume that the country experiencing the productivity increase is completely specialized and that expenditure increases by the full amount of the increase in output. We shall first determine the effects of a change in productivity on the terms of trade, and then its influence on real income.

The Terms of Trade. To determine the effect of a change in productivity on the terms of trade we first determine the excess demand created for one of the goods on the assumption that the terms of trade are constant. If output and expenditure in country A increases by dX_a^* , then the change in demand for imports in country A is

$$P \frac{\partial I_a}{\partial D_a} \frac{dD_a}{dX_a^*} dX_a^* = m_a dX_a^*$$

since expenditure (equals money income) increases by the full amount of the increase in output. At constant terms of trade no change occurs in country B , so this is also equal to the *excess* demand for imports in A . This excess demand must be eliminated by a change in the terms of trade. The criterion is therefore

$$\frac{dP}{dX_a^*} = \frac{m_a}{I(\eta_a + \eta_b - 1)}. \quad (7)$$

This result is obvious: An increase in the world output of X must lower the relative world price of X . The only exception (apart from constant costs and incomplete specialization, or perfect substitution in consumption) is the case where the country that has grown spends all its increased income on its own good ($m_a = 1 - c_a = 0$).⁷

Equation (7) can be translated into proportional changes by multiplying both sides by X (output) and dividing by P , with the following result:

$$\frac{dP/P}{dX^*/X} = \frac{m_a X / P I_a}{\eta_a + \eta_b - 1} = \frac{\sigma_a}{\eta_a + \eta_b - 1}, \quad (8)$$

where σ_a is the marginal propensity to spend on imports divided by the

⁷ To derive this criterion directly, differentiate $T = I_b(D_b, 1/P) - P I_a(D_a, P)$ with respect to X^* (output in A). With lending (T) constant and zero, this yields

$$-\left(-\frac{\partial I_b}{\partial (1/P)} - \frac{\partial I_a}{\partial P} - 1 \right) \frac{dP}{dX_a^*} = m_b \frac{dD_b}{dX_a^*} - m_a \frac{dD_a}{dX_a^*}.$$

Expenditure in B is constant (in terms of B 's good), so $dD_b/dX_a^* = 0$; but expenditure in A increases *pari passu* with output, that is, $dD_a/dX_a^* = 1$. Then, forming elasticities from the terms of the left, we get equation (7).

average propensity to spend on imports—that is, the income elasticity of demand for imports. In terms of growth rates the criterion is

$$\frac{\pi}{\rho_a} = \frac{\sigma_a}{\eta_a + \eta_b - 1} \quad (9)$$

where π is the percentage deterioration of A 's terms of trade per unit of time and P_a is the rate of growth of domestic product in A .

By following a similar procedure for country B we can find the annual percentage change in the terms of trade when both countries are growing:

$$\pi = \frac{\sigma_a \rho_a - \sigma_b \rho_b}{\eta_a + \eta_b - 1} \quad (10)$$

where σ_b , and ρ_b are, respectively, the income elasticity of demand for imports in B and the rate of growth of output in B .

Real Income. A more interesting question is whether or not real income will increase or decrease as a result of a change in productivity. An increase in productivity affects real income in two ways that work in opposite directions. At constant terms of trade, real income would increase by the full amount of the change in output. Against this must be set the negative income effect of the actual deterioration in the terms of trade. We can therefore measure the change in real income by adding the effects of the change in real income at constant terms of trade to the reduction in income due to the change in the terms of trade. The change in real income is $dU_a^* = dX_a - I dP$. Dividing by dX_a^* and applying equation (7) we obtain the following criterion:

$$\frac{dU_a}{dX_a^*} = 1 - I \frac{dP}{dX_a^*} = 1 - \frac{m_a}{\eta_a + \eta_b - 1}. \quad (11)$$

Real income will be increased by growth provided $\eta_a + \eta_b > 1 + m_a$, that is, if the sum of the elasticities of demand for imports is greater than 1 plus the marginal propensity to import. Note that violation of this condition is consistent with stability.

To clarify the meaning of (11) we can make use of the relationship used in the previous section between “ordinary” and “compensated” elasticities of demand for imports—in particular, $\eta_a = \eta'_a + m_a$. Manipulating (11) we get

$$\frac{dU_a}{dX_a} = \frac{\eta_a - m_a + \eta_b - 1}{\eta_a + \eta_b - 1} = \frac{\eta'_a + \eta_b - 1}{\eta_a + \eta_b - 1}, \quad (12)$$

Thus real income will increase in the growing country if $\eta'_a > 1 - \eta_b$, that is, if the compensated elasticity of demand for imports in the growing country is

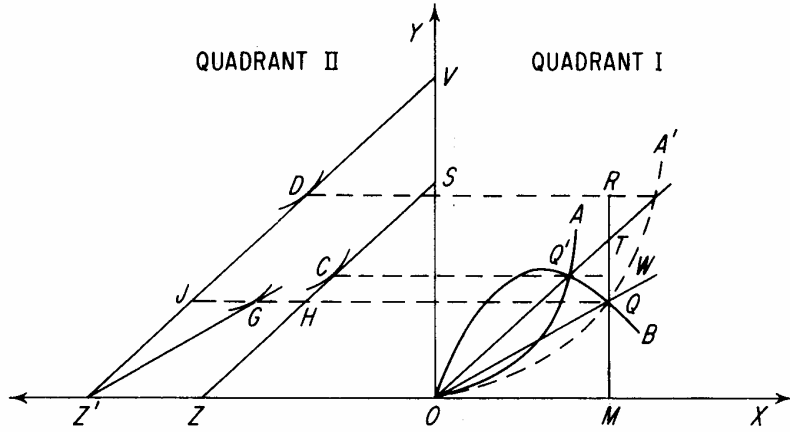


Figure 2-2.

Quadrant I illustrates trade equilibrium with the initial offer curves, OA and OB , intersecting at Q' . Quadrant II illustrates production and consumption equilibrium in country A : Output in A is initially OZ of X ; consumption equilibrium is at C (the length and slope of ZC is equal to the length and slope of OQ').

Suppose that output and expenditure in A increase to OZ' in terms of X . Then at constant terms of trade inhabitants of A demand more of both goods (in the absence of inferior goods), wishing to consume at point like D . This means that, at any given terms of trade, A demands more imports than before the productivity change so that A 's offer curve unambiguously shifts to the right (quadrant I). At the original terms of trade there is an excess demand for Y and a deficit in A 's balance of payments equal to RW . The disequilibrium induces deflation in A and inflation in B and a deterioration in A 's terms of trade.

To connect the ratio of the change in the terms of trade TQ/QM to the increase in output ZZ' , i.e., to derive a criterion for the change in the terms of trade, first define the marginal propensity to import in A . Since expenditure increases by VS at constant terms of trade and the demand for imports increases by the vertical distance between C and D , i.e., by RW , we have $m_a = RW/VS$. Now the deficit in A 's balance of payments at constant terms of trade is:

$$\frac{dB}{P} = RW = \frac{RW}{VS} \cdot VS = \frac{RW}{VS} \cdot ZZ' \cdot \frac{VS}{ZZ'} = m_a dX^* / P,$$

where $dX^* = ZZ'$. On the other hand we know from the analysis of Figure 1-2 that

$$\frac{dB}{p} = QM \cdot \frac{TQ}{QM} (\eta_a + \eta_b - 1).$$

It follows that:

$$\frac{dP}{dX_a^*} = \frac{m_a}{I(\eta_a + \eta_b - 1)}.$$

It is easily seen that the shift in A 's offer curve is greater the higher is the marginal propensity to import in A , and that if the latter is zero no shift occurs (all the extra expenditure in A is spent on home goods).

The change in real income in A , as a result of the productivity increase, is HG , measured at pretransfer prices. The criterion:

$$\frac{dU_a}{dX_a^*} = \frac{GH}{ZZ'} = 1 - \frac{JG}{ZZ'} = 1 - \frac{TQ}{VS} = 1 - I \frac{dP}{dX_a^*} = \frac{\eta'_a + \eta_b - 1}{\eta_a + \eta_b - 1}$$

is zero for small changes in output when $Z'G$ -extended passes through C . The numerator of this criterion can be derived directly by examining the conditions under which a change in the terms of trade to $Z'C$ can be an equilibrium. Note that this result is not possible if OB is elastic.

greater than 1 minus the ordinary elasticity of demand for imports in the other country. This criterion can be further simplified by substituting in it the well-known relation between the elasticity of demand for imports and the elasticity of supply of exports (ϵ): $\eta_b - 1 = \epsilon_b$.⁸ The criterion can thus be expressed as $\eta'_a + \epsilon_b > 0$.

An alternative, direct method of getting this criterion is to apply the *method of comparative statics*. To find whether real income in the growing country increases or decreases, first determine the excess demand for imports on the tentative supposition that real income in A is constant. If real income is constant, the terms of trade move against A so there is a pure substitution effect, $-\eta'_a IdP$, which measures the increase in demand for imports in A . On the other hand, the increase in supply of imports forthcoming from B due to the change in the terms of trade is $\epsilon_b IdP$. The excess demand at constant real income in A is thus $-(\eta'_a + \epsilon_b) IdP$. The deterioration in A 's terms of trade that leaves A 's real income unchanged is therefore too great or too little to relieve the excess demand due to the productivity change depending on whether

⁸ This relationship can be derived from the income = expenditure conditions discussed in Chapter 1. With no international lending, we have, for country B ,

$$\begin{aligned} \frac{x_b}{P} + y_b &= \frac{X_b}{P} + Y_b \\ Y_b - y_b &= \frac{1}{P}(x_b - X_b) \\ E_b &= \frac{1}{P} I_b \end{aligned}$$

where E_b represents B 's offers of exports. By differentiation we get

$$\frac{P}{E_b} \frac{dE_b}{dP} = \frac{P}{I_b} \frac{dI_b}{dP} - 1,$$

after dividing by $E_b = I_b/P$. Thus $\epsilon_b = \eta_b - 1$, recalling that

$$\frac{P}{I_b} \frac{dI_b}{dP} = - \frac{1/P}{I_b} \frac{dI_b}{d(1/P)} = \eta_b.$$

Note that when the elasticity of demand is 1, the elasticity of supply of exports is zero; this means that the same amount of exports is spent on imports regardless of the terms of trade.

A geometric proof of this relation can easily be got from Marshall's analysis ([52], pp. 337–338).

$\eta'_a + \varepsilon_b \lessgtr 0$. The criterion for the change in real income is thus established, since, depending on whether the terms-of-trade change has been too great or too little, real income increases or decreases.

The result shows that a country may be worse off with, than without, the improvement in productivity. Growth may be “damnifying,”⁹ Too rapid growth of the export industries of one country, and the resultant attempt to push exports onto world markets, results in such a large decline in the terms of trade that the negative income effect of the change in relative prices is greater than the positive income effect of the increase in domestic output at constant prices. The case of the group of primary-producing countries readily presents itself. Within a single multi-regional economy it might be found that U.S. agriculture is another example.

The possibility does not of course provide a valid argument against growth. In the first place, the conditions under which increasing productivity can affect real income perversely are quite strict: The foreign elasticity of demand must be less than 1 and perhaps appreciably so if home substitution effects are high. Second (and more important), since world income as a whole increases, by compensation both countries (or sectors) in the world economy could be made better off than before. Finally, the damnified country can always impose taxes on trade sufficient to reap at least some of the benefits of the productivity increase. Obviously the perverse effect is not possible if the growing country is following an optimum tariff policy, since that implies an elasticity of demand in the foreign country greater than unity.

Taxes and Subsidies on Trade

A tax or subsidy on trade introduces a divergence between foreign and domestic price ratios. Equal taxes on exports or imports create the same divergence between foreign and domestic prices ratios (if trade is balance), so that the *real* effects of import and export taxes are symmetrical. A tax on imports at constant terms of trade raises the relative price of imports in the taxing country and therefore *draws* resources away from export industries into import-competing industries. A tax on exports at constant terms of trade lowers the relative price of exports in the taxing country and thus *pushes* resources into import-competing industries. With balanced trade the revenues collected by the two taxes are the same. We may therefore speak of trade

⁹ Mill was aware ([66], pp. 150–53) that an increase in productivity would lower the commodity terms of trade and even the factorial terms of trade if foreign demand, in the latter case, were inelastic. Edgeworth interpreted ([12], p. 10) Mill's passage as indicating that a country could be “damnified” by growth, supplying the necessary assumption to make Mill's analysis correct. The first derivations of the criteria (8) and (12) were achieved by Meade ([57], e.g., p. 153). Their importance has been brought out by Bhagwati [5], who used the term “immiserizing growth,” by Corden [8], and by Johnson [29][30].

restriction or trade promotion without specifying whether the tax or subsidy is on exports or imports.¹⁰

There are two analytic methods of treating the disposition of the tariff proceeds. We may assume that the government spends the tariff proceeds on the two goods in a given proportion, or we may suppose that tax proceeds are redistributed as income subsidies to consumers. The latter method, which is used here, is simpler because it avoids the necessity of introducing a government demand equation, and does not give rise to asymmetries when dealing with trade subsidies. In the following analysis it should be remembered that we are in fact examining the effects of tariffs combined with this method of disposing of the proceeds.

The Terms of Trade. To determine the effect of a tariff on the terms of trade first compute the excess demand for imports at constant terms of trade. At constant terms of trade the relative price of imports in the tariff-imposing country (*A*) rises by the full amount of the tariff. Then, with t_a representing 1 plus the ad valorem rate of tariff, the change in demand for imports before redistribution of the proceeds is

$$\frac{\partial I_a}{\partial(Pt_a)} \frac{d(Pt_a)}{dt_a} dt_a = \frac{\partial I_a}{\partial(Pt_a)} \frac{Pt_a}{I_a} I_a dt_a = -\eta_a I_a dt_a$$

assuming initial free trade ($t_a = 1$). To this change in demand must be added the increase in demand for imports occasioned by the redistribution of the tariff proceeds, that is, $m_a I_a dt_a$. Adding the terms we get the excess demand for imports due to the tariff at constant terms of trade, that is, $(-\eta_a + m_a) I_a dt_a = -\eta'_a I_a dt_a$. This excess demand must be eliminated, at the new equilibrium, by a change in the terms of trade. We then have the following criterion:

$$\frac{dP}{dt_a} = \frac{-\eta'_a}{\eta_a + \eta_b - 1} \quad (13)$$

Tariffs normally improve the terms of trade.¹¹

¹⁰ Marshall writes ([51], pp. 180–81): “The considerations which can be urged for and against the levying of an import tax on a particular commodity differ widely from those appropriate to a particular export tax: and this is perhaps the origin of an opinion, which seems to pervade a good deal of economic discussion, that a general tax on all imports would have widely different effects from a general tax on all exports. In fact the two taxes would have the same effect: provided they were evenly distributed, equal in aggregate amount, and their proceeds were expended in the same way.” He then shows how this can be proved. Bastable, Edgeworth, and others were also aware of the symmetry. For a modern treatment see Lerner [44].

¹¹ To derive (13) directly differentiate

$$T = 0 = I_b(D_b, 1/P) - P I_a(D_a, Pt_a)$$

The degree to which a tariff will improve the terms of trade depends on the elasticities. The more elastic the foreign offer curve is, the smaller will be the improvement in the terms of trade due to a tariff, and, in the limiting case where the foreign offer curve is perfectly elastic, the terms of trade remain unchanged (the only exception). On the other hand, if the foreign offer curve is elastic,¹² the greater is the compensated elasticity of demand for imports at home, the more effective will a given tariff be in improving the terms of trade; in the limiting case where η'_a is infinite, the terms of trade will improve in the same proportion as the (ad valorem) tariff.

The above propositions are related to the classical notion about the division of the gains from trade between large and small countries. Because small countries tend to be more completely specialized than large countries, it was generally believed that the offer curve of a small country was less elastic than that of a large country. This means that the gain per unit of trade going to a small country was likely to be larger than that going to a large country. The corollary of the proposition is that since the small country already reaped a large proportion of the gain from trade, opportunities for increasing that gain further through tariff restriction were correspondingly small. On the other hand, large countries, gaining little from trade, could exact a larger gain by imposing tariffs and forcing small countries to trade at a less favorable price ratio.

The Domestic Price Ratio. A common motive for trade restriction is the protection of import-competing industries. In order that these industries be protected, the domestic relative price of imports (inclusive of the tariff) must rise. We shall therefore derive the criterion for the change in the domestic price ratio following a tariff.

The domestic price ratio in country A is Pt_a (where t_a is 1 plus the ad valorem rate of tariff). We are interested in how Pt_a will change as a result of an increase in t_a , that is, in the sign of

$$\frac{d(Pt_a)}{dt_a} = P + t_a \frac{dP}{dt_a},$$

with respect to t_a . With D_b constant this yields

$$\begin{aligned} (\eta_a + \eta_b - 1)I \frac{dP}{dt_a} &= P \frac{\partial I_a}{\partial D_a} \frac{dD_a}{dt_a} + \frac{\partial I_a}{\partial (Pt_a)}, \\ &= (m_a - \eta_a)I \end{aligned}$$

since $dD_a/dt_a = I$; that is, expenditure in A rises by the value of the tariff proceeds.

The qualitative direction of change in the terms of trade following the imposition of a tariff was admitted by Ricardo and known to most of the later classical economists. The algebraic criterion can be got from Meade's analysis [57].

¹² Note that if the foreign offer curve is inelastic, the terms of trade may improve by more than the tariff, provided the home offer curve is not perfectly elastic; if the latter is perfectly elastic the maximum change in the terms of trade is equal to the rate of the tariff.

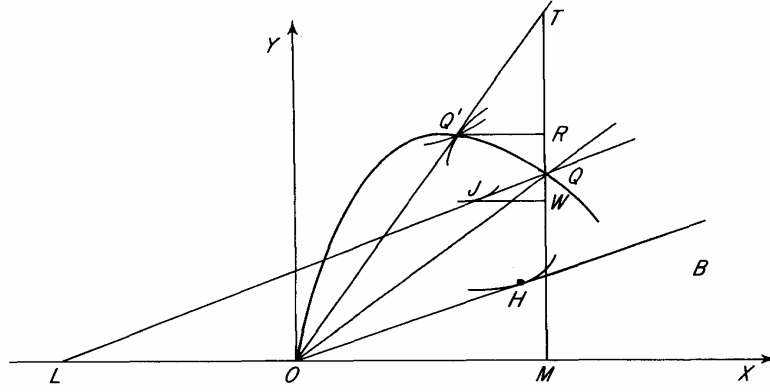


Figure 2-3.

The offer curves of A (not drawn) and B (OB) intersect at the free-trade equilibrium Q . Suppose that this equilibrium is disturbed by the imposition of a tariff by A 's government. At constant terms of trade the price of Y in A rises by the full amount of the tariff LO/OM and trade equilibrium in A moves to a point on A 's original offer curve, such as H . But when tariff revenues equal (approximately) to OL in terms of X are redistributed to consumers the demand for both goods increases. The equilibrium point for A at constant terms of trade therefore moves to a point such as J on A 's revenue-redistributed offer curve. At constant terms of trade the tariff-cum-income subsidy results in an excess supply of Y and a surplus in A 's balance of payments equal to QW since the new equilibrium at J must be below Q if substitution effects are positive. A 's terms of trade improve until the excess supply WQ is relieved. Assume that the new equilibrium is at Q' .

The excess demand for imports in A at constant terms of trade is:

$$-\frac{dB}{P} = WQ = \frac{WQ}{QM} \cdot QM = \frac{WQ}{QM} \cdot \frac{OM}{OL} \cdot \frac{OL}{OM} \cdot QM = \eta'_a I dt_a.$$

On the other hand we have:

$$\begin{aligned} \frac{dB}{P} = WQ &= WR + TR - TQ = \left[\frac{WR}{QM} \frac{QM}{TQ} + \frac{TR}{QM} \frac{QM}{TQ} - 1 \right] QM \frac{TQ}{QM} \\ &= (\eta_a + \eta_b + 1) I \frac{dP}{P}. \end{aligned}$$

It follows that:

$$\frac{dP}{dt_a} = \frac{-\eta'_a}{\eta_a + \eta_b - 1}.$$

Note that η_a refers to the elasticity of the revenue-redistributed offer curve in A .

For the domestic price ratio in A to be unchanged at the new equilibrium, as a result of the tariff, the slope of the A -indifference curve at Q' must be the same as the slope of the indifference curves of A and B at Q . But in that case the marginal propensity to import in A is equal to RQ/TQ (for small tariffs); and since

$$\varepsilon_b = \eta_b - 1 = -\frac{RQ}{QM} \frac{QM}{TQ} = \frac{RQ}{TQ},$$

it follows that $\eta_a - m_a - 1 = 0$. This is the borderline case. It is easily seen that the slope of A 's indifference curve at Q' is flatter or steeper than that at Q as $m_a < \eta_b - 1$.

where P and t_a are initially equal to 1. Substituting for dP/dt_a , from equation (13), we obtain

$$\frac{d(Pt_a)}{dt_a} = 1 - \frac{\eta'_a}{\eta_a + \eta_b - 1} = \frac{\eta_b + m_a - 1}{\eta_a + \eta_b - 1}. \quad (14)$$

A tariff raises the domestic price of imports if the sum of the foreign elasticity of demand for imports and the domestic marginal propensity to import is greater than 1.¹³ The only exception is the case previously mentioned in which the home offer curve is infinitely elastic, in which case the domestic price ratio remains unchanged.

The criterion can be derived also by following the method of comparative statics. We consider the excess demand for imports on the assumption that the domestic price ratio remains unchanged. In that event the terms of trade improve by the full amount of the tariff, so that the change in supply of imports from B is $-\epsilon_b I dt_a = (1 - \eta_b) I dt_a$. On the other hand, the redistribution of the tariff proceeds and the resulting increase in domestic expenditure in A increases the demand for imports by $m_a I dt_a$. Subtracting the change in supply of imports from B from the increase in demand for imports in A we get the excess demand for imports at constant domestic prices, that is, $(\eta_b + m_a - 1) I dt_a$. If the foreign demand is less than unit elastic (foreign supply elasticity is negative), an improvement in A 's terms of trade results in an increase in supply of imports from B ; but against this must be set the increased demand for imports in A resulting from the spending of the tariff proceeds. If the former effect is greater than the latter, the relative price of imports must fall. If, for example, the foreign elasticity of supply were -0.6 (implying an elasticity of demand equal to 0.4) while the domestic marginal propensity to import were 0.5 , the tariff would cause, at constant domestic prices, an excess supply of B 's good equal to $0.1 I dt_a$; to eliminate this excess supply of B 's good, the relative (tariff-inclusive) price of imports must fall, and the terms of trade must improve by more than the tariff.

The possibility that a tariff may lower the domestic market price of the import good is consistent with the assumption of stability. It means that a tariff may have an adverse protective effect. To protect the domestic industry imports must be subsidized instead of taxed. Under no circumstances, however, would a country ever find it beneficial in fact to subsidize imports to protect the domestic industry. For the adverse protective effect to occur the foreign demand must be inelastic, and in that case a tariff must always result in an improvement in national welfare (more imports are obtained for fewer

¹³ The classical economists, many of whom tried to determine whether a country gained more or less than the amount of the tax, generally employed the criterion $\eta_b \square 1$, assuming, implicitly or explicitly, that the tax proceeds were spent on domestic goods, or that the tax was on the transit of goods that would be reexported. Modern discussions of this point owe much to Lerner [44] and to Metzler [63].

exports). If an optimum tariff policy is being followed, an additional increase in the tariff always raises the relative price of imports in the tariff-imposing country and thus has a normal protective effect.

Tariff Changes in Both Countries. If both countries adjust their tariff rates simultaneously, the extent and direction of the disequilibrium depend on the size of the tariff changes and the elasticities of demand. In bilateral tariff negotiations it may be useful to know what adjustment in the tariffs of both countries will leave the balance of payments or the terms of trade unaltered. The answer to this question can readily be obtained from equation (13), making appropriate adjustments for country B . If we write π as the annual rate of improvement of country A 's terms of trade, τ_a as the annual change in A 's tariff, and τ_b as the annual change in B 's tariff, we can obtain the following criterion:

$$\pi = \frac{\eta'_a \tau_a - \eta'_b \tau_b}{\eta_a + \eta_b - 1}. \quad (15)$$

To prevent any change in the terms of trade, the numerator must be zero; tariffs must then be changed at a rate inversely proportional to the compensated elasticities of demand for imports. [Note that equation (13) applies with a changed sign to subsidies, as subsidies are simply negative tariffs.]

TRADE TAXES AND INCOME TRANSFERS

Suppose the authorities in one country wish to make a grant to another country but, for political or other reasons, want to present the gift in the form of alterations in tariffs. Alternatively, suppose that one country wishes to exact a transfer of real income from another country without imposing a formal tribute. Can this be accomplished efficiently by changes in trade taxes ?

To show that it can, consider first the relation between trade taxes and subsidies. Suppose that country A subsidizes exports (or imports) while country B taxes imports (or exports). In that case the same goods are being taxed, the only difference being that the customs duties are collected by officials of different nationality. Trade is subsidized in A and taxed in B . If the increase in trade subsidies in A is equal to the increase in trade taxes in B , this combined policy is equal to a transfer of income from A to B equal to the value of the tax-subsidy payments. Because the tax in B cancels the subsidy in A , price ratios in the two countries must be the same. The change in real income, evaluated at the original price ratio, in each country is given by

$$-dU_a = dU_b = I dP = \frac{(-\eta'_a t_a + \eta'_b t_b)I}{\eta_a + \eta_b - 1}.$$

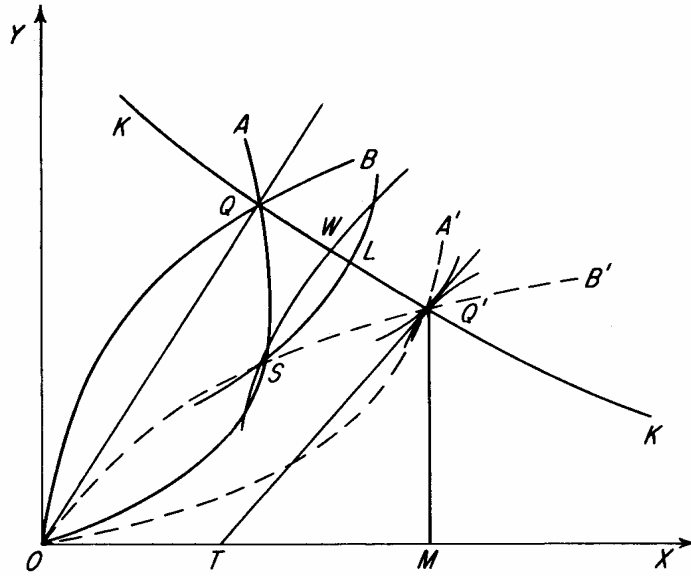


Figure 2-4.

Initial equilibrium is at Q on the contract curve KK . Suppose that A subsidizes, and B taxes, trade at the same rate OT/TM . Then A 's and B 's offer curves bend down to OA' and OB' , respectively, intersecting at Q' (they still originate from O). Since the price ratio in A remains equal to the price ratio in B , Q' must be on the contract curve. The slope of the indifference curves at Q' are, from the transfer analysis, greater or less than the slope at Q depending on whether the sum of the marginal propensities to import is greater or less than unity. The terms of trade are now OQ' , necessarily worse for A if the system is stable. Real income in A falls to the same extent as if A had made a gift of OT of X to B .

Suppose now that only B has a tax (equal to OT/TM) so that trade equilibrium is at S . To restore efficiency (Pareto optimum), A can impose a subsidy equal to B 's tariff, attaining the equilibrium (worse for A , better for B) Q' . A more interesting possibility is for A to bribe B to remove the tariff, the value of the bribe being the transfer necessary to effect an equilibrium between W and L (better for both than S). Or if A is already receiving gifts from B then tariff reduction in B and the elimination of gifts to A (i.e., "Trade, not Aid") can make both A and B better off.

Setting $-dt_a = dt_b = dt$ we then get

$$\frac{-dU_a}{I dt} = \frac{dU_b}{I dt} = \frac{\eta'_a + \eta'_b}{\eta_a + \eta_b - 1}. \quad (16)$$

But (16) is the same as the criterion for the change in real income after transfer [equation (6)] if $I dt$, the value of the tax-subsidy receipts, is substituted for the transfer.

Commodity Taxes

Taxes on commodities, as distinct from taxes on trade, make it necessary to distinguish between consumers' and producers' price ratios. A consumption tax or subsidy creates a divergence between the price ratio facing consumers in the taxing country and all other price ratios, whereas a production tax causes a discrepancy between the price ratio facing producers and all other price ratios.

Eight taxes and subsidies in each country are possible, but of these it will not be necessary to consider more than two. A subsidy is a negative tax, so that we need consider only taxes. And a tax on one good is equivalent to a subsidy on the other good because of our assumptions about the disposal of tax proceeds and the financing of subsidy payments. Because of these assumptions an equal tax on the two goods has no effect on equilibrium; this follows because each tax is combined with an income subsidy, and an income subsidy has the same effect as an equal subsidy (or an equal reduction in taxes) on the two goods. But if an equal tax on the two goods does not affect equilibrium, then neither does a tax on one of the goods combined with the elimination of a subsidy of equal amount on the other good—hence it follows that a tax on one of the goods is equivalent to a subsidy on the other. Thus we need only consider one consumption tax and one production tax.

CONSUMPTION TAXES AND THE TERMS OF TRADE

To find the effects of a consumption tax on the terms of trade first determine the excess demand caused by the tax at constant terms of trade. Let us suppose that a tax is imposed by country A on the consumption of imported good Y . Then at constant terms of trade the price of Y to consumers in A rises by the amount of the tax. Before the redistribution of the tax proceeds, the change in demand for Y in A , at constant terms of trade, is

$$\frac{\partial y_a}{\partial(Pt_{cya})} \frac{Pt_{cya}}{y_a} y_a dt_{cya} = -\eta_{ya} y_a dt_{cya}$$

where t_{cya} is 1 plus the rate at which commodity Y is taxed in A and η_{ya} is the elasticity of demand for Y in A .¹⁴ (P and t_{cya} are both *initially* taken to be 1.)

¹⁴ The elasticity of demand for an imported good is never larger than the elasticity of demand for imports of that good. The exact relation can be derived from the definition of the demand for imports. From $I_a = y_a - Y_a$ we get, by differentiation,

$$\frac{\partial I_a}{\partial P} = \frac{\partial y_a}{\partial P} - \frac{\partial Y_a}{\partial P}$$

and

$$-\frac{P}{I_a} \frac{\partial I_a}{\partial P} = -\frac{\partial y_a}{\partial P} \frac{P}{y_a} \frac{y_a}{I_a} + \frac{\partial Y_a}{\partial P} \frac{P}{Y_a} \frac{Y_a}{I_a}$$

Now the tax proceeds amount to $y_a dt_{cya}$, so that the increase in demand for y due to their disposition is $m_a y_a dt_{cya}$. Adding the two effects we get the excess demand at constant terms of trade,

$$(m_a - \eta_{ya}) y_a dt_{cya} = -\eta'_{ya} y_a dt_{cya}$$

where η'_{ya} is the compensated elasticity of demand for y in A , that is, the elasticity of demand for Y after consumers have been compensated for the change in real income implicit within the price change. This gives us the following criterion:

$$\frac{dP}{dt_{cya}} = -\frac{y_a}{I_a} \frac{\eta'_{ya}}{I_a \eta_a + \eta_b - 1}. \quad (17)$$

The compensated elasticity term is positive (it represents the elasticity of a consumption indifference curve), so that a consumption tax on the imported good generally improves the terms of trade of the taxing country. This conclusion is to be expected, because a tax on the imported good diverts demand away from that good, thereby causing an excess world supply of it.

There are some special cases we may consider:

1. In the unusual case where η'_{ya} is zero—implying no substitution in consumption (a kinked consumption indifference curve at that point)—the terms of trade do not change.
2. If the foreign offer curve is perfectly elastic, any excess demand can be eliminated by shifts in production or consumption at constant cost in the foreign country so there results no change in the terms of trade.
3. If the domestic offer curve is perfectly elastic (η_a is infinite), it is now necessary to know whether this is due to perfect substitution in production (incomplete specialization at constant cost) or perfect substitution in consumption; if the former is the case the denominator of (17) is infinite, so the terms of trade do not change, but if the goods are perfect substitutes in consumption both the denominator and the numerator are infinite so that the terms of trade change by the full amount of the tax.
4. If there is no domestic production of the imported good the tax has the same effect as a tariff ($y_a = I_a$ and $\eta'_{ya} = \eta'_a$).

whence

$$\eta_a = \eta_{ya} \frac{y_a}{I_a} + \epsilon_{ya} \frac{Y_a}{I_a}$$

where ϵ_{ya} is the elasticity of supply of Y in A . (A similar result holds for country B .) The elasticities η_{ya} and η_a coincide only when there is no home production of the imported good.

This analysis applies also to a subsidy on the consumption of the good that is exported and, with a change of sign, to a subsidy on the imported good or a tax on the exported good.

CONSUMPTION TAXES AND MARKET PRICES

Does a consumption tax necessarily raise the market price of the taxed good relative to that of the untaxed good? By analogy to the effect of a tariff on the domestic price ratio we should not expect this to be so. The market (relative) price of importables is Pt_{cya} , which we assume to be initially unity. The change in this price ratio due to the consumption tax is

$$\begin{aligned} \frac{d(Pt_{cya})}{dt_{cya}} &= 1 - \frac{dP}{dt_{cya}} = 1 - \frac{y_a}{I} \frac{\eta'_{ya}}{\eta_a + \eta_b - 1} \\ &= \frac{\eta_b + m_a + \varepsilon'_{ya} (Y_a / I) - 1}{\eta_a + \eta_b - 1} \end{aligned} \quad (18)$$

where ε'_{ya} is the compensated elasticity of supply of Y in A , and represents the elasticity of the production transformation curves.¹⁵ Only by this term does

¹⁵ The compensated elasticity of supply deserves some explanation. From the two relations

$$\eta_a = \eta'_a + m_a, \quad \text{and} \quad \eta_a = \eta_{ya} \frac{y_a}{I} + \varepsilon_{ya} \frac{Y_a}{I}$$

we can obtain

$$\eta'_a = \eta_a - m_a = (\eta_{ya} - m_a) \frac{y_a}{I} + (\varepsilon_{ya} + m_a) \frac{Y_a}{I}.$$

It can now be shown that $\eta_{ya} - m_a = \eta'_{ya}$, the compensated elasticity of demand for Y in A ; and that $\varepsilon_{ya} + m_a = \varepsilon'_{ya}$, the compensated elasticity of supply of Y in A . We have $dI_a = dY_a - dY'_a$, from the definition of the demand for imports. Now dI_a contains an income effect equal to $-m_a I_a dP$, where $-I_a dP$ measures the change in real income of country A looked at as a whole. The term dY'_a contains an income effect equal to $m_a Y_a dP$, where $-y_a dP$ measures the change in real income of people of country A looked at in their role as consumers alone. Finally, the term dY_a contains an income effect equal to $m_a Y_a dP$, where $Y_a dP$ measures the change in real income of producers of Y in country A . We now have the following relations:

$$dI_a = (dI_a)' - m_a I_a dP; \quad dY'_a = (dY'_a)' - m_a Y_a dP; \quad dY_a = (dY_a)' + m_a Y_a dP$$

where the primes denote pure substitution effects. Substituting in $dI_a = (dY'_a)' - dY_a'$ we get

$$(dI_a)' - m_a I_a dP = (dY'_a)' - m_a Y_a dP - [(dY_a)' + m_a Y_a dP].$$

The income effects on the two sides cancel and the proof of the relation between compensated elasticities follows readily. Dividing by $I_a dP$, multiplying by P , and changing signs we obtain

$$\eta'_a = \eta'_{ya} \frac{y_a}{I} + \varepsilon'_{ya} \frac{Y_a}{I}$$

where the primes denote that the elasticities contain no income effects. (For the interpretation given in this paragraph I am indebted to A. Harberger, a referee of my original AER article, unknown to me at the time.

the last criterion in (18) differ from the criterion for a change in the domestic price ratio after the imposition of a tariff [see equation (14)]. If a tariff will raise the domestic relative price of imports, so will a consumption tax on the import good. The converse is not true. Even if the foreign offer curve is inelastic and the domestic marginal propensity to import is low, high substitution effects in production will be sufficient to ensure a rise in the tax inclusive price of importables.

PRODUCTION TAXES AND THE TERMS OF TRADE

To find the effects of a production tax on the terms of trade, first consider the excess demand caused by the production tax at constant terms of trade. If a tax on the production of the import good is imposed and the proceeds of the tax are redistributed to producers, there remains only a pure substitution effect, a movement along the production-possibility curve. At constant terms of trade (which is also the price ratio facing domestic consumers) the excess demand for imports, after the redistribution of the proceeds, is equal to

$$\epsilon'_{ya} Y_a dt_{pya}$$

where t_{pya} is equal to unity plus the tax and ϵ'_{ya} is the elasticity of the transformation curve. This excess demand must be eliminated by a worsening of A 's terms of trade. The criterion is, therefore,

$$\frac{dP}{dt_{pya}} = \frac{Y_a}{I} \frac{\epsilon'_{ya}}{\eta_a + \eta_b - 1}. \quad (19)$$

With increasing opportunity costs ϵ'_{ya} is always positive, so the terms of trade of the taxing country fall. Again this applies to a production subsidy on the exported good and, with a change of sign, to a production subsidy on the imported good and a production tax on exported goods. This conforms to common sense. A tax on the production of any good decreases the production of that good and increases the production of the other good, causing a rise in the relative world price of the taxed good.

These elasticities have a simple interpretation: η'_a is the elasticity of a trade-indifference curve; η'_{ya} is the elasticity of a consumption-indifference curve; and ϵ'_{ya} is the elasticity of a production-indifference (production-possibility) curve. The identification is formally valid for small changes only.

Criterion (17) can be derived directly by differentiating:

$$T = 0 = I_b(D_b, 1/P) - P[y_a(D_a, Pt_{cya}) - Y_a(P)]$$

noting that D_b is constant and that

$$\frac{dD_a}{dt_{cya}} = y_a.$$

PRODUCTION TAXES AND PRICES AT FACTOR COST

The price ratio facing producers is P/t_{pya} , which is initially taken to be 1. This will change as a result of a tax depending on the sign of

$$\begin{aligned} \frac{d(P/t_{pya})}{dt_{pya}} &= \frac{dP}{dt_{pya}} - 1 = \frac{Y_a}{I} \frac{\varepsilon'_{ya}}{\eta_a + \eta_b - 1} \\ &= - \frac{\eta_b + m_a + \eta'_{ya}(y_a/I) - 1}{\eta_a + \eta_b - 1} \end{aligned} \quad (20)$$

The analogy to equations (14) and (18) readily presents itself.¹⁶

RELATION BETWEEN COMMODITY TAXES AND TRADE TAXES

A tariff, at constant terms of trade, raises the price of imports to both consumers and producers in the taxing country by the full amount of the tariff. Any other system of taxes which does the same thing will have the same effect on the terms of trade as a tariff. Thus taxes on trade can be duplicated by taxes on commodities. We can establish these relations either by showing that the tax combination affects the price ratios facing consumers and producers in the same way as a trade tax, or by adding the effects of the criteria obtained above in each case. By either method it is readily shown that a tariff (on Y) or an export tax (on X) is equivalent in real terms to:

- (a) A consumption tax on Y plus a production subsidy on Y ,
- (b) A consumption tax on Y plus a production tax on X ,
- (e) A consumption subsidy on X plus a production subsidy on Y , and
- (d) A consumption subsidy on X plus a production tax on X .

And because trade subsidies are negative trade taxes, an export subsidy (on X) or an import subsidy (on Y) can be duplicated by:

- (e) A consumption subsidy on Y plus a production tax on Y ,
- (f) A consumption subsidy on Y plus a production subsidy on X ,
- (g) A consumption tax on X plus a production tax on Y , and
- (h) A consumption tax on X plus a production subsidy on X .

¹⁶ Criterion (19) can be derived directly by differentiating:

$$T = 0 = I_b(D_b, 1/P) - P \left[y_a(D_a, P) - Y_a \left(\frac{P}{t_{ypa}} \right) \right]$$

noting that

$$\frac{dD_a}{dt_{pya}} = Y_a \cdot$$

The effects of consumption and production taxes on the terms of trade had not been formally analyzed in the literature before the article from which this paper is adapted appeared, although the general direction of their influence was known to many classical writers. See, for example, Viner ([103], p. 363).

From these relations it follows that (1) the effects of devaluation can be duplicated or frustrated by changes in commodity taxes and subsidies (since devaluation is equivalent to an import tariff plus an export subsidy), (2) the optimum tariff can be duplicated by commodity taxes, and (3) income transfers can be duplicated by changes in commodity taxes in both countries. An additional application is to customs unions; an agreement over tariff reduction has little force if it is not combined with agreement over the domestic tax structures.

Consideration of the commodity-tax structure is necessary before evaluating the desirability of tariff reductions. If there are commodity taxes and subsidies in each country none of the well-known welfare propositions of international trade theory holds. In particular, from a free-trade (that is, no *trade* taxes) position, it can be shown that, if there are commodity taxes and subsidies: (1) both countries simultaneously may be better off without, than with, *trade*; (2) a country may gain by a deterioration in its terms of trade even if the initiating cause occurs in the foreign country; (3) a small tariff may worsen the welfare of the tariff-imposing country even if the foreign offer curve is not infinitely elastic; and (4) the imposition of a tariff may simultaneously improve the welfare of both countries. These propositions follow because commodity taxes overextend or underextend trade.

Other Mechanisms of Adjustments

Thus far we have dealt with the effect of policy changes on the terms of trade, the latter adjusting through price-level or exchange-rate variations. It was argued earlier that authorities may adopt other policies that prevent, or render unnecessary, changes in the terms of trade. This would be the case if authorities pegged the exchange rate and stabilized domestic price levels, relying on, say, trade controls to correct disequilibria. The purpose of this section, then, is to show how the results already obtained can be applied to other mechanisms of adjustment. The procedure to be followed is the same as before: First, state the postulate on which dynamic behavior is based, then deduce the condition of dynamic stability, and then examine the excess demands caused by the policy changes.

Suppose that authorities peg the exchange rate and stabilize the domestic price level in each country. The price level may be stabilized in a variety of ways but the simplest for our purpose is to suppose that authorities innate domestic expenditure by means of a budget deficit when there is deflationary pressure (excess supply of its export good) and deflate domestic expenditure by means of a budget surplus when there is inflationary pressure (excess demand for its export good). We may assume that the deficits and surpluses are financed and disposed of by drawing on or accumulating credits with an international agency—say, the International Monetary Fund (IMF). Since

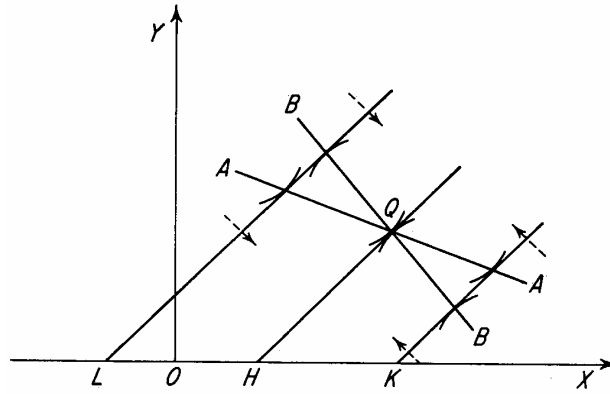


Figure 2-5.

Let equilibrium be initially at Q with the government of A making the annual payment OH to the government of B . It is assumed that exchange rates are fixed and that each government, by means of fiscal policy, stabilizes export price levels.

Suppose that the equilibrium is disturbed by, say, a private flow of capital of HL from B to A , and that this induces an excess of saving over investment in B , and an excess of investment over saving in A , equal to the transfer. If the sum of the marginal propensities to import is less than unity, as in the diagram, the Engel curve of A (AA) must be flatter than the Engel curve of B (BB); the capital flow therefore induces an excess demand for A 's good and an excess supply of B 's good, and a surplus in A 's and a deficit in B 's balance of payments.

To correct the disequilibrium, A 's government deflates expenditure by means of a budget surplus and turns the proceeds over to the IMF; and B 's government inflates expenditure by means of a budget deficit borrowing from the IMF. This process continues until the inflationary pressure in A and the deflationary pressure in B are eliminated, i.e., until the equilibrium Q and the net lending position OH are restored. By similar analysis it can be shown that a movement of capital from A to B in excess of OH (say to OK) will cause deflationary pressure in A and inflationary pressure in B , necessitating government action in each country to eliminate the disequilibrium. In either case the equilibrium Q is stable.

If, on the other hand, the sum of the marginal propensities to import exceeds unity the dynamic system just described would be unstable. This may be seen by considering again a movement of capital from B to A of HL . This time the capital movement causes an excess supply of A 's good and an excess demand for B 's good. A 's government therefore inflates expenditure and B 's government deflates expenditure, moving the system ever further from equilibrium.

an excess supply of one country's good implies an excess demand for the other country's good, it follows that one country will be borrowing at the time another country is lending; and because of the identity of income (including loans) and expenditure, the rate of lending by one country is equal to the rate of borrowing in the other country, and both are equal (with appropriate signs) to the rate at which the budgets are out of balance.

Whether or not a system based on these rules is stable depends on the effectiveness of the deflation-inflation policy in relieving excess supply of the deflating country's good and excess demand for the inflating country's good. But it is easily seen that this is equivalent to whether a transfer from one country to another will cause an excess supply of the transferring country's good. The system is therefore stable or unstable depending on whether the sum of the marginal propensities to import is less than or greater than 1. The term $1 - m_a - m_b$ also gives the denominator of the criterion, showing the direction and amount of lending required to eliminate a given excess demand.

To determine the effects of policy changes on lending in a system obeying the above rules, we (as before) find the excess demand due to the policy change with no lending. For example, the excess demand for imports due to a tariff in country A is $-\eta'_a I dt_a$. The change in the trade balance and lending of country A is, therefore,

$$\frac{dT}{dt_a} = \frac{\eta'_a I}{1 - m_a - m_b}. \quad (21)$$

If the system is stable the tariff improves the trade balance.¹⁷ Or we may consider the change in lending and the trade balance due to an increase in productivity in, say, country B :

$$\frac{dT}{dY_b^*} = \frac{m_b}{1 - m_a - m_b}. \quad (22)$$

Assuming stability, country A must lend to country B to maintain equilibrium in the balance of payments.

In a similar fashion we can find the effects on lending of all the policies discussed in previous sections. It may be helpful to consider two cases. Suppose that country A devalues its currency. Applying the same method we find that the criterion for the change in the balance of trade and lending is

$$\frac{dT}{dP} = \frac{(\eta_a + \eta_b - 1)I}{1 - m_a - m_b}. \quad (23)$$

It should be noticed that (23) is the reciprocal of (3), the criterion for the change in the terms of trade after transfer. The interpretation is different. In (3) the stability condition is that the sum of the elasticities is greater than 1,

¹⁷ This criterion has been used by Meade ([14], p. 155) and derived geometrically by Ozga [22], although in neither case is a distinction made between stable and unstable situations.

whereas in (23) the stability condition is that the sum of the marginal propensities to import is less than 1. In (3) lending induces—because of the “rules of the gold standard (or flexible-exchange-rate) game”—a change in the terms of trade; in (23) devaluation induces—because of the “rules of the IMF game”—a change in the balance of trade and lending. An interesting result is the following: If the “IMF system” is unstable, the gold standard (or flexible exchange) system is stable; and if the gold standard (or flexible exchange) system is unstable, the IMF system is stable. *Instability* of one system therefore implies *stability* of the other system, although not vice versa. This relation holds because the sum of the marginal propensities to import is less than the sum of the elasticities of demand for imports.

Finally, consider a trivial case. A change in capital exports has no ultimate effect on net lending! In the IMF system there is only one equilibrium rate of lending (in the absence of other trade policy changes), just as, in the classical system, there is only one equilibrium value of the terms of trade (assuming that the equilibrium is unique). This trivial case is cited for purposes of comparison with the classical contention that devaluation, from a position of equilibrium, does not change the terms of trade or the balance of trade; instead, it initiates price level changes which restore the equilibrium terms of trade. A displacement of the variable of adjustment from equilibrium initiates dynamic forces which induce a return to equilibrium.

Similar analysis can be applied to systems of adjustment based on tariff, tax, or productivity changes.

Summary

The results of the preceding analysis may all be summarized by introducing all policy parameters into the balance-of-payments equation and differentiating. We obtain

$$(1 - m_a - m_b)dT - I(\eta_a + \eta_b - 1)dP - I\eta'_a dt_a + I\eta'_b dt_b - y_a\eta'_{ya} dt_{ca} + x_b\eta'_{xb} dt_{cb} + Y_a\varepsilon'_{ya} dt_{pa} - X_b\varepsilon'_{xb} dt_{pb} + m_a dX_a^* - m_b dX_b^* = 0 \quad (24)$$

where the same terminology is used as before except that effective tax rates are used. (Thus d_{ta} and d_{tb} refer to the effective rate at which trade taxes are changed in A and B ; changes in trade subsidies are subtracted from changes in trade taxes. Similarly, dt_{ca} and dt_{cb} represent the effective rate at which consumption taxes or subsidies are changed in A and B ; a tax on the consumption of import goods combined with an equal tax on the consumption of home goods would leave the effective rate unchanged. Similarly, for production taxes dt_{pa} and dt_{pb} .)

The policy equation (24) shows the relation between policy changes that

are necessary to maintain equilibrium in the system; it can be used to show the policy changes that are necessary to offset the disequilibrium caused by other policies. Suppose, for example, country A wishes to know the rate at which it must tax import goods to relieve a disequilibrium caused by an increase in productivity in the foreign country. To find the answer, set all policy changes except dt_{ca} and dX_b^* equal to zero. This leaves the equation

$$-y_a \eta'_{ya} dt_{ca} - m_b dX_b^* = 0$$

and the answer

$$\frac{dt_{ca}}{dX_b^*} = -\frac{m_b}{y_a \eta'_{ya}}$$

The productivity change in B causes a surplus in A 's balance that can be relieved by a reduction in the rate at which consumption of import goods (export goods) are taxed (subsidized) in A . Any other relation between two or more policy changes can in this way be determined.

Chapter 3 / Generalization of the Classical Model¹

The propositions established in Chapter 2 were derived from a model consisting of only two goods and two countries. The traditional use of this model in international trade literature is based on a belief that it suggests “theorems which may be seen to admit of extension to more concrete cases” ([12], p. 31). In this chapter general results are derived and it is shown that in at least one important case the propositions previously established for two countries hold for an arbitrary number of countries.

Suppose that there are $n + 1$ countries, and let all prices and balances of payments be expressed in terms of the currency of country 0. If prices (of export goods or currencies) are flexible, then the balance of each country depends on all prices. The conditions of equilibrium can be written as follows:

$$\begin{aligned} B_1(P_1, \dots, P_n; \alpha) &= 0 \\ \dots &\dots \\ B_n(P_1, \dots, P_n; \alpha) &= 0 \end{aligned} \tag{1}$$

where α is a parameter representing a particular policy.² Note that only n

¹ Adapted from: *Amer. Econ. Rev.*, 50, 68–110 (March, 1960).

² Let x_{rs} and X_{rs} be, respectively, consumption and production of the r th good in the s th country, and let T_s be the capital exports of country s . Suppose that there are n countries and $m + 1$ goods. Then a general model can be expressed by the following equations:

$$Y_s - D_s \equiv \sum_{r=1}^m P_r (X_{rs} - x_{rs}) = T_s \quad (s = 1, 2, \dots, n). \tag{2}$$

These are national “budget” equations, income – spending = lending, for each country. If these equations are satisfied, each country is on its m -dimensional offer curve:

$$\sum_{s=1}^n (X_{rs} - x_{rs}) = 0 \quad (r = 1, 2, \dots, m). \tag{3}$$

These are the market clearing equations, world supply = world demand, for every good. Notice that the excess supply function of the numéraire, commodity 0 (for example, gold), is omitted; if equations (2) are satisfied, then the last equation in (3) can be deduced from the others (or vice versa).

$$x_{rs} = x_{rs}(D_s, P_1, \dots, P_m) \quad (r = 1, \dots, m); \quad (s = 1, \dots, n). \tag{4}$$

equations are required, since we are dealing with *normalized* prices; the balance of payments of country 0 follows from *Cournot's law*.³

We wish to determine the effects of a shift in the policy α on the equilibrium set of prices so we differentiate equations (1) with respect to α . With appropriate choice of units of currencies or goods we get

$$\begin{aligned} b_{11} \frac{dP_1}{d\alpha} + \dots + b_{1n} \frac{dP_n}{d\alpha} &= -\frac{\partial B_1}{\partial \alpha} \\ b_{n1} \frac{dP_1}{d\alpha} + \dots + b_{nn} \frac{dP_n}{d\alpha} &= -\frac{\partial B_n}{\partial \alpha} \end{aligned} \quad (6)$$

where $b_{ij} \equiv \partial B_i / \partial P_j$ is the change in the balance of the i th country due to a change in the price of the goods of the j th country. Solving for $dP_i/d\alpha$ we obtain

$$\frac{dP_i}{d\alpha} = -\frac{\partial B_1}{\partial \alpha} \frac{\Delta_{1i}}{\Delta} + \dots - \frac{\partial B_n}{\partial \alpha} \frac{\Delta_{ni}}{\Delta} = \sum_{j=1}^n \frac{\partial B_j}{\partial \alpha} \frac{\Delta_{ji}}{\Delta} \quad (i = 1, \dots, n) \quad (7)$$

where

$$\Delta \equiv \begin{vmatrix} b_{11} & \dots & b_{1n} \\ \vdots & & \vdots \\ b_{n1} & \dots & b_{nn} \end{vmatrix}$$

and where Δ_{ji} is the cofactor of the j th row and the i th column of Δ .

Demand for the r th good in the s th country depends on the level of spending and the prices both expressed in terms of money, commodity 0.

$$X_{rs} = X_{rs}(P_1, \dots, P_m) \quad (r = 0, 1, \dots, m; s = 1, \dots, n). \quad (5)$$

Supply of the r th good in the s th country depends on the prices.

Domestic expenditure is assumed to be linked to lending and other policy variables. If we add to this system n equations of the form $D_s = D_s(T_s; \alpha)$, where α is any policy, then we have a system of $2(mn + n) + m + n$ equations and $2(mn + n) + m + 2n$ unknowns. By specifying n parameters representing the capital exports of each country, the system becomes determined.

In the text the P 's refer to the price level of each country's exports (exchange rates constant), or the price of each country's currency (price levels constant). If each country exports only one product, and the budget equations (2) are satisfied, then the partial derivatives $\partial B_i / \partial P_j \equiv b_{ij}$ [used in equation (6)] can be identified with the word elasticity of demand and supply of the exports of the i th country with respect to a change in the price of the exports of the j th country, making use of the following relations:

$$\begin{aligned} B_i &= \text{value of exports} - \text{value of imports} \\ &= (\text{foreign demand} - \text{domestic excess supply}) P_i \\ &= P_i(x_{i1} + \dots + x_{in}) - P_i X_i, \end{aligned}$$

and differentiating with respect to P_j . Elasticities can then be formed by multiplying and dividing by X_i , leaving the typical term $\partial B_i / \partial P_j \equiv X_i(\eta_{ij} - \varepsilon_{ij})$. (This assumes that units are chosen so that each P_j is initially 1.)

³ Cournot made extensive use of the proposition that the sum of all balances is necessarily zero ([9], chap. 3).

Equations (7) provide a general framework into which specific policy changes can be introduced. But to evaluate any of the signs, $dP_i/d\alpha$, it is necessary to know the values, or at least the signs, of two kinds of terms: the coefficients $\partial B_j/\partial\alpha$ and the ratios Δ_{ji}/Δ . Now, the coefficients $\partial B_j/\partial\alpha$ describe the change in the balances of payments arising from the policy change at *constant prices*; to evaluate these coefficients, then, we can apply the method of comparative statics. The ratios Δ_{ji}/Δ , on the other hand, indicate the interactions of price changes in multiple markets, and the effectiveness of price changes in relieving the initial disequilibrium. In the two-country case these signs were determined by the stability conditions; in the multiple-country case, however, it is easily shown that some of the ratios may be positive while others are negative without conflicting with the conditions of stability. It appears, then, that in evaluating equations (7) we will be left with some positive and some negative terms, and no general presumption about the sign of $dP_i/d\alpha$.

To make progress some restriction on the signs of the elements b_{ij} in the basic determinant Δ is required. The most interesting special case, for present purposes, is that where $b_{ij} > 0$ for $i \neq j$. This assumption means that an increase in the price of the exports of any country, other prices being held constant, improves the balance of payments of every other country; it also implies, by Cournot's law, that a rise in the price level in one country worsens that country's balance of payments. From this assumption flow two important deductions: (1) the system is stable under the usual dynamic postulates⁴

⁴ There are two approaches to the stability of international equilibrium. One approach is to treat the world economy like the domestic economy and postulate that the price of any good rises and falls in proportion to the excess demand and supply of that good. For example, the dynamic system may be written

$$\frac{dP_r}{dt} = k_r \sum_{s=1}^n (x_{rs} - X_{rs}) \quad (8)$$

where the summation is over countries. By linearizing (8) (retaining only linear terms of a Taylor series), and translating the resulting partial derivatives into demand and supply elasticities, we obtain

$$\frac{dP_r}{dt} = k_r X_r \sum_{q=1}^m (\eta_{rq} - \varepsilon_{rq}) (P_q - P_q^\circ) \quad (9)$$

where the *own* elasticities of demand (η_{rr}) and supply (ε_{rr}) in the world as a whole are defined to be, normally, negative and positive, respectively. The linear system can be stable only if the real parts of the roots of

$$\left| k_r X_r (\eta_{rq} - \varepsilon_{rq}) - \delta_{rq} \lambda \right| = 0 \quad (10)$$

are all negative (δ_{rq} is the Kronecker delta). The theorem on gross substitutes states that if all cross elasticities are positive (including the cross elasticities of demand for the numéraire good), the system is stable.

The above system focuses attention on world markets for particular commodities. Classical international trade theorists, on the other hand (with the exception of F. D. Graham), emphasized the importance of disequilibrium in the balance of payments, gold flows, and changes in the terms of trade. If we now let P_i denote the world price of

([1], [19], and [79]) and (2) every ratio is negative ([68], pp. 49–51). With this information and the additional assumption that goods are *net* as well as *gross* substitutes, we can evaluate the direction of change in the terms of trade resulting from many policy changes.

Productivity Changes

Suppose that output and expenditures in country 0, the numéraire country, increase by dX_0^* . At constant prices, assuming no inferior goods, inhabitants of country 0 buy more of all goods, creating a deficit in their own balance and a surplus in the balance of every other country. The surplus in the balance of country i is $m_{i0}dX_0^*$, where m_{i0} is the marginal propensity to spend in country 0 on the goods of the i th country. The typical term in equation (7) is, therefore,

$$-\frac{\partial B_j}{\partial \alpha} = -m_{j0}.$$

exports of country i , we have the following system that is more compatible with the postulates of classical theory:

$$\frac{dP_i}{dt} = h_i B_i(P_1, \dots, P_n) \quad (i = 1, \dots, n) \quad (11)$$

assuming that there are now $n + 1$ countries and that prices are expressed in terms of the exports of country 0. Following the same procedure as above, we find that stability requires that the real parts of the roots of the equation

$$|h_i b_{ij} - \delta_{ij} \lambda| = 0 \quad (12)$$

must all be negative. Again, stability is assured if all $b_{ij} > 0$ for $i \neq j$. If prices were all constant and exchange rates were all flexible, the system would be stable if all currencies were gross substitutes.

Generally the systems (8) and (11) are fundamentally different. Goods may all be gross substitutes while some currencies are gross complements, and vice versa. The gap between the two systems narrows, however, when only one country produces each good: In that case an excess world demand for a good implies an excess demand for the currency of the country producing that good.

I have said that system (11) conforms more closely to the classical system than does system (8). This is not meant to imply that classical theorists would accept even as an approximation the rigid dynamic laws postulated. Consider, for example, the following passage from Marshall's privately circulated manuscript of 1879 ([52], pp. 19, 25):

... so that if we chose to assign to these horizontal and vertical forces any particular laws, we should obtain a differential equation for the motion of the exchange index ... Such calculations might afford considerable scope to the ingenuity of those who devise mathematical problems, but... they would afford no aid to the economist.

For the mathematical functions introduced into the original differential equations could not, in the present condition of our knowledge, be chosen so as to represent even approximately the economic forces which actually operate in the world... Whereas the use of mathematical analysis has been found to tempt men to expend their energy on the elaboration of minute and complex hypotheses, which have indeed some distant analogy to economic conditions, but which cannot properly be said to represent in any way economic laws.

By substitution, then, we get the criterion for the change in the terms of trade of the growing country:

$$\frac{dP_i}{dX_0^*} = -\sum_{j=1}^n m_{j0} \frac{\Delta_{ji}}{\Delta}. \quad (13)$$

Every m_{j0} is positive in the absence of inferior goods, and every Δ_{ji}/Δ is negative if all exports are gross substitutes. Therefore, *an improvement in productivity unambiguously worsens the commodity terms of trade of the growing country*: The prices of the exports of every other country rise relative to the price of the exports of the growing country.⁵

⁵ Why has country 0, whose exports are numéraire, been chosen as the growing country? Suppose instead that country i grows by dX_i^* . Then substituting in equation (7) the terms

$$-\frac{\partial B_i}{\partial X_i^*} = m_i$$

(the aggregate marginal propensity to import in country i), and the terms

$$-\frac{\partial B_j}{\partial X_i^*} = m_{ji},$$

when $i \neq j$, we obtain the criterion:

$$\frac{dP_i}{dX_i^*} = -m_{li} \frac{\Delta_{li}}{\Delta} - \dots + m_i \frac{\Delta_{ii}}{\Delta} - \dots - m_{ni} \frac{\Delta_{ni}}{\Delta}. \quad (14)$$

But $m_i \Delta_{ii}/\Delta$ is negative while all the other terms are positive. It would therefore appear that no unambiguous result is possible, and that the method of treating the change as occurring in the numéraire country is a special case.

Nevertheless, the economist's intuition tells him that in static analysis the choice of numéraire cannot affect the ultimate change in *relative* prices; and that if the terms of trade of the numéraire country deteriorate when that country grows, the terms of trade of any other country must fall when it grows. He may, therefore, conclude that P_i must fall in equation (14)—that the negative term dominates.

This is, in fact, correct. Making use of the definition of the aggregate marginal propensity to import, that is,

$$m_i \equiv m_{0i} + m_{li} + \dots + m_{ni},$$

we can arrange (14) to get

$$\frac{dP_i}{dX_i^*} = m_{0i} \frac{\Delta_{ii}}{\Delta} + m_{li} \frac{\Delta_{ii} - \Delta_{li}}{\Delta} + \dots + m_{ni} \frac{\Delta_{ii}}{\Delta} - \dots - m_{ni} \frac{\Delta_{ni} - \Delta_{ni}}{\Delta}. \quad (15)$$

The first term on the right side of (15) is clearly negative. The other terms will be negative if the *principal* cofactor of Δ dominates each of the other cofactors, that is, if $|\Delta_{ii}| > |\Delta_{ji}|$ ($j \neq i$). But by subtraction of the two cofactors it is easily shown that the resulting $(n-1)$ th-order determinant $\Delta_{ii} - \Delta_{ji}$ has all the characteristics of Δ (positive off-diagonal elements and dominant negative diagonal elements) except that its sign is opposite to the sign of Δ . (An analogous theorem has been proved by Metzler in analysis of the matrix multiplier.) All the terms on the right of (15) are therefore negative, so P_i must fall as a result of growth in country i .

This does not, however, conclude the proof that the replacement of country 0 by country i for the growing country leaves the essence of the proposition unaltered. For $dp_i/dX_i^* < 0$ merely asserts that the i th price falls relative to the 0th price. To complete the proof we must also show that $(dp_i/dX_i^*) - (dp_i/dX_i^*) < 0$ to establish that the i th price falls in terms of *all* other prices.

Tariff Changes

Suppose that country 0 applies an undiscriminatory tariff equal to dt_0 on all imports. At constant foreign prices the tariff-inclusive price of all imports in country 0 rises by dt_0 , and this induces a shift of demand away from all foreign goods onto domestic goods. The change in demand for the goods of the typical country j before redistribution of the tariff proceeds is $-\eta_{j0}I_{j0}dt_0$, where η_{j0} is the (positive) cross elasticity of demand in country 0 for the goods of country j when the price of the goods of country 0 falls relative to the price of the goods of country j^6 ; and where I_{j0} is the initial level of imports from

Since

$$\frac{dP_j}{dX_i^*} = -m_{ji} \frac{\Delta_{ij}}{\Delta} - \dots + m_{ij} \frac{\Delta_{ji}}{\Delta} - \dots - m_{ni} \frac{\Delta_{nj}}{\Delta} \quad (16)$$

we have

$$\frac{dP_i}{dX_i^*} - \frac{dP_j}{dX_i^*} = -m_{ji} \frac{\Delta_{ii} - \Delta_{ij}}{\Delta} - \dots + m_{ij} \frac{\Delta_{ii} - \Delta_{ij}}{\Delta} - \dots - m_{ni} \frac{\Delta_{ni} - \Delta_{nj}}{\Delta} \quad (17)$$

and again, except for the middle term on the right of (17), we are left with an apparently ambiguous result. However, when we solve for m_i from (14) and substitute the result in (17), we get, after simplification,

$$\frac{dP_i}{dX_i^*} - \frac{dP_j}{dX_i^*} = \frac{\Delta_{ii} - \Delta_{ij}}{\Delta_{ii}} \frac{dP_i}{dX_i^*} + \sum_{k=1}^n m_{ki} \frac{\Delta_{kj} \cdot \Delta_{ii} - \Delta_{ki} \cdot \Delta_{ij}}{\Delta \cdot \Delta_{ii}}. \quad (18)$$

The first term on the right of (18) is negative, since $dp_i/dX_i^* < 0$ from (14), and its coefficient is positive. The second term, however, is also negative since, by Jacobi's ratio theorem,

$$\Delta k_j \cdot \Delta_{ii} - \Delta_{ki} \cdot \Delta_{ij} \equiv \Delta_{ii \cdot kj}$$

which, from Mosak's theorem, must have a sign opposite to Δ_{ii} , which, in turn, has a sign opposite to Δ . Thus, both terms on the right of (18) are negative, so $(dp_i/dX_i^*) - (dp_j/dX_i^*) < 0$. It follows then that the device employed in the text of using the numéraire country as that in which the "policy change" occurred is a valid simplification.

The general implications of these mathematical manipulations are examined in greater detail in Chapter 7.

⁶ This term measures the percentage change in the imports of country 0 from country j as a proportion of the percentage increase in the price of goods of country 0, after the income effect implicit in the elasticity has been canceled by the redistribution of the tariff proceeds. This definition of the elasticity allows greater simplification than the conventional definition because it exploits the Hicksian law of composite commodities, which is applicable when the same rate of tariff is applied to all commodities.

A more general formulation, of which equation (23) below is a special case, is necessary to analyze the effects of discriminatory increases in tariff rates in country 0. Let $\eta_{j,0}$ be country 0's cross elasticity of demand for imports from country i with respect to the (tariff-inclusive) price of imports from country j , and let dt_{j0} be the change in country 0's tariff on goods from country j . Then before taking account of the disbursement of the tariff proceeds the effect on country i 's balance of payments of a tariff in country 0 on the goods of country j is $\eta_{j,0}I_{j0} dt_{j0}$, and the combined effects on country i 's balance of tariffs applied to all imports is $\sum_{j=1}^n \eta_{j,0}I_{j0} dt_{j0}$. This term can be split into income and substitution effects to get

$$\sum_{j=1}^n (\eta'_{i,j,0} I_{i0} - m_{i0} I_{j0}) dt_{j0}.$$

country j to country 0. On the other hand, the redistribution of the tariff proceeds raises the demand in country i for the goods of country j by $m_{j0}I_0$ where m_{j0} is the marginal propensity of country 0 to import from country i , and I_0 is the total level of imports into country 0. The combined change in demand for j 's goods is, therefore, $(-\eta_{j0}I_{j0} + m_{j0}I_0)dt_0 = \eta'_{j0}I_{j0}dt_0$, where η'_{j0} is the compensated cross elasticity of demand since the income effect implicit within the price change when all imports rise is also $m_{j0}I_0dt_0$. The typical term of the general equation (7) then becomes $-\partial B_j / \partial t_0 = \eta'_{j0}I_{j0}$, so that the criterion for the change in the terms of trade of country 0 is

$$\frac{dP_i}{dt_0} = \sum_{j=1}^n \eta'_{j0} I_{j0} \frac{\Delta_{ji}}{\Delta}. \quad (23)$$

The elasticities are all defined to be positive if the goods are net substitutes, so the conclusion is again unambiguous: *An increase in tariffs raises the world price of the exports of the tariff-imposing country relative to the prices of the exports of all other countries.*

Against these terms, which measure the initial effect on country i 's balance, must be set the redistribution of the tariff proceeds, equal to $\sum_{j=1}^n I_{j0}dt_{j0}$, which by itself increases country i 's balance by $\sum_{j=1}^n m_{j0}I_{j0}dt_{j0}$. The redistribution of the tariff proceeds therefore exactly cancels the income effect and we are left with the compensated elasticities. Thus

$$\sum_{j=1}^b \eta'_{ij,0} I_{i0}dt_{j0} \quad (19)$$

measures the effect of all the tariff changes on country i 's balance of payments. The effect of the combined tariffs in country 0 on the price of, say, country k 's exports is therefore

$$dP_k = \sum_{i=1}^n \sum_{j=1}^n \eta'_{ij,0} I_{i0}dt_{j0} \frac{\Delta_{ik}}{\Delta}. \quad (20)$$

When the tariff rates are applied equally on all products we have $dt_{10} = dt_{20} = \dots = dt_{n0} \equiv dt_0$ and (20) can be rewritten

$$\frac{dP_k}{dt_0} = \sum_{i=1}^n \sum_{j=1}^n \eta'_{ij,0} I_{i0} \frac{\Delta_{ik}}{\Delta}. \quad (21)$$

But $\sum_{j=1}^n \eta'_{ij,0}$, the sum of the compensated elasticities of demand in 0 for i 's imports when all import prices rise is equivalent to the compensated elasticity of demand for i 's imports when the price of the goods of the 0th country falls, that is, $\sum_{j=1}^n \eta'_{ij,0} = \eta'_{i0}$ where η'_{i0} is the elasticity of demand of i 's imports as defined in the text. Hence (21) can be rewritten

$$\frac{dP_k}{dt_0} = \sum_{i=1}^n \eta'_{i0} I_{i0} \frac{\Delta_{ik}}{\Delta} \quad (22)$$

which is equivalent to equation (23).

This section has been improved by H. G. Johnson's correction of my earlier treatment of income effects (see [35]).

Consumption and Production Tax Charges

The effects of a consumption tax on import goods are equivalent to the effects of a tariff if there is no domestic production of these goods. If there is domestic production of import goods, then the typical term, from the skeleton equation (7), is $\eta'_{cj0} y_{j0}$, where η'_{cj0} is the compensated cross elasticity of consumer demand in 0 for the type of products exported by country j when the price of country 0's goods falls, and y_{j0} is the level of domestic consumption of these products. The criterion for the change in the relative price of the exports of the typical country i is, therefore,

$$\frac{dP_i}{dt_{c0}} = \sum_{j=1}^n \eta'_{cj0} y_{j0} \frac{\Delta_{ji}}{\Delta} \quad (24)$$

which is negative since η'_{cj0} is positive. Thus *the terms of trade improve with respect to all countries as a result of a tax on importable goods*. By similar reasoning it can be shown that the terms of trade worsen as a result of an increased tax on the consumption of export goods. And by changing signs we get the criteria for the effects of subsidies on the consumption of import and export goods.

By similar analysis it can be shown that the typical coefficient of (7) resulting from a tax on the production of exportable goods is $\varepsilon'_{pj0} Y_{j0}$, 0 where ε'_{pj0} is the elasticity of supply in country 0 of the good exported by the j th country with respect to a change in the price of the goods of the 0th country, and Y_{j0} is the domestic production (that is, the production in 0) of the good exported by the j th country. The criterion is, therefore,

$$\frac{dP_i}{dt_{p0}} = \sum_{j=1}^n \varepsilon'_{pj0} Y_{j0} \frac{\Delta_{ji}}{\Delta}. \quad (25)$$

Thus if supply elasticities are all positive, *a tax on the production of exportables improves the terms of trade of the taxing country with respect to all other countries*. [Note that each term in (25) is zero if country 0 is completely specialized.] The same criterion applies, *mutatis mutandis*, for production taxes on imported goods, or production subsidies.

Unilateral Payments

Suppose that country 0 pays country s an annual tribute, or gift, or loan (ignoring interest payments). Then expenditure in 0 decreases and in s increases by the amount of the payment. The demand for all goods in 0 decreases and in s increases if there are no inferior goods. At constant prices the deficit

created by these expenditure changes in the balance of payments of the j th country is $(m_{j0} - m_{js})dT_{s0}$, where dT_{s0} is the value of the transfer. The criterion for the change in the price of exports in the receiving country, relative to the price of the exports of the paying country, is, therefore,

$$\frac{dP_s}{dT_{s0}} = \sum_{j=1}^n (m_{j0} - m_{js}) \frac{\Delta_{js}}{\Delta}. \quad (26)$$

[In the term $j = s$ the coefficient is $(m_{j0} - m_{ss}) = (m_{s0} + c_s) = (m_{s0} + m_s - 1)$, where c_s and m_s are, respectively, the marginal propensities to consume and import in country s .] The unilateral payment, through expenditure changes in the transferor and transferee, rearranges demand throughout the world in a way which does not permit any a priori generalization, a result which can be expected from the analysis of transfer between two countries.⁷

Comparison of Two-Country and Multiple-Country Models

The foregoing account of policy changes in a system containing many national units naturally leads to more complicated conclusions than in the case of a system containing only two countries. Applying only the restrictions of stability, we have not been able to show that two-country and multiple-country systems lead to substantially the same conclusions. The difficulty lies in relations of gross complementarity among the exports of the various countries. Gross complementarity is consistent with stability in the multiple-country system but inconsistent with stability in the two-country system. The two-country model cannot therefore be expected to suggest “theorems which admit of extension to more concrete cases” when gross complementarity is involved.⁸

However, when gross complementarity is absent—when all exports are gross substitutes—there is a remarkable similarity between the conclusions of the two models. Productivity, tariff, and tax changes move the terms of trade in the same direction in the many-country system, as in the simpler system. The explanation of this similarity lies in what may be called the *law of composition of countries*. If all foreign exports are *perfect* substitutes for each other, the foreign countries can be aggregated into a composite country and called the “rest of the world”; in that case the conclusions of the two models will agree

⁷ The propositions in this section require minor modification if there are limiting cases such as infinite or zero elasticities, and zero or negative marginal propensities to spend.

⁸ See Mosak [68] for an important generalization of the classical system and a discussion of complementarity. And see the Appendix to Part I of this book for an analysis of the general theoretical propositions associated with the presence or absence of homogeneity.

both qualitatively and quantitatively. But if foreign exports are only *imperfect* substitutes for each other, exact results cannot be obtained by the use of a composite country. However, while the *quantitative* conclusions of the two models will in this case differ, the *qualitative* conclusions remain. There is a presumption, then, that the use of two-country models will not be subject to serious error provided all exports are gross substitutes.

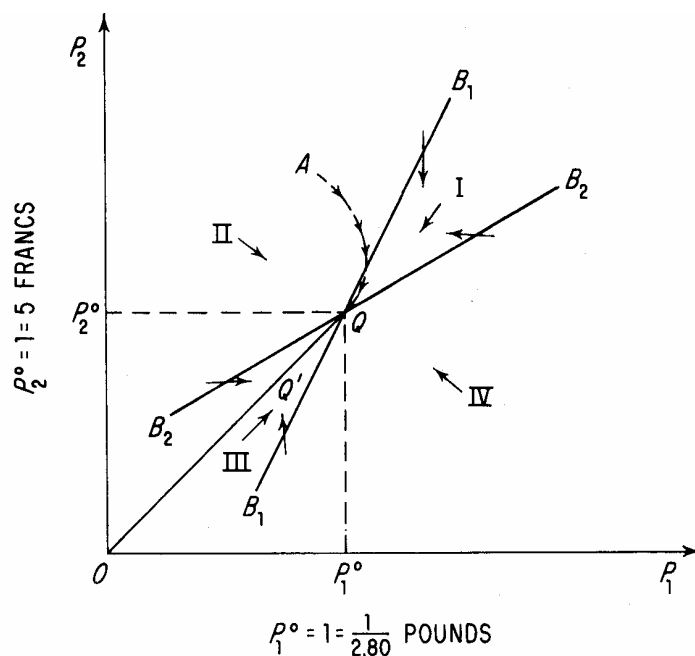


Figure 3-1.

Assume three countries, the United States (0), the United Kingdom (1) and France (2) with the respective currency prices (expressed in dollars) 1, P_1 and P_2 . Choose units of pounds and francs so that, at equilibrium, P_1 and P_2 are each unity. (If equilibrium ratios are $\$1 = 1/2.80$ pounds = 5 francs then $1/2.80$ pounds and 5 francs become the British and French currency units.) The two curves B_1B_1 and B_2B_2 trace the loci of pound-franc prices that allow equilibrium in the British and French balances. At Q both balances are in equilibrium implying, by Cournot's Law, equilibrium in the United States balance. A third curve (not drawn) passing through Q , B_0B_0 , could be drawn to reflect the pound-franc prices that will allow equilibrium in the United States balance.

If all currencies are gross substitutes both curves have positive slopes: This follows because appreciation of the franc must be associated with appreciation of the pound to maintain equilibrium. Moreover, B_1B_1 has an elasticity greater than unity and B_2B_2 has an elasticity less than unity; this follows because appreciation of the dollar is equivalent to depreciation of the franc and pound in equal proportion; a movement along the line OQ from Q to Q' must improve the French and British balances and worsen the United States balance. Four quadrants can then be identified: east and west of B_1B_1 there

are deficits and surpluses, respectively, in the British balance; and north and south of B_2B_2 there are deficits and surpluses in the French balance. (The curve B_0B_0 (not drawn) would have a negative slope and demarcate zones of surplus or deficit in the United States balance.)

On the dynamic assumption that the dollar prices of pounds and francs rise and fall in proportion to the disequilibrium in the British and French balances, the arrows in each quadrant indicate the forces impelling a return to equilibrium, and show that the equilibrium is stable. From the disequilibrium position A , for example, the path may follow the broken line AQ , becoming "trapped" in Quadrant I; or it may become trapped in Quadrant III and hence move to equilibrium.

To determine geometrically the movement of the prices as a result of policy changes it is necessary to indicate the direction in which the two curves shift. If United States output and expenditure increase, more British and French goods are demanded at constant prices improving both British and French balances; the two curves therefore shift away from the origin and the new equilibrium point moves to somewhere in Quadrant I. Similarly, for the tariff and tax changes analyzed in the text both curves shift toward the origin with an unambiguous improvement in the United States terms of trade.

Chapter 4 / *Tariff Preferences and the Terms of Trade*¹

The impact of tariff preferences on resource allocation and welfare has been the subject of notable theoretical advances in the past decade,² but there is a gap in the literature on the closely related question of their effect on the terms of trade, changes in which might significantly affect the distribution of the gains and losses among members and between the preference area as a whole and the rest of the world. The purpose of this chapter is to fill part of this gap by establishing what appear to be the main propositions valid for an arbitrary number of countries, and to contrast the results with those which derive from the traditional theory of nondiscriminatory tariffs.

A Geometric Model of Three Countries

We make three simplifying assumptions: (1) initial tariffs are low, (2) the contemplated tariff reductions are small, and (3) all exports are gross substitutes in world consumption in the sense that a rise in the price of any country's exports, all other prices remaining constant, creates an excess demand for the exports of every other country.³ The significance of these assumptions will be dealt with later.

Consider a three-country system in which *A* and *B* denote the prospective member countries and *C* denotes the rest of the world. The problem is to deduce the changes in the world (relative) prices of the exports of the three countries when the tariff concessions are initiated. The simplest approach to

¹ Adapted from: *Manchester School Econ. Soc. Stud.*, **32**, 1–13 (Jan. 1964).

² The three main works on the theory of customs unions are those of Viner [104], Meade [60], and Scitovsky [96]; but mention should also be made of the articles of Makower and Morton [50], Johnson [33], and Lipsey [45 and 46].

³ The significance of the assumption that exports are gross substitutes, in relating the results of multicountry models to two-country models, is brought out in Chapter 3. It is further explored in Chapters 7 and 21.

the solution is to investigate, for each tariff reduction in isolation, the changes in the balances of trade on the tentative supposition that international prices remain constant.

Let us examine first the reduction in A 's tariff on B 's exports. At constant international prices the price of B 's goods in A falls by the amount of the tariff reduction. This *price* effect, assuming for now that all goods are substitutes in A 's consumption,⁴ shifts demand in A away from home goods and C 's goods onto B 's goods, occasioning an improvement in B 's balance and a worsening of C 's balance. It can also be shown, however, that A 's balance worsens, since the difference between the improvement in B 's balance and the worsening of C 's balance must equal the change in A 's balance (by Cournot's law that the sum of all balances is identically zero), and because the improvement in B 's balance must exceed the worsening of C 's balance by the reduced spending in A on home goods (by Walras' law that all excess demands sum to zero within any country).⁵ The price effect thus induces an improvement in B 's balance and deteriorations in A 's and C 's balances.

The price effect, however, is partially offset by the *budgetary* effect— A 's

⁴ Some goods might be complements in a nation's consumption without interfering with the assumption that all goods are gross substitutes in world markets. We assume here that all goods are *net* and *gross* substitutes in A 's consumption, but the implications of relaxing this assumption will be discussed later.

⁵ Let A , B , and C be the balances of the three countries and dt the change in A 's tariff. With units chosen to make each price initially unity, the change in B 's balance at constant terms of trade, as a proportion of the tariff change, is

$$\left(\frac{\partial B}{\partial t}\right)' = \left(\frac{\partial I_{ba}}{\partial t} \frac{1}{I_{ba}}\right) I_{ba} = -\eta_{ba \cdot b} I_{ba}$$

where I_{ba} is the level of imports from B to A and $\eta_{ba \cdot b}$ is the negative (own) elasticity of demand for B 's goods in A due to a change in the price of B 's goods; and the change in C 's balance can be written

$$\left(\frac{\partial C}{\partial t}\right)' = \left(\frac{\partial I_{ca}}{\partial t} \frac{1}{I_{ca}}\right) I_{ca} = -\eta_{ca \cdot b} I_{ca}$$

where $\eta_{ca \cdot b}$ is the positive (cross) elasticity of demand for C 's goods in A due to the change in price of B 's goods. Now by Cournot's law we have

$$\left(\frac{\partial A}{\partial t}\right)' + \left(\frac{\partial B}{\partial t}\right)' + \left(\frac{\partial C}{\partial t}\right)' = 0$$

so

$$\left(\frac{\partial A}{\partial t}\right)' = (\eta_{ba \cdot b} I_{ba} + \eta_{ca \cdot b} I_{ca}).$$

On the other hand, from Walras' law we have

$$\eta_{aa \cdot b} I_{aa} + \eta_{ba \cdot b} I_{ba} + \eta_{ca \cdot b} I_{ca} = 0$$

where $\eta_{aa \cdot b}$ is the positive (cross) elasticity of A 's demand for home goods due to a change in B 's price, and I_{aa} is home consumption. It follows that

$$\left(\frac{\partial A}{\partial t}\right)' = -\eta_{aa \cdot b} I_{aa} < 0.$$

government experiences a budget deficit equal to the reduced tariff proceeds, and this deficit must be corrected by decreased government spending or increased taxes. The final result therefore depends on whether or not the change in spending due to the method by which the government restores balance in its budget is sufficient to offset the initial price effect. In principle either result is possible, depending on which taxes are increased or how the government reduces spending, but there is a strong presumption that the initial price effect will dominate. For example, if income taxes are raised, the reduced level of disposable income of the community means that consumers in A will spend less on all goods (in the absence of inferior commodities), but this budgetary effect is exactly equal, for small tariff changes, to the income effect implicit within the initial price effect,⁶ leaving only pure substitution terms that work in the same direction as the original price effect. Only in exceptional cases where reduction in government spending is the method used to balance the budget and where it is heavily biased against one of the goods can the budgetary effect dominate. In what follows we shall ignore these exceptional cases.

The tariff reduction, then, tends to improve B 's balance and worsen A 's and C 's balances at constant international prices. The latter must therefore move, if equilibrium is to be restored, in a direction that worsens B 's balance and improves the balances of A and C . Figure 4-1 provides a method of determining this direction.

The lines AA' , BB' , and CC' trace the loci of the world prices of A and B , relative to the world prices of C , which permit equilibrium (before the tariff changes) in the balances of A , B , and C , respectively. The following character-

⁶ The price effects treated in footnote 5 can be split into pure substitution elasticities and income propensities as follows:

$$\begin{aligned} -\eta_{ba \cdot b} I_{ba} &= -\eta'_{ba \cdot b} I_{ba} + m_{ba} I_{ba} \\ -\eta_{ca \cdot b} I_{ca} &= -\eta'_{ca \cdot b} I_{ca} + m_{ca} I_{ba} \end{aligned}$$

where m_{ba} and m_{ca} are the marginal propensities to spend in A on imports from B and C , and the primes denote that the elasticities have no income effects.

The increased income taxes reduce disposable income in A by $I_{ba} dt$, so that the budgetary effects alter B 's and C 's balances as a proportion of the tariff change, according to the equations

$$\begin{aligned} \left(\frac{\partial B}{\partial t}\right)'' &= -m_{ba} I_{ba} \\ \left(\frac{\partial C}{\partial t}\right)'' &= -m_{ca} I_{ba}. \end{aligned}$$

The combined impact of the price and budgetary effects, before world prices change is, therefore,

$$\begin{aligned} \frac{\partial B}{\partial t} &= \left(\frac{\partial B}{\partial t}\right)' + \left(\frac{\partial B}{\partial t}\right)'' = -\eta'_{ba \cdot b} I_{ba} > 0 \\ \frac{\partial C}{\partial t} &= \left(\frac{\partial C}{\partial t}\right)' + \left(\frac{\partial C}{\partial t}\right)'' = -\eta'_{ca \cdot b} I_{ca} < 0. \end{aligned}$$

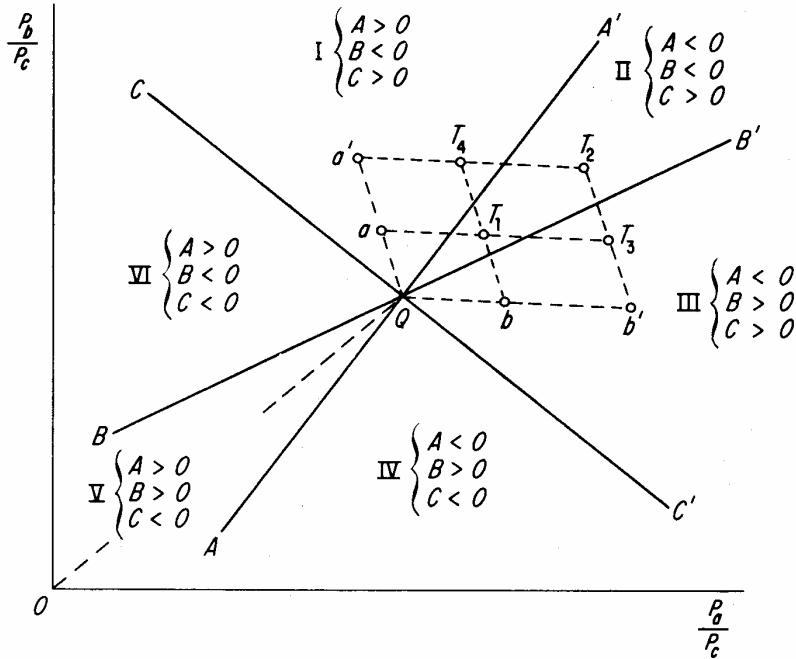


Figure 4-1.

istics of these curves are implied by the assumption that all goods are substitutes in world markets:

1. AA' and BB' have positive slopes.⁷ This follows because a rise in A 's price (relative to C 's price) must be associated with a rise in B 's price (relative to C 's price) along any isobalance line, since a corresponding price rise in A 's price worsens A 's and improves B 's balance, while a corresponding price rise in B 's price worsens B 's and improves A 's balance. Similarly, CC' has a negative slope because a rise in A 's price (relative to C 's price) would improve C 's balance and must therefore be associated, along C 's isobalance schedule, with a fall in B 's price that would worsen C 's balance [the asymmetrical position of C 's curve derives from the (unimportant) assumption that C 's goods serve as *numéraire*].
2. The slope of AA' must exceed, and the slope of BB' must fall short of the slope of a line from O to Q . This follows because a movement along this

⁷ The three schedules are drawn as straight lines to emphasize that the analysis is exact for small changes only.

line is a proportionate movement of B 's and A 's prices, and is therefore the same (in a "homogeneous" price system) as a corresponding price movement of C 's price. Any point on OQ must therefore be a point of balance-of-payments surplus for A and B and balance-of-payments deficit for C , while any point along OQ -extended must be a point of surplus for C and deficit for A and B .

3. When the system is not in equilibrium at the point Q , the situations of deficit or surplus in the balances of the three countries must be those indicated by the inequalities in the six sectors.

The Basic Proposition

The diagram can now be used to establish the direction of change in the terms of trade. From the initial equilibrium Q the tariff reduction in A causes the three schedules to shift. At constant international prices, that is, at the point Q , the tariff reduction causes B 's balance to be in surplus and A 's and C 's balances to be in deficit, so world prices must move in a direction which worsens B 's balance and improves those of A and C . In other words, the new point of equilibrium must lie in sector I (Figure 4-1), where, from the point of view of the situation before the tariff change, A 's and C 's balances are in surplus and B 's is in deficit. The characteristics of sector I therefore outline the changes in relative prices that must take place as a result of the tariff reduction; in this sector B 's price has risen relative to the prices of A and C . This establishes the most important proposition about discriminatory tariff reductions: *A tariff reduction in a member country unambiguously improves the terms of trade of the partner country.*

Notice that it cannot be determined, a priori, whether the terms of trade of the tariff-reducing country (A) rise or fall relative to the foreign country; an equilibrium in sector I is consistent with either result. But given the elasticities of demand in A for the goods of B and C (these elasticities determine the change in the balances at constant international prices), there exists a line that determines the new equilibria for successively larger tariff reductions in A . Thus, if the point a represents the new equilibrium as a result of a small tariff reduction in A , then the point a' would indicate that for a slightly larger tariff reduction. The line Qaa' we shall call A 's "tariff-reduction line." Its slope as drawn is negative, but in fact all that can be definitely established is that it must lie between the slopes of QC and QA' .

Now let us consider the effect of reduction in B 's tariff on A 's goods and the combined effect of both A 's and B 's tariff reductions. B 's tariff reduction creates a surplus in A 's balance and deficits in the balances of B and C , necessitating an improvement in A 's terms of trade relative to both other countries. In the diagram the new equilibrium, as a result of B 's tariff reduction alone,

must be in sector III, following the same line of reasoning as in the analysis of *A*'s tariff reduction. *B*'s tariff-reduction line is described by Qbb' , with any slope between that of QB' and QC' .

The final effect of any given set of mutual discriminatory tariff reductions can be determined by adding the results. If *A*'s tariff reduction results in a new equilibrium at, say, a , and *B*'s tariff reduction results in a new equilibrium at, say, b , the combined effect is determined by completing the parallelogram formed by the two tariff-reduction lines Qa and Qb , establishing the point T_1 as the new equilibrium. Similarly, the points T_2 , T_3 , and T_4 are the new equilibria for the respective sets of points on the tariff-reduction lines, (a', b') , (a, b') , and (a', b) .

Zone of Mutual Improvement

All the attainable points lie northeast of CC' , but they might lie in any of the three sectors, I, II, and III. The characteristics of these zones indicate the general conclusions that follow from discriminatory tariff reductions: in sector I, *B*'s terms of trade have unambiguously improved; in sector III, *A*'s terms of trade have unambiguously improved; and in sector II, *C*'s terms of trade have unambiguously worsened (the indicated change in the terms of trade is unambiguous in the sense that the improvement or deterioration is with respect to both the other countries). In all three sectors the terms of trade of the rest of the world worsen with respect to at least one and perhaps both of the member countries.

The entire area northeast of CC , however, is not attainable by given tariff reductions; given the elasticities of demand in the two member countries, only the area east of *A*'s and north of *B*'s tariff-reduction line encloses the point of final equilibrium, and this area is necessarily smaller than the area northeast of CC . But the attainable area must nevertheless enclose all of zone II, yielding another important conclusion: *Some sets of tariff reductions necessarily improve the terms of trade of both member countries with respect to the rest of the world* (this might not include the specific tariff reductions implied by a free-trade area, however). A special case is that in which the members lower tariffs in a ratio that preserves the original intra-union terms of trade, resulting in a new equilibrium along OQ -extended; in this case it is obvious that the terms of trade of the outside world unambiguously fall, because the balance of payments of each individual country in the union improves while that of the outside world worsens, as a result of the tariff reductions at constant world prices. But this special case is only one of many instances in which the terms of trade of the outside world fall with respect to both members; indeed, there is a general presumption that this is the normal case, as the balance of payments of the union as a whole

necessarily improves (at constant prices) while that of each country in the rest of the world worsens.

Finally, one can consider the possibility of independence or complementarity in national (but not in world) consumptions. The smaller the cross elasticities of demand in member countries between the exports of the partner country and the exports of third countries are, the greater is the likelihood that the terms of trade of one of the member countries will deteriorate with respect to foreign countries. At the limit—where *A*'s tariff reduction does not reduce imports into *A* from foreign countries, and where *B*'s tariff reduction does not reduce imports into *B* from foreign countries—the terms of trade of one of the member countries is likely to improve, while that of the other member country is likely to fall, because the tariff reductions cause a deficit in one member and a surplus in the other member, whereas the balance of the rest of the world is unaltered (there is an exception if the tariffs are reduced in a way that preserves the intraunion balance; in that case world prices remain unchanged). As we pass the limit—as some complementarity appears in the consumptions of member countries—there arises the possibility that the terms of trade of the rest of the world improve with respect to both member countries. Thus, if *B*'s and *C*'s goods were complementary and, similarly, if *A*'s and *C*'s goods were complementary in *B*'s consumption, *B*'s tariff reduction alone would prompt a fall in *B*'s terms of trade. Then the combined tariff reductions would stimulate, at constant world prices, a surplus in foreign countries and a deficit in the union as a whole, occasioning an improvement in the terms of trade of the outside world relative to the union.

Conclusions and Qualifications

The following generalizations now emerge from this study of tariff preferences :

1. A discriminatory tariff reduction by a member country improves the terms of trade of the partner country with respect to both the tariff-reducing country and the rest of the world, but the terms of trade of the tariff-reducing country might rise or fall with respect to third countries.
2. The degree of improvement in the terms of trade of the partner country is likely to be larger the greater is the member's tariff reduction; this establishes the presumption that a member's gain from a free-trade area will be larger the higher are the initial tariffs of partner countries.
3. It cannot be established, a priori, that arbitrary sets of discriminatory tariff reductions by member countries must improve the terms of trade of both member countries; it is possible that the terms of trade of one of the members deteriorate relative to third countries.

4. Nevertheless, there exists a presumption that the terms of trade of both member countries improve relative to the outside world. This presumption is established by the fact that the balance of trade of the preference area as a whole must improve, while that of each country in the rest of the world must deteriorate. It follows immediately that the terms of trade of one of the members improve relative to third countries; if, for example, the balance of trade of a member country deteriorates as a result of the tariff reduction (at constant world prices), the terms of trade of the partner country must improve.
5. Moreover, there are numerous sets of tariff reductions that must improve the terms of trade of both member countries. A special case is that in which tariffs are reduced so as to leave the intraunion terms of trade unaltered.
6. The above propositions hold where all goods are substitutes in national consumptions. If complementarity is present between the goods of partner countries and the outside world, there arises the possibility that the terms of trade of the latter improve relative to both member countries.

It remains now to indicate briefly the significance of the three assumptions made at the beginning, and to contrast the results with those that derive from traditional tariff theory. The assumption that initial tariffs are low ensures that the tariff reductions reduce the value of tariff proceeds and create deficits in the government budgets; our conclusions would not hold if, for example, initial tariffs were prohibitive. The assumption that the tariff changes are small is necessary for similar reasons, because large tariff changes would be likely to change the composition of imports and exports; and because the proposition relating to the equality of the budgetary effect (when income taxes are raised) and the income effect implicit within the price change would not be exact. The assumption of substitution in world markets, however, is one that requires more intensive examination.

If complementarity is present in the world economy the conclusions reached in this paper might be fundamentally changed; in general terms (even if the requirement that the system is dynamically stable be imposed), almost any result can occur. Analysis of complementarity would therefore deteriorate into a difficult exercise in taxonomy, and one which is probably unrewarding unless actual statistics can be introduced. The assumption of substitution seems to be necessary to get definite results and to establish a useful "normal" case with which more complicated examples can be compared.

It must not be thought, however, that the restrictive assumption of universal substitution is any less necessary in analysis of the traditional theory of tariffs or, indeed, in any of the other branches of international trade theory. The unambiguous results that appear to derive from traditional theory are equally based on the assumption of substitution, but the assumption is hidden

by the usual two-country model employed in that branch of analysis, whereas an analysis of discriminatory tariffs logically requires at least a three-country model of the world economy and thus explicit recognition of the problem of complementarity. Only if complementarity is assumed to be slight or absent does the proposition of traditional tariff theory—that an (undiscriminatory) tariff reduction worsens the terms of trade of the tariff-reducing country—hold, just as this assumption is necessary to establish that an undiscriminatory tariff reduction improves the terms of trade of the partner country.

Appendix

N – Country Case

The propositions now established for three countries hold also for an arbitrary number of countries. Suppose that there are $n + 1$ countries, numbered $0, 1, 2, \dots, n$, and that the exports of country 0 are *numéraire*. Let B_i be the balance of trade (or payments) of the i th country, expressed in terms of the *numéraire*, and let p_j denote the price of the exports of the j th country, with p_j initially equal to unity (by appropriate choice of units). The system can be written

$$B_i(p_1, \dots, p_n; t) = 0 \quad (1)$$

where t is a parameter representing the combined tariff reductions. By differentiation we obtain

$$\sum_{j=1}^n \frac{\partial B_i}{\partial p_j} \frac{dp_j}{dt} = - \frac{\partial B_i}{\partial t} \quad (i = 1, 2, \dots, n). \quad (2)$$

The solution for dp_i/dt is

$$\frac{dp_i}{dt} = - \sum_{j=1}^n \frac{\partial B_j}{\partial t} \frac{\Delta_{ji}}{\Delta} \quad (3)$$

where Δ is the Jacobian $\partial(B_1 \dots B_n) / \partial(p_1, \dots, p_n)$ and Δ_{ji} is the cofactor of its j th row and i th column. The assumption of gross substitution in world markets implies that Δ_{jj} and Δ are of opposite sign, so that the ratio of the two is negative.⁸

⁸ By Mosak's theorem—that if the off-diagonal elements of Δ are positive (implied by the assumption of gross substitution) and if the matrix of Δ is Hicksian, then all the elements of Δ^{-1} are negative—and by the stability theorems of Arrow and Hurwicz, Hahn, Negishi, and Uzawa—that if all the off-diagonal elements of Δ are positive and the row or column sums are negative, the matrix of Δ is Hicksian.

Suppose that the countries 0 and 1 are the member countries. Then it follows immediately that a tariff reduction in *one* of the member countries, say country 1,⁹ improves the terms of trade of the partner country, since, in that case, $\partial B_j / \partial t < 0$ for every $j = 1, 2, \dots, n$; the expression on the right of (3) is negative.

Taking the tariff changes in both countries into account, it is not definite that a member country's terms of trade rise. This can be seen by separating the first term in (3) from the other to get

$$\frac{dp_i}{dt} = -\frac{\partial B_1}{\partial t} \frac{\Delta_{1i}}{\Delta} - \sum_{j=2}^n \frac{\partial B_j}{\partial t} \frac{\Delta_{ji}}{\Delta}. \quad (4)$$

The first term might be positive or negative depending on the elasticities of demand in the two member countries and on the size of the relative tariff reductions. But, if a member's balance worsens as a result of the tariff reductions, it follows that partner's terms of trade must improve; the uncertainty as to sign appears to apply only if the balances of both members improve.

It is readily shown, however, that the terms of trade of both members cannot deteriorate. To see this, consider the intraunion terms of trade, and note that this might change in any direction. But if the intraunion terms of trade of one of the members improve, then the terms of trade of that member must improve relative to third countries. Suppose, for instance, that the intraunion terms of trade of country 0 improve so that

$$\frac{dp_1}{dt} = -\frac{\partial B_1}{\partial t} \frac{\Delta_{11}}{\Delta} - \sum_{j=2}^n \frac{\partial B_j}{\partial t} \frac{\Delta_j}{\Delta} < 0. \quad (5)$$

It follows, from (5), that

$$\frac{\partial B_1}{\partial t} = -\zeta - \sum_{j=2}^n \frac{\partial B_j}{\partial t} \frac{\Delta_j}{\Delta_{11}} \quad (6)$$

where ζ is a positive number. Substituting (6) in (4) we get

$$\begin{aligned} \frac{dp_i}{dt} &= \left(\zeta + \sum_{j=2}^n \frac{\partial B_j}{\partial t} \frac{\Delta_{j1}}{\Delta_{11}} \right) \frac{\Delta_{1i}}{\Delta} - \sum_{j=2}^n \frac{\partial B_j}{\partial t} \frac{\Delta_{ji}}{\Delta} \\ &= \zeta \frac{\Delta_{1i}}{\Delta} + \sum_{j=2}^n \frac{\partial B_j}{\partial t} \frac{\Delta_{j1} \Delta_{1i} - \Delta_{ji} \Delta_{11}}{\Delta \Delta_{11}}. \end{aligned} \quad (7)$$

⁹ The proof that if a country 0 lowers its tariff, the terms of trade of country 1 improve is slightly more difficult, and requires the introduction of a theorem developed by Metzler [65] for the Keynesian case, which I have applied to the classical case. But, because the choice of numéraire cannot affect *relative* prices, the reader's intuition should persuade him that the analysis in this chapter is sufficient.

Now the first term is obviously negative. The second term will be negative provided the numerator and the denominator of the term containing determinants are of the same sign; this is readily shown to be the case, making use of Mosak's theorem and another theorem about determinants.¹⁰ This is sufficient to prove that one of the member country's terms of trade must improve.

There are a number of special cases in which the terms of trade of both members improve, relative to outside countries. The case considered in this chapter is that where the intraunion terms of trade are unchanged; the proof in the general case follows readily by setting the expression in (5) equal to zero, and substituting in (4) to get the same results as in (7) without the first term.

¹⁰ By Jacobi's ratio theorem

$$\Delta\Delta_{11,ji} = \Delta_{11}\Delta_{ji} - \Delta_{ji}\Delta_{11};$$

but from Mosak's theorem, and the stability theorems, it follows that the two terms on the left have the same sign, so that the difference in the right is positive. This means that the ratio of the determinants in the second equation is negative.

See Metzler ([65], p. 26) for a previous application to the generalized Keynesian system.

Chapter 5 / *A Geometry of Transport Costs in International Trade Theory*^{1,2}

Transport costs have been neglected in the pure theory of international trade, most of which is expounded on the assumption that transport costs are absent. The purpose of this paper is to present a simple geometric method for depicting transport costs in offer-curve diagrams, and to apply the method to analyze transport costs in the context of the terms of trade, the transfer problem, the optimum tariff, and real factor returns.

To avoid introducing a third industry—the transport industry—I shall employ a drastic, but very useful, assumption regarding the nature of transport costs: Transport costs are met by the wastage of a proportion of the goods traded.³ This assumption will mean that only a proportion of the goods exported will be received as imports by the other country (the remainder being “used up” as costs of transport) in the case where each country provides the resources for transporting its own exports; that a proportion of its exports will be used up for every unit of the good imported in the case where each country provides the resources for transporting its imports; and that some of each country's resources will be used up in transporting each good in the case where each country shares in the transport of each good. The meaning of the assumption will become clearer later in the paper.

The Geometry

First we shall show how offer curves must be modified to take account of transport costs. Assume two countries, *A* and *B*, exporting commodities *X* and *Y*, respectively. For the moment, neglect the costs of transporting *Y*.

¹ Adapted from: *Can. Jour. Econ. Pol. Sci.*, 23, 331–348 (Aug. 1957).

² I am grateful to H. G. Johnson, J. E. Meade, and S. A. Ozga for helpful comment on and criticism of an earlier draft of this article. I am especially indebted to Professor Johnson for his method of representing the transfer problem with transport costs.

³ This assumption was first used by Samuelson in his analysis of the transfer problem [91].

Assume first that the cost of transporting X is incurred in X itself, so that only a proportion of A 's exports are received as imports by B . Call this proportion K_x . There are two ways in which the offer curves can be modified to determine the new equilibrium, the choice depending on whether it is more convenient to work with c.i.f. (cost, insurance and freight) or f.o.b. (free on board) offer curves. Thus, we can modify A 's offer curve to show that she offers less X per unit of Y , landed in B , because part of her exports are used up as costs of transport; or we can modify B 's offer curve to show that B demands more X per unit of Y , f.o.b., since she must use up some of A 's

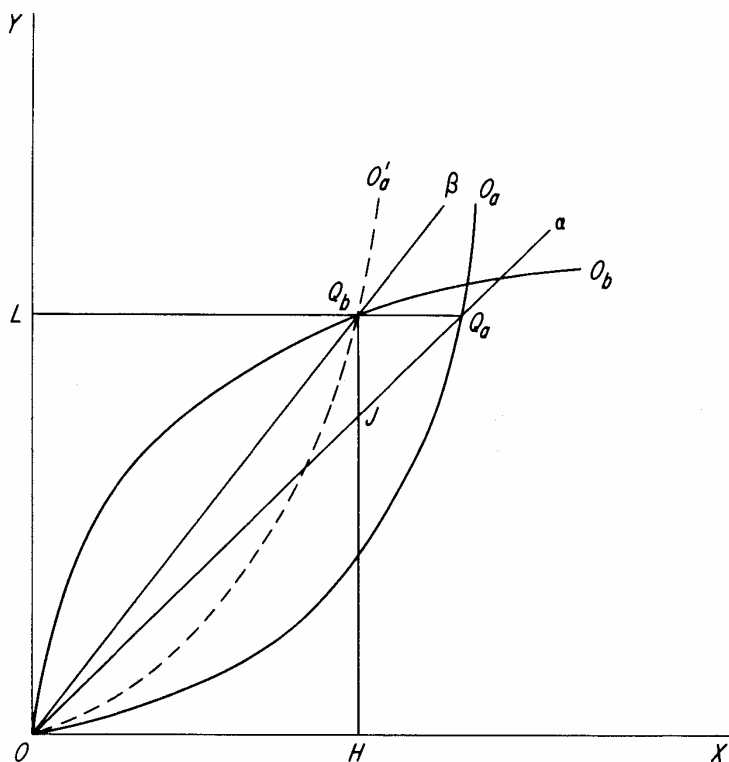


Figure 5-1.

exports to land X in B . In Figure 5-1, O_a and O_b are the offer curves of A and B before transport costs have been considered, and O_α is the schedule of A 's offers of X landed in B , that is, O'_α is A 's c.i.f. offer curve. This curve is determined by subtracting from the X value of O_α the amounts of X that would be

required to transport that X , so that for any given value of Y , the X value of O'_a is a proportion, K_x , of the X value of O_a . Equilibrium is determined by the intersection of A 's c.i.f. offer curve, O'_a , with B 's offer curve, O'_b , at the point Q_b . At this equilibrium, country A exports LQ_a of X and imports OL of Y , and country B exports OL of Y and imports LQ_b of X . Country A receives as imports the same amount of Y as country B exports, because no Y is used up as transport cost; but country B receives as imports only the proportion K_x of A 's exports, the difference being used up as transport cost. Thus Q_aQ_b is the cost of landing LQ_b of X in B .

Equilibrium can be determined by the intersection of the c.i.f. offer curves or by the intersection of the f.o.b. offer curves. In Figure 5-1, O_b is B 's c.i.f. offer curve, the amounts of Y that B offers to land in A for quantities of X landed in B ; and O'_a is A 's c.i.f. offer curve. Alternatively, country B 's f.o.b. offer curve (not drawn) would show the quantities of Y offered by B in return for quantities of X , f.o.b. in A ; and A 's f.o.b. offer curve is O_a , since there are no costs of transporting Y . The f.o.b. offer curves would intersect at Q_a .

The price of OH of X in B is HQ_b of Y , and in A it is HJ of Y . This is equivalent to saying that the price of OH of X is HQ_b , c.i.f., or HJ , f.o.b., where the amount of JQ_b of Y is the price, in terms of Y , paid for transport costs. Thus the domestic price ratio in A is α and in B is β . The terms of trade, when both export and import prices are calculated c.i.f., are determined by the intersection of the c.i.f. offer curves; and when prices are calculated f.o.b., the terms of trade are determined by the intersection of the f.o.b. offer curves. Thus the c.i.f. terms of trade are the same as B 's domestic price ratio, and the f.o.b. terms of trade are the same as A 's domestic price ratio. This conclusion is obvious, since there are no costs of transporting Y .

Price ratios are related by the proportion K_x . Let the P 's denote prices, the subscripts, commodities, and the superscripts, countries. Then

$$\left(\frac{P_x}{P_y}\right)^B = \frac{Q_bH}{OH} = \frac{Q_bH}{K_xLQ_a} = \frac{1}{K_x} \left(\frac{P_x}{P_y}\right)^A.$$

Let us now assume that both countries share in the transport of X , and retain the assumption that Y is transport-free. Transport costs incurred in Y mean that some Y is used up in transporting a unit of X ; call this fraction a_x . In Figure 5-2, a_x is represented by the slope of the line OK . Now to find the c.i.f. offer curve of A , first deduct from O_a the costs of transport incurred in X (as in Figure 5-1), to get O'_a , and then add the line OK vertically to O'_a to get O''_a . The c.i.f. offer curve, O''_a , shows the schedule of amounts of X landed in B that A is willing to offer B at different price ratios. Country A is willing to offer LQ_a of X , f.o.b., in return for OL of Y , but deducts from this PQ_a

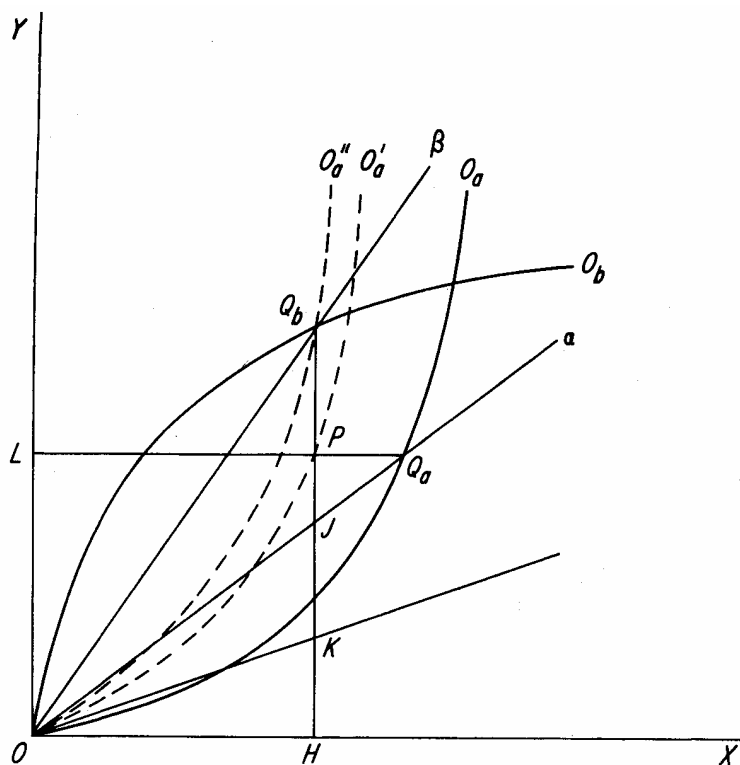


Figure 5-2.

of X , and demands PQ_b more of Y , to pay the costs of transport.⁴ The price of OH of X to B is thus HQ_b of Y , c.i.f., or HJ of Y , f.o.b. The terms of trade calculated at c.i.f. prices are β and, calculated at f.o.b. prices, α . The price ratios are related in the following way:

$$\left(\frac{P_x}{P_b}\right)^B = \frac{HQ_b}{OH} = \frac{HQ_b}{K_x LQ_a} = \frac{1}{K_x} \frac{HP}{LQ_a} + \frac{KH}{OH} = \frac{1}{K_x} \left(\frac{P_x}{P_y}\right)^A + a_x.$$

Until now we have considered only the cost of transporting X . If there are costs of transporting Y as well, both offer curves must be modified. To keep the geometry simple, I have assumed in Figure 5-3 that transport costs are

⁴ I have assumed throughout that transport costs are not required to "ship transport costs." Thus, in Figure 5-2, the proportion a_x measures the amount of Y used up in transporting X after transport costs incurred in X have been deducted. To make the alternative assumption it is necessary only to change the proportions K_x and a_x .

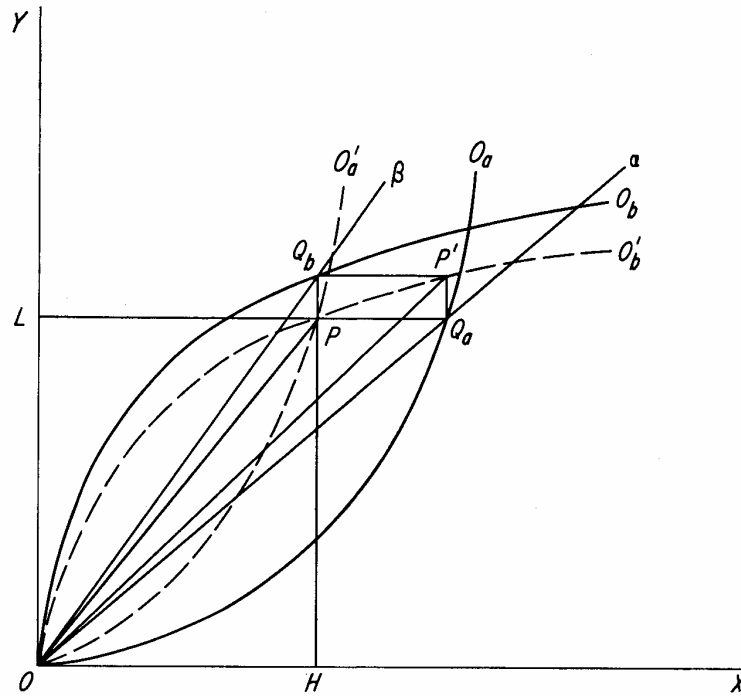


Figure 5-3.

incurred only in the good of the exporting country, which means that some X is used up in shipping X and some Y is used up in shipping Y . The curves O'_a and O'_b are the c.i.f. offer curves of A and B , respectively; these curves intersect at P . The trading equilibrium of A is at Q_a , where she exports LQ_a of X in return for HP of Y , so her domestic price ratio is given by the line α . The trading equilibrium of B is at Q_b , where she exports HQ_b of Y in return for OH of X , so her domestic price ratio is β .

Country A exports LQ_a of X but B receives only LP , since PQ_a is used up as the cost of transporting X . Country B exports HQ_b but only HP reaches A , since PQ_b of Y is used up as transport cost. The points Q_a and Q_b must be points of equilibrium, as they lie on the offer curves of A and B , respectively, and the difference between the exports of one country and the imports of the other country is wasted as transport costs.

The terms of trade with prices calculated c.i.f. are given by a line from the origin to the point of intersection of the c.i.f. offer curves, that is, OP . The f.o.b. terms of trade are given by a line from the origin to the intersection of

the f.o.b. offer curves (not drawn), and can easily be shown to be OP' . The price ratios are related in the following way:

$$\left(\frac{P_x}{P_y}\right)^B = \frac{HQ_b}{OH} = \frac{1}{K_x K_y} \frac{HP}{LQ_a} = \frac{1}{K_x K_y} \left(\frac{P_x}{P_y}\right)^A.$$

Since the c.i.f. and f.o.b. terms of trade are the slopes of the lines OP and OP' respectively, the following relation holds:

$$\begin{aligned} \left(\frac{P_x}{P_y}\right)^B &= \frac{1}{K_x} \text{ (f.o.b. terms of trade)} \\ &= \frac{1}{K_y} \text{ (c.i.f. terms of trade)} = \frac{1}{K_x K_y} \left(\frac{P_x}{P_y}\right)^A \end{aligned}$$

from which it can be seen that the f.o.b. terms of trade and the c.i.f. terms of trade will be equal when $K_x = K_y$.

A final case will be considered, the case where one country provides all the transport services. In Figure 5-4 the proportion K_x is the fraction of A 's

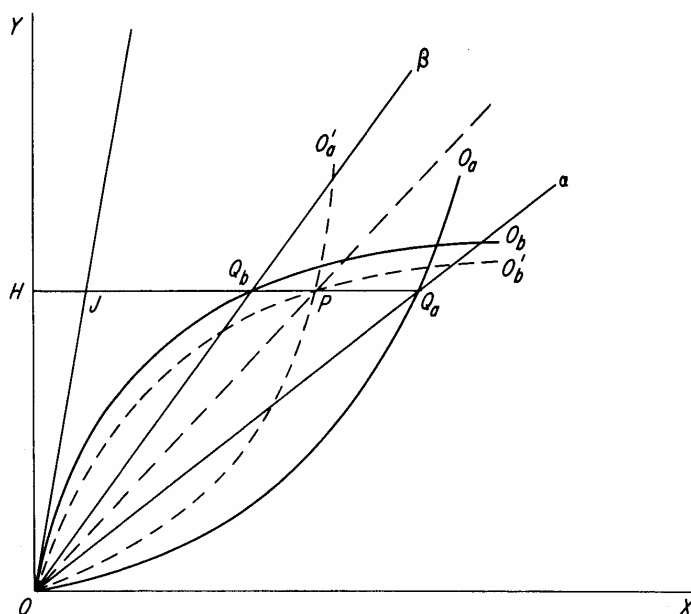


Figure 5-4.

exports of X that are received as imports by B after deducting the costs of transporting X , but before deducting the costs of transporting Y incurred in X . The cost incurred in X of transporting a unit of Y is given by the slope of the line OJ . The c.i.f. offer curve of A is O'_a , which is always a proportion, K_x , of the X value of O_a ; and the c.i.f. offer curve of B is O'_b , which is formed by adding horizontally to O_b the line of OJ . The c.i.f. offer curves intersect at P , giving the c.i.f. terms of trade, OP . (The price of OH of Y in B is HQ_b of X , and PQ_b of X is required to transport OH of Y to A , and so on.) The f.o.b. terms of trade must be calculated by reversing the position of O'_a and O'_b : instead of subtracting the cost of transporting X from A 's offer curve, add it to B 's offer curve (horizontally), and, similarly, subtract the cost of transporting Y from A 's offer curve. The f.o.b. terms of trade are then a line from the origin to the point of intersection of these f.o.b. offer curves and will be larger or smaller than the c.i.f. terms of trade depending on whether a_x is greater or less than $1 - K_x$.

The relation between the price ratios is

$$\left(\frac{P_x}{P_y}\right)^B = \frac{OH}{HQ_b} = \frac{OH}{HP - Q_bP} = \frac{OH}{K_xHQ_a - Q_bP} = \frac{1}{K_x(P_y/P_x)^A - A_x}$$

The above analysis suggests an alternative way of finding an equilibrium, a method analogous to that which Lerner made famous in his analysis of tariff equilibrium [44]. Given the offer curves O_a and O_b in any of the above four diagrams, a pencil, $\alpha O \beta$, can be rotated around O until two points are found on O_a and O_b between which transport costs will just consume the difference between the exports of one country and the imports of the other country. The equilibrium in Figure 5-1 is then the same as for a tariff imposed by A where A 's government spends all the proceeds of the tariff on the home good; Figure 5-2 shows the equilibrium where A 's government divides its expenditure of the tariff proceeds between PQ_a of its own good and PQ_b of imports; Figure 5-3 shows the equilibrium where each country imposes tariffs and spends the proceeds on its home good; and Figure 5-4 represents the case where each country imposes tariffs, and A 's government spends the proceeds on its own good whereas B 's government spends the proceeds on imports.

The F.O.B. and C.I.F. Terms of Trade

There are four measures of the terms of trade. These are: (1) country A 's domestic price ratio, the ratio of the f.o.b. price of X and the c.i.f. price of Y ; (2) country B 's domestic price ratio, the ratio of the f.o.b. price of Y and the c.i.f. price of X ; (3) the f.o.b. terms of trade, the ratio of the f.o.b. prices;

and (4) the c.i.f. terms of trade, the ratio of c.i.f. prices. In empirical studies it is important that these measures of the terms of trade be distinguished.

If domestic price ratios are used in calculating the terms of trade, a reduction in transport costs incurred in either good (because of, say, an innovation) will improve the terms of trade of both countries simultaneously, *provided both offer curves are elastic*. This is clear from an inspection of any of the above four diagrams, because a reduction in transport costs squeezes the price ratios together, and both countries offer more exports in return for more imports as a consequence of the reduced price of imports.

A reduction in transport costs incurred in, say, Y , must improve country A 's terms of trade irrespective of the elasticities; but it will improve or worsen country B 's terms of trade depending on whether country A 's offer curve is elastic or inelastic (regardless of the elasticity of B 's offer curve). This is demonstrated in Figure 5-5, where it is assumed that there are no costs of transporting X . Equilibrium is determined by the intersection of country B 's c.i.f. offer curve, O_b , with O_a ; the amount $P_a P_b$ of Y is used up as transport cost. Country A 's terms of trade are given by a line from the origin

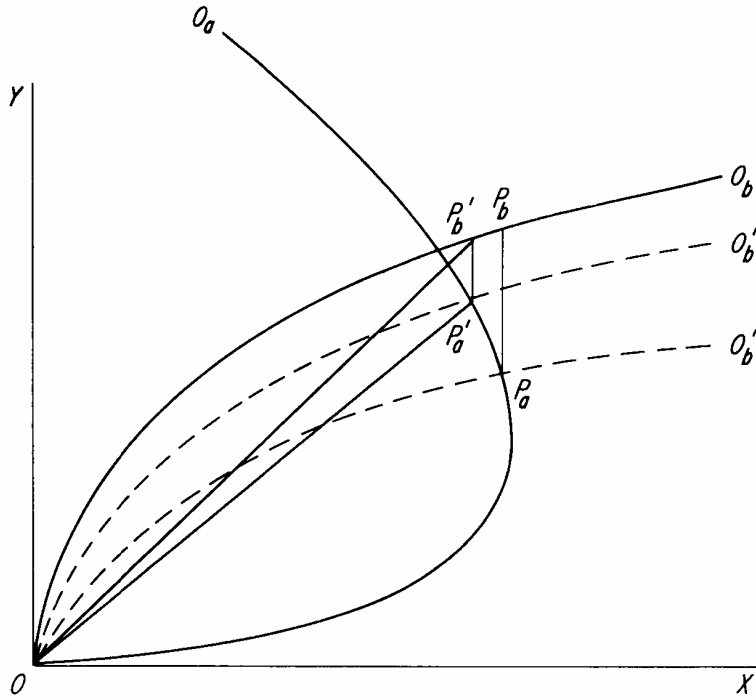


Figure 5-5.

to P_a , and country B 's by a line to P_b . Now suppose the reduction in transport costs alters B 's c.i.f. offer curve to O_b'' . The new points of equilibrium are P'_a and P'_b ; country A 's terms of trade have improved to OP'_a , and country B 's have worsened to OP'_b . This result depends on the inelasticity of O_a but not on the elasticity of O_b .

If one country provides all the transport services, then a reduction in the cost of transporting one good will have the same effect on the domestic price ratio in each country as an equivalent reduction in the cost of transporting the other good. This follows from the assumption that a reduction in demand for a country's resources used for transport has the same effect on the returns to those resources as a reduction in demand for that country's exports.

But which measure of the terms of trade should be used? For a country that does not provide any transport services, the appropriate measure of the terms of trade is her domestic price ratio, that is, the ratio of f.o.b. export prices to c.i.f. import prices. An alternative procedure would be to calculate both import and export prices f.o.b., and to include in the import index the price of the transport services imported (to carry imports). For a country that provides all the transport services the answer is less clear. If all prices are calculated f.o.b., the inclusion of transport services in the export price index only would fail to reflect the cost of transporting imports. For welfare purposes, the best measure is to use import prices c.i.f., and export prices f.o.b., including in the export price index the price of the transport services exported (to carry exports); or, alternatively, calculating both import prices and export prices, c.i.f., and neglecting exports of transport services. In general, however, the appropriate measure depends on the use to which the index is to be put.⁵

The Transfer Problem

In the classical model considered here, the balance of trade must change by an amount equal to the transfer, and expenditure in A and B must change by an amount equal to the change in the balance of trade. The simplest way to develop a criterion for changes in the terms of trade after transfer is to consider the effect on demand of these changes in expenditure, at constant prices. With no impediments to trade, and assuming that B is the transferring country, then B 's terms of trade will improve or worsen, depending on whether there is an increase or a decrease in the demand for B 's export good. There will be an increase or decrease in the demand for B 's export good after

⁵ Haberler ([16], pp. 28–29) discusses this problem but says that the correct procedure in empirical studies is to include the price of transport services in the computation of the terms of trade. It is not clear whether he means that export and import prices should be calculated c.i.f., or whether transport costs should be counted as an export or import. If the latter, should the indexes be calculated with reference to c.i.f. or to f.o.b. prices?

transfer, depending on whether A 's marginal propensity to import is greater or less than B 's marginal propensity to consume her own good, because A 's expenditure increases, and B 's expenditure decreases, by an amount equal to the transfer itself. This is equivalent to saying that B 's terms of trade will improve or worsen depending on whether the sum of the marginal propensities to import is greater or less than unity. This criterion can then be translated into a number of other criteria, the most convenient for our purposes being that used by Samuelson: The terms of trade of the transferring country will improve, remain the same, or worsen as $M_a/C_a \square C_b/M_b$, where M_a, C_a, M_b , and C_b are the marginal propensities to import and consume goods in A and B , respectively.⁶

In the absence of trade impediments, nothing can be said a priori about the direction of change in the terms of trade. With transport costs, two effects must be considered: First, transport costs raise the c.i.f. price of imports and thus change the demand for the good of the country whose resources are used up as transport services. With reference to the first factor, it is theoretically possible that the higher relative price of imports in each country *increases* the marginal physical propensity to import, although this is an unlikely result, since it implies a marginal propensity to import appreciably greater than the average propensity to import.⁷ The most that can be said about the first factor, in the absence of additional knowledge of demand conditions, is that if the marginal propensity to import is equal to the average propensity (that is, if the indifference map is "homothetic"), then the marginal propensity to import will be smaller with, than without, transport costs.

The direction of bias given to the criterion by the second factor depends on which good is used as the transport good. If the good of the exporting country is used, then A 's (the receiving country's) increase in demand for B 's good, because of the transfer, will cause an additional increase in demand for B 's good to carry it; and B 's decrease in demand for A 's good will involve an additional decrease in demand for A 's good used as transport costs. Thus the assumption that each country provides the transport services for its own exports creates a presumption that the transfer will improve the terms of trade of the transferring country, contrary to the orthodox direction. On the other hand, if each country provides the transport services for its own imports, there is a presumption that the terms of trade will change in the orthodox direction. The increase in demand in A for B 's good involves an increase in demand for A 's good used as transport costs, and the decrease in demand in B for A 's good involves a decrease in demand for B 's good used to carry A 's good; this tends to worsen the terms of trade of the transferring country. But

⁶ For recent discussions of the transfer problem, see Meade ([58], chap. 7), Samuelson [90], and Johnson [31].

⁷ For a discussion of this problem, see Samuelson ([90], part I, pp. 295–299).

when some of both goods are used as transport costs, nothing can be said as to any presumption unless further empirical information is available regarding the proportions in which the transport requirements are combined.

Figure 5-6 illustrates the transfer problem when transport costs are incurred in the good of the exporting country.⁸ The points Q_a and Q_b are the initial trading positions of A and B on their respective offer curves. The lines α and β are the pretransfer price ratios in A and B , and ϵ represents the f.o.b. terms of trade. Now suppose that country B makes a transfer to country A equal in value to ON of B 's good, c.i.f. The costs of delivering ON of Y to A are NM , so B must transfer OM . After the transfer is made, the new offer

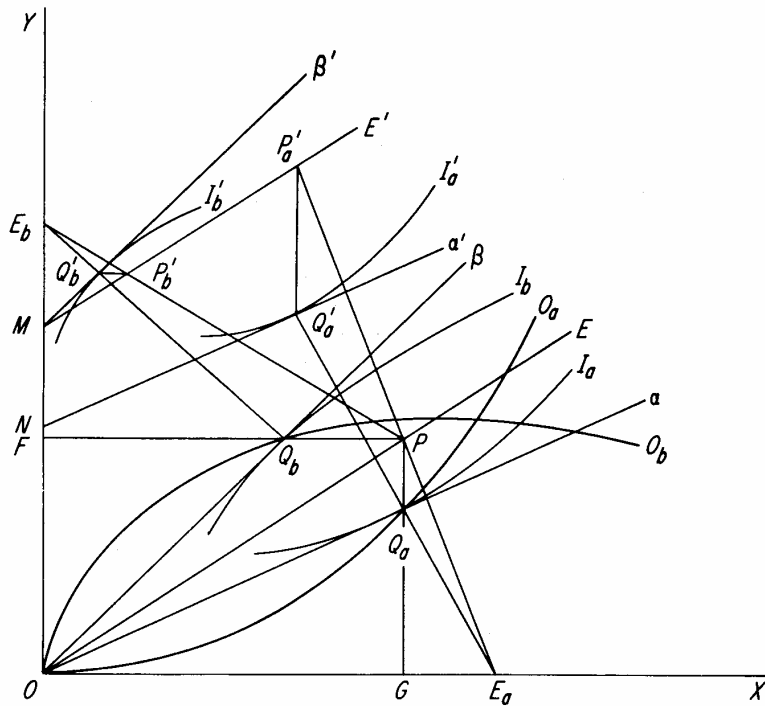


Figure 5-6.

⁸ Professor Samuelson writes ([90], part II, p. 282): "Our graphical analysis . . . fails to handle the real transport case, because then the final consumption points for the two countries do not coincide, instead differing by a vector representing the amount of goods actually used up in transport." This section shows that the problem is nevertheless amenable to purely graphical analysis; the methods employed here were suggested by Professor Johnson.

curves of A and B begin at their new endowment positions, N and M , respectively.

As in the no-impediment case, we consider the changes in demand at constant prices. Draw a' from A 's new endowment position N , parallel to a . Consumers in A , at constant prices after transfer, would move up a' to the point where the latter is tangent to an A indifference curve, that is, to Q'_a . Consumers in B at constant prices would move up β' to the point where β' is tangent to a B indifference curve, that is, to Q'_b . Now draw $Q_a Q'_a$ and extend it to the X axis at E_b , and draw $Q_b Q'_b$, and extend it to the Y axis at E_b ; the slopes of the lines $Q_a Q'_a$ and $Q_b Q'_b$, are the ratios of the *marginal physical propensities* in each country.⁹ But these slopes do not take into account the changes in the quantities of X and Y required for transport costs. What is relevant for the criterion with real impediments are the *marginal propensities to spend* on imports, which include the amount spent on transport costs. Now at E_a , where no Y is imported, the transport costs of Y imports are of course zero; at Q_a , transport costs are PQ_a ; and at Q'_a transport costs are equal to $Q'_a P'_a$. The new line traced out by these points, PP'_a , is the transport-modified expenditure line and its slope is the ratio of A 's marginal propensity to spend on imports and her marginal propensity to spend on domestic goods. Similarly, PP'_b is B 's transport-modified expenditure line and its slope is the ratio of B 's marginal propensity to spend on domestic goods and her marginal propensity to spend on imports.

Now draw ϵ' parallel to ϵ from M ; clearly, the points P'_b and P'_a must lie along this line, since the horizontal distance between β' and ϵ' measures the cost of transporting X , and the vertical distance between α' and ϵ' measures the costs of transporting Y . Then, if the pretransfer price ratios are to remain unchanged, the horizontal distance between Q'_a and Q'_b must be exactly equal to the amount of X used up as transport cost, and the vertical distance must exactly equal the amount of Y used up as transport cost; otherwise, Q'_a and Q'_b are not equilibrium positions and the terms of trade would have to change. For the terms of trade to remain unchanged, then P'_a must coincide with P'_b and the lines PP'_a and PP'_b must be the same.

The geometric criterion is thus established. The terms of trade of B , the transferring country, will improve, stay the same, or worsen depending on whether the slope of PP'_a \square the slope of PP'_b . That this is the geometric form of Samuelson's criterion can be shown as follows: The slope of

$$PP'_a = \frac{PG}{GE_a} = \frac{GQ_a}{GE_a} \frac{1}{K_y}$$

but GQ_a/GE_a is the slope of $Q'_a Q'_a$, that is, the ratio of A 's marginal physical

⁹ These lines relate to behavior between points; the "Engel's curves" are not necessarily straight lines.

propensity to import and her marginal physical propensity to consume, so the slope

$$PP'_a = \frac{1}{K_y} \frac{m_a}{c_a}.$$

Similarly, the slope of

$$PP'_b = K_x \frac{c_b}{m_b},$$

so the criterion becomes whether

$$\frac{1}{K_y} \frac{m_a}{c_a} \diamond K_x \frac{c_b}{m_b}$$

or

$$m_a m_b \diamond K_x K_y c_a c_b$$

which is Samuelson's criterion. Now

$$\left(\frac{P_y}{P_x}\right)^B \bigg/ \left(\frac{P_y}{P_x}\right)^A = K_x K_y$$

so the criterion is equivalent to whether

$$\frac{m_a}{c_b} \left(\frac{P_y}{P_x}\right)^A \diamond \frac{c_b}{m_b} \left(\frac{P_y}{P_x}\right)^B$$

or

$$\frac{M_a}{C_a} \diamond \frac{C_b}{M_b}$$

in terms of the marginal propensities to spend.

In Figure 5–6 the terms of trade of the transferring country improve, because the slope of $PP'_a (M_a/C_a)$ is greater than the slope of $PP'_b (C_b/M_b)$, causing an excess demand for B 's good. It is easily seen from the diagram (or from the above formulas) that transport costs incurred in the export good increase the likelihood that the transferring country's terms of trade improve, since PP'_a is steeper than $Q_a Q'_a$ and PP'_b is flatter than $Q_b Q'_b$. Against this must be set the effect of the higher price of imports in changing the marginal propensities to import.

Transport costs incurred in the good of the importing country result in an increased demand for the receiving country's good used as transport costs due to her increased imports, and a decreased demand for the transferring country's good used as transport costs because of her reduced imports; in this case the terms of trade will be more likely to turn in the orthodox direction. When transport costs are incurred in both goods, the presumption as

to the direction of change in the terms of trade depends on the proportions in which these are combined. This case is represented in Figure 5-7, but for simplicity we have assumed that there are no costs of transporting Y . The initial equilibrium is the same as in Figure 5-3, with A and B initially in equilibrium at Q_a and Q_b ; in the initial equilibrium, RQ_a of X and RQ_b of Y are used up in landing FQ_b of X in B . Country A 's domestic price ratio, α , is also the f.o.b. terms of trade, and country B 's domestic price ratio, β , is also the c.i.f. terms of trade, since there are no costs of transporting Y .

Country B makes a transfer of OM of Y , all of which reaches A , as there are no costs of transporting Y . At unchanged prices, A moves up its price line α' to Q'_a and B moves up its price line β' to Q'_b , the points where the price lines are tangent to indifference curves. Draw $Q_aQ'_a$ and extend it to E_a on the X axis; this line is the ratio of the marginal physical propensities to import and consume, and since there are no transport costs to be paid on A 's imports, it is also the ratio of the marginal propensities to spend on imports and consumption.

Draw $Q_bQ'_b$ and extend it to the Y axis at E_b ; this is the ratio of the marginal physical propensities to consume and to import in B . Because transport

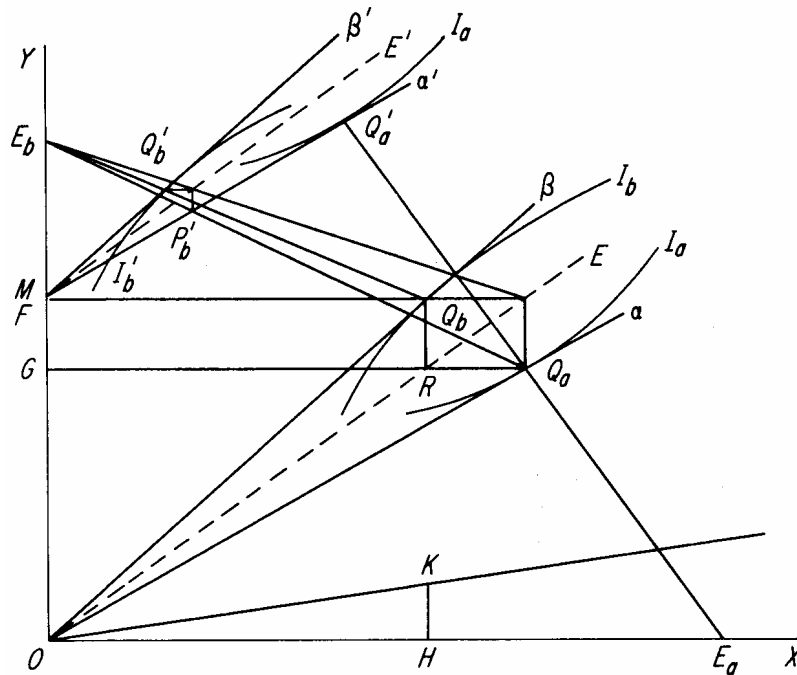


Figure 5-7.

costs must be paid on B 's imports, this line is not the same as the ratio of the marginal propensities to spend; to find the latter, connect $Q_aP'_b$ with E_b .

The geometric criterion for changes in the terms of trade is whether the slope of $Q_aQ'_a$ is greater or less than the slope of $Q_aP'_b$. The slope of $Q_aQ'_a$ is M_a/C_a , because there are no costs of transporting Y , and the slope of $Q_aP'_b$ is

$$\frac{E_bG}{GQ_a} = \frac{E_bG}{GR} K_x = K_x \left(\frac{E_bF}{GR} + \frac{FG}{GR} \right).$$

But

$$\frac{E_bF}{GR}$$

is the slope of $Q_bQ'_b$, or C_bM_b , and

$$\frac{FG}{GR} = \left(\frac{KH}{OH} \right)$$

is the amount of Y required to transport a unit of X , that is, a_x ; so the slope of $Q_aP'_b$ is equal to

$$K_x \left(\frac{C_b}{M_b} + a_x \right).$$

Our criterion then becomes whether

$$\frac{M_a}{C_a} \diamond K_x \left(\frac{C_b}{M_b} + a_x \right).$$

K_x reduces, and a_x raises, the right-hand argument, so with transport costs incurred in both goods it is impossible to determine a priori the bias given to the criterion. In Figure 5–7, since $Q_aP'_b$ is steeper than $Q_bQ'_b$, the effect is to decrease the likelihood that the terms of trade will turn in favor of the transferring country.

When there are costs of transporting both X and Y , the terms of trade of the paying country, B , will improve, stay the same, or deteriorate, as

$$\frac{1}{K_x K_y} \diamond \left(\frac{C_b}{M_b} + a_x \right) \left(\frac{C_a}{M_a} + a_y \right).$$

which includes Samuelson's criterion as a special case when a_x and a_y are zero. In practical terms the criterion implies that the greater the share the transferring country has in providing transport services for its own exports, and the smaller the share it has in transporting its own imports, the more likely it is that the terms of trade will move in favor of the transferring

country. If its own ships carry a large proportion of its exports, but only a small proportion of its imports, then, since the transfer is effected by an increase in its exports and a decrease in its imports, demand for the factors of production in the transferring country will increase, and their prices will rise, unless this effect is offset by an income consumption bias in each country for domestic goods. It should be noted that a monopoly of transport services by either of the countries does not in itself provide any presumption as to the direction of the change in the terms of trade, but if it were known that transport costs represented a higher proportion of the value of one good than the other, then such a presumption could be said to exist. For example, if Britain's merchant fleet carried most of her exports and imports, and Britain made a transfer to the United States (the end of Marshall Plan aid), then the British terms of trade would be more, or less, likely to turn in her favor, depending on whether her exports were "heavy" or "light" relative to her imports. Or, if Canada's exports were "heavier" than her imports, a capital movement from the United States to Canada would be more likely to cause an improvement in Canada's terms of trade the smaller the share of Canada and the larger the share of the United States in providing transport services.

In summary, transport costs result in higher import prices and thus affect the marginal physical propensities to import, but unless one accepts the "symmetrical ignorance" argument, it cannot be demonstrated a priori that they will be lower. Even if this argument is accepted, whether or not a "presumption" exists depends on which country provides the transport services, and on how important transport costs are in one good relative to their importance in the other.

The Optimum Tariff

If a country is following an optimum tariff policy, then a reduction in costs of transport is likely to necessitate a change in the optimum tariff rate. To examine the implications of a change in transport costs, we shall compare the optimum tariff without transport costs with the optimum tariff with transport costs. To keep the analysis simple we shall assume that transport costs are incurred in the good of the exporting country only, and that there are no costs of transporting X . We also assume that there is no retaliation, and that tariff proceeds are redistributed to consumers.

The optimum tariff is the tariff that will make the domestic marginal rate of substitution of X for Y equal to the marginal rate of transformation of X into Y through foreign trade. Geometrically, this means that country A 's optimum tariff is that which will force country B to trade at the point where an A -indifference curve is tangent to B 's offer curve. In Figure 5-8 this point is P , where I_a , an A -indifference curve, is tangent to O_b , country B 's offer curve.

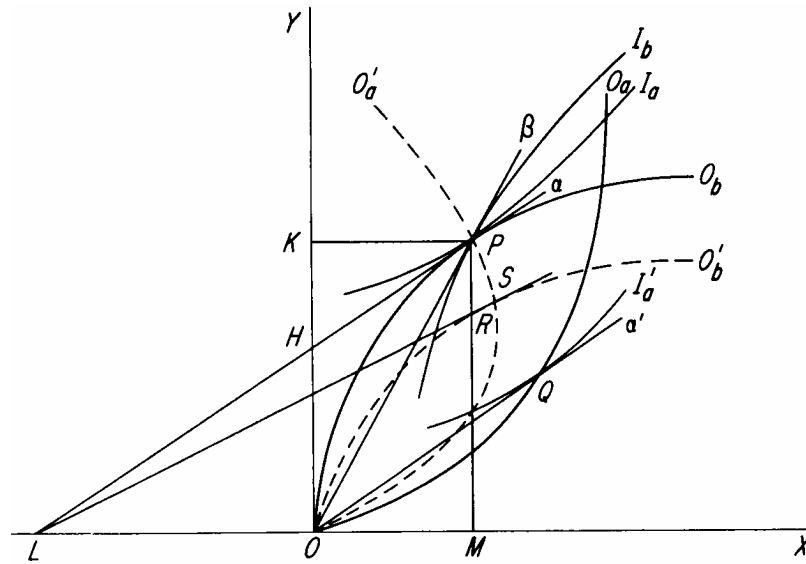


Figure 5-8.

The tariff that will make P a trading equilibrium is determined by extending the tangent at P to L on the X axis. The optimum tariff, then, is

$$\frac{LO}{OM} = \frac{1}{LM / LO - 1}.$$

But

$$\frac{LM}{LO} = \frac{OK}{OH}$$

the elasticity of B 's offer curve, so the optimum tariff formula¹⁰ is

$$t = \frac{1}{\epsilon_b - 1}.$$

The price ratio in B (also the terms of trade) is β , and the price ratio in A is α . Before tariff proceeds have been redistributed, A -consumers consume at Q , on O_a ; and after tariff proceeds (OL in terms of X) have been redistributed, they consume at P . The curve O'_a is A 's tariff-modified offer curve, which will pass through P when the tariff is optimal.

To find the optimum tariff when there are costs of transporting Y , we first draw country B 's c.i.f. offer curve, O'_b , in Figure 5-8. This is now country A 's marginal rate of transformation of X into Y through foreign trade, so the

¹⁰ See, for example, Meade ([55], p. 76).

optimum tariff with costs of transporting Y is determined at the point where an A -indifference curve is tangent to O'_b ; in the optimum tariff formula we substitute the elasticity of O'_b , which we shall designate as ε'_b . Whether the optimum tariff without transport costs is larger or smaller than the optimum tariff with transport costs depends on whether the elasticity of O_b is smaller or larger than the elasticity of O'_b , at the points where each curve is tangent to an A -indifference curve.

To determine how ε_b and ε'_b are related, consider the point R on O'_b directly below P on O_b . Since the Y -value of O'_b , that is, RM , is always a constant proportion (K_x) of the Y value of O_b , that is, PM , then a proportional movement along O'_b must equal the same proportional movement along O_b . Therefore, the tangent at R , when extended, must meet the tangent at P , when extended, on the X axis at L ; then, since LM/LO measures the elasticity of O_b at P , it must also measure the elasticity of O'_b at R . The two elasticities at P and R are equal, and this holds for similar points along O_b and O'_b .

If an A -indifference curve is tangent to O'_b at R , the optimum tariff with and without transport costs is the same, and a reduction in the costs of transporting Y does not change the optimum tariff. In this case, country A 's tariff-modified offer curve, O'_a , passes through both P and R , and its elasticity between these points is unity. Thus the optimum tariff will be the same with and without transport costs if the elasticity of A 's tariff-modified offer curve is unity. But when O'_a is not unit elastic, an A -indifference curve is tangent to O'_b to the right or to the left of the point R , and to compare the level of optimum tariffs in the two cases we must know something about the direction in which the elasticity of O'_b (or O_b) is changing as the point of equilibrium moves farther from the origin. If O_b were an offer curve of constant elasticity over the relevant range, then the level of optimum tariff would be the same in the two cases regardless of the elasticity of O'_a .

In Figure 5–8, O'_a is inelastic, so A 's optimum tariff will be higher or lower with, than without, transport costs depending on whether the elasticity of O_b or O'_b decreases or increases as the volume of trade increases. On the other hand, if O'_a were elastic, the converse would be true. Thus, to compare the two cases it is necessary to know the elasticity of the tariff-modified offer curve, and the direction in which the elasticity of the other country's offer curve is changing as the volume of trade increases. Under the assumption that tariff proceeds are redistributed, it is impossible to determine, a priori, the relation between A 's tariff-modified offer curve and her free-trade offer curve; it is perfectly consistent with convex indifference curves and the absence of inferior goods for one curve to be elastic while the other is inelastic. It is also impossible to determine, in the absence of further knowledge of tastes, in which direction elasticities change as the volume of trade increases. Perhaps a "presumption" could be established (but it is a very weak presumption) in the following way. The elasticities of the offer curves at the origin are in-

finite but become less elastic as the volume of trade increases; thus it is likely that demand for imports becomes less responsive to price changes as the quantity of goods imported increases. If this presumption were valid, then a reduction in transport costs would suggest that a downward or an upward adjustment in tariffs is required, depending on whether *A*'s tariff-modified offer curve is inelastic or elastic.

No general conclusion is possible, even in this simple case, without empirical knowledge of the elasticities, so we shall not pursue the matter further.

Real Factor Returns

Under the Heckscher-Ohlin assumptions, where each country exports its abundant-factor-intensive commodity, a reduction in transport costs will affect the functional distribution of the national income. The direction in which factor returns change depends on the direction in which the domestic price ratio changes; the absolute return of the abundant factor will rise or fall, and the absolute return of the scarce factor will fall or rise, depending on whether the domestic price of exportables relative to the domestic price of importables rises or falls. This follows directly from the analogy to tariff theory.¹¹

If both offer curves are elastic, a reduction in transport costs incurred in either good will improve the terms of trade (calculated with f.o.b. export prices and c.i.f. import prices) of both countries and thus increase the absolute return of the abundant factor and decrease the absolute return of the scarce factor. If country *B*'s offer curve is inelastic, while country *A*'s is elastic, then a reduction in transport costs *incurred in B's good* will improve the terms of trade and thus the real income of the abundant factor in both countries; but a reduction in transport costs *incurred in A's good* will improve *B*'s and worsen *A*'s terms of trade, thus raising the real income of *B*'s and lowering that of *A*'s abundant factor. The converse is true if *A*'s offer curve is inelastic while *B*'s is elastic. If both offer curves are inelastic, a reduction in transport costs incurred in one good will worsen the terms of trade of that country and improve the terms of trade of the other country, and thus change absolute factor returns.

¹¹ Stolper and Samuelson [99] showed that, under the Heckscher-Ohlin assumptions, with constant terms of trade, tariffs increase the scarcity, and thus the real income, of the scarce factor. Metzler [63] qualified the argument taking into account changes in the terms of trade, making use of a criterion derived by Lerner [44]. Lerner's criterion showed that a tariff would increase the price of importables relative to exportables in the tariff-imposing country if the foreign elasticity of demand plus the domestic marginal propensity to import were greater than unity. In the case of transport costs, the criterion does not involve the marginal propensity to import, as the transport costs are used up rather than (as in the case of tariff proceeds) redistributed to consumers.

Concluding Remarks

It remains to consider briefly our assumptions regarding the nature of transport costs. The transport industry is an intermediate-goods industry, and when trade takes place, and transport costs are involved, resources have to be released from the final-goods industries to produce an intermediate good—transport costs. Our assumption that some final goods must be used up in transport is a means of avoiding a three-dimensional diagram in which the production possibilities of a country are depicted by a three-good transformation locus. The assumption that K_x and a_x are constant implies that final goods can be converted into the transport good at constant opportunity costs, but this assumption is easily modified by making K_x and a_x depend on the volume of trade. For example, if K_x decreases as the volume of X exported increases, and a_x increases as the volume of Y imported increases, increasing opportunity costs are implied. With increasing opportunity costs, however, the relative share of each country in providing transport services will depend on the terms of trade, and different points of equilibrium on the offer curves will imply different values of K_x , K_y , a_x , and a_y , as the terms of trade change.

Transport costs depend on the distance between countries. The greater the distance, the smaller are K_x and K_y , the larger are a_x and a_y , and the more closely are the c.i.f. offer curves squeezed together; if the distance is sufficiently large, opportunities for gains from trade are eliminated, and trade ends.

Chapter 6 / *International Trade and Factor Mobility*^{1,2}

Commodity movements and factor movements are substitutes. The absence of trade impediments implies *commodity*-price equalization and, even when factors are immobile, a tendency toward *factor*-price equalization. It is equally true that perfect factor mobility results in factor-price equalization and, even when commodity movements cannot take place, in a tendency toward *commodity*-price equalization.

There are two extreme cases between which are to be found the conditions in the real world: There may be perfect factor mobility but no trade, or factor immobility with unrestricted trade. The classical economists generally chose the special case where factors of production were internationally immobile.

This paper will describe some of the effects of relaxing the latter assumption, allowing not only commodity movements but also some degree of factor mobility. Specifically it will show that an increase in trade impediments stimulates factor movements and that an increase in restrictions to factor movements stimulates trade.³ It will also make more specific an old argument for protection.

Trade Impediments and Factor Movements

Under certain rigorous assumptions the substitution of commodity for factor movements will be complete. In a two-country two-commodity two-factor model, commodity-price equalization is sufficient to ensure factor-price equalization and factor-price equalization is sufficient to ensure commodity-price equalization if (1) production functions are homogeneous of the first

¹ Adapted from: *Amer. Econ. Rev.*, **47**, 321-335 (June 1957).

² This paper was originally presented to Professor Meade's seminar at L.S.E. in 1956. I am indebted for helpful comments to W. M. Corden, M. Friedman, A. Harberger, H. G. Johnson, R. Lipsey, J. E. Meade, S. A. Ozga, and T. Rybczynski.

³ This proposition is implied in (Ohlin [81], chap. 9), Iversen ([28], chap. 2), and Meade ([55], chaps. 21 and 22).

degree (that is, if marginal productivities, relatively and absolutely, depend only on the proportions in which factors are combined) and are identical in both countries; (2) one commodity requires a greater proportion of one factor than the other commodity at any factor prices at all points on any production function; and (3) factor endowments are such as to exclude specialization.⁴

These assumptions permit us to isolate some important influences determining the pattern of international trade and factor flows and for present purposes will be adhered to. Our first task is to show that an increase in trade impediments encourages factor movements.

Assume two countries, *A* and *B*, producing two final commodities, cotton and steel, by means of two factors, labor and capital.⁵ Country *A* is well endowed with labor but poorly endowed with capital relative to country *B*; cotton is labor-intensive relative to steel. For expositional convenience we shall use community indifference curves.

For the moment we shall assume that country *B* represents the “rest of the world” and that country *A* is so small in relation to *B* that its production conditions and factor endowments can have no effect on prices in *B*.⁶

Let us begin with a situation where factors are immobile between *A* and *B* but where impediments to trade are absent. This results in commodity- and factor-price equalization. Country *A* exports its labor-intensive product, cotton, in exchange for steel. Equilibrium is represented in Figure 6–1: *TT* is *A*'s transformation function (production-possibility curve), production is at *P*, and consumption is at *S*. Country *A* is exporting *PR* of cotton and importing *RS* of steel. Her income in terms of steel or cotton is *OY*.

Suppose now that some exogenous factor removes all impediments to the movement of capital. Clearly, since the marginal product of capital is the same in both *A* and *B*, no capital movement will take place and equilibrium will remain where it is. But now assume that *A* imposes a tariff on steel and for simplicity make it prohibitive.⁷ Initially the price of steel will rise relative to the price of cotton in *A* and both production and consumption will move to *Q*, the autarky (economic self-sufficiency) point. Factors will move out of the cotton into the steel industry, but since cotton is labor-intensive and steel is capital-intensive, at constant factor prices the production shift creates an excess supply of labor and an excess demand for capital. Consequently the

⁴ For the necessity of these assumptions and a fairly complete list of references to the literature on factor-price equalization see Samuelson [92].

⁵ It is assumed that capitalists in their role as consuming units do not move with their capital.

⁶ It will become evident later that the terms of trade and factor prices do not change even when this assumption is dropped.

⁷ Actually, under the assumed conditions any tariff is prohibitive, as will eventually become clear.

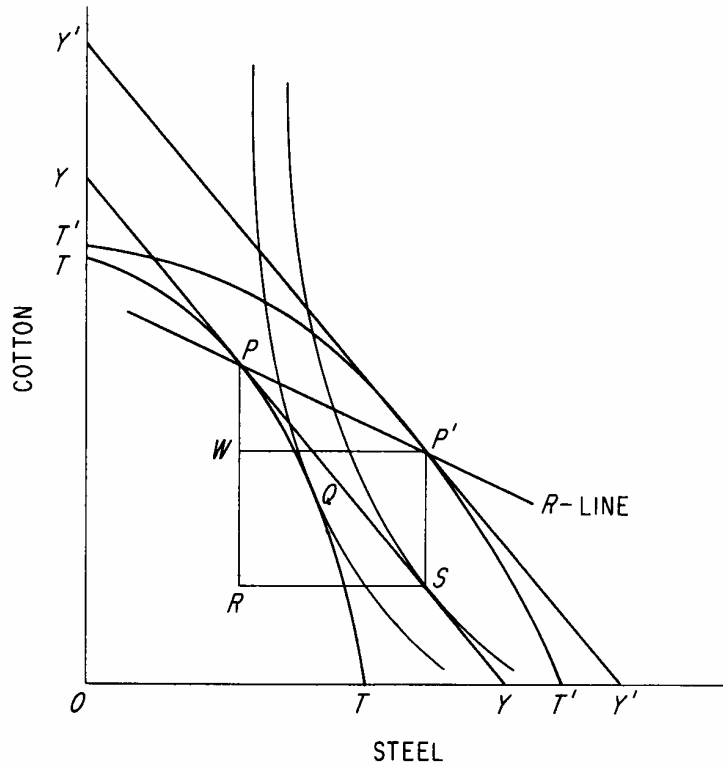


Figure 6-1.

marginal product of labor must fall and the marginal product of capital must rise. This is the familiar *Stolper-Samuelson tariff argument*.⁸

But since capital is mobile, its higher marginal product in *A* induces a capital movement into *A* from *B*, changing factor endowments so as to make *A* more capital-abundant. With more capital, *A*'s transformation curve expands until a new equilibrium is reached.

Some help in determining where this new equilibrium will be is provided by Figure 6-2. Country *A* initially has *OC* of capital and *OL* of labor; *OO'* is the efficiency locus along which marginal products of labor and capital are equalized in steel and cotton. Equilibrium is initially at *P*, which corresponds to *P* on the production block in Figure 6-1. Factor proportions in steel and cotton are given by the slopes of *OP* and *O'P*, respectively.

After the tariff is imposed, production moves along the efficiency locus to *Q*, corresponding to the autarky point *Q* in Figure 6-1. The slopes of *OQ*

⁸ Cf. Stolper and Samuelson [99].

to the marginal product of the capital inflow. In Figure 6–1, then, production equilibrium must be at some point above or to the northeast of S .

To find the exact point we must show the effects of a change in capital endowments on production block. Because steel is capital-intensive we should expect the production block after the capital movement has taken place to be biased in favor of steel at any given price ratio; that this is so has been recently proved by Rybczynski [87].⁹

Because the same price ratio as at P will prevail, the locus of all tangents to larger and larger production blocks based on larger and larger endowments of capital must have a negative slope. Such a line, which I shall call the R line, is drawn in Figure 6–1.

Capital will flow in until its marginal product is equalized in A and B , which will be at the point where A can produce enough steel and cotton for consumption equilibrium at S without trade, and at the same time make the required interest payment abroad. This point is clearly reached at P' directly above S . At any point along the R line to the northwest of P' , country A would have to import steel in order to consume at S (that is, demand conditions in A cannot be satisfied to the northwest of P'). At P' demand conditions in A are satisfied and the interest payment can be made abroad at the same price ratio as before the tariff was levied. Thus the capital movement need not continue past this point, although any point to the southeast of P' would be consistent with equilibrium.

Production takes place in A and P' , consumption is at S , and the transfer of interest payments is the excess of production over consumption in A , SP' of cotton.¹⁰ The value of A 's production has increased from OY to OY' in terms of steel, but YY' (which equals in value SP' of cotton) must be transferred abroad, so income is unchanged.

We initially assumed a prohibitive tariff; in fact, even the smallest tariff is prohibitive in this model! A small tariff would not prohibit trade immediately: Because of the price change some capital would move in and some trade would take place. But as long as trade continues, there must be a difference in prices in A and B equal to the ad valorem rate of tariff—hence a difference in marginal products—so capital imports must continue. Marginal products and prices can only be equalized in A and B when A 's imports cease.

The tariff is now no longer necessary! Because marginal products and prices

⁹ The proof is easily demonstrated in Figure 6–2. At unchanged prices equilibrium must lie along OP -extended. With the larger endowment of capital, $O'P'$ must be shorter than OP . Since these lines have the same slope and constant returns to scale apply, output of cotton at P' must be less than at P . A paper by R. Jones written at the Massachusetts Institute of Technology in the spring of 1955 contained a similar proof.

¹⁰ SP' must equal in value the marginal product of the capital inflow at constant prices. In Figure 4–1, PP' is the change in output associated with the increase in capital; steel output increases by RS but cotton output decreases by PW . The marginal product of the capital inflow is the value of RS minus the value of PW , which, in terms of cotton, is $P'S$.

are again equalized, the tariff can be removed without reversing the capital movement. The tariff has eliminated trade, but after the capital movement there is no longer any need for trade.

This is not really such a surprising result when we refer back to the assumptions. Before the tariff was imposed we assumed both unimpeded trade and perfect capital mobility. We have then two assumptions each of which is sufficient for the equalization of commodity and factor prices. The effect of the tariff is simply to eliminate one of these assumptions—unimpeded trade; the other is still operative.

However, one qualification must be made. If impediments to trade exist in both countries (tariffs in both countries or transport costs on both goods) and it is assumed that capital owners do not move with their capital, the interest payments on foreign-owned capital will be subject to these impediments; this will prevent complete equalization of factor and commodity prices. (This question could have been avoided had we allowed the capitalist to consume his returns in the country where his capital was invested.) The proposition that capital mobility is a perfect substitute for trade still stands however, if one is willing to accept the qualification as an imperfection to capital mobility.

Effect of Relative Size

The previous section assumed that country *A* was very small in relation to country *B*. It turns out, however, that the relative sizes of the two countries make no difference in the model provided complete specialization does not result.

Suppose as before that country *A* is exporting cotton in exchange for steel. There are no impediments to trade and capital is mobile. But we no longer assume that *A* is small relative to *B*. Now *A* imposes a tariff on steel raising the internal price of steel in relation to cotton, shifting resources out of cotton into steel, raising the marginal product of capital, and lowering the marginal product of labor. *A*'s demand for imports and her supply of exports fall. This decline in demand for *B*'s steel exports and supply of *B*'s cotton imports raises the price of cotton relative to steel in *B*; labor and capital in *B* shift out of steel into cotton raising the marginal product of labor and lowering the marginal product of capital in *B*. Relative factor returns in *A* and *B* move in opposite directions, so the price changes in *A* which stimulate a capital movement are reinforced by the price changes in *B*. The marginal product of capital rises in *A* falls in *B*; capital moves from *B* to *A*, contracting *B*'s and expanding *A*'s production block.

The assumption that capital is perfectly mobile means that factor and commodity prices must be equalized after the tariff. It is necessary now to

show that they also will be unchanged. The price of cotton relative to steel is determined by world demand and supply curves. To prove that prices remain unchanged it is sufficient to show that these demand and supply curves are unchanged—or that at the pretariff price ratio demand equals supply after the capital movement has taken place. But we know that at the old price ratio marginal products, hence incomes, are unchanged—thus demand is unchanged. All that remains then is to show that at constant prices production changes in one country cancel out production changes in the other country.

This proposition can be proved in the following way: If commodity and factor prices are to be unchanged after the capital movement has taken place, then factor proportions in each industry must be the same as before; then the increment to the capital stock used in *A* will, at constant prices, increase the output of steel and decrease the output of cotton in *A*, and the decrement to the capital stock in *B* will decrease the output of steel and increase the output of cotton in *B*. But the increase in *A*'s capital is equal to the decrease in *B*'s capital, and since production expands at constant prices and with the same factor proportions in each country, the increase in resources used in producing steel in *A* must be exactly equal to the decrease in resources devoted to the production of steel in *B*. Similarly, the decrease in resources used in producing cotton in *A* is the same as the increase in resources devoted to cotton production in *B*. Then, since production functions are linear and homogeneous, the equal changes in resources applied to each industry (in opposite directions) imply equal changes in output. Therefore, the increase in steel output in *A* is equal to the decrease in steel output in *B*, and the decrease in cotton output in *A* is equal to the increase in cotton output in *B* (that is, world production is not changed, at constant prices, by a movement of capital from one country to another). In the world we are considering it makes no difference in which country a commodity is produced if commodity prices are equalized.

This proposition can perhaps be made clearer by a geometric proof. In Figure 6–3a, T_aT_a is *A*'s transformation curve before the tariff, and $T'_aT'_a$ is the transformation curve after the tariff has been imposed and the capital movement has taken place. At constant prices equilibrium moves along *A*'s *R* line from P_a to P'_a , increasing the output of steel by RP'_a and decreasing the output of cotton by RP_a . Similarly, in Figure 6–3b, T_bT_b is country *B*'s transformation curve before the capital movement and T_bT_b is the transformation curve after capital has left *B*. At constant prices production in *B* moves along *B*'s *R* line to P'_b , steel production decreasing by SP_b and cotton production increasing by SP'_b .

To demonstrate the proposition that world supply curves are unchanged, it is necessary to prove that RP'_a equals SP_b and that RP_a equals SP'_b . The proof is given in Figure 6–4. OL_a and OC_a are, respectively, *A*'s initial endowments of labor and capital; OL_b and OC_b are the endowments of *B*. OO_a and OO_b

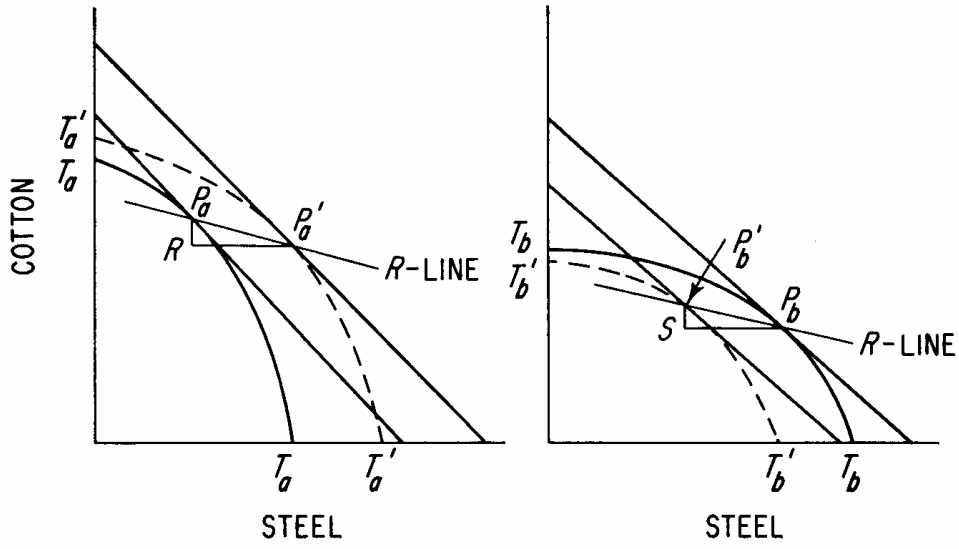


Figure 6-3a. Country A.

Figure 6-3b. Country B.

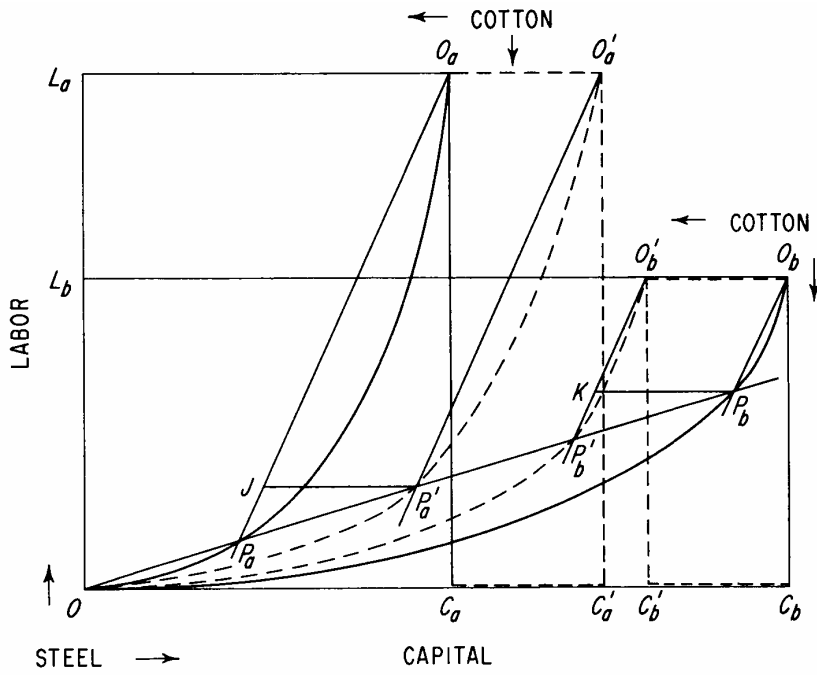


Figure 6-4.

are the efficiency loci of A and B with production taking place along these loci at P_a and P_b , corresponding to the same letters in Figures 6–3a and 6–3b.

Now when A imposes a tariff on steel, suppose that $C_b C'_b$ of capital leaves B , shifting B 's cotton origin from O_b to O'_b . At constant prices labor-capital ratios in each industry must be the same as before, so equilibrium must move to P'_b , corresponding to P'_b , in Figure 3–3b. Because the capital outflow from B must equal the capital inflow to A , A 's cotton origin must move to the right by just the same amount as B 's cotton origin moves to the left (that is, from O_a to O'_a ; and A 's production equilibrium at constant prices must move from P_a to P'_a). The proof that world supply is unchanged at constant prices is now obvious, since $JP_a P'_a$ and KP'_b, P_b , are identical triangles. $P_a P'_a$, representing the increase in steel output in A , equals $P_a P'_a$, the decrease in steel output in B , and the decrease in cotton output in A , JP_a , equals the increase in cotton output in B , KP'_b .¹¹

This relationship holds at all combinations of commodity and factor prices provided some of each good is produced in both countries. It means that world supply functions are independent of the distribution of factor endowments. More simply it means that it makes no difference to world supply where goods are produced if commodity and factor prices are equalized. Because world supply and demand functions are not changed by the capital movements, so that the new equilibrium must be established at the same prices as before, our earlier assumption that A is very small in relation to B is an unnecessary one.¹²

The general conclusion of this and the preceding is that tariffs will stimulate factor movements. Which factor moves depends, of course, on which factor is more mobile. The assumption used here, that capital is perfectly mobile and that labor is completely immobile, is an extreme one which would have to be relaxed before the argument could be made useful. But a great deal can be

¹¹ The R lines in Figures 6–3a and 6–3b must be parallel when output expands at the same price ratio in each country, and they must be straight since production changes are compensating.

¹² One qualification to the argument must be noted which is not necessary when the other country is very large. A condition for the marginal product of capital in A to rise as a result of the tariff is that the price of steel rise relative to the price of cotton. It is possible, if the foreign offer curve is very inelastic, that the improvement in A 's terms of trade in raising the relative price of exports (cotton) will more than offset the effect of the tariff in raising the relative price of imports (steel). The condition that the “normal” case is satisfied requires that the sum of the foreign elasticity of demand and the domestic marginal propensity to import be greater than 1 (the marginal propensity to import is relevant because the improvement in the terms of trade increases income). This is Metzler's qualification to the Stolper-Samuelson tariff argument (see Metzler [63]). If this criterion is less than 1 a tariff imposed by a labor-abundant country would stimulate foreign investment rather than attract capital—a result, it should be noted, based on the static assumptions of this model; if dynamic elements were involved, the direction of the capital movement would depend on whether the effects of the tariff on production preceded or followed the effects on the terms of trade.

learned qualitatively from extreme cases and the rest of the paper will retain this assumption. When only capital is mobile, a labor-abundant country can attract capital by tariffs and a capital-abundant country can encourage foreign investment by tariffs. The same is true for an export tax, because in this model the effect of an export tax is the same as that of a tariff.

The analysis is not restricted to tariffs; it applies as well to changes in transport costs. An increase of transport costs (of commodities) will raise the real return of and thus attract the scarce factor, and lower the real return and thus encourage the export of the abundant factor. The effect of any trade impediment is to increase the scarcity of the scarce factor and hence make more profitable an international redistribution of factors. Later we shall consider, under somewhat more realistic assumptions than those used above, the applicability of this proposition as an argument for protection.

Factor Mobility Impediments and Trade

To show that an increase in impediments to factor movements stimulates trade, we shall assume that some capital is foreign-owned and illustrate the effects on trade of taxing this capital. Strictly speaking, this is not an impediment to a capital *movement*; but if it were assumed that a steady capital flow was taking place, the tax on foreign-owned capital would operate as an impediment.

We shall use Figures 6-1 and 6-2. Begin with equilibrium initially at P' in Figure 6-1. No impediments to trade exist, but because factor and commodity prices are already equalized no trade takes place. We assume that $O'O''$ of capital in Figure 6-2 is foreign-owned, so a transfer equal in value to YY' in Figure 6-1 is made. Consumption equilibrium in A is at S .

If a tax is now levied on all foreign capital its net return will be decreased, and since factor prices must be equalized in A and B , all of it ($O'O''$) must leave A . As capital leaves A , her production block contracts. At constant prices more cotton and less steel are produced. The price of steel relative to cotton tends to rise but, because there are no impediments to trade, it is prevented from doing so by steel imports and cotton exports.

As all foreign capital leaves A , the final size of A 's transformation function is TT , that consistent with domestically owned capital. Production equilibrium moves from P' to P , but consumption equilibrium remains at S because interest payments are no longer made abroad. PR is now exported in exchange for steel imports of RS . The effect of the tax has been to repatriate foreign capital and increase trade. By similar reasoning it could be shown that a subsidy will attract capital and decrease trade, although in the latter case the capital movement will only stop when factor prices change (that is, specialization takes place).

To achieve efficiency in world production it is unnecessary that both commodities and factors move freely. As long as the production conditions are satisfied, it is sufficient that *either* commodities *or* factors move freely. But if some restrictions, however small, exist to both commodity and factor movements, factor- and commodity-price equalization cannot take place (except in the trivial case where trade is unnecessary because prices are already equal). This principle applies only to those restrictions that are operative—obviously it does not apply to import tariffs on goods which are exported, transport costs for factors that are immobile anyway, or quotas larger than those required for equalization to take place.

If it were not for the problem of transporting interest payments, referred to earlier, one mobile factor would be sufficient to ensure price equalization. When the labor-abundant country imposes the tariff, equalization will take place as long as the other country continues a free-trade policy and there are no transport costs involved. But if the capital-abundant country imposes a tariff, inducing the export of capital, prices cannot be equalized even if the labor-abundant country maintains free trade unless the transfer of goods constituting interest payments is also tariff-free.¹³

An Argument for Protection?

The proposition that an increase in trade impediments stimulates factor movements and an increase in impediments to factor movements stimulates trade has implications as an argument for protection. To examine these implications we shall relax some of the assumptions previously made—first, by introducing trade impediments, then by decreasing the degree of factor mobility, and finally by relaxing the assumption that constant returns to scale apply by taking account of external economies. We shall begin with a model similar to that used earlier except that we shall assume country *A* to be considerably smaller than country *B*.¹⁴

¹³ If trade were a perfect substitute for factor movements in the absence of trade impediments, a rough idea of the cost of trade impediments could be acquired by calculating the increase in world income which could take place if capital were redistributed from capital-rich to capital-poor countries until its marginal product throughout the world was equalized. Alternatively, this could be considered the cost of capital immobility. This statement would have to be qualified in the many-factor case.

¹⁴ We make this assumption so that the change in the terms of trade resulting from *A*'s tariff is small. In passing, however, it should be noted that the more mobile is capital, the smaller is the change in the terms of trade resulting from a tariff; this means that the optimum tariff will be smaller with, than without, capital mobility; and in the limiting case where capital is perfectly mobile, discussed earlier, the optimum tariff is zero.

Also, in what follows I neglect to discuss the tariff proceeds which are implicitly assumed to be redistributed in such a way as to leave *A*'s indifference map unchanged. Alternatively, to abstract both from changes in the terms of trade and the tariff proceeds, it could be assumed that the tariff is prohibitive.

Take as a starting point the absence of trade impediments; trade is sufficient to ensure commodity- and factor-price equalization. Suppose that, overnight, transport costs come into existence; this raises the price of importables relative to exportables, shifts resources into importables, raises the marginal product of the scarce factor, and lowers that of the abundant factor in each country. Incomes of *A*-capitalists and *B*-workers increase while incomes of *A*-workers and *B*-capitalists decrease. These changes in factor returns create the incentive for a capital movement from *B* to *A*, a labor movement from *A* to *B*, or a combination of both movements. Where the final equilibrium will be depends on the degree of factor mobility. I shall assume that labor is immobile between countries but that capital is at least partially mobile.

If we assume that capital is perfectly mobile, but that capitalists do not move with their capital, the latter will move from *B* to *A* until the return from capital invested in *A* is the same as from that invested in *B*; but this implies that marginal physical products cannot be equalized, since transport costs must be paid on the goods constituting interest payments.¹⁵ The introduction of transport costs would, then, reduce world income even if capital were perfectly mobile unless capitalists are willing to consume their income in the country in which their capital is invested.

But we shall not assume that capital is perfectly mobile. Instead suppose that *B*-capitalists insist on receiving a higher return on any capital they invest in *A* than on that which they invest in *B*, perhaps because of political instability, patriotism, risk, or economic uncertainty. Let us assume that *B*-capitalists require a 10 per cent higher return on capital invested in *A* than on that invested in *B*, but that if this interest differential rises above 10 per cent, capital is perfectly mobile. Suppose further that the return to capital in both countries before introducing transport costs was 12 per cent, and that the effect of introducing transport costs is to lower the marginal product of capital in *B* to 11 per cent and to raise it in *A* to 17 per cent. Since the interest differential is less than 10 per cent, no capital movement will take place.

It is at this point that we shall consider the argument for a tariff in *A*. Let *A* impose a tariff, further increasing her relative scarcity of capital and *B*'s relative scarcity of labor. Rates of return on capital change to, let us say, 25 per cent in *A* and 9 per cent in *B*, creating an interest differential of 16 per cent. Capital will now move from *B* to *A* until this differential is reduced to

¹⁵ However, interest rates must be the same! Because capital goods—call them machines—can move costlessly from one country to the other, the price of machines in money terms will be the same in both countries; and since machines will move to *A* until marginal products in money terms are equal, interest rates (the return to a machine as a proportion of the price of a machine) must be the same in both countries. The interest rate, of course, is not commensurable with the marginal product of capital unless the latter is defined as a proportion of the price of machines; in the new equilibrium the two are equal when the marginal product of capital is so defined.

10 per cent. Obviously the rates of return cannot return to the pretariff rates of 17 per cent for *A* and 11 per cent for *B*: (1) because part of the tariff will be “used up” in bringing the marginal products of capital in *A* and *B* to the point where *B* has an incentive to export capital; and (2) because transport costs must be paid on the interest returns.

If capital moves until the return in *A* falls to 20 per cent and in *B* rises to 10 per cent, what can be said about the economic effects of the tariff as far as country *A* is concerned?

1. *A*-capitalists are better-off; the tariff increases and the capital inflow decreases capital scarcity, but the net effect is a higher return than before the tariff.
2. *A*-workers are worse off in spite of the fact that the total ratio of capital to labor in *A* has increased. Marginal products are determined not by the total ratio of capital to labor in a country, but by the ratio of capital to labor in each industry. The capital from *B* is largely absorbed by increasing the output of capital-intensive importables in *A*; it can never succeed in raising the capital-labor ratio in each industry to its pretariff level. Real wages must be lower than before the tariff.
3. Real national income in *A* is less than before the tariff; the tariff makes *A*'s scarce factor relatively more scarce, and her abundant factor relatively more abundant, reducing her potential gains from international trade. Even under the most favorable assumptions, with capital perfectly mobile and capitalists moving with their capital, *A*'s income would remain the same; it could not improve.

So far no valid tariff argument has been produced.¹⁶ Capital can be attracted to a capital-scarce country by a tariff, but the capital movement can only alleviate some of the unfavorable effects of the tariff; it cannot eliminate them.

The argument can be rescued if we assume the appropriate nonlinearities of scale.¹⁷ If external economies of scale exist in the production of

¹⁶ It is true that *B*'s national income has increased, since the effect of *A*'s tariff is to raise *B*-wages and stimulate capital investment in *A*, where *B*-capitalists receive a higher rate of return than at home; but it cannot be said that *B*-capitalists are better off, since, *ex hypothesi*, they are indifferent between investment at home and an investment in *A* in which the rate of return is 10 per cent higher. In any case, the purpose of policy makers in *A* is to raise *A*'s, not *B*'s, income.

¹⁷ It may be possible to rescue the argument in other ways by assuming irrational, although possibly not implausible, behavior. For example, after *B*-capitalists have begun investing in *A*, they may acquire more confidence and be willing to accept a smaller interest differential. In this case, after the capital movement the marginal product of labor may be higher, and the marginal product of capital lower, than before the tariff, thereby increasing *A*'s national income. Or, whereas some (relatively) capital-scarce countries may fear “exploitation” from foreign investment, others may view the increase in productive capacity resulting from it as desirable in itself (perhaps with the intent of future expropriation!)—in which case this factor would have to be balanced against the reduction in national income.

A-importables,¹⁸ the tariff will encourage more capital to enter than would otherwise be attracted, as the marginal product of capital entering *A* will not fall as rapidly as it would fall in the absence of economies of scale. The new equilibrium will be established with a higher marginal product of labor, factor returns now being dependent not only on the proportions in which factors are combined but also on the total output of importables. Real wages will be higher in *A* with than without economies of scale, although it is not certain that they will be higher than before the tariff; to demonstrate the latter it would have to be established that the economies of scale are sufficient to make up for the transport costs which must be paid on the interest returns. If they are sufficient, the tariff would be unequivocally beneficial.¹⁹

It is easy to see that economies of scale in importables or diseconomies of scale in exportables increase the likelihood that the net effect of the tariff in a labor-abundant country is favorable, and vice versa. To justify an argument for protection on the above grounds, it would have to be established that capital-intensive industries are subject to external economies of scale and/or that labor-intensive industries are subject to external economies of scale; and these nonlinearities are of the required size.²⁰

¹⁸ It is sometimes overlooked that internal economies of scale do not constitute an argument for a tariff. An industry must not only be able to compete some years after the tariff; it must also earn a sufficient return to repay the economy for the loss of income resulting from the tariff in the period of the industry's infancy. The investment will then be worthwhile only if future output is sufficient to earn for the firm the current rate of interest on the capital involved. But when economies to scale are internal, the investment will be profitable for private enterprise. Only when divergences between private and social costs due to *external* economies of scale are present is the case for government intervention valid.

¹⁹ But if the same nonlinearities of scale exist in *B* the argument is weakened; economies of scale in *A*-importables will cause the marginal product of capital to fall at a slower rate than in their absence, but in this case the marginal product of capital in *B* will rise at a much faster rate as capital is exported. Similar economies of scale in *B*, then, may cancel out the effect of economies in *A* in inducing a larger capital movement, although this effect could be neglected if *B* were the rest of the world and *A* were a small country.

²⁰ A possible extension of the model to allow for many goods could be made as follows: All goods could be ordered in terms of their capital intensities (that is, the ratios of capital to labor at any given price ratio). *B* would export those goods that are most capital-intensive and *A* those goods which are most labor-intensive. In the absence of trade impediments, one of the intermediate commodities would be produced in common, establishing the ratio of factor returns in much the same way as goods produced in common establish the ratio of international values in a Graham model. The effect of a tariff in *A* (as of any impediment) is to increase the relative price of capital-intensive goods in *A* and to lower them in *B*, thus raising in *A* and lowering in *B* the marginal product of capital. Thus, not one commodity but a whole series of commodities would be produced in common, *A*'s exports comprising only the most labor-intensive and *B*'s exports only the most capital-intensive goods. In *A* new capital-intensive industries, and in *B* new labor-intensive industries, would be created. If some capital were not allowed to move to *A*, the margin of comparative advantage would be extended to capital-intensive industries in *A*, thus increasing the number of goods produced in common in both countries.

Concluding Remarks

A number of questions present themselves. Did increased protection in the late-nineteenth century in North America stimulate the large labor and capital inflows of that period (assuming land to have been the abundant factor) ? Did the increased protection in Britain in this century stimulate capital export ? Did the breakdown in international factor movements in the interwar period stimulate trade? And to what extent have the high tariff barriers between Canada and the United States contributed to the stimulus of American investment in Canada ? It would be interesting to see what help this model offers in finding answers to these questions.

Chapter 7 / *The Laws of Comparative Statics and Homogeneity*¹

It is well known that there are formal structural similarities between economic models that encompass quite different subject matters. We cite, for example, the similarities between the Walrasian multiple-commodity price system and the Metzleric multiple-region income system.²

These similarities produce analogies between the laws of stability and comparative statics of the two systems that further our understanding of the basic unity of economic science. The analogies are produced by an underlying mathematical isomorphism that is, however, not complete.

The mathematical isomorphism between the Walrasian multi-commodity price system and the Metzleric multi-region income system is not complete even in the well-behaved case of gross substitutes (for the stable price system) and superior goods (for the stable income system). A difference arises because of the price system's characteristic of zero-degree homogeneity that imposes additional constraints upon the inverse. The inverse of the price system has diagonal elements in both the same row *and* the same column, while the inverse of the income system has diagonal elements that are necessarily dominant only over single elements in the same column.

This leads to a whole class of comparative statics propositions for the price system that have no counterpart in the income system, and to economic implications about our ability to aggregate sectors or markets for qualitative analysis.

¹ Adapted from *Econometrica*, **33**, No. 2 (April 1965), pp. 349–356. Original title: “The Homogeneity Postulate and the Laws of Comparative Statics.”

² For a description of the “Walrasian” system see, for example, Hicks ([24], chap. V), Samuelson ([91], pp. 269–276), or Metzler [62]; for the “Metzleric” system see Metzler [64], Chipman [7], or Goodwin [17]. Metzler's paper, although published in 1950, was written in 1945.

Relative Prices and Absolute Incomes

Consider a Walrasian system in which all goods are gross substitutes, and a Metzleric system in which all income effects (including hoarding) are positive; then both systems are stable.³ Now consider three types of changes in (excess) demand and note the laws of comparative statics (proved in the final section) pertaining to each system. In the Walrasian system it can be demonstrated⁴ that:

- I. A shift of demand from the numéraire to good k (a) raises the price of k and the price of all other goods and (b) raises the price of all other goods by less than the price of k .
- II. A shift of demand from good i to good k (a) raises the price of k and lowers the price of i and (b) lowers the price of every other good by less than the price of i or raises it by less than the price of k .
- III. A shift of demand from all other goods onto good k (a) raises the price of k and (b) lowers the price of all other goods in terms of k .

On the other hand, in the Metzleric system, it can only be proved⁵ that:

- I. A shift of demand from saving onto the goods of country k raises the income of country k and raises income in every other country; it cannot be proved that income in any other country rises by less than income in country k .
- II. A shift of demand from country i to country k raises income in country k and lowers income in country i ; it cannot be proved that incomes in other countries rise by less than in country k or fall by less than in country i .
- III. A shift of demand from all other countries onto country k raises income in country k ; it cannot be demonstrated that incomes in other countries fall, or rise by less than income in country k (although income in at least one other country must fall).

³ This follows because the diagonal elements of the characteristic matrix are in each case dominant. For proofs for the Metzleric system see [7], [17], and [64]; for the Walrasian system see [1], [19], and [79]. Relevant mathematical generalizations have been given by Solow [98], Debreu and Herstein [10], and Mackenzie [49] for indecomposable matrices, nonnegative square matrices, and dominant-diagonal matrices, respectively. The mathematical contribution of this chapter is to show that it is useful to distinguish between “one-way” and “two-way” dominance of the diagonals in the basic matrices for comparative statics purposes; see the last section.

⁴ Class I propositions are well known from Hicks ([24], p. 75); Morishima [67] proves their validity for *finite shifts in demand*. Class II propositions have not, to my knowledge, been proved before, although any economist's intuition must tell him they are correct if class I propositions hold, since they differ only in the choice of numéraire. Class III propositions have been used in my papers [70 and 74]. See chapters 3 and 4.

⁵ Class I and class II propositions of the Metzleric system have been proved by Metzler in [64 and 65], respectively. Class III propositions are proved in the final section.

It can be seen that there are analogies in the Metzleric system to propositions I(a), II(a), and III(a) of the Walrasian system, but there are no analogies to propositions I(b), II(b), and III(b). Those propositions in the Walrasian system that have no counterpart in the Metzleric system all have to do with changes in the price of one good expressed in terms of a nonnuméraire good; we cannot assert much about the differences between income increases in various countries. The economic explanation is that we cannot apply the additional information that we have available in the Walrasian system, that is, that the system is homogeneous of degree zero, to the Metzleric system. The (a) propositions in the Walrasian system do not depend on homogeneity, but the (b) propositions require additional information such as that provided by homogeneity.

Two-Region and Multiple-Region Metzleric Models

Most propositions of comparative statics in economic theory have been derived originally from simple models involving only two or three entities (goods, factors, regions, countries), although such propositions are useful only if there is at least one general case in which the same propositions are applicable. The usefulness of the gross substitutes case of the Walrasian system lies partially in its affirmation of the propositions derived from simple two-good systems: If all goods are gross substitutes, one good can be taken to represent the remaining goods, and qualitative analysis can be much simplified. By analogy it might appear that the “normal case” of the multiple-region income system would have a similar utility. Thus Metzler ([64], p. 352) has concluded, for the multiple-region income model, that there “are no processes of income adjustment in the n -country model that are not also revealed by the simple two-country model, and in the main the conclusions reached by employing the latter are the same as those reached by employing the former.”

Given, however, the dissimilarity between the comparative statics propositions pertaining to the two systems, and (specifically) the additional information provided by the homogeneity postulate in the Walrasian system, it seems unlikely that the similarity of results between two-entity and multiple-entity systems is not influenced by the homogeneity postulate. In other words, is it not possible to find some discrepancies between the conclusions of two-region and multiple-region income models that are based on the absence of homogeneity?

Let us consider a two-region model with one region representing the rest of the world. Suppose we try to determine the effects that a shift in demand from the rest of the world onto the products of one country would have on the income in that country and in the rest of the world. This involves (by assumption) no change in aggregate spending in the world as a whole, so

world saving remains constant. It should be apparent then that income in the country for which demand has increased must rise while income in the country for which demand has decreased must fall, since only in that way can world saving remain constant. In other words we should conclude, on the basis of the two-region model with one region representing the rest of the world, that a shift of demand from the rest of the world onto one region raises income in that region and lowers income in the rest of the world.

Consider, however, the following example of a three-country world, where y represents income in the country denoted by the subscript, β is a parameter, and the A 's are constants:

$$\begin{aligned}y_1 &= 0.4y_1 + 0.01y_2 + 0.01y_3 + A_1 + 11\beta \\y_2 &= 0.5y_1 + 0.97y_2 + 0.01y_3 + A_2 + \beta \\y_3 &= 0.01y_1 + 0.01y_2 + 0.5y_3 + A_3 + 10\beta.\end{aligned}$$

This is a “normal” Metzleric model. The coefficients of the parameter β specify that aggregate world demand (at constant incomes) is unchanged by a shift in the parameter. Yet the approximate solutions for the changes in incomes of the three countries due to a change in β are $dy_1/d\beta = 24.2$, $dy_2/d\beta = 366.6$, and $dy_3/d\beta = -2.2$. This shows that a shift of demand onto one country from the rest of the world can raise income in the world as a whole and can also raise income in that part of the world for which demand has initially decreased.

My example does not refute Metzler's statement, but it does prove that it must be carefully interpreted. There is, in fact, an analogy in the multiple-region system that corresponds to that implied by the two-region system. When it is proved, in the two-region income model, that income in one region falls and income in the other region rises, the interpretation must be that a shift of demand from one region onto another region raises income in the latter region and lowers income in the former region. The error in the previous interpretation is that one region was taken to represent the rest of the world, a representation that is generally invalid in a nonhomogeneous system.⁶

Mathematical Analysis

Let us now prove the laws of comparative statics advanced in the first section for the Walrasian and Metzleric systems. Consider the Walrasian system with $n + 1$ goods:

$$B_i(p_1, \dots, p_n; \alpha) = 0 \quad (i = 1, \dots, n)$$

⁶ Perhaps the most obvious economic implication of the possibilities we have raised is that devaluation and tariffs are not necessarily beggar-thy-neighbor policies even when the entire world is in a state of unemployment; at least one neighbor gets “beggared,” but the combined income of the rest of the world may rise.

where B_i is the excess demand for the i th good, the p 's are prices expressed in terms of the numéraire (good 0), and $|\alpha|$ is a parameter; compare (1) with the n -country Metzleric system:

$$X_i(y_1, \dots, y_n; \beta) = 0 \quad (i = 1, \dots, n) \quad (2)$$

where X_i is the aggregate excess demand for the goods of the i th country, the y 's are national incomes expressed in a common currency unit, and β is a parameter.

Choose commodity units in (1) so that initially each $p_i = 1$, and differentiate (1) and (2) with respect to the parameters α and β . The solutions are

$$\frac{dp_i}{d\alpha} = -\sum_{j=1}^n \frac{\partial B_j}{\partial \alpha} \frac{D_{ji}}{D} \quad (3)$$

$$\frac{dy_i}{d\beta} = -\sum_{j=1}^n \frac{\partial X_j}{\partial \beta} \frac{M_{ji}}{M}, \quad (4)$$

where D is the Walrasian determinant,

$$D = \begin{vmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \vdots & & & \\ b_{n1} & b_{n2} & \cdots & b_{nn} \end{vmatrix},$$

with $b_{ij} = \frac{\partial B_i}{\partial p_j}$, and where D_{ij} is the cofactor of the i th row and j th column of

D , M is the Metzleric determinant,

$$M = \begin{vmatrix} c_1 - 1 & m_{12} & \cdots & m_{1n} \\ m_{21} & c_2 - 1 & \cdots & m_{2n} \\ \vdots & & & \\ m_{n1} & m_{n2} & \cdots & c_n - 1 \end{vmatrix}$$

and M_{ij} is the cofactor of the i th row and j th column of M , while c represents the marginal propensity to consume home goods in the country denoted by the subscript, and m_{ij} denotes the marginal propensity in j to import from i .

Determinants D and M have, by assumption, positive off-diagonal elements and negative column sums. This yields two properties in common:

1. Every first-order cofactor has a sign opposite that of the basic determinant,⁷ that is, $D_{ij}/D < 0$, and $M_{ji}/M < 0$.

⁷ By Mosak's theorem ([68], pp. 49–51). Its application to the income system is due to Metzler ([64], p. 340).

2. In absolute value every principal cofactor dominates off-diagonal cofactors in the same *column* as the principal cofactor,⁸ that is, $|D_{ii}| > |D_{ji}|$ and $|M_{ii}| > |M_{ji}|$.

Homogeneity, however, provides additional information about D . If the system (1) is homogeneous in all $n + 1$ prices, then the row sums must also be negative, and this implies that principal cofactors in D will dominate off-diagonal cofactors in the same *row* as the principal cofactor. An implication of homogeneity is therefore that $|D_{ii}| > |D_{ij}|$ ⁹; an analogous result, $|M_{ii}| > |M_{ij}|$, cannot be asserted for the Metzleric system.¹⁰

These properties can now be utilized to prove propositions I, II, and III. To prove the first proposition set $\partial B_j / \partial \alpha = 1$ and every other $\partial B_j / \partial \alpha = 0$; and set $\partial X_k / \partial \beta = 1$ and every other $\partial X_j / \partial \beta = 0$. Then from equations (3) we have

$$\frac{dp_k}{d\alpha} = -\frac{D_{kk}}{D} > 0 \tag{5}$$

$$\frac{dp_i}{d\alpha} = -\frac{D_{ki}}{D} > 0 \tag{6}$$

which proves proposition I(a) using Mosak's theorem; and

$$\frac{dp_k}{d\alpha} - \frac{dp_i}{d\alpha} = -\frac{D_{kk} - D_{ki}}{D} > 0, \tag{7}$$

which proves proposition I(b), making use of homogeneity.

Similarly, from (4) we get

$$\frac{dy_k}{d\beta} = -\frac{M_{kk}}{M} > 0 \tag{8}$$

$$\frac{dy_i}{d\beta} = -\frac{M_{ki}}{M} > 0. \tag{9}$$

⁸ See Metzler ([65], p. 21).

⁹ This follows by analogy to Metzler's result. For example, in the 2 x 2 case the basic determinant is

$$D = \begin{vmatrix} b_{ii} & b_{ij} \\ b_{ji} & b_{jj} \end{vmatrix} \text{ and } D_{ii} - D_{ij} = b_{jj} + b_{ji}$$

has a sign opposite to D .

¹⁰ In a two-region model the basic determinant is

$$M = \begin{vmatrix} c_i - 1 & m_{ij} \\ m_{ji} & c_j - 1 \end{vmatrix} \text{ and } M_{ii} - M_{ij} = c_j - 1 + m_{ji},$$

and there is no economic reason why its sign should be determinate.

But the sign of

$$\frac{dy_k}{d\beta} - \frac{dy_i}{d\beta} = -\frac{M_{kk} - Mk_i}{M} \quad (10)$$

is indeterminate for any particular i because we do not have the information provided by homogeneity.

To prove proposition II(a) we can set $-\partial B_i / \partial \alpha = \partial B_k / \partial \alpha = 1$ in the Walrasian system and drop all other coefficients; and set $-\partial B_i / \partial \beta = \partial X_k / \partial \beta = 1$ in the Metzleric system and drop all other coefficients. Then we have, from (3),

$$\frac{dp_k}{d\alpha} = \frac{D_{ik} - D_{kk}}{D} > 0 \quad (11)$$

$$\frac{dp_i}{d\alpha} = \frac{D_{ii} - D_{ki}}{D} < 0 (i \neq k), \quad (12)$$

and, from (4)

$$\frac{dy_k}{d\beta} = \frac{M_{ik} - M_{kk}}{M} > 0 \quad (13)$$

$$\frac{dy_k}{d\beta} = \frac{M_{ii} - M_{ki}}{M} < 0 (i \neq k). \quad (14)$$

These results do not depend on homogeneity.

To prove proposition III and also, indirectly, proposition II(b), set

$$\frac{\partial B_k}{\partial \alpha} = -\sum_{\substack{j=0 \\ j \neq k}}^n \frac{\partial B_j}{\partial \alpha} > 0 \quad \text{with} \quad \frac{\partial B_j}{\partial \alpha} (j \neq k) < 0$$

in (3); and set

$$\frac{\partial X_k}{\partial \beta} = -\sum_{\substack{j=1 \\ j \neq k}}^n \frac{\partial X_j}{\partial \beta} > 0 \quad \text{with} \quad \frac{\partial X_j}{\partial \beta} < 0 \text{ for } j \neq k$$

in (4). Then, after eliminating $\partial B_k / \partial \alpha$ from (3) we have

$$\frac{dp_k}{d\alpha} = \frac{\partial B_0}{\partial \alpha} \frac{D_{kk}}{D} + \sum_{j=1}^n \frac{\partial B_j}{\partial \alpha} \frac{D_{kk} - D_{jk}}{D} > 0; \quad (15)$$

and from (4) we get

$$\frac{dy_k}{d\beta} = \sum_{j=1}^n \frac{\partial X_j}{\partial \beta} \frac{M_{kk} - M_{jk}}{M} > 0. \quad (16)$$

This proves proposition III(a).

To prove proposition III(b) we need to prove that $dp_k/d\alpha - dp_i/d\alpha > 0$. Solving for $\partial B_k/\partial\alpha$ from (3) and eliminating it from the expression for $dp_k/d\alpha - dp_i/d\alpha$ we find that

$$\frac{dp_k}{d\alpha} - \frac{dp_i}{d\alpha} = \frac{D_{kk} - D_{ki}}{D_{kk}} \frac{dp_k}{d\alpha} + \sum_{j=1}^n \frac{\partial B_j}{\partial\alpha} \frac{D_{ji}D_{kk} - D_{jk}D_{ki}}{DD_{kk}}. \quad (17)$$

Now the numerator of the last expression on the right in (17) is positive by Mosak's theorem and the stability proofs since, for any determinant D ,

$$DD_{kk,ji} = D_{ji}D_{kk} - D_{jk}D_{ki};$$

and the first expression on the right of (17) is positive, by the homogeneity postulate and by (15). Therefore, both terms on the right of (17) are positive, so the price of the good for which demand has increased rises relative to all other prices. A similar proof can be applied to prove II(b) and to demonstrate that the expression on the right of (11) exceeds the expression for the change in any other price, and that the expression on the right of (12) is less than the expression for any other price change.

We cannot apply the same method to prove a theorem analogous to propositions II(b) or III(b) for the income theory, because we would always have an expression like $|M_{kk}| - |M_{ki}|$, whose sign is indeterminate. Nor can analogous theorems exist, as the counterexample in this chapter illustrates.

We can, however, demonstrate that incomes in one of the countries for which demand has decreased must fall in case III. Because world expenditure is unchanged (at constant incomes), world saving must be unchanged, so $\sum_{j=1}^n s_j dy_j/d\beta = 0$. Thus, if income in one country increases, income in at least one other country must decrease.

Part II

MONETARY
EQUILIBRIUM AND
ADJUSTMENT
PROCESSES

Chapter 8 / *Barter Theory and the Monetary Mechanism of Adjustment*¹

The barter theory developed by Ricardo and his school evolved, in the hands of Mill, Marshall, Edgeworth, and modern writers, into a carefully tooled and sophisticated engine of analysis. Elaborations took many directions. Comparative cost doctrine was extended to the many-country many-commodity case by Edgeworth, Bastable, and Graham and was further refined by modern linear programming techniques. The theory of comparative costs was deepened by a model introduced by Heckscher that undertook to explain differences in productivity that the Ricardian school had merely postulated; the factor endowment model too was elaborated and refined in the hands of Ohlin, Iversen, Lerner, Stolper-Samuelson, and Samuelson in writings that have now become classics. The classical system was finally extended into the framework of general equilibrium theory in the hands of Yntema, Mosak, and Samuelson, while the earlier work of Edgeworth on the laws of contract under competition provided the starting point for the theory of the core of an economy.

There is a sense, however, in which the successful nature of the barter theory, in achieving constant refinement and extension, created a vacuum in international trade theory. There was no comparable development of the short-run monetary theory of the adjustment process. Whereas the barter theory of exchange exploited the powerful geometric and algebraic tools that had become prominent in value theory, permitting analytical developments surpassing the possible achievements of unaided intuition, international monetary economic analysis never received precise mathematical formulation. Restrained by limited techniques, international monetary analysis did not develop the rigorous base that was required for an orderly self-sustaining growth of scientific knowledge.

Even today we have a double standard. We demand rigorous logic from

¹Adapted from *Capital Movements and Economic Development* (ed. J. H. Adler), London: Macmillan, 1967.

practitioners of the fine art of offer curve analysis, in striking contrast to much looser standards exacted in monetary economics as a whole. Attacking the real world from a lower level of abstraction, international monetary economics offers a greater appearance of realism than barter theory, but it is achieved at the sacrifice of precision and rigor. Monetary analysis appears to be a “soft” area of research because it is harder to separate, on grounds of logic alone, the foolish from the fertile. Reaching farther into the real world it has lost track of the “axioms” along its trail by which its rigor can be established.

My purpose is not to belittle important developments in international monetary economics in the last two decades, but rather to emphasize that these developments have not succeeded in integrating classical monetary theory with classical barter theory. Innovations in the field since the 1930s have stressed the application of Keynesian economic concepts to the international sphere, rather than the integration of Keynesian international economics with classical barter theory or classical international monetary economics, creating a weakness in the area.

To a certain extent this weakness is the unavoidable product of two dominating forces. The 1930s witnessed simultaneously two important revolutions in the science: One was in macroeconomics, led by Hayek, Myrdal, and, above all, Keynes; and one was in technique, led by Frisch, Tinbergen, Leontief, and Samuelson. The younger people interested in trade theory at the time leaned toward Keynesianism and many also picked up the mathematical techniques that were becoming prominent in value theory and in business cycle theory. It was natural, therefore, that when mathematical techniques came to be extended to international trade theory the models chosen would be Keynesian.²

Good theory is good theory and there is no doubt that there was much in the *General Theory* that could be used to refresh and revise international monetary economics. But in practice the Keynesian revolution held back trade theory. Fundamental theoretical problems in macroeconomics had not been solved. The major weakness lay in the very place in which Keynes had hoped to make his major theoretical contribution, the integration of the monetary and real sectors of a closed economy. His attempt to integrate the two sectors was faulty. This turned out to be a weak spot in the *General Theory*, but it was one that could be concealed for a couple of decades in macroeconomic theory. Its weakness, however, could not be sustained for any length of time when one attempted to construct a model of the international economy incorporating monetary elements. As a result the Keynesian model

² Mosak's work was an exception but he was working in a different milieu (Chicago) in the 1940s where Keynes' ideas were not regarded as so novel; in any case his example is the exception that proves the rule because his treatise is itself an important landmark in international trade theory.

applied to the international economy in the 1940s was the naive one leading in the direction of matrix multiplier theory, a model of considerable mathematical interest, but of little use in resolving the problems of integrating a sophisticated theory of money into international monetary economics.

The purpose of the present inquiry is to make a fresh start at removing the weaknesses of international economics. But before defining the limits of the inquiry it is necessary to say something about the contributions of Meade to the subject.³

In his studies Meade attempted an integration of the work of Slutsky and Hicks and Mosak on the one hand, and Keynes on the other. In this he was only partially successful. The monetary and employment sectors were grafted onto the model rather than built into it. Writing as he was before the problems of valid and invalid dichotomization of the monetary and real sectors of an economy had been brought out or resolved, it would have been extremely difficult to solve, at the time, the most subtle problems of the pure theory of money. That Meade's own model, buried in the Mathematical Supplement to the Balance of Payments, incomplete and unsatisfactory as it is, is still one of the best attempts at the integration of monetary and real analysis in the theory of international trade, is the most eloquent testimony to the importance of his contribution and at the same time the most devastating criticism of the current state of theoretical work in international monetary economics.

Bridges are necessary between the barter and the monetary models, on the one hand, and between the classical and Keynesian traditions in international economics, on the other. This need is, I think, obvious and needs no further elaboration. But, how should money be "added" to barter models of trade, and how can classical analysis be united with Keynesian concepts ?

The general purpose of this chapter is to make a start on this problem by creating connecting links between classical international monetary economics and the theory of barter, and between classical and Keynesian concepts and methods of analysis. The first bridge requires the development of an explicit theoretical model of the classical balance-of-payments adjustment process, a model that can be shown to be reducible in principle to a barter model; the second requires that the model can be expressed either in the classical language

³ The two-volume work by Meade on the Theory of International Economic Policy is a landmark in the theory of international trade and economic theory in general, and it will be the source of fruitful insights into economic theory for years to come. There is no question in my mind that the reviews of this work published in the 1950s did not do justice to it or recognize its real significance as a major treatise on economics. This is only partly because of defects of its organization and presentation. To be sure the dichotomy between lucid, but unexciting prose, forbidding notation in the first mathematical supplement, and the separate publication of an isolated companion volume of tough geometry were tactical mistakes in presentation; so was the author's reticence in drawing attention to the originality of his own work. But I should attribute its tepid reception rather to the state of confusion of the science in the early 1950s, and the lack of sensible criteria by which merit could be separated from chaff.

of the quantity theory of money, or in the Keynesian language of income-expenditure equalities.

I shall make two assumptions that in subsequent work can and should be generalized: One is that the country under consideration is a small economy looking outward on a large world, the other is that it lacks a credit market. These simplifications are not damaging to the logical structure of the model although they do limit the direct applicability of the conclusions to a small country that is underdeveloped in the sense that it lacks an important capital market.

Despite the simplicity of the model, I would maintain that it is of direct use in analyzing simple open economies, and in that spirit I have discussed the effects of devaluation, income transfers, budget deficits, and reserve accumulation, and not made any attempt to conceal what I believe to be some practical implications for policy of the insights thus gained.

Income, Expenditure, and the Quantity of Money

The model I shall develop owes its origin to David Hume. Based on a very simple open economy, it assumes that wealth is held in the form of money and goods. The key assumptions that greatly simplify the analysis are that there is no market for securities and that the world price of imports is given by considerations outside the model.

Consider such a simple economy. The demand for money depends on money income or, assuming output is given, the price level, in accordance with the *quantity theory of money*. The supply of money is determined by the balance of payments, either because international reserves and domestic money are the same, as under a gold specie standard, or because domestic money is rigidly linked to the stock of international reserves through the banking system.

Three conditions must be met before the system can be said to be in equilibrium. First, the supply of money must be equal to the demand for money; second, the balance of payments must be in equilibrium; and, third, the demand for domestic output must equal the supply of domestic output. If the first condition were not met there would be a tendency for spending to exceed or fall short of income; if the second were not met the money supply would be increasing or decreasing; and if the third were not met the domestic price level would be rising or falling.

The significance of the equilibrium conditions can be seen diagrammatically. First let us represent the quantity theory of money by placing on one axis the quantity of money, M , and on the other axis the domestic price of home-produced goods, P . The line LL portrays the amount of money that would be demanded at each price level. Thus at a price level equal to OP_1 , the demand

for money is OM_1 ; and at a price level equal to OP_2 , the demand for money is OM_2 . Normally LL will have an elasticity exceeding unity on the assumption of the *homogeneity postulate* of economic theory, because a proportionate change in the price level implies a less than proportionate increase in the demand for money when the price of all imported goods remains constant.

Every point in Figure 8-1 corresponds to a particular combination of money

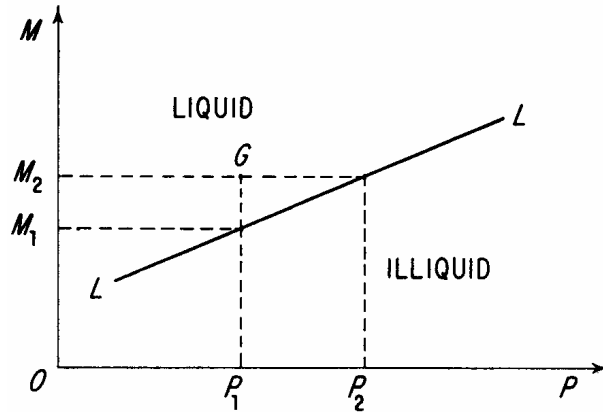


Figure 8-1. The State of Liquidity.

and price level. For example, at the point G , the price level is OP_1 and the actual quantity of money is OM_2 . G is not an equilibrium point, for it implies inequality between the demand for money and the supply of money. At G there is an excess supply of money equal to M_1M_2 . Only if the supply of money were reduced to OM_1 would the demand for money be equal to the supply of money at the price level OP_1 , or only if the price level were at OP_2 would the demand for money be equal to the supply of money OM_2 .

Only points on LL are equilibrium points. Above and to the left of LL the supply of money is greater than the demand for money, and below and to the right of LL the demand for money is greater than the supply of money. The area above and left of LL is an area of excess liquidity, and the area below and right of LL is a zone of liquidity scarcity. I shall refer to the first zone as "liquid" and to the second zone as "illiquid."

From the characterization of the two zones we may now ask what happens when there is an excess or deficient level of liquidity. This is a question in economic dynamics and can only be answered by reference to observable behavior. The community holds money and goods, so that if they have an excess demand for money they must also have an excess supply of goods, just as an excess supply of money means that they have an excess demand for goods; this follows from Walras' law that the sum of the values of excess

demands for every economic object (including money) is zero for any individual economic agent.

We have not yet stated what happens in a position of excess or deficient liquidity, although we have found a clue. When there is an excess supply of money there is an excess demand for goods, and this will mean that, *unless increased supplies are forthcoming*, prices will rise. And similarly, when there is an excess demand for money there also is an excess supply of goods, so prices will tend to fall *if no additional demand is forthcoming*.

It is important to emphasize at this point, however, that it is not valid to assert in the context of an open economy, that the price level rises or falls according to whether there is excess or deficient liquidity. However valid this dynamic postulate may be in a closed economy, it is incorrect in an open economy. An excess supply of money implies an excess demand for goods *in general* and an excess of expenditure over income, but the *domestic* price level would only be pushed up insofar as the excess of expenditure reflected an excess demand for *domestic* goods. Insofar as an excess demand for goods can be expended on imports, the price level will have no tendency to rise. Indeed, as the subsequent analysis will show, an excess of liquidity is entirely consistent with deflationary pressure in the market for home goods and services.⁴

Domestic expenditure (expenditure by domestic residents on both home and foreign-produced goods) is assumed to depend on income (defined as domestic output multiplied by its price) and liquidity. Specifically, we assume that expenditure equals income if the community is satisfied to hold the existing stock of money, and that any excess of planned expenditure⁵ over expected income is proportionate to the excess supply of money. Thus an excess supply of money means that expenditure exceeds income, as the community tries to rid itself of excess cash holdings; and, similarly, an excess demand for money means that expenditure falls short of income, as the community tries to build up its cash holdings.

According to this assumption expenditure equals income only when the demand for money is equal to the supply of money, so we can describe the condition of balance between the two by the *LL* line in Figure 8–1, except that we now have an additional interpretation of it. Not only is *LL* the line along which the demand for money is equal to the supply of money, it is also the

⁴In what follows we assume that an excess demand for foreign goods (imports) is automatically satisfied to avoid complicating the analysis with the otherwise necessary distinction between the ex ante and ex post balance of payments; this assumption would be realistic enough if importers kept sufficient stocks on hand to satisfy any incipient excess demand, and were willing to accumulate stocks (and reduce orders correspondingly) in the event of any excess supply.

⁵Expenditure is defined in an ex ante sense of a schedule of plans rather than as an actual realized magnitude. An expenditure function of this sort was used by Prais [84] and is a novelty that deserves wider application.

line along which planned money expenditure is equal to expected money income.

We next place in the diagram (Figure 8-2) a line BB expressing the locus of combinations of the price level and the money supply resulting in a zero balance of payments; assuming for now no capital imports, BB is also the line along which the trade balance is zero. We assume that the balance of trade

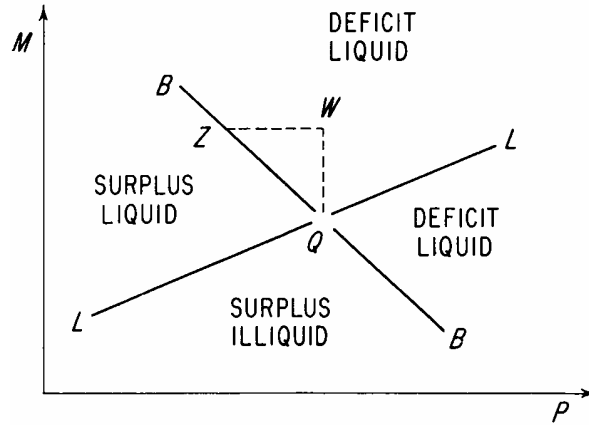


Figure 8-2. The Balance of Trade and Liquidity.

depends both on domestic expenditure and on the price level. As we shall see, this means that the slope of BB will normally be negative.

To see why the slope is negative consider the point Q , where income equals expenditure (because Q is on LL) and where the balance of payments is in equilibrium (because Q is on BB); and suppose from Q the money supply is increased by QW . At W there is an excess supply of money so that expenditure rises in excess of income. Part of the increase in expenditure falls on imports, and part on export goods, increasing the former and decreasing the latter, creating, at W , a balance-of-payments deficit.

To correct the deficit the domestic price level can be lowered to shift both home and foreign demand away from foreign products onto domestic products. There must be some lower price level at which the balance of trade will again be in equilibrium if the system is stable. In the diagram this point is taken to be the point Z .

We now have two schedules that intersect at an equilibrium point, Q , at which the system will rest if it is stable. We could now proceed to an examination of the dynamics. However, we lack one of the basic ingredients for a dynamic analysis. We know that the money supply will increase or decrease according to whether the balance of payments is positive or negative, but we

do not yet know the conditions under which the price level will rise or fall. We need also to find the locus of combinations of money and prices at which there is no excess demand for domestic goods.

Can we derive this additional line independently of the LL and BB lines? The answer is, definitely not, for there can be only one point in the diagram that is an equilibrium point. Q is already established as the equilibrium, so that the line along which there is no excess demand for domestic goods (which we shall denote as the XX line) must pass through the point Q . The XX line in Figure 8–3 is not independent of the other two lines. Indeed, it can be derived from them.

The excess demand for domestic goods is the difference between the sum of foreign and domestic demands for domestic goods and the level of domestic output; this is equivalent to domestic expenditure minus imports plus exports minus domestic output when these variables are all expressed in units of home goods. In other words, the excess demand for domestic goods is equal to the difference between the sum of planned domestic expenditure plus the balance of trade, and expected income. Thus by “adding” the BB and LL curves we get the XX curve, the locus of money and price levels along which there is no excess demand for domestic goods.

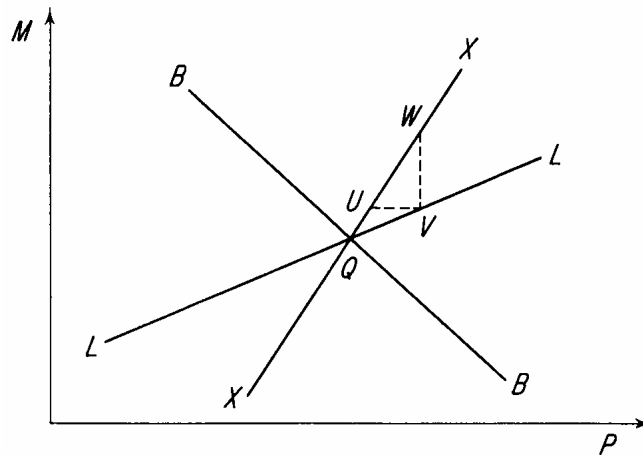


Figure 8–3. Liquidity, the Balance of Trade, and Excess Demand.

It is easy to determine the position of XX in Figure 8–3. It must have a positive slope that is steeper than LL . To demonstrate this fact let E = expenditure, Y = income, and B = the balance of trade.

Then consider, in Figure 8–3, the point V on LL . At V , $E = Y$, so the excess demand for domestic goods ($X = E + B - Y$) is equal to the balance of trade surplus (B). But B is negative because V is in the deficit zone above and

right of BB . Hence there is excess supply of domestic goods that can be corrected only by a decrease in the domestic price level or a liquidity-induced increase in expenditure. Thus, in Figure 8-3, an increase in the money supply of VW would eliminate the excess supply of domestic goods, as would a decrease in the price level by the amount UV .

The Anatomy of Disequilibrium and Dynamics

Having established the new line XX , as derived from the BB and LL lines, we can note that we could have begun with any two of the lines to get the third line. Knowing XX and BB we can deduce LL , knowing LL and XX we can deduce BB , and knowing BB and LL we can deduce XX (as we did, in fact). No single one of the lines has any priority over the other.

The interdependence of the three curves does not mean, however, that it is not useful to use all three curves for purposes of analysis. Instead of the four zones of Figure 8-2 we now have six zones in Figure 8-3—repeated in Figure 8-4. The elaboration of the meaning of these zones can help us to determine

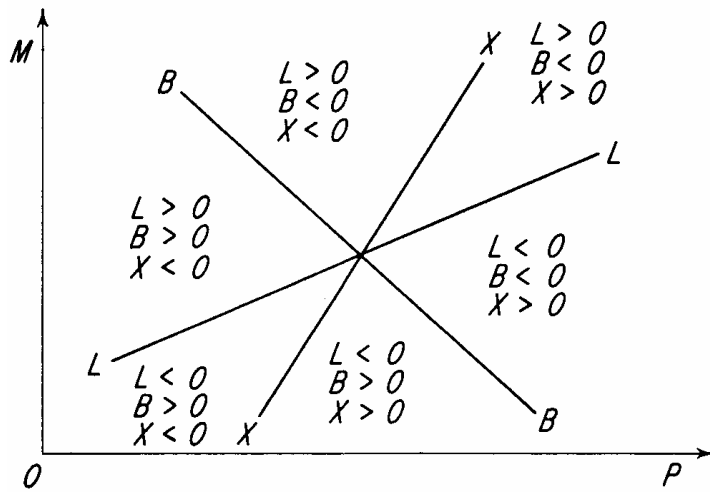


Figure 8-4. Anatomy of Disequilibrium.

exactly the nature of the disequilibrium. The six zones are characterized by the state of

- EXCESS LIQUIDITY (L)
- THE BALANCE OF PAYMENTS (B)
- DEFLATIONARY PRESSURE (X)

which are denoted positive or negative by the inequality signs in Figure 8-4.

The separation of the zones is useful for policy purposes because it helps to determine the direction in which the money supply or price level should be adjusted to reach equilibrium. Thus, if we observe a situation in which $B < 0$ and $X < 0$, we know that the money supply must be reduced; if $B < 0$ and $X > 0$, the price level must be reduced; if $B > 0$ and $X > 0$, the money supply must be increased; and if $B > 0$ and $X < 0$, the price level must be increased. We can observe the disequilibrium situation, and, even though we are ignorant of the exact shapes of the curves, deduce the direction in which the money supply and the domestic price level have to move to restore equilibrium.⁶

The development of the XX line along with the anatomy of disequilibrium zones allow greater precision in formulating the dynamics of the system. It can be postulated that the money supply increases or decreases according to whether the balance of payments is in surplus or deficit, and that the price level rises or falls according to whether there is inflationary or deflationary pressure (excess demand or supply of domestic goods). In other words, the line demarcating price-level increases from price-level decreases over time is the XX line and that distinguishing increases from decreases in the money supply is the BB line. The dynamic forces are indicated by the arrows in Figure 8–5.

From a disequilibrium point like W , a point that could be reached as a result of an “annihilation” of part of the money supply, following the famous experiment first considered by Hume, the reduction in the money supply would reduce expenditure and hence imports. This implies an improvement in the balance of payments, which would induce a replenishment of the money supply. (Unlike Hume's analysis, the present model shows that money can have a direct effect on the balance of payments through its immediate impact

⁶ It is, perhaps, a harmless parody on the history of economic thought to refer to LL as the Say's Law line (because along LL the demand and supply of money are equal), to XX as the Keynes' Law line (because along XX the excess of investment over saving equals the excess of imports over exports) and to BB as the Hume's Law line (because along BB imports equal exports). In the conceptual language of the Keynesian model, supplemented now, for completeness by including T , the rate of capital export, we can make the following identifications:

$$\begin{aligned} \text{Along } XX, \text{ SAVING} - \text{INVESTMENT} &= \text{TRADE BALANCE} \\ \text{Along } LL, \text{ CAPITAL EXPORTS} &= \text{SAVING} - \text{INVESTMENT} \\ \text{Along } BB, \text{ TRADE BALANCE} &= \text{CAPITAL EXPORTS}. \end{aligned}$$

This illustrates the mutual interdependence of the schedules at Q , an equilibrium that could be characterized as “Mill's Intersection” in view of Mill's correct statement of what has become known as Walras' Law.

In the following dynamic argument a partial dynamical approach is taken. More refined dynamical analysis would take account, in the formulation of dynamic hypotheses, of all markets in the system. This is suggested in the appendix, and elaborated more completely in Chapter 21. As a rough approximation, the present formulation probably suffices.

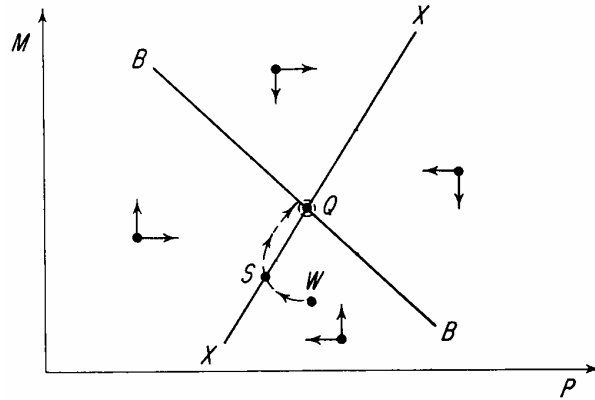


Figure 8-5. The Dynamics of Disequilibrium.

on expenditure, part of which inevitably falls on imported goods.⁷) From *W* deflationary pressure forces the price level down and the balance of payments surplus stimulates a monetary expansion, both forces moving the path of money and prices to a point like *S* on the *XX* line. After *S* the system travels to the equilibrium *Q* either directly or in a spiral, as indicated in Figure 9-5.⁸

The Classical Case and Devaluation

In developing the model we began with the money line *LL*, but in the dynamic computation it was shunted into the background. To be sure, it is implicit in the *XX* and *BB* schedules, because these curves depend on expenditure, which in turn depends on the excess demand or supply of money. But does it not deserve more explicit prominence? Does *LL* not have direct relevance?

Its importance asserts itself in another form than in stability analysis. Its importance lies in the solution of those comparative statics questions that

⁷ I consider the immediate effect of a reduction in the money supply on the balance of payments as of the utmost importance in the adjustment mechanism, quite separate from ultimate effects on income. It accounts for a far more prompt adjustment under fixed exchange rates than has hitherto been realized.

⁸ Strictly speaking, *Q* would no longer be the equilibrium if (1) the initial disturbance implied a change in the real wealth position of the country (as it would if foreign exchange reserves were “annihilated” with no quid pro quo), (2) the process of restoring equilibrium itself influenced capital formation and real wealth (“hysteresis” effects), or (3) the domestic disequilibrium caused a permanent change in foreign wealth positions. In this chapter, which is a first attempt at an exact account of the mechanism, we emphasize first-order effects alone, and it seems legitimate to abstract from these considerations. Subsequent analysis, however, would, it is hoped, take them into account.

involve shifts of demand between domestic and foreign goods without any alteration in the demand for money, and it preserves its importance even for dynamic analysis in the special case where the community maintains equality of expenditure and income, a case that can be identified closely with classical analysis.

To investigate this interesting dynamic phenomenon first, consider Figure 8-6, where it is assumed that spending is always equal to income. Equality

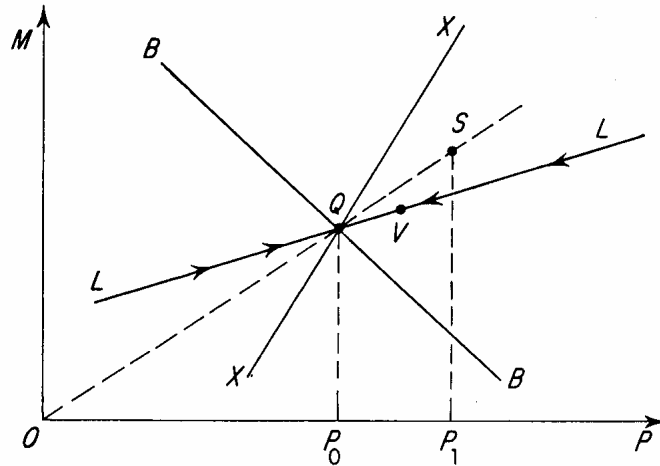


Figure 8-6. The Classical Approach and the Quantity Theory.

of E and Y automatically implies that the excess demand for domestic goods (the degree of inflationary pressure) equals the balance-of-payments surplus. The dynamic path therefore always remains on the LL line and adjustment consists solely of moving up or down the LL line. Under these conditions we should observe a strict conformity of money and the price level (or money income if allowance were made for output changes) to the quantity theory equation.

The special case in which spending is always equal to income, and in which the demand for money is always equal to the supply of money, may properly be designated the classical case: It amounts to the assumption of Say's Law and is the case in which the separation of real from monetary phenomenon is exact. An excess demand for domestic goods is equal to the balance-of-trade deficit, the case in which a correspondence between monetary analysis and pure barter theory can be most closely established.

The quantity theory and the LL line have additional uses in comparative-static analysis involving the shifts of demand between foreign and domestic goods. These shifts may be induced by artificial trade impediments such as tariffs or exchange restrictions, or by exchange-rate adjustments. Let us

consider the case of a devaluation, from an initial position of equilibrium of, say, 50 per cent. What new equilibrium will be established?

We may find the new equilibrium by conducting a hypothetical experiment: What would happen if the domestic price level were doubled, the money supply were doubled, and the exchange rate (the price of domestic currency in terms of foreign currency) were halved. Clearly there would be no change in any real variable because market participants would have the same real money balances and incomes as before, and there would have been no change in relative prices. This is the case in which the purchasing power parity theory of the exchanges, which is the international counterpart of the quantity theory of money, is most relevant.

Devaluation from a position of equilibrium will in fact *induce* a proportionate increase in the price level and the money supply. Again the relation between money and prices will be unaltered, as predicted by the quantity theory. For example, a devaluation, in Figure 8–6, in the proportion of P_0P_1/OP_0 would induce a rise in the price level and the money supply to the level indicated by S , a point along OQ -extended, above LL .

It is hardly necessary to point out, of course, that no country would need to devalue if it were already in equilibrium (unless it needed to accumulate exchange reserves). The usefulness of the analysis is rather in showing the type of *disequilibria* that can be corrected by changes in the exchange rate. We may reverse the procedure and suppose that *equilibrium* levels of money and prices are at Q , but that the price level and the money supply are *actually* at levels indicated by S . Obviously a deflationary process would reduce the price level and the money supply to Q under the automatic fixed-exchange-rate adjustment process. But the deflation involved may be a painful process, and would involve unemployment if factor prices were rigid. The adjustment can be avoided by a devaluation of the proportion of P_0P_1/OP_0 (without any accompanying change in the money supply or the price level).

Budgetary Policy

Still another reason why the LL line is of great importance is in the analysis of *disequilibrium policies*. Suppose the government runs a budget deficit annually, which it finances by money creation. What new “equilibrium” will be established?

To analyze this question we have to go back to the basic equilibrium conditions implicit in the system and introduce government spending, supposing this to be financed solely by money creation,⁹ and a central bank equation

⁹ It could be assumed that government spending is partially financed by taxes, but there is no need to introduce even this minor complication to establish the theoretical conclusion.

determining the money supply. First we have the condition of equilibrium in the home goods market:

$$Y = E + B + G \quad (1)$$

where E (domestic expenditure) is defined exclusive of G (government expenditure). Next we have a definition of the relation between exchange reserves and the balance of trade:

$$B = \frac{dR}{dt} \quad (2)$$

where R represents international reserves. And, finally, we have the banking condition stating that the increase in banking assets is equal to the increase in banking liabilities (the money supply), noting that in this system of no lending the banking authorities, merged with the government, can only hold goods or foreign reserves. Thus

$$G + \frac{dR}{dt} = \frac{dM}{dt} \quad (3)$$

remembering that G represents both the value of government spending and the budget deficit. Now if the domestic goods market is in balance [that is, if equation (1) is satisfied] and total expenditure equals income, it follows that

$$B + G = \frac{dM}{dt} = 0 \quad (4)$$

is a condition of equilibrium. This equality between the balance of payments deficit and the deficit in the government budget represents a condition of "quasi equilibrium."

Consider point V in Figure 8-6. This shows the nature of the quasi equilibrium that would result from a budget deficit financed by credit creation. The money supply is constant, but this is because the increase in domestic assets of the banking and government sector is exactly matched by a decrease in the foreign assets of that sector. The government, which may initially try to finance its deficit by creating more money, finds that its deficit is really being financed out of foreign exchange reserves; in every other respect the system is in equilibrium. Of course, the process cannot go on forever, because exchange reserves are not inexhaustible; it is in that sense that position V is a quasi equilibrium.

By a similar analysis it can be shown that, by means of a budget surplus, a country can attract reserves at a rate equal to a budget surplus of the government, after equilibrium has been reestablished in all other markets and sectors

The Transfer Problem

We may consider next how analysis of the transfer problem fits into the model. When there are international transfers, the equations of equilibrium have to be supplemented. Before we used three equations:

$$Y - E = B$$

establishing equilibrium in the market for goods and services.

$$Y - E = 0 \quad \text{or} \quad M - L = 0$$

establishing equality of expenditure and income or equality of demand for money (L) and supply of money (M), and

$$B = 0$$

specifying balance of payments equilibrium. To take account of international transfers we have instead

$$Y - E = B \tag{5}$$

as before, for the market for domestic goods and services, but then

$$Y - E = T \tag{6}$$

for equality of income and expenditure plus transfers abroad (Y being denned as before exclusive of transfers), where T represents net outward transfers, and

$$B - T = 0 \tag{7}$$

establishing balance-of-payments equilibrium, that is, equality of the balance of trade surplus and outward transfers (or net capital exports).

To illustrate the transfer process let us consider the effect of an inward transfer so that T is negative; the country receives foreign aid or borrows. Following the traditional transfer analysis, expenditure in the rest of the world falls, and expenditure at home rises, by the full amount of the transfer, directly affecting the balance of trade. Part of the decrease in expenditure abroad reduces exports, and part of the increased expenditure at home increases imports. The financial transfer gets at least partially effected in real terms by the direct impact of the expenditure changes before any effects have been felt on the balance of payments.

Whether the financial transfer is overeffected or undereffected depends on the size of the marginal propensities to spend on imports, as compared to home goods, out of domestic expenditure inclusive of the transfer. If the

marginal propensity to consume domestic goods in the receiving country exceeds the foreign marginal propensity to import, the result of the transfer will be an excess demand for domestic goods and a surplus in the balance of payments, which will induce an increase in the domestic price level as money flows in. In other words, a position on the LL line up and to the right of Q will be the new equilibrium.

If, on the other hand, the marginal propensity to consume domestic goods in the receiving country is less than the foreign marginal propensity to import, the primary effect of the transfer is to shift demand away from domestic goods, worsen the balance of payments, and induce a fall in domestic prices as the money supply declines.

In the intermediate case where the domestic marginal propensity to consume domestic goods is equal to the foreign marginal propensity to import, there is no change in the price level or the terms of trade. The expenditure changes caused by the direct effects of the transfer are the same as the final effects; the receiving country buys, as a result of the transfer, just those goods which the rest of the world gives up.

Thus, even in the case where monetary elements are explicitly introduced into the transfer analysis, the effect of the transfer on the terms of trade is ambiguous. Nothing a priori can be asserted. There is no reason to suppose, unless aid is “tied” or without specific empirical information, that the receiving country gains by more or by less than the normal amount of the transfer.¹⁰

Growth and Liquidity

In an economy that is growing over time the money supply will be rising over time and with it the willingness of the monetary authorities to acquire reserves. In this case we can relate the budget deficit or surplus to the rate of growth.

First note that if the nongovernment sector of the community wants to accumulate money, it must spend less than it earns, so that

$$Y - E = \frac{dL}{dt} \quad (8)$$

where dL/dt is the desire to accumulate money over time.

¹⁰ This conclusion would have to be altered if it were assumed that the demand for the stock of money in each country were itself dependent, not only on the value of domestic production, but on national income, inclusive of the transfer from abroad. This is an unsolved problem in monetary theory that is of considerable potential significance. In practice willingness to hold money will depend on the past nature of the transfer, and in particular whether working balances arising from the use to which the capital import is put are held in foreign currency or in domestic currency.

Next recall that a balance of trade surplus results in an increase in reserves, so that

$$B = \frac{dR}{dt} \quad (9)$$

Finally, note the condition that increases in official foreign and domestic assets (net public spending) equal increases in monetary liabilities (the money supply), so that, as before,

$$\frac{dR}{dt} + G = \frac{dM}{dt} \quad (10)$$

Then it follows that when $dM/dt = dL/dt$, that is, when the community's desires for additional money are satiated at existing prices, there is also equilibrium in the market for goods and services, as

$$B + G = \frac{dM}{dt} = \frac{dL}{dt} = Y - E \quad (11)$$

Now let the desire to accumulate money be proportionate to the growth of money income so that

$$\frac{dL}{dt} = k \frac{dY}{dt} \quad (12)$$

We also have from (1) and (10) that

$$\frac{dM}{dt} = B + G \quad (13)$$

so that growth equilibrium requires

$$B + G = k \frac{dY}{dt} = k \left(\frac{1}{Y} \frac{dY}{dt} \right) Y = k\lambda Y \quad (14)$$

where λ is the rate of growth of output. If the rate of growth is positive, the budget deficit will no longer equal the balance of trade surplus. The sum $B + G$ must equal the resources sacrificed by the private sector to build up its cash balances over time.

Now assume that the authorities want to keep a fixed proportion of reserves to back domestic money creation, so that

$$R = \alpha M \quad (15)$$

where α is a fraction. Then, if this holds over time we have

$$\frac{dR}{dt} = \alpha \frac{dM}{dt} \quad (16)$$

so that, if we substitute for dR/dt making use of (10) we get

$$G = (1 - \alpha) \frac{dM}{dt} \quad (17)$$

or

$$G = (1 - \alpha) k \lambda Y \quad (18)$$

after making use of (13) and (14). If (18) is now put in (14) we get

$$B = \alpha k \lambda Y \quad \text{or} \quad \frac{B}{Y} = \alpha k \lambda \quad (19)$$

In other words, the balance of trade surplus, expressed as a proportion of income, that is required to satisfy both the community's appetite for money and the authorities' appetite for reserves, is proportionate to the rate of growth, the factor of proportionality being αk , the ratio of foreign reserves to national income.

But we must take account of the fact that interest may be paid on the foreign reserves held by the monetary authorities; let us assume it is paid at the rate r . Then interest becomes a foreign exchange receipt and the balance-of-payments equation, instead of (9), becomes

$$B + rR = \frac{dR}{dt} \quad (20)$$

The increase in the money supply is then determined by the equation

$$G + \frac{dR}{dt} = rR + \frac{dM}{dt} \quad (21)$$

because the interest payments now represent a source of government finance supplementary to money creation. In this case the required balance of trade expressed as a proportion of national income, turns out to be

$$\frac{B}{Y} = (\lambda - r) \alpha k \quad (22)$$

while the budget deficit is

$$\frac{G}{Y} = -(\lambda - r)\alpha k. \quad (23)$$

To summarize, the balance of trade must be positive or negative, for monetary growth equilibrium, including growth of exchange reserves, depending on whether the domestic rate of growth exceeds or falls short of the rate of interest paid on foreign exchange reserves. By leaving its reserves on deposit, in a foreign center such as New York or London, a country may well finance the bulk of its additional reserve needs.

Conclusions

I have attempted to extend some of the theoretical conclusions of classical international trade theory in a wider framework using a simple model that can be reconciled with classical and Keynesian concepts. The basic assumption, that there are no securities, means that monetary and fiscal policies are not distinct from one another and that balance-of-payments problems persist because of the failure of the authorities to balance the budget. This model is not irrelevant to many of the less developed countries, and it contains insights into the adjustment process for developed countries as well.

Devaluation is a means by which a country, whose prices and costs have got out of line internationally, can restore equilibrium without the less attractive alternatives of deflation or trade and exchange controls. Bygones have to be accepted as bygones. However, looking prospectively rather than retrospectively, incipient deficits can be prevented by a monetary policy that is directed at preserving equilibrium in the balance of payments rather than at financing budget deficits.

International capital movements or foreign aid need not present balance-of-payments difficulties for either the receiving or transferring country. The bulk of the transfer may be effected in real terms by direct expenditure effects, and it may even be overeffected. In any case the residual gap to be corrected by the adjustment process is necessarily smaller than the initial transfer.

A growing country should make some provision for increasing its international reserves over time to provide the extra safety, convenience, choice of adjustment measures, and cushioning for bad harvests that foreign reserves can provide. But a secular growth of reserves does not require a balance of trade surplus if reserves are held in the liquid assets of a deposit center and interest is paid on them. In this connection, it should be remarked that the attachment to a major currency area such as the dollar area or a sterling area presents, for a smaller country, an opportunity that many current plans for international monetary reform do not provide.

As a rule of thumb, for a growing country, provision should be made for an increase in the money supply every year. But the proper rule is not to fix attention on a constant rate of growth of the money supply, as suggested by Friedman; the spirit of this rule is maintained only if the Friedman's companion proposal of flexible exchange rates is accepted. Instead, the authorities should keep in mind a rate of central bank *credit expansion* more or less equal to the rate of growth after making due allowance for income elasticities of credit demand differing from unity and altering needs for real money balances in the economy. This leaves room for the adjustment process to operate under fixed exchange rates, because it implies that the money supply will grow at a slower or faster rate than central bank credit expansion depending on whether there is a deficit or surplus in the balance of payments.

Fixed exchange rates, coupled with an absence of controls and a monetary policy that pays close attention to the balance of payments, can be a powerful instrument for generating the confidence needed to attract foreign capital. For the smaller countries there is no alternative system better adapted for generating a climate in which rapid growth can take place. It is difficult to see how the policies currently adopted by many of the smaller less developed countries, with the proliferation of controls, inflated budgets, and excessive inflation,¹¹ can be conducive to attracting needed capital imports or encouraging private investment to proceed in a stable environment of confidence. A restoration of freer commodity and exchange markets, fewer controls over the private sector of the economy, and greater automaticity in the balance-of-payments adjustment process could lay an improved foundation for a properly run, efficiently managed country.

APPENDIX

Three Monetary Standards

The text restricts the analysis to the case of a fixed exchange system. The method, however, is easily generalized to alternative monetary standards. This appendix is designed to illustrate a method of analyzing these alternative standards and to show how the results can be generalized.

For purposes of analysis let us identify three markets—goods, foreign exchange, and money—in the economic system and let X , F , and L denote, respectively, the flow excess supplies in these markets. Assume that the conditions of market equilibrium depend on the domestic price level, the price

¹¹ I have discussed elsewhere the growth argument for inflationary finance [75].

of foreign exchange, and the stock of money. Then we have three conditions of equilibrium as follows:

$$X(P, \pi, M) = 0 \tag{24}$$

$$F(P, \pi, M) = 0 \tag{25}$$

$$L(P, \pi, M) = 0 \tag{26}$$

Under suitable assumptions we can identify $X = 0$ with $Y = E + B$, $F = 0$ with $B = T$, and $L = 0$ with $Y = E + T$, where Y , E , B , and T are now all interpreted in a behavioral (ex ante) sense. On the basis of this identification it can be seen that the three equations are interdependent, since $X = 0 = F$ implies $Y = E + T$, $X = 0 = L$ implies $B = T$, and $F = 0 = L$ implies $Y = E + B$. The equations are homogeneous of the first degree if X , F , and L are interpreted in value terms, and homogeneous of zero degree if they are expressed in real terms.

There are three cases of special interest worth isolating: (1) M is constant and π and P are variable, (2) π is constant and M and P are variable, and (3) P is constant and M and π are variable. The first case may be referred to as the monetary standard (the stock of money is fixed), the second as the international standard (this is the case analyzed in the text), and the third as the commodity standard.

The three standards are illustrated by Figures 8-7a, 8-7b, and 8-7c on the assumption that goods, money, and foreign exchange are all substitutes for one another. This information is sufficient to establish the condition of disequilibrium true for each diagram indicated in Table 8-1.

Table 8-1

Market Zone	Excess Supply of Goods (X)	Excess Supply of Foreign Exchange (F)	Excess Supply of Money (L)
I	+	+	-
II	+	-	-
III	+	-	+
IV	-	-	+
V	-	+	+
VI	-	+	-

The arrows in the zones indicate the movement of the (two) variables for each of the three standards under the most plausible dynamic assumptions. Thus, if the supply of money is fixed (Figure 8-a), the exchange rate will appreciate (depreciate) when there is an excess demand for (supply of) both

Figure 8-7a.

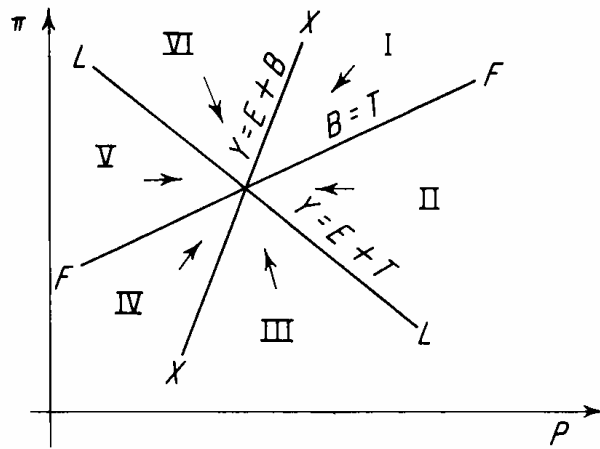


Figure 8-7b.

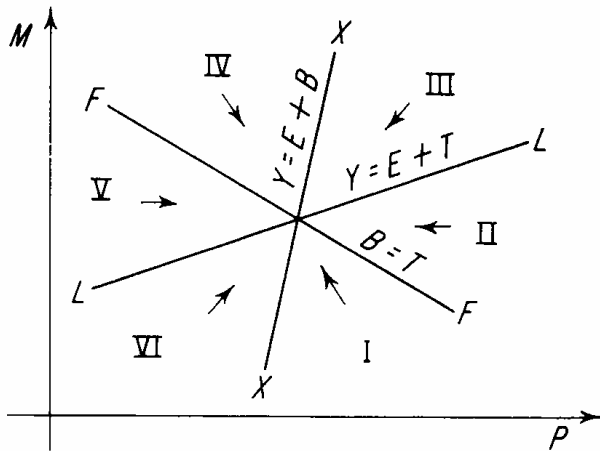
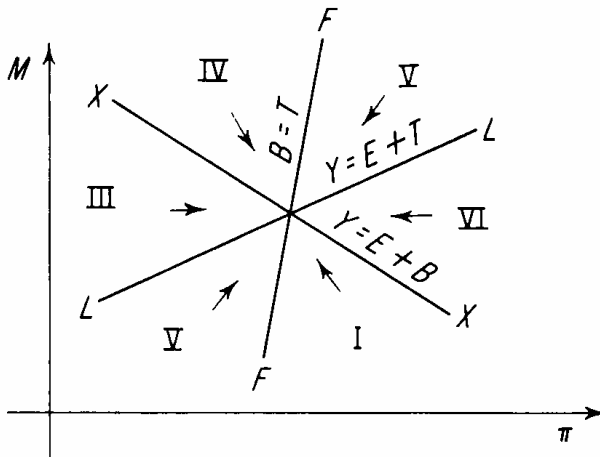


Figure 8-7c.



goods and money; the price level will rise (fall) when there is an excess supply of both money and foreign exchange; and both the price level and the price of foreign exchange will rise (fall) when there is an excess demand for (supply of) both domestic goods and foreign exchange. A similar analysis applies when the money supply is variable and either the price of domestic goods or the exchange rate is stabilized once it is recognized that stabilization policy implies that the authorities are purchasing or selling the stabilized object and thus increasing or decreasing the money supply whenever there is, respectively, an excess demand or supply of the stabilized object.

This development provides a general framework within which balance-of-payments problems can be studied under various exchange systems. In each of the diagrams the balance of payments is in disequilibrium whenever the domestic price level, the exchange rate, or the money supply does not generate a point on the *FF* lines in any of the graphs. Cases of disequilibrium in the balance of payments imply disequilibrium in other markets, and after the counterparts are identified the direction of the equilibrium points, and therefore the required movements of the other variables in the system, can be ascertained.

The analysis, moreover, is readily generalized to any number of commodities, following traditional general equilibrium lines. In the foregoing, for example, it is implicitly assumed that wages and domestic prices move together. Suppose, however, that there are excess demands for the *l* types of goods, X_1, \dots, X_l ; *m* types of labor, N_1, \dots, N_m ; *n* types of foreign exchange, F_1, \dots, F_n ; and domestic money. Then the homogeneity and interdependent properties of the above system are retained in the following generalized case:

$$\text{Goods: } \frac{X_1(P_1, \dots, P_l; W_1, \dots, W_m; \pi_1, \dots, \pi_n; M)}{X_l(P_1, \dots, P_l; W_1, \dots, W_m; \pi_1, \dots, \pi_n; M)} = 0$$

$$\text{Labor: } \frac{N_1(P_1, \dots, P_l; W_1, \dots, W_m; \pi_1, \dots, \pi_n; M)}{N_m(P_1, \dots, P_l; W_1, \dots, W_m; \pi_1, \dots, \pi_n; M)} = 0$$

$$\frac{F_1(P_1, \dots, P_l; W_1, \dots, W_m; \pi_1, \dots, \pi_n; M)}{F_n(P_1, \dots, P_l; W_1, \dots, W_m; \pi_1, \dots, \pi_n; M)} = 0$$

$$\text{Money: } L(P_1, \dots, P_l; W_1, \dots, W_m; \pi_1, \dots, \pi_n; M) = 0$$

where the *P*'s denote prices, the *W*'s wages, and the *π*'s exchange rates.

Chapter 9¹ / *Growth and the Balance of Payments*

A dominant theme of post-World War II writing on international adjustment theory is that the balance of payments is a restraining factor upon economic growth. From the balance-of-payments equation (ignoring capital movements),

$$B(t) = X(t) - M(t) \quad (1)$$

where X = exports, M = imports, and t = time, and an import demand function of the form

$$M(t) = a + mY(t), \quad (2)$$

where m is the marginal propensity to import, we get

$$B(t) = X(t) - mY(t) - a. \quad (3)$$

On the basis of (3) it can be argued that increases in Y , for any given time path of exports, must lower the rate of increase of foreign reserves. Hence countries that are growing rapidly relative to the rest of the world will

¹ This chapter is an excerpt from a wider study of monetary adjustment and growth processes. The basic model was used in public lectures at the Graduate Institute of International Studies in Geneva in the spring of 1965 to elaborate the concepts of seigniorage, and optimal money holdings. In my Frank Graham Memorial Lecture (given at Princeton in April 1966), I extended the analysis, using Figure 9 – 1, to show: (1) the costs and benefits of replacing an international circulating medium by national credit money; (2) that the optimal quantity of money results when interest is paid on national credit money at a rate equal to $i = (1 - \alpha)r$ where r is the rate of return on other assets and α is the ratio of foreign reserves to domestic money; (3) that an optimally constructed world central bank would pay an interest rate on international money as a proportion of the world interest rate equal to the proportion of interest-bearing assets to total (interest-bearing plus gold-type) assets; (4) that the issuing of new reserves (to “finance” noninflationary growth) in proportion to existing reserves would be a practical means of paying interest on world money, which, however, would stimulate optimal world reserve holdings only if the world were growing at a rate conforming to the “Golden Rule.”

eventually have to impose increasing trade restrictions, or reduce their rate of growth, to maintain the existing exchange parity. Alternatively their currencies must undergo progressive devaluation.

No theory advanced in the postwar era has been more greatly in conflict with the facts. One could point to the experience of “surplus” countries (for example, Germany, France, Italy, Austria, Holland, and Peru), as examples of countries with convertible currencies that have grown rapidly, and to the experience of “deficit” countries (for example, the United States, the United Kingdom, and Belgium), as examples of countries that have grown relatively slowly. However, this appeal to facts is quite unnecessary, because the theory itself is inadequate and misleading. High growth rates per se might just as well be said to induce balance-of-payments surpluses, not deficits.

Money, Trade, and Growth

To demonstrate the correct connection between growth and the balance of payments in the simplest possible way, we ignore all irrelevant complications by using a model of an open economy that trades goods with the rest of the world at given international prices and uses international reserves as its domestic currency. The conclusions do not depend on capital mobility, but they remain valid when such mobility exists, so we shall assume capital is completely immobile.

Under these assumptions the equilibrium of the system and the balance of payments rests on two major choices confronting the citizens (or residents); the division of assets between money and capital, and the division of income between current consumption and saving. We assume that the first (portfolio) decision is based on interest rate considerations, identified here with the rate of return on capital; and that the second (saving) decision is based on time preference considerations exogenous to the model itself.

In Figure 9–1 the horizontal axis depicts the net wealth of the community, assumed to be composed of money and capital assets, and any point along it implies a specific division of wealth between money and capital. The vertical axis depicts the rate of interest, which is assumed to be equal to the rate of return on capital.

The schedule LL' , drawn in relation to the origin, O , describes the marginal efficiency of money for given quantities of money represented on the horizontal axis, and the schedule KK' , drawn in relation to the other origin, O' , measures the marginal efficiency of capital for given quantities of capital. Both schedules are assumed to obey the law of diminishing returns and are, for simplicity of exposition, assumed to be independent in the sense that the marginal productivities of money and capital depend only on the quantities of money and capital, respectively.

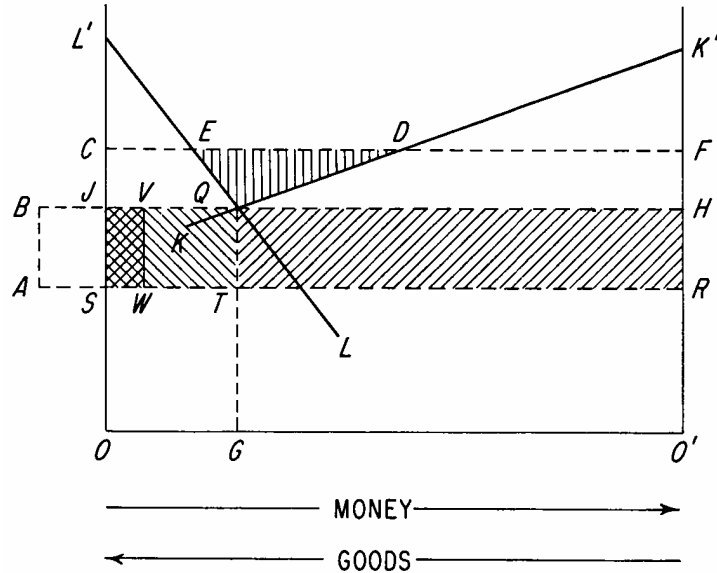


Figure 9-1.

The two schedules determine the division of wealth between money and capital. Consider, for example, the interest rate OC . At this interest rate the community wants to hold CE of money and DF of capital, a sum that falls short of its wealth by the amount ED and implies an equal excess demand for securities. If the world capital market were integrated, the excess ED would be invested abroad. But we assume no international borrowing, so the interest rate would be driven down to GQ , where the community is just exactly willing to hold its available stock of wealth.

At the equilibrium interest rate GQ the community holds OG of money and $O'G$ of goods. Measured national income in the conventional sense is $O'GQK'$, composed of $O'GQH$, the return to capital, and HQK' , the return to factors cooperating with capital. But real national income is the area $OL'QK'O'$, greater than measured national income by the sum of the area $OJQG$, the psychic return to real money balances, and the area JQL' , the return to factors cooperating with money ("shopping services"). (If capital were mobile and the world interest rate were OC , the area EQD would have to be added to account for the fact that total interest receipts from capital invested abroad, the product $ED \cdot OC$ exceeds the opportunity cost of employing the capital and money at home.)

Let us suppose the community saves a part of its income, say, the area $SJHR$. Then the growth rate, the rate at which its wealth is increasing, is $SJ(=RH)$. What does this growth rate imply for the balance of payments?

Given the saving decision the community makes a portfolio decision at the

margin. To preserve the ratio of money to real assets represented by the initial ratio $OG/O'G$, the community must divide the objects of its saving into two parts; nonconsumption of real capital of an amount equal to $TQHR$; and acquisition of money equal to the area $TSJQ$. Because international reserves are not produced at home, the community must acquire them from abroad by running an export surplus. The fact of growth therefore implies a balance-of-payments surplus. Net exports of $TSJQ$ will be exchanged for $TSJQ$ of international money. The decision to save per se implies a decision to acquire additional money balances, and when money balances are equivalent to international reserves this implies a balance of payments surplus.

Allowance for Credit Creation

The analysis is nevertheless not dependent on the assumption that domestic money and international reserves are equivalent. Suppose that international reserves are maintained by the central bank in a constant ratio to its domestic monetary liabilities, with a fractional reserve requirement of, say, one fourth. Let JV be one fourth the distance JQ . Then, as before, additional money of $SJQT$ is desired by the public, and the central bank supplies this by purchasing $SJQT$ of domestic assets and exchanging $SJVV$ of them for international reserves. Alternatively, this can be expressed by saying that the central bank purchases $WVQT$ of domestic assets while the community acquires $SJVV$ of foreign assets by reducing their spending beneath income-plus-credit creation by the amount $SJVV$; this amounts to running a balance of payments surplus of $SJVV$, and it means that the central bank will acquire additional reserves, at the same time increasing the public's holding of domestic money. However it is explained, the mechanism is the same. The growing country runs a balance of payments surplus equal to the required increase in reserves.

It is true, of course, that the central bank can prevent this result from occurring if it progressively lowers its reserve ratio. It can monetize all the assets the private community wants to commit to additional money holdings and thus prevent a balance-of-payments surplus from arising, as Japan has done for the past decade. It can generate a balance of payments deficit by "credit creation" (the purchase of domestic assets) in excess of hoarding, or whatever balance of payments deficit or surplus it wishes.² But this is the

² Hoarding (desired increase in money balances) is, in the diagram, the area $SJQT$, and the balance surplus per unit of time is the difference between this area and the purchase of domestic assets by the government or banking system. The case of a deficit is easily represented by expanding the area $WVQT$ in excess of $SJQT$. Thus, if the central bank's purchase of nonreserve assets were $ABQT$, its loss of reserves per unit of time would amount to $ABJS$. The essential point to notice is that balance-of-payments deficits are monetary phenomenon induced by explicit policies of the monetary authorities.

consequence of deliberate policy and in no way detracts from the generality of the proposition that growth per se induces a balance of payments surplus.

Defects of Traditional Theory

One way of interpreting the mistake in the traditional analysis is that it makes the demand for international goods depend on income rather than domestic expenditure and thus misses the connection between the demand for international goods (more generally, all consumption) and liquidity requirements. From the balance-of-payments identity we have

$$X - M = R \quad (4)$$

where R is the change in reserves (identified here with the money supply), and from the community's sectoral restraint we have

$$Y - E = \dot{L} \quad (5)$$

where Y is income, E is domestic expenditure, and L growth in the demand for liquidity. If the demand for money, at a given rate of interest, is

$$L = kY \quad (6)$$

then

$$L = k\dot{Y} = k\lambda Y \quad (7)$$

where λ is the rate of growth.

Substituting (7) in (5) yields

$$Y - E = k\lambda Y \quad (8)$$

or

$$E = (1 - k\lambda)Y \quad (9)$$

In the general case, both exports and imports will be affected by a reduction in expenditure. But the case most unfavorable to my argument is that in which exports are entirely determined by exogenous considerations, so we shall retain the usual assumption that exports are an exogenous function of time. If we then replace the import demand function as written in (2) by

$$M(t) = a + mE(t) \quad (10)$$

and substitute (9) for E we get

$$M(t) = a + m(1 - k\lambda)Y(t) \quad (11)$$

and the balance-of-payments equation³

$$B(t) = X(t) - m(1 - k\lambda)Y(t) - a \quad (12)$$

This equation shows that the rate of growth of income, λ , affects the balance of payments favorably.

³ More generally, if foreign reserves are only a fraction, α , of the money supply, the import function is $M(t) = a + m(1 - k\alpha\lambda)Y(t)$. The analysis is easily generalized to take account of the reduction in home demand for export goods due to liquidity needs, an additional factor, especially important in a large country, in automatically generating the required balance-of-payments surplus. Notice, however, that (12) implies monetary equilibrium in the sense that the community is getting the additional quantity of money it desires; the contrary assumption, that the community remains in monetary disequilibrium over the time period in which balance of payments analysis is relevant, is, in my view, wholly untenable.

Chapter 10 / *The Balance of Payments*¹

From the earliest times trade has involved discrepancies in values exchanged, settled in credit or money, and these discrepancies constitute the origin of the concept *balance of payments*. The generic meaning of the term today is the excess of receipts over payments of *any* economic entity, although the concept was initially applied to, and received its greatest elaboration in, the theory of international trade. The term itself entered the English economic literature during the mercantilist period, eventually replacing “overplus,” “remanyne,” “overvalue,” “balance of accounts,” “balance of remittance,” and “grand balance of payments” ([103], pp. 1, 13, 14).

In its original usage, balance of payments meant an “excess of payments over receipts” and under the gold standard this excess meant a gold outflow. But the term soon acquired the neutral meaning of the “state of the balance of international accounts,” whether negative or positive. Thus one speaks of a “balance of payments problem” whether gold is flowing in or out, and the term “balance of payments theory” is used to cover the entire subject, not just that aspect of it pertaining to an excess of payments.

The mercantilists used the adjectives “favorable” and “unfavorable” to identify, respectively, inflows and outflows of gold, but these terms were rejected during the classical reaction to mercantilism on the grounds that goods, not gold, constituted true wealth and that there was nothing intrinsically favorable about an export of goods in exchange for gold. Alternative terms like “active” and “passive” and “positive” and “negative” came into temporary favor, but they proved equally unsatisfactory; there is nothing “passive” about a gold outflow, for example. The terms in favor today are *surplus* and *deficit*, and their identification with accounting practice renders them free of any important ambiguity.

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Definition

The balance sheet of international accounts or “accounting balance of payments,” is a statement recording transactions between residents (or citizens) of a given country and the rest of the world. Transactions are either *debit items*, which arise from *purchases*, or *credit items*, which arise from *sales*. Sales of goods, of claims, and of gold and foreign exchange are credit items, and purchases of goods, of claims, and of gold and foreign exchange are debit items.

All transactions (sales or purchases) have a dual character—a sale of something implies a purchase of something else. When a good is sold for money, the ownership of the good and the ownership of money change hands in opposite directions, the ratio between the two payments being the money price of the good. It follows that the value of the goods payment equals the value of the money payment, so that the sum of debit items arising from purchases is equal to the sum of credit items arising from sales.

The identity between debits and credits is preserved even when transactions include gifts, reparations payments, and other unrequited transfers. In the balance of payments accounts an unrequited transfer to foreign residents is recorded as a debit, and the means by which the transfer is financed (a sale of goods, of claims, or of gold or foreign exchange itself) is recorded as a credit. Thus the accounting balance of payments is a tautology, and therefore it has no economic (market) significance. Its significance lies rather in its role as the basis on which accounts are organized and as the starting point from which balance of payments analysis proceeds.

The accounting balance of payments records both regular transactions *and* transactions made to settle any gap between regular purchases and sales [102]. The problem in constructing a useful *operational* definition of the balance of payments is thus the problem of separating “regular” transactions from “settling” transactions, a distinction best suited to the purpose of balance-of-payments analysis.

The balance of payments, if operationally defined in this way, can be regarded as an “error signal” announcing the need for a change in economic policy, a signal of actual or potential threat to the existing exchange system. Since exchange rates are typically “pegged” to some international asset at a fixed price (usually with a small margin between buying and selling rates), the authorities must maintain stocks of the international asset, and the balance of payments ought to reflect present or future threats to the size of those stocks. It is this feature of the present exchange-rate system that suggests a definition of the balance of payments as *the change in international reserves*, thus converting the burden of finding an operational definition of the balance of payments into the problem of determining which assets are to be counted as international reserves.

Of the assets to be counted among reserves the most important—in the sense that it is the most immediately useful—is the one to which the currency is pegged. To a country whose currency is pegged to gold the most important reserve is gold; to a country whose currency is pegged to the U.S. dollar the most important reserve is the U.S. dollar; and so on for countries whose currencies are pegged to the pound sterling, the franc, or some minor international currency.

Most countries also hold (what they regard as) reserves in assets that are close substitutes for the asset to which they peg their currencies. The United States today (1968) pegs the dollar to gold and holds the bulk of its reserves in gold; the United Kingdom, however, pegs the pound sterling to the dollar yet holds the bulk of its reserves in gold. Other countries hold gold, dollars, and sterling in varying proportions that reflect not their immediate exchange stabilization needs but the asset preferences of the monetary authorities in charge of the reserves [38]. Since gold, dollars, and sterling are all acceptable reserve assets, substitutable for one another at a fixed price (within small margins), a central bank can diversify its portfolio of assets beyond that immediately needed for working balances.

There is a third category of assets, the changes in which are (and should be) incorporated into the balance of payments. In 1946, when operations of the International Monetary Fund began, each member country deposited with the IMF a subscription, of which 25 per cent was paid in gold and 75 per cent in its own currency; on the basis of this subscription that country can “draw” (that is, borrow) other convertible currencies, depositing in exchange additional quantities of its own currency. In other words, when a country draws from the IMF it sells its own currency to the IMF and acquires in exchange a foreign (convertible) currency that it “needs,” and when a country repays a drawing on the IMF it “repurchases” its own currency, paying for it with a convertible foreign currency. Drawings from the IMF constitute a credit item in the balance of payments, and repurchases constitute a debit item, since drawings represent a receipt of foreign exchange and repurchases a payment. To these transactions a country must add the transactions of other member countries in its currency when they draw or repurchase, and the net sum of all such transactions in the time during which the balance of payments is measured is called the change in the *net fund position* (the difference between the subscription or quota and IMF holdings of the domestic currency). Because changes in the net fund position affect a country's liquidity in the sense that they alter the country's capacity to defend its exchange system, those changes should be counted in an operational definition of the country's balance of payments, along with changes in gold and in holdings of convertible currencies.

Before analyzing the implications of this definition in a global context, it is necessary to clear up a source of some confusion among nonspecialists about the “time dimensions” of the balance of payments.

The balance of payments—the change in reserves over time—is a *flow per unit of time*. But items recorded in the balance-of-payments accounts (like the national income accounts) represent the accumulated flow over a *specified period of time*. The balance of payments of a country over, say, a year is the integral of the flow during the year and thus is a stock.

Suppose reserves, R , fluctuate between time $t = t_0$ and time $t = t_1$ according to the equation $R = R(t)$. Then the balance of payments equation, $B(t) \equiv dR/dt \equiv R'(t)$, reflects the slope of the function $R(t)$; conversely, $R(t)$ reflects the integral of $B(t)$ over past history. If the time from t_0 to t_1 is, say, a year, then \bar{B} , the balance of payments over the year, is

$$\bar{B} = \int_{t_0}^{t_1} B(t)dt,$$

where $\bar{B} = \Delta R \equiv R_{t_1} - R_{t_0}$. The stocks of reserves at given periods of time are therefore related to the balance of payments by equations like

$$R_{t_1} = R_{t_0} + \int_{t_0}^{t_1} B(t)dt.$$

Analogous concepts apply to every entry in the balance-of-payments accounts. Thus if $C(t)$ represents the net balance of payments (surplus) on *capital* account at time t , then D_{t_1} , the accumulated net debtor position of a country at time t_1 , is

$$D_{t_1} = D_{t_0} + \int_{t_0}^{t_1} C(t)dt,$$

where D_{t_0} represents the initial debtor position at time $t = t_0$.

International Consistency

Analytical precision requires that balance of payments definitions be internationally consistent. To develop the analysis in a global context, then, we divide a country's accounting balance of payments into regular and settling transactions. Thus if B_i denotes the balance of regular transactions of country i and B'_i the balance of settling transactions, we have a balance of payments identity, true for each of n countries in the world:

$$B_i + B'_i \equiv 0. \quad (1)$$

Since B'_i represents the *net exports* of the settling items (balance-of-payments

deficit), $B'_i < 0$ implies *increasing* international reserves. Specifically, $B'_i + dR_i/dt \equiv 0$, where R_i is the level of reserves in country i and

$$B_i \equiv \frac{dR_i}{dt}. \quad (2)$$

For all countries,

$$\sum_{i=1}^n B_i \equiv \sum_{i=1}^n \frac{dR_i}{dt} \equiv \frac{dR}{dt} \quad (3)$$

(where R represents world reserves), and unless both sides of the identity equal zero it appears that the global balance of regular transactions,

$\sum_{i=1}^n B_i$, can be other than zero!

The apparent paradox is, of course, easily dismissed. The balance of the payments of the world as a whole is identically zero; this identity has become known as Cournot's law because of the extensive use Cournot made of the proposition. Cournot's law, however, does not imply that the balance of payments of the world *excluding the transactions of the monetary authorities* (B'_i) is necessarily zero. The inequality $dR/dt > 0$ simply means that the monetary authorities are acquiring, collectively, reserve assets from the private sector, whereas $dR/dt < 0$ means they are losing reserve assets to the private sector.

Assume, for example, that central banks peg their currencies to gold and hold no other reserve assets, as is the case under (one version of) the gold standard, and start with the accounting identity (1) above. The settling transactions, B'_i , are central bank net trade in gold (net purchases if positive, net sales if negative) with private markets. If we now separate the net balance of trade in gold from B_i , we have

$$B_i = B_i^* + B_i^g \quad (4)$$

the balance of regular transactions, and (1) becomes

$$B_i^* + B_i^g + B'_i \equiv 0, \quad (5)$$

where B_i^g denotes net exports of gold from the private sector and B_i^* includes everything else in B_i . Then, since $B'_i \equiv -dR_i/dt$, we can rewrite (5) as

$$B_i^* + B_i^g \equiv \frac{dR_i}{dt}. \quad (6)$$

For all countries,

$$\sum B_i^* + \sum B_i^g \equiv \sum \frac{dR_i}{dt}, \quad (7)$$

where the summations extend over all countries. But $\sum B_i^*$ represents the net exports of (nongold) commodities in the world as a whole and must be zero, and so of course

$$\sum B_i^g \equiv \sum \frac{dR_t}{dt}. \quad (8)$$

The net private exports of gold in the world as a whole equals the sum of the gold purchases of the monetary authorities [26].

When gold production exceeds the disappearance of gold for use as hoards, in industry, and in the arts, world monetary reserves increase, and when gold production falls short of total private uses, world monetary reserves decrease. In other words, there is an excess of surpluses over deficits, or an excess of deficits over surpluses, in the world as a whole, depending on whether gold production exceeds, or falls short, of new private purchases of gold.

A similar analysis can be developed for the key currency system. Assume that countries hold reserves not only in gold but also in the national currency of a particular country—for example, the United States—designated country 1, and proceed as before by dividing the balance of payments accounts of the typical country into regular and settling transactions ($B_i + B'_i \equiv 0$).

A distinction must now be made between the reserve center (country 1) and the rest of the world. For the other countries, 2, . . . , n , the settling transactions are composed of sales of both gold and dollars, whereas the settling transactions of the reserve center will be gold sales alone or gold sales plus an increase in the dollar assets held by foreign countries, depending on whether a *net* or *gross* concept of reserves for the reserve center is used.

Denote the gold assets of country i by G_i and its dollar assets by C_{1i} . Then the balance of payments of the n countries can be defined as follows, using a *net* concept of reserves for the reserve center.

$$\begin{aligned} B_1 &\equiv \frac{dG_1}{dt} - \frac{dL_1}{dt} \\ B_2 &\equiv \frac{dG_2}{dt} - \frac{dC_{12}}{dt} \\ B_n &\equiv \frac{dG_n}{dt} - \frac{dC_{1n}}{dt} \end{aligned} \quad (9)$$

where L_1 , the liabilities of the reserve center to the rest of the world, is identically equal to $\sum_{i=2}^n C_{1i}$, since the “dollar liabilities” of the United States (country 1) are the same as the dollar assets of the rest of the world.

Under this (net) concept of the first country's balance of payments, the

excess of surpluses over deficits in the world as a whole is the same as under the gold standard, since

$$\sum_{i=1}^n B_i \equiv \sum_{i=1}^n \frac{dG_i}{dt} + \sum_{i=2}^n \frac{dC_{1i}}{dt} - \frac{dL_1}{dt} \equiv \sum_{i=1}^n \frac{dG_i}{dt}. \quad (10)$$

But had we used a gross concept of the reserves of the key currency center, the balance of payments of country 1 would instead have simply been written $B_1 \equiv dG/dt$ with dL_1/dt incorporated (with a positive sign) in B_1 as a capital movement. In that case the excess of surpluses over deficits in the world as a whole would have been

$$\sum_{i=1}^n \frac{dG_i}{dt} + \sum_{i=1}^n \frac{dC_1}{dt} \equiv \sum_{i=1}^n \frac{dG_i}{dt} + \frac{dL_1}{dt} \quad (11)$$

that is, the increase in world monetary-gold holdings plus the increase in monetary liabilities of the reserve center.

What consideration should lead us to prefer the use of a net to a gross concept of reserves, or vice versa? This is a controversial question. If one country were the sole creator of international monetary reserves (assuming monetary gold is constant), and if its currency were universally acceptable for the payment of international debts, it would be fulfilling the role, for all practical purposes, of an international bank, and to regard its balance of payments as zero would be consistent with the concept of the balance of payments as an error signal.

At the present time there is no international legal tender and therefore no legal justification for treating one country's deficit as being any different from any other country's deficit, even though in practice the U.S. dollar and the British pound closely approximate true international reserve media. In a formal sense, then, it may be better to adopt the net concept of reserves of the key currency country and thus treat an increase in key currency liabilities to foreign monetary authorities as a deficit of the key country. Adopting that convention means modifying the concept of the balance of payments as an error signal and thus qualifying the extent to which a deficit in the balance of payments requires a change in policy or is a threat to the existing exchange system. The net definition preserves symmetry, but at the cost of the usefulness of the balance of payments as an error signal. Instead of regarding a zero balance as a target of policy, the reserve center must try to generate a deficit acceptable both to itself and to the rest of the world, so as to permit an appropriate growth of foreign holdings of its currency and reserves.

Let us now complete the system by allowing for an arbitrary number of reserve currencies (as under a multiple-currency system) and also IMF transactions. Let C_{ij} be the holdings of the currency of country i by the monetary authorities in country j ; L_i be the outstanding short-term liabilities of country

i to monetary authorities in the rest of the world; G_i be the monetary gold holdings of country i ; and F_i be the net fund position of country i defined as country i 's quota less IMF holdings of country i 's currency.

Then the balance-of-payments equation can be comprehensively represented by the following equations:

$$\begin{aligned} B_1 &= \frac{dG_1}{dt} + \frac{dF_1}{dt} - \frac{dL_1}{dt} + \frac{dC_{21}}{dt} + \dots + \frac{dC_{n1}}{dt} \\ B_2 &= \frac{dG_2}{dt} + \frac{dF_2}{dt} + \frac{dC_{12}}{dt} - \frac{dL_2}{dt} + \dots + \frac{dC_{n2}}{dt}; \\ B_n &= \frac{dG_n}{dt} + \frac{dF_n}{dt} + \frac{dC_{1n}}{dt} + \frac{dC_{2n}}{dt} + \dots - \frac{dL_n}{dt}. \end{aligned} \quad (12)$$

The excess of surpluses over deficits still equals the increase in monetary gold reserves in this system, since

$$\begin{aligned} \sum_{i=1}^n \frac{dL_i}{dt} &\equiv \sum_{i=1}^n \sum_{j=1}^n \frac{dC_{ij}}{dt} \\ \sum_{j=1}^n \frac{dF_j}{dt} &\equiv 0. \end{aligned}$$

The latter identity follows from the definition of a change in the net fund position of a country, every increase in IMF holdings of one currency implying a decrease in its holdings of another currency.

The Exchange Market

Balance-of-payments adjustment can be explained in the context of present institutional arrangements. Exchange rates are pegged through central bank (or treasury) intervention in the exchange market at "support points." When the domestic demand for foreign exchange sufficiently exceeds the supply, the price rises until it reaches the upper support point at which the central bank sells reserves from its own stock in exchange for its own currency; similarly, when the supply of foreign exchange sufficiently exceeds demand the price falls, until it reaches the lower support point at which the central bank intervenes by purchasing foreign exchange to prevent further appreciation of the domestic currency. (Intervention may also take place between the support points.)

The mechanism is illustrated in Figure 10-1, in which the demand and supply of dollars in exchange for German marks is plotted. To simplify, dollars

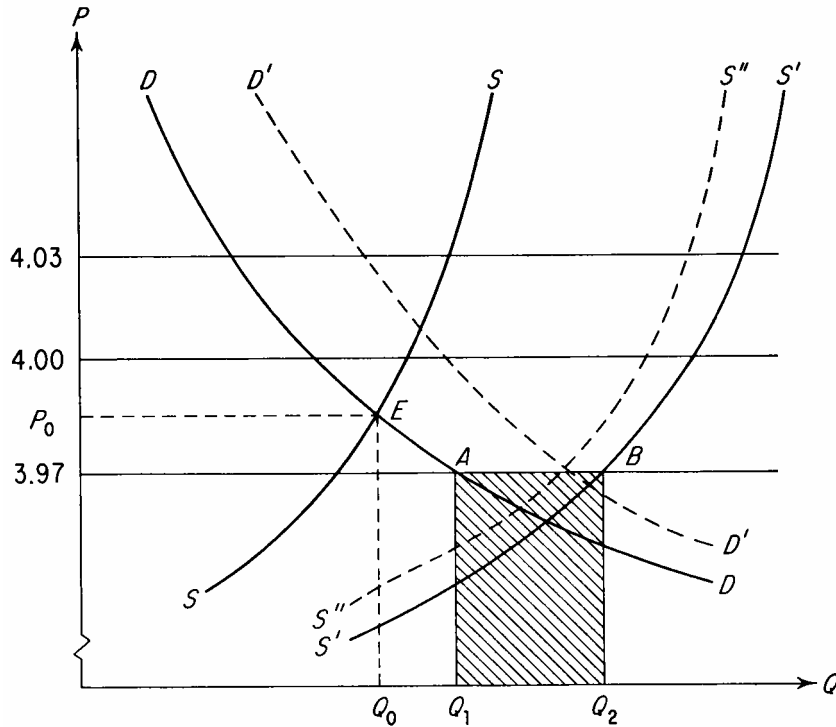


Figure 10-1.

are taken to represent all foreign exchange, and the market is taken to encompass all transactions, including those in connected forward markets [48].

The DD curve plots the demand curve for dollars on the part of German residents as a function of the price of dollars, on the assumption that the mark prices of German goods and the dollar prices of foreign goods are constant. The area under the curve at any given price represents the sum of marks that German residents will pay for the quantity of dollars represented on the abscissa; in this sense the demand for dollars by German residents simultaneously represents the supply of marks offered by German residents in exchange for dollars.

The curve SS represents the supply of dollars offered by the rest of the world in exchange for marks at given exchange rates, again on the assumption that the mark prices of German goods and the dollar prices of goods in the rest of the world are constant. The curve SS simultaneously represents the supply of dollars and the demand for marks, the latter being indicated by the area described at any price-quantity relationship on the supply schedule.

The free market price would be P_0 , determined by the intersection of SS and DD , at which the quantity Q_0 of dollars would be exchanged for P_0Q_0

of marks. It is assumed that the initial price P_0 is within the support points, which are taken to be $\frac{3}{4}$ of 1 per cent below and above the “par value,” which is DM 4.00 per dollar in accordance with the IMF “par value” prevailing in 1966.

Suppose now that in the rest of the world there is a spontaneous increase in the demand for German goods. This implies an increase in the supply of dollars, at any given price, so that SS shifts to the right — to, say, $S'S'$. Such a shift in a free market would mean that the price of the dollar would fall below the (lower dollar and upper mark) support point of DM 3.97 per dollar. But the free market adjustment would be prevented by the German central bank, which would step into the market at the rate DM 3.97 per dollar (or perhaps even sooner) to prevent the appreciation of the mark beyond the set limits.

Specifically, at the rate $DM\ 3.97 = \$1$, there will be an excess supply of dollars equal to the horizontal distance on the graph between DD and $S'S'$ at that rate, an amount equal to Q_1Q_2 dollars; this means an excess demand for marks equal to the shaded area on the graph. To stabilize the rate at DM 3.97 the German central bank will buy up Q_1Q_2 of dollars and supply to the market the area ABQ_2Q_1 of marks; the former (distance) represents Germany's balance of payments surplus expressed in dollars and the latter (area) Germany's surplus measured in marks.

The process of stabilization just considered automatically produces equilibrating forces tending to correct the disequilibrium. The German central bank is taking up the excess supply of dollars on the market, and (barring the creation of additional dollars in the rest of the world) this must eventually reduce spending in the part of the world using dollars, thereby shifting the supply curve $S'S'$ to the left as prices in the rest of the world fall (or interest rates rise). Similarly, the additional supplies of marks created by the German central bank must eventually shift DD to the right as German prices (the prices of German goods) rise (or interest rates fall). After price levels or interest rates have adjusted, a new equilibrium would be established at the dollar support point indicated by the intersection of $D'D'$ and $S''S''$.

This automatic adjustment process may, however, be resisted by the monetary authorities. The practice of “sterilizing” the monetary effects of foreign exchange (or gold) purchases and sales has become widespread as countries look for means of adjusting the balance of payments other than that implicit in price level (or interest rate) adjustments. Central banks may prefer to delay adjustment for a time by allowing reserves to be built up or depleted.

Analytical Approach

The balance of payments is related to other aspects of the economic system because it describes the transactions of all the residents of the country with

the rest of the world. These connections have given rise to three approaches to balance-of-payments analysis that can be compared most simply by assuming at first that there are no capital movements (this means that the balance of trade and the balance of payments are the same).

The *elasticity approach* works directly [86] on the balance-of-payments equation,

$$B = X - M, \quad (13)$$

where X is the value of exports and M the value of imports. By differentiating (13) with respect to an exogenous parameter (say, the exchange rate), a criterion can be established that shows the effects of a change in the parameter on the balance of trade, assuming that export and import prices adjust to equate the demand and supply of exports and imports. In the literature the usual method of analysis has been to assume that exports depend on the price of exports and imports on the price of imports (an inadequate vestige of partial equilibrium analysis) and then to translate these relations into elasticities.

A second method, the *absorption approach*, makes use of the fact that, from national income accounting,

$$B = Y - E, \quad (14)$$

where Y is income and E is domestic expenditure [56], or “absorption.” This equation directs attention to the fact that the balance of trade can be improved by a policy change, such as devaluation, only if income is increased by more than expenditure.

A third approach, which may be called the *monetary approach*, stresses the fact that the balance of payments implies a change in the foreign reserves of the monetary authorities (the central bank) and that the central bank's total assets, which can be divided into foreign assets (reserves) and other assets (for example, government bonds), must equal its monetary liabilities. Thus the increase in reserves (R), which equals (in the case of no capital movements) the balance of trade, must be equal to the difference between central bank credit creation and new central bank money. When the banking system is taken as a whole, and interbank transactions are canceled, this means that

$$B = H - C, \quad (15)$$

where H is hoarding (additional domestic money holdings) by the public and C is credit creation by the banking system as a whole. This approach, which is valid even when there are capital movements, directs attention to the fact that the balance of payments cannot be improved unless credit creation is less than hoarding [34].

It is not meaningful to question the validity of the three approaches. The

terms can be defined so that they are all correct and assert identical propositions, even if capital movements are included. Suppose, for example, that all variables are defined as ex post, realized entities. Then from national income accounting we have $Y \equiv E + B$; from banking accounts we have $H \equiv C + R$; and from the balance-of-payments accounts we have $R \equiv B - T$, where T represents net capital exports. It follows, then, that $R \equiv B - T \equiv Y - E - T \equiv H - C$.

The identity of the three approaches, when they are properly interpreted, does not mean that each approach is not in itself useful. The fact that an improvement in the balance of payments must imply an increase in $Y - E - T$, an increase in R , and an increase in $H - C$ provides additional checks on the logic of balance-of-payment policies.

Chapter 11 / *The Monetary Dynamics of International Adjustment under Fixed and Flexible Exchange Rates*¹

The basic criticism hitherto advanced against a system of fixed exchange rates—that the powerful instruments of monetary policy are tied to the goal of external balance thereby ruling out a domestic rate of interest compatible with full employment—has been the subject of continued debate over past decades. First advanced over a century ago during the bullionist controversy, and revived in this century by Fisher and Keynes, the argument poses the conflict between internal stability (stable employment and price levels) and external stability (balance-of-payments equilibrium at a fixed exchange parity). In the absence of trade restrictions, which cause inefficiency and invite retaliation, one of the targets implicit in the concepts of internal and external stability must be abandoned. But, so the argument runs, full employment is a prime goal of public policy, balance-of-payments equilibrium is a long-run necessity, and sufficient price flexibility does not exist in the modern world: The rate of exchange must therefore be freed.

The argument is based on money illusion: The community is unwilling to accept variations in real income through changes in money prices, but it will accept the same changes in real income through adjustments in the rate of exchange. A flexible exchange system may then be interpreted as a device for providing a more acceptable means (than employment changes) of altering the real income of the community. But what if money illusion is absent? Then, it is argued, there is no reason for changing to a system of flexible exchange rates: “If internal prices were as flexible as exchange rates, it would make little economic difference whether adjustments were brought about by changes in exchange rates or by equivalent changes in internal prices.”²

In this chapter it will be demonstrated that although this view, under certain circumstances, may be valid in statics, it is entirely erroneous in dynamics.

¹ Adapted from *The Quart. Jour. Econ.*, 74, 227–257 (May 1960). Copyright (c) Harvard University Press.

² Friedman [16]; see also Meade ([56], p. 190) for a similar statement. It is, of course, recognized that monetary differences between the two systems exist based on consideration of fixed debts.

The dynamical differences between the two systems are based on an inversion of the roles, in the dynamic adjustment process, of the terms of trade and the rate of interest. In the fixed exchange system money income (the price level) moves to equilibrate the market for domestic goods and services, and monetary policy is directed at the requirements of the foreign balance; but in the flexible exchange system the rate of exchange moves to correct external disequilibrium, and monetary policy aims at the goal of internal stabilization. These dynamical dissimilarities have important implications for economic policy.

A dynamic analysis of the two systems is necessary to provide a description of the relative merits of fixed and flexible exchange rates—one system may work well (dynamically) under one set of static parameters and speeds of adjustment but badly under another. Moreover, the type of model that such an analysis requires reveals a conspicuous gap in the international trade literature. Since the days of Hume's classic analysis of the price-specie-flow mechanism, the adjustment process has been rightly recognized as dynamic. Yet it is seldom stated, or even hinted, in expositions of the gold-standard mechanism that an explicit dynamic model is necessary for examining processes that occur simultaneously but at different speeds. The conclusions that follow from this rich field of analysis are essential to even a minimal understanding of the meaning of the adjustment mechanism.

This chapter offers a simplified exposition of the dynamics of the international adjustment process and provides preliminary answers to the following questions: 1. Under what conditions will one system be stable while the other system is unstable? 2. How is the cyclicity or directness of the paths to equilibrium, in each system, affected by the extent to which capital is internationally mobile? 3. To what extent should the central bank be concerned, in the fixed exchange system, about the absolute level of its reserves, as opposed to the situation in the current balance of payments? 4. To what extent can offsetting central bank action stabilize a system that is inherently unstable because of speculative capital movements?

I assume throughout that money prices are flexible unless stabilized by the monetary authorities. The purpose of this assumption is to maintain the static and real equivalence of the two systems and thereby isolate most clearly the dynamical dissimilarities. It will nevertheless become clear that the main conclusions would hold in an underemployed economy in which prices were rigid downward and flexible upward.

The Static System

The economic system to be investigated below is dominated by the conditions of equilibrium in two markets: the market for domestic goods and

services, and the market for foreign exchange. Equilibrium in the goods-and-services market is assumed to prevail when the current world demand for domestic goods and services is equal to the current supply of domestic goods and services, a condition which is equivalent to the equality of the excess of domestic saving over domestic investment and the trade balance surplus. When the excess of domestic saving over domestic investment is greater than the trade balance surplus there is deflationary potential, and when it falls short of the trade balance surplus there is inflationary potential.

Equilibrium in the foreign exchange market requires equality of foreign exchange payments and receipts (excluding central bank transactions) or, equivalently, equality of the rate of lending (net capital exports) and the trade balance surplus. When this equality does not hold, there is a balance-of-payments surplus or deficit, depending on whether lending is greater or less than the trade balance surplus.

I assume that the goods-and-services market and the foreign exchange market are subject to two main influences: the domestic rate of interest, and the ratio of home and foreign prices (the terms of trade). The rate of interest is assumed to be determined by the monetary policy of the central bank—which means that the latter must always supply funds to the public (through, say, open market operations) to make any given interest rate compatible with equilibrium in the capital market.³ I also assume that all foreign prices, incomes, and interest rates are constant during the period under consideration; this means that changes in the terms of trade can result only from changes in the exchange rate or variations in the domestic price level.

Given these assumptions it is possible to construct a simple geometric interpretation of the forces governing the rate of interest and the terms of trade. Consider first the foreign exchange market. This market can be divided into two components: the balance of trade governed primarily by the terms of trade, and the net flow of capital, influenced chiefly by the rate of interest. To every level of the terms of trade there will correspond a given balance of trade, and for every rate of interest there will be a specific rate of lending. At high levels of the terms of trade, other things equal, the balance of trade will be smaller than at low levels of the terms of trade.⁴ Similarly, at high rates of interest the net inflow of capital will be larger, or the net outflow will be

³ For the entire system to be in equilibrium stock and flow markets for domestic and foreign goods, securities, and money must be cleared. The present analysis constitutes an attempt to sidestep many of the complications and unresolved difficulties associated with general equilibrium of an open economy, problems which exist even in analysis of a closed economy. At the present stage of the development of the subject, this pragmatic theoretical approach seems amply justified, although final verification of the theoretical results must await the creation of a complete and exact model.

⁴ This is necessarily the case if domestically produced goods are not “Giffen goods” in world consumption, or if the sum of the elasticities of demand for imports is greater than unity.

smaller than at low rates of interest. For any given rate of interest, therefore, an increase in the price level or an appreciation of the rate of exchange worsens the balance of payments; and for any given level of the ratio of export to import prices, an increase in the rate of interest improves the balance of payments.⁵

One can now conceive of a schedule indicating what the terms of trade would have to be, for different rates of interest, to make the country's foreign exchange payments equal to its foreign exchange receipts (or its net capital exports equal to the balance-of-trade surplus). This curve, which we shall refer to as the "foreign-balance schedule," is plotted as the *FF* line in Figure 11-1. At any point on this line the balance of payments is in equilibrium, although its composition changes in favor of higher rates of borrowing and higher balance-of-trade deficits as we move upward and to the right along it. Any point below or to the right of *FF* represents a point of balance-of-payments deficit: The rate of interest is too low, or the price level or exchange rate is too high, for equilibrium. Similarly, any point above or to the left of *FF* indicates a point of surplus in the balance of payments: The rate of interest

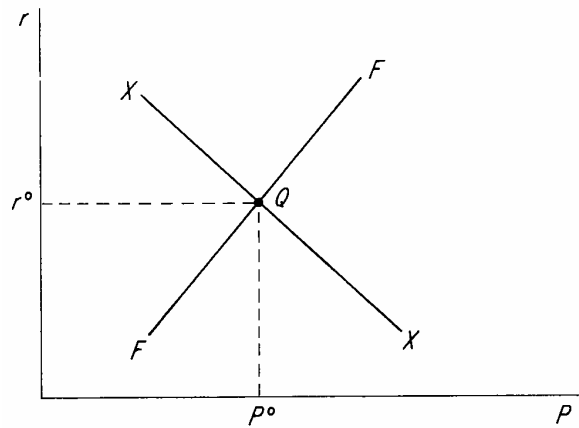


Figure 11-1. The Determination of Equilibrium.

⁵ I assume that expenditure on goods and services is affected by a capital inflow only insofar as the latter affects the domestic rate of interest. This assumption can be justified—especially in a short-run analysis—for some types of capital movements but not for others. The analysis traditionally associated with the transfer problem can easily be incorporated into the present analysis, but it would complicate the exposition without affecting the conclusions fundamentally. The assumption that the trade balance is not *directly* affected by the rate of interest is made for simplicity, and would have to be modified if durable goods bulked large in imports.

is too high, or the relative price of domestic goods is too low, for equilibrium. The economic system can be in equilibrium only on this line.

It may be seen that there is a whole series of combinations of rates of interest and terms of trade at which the balance of payments is in equilibrium. But the entire economic system cannot be in equilibrium unless there is also balance in the market for goods and services. For this market to be in equilibrium, the balance of trade must equal the excess of saving over investment. Now the balance of trade, as we have seen, is affected primarily by relative prices: A rise in the price level or exchange rate worsens the balance of trade so higher levels of the terms of trade tend to cause an excess supply of goods and services. We must add to this, however, the deflationary effect of an increase in the price level or the exchange rate on the rate of saving. Because at high levels of the terms of trade real income is higher than at low levels of the terms of trade, the level of saving also tends to be higher.⁶ An increase in the price level for the exchange rates, therefore, is deflationary for two reasons: It lowers the balance of trade and it increases saving. On the other hand, changes in the rate of interest influence primarily the rate of investment spending. At high rates of interest the rate of investment is lower than at low rates of interest, so an increase in the interest rate is deflationary. Both increases in the price level or the exchange rate, and increases in the rate of interest, are deflationary.

One can now construct an “internal balance schedule” for the goods-and-services market analogous to the foreign balance schedule developed for the foreign exchange market. From any point on this schedule an increase in the rate of interest causes deflationary pressure and a fall in the price level or the exchange rate causes inflationary pressure. A hypothetical rise in the rate of interest, starting from a position of balance, must therefore be compensated by a fall in the price level or the exchange rate in order to retain balance. This means that the internal balance schedule, plotted as the XX line in Figure 11–1, must have a negative slope. At any point above and to the right of this line there is deflationary potential, and at any point below and to the left of this line there is inflationary potential. Only along XX is the goods-and-services market in equilibrium.

We have now described the conditions necessary for equilibrium in each of two markets. At any point on FF the balance of payments is in equilibrium, and at any point on XX the goods-and-services market is in equilibrium. The entire economic system can be in equilibrium only at the point common to both schedules, Q . The equilibrium interest rate is therefore r_0 , and the equilibrium terms of trade is P_0 .

It is necessary to point out, however, that equal percentage changes in the

⁶ An excellent survey of the extensive literature on the effects of a change in the terms of trade on the rate of saving has been provided by Johnson [32].

price level and exchange rate have different monetary effects inasmuch as a price-level increase reduces, while an exchange-rate appreciation increases, the real value of cash balances. An exact identification between the two is possible, however, if an exchange-rate appreciation is accompanied by an equal percentage reduction in nominal cash balances, or, alternatively, if an increase in the price level is accompanied by an equal percentage increase in nominal cash balances. Under these monetary assumptions there is no reason to expect a change in the terms of trade achieved through price-level adjustments or exchange-rate variations to have differential effects on the level of saving or the division of expenditure between home and foreign goods, except insofar as other contractual obligations fixed in terms of domestic or foreign currency have to be taken into account.

The Dynamic Systems

The static system described by the foreign balance schedule and the internal balance schedule provides a convenient framework for analyzing the dynamic responses appropriate to systems of fixed and flexible exchange rates. These responses are determined in part by free market reactions and in part by the stabilization policy of the central bank. In the absence of stabilization there is a tendency for the price level to rise or fall, depending on whether there is excess demand (inflationary potential) or excess supply (deflationary potential) in the goods-and-services market, and a tendency for the exchange rate to rise or fall depending on whether there is a surplus or deficit in the balance of payments. But, if the monetary authorities stabilize the exchange rate they must be prepared to buy and sell foreign exchange reserves at a fixed price, and if they stabilize the price level they must buy and sell goods and services at a fixed price. To protect their reserve position (of foreign exchange in the one system, or of goods in the other system) they will pursue a monetary policy that tends to relieve the disequilibrium.

Consider first the case where the central bank pegs the exchange rate. It will raise the interest rate when there is a balance-of-payments deficit, and lower the interest rate when there is a balance-of-payments surplus.⁷ In this case the price level is free to respond to disequilibrium in the market for goods and services. Thus the interest rate will be rising at any point below and to the right of the foreign balance schedule and falling at any point above and to the left of the foreign balance schedule. Similarly, the price level will be rising at any point below and to the left of the internal balance schedule and falling at

⁷ The central bank adjusts interest rates to prevent *changes* in its reserve position. Later we shall consider the effect of a monetary policy which attempts to maintain a given *level* of reserves.

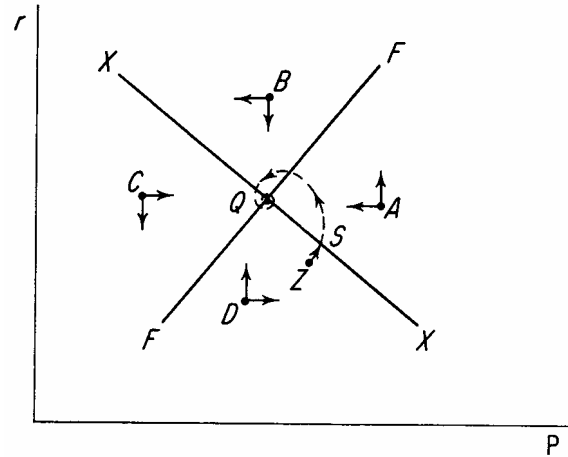


Figure 11-2. Adjustment under Fixed Exchange Rates.

any point above and to the right of this schedule. These dynamic responses are described by the arrows in Figure 11-2.

The points *A*, *B*, *C*, and *D* represent four points not on either of the two schedules. From the point *A*, the interest rate is rising because of the balance-of-payments deficit, and the price level is falling because of the deflationary gap. Similarly, at the point *B* both the interest rate and the price level fall; at the point *C* the price level rises and the rate of interest falls; and at the point *D* both the price level and the interest rate rise.

One of the arrows in each quadrant points in the direction of equilibrium, whereas the other arrow points in a direction that suggests a cyclical motion around equilibrium. This means that the equilibrium *Q* is a stable equilibrium, and that it may be approached cyclically. Consider, for example, the point *Z*. This point is in the same quadrant as the point *D*, so, from *Z*, the price level rises because of inflationary pressure and the interest rate rises because of the deficit in the balance of payments. These changes work in opposite directions on the foreign balance—capital is attracted while the balance of trade is worsened—but in the same direction on the goods-and-services market—both the interest-rate and price-level changes relieve excess demand. The goods-and-services market is therefore equilibrated before the foreign balance is brought into equilibrium. Now, at the point *S* on the *XX* line, the internal market is in equilibrium but there is a deficit in the balance of payments; the interest rate thus continues to rise and this works to produce deflationary pressure in the goods-and-services market. In quadrant *A* the interest rate rises and the price level falls. Both these forces now operate to relieve the external disequilibrium, but they operate in opposite directions on the internal market; this time the foreign exchange market is cleared before the goods-and-

services market. Now the path of the interest rate and the price level moves into quadrant *B*, in which the interest rate is lowered and the price level falls; and so the cycle continues in a counterclockwise direction.⁸

Now consider the flexible exchange system in which the central bank stabilizes the domestic price level. When there is an inflationary gap in the market for goods and services the central bank will tighten credit, raising the interest rate; and when there is a deflationary gap it will ease credit conditions, lowering the interest rate.⁹ On the other hand, the rate of exchange is, in this system, free to move to preserve external balance. Under these conditions the interest rate will be rising at any point below and to the left of the *XX* line in Figure 11-3 and falling at any point above and to the right of this schedule. Similarly, the rate of exchange will be falling at any point below and to the right of the *FF* line because of the payments deficit, and rising at any point above and to the left of this line. The points *A*, *B*, *C*, and *D* represent four typical points in the four quadrants, and the directions of the arrows describe the paths of the interest rate and the exchange rate.

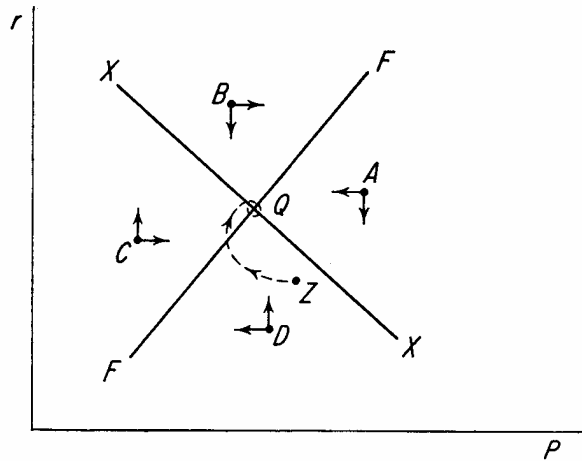


Figure 11-3. Adjustment under Flexible Exchange Rates.

⁸ A formal proof of stability, based on a linear system, is given in the Mathematical Appendix. The assumption of linearity is an important one. It must be expected that central bankers—not governed by the restrictions of mathematical laws—would anticipate future positions and modify their reactions accordingly. But the linear system must be stable if the nonlinear system is to be stable.

⁹ To stabilize the price level the authorities must be willing to buy and sell domestic goods at a fixed price in terms of local currency; the monetary policy may then be interpreted as an attempt to prevent further changes in the stocks of goods held by the government, theoretically, quite analogous to the role of monetary policy under fixed exchange rates in preventing changes in external reserves.

As in the fixed exchange case one of the arrows always points in the direction of equilibrium, while the other arrow tends to impart a cyclical motion to the system; the system is stable but equilibrium may be reached cyclically. Consider the point Z , referring to the same point of real disequilibrium as that analyzed in the fixed exchange case. From the point Z the exchange rate falls because of the external deficit, and the interest rate rises because of the inflationary pressure. Both changes work to correct the foreign balance, but they work in opposite directions on the internal market; the foreign balance is therefore equilibrated before the inflationary gap is relieved. The cycle may continue, as in the fixed-exchange system, but it moves in an opposite direction. The path to equilibrium under flexible exchange rates is *clockwise* but under fixed exchange rates it is *counterclockwise*.

Although the cycles around the real equilibrium Q may occur, they are not inevitable. From any of the quadrants the approach to equilibrium may be direct, depending, in part, on the relative speeds with which the interest rate and relative prices move in response to disequilibrium. I have described the cycles that may occur only to emphasize the difference in the nature of the approach to equilibrium. This difference does not, in itself, demonstrate that one system is superior to the other. But the difference in the paths that the interest rate and the terms of trade follow assumes more importance as we consider different values of the static parameters and the importance to the central bank of a given level of foreign exchange reserves.

The Importance of Capital Mobility

To show how the nature of the path to equilibrium is affected by the static parameters and the speeds with which the authorities respond to disequilibrium in each system, we shall demonstrate that one system may work well (in some definable sense) if capital is internationally mobile but badly if capital is immobile. To set the stage for the analysis, suppose that a position of initial equilibrium is disturbed by a reduction in the rate of interest below its equilibrium level. This creates inflationary pressure and a very large balance of payments deficit in the case, with which we shall begin, where capital is highly mobile.

Under fixed exchange rates and virtually perfect capital mobility, the approach to equilibrium is direct rather than cyclical.¹⁰ This may be understood by noting that the disturbance immediately creates a rapid rise in the rate of interest (because of the large balance-of-payments deficit) relative to the change in the domestic price level (due to the inflationary pressure). In the extreme case of perfect mobility the interest rate would bounce back to

¹⁰ For rigorous proofs of the propositions established in this section see sections III and IV in the Appendix of this chapter.

equilibrium without any increase in the domestic price level. In the less extreme case, on the other hand, the price level rises somewhat above its equilibrium value, and this, in conjunction with rapidly rising interest rates, results in deflationary pressure; the system moves into a quadrant in which there is deflationary pressure and balance-of-payments deficit. From this quadrant the interest rate will rise and the price level will fall until equilibrium is reached directly, there being no possibility of the rate of interest rising above the level required for the final equilibrium in the balance of payments. The process of adjustment will therefore be noncyclical under fixed exchange rates and perfect capital mobility.

This result contrasts with that obtaining under flexible exchange rates and high capital mobility, for in that case the deficit in the balance of payments and inflationary pressure results in a fall in the exchange rate and a rise in the rate of interest. But the exchange-rate movement swamps the interest-rate adjustment because of the high capital mobility. The exchange rate moves below its equilibrium level until external balance is again reached at a higher interest rate. Yet this position cannot be an equilibrium one, for there remains inflationary pressure in the commodity market, prompting further increases in interest rates and generating a balance-of-payments surplus, which in turn initiates a rapid appreciation of the exchange rate. The path of the interest rate and the exchange rate then moves past the point where internal balance is achieved, and a downward movement of the interest rate commences. The system does eventually get to equilibrium, but it can only approach it after oscillating around it.

The opposite conclusions *tend* to hold in the case where capital is immobile. In the fixed-exchange-rate case an interest rate below its equilibrium level creates inflationary pressure and a rise in the price level, which in turn generates a balance of trade and payments deficit, prompting a rise in the interest rate. The goods-and-service markets become cleared at a higher interest rate and increased price level, but there remains a balance-of-payments deficit. The interest rate continues to increase and the price level begins to fall until equilibrium is reached after a series of cycles, or at once, depending partially on whether interest rate policy adapts rapidly or slowly, respectively, to disequilibrium in the balance of payments. An oscillatory approach to equilibrium is possible, but it is not certain.

Under flexible exchange rates, on the other hand, oscillations are not possible if capital is immobile. An interest rate below equilibrium implies inflationary pressure that is promptly corrected by a rise in the interest rate. No change in the exchange rate need ensue. Yet, even if the exchange were above equilibrium while the interest rate were below it, such that there existed inflationary pressure and a balance of payments deficit, the exchange rate would depreciate and the interest rate rise until equilibrium is reached directly. There is no possibility of an oscillatory approach to equilibrium.

These conclusions are important for their own sake because they imply that a flexible exchange system may not work smoothly for an economy in which capital flows are highly sensitive to interest rates but may work better than a system of fixed exchange rates if capital is immobile. There is a simple economic explanation of this fact. Under fixed exchange rates, the interest rate corrects the balance of payments, and it is exceedingly effective in doing so provided the balance of payments is *directly* influenced substantially by the interest rate, which is the case when capital is mobile; if capital is immobile, however, the interest rate affects the balance of payments only insofar as it first creates inflationary or deflationary pressure in the goods-and-services market. The fixed-exchange-rate system, in other words, tends to work well when the interest rate has a direct impact on the balance of payments because the interest rate is itself the variable that *adapts* to the balance of payments.

A corresponding generalization holds under flexible exchange rates. When capital is immobile, the interest rate, which adapts to the requirements of internal balance, has a direct effect upon the goods-and-services market, whereas the exchange rate has a direct effect upon the balance of payments. But when capital is highly mobile, the interest rate effect upon capital imports swamps the interest-rate effect upon the goods-and-services market, so that internal stability is achieved more by the indirect effect of altered interest rates in attracting or repelling capital from abroad, and thus appreciating or depreciating the exchange rate, than it is by the direct effect upon the goods-and-services market itself. This indirectness of the mechanism imparts a cyclical tendency to the adjustment process.

We have now demonstrated (mathematical proofs are supplied in the Mathematical Appendix) that the ease of correcting a disequilibrium under systems of fixed and flexible exchange rates depends partially on the extent to which capital is internationally mobile. If capital is highly mobile the fixed exchange dynamic system leads directly to equilibrium, while the flexible exchange mechanism generally leads to cycles around equilibrium. On the other hand, if capital flows are insensitive to changes in the rate of interest, the fixed exchange system leads to cycles if the central bank reacts too quickly to a foreign deficit, whereas the flexible exchange system leads directly to equilibrium regardless of the speeds of adjustment.¹¹

¹¹ My conclusions conflict with the analysis of Professor Meade ([56], pp. 255-258), who writes: "The reader is left to himself... to establish the fact that the mobility of labour and capital upon the ease of adjustment is similar for both the gold-standard and the variable-exchange-rate mechanisms of price adjustment." He then speaks of different spontaneous disturbances and how, for each case, the process of adjustment will be affected by the extent to which capital is mobile.

Meade defines the ease of the adjustment process in static terms: in the extent to which the terms of trade must adjust to correct a disequilibrium caused by a spontaneous disturbance. His method can be described in my model by shifting the two curves and comparing the terms of trade at the new equilibrium with the original level.

These conclusions illustrate a more general proposition, which is referred to below as the *principle of effective market classification*. Dynamic systems tend to work better when variables adapt dynamically to those markets on which they have a (relatively) dominant influence. In devising policy schemes, therefore, it is important to allocate particular instruments to those targets on which they exert the most influence.

The Stock of Reserves

As a description of central bank policy in the modern world, the validity of the above analysis of the fixed exchange system is subject to one important qualification. I have assumed that the central bank eases or tightens credit conditions depending on whether *current* foreign exchange receipts exceed, or fall short of, *current* foreign exchange payments. This leaves out of account the lingering effects of past deficits and surpluses on central bank policy. But past deficits and surpluses affect the level of foreign exchange reserves, so this implicitly assumes that the central bank is concerned only with *changes* in the level of reserves, and not at all with the absolute level, at any point in time. It is unrealistic, however, to suppose that the central bank would react to disequilibrium in the balance of payments in the same way at substantially different levels of reserves. If reserves are excessively high, the authorities are more likely to allow a deficit in the current balance to continue before remedial action is taken; and if reserves are too low, imperiling confidence in convertibility, the central bank is likely to keep tighter monetary conditions until reserves are again built up.

In this section we shall consider the extreme case where the central bank is concerned only with the level of stocks, in order to isolate the effects of this response. We assume that there is a normal or “optimum” level of reserves and consider what happens if the central bank aims at maintaining this level by raising or lowering the interest rate in proportion to the discrepancy between the desired and actual level. As before, we assume that the price level responds to any disequilibrium in the goods-and-services market.

For purposes of exposition it will be convenient first to drop some of the assumptions and then gradually reintroduce them. Suppose first that the price level does not exert any influence on the balance of payments; this means that there can be only one rate of interest at which there is external balance. The system is represented in Figure 11–4.

As suggested in the introduction, I believe that one should discuss the “process” or “ease” of adjustment in dynamic terms. Meade's textual exposition (unlike his Mathematical Supplement [54]) hints at a dynamic process, but without the use of an explicit model all the implications cannot be derived.

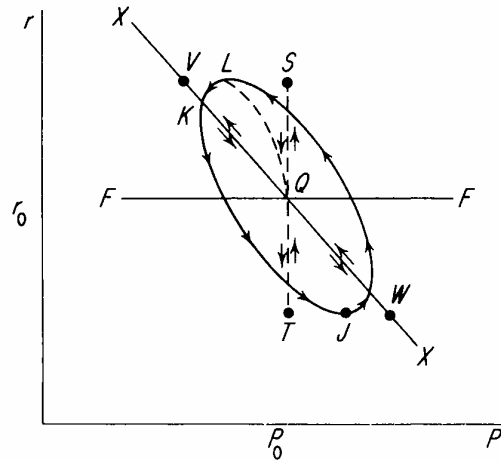


Figure 11-4.

Let the interest rate be initially r_0 and the price level p_0 , so that there is equilibrium in the balance of payments and the goods-and-services market. This does not now imply equilibrium in the entire system because the level of central bank reserves may not be at the desired level. Suppose that reserves are below the desired level.

Consider first the movement of the system if the price level is fixed. From Q the rate of interest rises (because reserves are below the desired level) and capital is attracted from abroad. As the foreign balance improves reserves accumulate, reducing the discrepancy between the desired and actual level and slowing down the change in the rate of interest. But the rate of interest nevertheless continues to rise until stocks reach the required level. At a point such as S , the rise in the rate of interest stops: Reserves are at the desired level. But the point S cannot be an equilibrium point, because there is a surplus in the foreign balance. Reserves begin to accumulate and the rate of interest is moved downward. Throughout the return path from S to Q the foreign balance is in surplus, so reserves increase until the point Q is reached. At Q the discrepancy between actual and desired reserves reaches a maximum, and so does the speed with which the rate of interest is changing. The rate of interest now falls below Q and the excess reserves are gradually depleted until another point T is reached at which reserves are in equilibrium. The point T is below Q by as much as the point S is above Q . The cycle therefore continues in pure undamped harmonic motion with an amplitude of the interest rate fluctuation equal to ST . The motion exactly resembles that of a frictionless pendulum pivoted above Q .

This cycle applies only when the price level does not respond to disequilibrium in the market for goods and services. In other words, we have thus far

assumed a speed of response in the goods-and-services market equal to zero. But consider now the opposite case, where the price level responds instantaneously (that is, an infinite speed of response). In this case the initial rise in the rate of interest from Q causes deflationary pressure which induces an immediate fall in the price level. But above we have tentatively assumed that the price level does not affect the balance of payments (FF is horizontal) so the cycle of the interest rate, central bank stocks, and the foreign balance goes on undisturbed. The only difference from the previous case studied is that a price cycle is added. The interest-rate cycle induces the price cycle, but the price cycle does not, in turn, affect the interest-rate cycle. The cycle is described in the graph by movements back and forth along the segment VW of the XX line. The amplitude of the interest-rate fluctuation is the same as before, and the amplitude of the price-level fluctuation is given by the horizontal distance between V and W .

We have now examined two extreme cases: one in which the price level is unresponsive to excess demand in the goods-and-services market, and one in which it is instantaneously responsive. In the normal intermediate case the path of the initial departure from Q will fall somewhere between QS and QV . Eventually a point such as L is reached at which reserves are equal to the desired level. The slope of the path at L must be horizontal, since the interest rate reaches a maximum at that point. From L the price level continues to fall (if L is to the right of XX); and, because of the balance-of-payments surplus and the gradual accumulation of excess reserves, the interest rate begins to fall. When point K is reached, the decline in the price level is reversed, but the interest rate continues to fall until the balance of payments has been in deficit long enough to bring reserves down to the desired level. At point J reserves are again in equilibrium, but, because the balance of payments is in deficit, the cycle continues. The path of the interest rate and the price level is indicated by the elliptic orbit; it is an undamped cycle with the same amplitude of the interest rate as before.

All the above systems have resulted in pure cycles of the interest rate, the level of foreign exchange reserves, the balance of payments, and, in the last two cases, the price level; these cycles were neither damped nor undamped. But once we relax the assumption that the price level has no effect on the foreign balance, the conservative motion of the system turns into unstable motion. When the foreign-balance schedule has a positive tilt, price changes react on the balance-of-payments schedule and subject the rate at which reserves are being accumulated or run down to sustained “shocks” that continually increase the amplitude of the fluctuations. The system therefore leads to ever-increasing cyclic movements of reserves and to the paradoxical conclusion that the central bank needs an *infinite* quantity of reserves to follow a policy designed to maintain *any* given level of reserves!

I have not presented this system as an actual description of the policy

followed by any central bank, or to suggest that the central bank should never be concerned with the *level* of foreign exchange reserves. It is more reasonable to suppose that the central bank governs its action according to both the level of reserves and the condition of the current balance. If reserves are too low, an interest rate high enough to develop a surplus in the current balance can be maintained, allowing reserves to build up gradually. Such a system is not necessarily unstable, as is shown in the Mathematical Appendix. It is important to note, however, that too great a concern for foreign exchange stocks *may* lead to instability. And because central banks are prompted to act more vigorously when reserves are too low than when reserves are too high,¹² an effective system of international payments based on fixed exchange rates must be one which provides a reasonably high degree of international liquidity. The social cost of these reserves—which is necessarily positive only when commodity money is used as international currency—must then be weighed in considering the relative merits of fixed- and flexible-rate systems.

Speculation and Stability

The preceding analysis provides a useful introduction to an important kind of speculation inherent in the fixed exchange systems of today. The confidence in the permanence of existing exchange parities that prevailed under the gold standard no longer exists today. The decline of confidence means that the safety of capital values becomes a prime factor determining the international location of short-term capital. Fear of inconvertibility or devaluation often swamps the effects of small differences in rates of interest between money markets and encourages capital outflows. But confidence is generally linked to the level of exchange reserves. Other things being the same, confidence is higher the larger are the central bank holdings of foreign exchange: An increase in reserves makes a speculator more bullish with regard to the exchange value (or degree of convertibility) of a currency. The balance of payments therefore becomes a function of the level of exchange reserves with an improvement in the latter stimulating a capital inflow or restraining a capital outflow.

But is a system based on this type of speculative response stable? Intuition leads one to suspect that it may be stable or unstable, depending on the strength of opposing forces. Speculators and the central bank engage in a fight for reserves. On the one hand, the central bank acts, through interest rate changes, to correct any foreign imbalance; on the other hand, speculators operate to exaggerate any imbalance because of the change in reserves and confidence.

¹² Compare, for example, the British reaction to a deficit in the summer and fall of 1957 with the German reaction to a surplus in recent years.

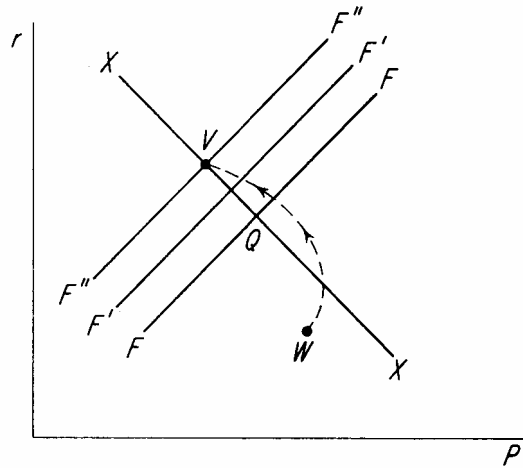


Figure 11-5.

To show that this view is substantially correct consider Figure 11-5 and the initial disequilibrium W . The deficit in the balance of payments and the inflationary gap cause the interest rate and the price level to rise. But the deficit also lowers the level of exchange reserves and causes the foreign balance schedule itself to shift in a northwesterly direction. There exists a different position of this schedule for every level of foreign exchange reserves. Now it may easily be seen that the stability of the system depends partially on how quickly the central bank reacts to a foreign deficit compared with the extent to which the FF curve is shifted because of speculation. For a new equilibrium to be established, the interest rate must move sufficiently fast, and foreign capital must respond quickly to the movement in the interest rate, to arrest (or reverse) the shift in the foreign balance schedule. A new equilibrium may, for example, be established at point V .

On the other hand, the interest rate may move too fast, turn the deficit into a surplus, and begin a downward path “chasing” the foreign balance schedule in the other direction. But in any case the system may be stable or unstable, cyclical or asymptotic, depending on the particular static parameters and speeds of response. It should be clear that a low sensitivity of the foreign balance to changes in reserves, a high sensitivity to the rate of interest, and relatively rapid response of the central bank are stabilizing.¹³ It is no longer true that central bank adjustment to stocks of reserves is destabilizing.

¹³ The destabilizing nature of this type of speculation has been described by Friedman^[16] and Meade [56].

Among the more important factors influencing speculation under the fixed-exchange-rate system that we have not considered, may be included: (1) the extent of short-term liabilities and the so-called “flight-capital ratio”; (2) international credit facilities such as IMF drawing rights; (3) the “lead-and-lag” effect on the trade balance; (4) the relation between spot and forward markets and the rate of interest; (5) international speculation

The precarious nature of the stability conditions of the above system—its sensitivity to speculative capital movements—is based on the reactions of speculators to changes in central bank stocks. It has no practical counterpart in a system of flexible exchange rates because central banks, in that system, do not need to hold foreign exchange reserves; and, if they do hold reserves, the central banks may use them merely to even out what they consider “sporadic” fluctuations in the exchange rate.¹⁴

There may, however, be a type of speculation which applies to flexible exchange, but not to fixed exchange, systems. The greater ease, and lower storage costs, of buying and holding units of currency in the flexible exchange system than of purchasing collections of goods in a fixed exchange system may induce more direct speculation in the former system. Speculators may interpret a current change in the exchange rate as a signal indicating further changes in the same direction, or as a signal indicating that the direction in which the rate is changing will be reversed. Proponents of flexible exchange rates have argued persuasively that, when the exchange rate appreciates or depreciates because of a change in import or export demand-and-supply schedules, speculators are likely to consider this a signal for an eventual movement of the exchange rate in the opposite direction, basing their expectations on the tendency for elasticities to be greater in the long run than in the short run. The more conventional view, however, which was widespread after World War II, urges that a change in the exchange rate is likely to be interpreted as a signal for further changes in the same direction because speculators may extrapolate past trends. This view is certainly confirmed during periods of monetary instability—during inflation the exchange rate would, in a free market, depreciate more or less at the same rate that other prices are rising—but it is also irrelevant in this case: The main advantage of a flexible exchange system is that it permits central bank authorities to control price-level fluctuations.¹⁵

Nevertheless, it is easily proved that *a system of flexible exchange rates may be stable even if speculators interpret a given variation in the exchange rate as a signal of further changes in the same direction*. This is demonstrated in the Mathematical Appendix. Furthermore, stability depends both on the behavior of speculators and the speed with which the exchange rate responds to external imbalance. If, therefore, the system is unstable in because of speculative capital

in spot and forward commodity markets; and (6) the fact that much international speculation is of a once-and-for-all character.

¹⁴ There is, however, an analytical parallel. The central bank or the government (through fiscal policy) must buy and sell goods at a fixed price to be completely successful in stabilizing the price level. There would be a direct analogy if speculation in commodity markets were conditioned by the level of commodity reserves of the government.

¹⁵ The relation between speculation and the stability of the foreign exchange market has been discussed by Friedman [16], Meade [59], [56], Lutz [44], [47], Baumol [4], and Tsiang [101].

movements, central bank intervention in the foreign exchange market can slow down the speed of the fluctuations and make the system stable. But this use of exchange equalization funds would not be necessary if speculators expected exchange rate changes to be reversed in direction, or if the extent of “destabilizing” speculation is small.

The Principle of Effective Market Classification

Before concluding, it may be useful to express in more general terms the problem initially posed. Society has two goals: full employment and balance-of-payments equilibrium. To achieve these goals it has two free variables: the terms of trade (the price level or the exchange rate) and the rate of interest (financial policy). Monetary authorities may stabilize the exchange rate, using financial policy to maintain external equilibrium and allowing the price level to maintain internal equilibrium; or they may stabilize the price level, using financial policy to maintain internal balance and allowing the exchange rate to preserve external balance. Which of these policies should be followed?

The answer was seen to depend on the values of the parameters and the speeds of adjustment. In the simple systems first studied, for example, it was demonstrated that the fixed-exchange-rate system operates most effectively if capital is highly mobile, whereas the flexible-exchange-rate system works best if capital is immobile. (“Best” is judged in terms of the directness of the approach toward equilibrium.) These conclusions have a useful application to economic policy. Equally interesting, however, is the general principle they illustrate.

The reason a high mobility of capital improves the effectiveness of the fixed-exchange-rate system is that the adjusting variable (the rate of interest) has a *direct* effect on the market to which it responds (the balance of payments) and the reason a low mobility of capital may lead to cycles in this system is that the rate of interest can affect the balance of payments only through interaction with the goods-and-services market and the price level. On the other hand, the flexible exchange system works badly if capital is mobile because the rate of interest has a more direct effect on the balance of payments than on the market to which it responds (the goods-and-services market); and it works effectively if capital is immobile because this indirect repercussion is small or nil. In both these cases, it should be noted, *a system works best if variables respond to the markets on which they exert the most direct influence*. It may be seen that this principle has a wider application to general problems in the theory of economic policy.¹⁶

¹⁶ The mathematical counterpart of this principle, which has obvious applications to a planned economy in which the “Ministry of Production” sets prices, is that variables should respond to markets in such a way as to make the diagonal elements of the characteristic matrix dominate. This, of course, may not always be possible.

In extreme cases this principle provides an unambiguous guide to “effective market classification”: In addition to the example already cited, one can consider varying responsivenesses of the goods-and-services market to changes in the rate of interest or the terms of trade and verify, for example, that a high responsiveness of this market to the rate of interest is conducive to the effective operation of the flexible-exchange-rate system, whereas a low responsiveness hinders its operation. In the less extreme cases a mixed system—where equilibrium conditions in both markets are considered before allowing any variable to adjust—may be theoretically preferable.¹⁷

APPENDIX

I.

Some of the propositions advanced in the text require more rigorous proof. The purpose of this appendix is to furnish these proofs.

II.

Let X represent the excess demand for goods and services, so that

$$X = \text{investment} - \text{saving} + \text{trade balance},$$

and let F be the balance-of-payments surplus, so that

$$F = \text{trade balance} - \text{capital exports}.$$

Both X and F are assumed to depend on the domestic rate of interest, r , and the ratio of home and foreign price levels, p . The equilibrium conditions are, therefore,

$$X(p, r) = 0 \quad (\text{goods-and-services market}) \quad (1)$$

$$F(p, r) = 0 \quad (\text{foreign exchange market}) \quad (2)$$

¹⁷ Nurkse has argued [80] that it is invalid to identify one instrument with a specific target (employing Tinbergen's terminology), since each instrument affects both markets: Devaluation stimulates employment and improves the balance of trade, and changes in the interest rate affect the balance of payments in addition to the level of employment. In the mathematical system discussed in section V of the Mathematical Appendix it is implicitly argued that both the k 's and the h 's should be positive. This is the mixed system referred to above.

With perfect information, and international collaboration to prevent beggar-thy-neighbor policies, this recommendation would be justified. In the absence of these conditions simpler rules are necessary.

By differentiation of (1) we can obtain

$$\left(\frac{dr}{dp}\right)_{X=0} = -\frac{X_p}{X_r} (= \text{slope of the internal schedule}) \quad (3)$$

and by differentiation of (2) we have

$$\left(\frac{dr}{dp}\right)_{F=0} = -\frac{F_p}{F_r} (= \text{slope of the foreign balance schedule}) \quad (4)$$

The subscripts of X and F denote differentiation with respect to p and r .

It can normally be assumed that $X_p < 0$ (appreciation of the exchange rate or an increase in the price level are deflationary in the sense that they lower the excess demand for goods); $X_r < 0$ (an increase in the interest rate is deflationary); $F_p < 0$ (appreciation or an increase in the price level worsens the balance of payments); and $F_r > 0$ (an increase in the interest rate improves the balance of payments). In the chapter we made the simplifying assumption that the price level or the exchange rate affects only the balance of trade, and that the rate of interest affects only the rate of capital imports or exports.

III.

The dynamic postulates of the fixed-exchange system can be approximated by

$$\frac{dp}{dt} = k_1 X(p, r) \quad (5)$$

which states that the price level rises in proportion to the excess demand for goods and services, and

$$\frac{dr}{dt} = -k_2 F(p, r) \quad (6)$$

which states that the rate of interest rises and falls in proportion to the discrepancy between foreign exchange payments and receipts. The k 's indicate the speed of response in each market.

Expanding Equations (5) and (6) in a Taylor series, and retaining only linear terms, we obtain

$$\frac{dp}{dt} = k_1 X_p (P - P^0) + k_1 X_r (r - r^0) \quad (7)$$

$$\frac{dr}{dt} = k_2 F_p (P - P^0) + k_2 F_r (r - r^0) \quad (8)$$

where p° and r° refer to the price level and the rate of interest at equilibrium. This system has the characteristic equation

$$\begin{vmatrix} m - k_1 X_p & -k_1 X_r \\ K_a F_p & m + k_2 F_r \end{vmatrix} = m^2 - (k_1 X_p - k_2 F_r)m - k_1 k_2 (X_p F_r - X_r F_p) = 0 \quad (9)$$

with roots

$$m_1 m_2 = \frac{k_1 X_p - k_2 F_r \pm \sqrt{(k_1 X_p + k_2 F_r)^2 - 4k_1 k_2 X_r F_p}}{2} \quad (10)$$

that, under the assumed signs, are negative if real and have negative real parts if complex.

The system approaches equilibrium asymptotically or cyclically, depending on whether the discriminant D is positive or negative. But $D > 0$ if F_r is very large (capital mobility); and $D \leq 0$ depending on whether k_2/k_1 (relative speeds of adjustment) is small or large, if $F_r = 0$ (capital immobility).¹⁸

IV.

The assumed dynamic postulates of the flexible exchange system are as follows:

$$\frac{dp}{dt} = h_1 F(p, r) \quad (11)$$

which states that the exchange rate rises and falls in proportion to the surplus or deficit in the balance of payments, and

$$\frac{dr}{dt} = h_2 X(p, r) \quad (12)$$

which states that the central bank raises or lowers the interest rate in proportion to the inflationary or deflationary gap in the goods-and-services market.

¹⁸ Incidentally, this example illustrates a minor misconception which has developed in the theoretical literature on the stability of equilibrium. Metzler [62] proved that the Hicks conditions are necessary, but not sufficient, if a system is to be stable for all possible speeds of adjustment. This theorem has been interpreted by Samuelson ([188], p. 273) and by Arrow and Hurwicz [1] to apply for positive speeds of adjustments. But any matrix with a pattern of signs

$$\begin{bmatrix} - & + \\ - & 0 \end{bmatrix} \text{ (the fixed exchange system with capital immobile)}$$

is stable—yet the Hicks conditions are not satisfied. Metzler's theorem applies, as his proof indicates, to all possible *nonnegative* speeds of adjustment.

After linearizing equations (11) and (12) we find that the roots of the characteristic equation are

$$m_1, m_2 = \frac{h_1 F_p + h_2 X_r \pm \sqrt{(h_1 F_p - h_2 X_r)^2 + 4h_1 h_2 F_r X_p}}{2}. \quad (13)$$

These roots are negative if real, and have negative real parts if complex, so the system is stable.

If capital is immobile ($F_r = 0$) the discriminant is necessarily positive, so the roots are real; the system leads directly (asymptotically) to equilibrium. On the other hand, if capital is highly mobile the roots are complex and the approach to equilibrium is oscillatory.

V.

One can now consider a generalization of the above systems based on the following system of equations:

$$\frac{dp}{dt} = k_1 X(p, r) + h_1 F(p, r) \quad (14)$$

$$\frac{dr}{dt} = k_2 X(p, r) + h_2 F(p, r) \quad (15)$$

This is the fixed exchange rate system with h_1 and h_2 zero, and the flexible exchange rate case with k_1 and k_2 zero. For stability of the linear system

$$\frac{dp}{dt} = (k_1 X_p - h_1 F_p)(p - p^0) + (k_1 X_r + h_1 F_r)(r - r^0) \quad (16)$$

$$\frac{dr}{dt} = (h_2 X_p - k_2 F_p)(p - p^0) + (h_2 X_r + k_2 F_r)(r - r^0) \quad (17)$$

the “trace” (sum of the diagonal coefficients) must be negative and the basic determinant positive. Roughly, the larger the absolute values of the diagonal elements are, relative to the absolute values of the off-diagonal elements, the more direct will be the approach to equilibrium. This explains, in more general terms, the conclusion that a high degree of capital mobility causes cycles in the flexible exchange system but not in the fixed exchange system, and that a low degree of capital mobility interferes with a direct approach to equilibrium under fixed exchange rates and conduces to a direct approach under flexible exchange rates. The reader can easily demonstrate for himself other propositions relating to differences in the values of other parameters. It also helps

to explain the “principle of effective market classification”: instruments (that is, variables) should be directed at those targets (that is, markets) on which they have the most direct influence.

VI.

Consider now a system of fixed exchange rates in which the central bank bases its monetary policy on a discrepancy between the *desired* reserves of foreign exchange, Q^0 , and *actual* reserves, $\int_0^t F(p, r) dt$ (past accumulations), according to the new system

$$\frac{dp}{dt} = k_1 X(p, r) \quad (18)$$

$$\frac{dr}{dt} = b \left[Q^0 - \int_0^t F(p, r) dt \right]. \quad (19)$$

Equation (19) states that the interest rate moves in proportion to the difference between desired and actual reserves, the constant b indicating the speed of the reaction.

This system, linearized, has the following characteristic equation:

$$\begin{vmatrix} m - k_1 X_p & -k_1 X_r \\ bF_p & m^2 + bF_r \end{vmatrix} = 0. \quad (20)$$

By Descartes rule, it has no positive real roots. It does, however, have complex roots with positive real parts, so the system is unstable; the system moves ever further from equilibrium in an expanding spiral.

Note that if the price level is fixed, the path of the interest rate is

$$\begin{aligned} r(t) &= r^0 + c \exp(\sqrt{-F_r} t) + d \exp(-\sqrt{-F_r} t) \\ &= r^0 + j \cos \sqrt{F_r} t + k \sin \sqrt{F_r} t \end{aligned} \quad (21)$$

an undamped harmonic. This also holds if F_p is zero. These results justify the validity of the step-by-step exposition in the text.

VII.

Suppose now that the central bank takes account of both the current balance and the level of stocks in the fixed exchange system. Then we have

$$\frac{dp}{dt} = k_1 X(p, r) \quad (22)$$

$$\frac{dr}{dt} = -k_2 F(p, r) + b \left[Q^0 - \int_0^t F(p, r) dt \right] \quad (23)$$

which has the characteristic equation

$$\begin{vmatrix} m - k_1 X_p & -k_1 X_r \\ k_2 F_p m + b F_p m^2 + k_2 F_r m + b F_r & \end{vmatrix} = 0 \quad (24)$$

with no positive real roots. But it will have complex roots with positive real parts unless

$$k_1 (F_p X_r - X_p F_r) \left[k_2 / b (k_2 F_r - k_1 X_p) - 1 \right] + F_r (k_2 X_p) > 0.$$

The lower is the weight attached to stocks (b small) and the higher is the degree of capital mobility (F_r large), the more likely it is that the system is stable.

VIII.

Next, suppose that speculators react to a change in the level of central bank reserves (q), and that the central bank responds to the current balance. Then we have

$$\frac{dp}{dt} = k_1 X(p, r) \quad (25)$$

$$\frac{dr}{dt} = -k_2 F(p, r, q) \quad \text{where } q = \int_0^t F(p, r, q) dt \quad (26)$$

which has a characteristic equation

$$m^3 + (k_2 F_r - F_q - k_1 X_p) m^2 + k_1 [k_2 (X_r F_p - X_p F_r) + X_p F_q] m = 0 \quad (27)$$

where F_q is the change in the foreign balance which results from a change in the level of reserves, assumed to be positive. From (27) it is clear that the system has one zero root and that high values of F_q and low values of F_r and k_2 are destabilizing.

IX.

Consider now speculation under flexible exchange rates. Suppose that speculative purchases of foreign exchange depend not only on the exchange rate but also on its rate of exchange. Then

$$\frac{dp}{dt} = h_1 F \left(p, r, \frac{dp}{dt} \right) \quad (28)$$

$$\frac{dp}{dt} = h_2 X(p, r) \quad (29)$$

has the characteristic equation

$$m^2 - (aF_p + h_2X_r)m + ah_2(F_pX_r - F_rX_p) = 0 \quad (30)$$

in which $a = h_1/(1 - h_1\eta)$ and η is the speculative outflow due to the changing exchange rate (it is a variant of the coefficient of expectations). A necessary and sufficient condition for stability, given the assumed signs, is that $h_1\eta < 1$. Note that $\eta < 0$ is not a necessary condition of stability: Even if speculators believe the exchange rate will continue to move in the same direction that it is currently moving, the system may be stable.

Chapter 12 / *A Theory of Optimum Currency Areas*¹

It is patently obvious that periodic balance-of-payments crises will remain an integral feature of the international economic system as long as fixed exchange rates and rigid wage and price levels prevent the international price system from fulfilling a natural role in the adjustment process. It is, however, far easier to pose the problem and to criticize the alternatives than it is to offer constructive and feasible suggestions for the elimination of what has become an international disequilibrium system.² This chapter, unfortunately, illustrates that proposition by cautioning against the practicability, in certain cases, of the most plausible alternative: a system of national currencies connected by flexible exchange rates.

A system of flexible exchange rates is usually presented, by its proponents,³ as a device whereby depreciation can take the place of unemployment when the external balance is in deficit, and appreciation can replace inflation when it is in surplus. But the question then arises whether all existing national currencies should be flexible. Should the Ghanaian pound be freed to fluctuate against all currencies or ought the present sterling-area currencies remain pegged to the pound sterling? Or, supposing that the Common Market countries proceed with their plans for economic union, should these countries allow each national currency to fluctuate, or would a single currency area be preferable?

The problem can be posed in a general and more revealing way by defining a currency area as a domain within which exchange rates are fixed and asking: What is the appropriate domain of a currency area? It might seem at first that the question is purely academic, since it hardly appears within the realm of political feasibility that national currencies would ever be abandoned in favor of any other arrangement. To this, three answers can be given: (1)

¹ Adapted from: *Amer. Econ. Rev.*, **51**, 509–517 (Nov. 1961).

² I have analyzed this system in some detail in Chapter 15.

³ See, for example, [16], [47], and [59].

Certain parts of the world are undergoing processes of economic integration and disintegration, new experiments are being made, and a conception of what constitutes an optimum currency area can clarify the meaning of these experiments; (2) those countries, like Canada, that have experimented with flexible exchange rates are likely to face particular problems which the theory of *optimum* currency areas can elucidate if the national currency area does not coincide with the optimum currency area; and (3) the idea can be used to illustrate certain functions of currencies that have been inadequately treated in the economic literature and that are sometimes neglected in the consideration of problems of economic policy.

Currency Areas and Common Currencies

A single currency implies a single central bank (with note-issuing powers) and therefore a potentially elastic supply of interregional means of payments. But in a currency area comprising more than one currency, the supply of international means of payment is conditional upon the cooperation of many central banks; no central bank can expand its own liabilities much faster than other central banks without losing reserves and impairing convertibility.⁴ This means that there will be a major difference between adjustment within a currency area that has a single currency and a currency area involving more than one currency; in other words, there will be a difference between interregional adjustment and international adjustment even though exchange rates in the latter case are fixed.

To illustrate this difference, consider a simple model of two entities (regions or countries), initially in full employment and balance-of-payments equilibrium, and see what happens when this equilibrium is disturbed by a shift of demand from the goods of entity *B* to the goods of entity *A*. Assume that money wages and prices cannot be reduced in the short run without causing unemployment, and that monetary authorities act to prevent inflation.

Suppose first that the entities are countries with national currencies. The shift of demand from *B* to *A* causes unemployment in *B* and inflationary pressure in *A*.⁵ To the extent that prices are allowed to rise in *A*, the change in the terms of trade will relieve *B* of some of the burden of adjustment. But, if *A* tightens credit restrictions to prevent prices from rising, all the burden of adjustment is thrust onto country *B*; what is needed is a reduction in *B*'s real income, and if this cannot be effected by a change in the terms of trade—because *B* cannot lower, and *A* will not raise, prices—it must be accomplished by a decline in *B*'s output and employment. The policy of surplus countries

⁴ More exactly, the rates at which central banks can expand monetary liabilities depend on income elasticities of demand and output elasticities of supply.

⁵ For present purposes inflation is defined as a rise in the prices of home-produced goods.

in restraining prices therefore imparts a recessive tendency to the world economy on fixed exchange rates or (more generally) to a currency area with many separate currencies.⁶

Contrast this situation with that where the entities are regions within a closed economy lubricated by a common currency, and suppose now that the national government pursues a full-employment policy. The shift of demand from *B* to *A* causes unemployment in region *B* and inflationary pressure in region *A* and a surplus in *A*'s balance of payments.⁷ To correct the unemployment in *B* the monetary authorities increase the money supply. The monetary expansion, however, aggravates inflationary pressure in region *A*: indeed, the principal way in which the monetary policy is effective in correcting full employment in the deficit region is by raising prices in the surplus region, turning the terms of trade against *B*. Full employment thus imparts an inflationary bias to the multiregional economy or (more generally) to a currency area with a common currency.

In a currency area comprising different countries with national currencies, the pace of employment in deficit countries is set by the willingness of surplus countries to inflate. But in a currency area comprising many regions and a single currency, the pace of inflation is set by the willingness of central authorities to allow unemployment in deficit regions.

The two systems could be brought closer together by an institutional change: Unemployment could be avoided in the world economy if central banks agreed that the burden of international adjustment should fall on surplus countries, which would then inflate until unemployment in deficit countries is eliminated; or a world central bank could be established with power to create an international means of payment. But a currency area of either type cannot prevent both unemployment and inflation among its members. The fault lies not with the type of currency area but with the domain of the currency area. The "optimum" currency area is not the world. Optimality is here defined in terms of the ability to stabilize national employment and price levels.

National Currencies and Flexible Exchange Rates

The existence of more than one currency area in the world implies (by definition) variable exchange rates. In the international trade example, if

⁶ The attempt of surplus countries to control (what is, from a national point of view) inflation can be documented by U.S. and French policy in the 1920s and continental European policy from 1957 to 1966. But it is unfortunate that a simple change in world relative prices is interpreted, in the surplus countries, as inflation.

⁷ Instructive examples of balance-of-payments problems between different regions of the United States can be found in ([22], chap. 14). For purposes of this chapter regions are defined as areas within which there is a factor mobility, but between which there is factor immobility.

demand shifts from the products of country *B* to the products of country *A*, a depreciation by country *B* or an appreciation by country *A* would correct the external imbalance and also relieve unemployment in country *B* and restrain inflation in country *A*. This is the most favorable case for flexible rates based on national currencies.

Other examples, however, might be equally relevant. Suppose that the world consists of two countries, Canada and the United States, each of which has separate currencies. Also assume that the continent is divided into two regions that do not correspond to national boundaries—the East, which produces goods such as cars, and the West, which produces goods such as lumber products. To test the flexible-exchange-rate argument in this example assume that the U.S. dollar fluctuates relative to the Canadian dollar, and that an increase in productivity (say) in the automobile industry causes an excess demand for lumber products and an excess supply of cars.

The immediate impact of the shift in demand is to cause unemployment in the East and inflationary pressure in the West, and a flow of bank reserves from the East to the West because of the former's regional balance-of-payments deficit. To relieve unemployment in the East the central banks in both countries would have to expand the national money supplies or, to prevent inflation in the West, contract the national money supplies. (Meanwhile the Canada-U.S. exchange rate would move to preserve equilibrium in the national balances.) Thus unemployment can be prevented in both countries, but only at the expense of inflation; or, inflation can be restrained in both countries but at the expense of unemployment; or, finally, the burden of adjustment can be shared between East and West with some unemployment in the East and some inflation in the West. But both unemployment and inflation cannot be escaped. The flexible exchange rate system does not serve to correct the balance-of-payments situation between the two regions (which is the essential problem), although it will do so between the two countries; it is therefore not necessarily preferable to a common currency or national currencies connected by fixed exchange rates.

Regional Currency Areas and Flexible Exchange Rates

The preceding example does not destroy the argument for flexible exchange rates, but it might severely impair the relevance of the argument if it is applied to national currencies. The logic of the argument can in fact be rescued if national currencies are abandoned in favor of regional currencies.

To see this suppose that the "world" reorganizes currencies so that Eastern and Western dollars replace Canadian and U.S. dollars. If the exchange rate between the East and the West were pegged, a dilemma would arise similar to that discussed in the first section. But if the East-West exchange rate were

flexible, then an excess demand for lumber products need cause neither inflation nor unemployment in either region. The Western dollar appreciates relative to the Eastern dollar, thus assuring balance-of-payments equilibrium, while the Eastern and Western central banks adopt monetary policies to ensure constancy of effective demand in terms of the regional currencies, and therefore stable prices and employment.

The same argument could be approached from another direction. A system of flexible exchange rates was originally propounded as an alternative to the gold standard mechanism, which many economists blamed for the worldwide spread of depression after 1929. But, if the arguments against the gold standard were correct, then why should a similar argument not apply against a common currency system in a multiregional country? Under the gold standard, depression in one country would be transmitted, through the foreign-trade multiplier, to foreign countries. Similarly, under a common currency, depression in one region would be transmitted to other regions for precisely the same reasons. If the gold standard imposed a harsh discipline on the national economy and induced the transmission of economic fluctuations, then a common currency would be guilty of the same charges; interregional balance-of-payments problems are invisible, so to speak, precisely because there is no escape from the self-adjusting effects of interregional money flows. (It is true, of course, that interregional liquidity can always be supplied by the national central bank, whereas the gold standard and even the gold exchange standard were hampered, on occasion, by periodic scarcities of internationally liquid assets; but the basic argument against the gold standard was essentially distinct from the liquidity problem.)

Today, if the case for flexible exchange rates is a strong one, it is, in logic, a case for flexible exchange rates based on *regional* currencies, not on national currencies. The optimum currency area is the region.

A Practical Application

The theory of international trade was developed on the Ricardian assumption that factors of production are mobile internally but immobile internationally. Williams, Ohlin, Iversen, and others, however, protested that this assumption was invalid and showed how its relaxation would affect the real theory of trade. I have tried to show that its relaxation has important consequences also for the monetary theory of trade and especially the theory of flexible exchange rates. The argument for flexible exchange rates based on national currencies is only as valid as the Ricardian assumption about factor mobility. If factor mobility is high internally and low internationally, a system of flexible exchange rates based on national currencies might work effectively enough. But if regions cut across national boundaries or if countries

are multiregional, then the argument for flexible exchange rates is only valid if currencies are reorganized on a regional basis.

In the real world, of course, currencies are mainly an expression of national sovereignty, so that actual currency reorganization would be feasible only if it were accompanied by profound political changes. The concept of an optimum currency area therefore has direct practical applicability only in areas where political organization is in a state of flux, such as in ex-colonial areas and in Western Europe.

In Western Europe the creation of the Common Market is regarded by many as an important step toward eventual political union, and the subject of a common currency for the six countries has been much discussed. One can cite the well-known position of Meade ([61], pp. 385–386), who argues that the conditions for a common currency in Western Europe do not exist, and that, especially because of the lack of labor mobility, a system of flexible exchange rates would be more effective in promoting balance-of-payments equilibrium and internal stability; and the apparently opposite view of Scitovsky ([96], chap. 2),⁸ who favors a common currency because he believes that it would induce a great degree of capital mobility, but adds that steps must be taken to make labor more mobile and to facilitate supernational employment policies. In terms of the language of this paper, Meade favors national currency areas whereas Scitovsky gives qualified approval to the idea of a single currency area in Western Europe.

In spite of the apparent contradiction between the two views, the concept of optimum currency areas helps us to see that the conflict reduces to an empirical rather than a theoretical question. In both cases it is implied that an essential ingredient of a common currency, or a single currency area, is a high degree of factor mobility; but Meade believes that the necessary factor mobility does not exist, whereas Scitovsky argues that labor mobility must be improved and that the creation of a common currency would itself stimulate capital mobility. In other words, neither writer disputes that the optimum currency area is the region—defined in terms of internal factor mobility and external factor immobility—but there is an implicit difference in views on the precise degree of factor mobility required to delineate a region. The question thus reduces to whether or not Western Europe can be considered a single region, and this is essentially an empirical problem.

Upper Limits on the Number of Currencies and Currency Areas

A dilemma now arises: Factor mobility (and hence the delineation of regions) is most usefully considered a relative rather than an absolute concept,

⁸ These statements, of course, cannot do full justice to the arguments of Meade and Scitovsky.

with both geographic and industrial dimensions, and it is likely to change over time with alterations in political and economic conditions. If, then, the goals of internal stability are to be rigidly pursued, it follows that the greater is the number of separate currency areas in the world, the more successfully will these goals be attained (assuming, as always, that the basic argument for flexible exchange rates per se is valid). But this seems to imply that regions ought to be defined so narrowly as to count every minor pocket of unemployment arising from labor immobility as a separate region, each of which should apparently have a separate currency!

Such an arrangement hardly appeals to common sense. The suggestion reflects the fact that we have, thus far, considered the reasons for keeping currency areas small, not the reasons for maintaining or increasing their size. In other words, we have discussed only the stabilization argument, to which end it is preferable to have many currency areas, and not the increasing costs likely to be associated with the maintenance of many currency areas.

It will be recalled that the older economists of the nineteenth century were internationalists and generally favored a world currency. Thus John Stuart Mill wrote ([66], p. 176):

... So much of barbarism, however, still remains in the transactions of most civilised nations, that almost all independent countries choose to assert their nationality by having, to their own inconvenience and that of their neighbours, a peculiar currency of their own.

Mill, like Bagehot and others, was concerned with the costs of valuation and money changing, not stabilization policy, and it is readily seen that these costs tend to increase with the number of currencies. Any given money *qu numéraire*, or unit of account, fulfills this function less adequately if the prices of foreign goods are expressed in terms of foreign currency and must then be translated into domestic currency prices. Similarly, money in its role of medium of exchange is less useful if there are many currencies; although the costs of currency conversion are always present, they loom exceptionally large under inconvertibility or flexible exchange rates. (Indeed, in a hypothetical world in which the number of currencies equaled the number of commodities, the usefulness of money in its roles of unit of account and medium of exchange would disappear, and trade might just as well be conducted in terms of pure barter). Money is a convenience and this restricts the optimum number of currencies. In terms of this argument alone, the optimum currency area is the world, regardless of the number of regions of which it is composed.

There are two other factors that would inhibit the creation of an arbitrarily large number of currency areas. In the first place, markets for foreign exchange must not be so thin that any single speculator (perhaps excepting central banks) can affect the market price; otherwise the speculation argument against flexible exchange rates would assume weighty dimensions. The

other argument limiting “Balkanization” concerns the very pillar on which the flexible-exchange-rate argument rests. The thesis of those who favor flexible exchange rates is that the community in question is not willing to accept variations in its real income through adjustments in its money wage rate or price level, but that it is willing to accept virtually the same changes in its real income through variations in the rate of exchange. In other words, it is assumed that unions bargain for a money rather than a real wage, and adjust their wage demands to changes in the cost of living, if at all, only if the cost-of-living index excludes imports. As the currency area grows smaller and the proportion of imports in total consumption grows, this assumption becomes increasingly unlikely. It may not be implausible to suppose that there is some degree of money illusion in the bargaining process between unions and management (or frictions and lags having the same effects), but it is unrealistic to assume the extreme degree of money illusion that would have to exist in small currency areas. Because the necessary degree of money illusion becomes greater the smaller currency areas are, it is plausible to conclude that this also imposes an upper limit on the desirable number of currency areas.

Concluding Argument

The subject of flexible exchange rates can logically be separated into two distinct questions. The first is whether a system of flexible exchange rates can work effectively and efficiently in the modern world economy. For this to be possible it must be demonstrated that: (1) an international price system based on flexible exchange rates is dynamically stable after taking speculative demands into account; (2) the exchange rate changes necessary to eliminate normal disturbances to dynamic equilibrium are not so large as to cause violent and reversible shifts between export and import-competing industries (this is not ruled out by stability); (3) the risks created by variable exchange rates can be covered at reasonable costs in the forward markets; (4) central banks will refrain from monopolistic speculation; (5) monetary discipline will be maintained by the unfavorable political consequences of continuing depreciation, and it is to some extent maintained today by threats to the levels of foreign exchange reserves; (6) reasonable protection of debtors and creditors can be assured to maintain an increasing flow of long-term capital movements; and (7) wages and profits are not tied to a price index in which import goods are heavily weighted. These issues have not been discussed explicitly; some of them are taken up in following chapters.

The second question concerns how the world should be divided into currency areas. We have argued that the stabilization argument for flexible exchange rates is valid only if it is based on regional currency areas. If the

world can be divided into regions within each of which there is factor mobility and between which there is factor immobility, then each of these regions should have a separate currency which fluctuates relative to all other currencies. This carries the argument for flexible exchange rates to its logical conclusion.

But a region is an economic unit, whereas a currency domain is partially an expression of national sovereignty. Except in areas where national sovereignty is being given up, it is not feasible to suggest that currencies should be reorganized; the validity of the argument for flexible exchange rates therefore hinges on the closeness with which nations correspond to regions. The argument works best if each nation (and currency) has internal factor mobility and external factor immobility. But if labor and capital are insufficiently mobile within a country, then flexibility of the external price of the national currency cannot be expected to perform the stabilization function attributed to it, and one could expect varying rates of unemployment or inflation in the different regions. Similarly, if factors are mobile across national boundaries, then a flexible exchange system becomes unnecessary, and may even be positively harmful, as I have suggested elsewhere.⁹

Canada provides the only modern example where an advanced country has experimented with flexible exchange rates. According to my argument, the experiment should be largely unsuccessful as far as stabilization is concerned. Because of the factor immobility between regions, an increase in foreign demand for the products of one of the regions would cause an appreciation of the exchange rate and therefore increased unemployment in the remaining regions, a process that could be corrected by a monetary policy that aggravated inflationary pressures in the first region; every change in demand for the products in one region is likely to induce opposite changes in other regions that cannot be entirely modified by national stabilization policies. Similarly, the high degree of external capital mobility is likely to interfere with stabilization policy for completely different reasons: To achieve internal stability the central bank can alter credit conditions but it is the change in the exchange rate rather than the alteration in the interest rate which produces the stabilizing effect; this indirectness conduces to a cyclical approach to equilibrium. Although an explicit empirical study would be necessary to verify that the Canadian experiment has not fulfilled the claims for made flexible exchange rates, the *prima facie* evidence indicates that it has not. It must be emphasized,

⁹ In Chapter 11, I advanced the argument that stabilization policy would be more difficult under fixed exchange rates if short-term capital were immobile than if it were mobile, and more difficult under flexible exchange rates if capital were mobile than if it were immobile. Although the method of analysis was fundamentally different, the conclusions support the contention of this paper that the fixed-exchange-rate system is better within areas where factors are mobile and the flexible-exchange-rate system is better for areas between which factors are immobile. The argument in Chapter 11 imposes an additional argument against increasing the number of currency areas.

though, that failure of the Canadian experiment would cast doubt only on the effectiveness of a flexible exchange system in a multiregional country, not on a flexible exchange system in a unitary country.¹⁰

¹⁰ Other economists have advanced arguments in favor of Balkanization of multiregional countries (see, for example, Scott [97]); and the argument for regional currency adds to the list; but, as Scott is careful to emphasize, no country can make such decisions on purely economic grounds.

Chapter 13 / *The Proper Division of the Burden of International Adjustment*¹

The efficiency of the international adjustment mechanism is intimately bound up with the distribution of the burden of adjustment between deficit and surplus countries. To what extent should surplus countries expand; to what extent should deficit countries contract? The purpose of this chapter is to explore theoretical criteria on which an appropriate division of the burden of adjustment can be based.

The Internal Stability Criterion

A conventional criterion emphasizes the state of internal balance in the deficit and surplus countries. When the deficit countries are inflating and the surplus countries are depressed, internal and external balance both require contraction in the deficit countries and expansion in the surplus countries. Thus Italy, in 1963–1964, was inflating considerably beyond the call of external equilibrium, and corrected appropriately (although perhaps too aggressively) through financial contraction. Similarly, Germany, in 1959, had a mild recession and a continuing surplus, and expanded appropriately.

When there is a general depression throughout the world, both surplus and deficit countries should expand, but the responsibility for the initiative, unless international reserves are very large or unevenly distributed in favor of the deficit countries, rests with the *surplus* countries, because they are in the best position to expand. Thus, after 1934, the United States had a substantial gold inflow when the Free World was in a state of depression, and responsibility rested with the United States to initiate recovery (this attempt had only modest success).

When there is general world inflation, both surplus and deficit countries should contract. The responsibility for initiating restrictive measures in this case, however, rests with the *deficit* countries, as restrictive financial policies

¹ Adapted from: *Nat. Banking Rev.*, 3, 81–87 (Sept. 1965). 187

will promote internal and external balance in the deficit countries whereas they are in opposition to external balance in the surplus countries. Thus, in the early post–World War II period, when both America and Europe were confronted with substantial inflationary pressure, restrictive financial policies should have commenced first in Europe.

In the cases above there is a harmony of interests under fixed exchange rates according to the internal stability criterion. But this harmony breaks down in situations where the deficit countries are depressed and the surplus countries are inflating. Under those conditions, restrictive financial measures in the deficit countries might improve the external balance, but only at a cost of worsening the domestic depression, and expansionary measures in the surplus countries would promote balance of payments equilibrium, but only at the expense of aggravating the domestic inflation. This is, by and large, the problem that confronted France, Holland, Germany, and Switzerland, on the one hand, and the United States, on the other, in the years 1959–1964.

It should not be thought that the exception we have recently experienced, where the internal stability criterion broke down, is an unusual case. Indeed, in the days of the gold standard, this was considered the normal case. Gold flows from deficit countries promoted deflation or depression, and gold flows into surplus countries promoted inflation. This very mechanism was the method through which equilibrium was restored. It is also the form toward which each of the other disequilibrium conditions gravitates as the appropriate corrective policies are implemented.

The Relative Cost Criterion

At this point, a “relative cost criterion” might be invoked to supplement the internal stability criterion where surplus countries are already inflating and deficit countries are already depressed. There is a cost to higher inflation rates in surplus countries, and a cost to continued depression in deficit countries; but the costs are presumed to be measurable, at least in principle. What is the cost to Europe of a continued inflation rate of, say, 4 per cent per year compared to the cost of depression in the United States reflected in an excess unemployment rate (that is, an unemployment rate exceeding the rate of frictional unemployment) of perhaps 1 or 2 per cent of the labor force? Adjustment, it might be argued, should take place in the surplus countries if the cost of inflation is less than the waste from unemployment and, vice versa, if the inflationary solution is more costly. If we make the reasonable assumption that the economic waste from unemployment and inflation increases sharply as these become more serious, this criterion would probably suggest some excess unemployment in the deficit countries and some inflation in the surplus countries.

But is this criterion very useful in determining the appropriate distribution of the burden of adjustment? There are both theoretical and practical problems suggesting that it is not.

In the first place, the science of measuring waste is still in its infancy and it is unlikely that any methods thus far advanced to measure the cost of unemployment and the cost of inflation could possibly be accurate enough for determining the relative cost of unemployment in one group of countries and inflation in another group of countries. One way of measuring the cost of unemployment is to calculate what gross national product would have been in its absence, making rough guesses about productivity and the potential, compared to the actual, size of the labor force. But it is difficult to make an appropriate allowance for leisure and for the fact that the burden of unemployment typically falls on the poorer members of society (who are usually least able to bear it). On the other hand, the cost of inflation is practically impossible to measure in a precise way, given our present tools, and quantitative studies (except one study assuming that the inflation rate is constant and anticipated with certainty by the general public) have not even been attempted. How can the cost of disrupting deep-rooted social expectations ever be measured?

The difficulty of measuring the costs of unemployment and inflation might alone render the relative cost criterion useless. But it can also be argued that the asymmetry between inflation and unemployment is misplaced. Why not *deflation* instead of unemployment? The problem lies in the downward rigidity of the level and structure of wage rates and, to a lesser extent, other costs. But if deflation implies a smaller cost to the economy than does unemployment, should surplus countries experience the additional discomfort of further inflation because deficit countries have failed to resolve a basic institutional problem? Whatever the justice of it surplus countries are unlikely to acquiesce in allowing inflation they can prevent.

A third difficulty with the relative cost criterion is that compensation cannot, in practice, be paid directly. If, for example, it is judged that surplus countries should inflate at a higher rate than they had previously been inflating to relieve the deficit countries of the problem of additional unemployment, could the surplus countries justify to their own people the act of altruism that additional inflation would imply? The implicit *quid pro quo* may be, of course, that, when the situation reverses itself, the country previously in deficit would return the favor by inflating. But could Europe have been confident, if governments there had inflated more rapidly between 1959–1964, that the United States would in turn inflate if its deficit turned into a substantial surplus? A European government may well feel that a commitment to inflate to solve U.S. problems is like accepting a check that will ultimately bounce.

Exchange-Rate Adjustment

The failure of the internal stability criterion in the case where it may well be most relevant, and the practical impossibility of applying a relative cost criterion, naturally suggest a consideration of alternative adjustment measures. When deficit countries are depressed and surplus countries are inflating, why not alter the exchange rate ?

Disregarding the relevant fact that exchange-rate adjustments have been deemphasized in recent years, and that the adjustable peg mechanism introduced at Bretton Woods has been all but abandoned, a little reflection shows that the possibility of exchange-rate adjustment does not avoid the problem of determining the distribution of the adjustment burden.

One reason is that an exchange-rate adjustment will not ordinarily suffice to bring about, simultaneously, balance-of-payments equilibrium along with internal balance in each country (one instrument ordinarily cannot suffice for multiple objectives); and this means that residual financial adjustments will be required in any case, the burden of which must be decided in some fashion. But, more important, both from a theoretical and a practical standpoint, is the fact that an exchange-rate adjustment must itself be “distributed” between deficit and surplus countries.

Should the deficit countries devalue, the surplus countries appreciate, or does it make any difference ?

The simplest way to test whether it makes any difference is to consider what happens when both countries devalue (or appreciate) in the same proportions. If an equal devaluation has no effect on real or money values, it cannot matter whether the deficit country devalues or the surplus country appreciates.

When the problem is posed in this way, it is immediately clear that the key issue is the meaning to be attached to devaluation. There is, first of all, a trivial sense in which appreciation of both currencies has no effect on equilibrium. If Germany appreciates the mark with respect to the dollar by 10 per cent of the initial mark-dollar exchange rate, and then appreciates the dollar relative to the mark to the same extent, the exchange rate is back where it was before and no economic variables can have been affected (provided the exchange markets are closed in the interim!). But this is completely trivial, for it amounts to changing something and then putting things back to where they were at the beginning.

In a nontautological sense we might consider a world of only two currencies, the franc and the mark, and suppose that France appreciates the franc against the mark by 10 per cent of the initial rate of $F 5.0 = DM 4.0$ (so that the Banque de France stands willing to buy and sell marks freely at the rate of $F 5.0 = DM 4.4$); and that Germany simultaneously appreciates the mark against the franc by 10 per cent of the initial rate (so that the Bundesbank

stands willing to buy and sell francs freely for marks at the rate of F 5.0 = DM 3.6). Can this leave economic variables unchanged?

Obviously not! The Banque de France cannot long offer to buy and sell marks for francs at one rate and the Bundesbank at another. The rates are incompatible, and arbitrageurs worth their salt would buy marks at the Banque de France (where they are cheap) in exchange for francs, and buy francs at the Bundesbank (where they are cheap) in exchange for marks. Both banks would be flooded with their own currency and would quickly exhaust all their foreign exchange reserves, resulting in strong automatic deflationary effects. In this sense of exchange-rate changes, simultaneous appreciation in the two countries cannot be said to have no effect on economic variables.

There is a third sense in which exchange-rate adjustment can be conceived. Suppose that both countries appreciate their currencies against a unit of account such as gold. To take another hypothetical example, suppose that Britain defines the pound as being worth $2/25$ of an ounce of gold, while the United States defines the dollar as being worth $1/35$ of an ounce of gold, so that the dollar-pound exchange rate is $\text{£}1 = \$2.80$. Then suppose that Britain and the United States simultaneously appreciate their currencies in terms of gold by, say, halving its price. Then the pound becomes worth $4/25$ of an ounce of gold and the dollar $2/35$ of an ounce of gold. The exchange rate between the pound and the dollar is unchanged, at $\text{£}1 = \$2.80$. Are there any economic effects of this change?

The answer is that it depends on whether gold is a fictitious unit of account or whether it is a tangible commodity that is bought and sold and held, either privately or as a reserve by the central banks. If it is an abstract unit, it has only a definitional purpose and the change referred to above would have no consequence.

In the real world gold has a tangible function, so that, in this meaning of exchange-rate adjustment, simultaneous appreciation must directly affect economic equilibrium. And, if this is the relevant sense of exchange-rate adjustment, it means that appreciation in surplus countries is not the same as depreciation in deficit countries, and that therefore the same problem of determining the distribution of the burden of international adjustment presents itself under a system of variable exchange rates as under a system of fixed exchange rates.

Par values are today defined in terms of the gold content of the U.S. dollar of 1944 so that, in effect, gold is the unit of account even though countries peg directly, or indirectly through the pound sterling, to the current U.S. dollar. To illustrate the effects of devaluation in one country as compared to appreciation in another country, consider again the U.K.–U.S. example. Suppose that the United Kingdom has a deficit and the United States a surplus. What then would be the difference between a depreciation of the pound of, say 10 per cent, and an appreciation of the dollar of 10 per cent?

In the case of a devaluation of the pound, the pound price of gold rises from £12.5 per ounce to £13.75, and the dollar-pound exchange rate moves to £1 = \$2.52. The pound value of both U.S. and British gold reserves increases by 10 per cent, while the dollar value of reserves in both countries remains unchanged. In other words, the purchasing power of the U.S. and U.K. gold stocks, in terms of British goods, rises while (initially at least) remaining unchanged in terms of American goods. World liquidity has *increased*.

Now consider appreciation by 10 per cent in the United States. The dollar price of gold goes down to \$31.50, creating again an exchange rate of £1 = \$2.52. But this time the dollar value of the British and the U.S. gold stocks goes down by 10 per cent while the pound value of gold stocks is unchanged. World liquidity has *decreased*.

It follows, then, that devaluation in one country cannot be considered the equivalent of appreciation in another country, and that the question of the distribution of the burden of exchange-rate adjustment reasserts itself; in what proportion should deficit countries devalue and to what extent should surplus countries appreciate?

The Relative Size Criterion

I have now argued that the internal stability criterion for determining how adjustment should be distributed between deficit and surplus countries fails in the important case where surplus countries are inflating and deficit countries are depressed; that the relative cost criterion is of little practical use; that the possibility of exploiting exchange rate variation does not eliminate the problem because there always remain required residual price or income adjustments; and, finally, that the distribution of exchange-rate variations between appreciating and depreciating countries itself requires a theory. There is, in other words, a gap in the literature on the theory of the adjustment process: There is no criterion establishing how adjustment between deficit and surplus countries should be distributed—whether the adjustment is to be effected by price or by exchange-rate changes—although both the internal stability criterion and the relative cost criterion retain considerable importance in certain cases.

I shall now show, however, that size is a factor that must be taken directly into account. Specifically, I shall demonstrate that, in theory, adjustment should be divided *in inverse proportion to the sizes of the countries*. To develop this proposition, we shall first show that adjustment under automatic mechanisms will normally be inversely proportionate to size, on the basis of either elementary classical or Keynesian assumptions. I shall then argue that in the important sense of maintaining world price stability this division is optimal.

First, consider a crude classical model of two countries—in which the quantity theory of money applies—operating on the gold standard. Suppose that one country has a deficit and loses gold and that the other has a surplus and gains gold. How will size affect the extent to which the price level goes up in the surplus country and down in the deficit country?

Apart from complications arising from different banking systems and differential fractional reserve ratios, the price level in each country will change in proportion to the increase or decrease in the stock of money, which, under a gold specie standard, would be equal to the gold flow. However, the percentage change in the price level in either of the two countries will be equal to the *percentage* change in the money stock, and this percentage change is equal to the gold flow divided by the initial stocks of gold. Then, since the surplus of the surplus country is equal to the absolute amount of gold lost by the deficit country, it follows that the ratio of the price changes will be inversely proportionate to the size of the country, to the extent that the stocks of money in the two countries reflect the sizes of the countries.

Consider, for example, a world of two countries disparate in size—the United States and Andorra—and suppose that an initial equilibrium is disturbed by a capital movement from the United States to Andorra, one that is not immediately transferred in real terms. Then Andorra will have a balance-of-payments surplus and the United States an equal payments deficit, but the domestic monetary effects of the external disequilibrium in Andorra will be huge in relation to the domestic monetary effects of the external disequilibrium in the United States. Andorran prices and costs will go up substantially while U.S. prices will hardly be affected at all. The small country in surplus bears the brunt of the adjustment burden.

The opposite situation applies, of course, when there is a capital movement from Andorra to the United States. This time Andorra will have a payments deficit and the United States an equal surplus, but the resulting monetary contraction in Andorra will be a large proportion of the money supply in that little country, inducing a prompt and considerable decline in prices, whereas the monetary effects in the United States will be felt only in small measure. The small country in deficit bears once more the brunt of the adjustment burden.

Small countries have to adjust absolute price levels to big countries and, if a change in relative price levels is required, the adjustment will be effected by a movement of the absolute price level in the small country with hardly any change in the price level in the big country.

The validity of this proposition does not depend on the *simpliste* classical assumptions by means of which it was demonstrated; the conclusion holds in a world of two countries in which all adjustments are effects—a la Keynes—through interest rate and income changes. If the surplus country is large compared to the deficit country, the gold flows will have little effect on interest

rates, and therefore little effect on investment, in the surplus country; but the same gold flows will have a relatively substantial effect on interest rates and investment, and therefore on money income, in the smaller countries. Consequently, the percentage adjustment in money income will be very large in the small country compared to the percentage adjustment in the money income of the big country.

Normative Aspects of the Relative Size Criterion

We have now demonstrated that adjustment normally *will* occur in the small country, but not yet that it is in the interests of world stability for it to occur there. Yet it follows easily in both the classical and Keynesian examples. For, if a relative price adjustment between the export prices of deficit and surplus countries of, say, 10 per cent is required to restore equilibrium, stability of a *world* price index will require that the bulk of the adjustment be borne by the small country; as one country becomes infinitesimal in size, a world price index of production approaches the internal price index of the big country. A similar argument also holds in the unemployment case, because the correction of a given balance of payments gap by income changes in a small country rather than a large country minimizes the fluctuations of world output, since the marginal propensity to import in an economically small country is high relative to the marginal propensity of the large country, “openness” itself being a function of size.

Further, it should be apparent that the relative size criterion also provides the information necessary to determine the optimal division of exchange-rate adjustments when the currencies of both countries under consideration are pegged to a commodity like gold or to a third currency. Assuming the world as a whole has a sufficient amount of liquidity (in the sense that an adjustment of relative price levels and a redistribution of reserves could be found which would establish general equilibrium), the normal and correct adjustment under fixed exchange rates would imply a reduction in reserves and the money supply and price level in the deficit country, and an increase in reserves and the money supply and price level in the surplus country. To render this adjustment process unnecessary, by exploiting the possibility of exchange-rate changes, the changes in gold prices should be roughly in inverse proportion to the size of the two countries, provided domestic money supplies are linked to external reserves. A large increase in the gold price of the deficit country, if it were small, combined with a small decrease in the gold price in the surplus country, if it were large, would be required to preserve the average real value of external reserves in the world as a whole and at the same time effect the needed adjustment of relative prices. Thus, if an adjustment of 10 per cent in relative price levels was required to restore equilibrium between, say, France

(assumed to be in surplus) and the United States, and these were the only two countries in the world, an increase in the price of gold in the United States by 2 per cent, combined with a decrease in the price of gold in France by 8 per cent, would effect the required relative exchange rate adjustment without creating excess or deficient liquidity in the world as a whole, on the assumption that the United States is four times as large as France.

APPENDIX

The redundancy problem and the world price level

I.

The combined balance-of-payments surpluses of the surplus countries exactly matches the balance-of-payments deficits of all the deficit countries, since the global balance (when asymmetrical treatment of gold or other reserve assets is avoided) is zero. This means that if each country has a distinct instrument to control its balance of payments there is an additional degree of freedom. Only $n - 1$ independent balance-of-payments instruments are needed in an n -country world because equilibrium in the balances of $n - 1$ countries implies equilibrium in the balance of the n th country. The *redundancy problem* is the problem of deciding how to utilize the extra degree of freedom.

II.

Let B_i be the balance of payments of the i th country, p_i its control variable, and

$$\frac{dp_i}{dt} = \alpha_i B_i \quad (i = 1, \dots, n) \quad (1)$$

the adjustment equation linking variations in the control variable to the target. Then if

$$\sum_{i=1}^n B_i = 0 \quad (2)$$

it follows that

$$\sum_{i=1}^n \frac{1}{\alpha_i} \frac{dp_i}{dt} = 0 \quad (3)$$

whence, upon integration,

$$\sum_{i=1}^n \frac{1}{\alpha_i} P_i = \text{constant}, \quad (4)$$

assuming the “speeds of adaptation,” the α_i 's, to be constant. Thus interdependence of the targets, as implied by (2), implies interdependence among the instruments; if some control variables are rising, others must be falling, a necessary consequence of the fact, given the adjustment equation (1), that if some countries have deficits others must have surpluses.

III.

If all countries “use” price levels to correct the balance of payments, (4) implies that an “index of price levels in the world as a whole is constant,” the weights in the index being the reciprocals of the speeds of adaptation. Under a gold standard system, for example, (4) can be identified with an international version of the quantity theory of money.

To see this we need to find an interpretation of the constant of integration in (4) and the speeds of adjustment in (1) and (4). Thus, suppose we consider a gold specie standard in which the balance of payments is identically equal to the change in gold reserves. Then

$$\frac{dG_t}{dt} = B_t \quad (i = 1, \dots, n) \quad (5)$$

where G_i is the gold stock of the i th country. From (1) and (5) we get

$$\sum_{i=1}^n \frac{dG_t}{dt} = \sum_{i=1}^n \frac{1}{\alpha_i} \frac{dp_t}{dt} \quad (6)$$

whence

$$\bar{G} = \sum_{i=1}^n \frac{1}{\alpha_i} P_t \quad (7)$$

where $\bar{G} \equiv \sum G_i O_i$ is the world's gold stock. G must be a constant if (2) and (5) are to be consistent, so that (7) fixes the relation between the world's stock of gold and a world index of prices.

But what are the weights in the world price index? From a version of the quantity theory of money, applicable to each country, we have

$$G_t V_i = P_t O_t, \quad (8)$$

where O_i is output in the i th country, taken as given, and V_i is income velocity. If this holds at every moment of time we get

$$\frac{dG_t}{dt} = \frac{1}{V_i} O_i \frac{dp_i}{dt} \quad (9)$$

assuming income velocity is constant. Taking account of (5), then,

$$\frac{dp_i}{dt} = V_i \frac{B_i}{O_i}. \quad (10)$$

More usefully (for some purposes), the *proportionate* change in the national price level is

$$\frac{1}{p_i} \frac{dp_i}{dt} = V_i B_i^* \quad (11)$$

where B_i^* is the balance of payments expressed as a fraction of national income and the speed of adaptation in (1) turns out to be the ratio of income velocity to output. This equation shows that price-level adjustments under the gold specie standard are governed by the balance of payments expressed as a proportion of national income, so that relatively small percentage adjustments occur in big countries compared to small countries unless income velocities are markedly different.

Solving for the world price-level index by substituting $\alpha_i = V_i/O_i$ in (7) gives

$$\bar{G} = \sum_{i=1}^n \frac{1}{V_i} p_i O_i \quad (12)$$

or

$$\bar{GV} = \sum_{i=1}^n p_i O_i \quad (13)$$

in the special case where income velocity (or its reciprocal, the ratio of money to income) is the same in all countries. In a fractional reserve banking system where gold reserves are linked to money supplies according to the equation $G_i = \mu_i M_i$, where M_i includes bank money, the equation corresponding to (11) would be

$$\frac{1}{P_i} \frac{dp_i}{dt} = \frac{V_i}{\mu_i} B_i^*$$

where μ_i is the fractional reserve ratio, while that corresponding to (12) would be

$$\bar{G} = \sum_{i=1}^n \frac{\mu_i}{V_i} P_i O_i.$$

We may therefore conclude that the simple gold standard “solution” to the redundancy problem results in the stabilization of world income if all income velocity and reserve ratios are identical. Differences in income velocities or fractional reserve ratios can, however, produce “distortions,” since countries

with low ratios of international reserves to national income will have relatively high speeds of adaptation and relatively low weights in the world price index.

IV.

The solution is the same, in principle, under a world currency standard, but it differs somewhat under a standard in which a national currency is used as international reserves by other countries. The reserve ratio in the reserve currency country is unity, while that in other countries is less than unity, which means that a greater "share" of the burden of adjustment will be shifted to the other countries. If, for example, the U.S. income represented one third of world income, and the ratio of dollar reserves to national money supplies were 5 per cent in each country outside the United States, the U.S. "weight" in the world price index would be 10 times as large as that in the rest of the world, despite the fact that U.S. production was only one half as large. The reserve center authorities could, however, stabilize domestic prices entirely by sterilizing the domestic monetary effects of deficits and surpluses and shifting the entire burden of adjustment onto the rest of the world.

A still different system results, however, in a bi-reserve system in which gold and (say) dollars are used as international money. If the United States maintains a reserve ratio of gold behind monetary liabilities, control of the system is shifted once again to, and shared between, the other countries who can determine, by their gold-dollar policies, the level of world prices and the U.S. "share" in the distribution of adjustment.

In each of these cases the redundancy problem is "solved" in a different way, and has different implications for world stability. Thus, in the final analysis, the redundancy problem, conceived of as the problem of using the free variable, reduces to an international standards "problem," that of determining an index of world prices and the weights to be accorded in that index to each country.

Part III

DISEQUILIBRIUM AND
ECONOMIC POLICY

Chapter 14 / *The Nature of Policy Choices*

The separate listing of targets (objects of policy) and instruments (vehicles of policy) has proved to be of considerable help in testing the consistency of systems of economic policy. To achieve a given target there must be an effective instrument, and to achieve various independent targets there must be at least an equal number of effective instruments. If a program includes more targets than instruments, at least one target cannot be fully attained; whereas if it contains more instruments than targets, there will be more than one way of achieving the combination of targets. Just as a mathematical system will be “overdetermined” or “underdetermined” if the number of variables differs from the number of equations, so a policy system will not generally have a unique attainable solution if the number of targets differs from the number of instruments. This reflects the rule made famous by Tinbergen¹ and it is of fundamental importance in the selection of a consistent program of economic policy.

Matching the number of instruments and targets is not of course a sufficient guide for policy. In the first place, instruments must be *effective* in the sense that they are capable of influencing to the necessary degree the target variable. An increase in a tariff that is already prohibitive, for example, cannot affect imports at all, whereas a tax on peanuts, although it may affect peanut production, would exert no important influence on the general level of effective demand. “Effectiveness,” moreover, is partially a matter of degree: An increase in the discount rate may be effective in reducing the volume of credit up to the point where banks no longer borrow, but it would not be effective beyond it unless the banks were forced into the central bank by other instruments (for example, open market operations).

Consistency also requires that targets and instruments be mutually *independent*. For example, full employment and maximum output could not be considered targets if there is a unique functional relationship between the level

¹ See, for example, ([100], chap. V).

of employment and of output, just as an adjustment of the exchange rate and certain applications of tariffs and export subsidies could produce equivalent effects on output and on the balance of payments.

The distinction between targets and instruments is, moreover, neither entirely unambiguous nor obvious. In Polak's apt phrase, targets refer to variables for which we "care," instruments to those for which we "do not care" [83]. But it is not easy to decide which variables we in fact care about. Nowadays, most people do not "care" about a change in the interest rate per se except insofar as it affects output or prices or the balance of payments, although this was not true in many countries immediately after World War II; in the United States, for example, before the "Accord" of 1951 between the Treasury and the Federal Reserve (which permitted interest rates to rise), a prime object of Treasury policy was to defend the price of bonds. The same can be said for the exchange rate; thus, in 1925, some people in Britain "cared" about the traditional value of the pound sterling, but others (like Keynes) did not. Most people today do not "care" about the particular gold or foreign exchange value of a currency per se, although they do care, and strongly, that the gold value—whatever it happens to be—remain constant. "Defense of the dollar" is as much (or more) a part of U.S. policy today as "defense of the bond price" was in the early post-World War II period.

The difficulties of classification arise partially because targets and instruments are "hierarchical" in structure. Like the imputation view of production, in which inputs produce outputs that turn out to be only inputs at a higher stage in the hierarchy, the structure of a policy system includes instruments for the attainment of targets that are themselves only instruments on another level. Certainly the achievement of balance-of-payments equilibrium, or of a particular level of foreign reserves, and even maximum output and employment are only instruments for attaining higher welfare targets. There is also a sense in which the interest rate, the money supply, and the price level are simultaneously instruments and targets.

It really depends on the vantage point from which one views economic (or social) reality. A telephone call from the governor of a central bank may be the "instrument," while the "target" is an open market operation of the central bank; this, in turn, is the instrument for the achievement of a certain target level of bank reserves. Subsequently the latter is the instrument for attaining a certain level of interest rates or credit, a given degree of ease or tightness in the market, and, on a still higher stage, a prescribed level of effective demand. The latter is in turn the "instrument" used to stimulate given output and employment targets.

What is a target for one set of persons is an instrument for another; a certain degree of monetary expansion may be the target of a particular central bank technician, but it would be regarded by his superior as an instrument for attaining full employment. The hierarchical structure of economic policy

processes is thus flanked by a parallel bureaucratic structure controlling the links within the process.

But an over-all view is necessary. Fiscal experts in the Treasury have to evaluate the general effects of tax changes while monetary experts of the central bank should understand the relationships among money, velocity of circulation, interest rates, and employment; all must have some knowledge of the influence of their policies on the balance of payments. But at a certain stage, when a dilemma of importance arises, there is the problem of selecting a program after examining the full gamut of policy alternatives. This usually requires some generalized knowledge of the degrees of effectiveness of different policy prescriptions.

It will be found in most cases that each instrument influences all target variables, although the *relative* impact of a given set of instruments on a certain pattern of targets, if they are independent, will nevertheless be different. A useful guide that can be used in this connection is the *principle of effective market classification*, according to which an instrument should be matched with the target on which it exerts the greatest relative influence. The application of this rule, which takes into account the fact that “comparative advantages” of instruments are different with respect to different targets, reduces the unfavorable side effects of policies and hence minimizes the magnitude of the adjustments that must be made when an instrument is “attached” to a target that is not appreciably out of equilibrium.

In the final stages of policymaking, however, qualitative information alone is generally not sufficient. To decide which sets of policy responses are likely to be appropriate, some judgment about the likely magnitude of the required adjustment is necessary. It would be unusual, for example, if a country considering devaluation of its currency were to be entirely indifferent to the magnitude of the devaluation required; this judgment requires at least a crude estimate of relevant elasticities, wealth liquidity, and redistribution effects involved. Similarly, an expansive fiscal policy might be under consideration, but it may be known in advance that limitations exist as to the permissible size of budget deficits. The degree of effectiveness of fiscal policy will play an important role in the decision to use fiscal policy at all.

What this means is that there are either institutional barriers to the free adjustment of particular instruments or that, after a point, the instrument itself becomes a target or at least impinges on other targets that have not been explicitly taken into account. Variations in interest rates, for example, may be entirely permissible within some ranges but not in others, just as in the present system of international payments, free adjustment of exchange rates for IMF members is permissible within the 1 per cent margin on either side of parity but not outside this margin (except in unusual cases).

Accordingly, before a policy program is formulated in its final stages, there must be preparatory quantitative work examining the effectiveness of various

instruments to establish whether the extent of the adjustment needed is within the realm of political possibility. Otherwise, alternative methods must be sought.²

Employment and the Balance of Payments

Some of the above precepts can be illustrated by the problems likely to be encountered in pursuing two “targets” that have become recognized as extremely important in the post–World War II years: “full employment without inflation” and “balance-of-payments equilibrium.”

It will be apparent at the outset that the mere specification of these goals as “targets” involves a great deal of ambiguity and implicit assumptions about the economic system. In the first place, the expression “full employment without inflation” seems to involve *two* targets, rather than one, since the attainment of full employment is certainly different from the attainment of price stability. Post–World War II literature has, however, frequently assumed that an increase in effective demand leads to an expansion of employment and of output up to the point of full employment; further increases will cause inflation. The underlying implicit assumption is that the aggregate supply curve, reflecting the marginal costs of firms (on the assumption of competition), is perfectly elastic up to the point of full employment, and completely inelastic after that point, at any given monthly wage. This assumption is not generally satisfied in reality, first, because of diminishing returns at constant wage rates and, second, because wage rates, determined through the collective bargaining process, are influenced by the level of activity as bargaining power shifts back and forth between management and labor with the contraction or expansion of economic activity. But in extreme cases—high unemployment or rapid price increases—it is usually not difficult to determine whether inflation or unemployment is the major problem, and therefore in which direction the authorities should try to push aggregate demand. For this reason there is some justification for lumping full employment and stable prices together as a single target, provided this is recognized as only an approximate description of a set of very complicated economic facts.

A more serious problem with the target of “full employment without inflation” relates to its closed-economy connotation. If one is dealing with a closed economy (such as the world as a whole or—to a lesser extent—the Soviet or non-Soviet bloc), a stable price level is not an unreasonable practical goal. As the closed economy expands, the increase in real income can be distributed through wage increases more or less in line with productivity growth (maintaining reasonable price stability) or through falling prices also in line with productivity growth (maintaining constant money wages, but growing real wages). The second method is theoretically preferable, because it permits a competitive interest payment (in real terms) on money balances;

² Introduction to Chapter 14 adapted from “The Nature of Policy Choice,” *Banca Nazionale del Lavoro Quarterly Review*, LXVI (September 1963).

because these bear little or no social cost optimal money holdings require that a return be paid on money. But a fact of life at the present time is the existence of some degree of wage rigidity downward and, because of this fact, economists all over the world typically recommend a system of expanding wages (with growth) and constant prices even if this is at the expense of optimal money holdings.

For a single economy facing the rest of the world, however, it is far from clear that price stability should be treated as a target of policy. If it means stability of a price index of home-produced goods, it means (literally interpreted in a world of fixed exchange rates) no possibility of *relative* price changes in the world as a whole. If the prices of German goods, Italian goods, Indian goods, and American goods are all stabilized, then the international price mechanism cannot function at all under fixed exchange rates. It is clear, therefore, that the goal of price stability must be very cautiously interpreted in an international context. If an implicit goal is a system of fixed rates of exchange, what is required is *differential rates of inflation* between countries: Surplus countries should let prices go up while deficit countries should either prevent them from going up or let them fall, depending on how the “burden of adjustment” is to be divided.

There appear to be even greater ambiguities connected with the target of “balance-of-payments equilibrium.” The balance of payments reflects the budget of the community as a whole excepting the monetary authorities; after netting out home-produced and home-consumed goods, and home-issued and home-bought securities, the “balance” is the difference between the values of the goods plus securities sold and bought abroad. Any gap must be settled in money acceptable to foreign central banks—gold or liquid assets. Strictly speaking, a balance-of-payments deficit does not, per se, cause any discomfort. The man in the street does not care about a balance-of-payments deficit. Discomfort arises from the actions that a dwindling level of foreign reserves will necessitate. The man in the street will care about these actions insofar as they must affect him directly or indirectly.

To some extent, therefore, it is *stocks* rather than *flows* that people do worry about, and should worry about. The balance of payments is a flow over time that, when added up from a certain date, implies a change in the *stock* of foreign reserves between the two dates. In turn, significant changes in the stock of reserves will induce discomfort. If reserves begin to accumulate rapidly, the country will realize that it is investing too large a portion of its savings in an asset that yields no return (for example, gold or a creditor position at the IMF) or only a small return (for example, foreign exchange balances). And if reserves get too low, the country will be placed at the mercy of foreign private speculators or central banks or else be forced into precipitate action at inopportune times. Reaction to excessively low reserves is, of course, usually more rapid than reaction to unnecessarily high reserves.

There is an analogy in this to the budget of the government. Economists have become accustomed to regard the budget deficit—as it is altered through changes in taxes or government spending—as an instrument of policy. The man in the street has no objections to budget deficits, but he has, in many countries, strong objections to increases in the public debt, arguing, rationally or otherwise, by analogy with his own budgetary problems as an individual. Of course, the rub is that the budget deficit always leads to an increase in the public debt. But again the discomfort is produced by the stock of outstanding debt and its implied tax liabilities rather than by the flow of the deficit over time. In the same way, individuals, as citizens, would be worried about an excessive accumulation of external debt rather than about the position of the balance of payments at any instant of time.

Related to the importance of stocks of reserves is a problem concerning the consistency of domestic decisions in relation to the rest of the world. Under one definition of the over-all balance-of-payments position—a perfectly symmetrical definition—the sum total of the balances of payments of all countries in any one period of time is zero, so that there is no inconsistency if every country aims for a precise balance at all points in time. But in practice an asymmetrical definition of the balance-of-payments position is generally used. If gold were the only type of international reserve, the sum of the external positions of all countries would add up not to zero but to the amount of new gold finding its way into the monetary reserves of the central banks. The reason is that South Africa and other gold-producing countries treat the export of gold just like any other commodity export, whereas the import of gold into the coffers of central banks is excluded from ordinary imports. For this reason it is possible for each and every country to have a balance-of-payments surplus when monetary gold holdings of the world are increasing, which is the case whenever gold production exceeds the current use of gold for the arts and for private hoarding.

This does not imply consistency in the targets of each country, as the external surpluses planned by all countries—as they attempt to let reserves grow with trade or some other measure of growth—may add up to more than the net accretions of gold into monetary reserves. (This, of course, is the crux of the liquidity problem of the present decade: Most countries desire a balance-of-payments surplus to finance a level of desired reserves growing at a faster rate than actual reserves; the demand of all countries cannot in this way be satisfied, thus threatening progressive contractionary employment or restrictive trade policies). Every country cannot have a surplus of an arbitrary size, since the sum of the surpluses is limited to the growth of the gold reserves.

There are additional reasons, based on accounting practices, why the balances of payments of all countries do not sum to zero. Countries do not all follow the same practice in recording various transactions in the balance of

payments. Thus, a deposit by German commercial banks in New York would be counted in the United States as an item *financing* a U.S. deficit, according to the pre-Bernstein Department of Commerce definition, but there would be no offsetting surplus in German accounts, since the transaction would be treated in Germany as a capital outflow. These are technical questions of definition, but they have real significance insofar as policy becomes conditioned to particular accounting practices.³

The ambiguities do not end with problems of asymmetries in the definition of the balance-of-payments position. Discomfort is provided by a bad *composition of the balance*. Thus there was a sense in which Canada had a continuing external equilibrium during the period 1950–1962 when the exchange rate was (in varying degrees) flexible and the level of official reserves remained approximately constant. But the composition of the balance, achieved through an import surplus financed by capital inflows from the United States, was a source of considerable worry. What is involved here is an additional goal implicit in the system: the level of the net external indebtedness. Increasing indebtedness causes discomfort because it introduces present feelings of future insecurity. Just as the composition of output is important (the division of output between investment and consumption affects additional growth targets), so an appropriate composition of the balance of payments is a legitimate target of policy.

Mathematical Aspects of the Theory of Policy

Some of these considerations are worth formalizing mathematically, as a convenient introduction to some of the work in the following chapters. We can start with the statical policy solutions outlined by Tinbergen.

Tinbergen's rule—that consistent, determinate policy systems require an equal number of targets and instruments—reflects the mathematical fact that an equal number of variables and equations is necessary for a mathematical system to have a unique solution. Suppose that we have two instrumental variables, a and b , and one target variable X . Then, generally, a and b will each affect X so that

$$X = X(a, b). \tag{1}$$

If we now set X at some target level, say X_0 , then the target will be achieved whenever

$$X_0 = X(a, b) \tag{2}$$

holds.

³ For a review of the major asymmetries see Høst-Madsen [26].

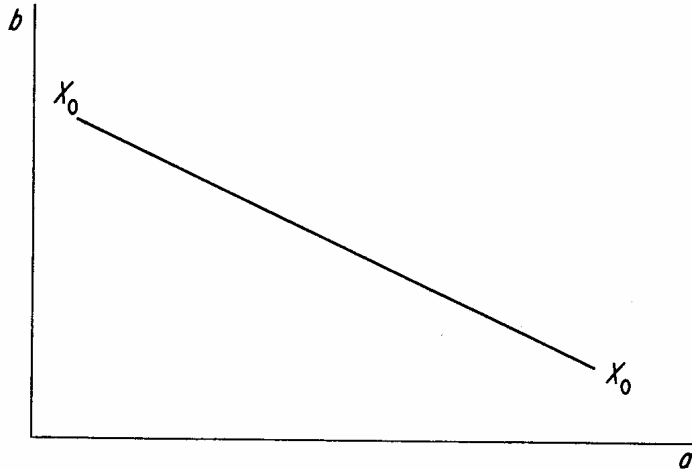


Figure 14-1.

The function (2) may be plotted on a graph (Figure 14-1) with the instruments on the abscissa and ordinate. The graph shows that there is a single-fold infinity of ways of setting a and b to achieve the target for X . The line X_0X_0 could, for example, illustrate the requirements of internal balance as functions of the interest rate a and the level of taxes b , as discussed in Chapter 16. This case of redundancy is the policymaker's delight because he has a great variety of ways to achieve a single target.

As a second case we may assume the same two instruments but *two* target variables, X and Y , each of which are functions of the instrumental variables. Mathematically we have

$$X = X(a, b) \quad (3)$$

$$Y = T(a, b) \quad (4)$$

and when we set target levels X_0 and Y_0 we get a determinate system

$$X_0 = X(a, b) \quad (5)$$

$$Y_0 = Y(a, b) \quad (6)$$

which can be plotted in Figure 14-2. Here the policymaker has no recourse but to set the instruments at the levels a_1 and b_1 if he wants to achieve the targets; only at a_1 and b_1 are $X = X_0$ and $Y = Y_0$. Again the example of

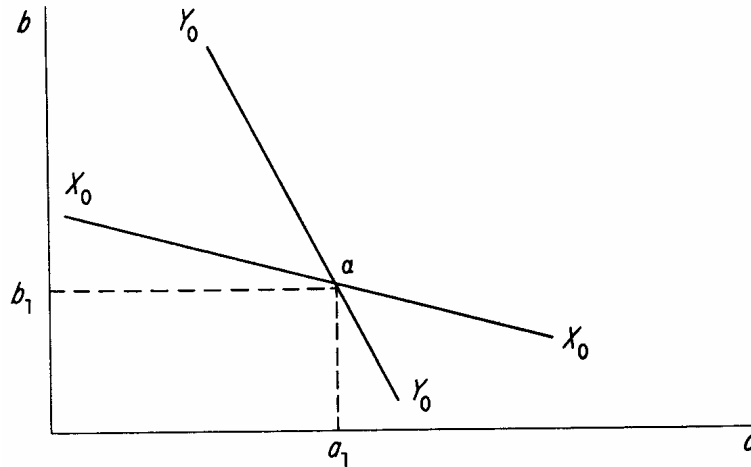


Figure 14-2.

Chapter 16 may be used in illustration, where, as before, the X_0X_0 line is the internal balance schedule, and the Y_0Y_0 line is the foreign balance schedule.

As a third case we again have the two instruments a and b , but this time three target variables, X , Y , and Z , so that

$$X = X(a, b) \tag{7}$$

$$Y = Y(a, b) \tag{8}$$

$$Z = Z(a, b) \tag{9}$$

If we now set target values X_0 , Y_0 , and Z_0 , we have three equations in two unknowns,

$$X_0 = X(a, b) \tag{10}$$

$$Y_0 = Y(a, b) \tag{11}$$

$$Z_0 = Z(a, b) \tag{12}$$

which we can plot on Figure 14-3. There are three points of intersection but at none of them are all three equations satisfied; one of the targets is not reached. The monetary-fiscal policy mix example may again be used for illustration with the new target variable, Z , denoting, for example, the rate of economic growth and Z_0 its target level. Then if an economy were following the

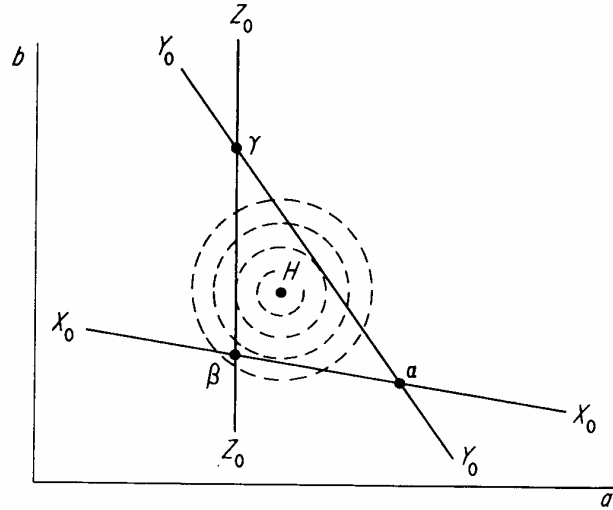


Figure 14-3

monetary-fiscal policy mix represented by the point H , it would have a balance-of-payments deficit, excess unemployment, and a rate of growth below its target rate, as, for example, the United States experienced in 1961 and 1962.

The point H presents a policy dilemma. Those who regarded the balance of payments and full employment as the primary targets (neglecting growth) would urge higher interest rates and a budget deficit to get toward the point α . Those who advocated higher growth and employment, neglecting the balance of payments, would urge a budget deficit and lower interest rates to get to the point β . And those who stressed secular growth and the balance of payments, to the exclusion of the level of employment, would urge lower interest rates and higher taxes to get to the point γ .

Actual policy makers, hovering in indecision, may indeed elect to remain at H . It is quite possible, in fact, that H is the best of a set of bad positions as represented by planners' preferences. (We can conceive of planners' preference functions—to be sure a mere toy—reaching an apex at the point H .)

Anatomy of Policy Failure

An equal number of instruments and targets is not, however, a sufficient condition for establishing a solution to a policy problem. Failure may result from (1) a lack of independence in the targets, (2) multiple solutions, or (3) limitations on the variability of the instruments.

The first case is illustrated in Figure 14-4, where the X_0X_0 and Y_0Y_0 lines

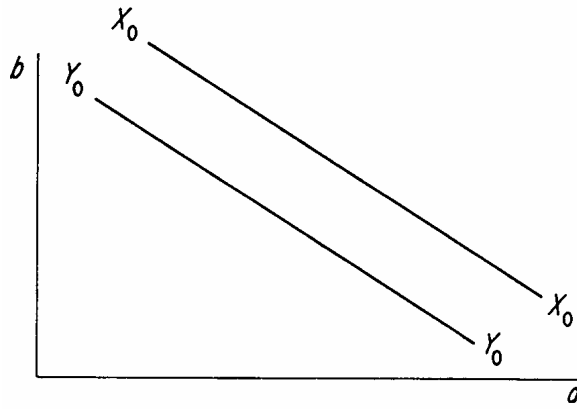


Figure 14-4.

are parallel (a result that could occur in the illustrative example if capital is immobile). Mathematically this means that the Jacobian is singular, that is,

$$\begin{vmatrix} \frac{\partial X}{\partial a} & \frac{\partial X}{\partial b} \\ \frac{\partial Y}{\partial a} & \frac{\partial Y}{\partial b} \end{vmatrix} = 0,$$

since

$$\text{the slope of } X_0X_0 = -\frac{\partial X}{\partial a} / \frac{\partial X}{\partial b}$$

and

$$\text{the slope of } Y_0Y_0 = -\frac{\partial Y}{\partial a} / \frac{\partial Y}{\partial b}.$$

(13)

The second case results from nonlinearities in the schedules, as illustrated in Figure 14-5, which can give rise to multiple intersections; in the graph α , β , and γ , are all solutions to the system. This result is unlikely in the illustrative example, but it is not impossible if certain reverse transfer conditions or interest rate effects on the composition of the trade balance occur.

A third case of failure results from intersections outside the feasible zone of variation of the instruments, as indicated in Figure 14-6. Suppose for political or economic reasons a and b are restricted to the shaded area. Then the solution α cannot be attained. In the illustrative example this case is possible and even likely if the degree of disequilibrium is very high. Political considerations may limit the “doses” of monetary and fiscal policy. But there may be economic reasons limiting its use as well, for example, the interest rate implied by α may be outside the scope of manipulation by the central bank.

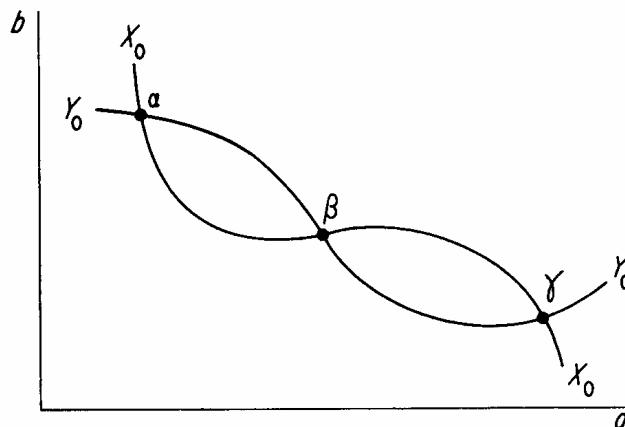


Figure 14-5.

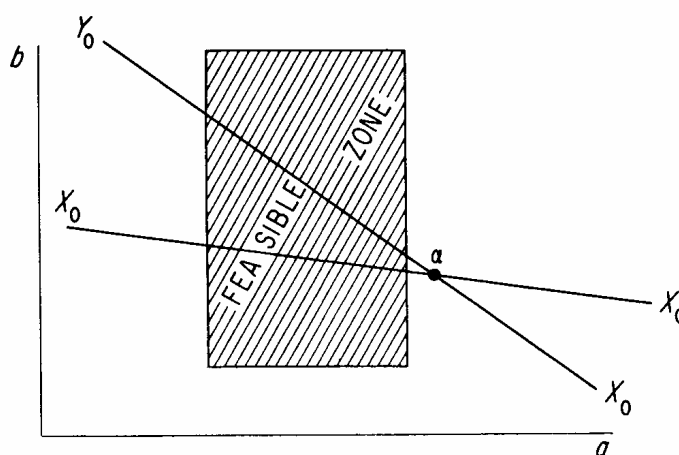


Figure 14-6.

Incomplete Information and Policy Dynamics

If we have complete information about the system, we need only solve the equations for the changes in the instrumental variables needed to eliminate any discrepancy between the target values of the target variables and their actual values. Retaining only the linear terms of a Taylor series, from

$$X_0 - X = \frac{\partial X}{\partial a}(a_0 - a) + \frac{\partial X}{\partial b}(b_0 - b) \quad (14)$$

$$Y_0 - Y = \frac{\partial Y}{\partial a}(a_0 - a) + \frac{\partial Y}{\partial b}(b_0 - b) \quad (15)$$

we can invert to get

$$a_0 - a = \frac{\begin{vmatrix} X_0 - X & \partial X / \partial b \\ Y_0 - Y & \partial X / \partial b \end{vmatrix}}{\begin{vmatrix} \partial X / \partial a & \partial X / \partial b \\ \partial Y / \partial a & \partial Y / \partial b \end{vmatrix}} \quad (16)$$

and

$$b_0 - b = \frac{\begin{vmatrix} \partial X / \partial a & X_0 - X \\ \partial Y / \partial a & Y_0 - Y \end{vmatrix}}{\begin{vmatrix} \partial X / \partial a & \partial X / \partial b \\ \partial Y / \partial a & \partial Y / \partial b \end{vmatrix}}. \quad (17)$$

By substituting the (known) values of $X_0 - X$ and $Y_0 - Y$, the policy problem is solved (once the problems of existence and uniqueness have been settled).

The fact is, however, that we never (or hardly ever) have complete information. The values of the coefficients $\partial X / \partial a$, $\partial X / \partial b$, $\partial Y / \partial a$, and $\partial Y / \partial b$ may not be known, and they may even change over time. To be sure, as econometrics progresses it may be expected that information will improve over time. But in the meantime policy must be guided somehow, and to this end we need means of getting to the target equilibrium without having full information about its position.

It is here that economic dynamics becomes relevant. We want to find the equilibrium solution without knowing exactly where it is. To do this we can make use of our understanding of the stability of particular dynamic processes, since knowledge of stability conditions never (again, hardly ever) requires complete information about the parameters. If we can invent a set of rules for policymakers to follow—a set of rules that is not contingent on complete knowledge of the whole system—we will have found a way of compensating for our lack of complete information.

The analogy to the correspondence principle readily presents itself. Marshall, Hicks, Samuelson, and others made use of stability conditions to derive meaningful theorems in comparative statistics; the conformity that seemed to exist between “well-behaved” dynamic systems and “normal” comparative-static results Samuelson termed the correspondence principle. The same relation can be exploited, but in a different way, in policy systems.

The dynamic stability literature asks whether a system is stable under a *given* set of dynamic postulates, and then makes use of the information about stability to deduce comparative-static results. The policy literature, on the other hand, asks how instruments should be allocated to targets, or how “prices” should be allocated to “markets.”

The principle to be followed is to assign instruments to targets in such a way as to ensure that the dynamic system implied by the policy rules is a stable system. It is this principle that I have called the principle of effective market classification, and the guide to be followed is that *instruments should be allocated to targets which they influence most directly*.

Alternative Mathematical Formulations

There are two ways of posing the problem in a formal mathematical way. One is to specify how the instruments should be adjusted over time in relation to each target variable or market. In linear differential form, for example, we could write the two-target, two-instrument system as follows:

$$e_{11}\dot{a} + e_{12}\dot{b} = X(a, b) \quad (18)$$

$$e_{21}\dot{a} + e_{22}\dot{b} = Y(a, b) \quad (19)$$

where X and Y may now be so taken as discrepancies from their target values. The e_{ij} 's are dynamic policy parameters indicating the direction and speed at which instruments change in relation to targets. For example, if X and Y represented inflationary pressures (unemployment, if negative) and the balance-of-payments surplus (in excess of the *desired* surplus), and a and b denoted interest rate and tax policies respectively, e_{11} and e_{21} would state how slowly the interest rate would be required to adjust to unemployment and to the balance of payments, while e_{12} and e_{22} would similarly determine the specified rates at which taxes or government spending should be altered.

The other way of posing the problem is to specify the weight given to each target variable in determining the movement of each instrument. Mathematically this is equivalent to writing

$$\dot{a} = K_{11}X(a, b) + K_{12}Y(a, b) \quad (20)$$

$$\dot{b} = K_{21}X(a, b) + K_{22}Y(a, b) \quad (21)$$

and the K_{ij} 's are "speeds of adjustment." This system is linearly related to the other system, since the matrix

$$\begin{bmatrix} K_{11} & K_{12} \\ K_{21} & K_{22} \end{bmatrix} = \begin{bmatrix} e_{11} & e_{12} \\ e_{21} & e_{22} \end{bmatrix}^{-1}; \quad (22)$$

There is therefore no difference between them in the linear case. From an institutional point of view, however, (18) and (19) would be more revealing if

institutions were set up on a “target basis” (had specific functions to perform) while (20) and (21) would be more revealing if institutions were set up on an instrument basis (had specific tools to manipulate). Since the central bank and Treasury may be best conceived of as having instruments to control (money or interest rates, and taxes or government spending), we shall use, for illustrative purposes, (20) and (21).

Now (20) and (21) are written in completely general terms (except for the assumption of linearity). After linearizing the system to make $X(a, b)$ and $Y(a, b)$ explicit functions we get

$$a = \left(K_{11} \frac{\partial X}{\partial a} + K_{12} \frac{\partial Y}{\partial a} \right) (a - a^0) + \left(K_{11} \frac{\partial X}{\partial b} + K_{12} \frac{\partial Y}{\partial b} \right) (b - b^0) \quad (23)$$

$$b = \left(K_{21} \frac{\partial X}{\partial a} + K_{22} \frac{\partial Y}{\partial a} \right) (a - a_0) + \left(K_{21} \frac{\partial X}{\partial b} + K_{22} \frac{\partial Y}{\partial b} \right) (b - b^0) \quad (24)$$

The solution of the system takes the form

$$a = a_0 + A_{11} \exp(\lambda_1 t) + A_{12} \exp(\lambda_2 t) \quad (25)$$

$$b = b_0 + A_{21} \exp(\lambda_1 t) + A_{22} \exp(\lambda_2 t) \quad (26)$$

where the A_{ij} 's depend on initial conditions and the λ 's are the roots of the following equation:

$$\lambda^2 - \left(K_{11} \frac{\partial X}{\partial a} + K_{12} \frac{\partial Y}{\partial a} + K_{21} \frac{\partial X}{\partial b} + K_{22} \frac{\partial Y}{\partial b} \right) \lambda + \begin{vmatrix} K_{11} \frac{\partial X}{\partial a} + K_{12} \frac{\partial Y}{\partial a} & K_{11} \frac{\partial X}{\partial b} + K_{12} \frac{\partial Y}{\partial b} \\ K_{21} \frac{\partial X}{\partial a} + K_{22} \frac{\partial Y}{\partial a} & K_{21} \frac{\partial X}{\partial b} + K_{22} \frac{\partial Y}{\partial b} \end{vmatrix} = 0 \quad (27)$$

The policy problem is to find values for the “weights” K_{ij} that will make the roots of (27) negative if real, and have negative real parts if complex. This amounts to making the coefficient of λ and the determinant positive, stability conditions of the system.

Equation (27) may be simplified notationally to

$$\lambda^2 - (K_{11}X_a + K_{12}Y_a + K_{21}X_b + K_{22}Y_b)\lambda + (K_{11}K_{22} - K_{12}K_{21})\Delta = 0 \quad (28)$$

where $X_a \equiv \partial X / \partial a$, $X_b \equiv \partial X / \partial b$, $Y_a \equiv \partial Y / \partial a$, and $Y_b \equiv \partial Y / \partial b$, and

$$\Delta \equiv \begin{vmatrix} X_a & X_b \\ Y_a & Y_b \end{vmatrix}$$

so that stability requires

$$\begin{vmatrix} K_{11} & K_{12} \\ K_{21} & K_{22} \end{vmatrix}$$

to have the same sign as Δ and that

$$K_{11}X_a + K_{12}Y_a + K_{21}X_b + K_{22}Y_b < 0. \quad (29)$$

It is at once clear that it is not necessary to know each of the slopes X_a , X_b , Y_a , and Y_b to develop a stable policy system, for we can always find a way of making two of the K_{ij} 's equal to zero. Suppose, for example, $\Delta > 0$. Then setting $K_{12} = K_{21} = 0$ ensures the first stability condition if K_{11} and K_{22} have the same sign. We also have to make $K_{11}X_a + K_{22}Y_b < 0$. If X_a and Y_b have the same sign, giving both K_{11} and K_{22} the opposite sign ensures all stability conditions; and if X_a and Y_b have opposite signs, say, $X_a < 0$ and $Y_b > 0$, then negative values of both K_{11} and K_{22} are sufficient to ensure stability. A stable system can always be found without knowing the values of all the slopes.⁴

⁴ For a discussion of the complications associated with the general case see Chapter 21 of this book. Decentralization is always possible if the so-called Hicks conditions of perfect stability are satisfied.

Chapter 15 / *The International Disequilibrium System*¹

The fundamental proposition of classical international trade theory, that there is an automatic mechanism ensuring balance-of-payments equilibrium, enabled the classical economists to isolate the short-run, dynamic process of international adjustment from the long-run, static theory of international barter. To this analytical separation we owe many of the important theorems that have come down to us from classical economics, and on it is based a good deal of modern international trade theory. This is despite the fact that the history of international economic relations in the past 30 years has not been characterized by a persistent tendency toward balance-of-payments equilibrium; the assumption of automaticity now appears to be an anachronism.

The decline of automaticity dates from the first attempts of central banks to adjust the domestic supply of notes to accord with the needs of trade (the banking principle) instead of the requirements of external equilibrium (the bullionist principle); and although these attempts have their origin far back in history, the abandonment of the bullionist principle became widespread only after the revolution in Federal Reserve policy during the 1920's, and especially after legal or de facto recognition in post-World War II years of full employment as a primary goal of public policy.² The basic instrument of the adjustment process (monetary policy) was for several years diverted away from its original function toward the new requirement of internal balance, and no new weapon had developed to cope with the balance of payments.³ The absence of an adjustment mechanism implies a policy vacuum that gives rise to the *international disequilibrium system*, the theory of which forms the subject of this chapter.

¹ Adapted from: *Kyklos*, 14, 154–172 (1961).

² The adjustment of the money supply to accord with the “needs of trade” is quite different from the adjustment to achieve “full employment without inflation,” but both methods imply that the “bullionist principle” is abandoned.

³ Exchange-rate variations and trade controls have been used as ad hoc policies to suit the exigencies of particular situations rather than as consistent instruments of equilibration.

Other writers have examined disequilibrium systems based on stereotypes of the Keynesian model in which it is assumed (sometimes only implicitly) that monetary factors have no influence on the level of effective demand or on the rate at which capital moves internationally.⁴ Such models serve a useful purpose in isolating the employment and output effects of changes in expenditure or policy, and often indicate the type of monetary policy that is, in fact, needed to offset these effects; but the results are subject to serious misinterpretation. It has, for instance, been asserted by more than one authority that Hume's law does not apply to an economy in which there is saving and unemployment, or in which the quantity theory of money does not hold. This statement is wrong, as the following analysis proves, and it indicates that a simple exposition of these matters is needed.⁵

The chapter is divided into three parts. The following section describes the international adjustment mechanism in a sufficiently general way to incorporate as special cases the *price-specie-flow* mechanism of Hume and the *income-specie-flow* mechanism of Keynes. The subsequent part is concerned with the disequilibrium system which has developed in recent decades, and the particular kinds of central bank operations needed to maintain it. The final section discusses some of the ad hoc policies that the authorities may pursue to restore equilibrium at a time when reserves become dangerously low or unnecessarily high.

Hume's Law and the Process of Adjustment

General equilibrium in an open economy requires that the markets for goods and services, capital, money, and foreign exchange all be in balance in terms of both current and inventory excess demands. For present purposes, however, we shall suppose that it is sufficient for general equilibrium that:

1. The current supply of goods equals the current demand for goods.
2. The community is willing to hold the existing stock of money.
3. The balance of payments is in equilibrium.

⁴ The "Keynesian" models used in international trade theory are all variants of the following system:

$$X_i(y_1, \dots, y_n) = 0 \quad (i = 1, \dots, n)$$

where X_i is the excess demand for the goods of the i th country and y_1, \dots, y_n are the national incomes of the n countries. This is a *disequilibrium* system in the sense that there are no equations specifying equilibrium in the balance of payments; but it should be remembered that it is *not* the international system discussed in *Keynes' General Theory*, where the monetary mechanism of adjustment is taken into account.

⁵ It seems especially desirable to incorporate monetary elements explicitly into the theory of trade to fill a gap in analysis noted by Harberger as early as 1952 and just as evident today (see [21]). See footnote 9 for examples of the misinterpretation referred to above.

We shall assume that the conditions of balance in each of the above (goods, money, and foreign exchange) markets depend only on the level of money income, the rate of interest, and the quantity of money; for simplicity, however, and also to show that the results are not dependent on the quantity theory of money, we assume that a change in the money supply affects the level of effective demand and the balance of payments only insofar as it first affects the rate of interest.⁶

The system is illustrated in Figure 15-1. The curve *XX* traces the locus of interest rates and money income levels along which there is equilibrium in

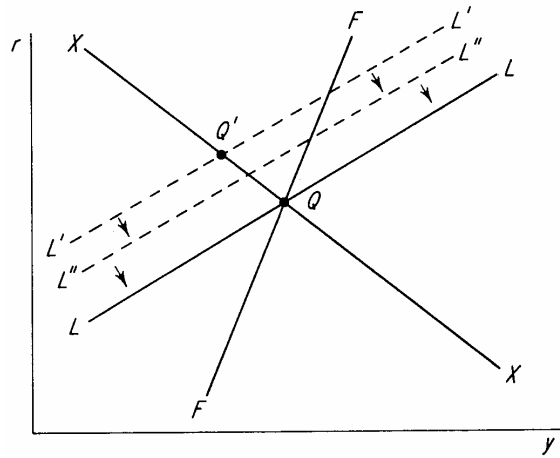


Figure 15-1.

Money income is plotted on the abscissa and the rate of interest on the ordinate. The three schedules *XX*, *FF*, and *LL* trace the conditions of equilibrium in the goods, foreign exchange, and money markets. *LL* shifts to the right or to the left depending on whether there is a surplus or deficit in the balance of payments, since the money supply depends on gold reserves. Only at *Q* are all markets in equilibrium.

⁶ The static system can be written symbolically as follows:

$$X(y, r) = 0 \tag{1}$$

$$L(y, r, m) = 0 \tag{2}$$

$$F(y, r) = 0 \tag{3}$$

where *X*, *L* and *F* denote, respectively, the excess demand for goods and services (*X* = investment – saving + trade balance), the excess demand for money, and the balance-of-payments surplus (*F* = trade balance + net capital imports); and where the three variables, *y*, *r*, and *m*, represent money income, the rate of interest, and the quantity of money. The system can be generalized by incorporating *m* into (1) and (3).

the goods market; this *internal balance* schedule has a negative slope because a rise in interest rates is deflationary and a decrease in money income is inflationary [in the sense that a hypothetical (*ceteris paribus*) decrease in money incomes creates excess demand]. The curve *FF* traces the locus of interest rates and money incomes along which there is equilibrium in the balance of payments; this *foreign balance* schedule has a positive slope because an increase in the rate of interest improves the balance of payments (by attracting capital), whereas an increase in money income worsens the balance of payments (by worsening the trade balance). The *LL* curve, on the other hand, gives the pairs of interest rates and money incomes at which there is equilibrium in the money market *for any given quantity of money*, and it occupies a different position as the quantity of money varies, moving downward to the right as the supply of money increases, and upward and to the left as the supply of money decreases.⁷ General equilibrium of the system is determined at the point *Q* common to both the *XX* and *FF* schedules, with a supply of money that will make the *LL* curve pass through *Q*.

So much for the static system. The adjustment process implies a dynamic system based on the following (admittedly oversimplified) postulates of the gold standard:

1. Money income rises or falls as there is excess demand or excess supply of goods and services.
2. The rate of interest rises or falls as there is excess demand or supply in the money market.
3. Bank reserves increase or decrease as there is a surplus or a deficit in the balance of payments (because of gold flows).
4. The money supply increases or decreases as actual bank reserves exceed or fall short of desired bank reserves.

This dynamic process can be illustrated with reference to the diagram.

⁷ The slopes of the three schedules are based on the following signs of the partial derivatives:

$$X_y < 0, X_r < 0, L_y > 0, L_r < 0, L_m < 0, F_y < 0, F_r \geq 0$$

(depending on whether capital is mobile or not).

The first five signs follow from the theory of rational behavior or empirical experience; the term F_y is negative in the Keynesian case if the marginal propensity to import is positive, and negative in the classical case if the sum of the domestic and foreign elasticities of demand exceeds unity; while the last term F_r has the indicated sign if the rate of interest does not have a predominant direct effect on the trade balance. Also, it is implicitly assumed (for simplicity) that capital movements do not directly affect spending, an assumption that would have to be modified to incorporate the modern theory of transfer in an analysis emphasizing long-run adjustment; see Chapter 2.

Note that the *XX* schedule does not imply full employment if wages and prices are inflexible. To avoid complications associated with the asymmetrical effects of increases and decreases in effective demand, it is preferable, for expositional purposes, to assume either unemployment and rigid prices and wages, or full employment with flexible prices and wages.

Consider a Hume-type experiment in which a fraction of the money supply is “annihilated overnight.” From an initial equilibrium position passing through Q the LL curve shifts upward and to the left to, say, $L'L'$, raising interest rates and lowering money income, and generating a new equilibrium in the markets for goods and money at Q' . But Q' cannot be a position of overall equilibrium, because there is, at this point, a surplus in the balance of payments which stimulates a gold flow and an increase in bank reserves, which in turn induces an increase in the money supply, a decrease in interest rates, and an increase in money income. The LL curve thus begins a gradual shift back to its original position, the only one which permits general equilibrium at the point Q .

One should be careful to note, however, that the above description of the dynamic adjustment process hardly begins to exhaust the manifold possibilities inherent in the four dynamic postulates. The system may be unstable (if it is, it must be cyclically unstable); it is easily shown that the traditional criterion for stability is neither necessary nor sufficient. Even restricting the system to the case where all signs are “normal,” stability depends, at the very least, on the relative speeds of response in the three markets and on the banking reserve ratio.⁸

⁸ The most plausible simple dynamic system expressing the gold standard (with commercial banking) adjustment process mathematically might be written as follows:

$$\frac{dy}{dt} = K_1 X(y, r)$$

(money income moves in proportion to the excess demand for goods);

$$\frac{dr}{dt} = K_2 L(y, r, m)$$

(the rate of interest moves in proportion to the excess demand for money);

$$\frac{dm}{dt} = K_3 \left[\frac{\int_0^t F(y, r) dt}{a} - m \right]$$

(the money supply moves in proportion to the excess reserve position of the commercial banks, where a is the fraction of liabilities that banks want to hold in the form of gold or cash, and the integral is the accumulated gold supply in the nation). The last equation assumes that gold is used only for banking reserves.

The linearized form of this system has the following characteristic equation of the fourth order:

$$\begin{vmatrix} \partial - K_1 X_y & -K_1 X_r & 0 \\ -K_2^2 L_y & \partial - K_2 L_r & -K_2 L_m \\ -\frac{K_3}{a} F_y & -\frac{K_3}{a} F_r & \partial^2 + K_3 \partial \end{vmatrix} = 0$$

from which it can be deduced that the latent roots ($\delta_1, \delta_2, \delta_3, \delta_4$), if real, are not positive (by Descartes rule); and that whether there are complex roots with positive real parts or not depends partly on the relative values of K_1, K_2, K_3 , and a . Thus instability must be cyclical, if it exists, and stability depends on the relative speeds of adjustment and the banking reserve ratio. It can also be demonstrated that $F_y < 0$ (the traditional stability condition) is not a necessary condition for stability if capital is, to some extent, mobile.

Our main concern, however, is with the *existence* of an adjustment process under both classical and Keynesian assumptions. In the classical case of price flexibility the movement of money income implies a movement of wages and prices: The diminution of the money supply causes a rise in interest rates that induces both a fall in prices and an inflow of capital, while the resulting balance-of-payments surplus brings in the additional foreign exchange reserves necessary to support a monetary expansion and, eventually, the original level of prices; this is the *price-specie* flow mechanism of Hume. But in the Keynesian case of wage and/or price rigidity, the decreased money supply results in higher interest rates and therefore an inflow of capital and a reduction in the rate of investment and (through the multiplier) output, a process that is eventually reversed as the gold inflow (due to the inflow of capital and the reduction in imports) supplements bank reserves and permits a monetary expansion; this is the *income-specie-flow* mechanism of Keynes. The difference between the classical and Keynesian cases (apart from a difference in the mode of expression) is that the temporary change in money income is effected through variations in the price level in the one case and adjustments in the level of output in the other case. In both cases the original level of prices and output is restored.

The above analysis shows that the validity of Hume's law does not depend on full employment, zero savings,⁹ or the quantity theory of money. The classical propositions concerning the distribution of the precious metals, the tendency toward international balance, and the ultimate irrelevance of changes in the quantity of money all have counterparts in a Keynesian world of underemployment.

This is not to assert that balance of payments disequilibria cannot exist in modern times! But the source of their existence does not directly depend on the degree of price flexibility, the rate of saving, or the level of employment.

Monetary Policy and Sterilization Operations

The automatic nature of the adjustment mechanism described in the preceding section depends on the link between the balance of payments and the money supply. Under the pure gold standard the link is direct (gold *is* the money supply); under the gold standard with fractional reserve banking, the

⁹ See Kindleberger ([40], pp. 181 and 194) for the view that Hume's law is valid only under conditions of no savings, and Scammell ([95], p. 44) (among others) for the belief that price effects are necessary to complete the adjustment process when saving exists. Both these positions are based on foreign trade multiplier theory and a complete neglect of the monetary mechanism. But they could be rescued if it were assumed that changes in the quantity of money had no effect on spending or interest rates; this would be the case under the extreme Keynesian assumption of the liquidity trap. See, on the other hand, the description of the adjustment process under both classical and Keynesian assumptions in Scitovsky ([96], chap. 2).

link depends on the stability of the ratio between gold and bank deposits; under the gold standard (or, more generally, the fixed-exchange-rate system), with commercial banking and also fiduciary note issues of the central bank, the link depends on the stability of both the ratios of cash to commercial bank deposits, and gold and foreign exchange reserves to cash. It is the variability of the latter ratio that ruptured the link between the balance of payments and the money supply and gave rise to the “disequilibrium system.”

The de facto abandonment of a fixed cash-gold (and foreign-exchange-reserves) ratio is the result of monetary policies designed to ensure full employment and price stability. A balance-of-payments disequilibrium has, it is true, an automatic effect on the supply of cash because of the central bank's fixed-exchange-parity policy, but this effect can be canceled and typically is canceled if the change in the liquidity situation implied by balance-of-payments considerations conflicts with the monetary policy needed for internal balance. Institutional arrangements vary according to country: In some the liquidity effect is automatically canceled by offsetting open market purchases; in others, the liquidity effect is canceled at the discretion of the central bank. In both cases, however, the end result is the same: External disequilibrium affects the money supply only if this coincides with the internal-balance policy of the monetary authorities.

There are three main devices used to offset the liquidity effects of external disequilibrium—apart from changes in government expenditure or taxes. The central bank may alter reserve requirements, shift government deposits between the central bank and the commercial banks, or buy and sell Treasury bills. In the latter case there usually remains some liquidity impact on the economy.¹⁰ Suppose, for example, that from the following position of the central bank and the commercial banks:

Central Bank			
Treasury bills	200	Treasury deposits	100
	—	Commercial bank deposits	<u>100</u>
	200		200
Commercial Banks			
Central bank deposits	100	Deposits	1000
Treasury bills	200		
Other assets	<u>700</u>		—
	1000		1000

¹⁰ This subject is treated in Sayers ([94], chap. 6).

(where the cash ratio of the commercial banks is 10 per cent, and the money market assets ratio is 20 per cent), the equilibrium is disturbed by a foreign deficit of 50 (ignoring how it came about). Private persons will be buying foreign exchange from the Treasury through the commercial banks and the central bank. At the end of the period of the transaction, Treasury deposits are up 50, commercial bank deposits are down 50 at the central bank, and private deposits are down 50 at the commercial banks, leading to the following disequilibrium situation:

Central Bank			
Treasury bills	200	Treasury deposits	150
	—	Commercial bank deposits	<u>50</u>
	200		200
Commercial Banks			
Central bank deposits	50	Deposits	950
Treasury bills	200		
Other assets	<u>700</u>		—
	950		950

(The cash ratio is down to little more than 5 per cent and the money market assets ratio is up slightly.) The commercial banks must now sell Treasury bills to recoup their cash reserves, while the Treasury buys Treasury bills (with the money accumulated from the initial sale of foreign exchange) to prevent this from lifting interest rates. The final situation might look as follows:

Central Bank			
Treasury bills	195	Treasury deposits	100
	—	Commercial bank deposits	<u>95</u>
	195		195
Commercial Banks			
Central bank deposits	95	Deposits	950
Treasury bills	155		
Other assets	<u>700</u>		—
	950		950

(In effect, the Treasury has bought 45 Treasury bills from the commercial banks and 5 from the central bank.) In the final position the cash ratio of the commercial banks is the same as it was originally, but private deposits are down 50 at the commercial banks, and the money market assets ratio has gone down from 20 per cent to just a little over 16 per cent, leaving some deflationary effect after the neutralization policy.

Whatever is the technique employed by the monetary authorities to divorce the money supply from the balance of payments, the result is to impede the operation of the adjustment process. This is shown in Figure 15-2. Assume that the initial equilibrium Q is disturbed by an increase in foreign interest rates; this causes a greater outflow, or a smaller inflow of capital at the same domestic rate of interest, shifting the foreign balance schedule upward and to the left to, say, $F'F'$. Only at the higher interest rate, and lower money income, represented by the new equilibrium Q' can equilibrium in both the home market and the balance of payments be restored. This point would automatically be reached if the authorities allowed the adjustment process to go on unimpeded; the LL curve through Q (not drawn) would shift upward and to the left until the point Q' is reached.

With a policy of neutralization, however, the LL curve stays approximately in its original position (through Q). The *partial* equilibrium Q is therefore

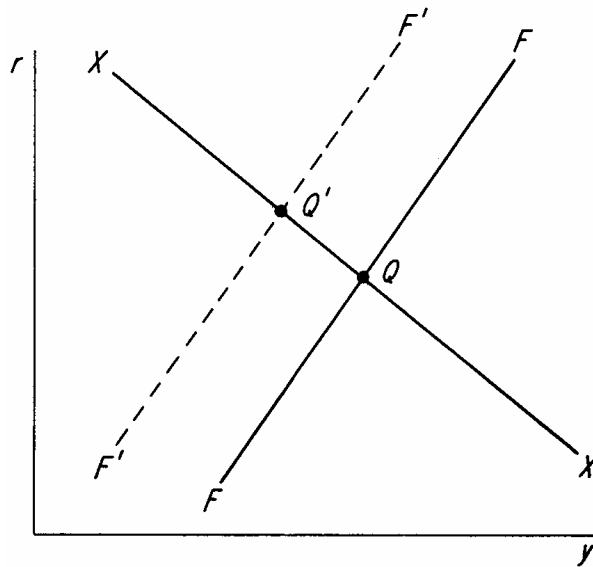


Figure 15-2.

An increase in foreign interest rates causes an increased capital outflow and therefore shifts the FF schedule north-west. But the authorities will prevent income from falling (to that represented by Q') by maintaining the supply of money through neutralization operations.

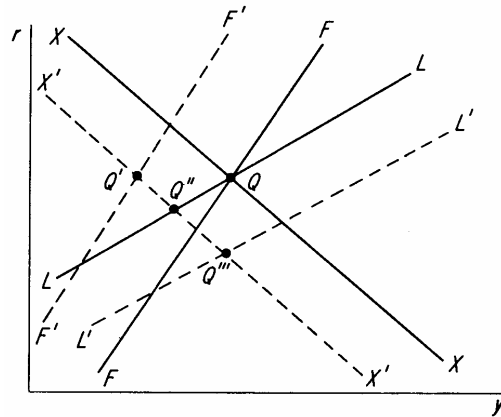


Figure 15-3.

A fall in exports shifts the two schedules to $X'X'$ and $F'F'$. The adjustment process would lead to the point Q' , whereas neutralization operations would establish Q'' as “equilibrium.” However, the central bank will usually go further than neutralization, increasing the supply of money to make Q''' the new “equilibrium.”

maintained with equilibrium in the goods and money markets but disequilibrium in the balance of payments. This situation will continue as long as the central bank or Treasury can maintain the money supply and continue to run down its foreign exchange reserves.¹¹

The neutralization policy in the above case coincides with the policy of stabilizing national income—failure to neutralize the gold outflow would result in the lower level of employment and output represented by the equilibrium Q' . More usually, however, the central bank will have to reinforce or

¹¹ It is worth being explicit about the exact equations ensuring quasi-equilibrium under the sterilization operation. If there is to be no inventory accumulation by firms it is necessary that

(1) saving – investment = trade balance surplus

The balance-of-payments identity is that

(2) trade balance surplus – net capital exports = increase in foreign reserves. For equilibrium in the market for new securities we have, with no hoarding,

(3) investment – saving = net capital imports + new bank lending. Also, for the banking sector, including the central bank, we have

(4), (5) new bank lending + increase in foreign reserves = increase in money supply = 0, since monetary equilibrium, abstracting from growth, requires that the money supply be constant.

It follows from these five equations that every market is in equilibrium when the banks exactly take up the net excess of new securities offered by the private sector over and above what is subscribed to by foreigners, so that the counterpart of the balance of payments deficit is the additional credit creation by the banking system.

offset the neutralization policy by further operations in the open market. Suppose, for instance, that there arises a depression in the rest of the world which lowers demand for the exports of the country under consideration. The reduction in exports has multiplier effects on income, and it worsens the trade balance, thus shifting both the FF and XX curves to the left. In the absence of neutralization the automatic adjustment mechanism would carry the new equilibrium to the point Q' in Figure 15-3, at a lower level of output and employment. But even with a policy of neutralizing the external deficit (thus maintaining a constant money supply), the fall in export markets would lead to a lower level of output and employment, as implied by the point Q'' . The central bank will, in this instance, reinforce its neutralization policy by further open market operations to preserve the original level of output and employment. The money supply must be increased to the point where the LL curve shifts to $L'L'$ to intersect the internal balance schedule at the point Q''' . At this point there is, of course, a balance-of-payments deficit greater than that represented by Q'' .

Occasionally, the adjustment process will lead to the desired income without interference; the central bank will then have to abandon the neutralization policy, or offset it by open market operations (or changes in reserve requirements) in the opposite direction. One such case is represented in Figure 15-4, where it is assumed that capital is immobile (the FF curve is vertical). Suppose now that there is domestic contraction (reduced home demand for domestic goods). Neutralization policy would then lead to a new equilibrium at Q' ,

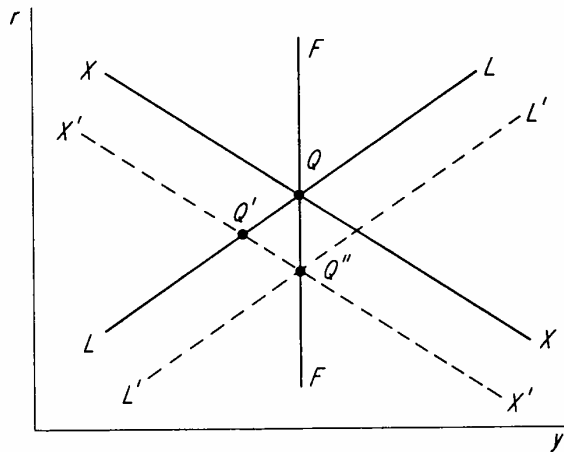


Figure 15-4.

A domestic recession shifts the internal balance schedule to $X'X'$. "Neutralization" would lead to a lower income as at Q' , while the adjustment process preserves the original level of income at the point Q'' .

whereas the automatic adjustment process would restore the original level of money income at Q'' . The central bank would thus have to offset the neutralization policy by increasing the money supply to the point where LL' intersects XX' at the original level of money income represented by Q'' .

The above examples¹² suffice to illustrate the nature of the disequilibrium system, and why it has arisen. Of paramount importance today is the stabilization of money income (apart from growth); and any change in the economic situation that threatens to affect it will be met by corrective monetary steps even if this policy adversely affects external balance. Many countries may therefore remain in external disequilibrium for a considerable period of time, taking no explicit policy steps to correct the situation, and preventing the adjustment process from having its natural corrective influence.

To maintain this situation requires a substantial level of foreign exchange reserves in deficit countries, and a willingness to make unrequited capital exports in surplus countries. If this disequilibrium policy evens out—so to speak—over the business cycle, no long-run difficulty exists if international liquidity is sufficient. But any secular change in the competitive situation, or a persistent tendency in some countries to inflate at faster rates than other countries, must eventually bring the day of reckoning, and either an abandonment of income stabilization, or further policy steps, some of which are considered in the next section.

Alternative Means to Equilibrium

It is seldom possible to determine the appropriate policy for correcting an external disequilibrium without first examining the nature of the equilibrium situation in other markets. In Figure 15–5 there are four quadrants, *A*, *B*, *C*, and *D*, labeled according to whether there is unemployment or inflationary

¹² The techniques used in this section can also be applied to a much neglected aspect of the transfer problem the theory of which, despite its popularity in the literature, is still incomplete. It is clear that many transfers between governments, or from governments to international agencies, in recent years have not been accompanied by increased taxation in the transfer or decreased taxation in the transferee (witness the payments of many countries to the IMF after the 1958 increase in quotas, as only one example), the situation necessary to make the traditional Ricardo-Ohlin stereotype of transfer valid. On the contrary, many transfers have been effected between countries simply by means of an exchange of reserves. Thus a transferring country might maintain, for a period of time before the transfer is to be made, a tighter monetary policy and a lower rate of price-level increases in order to build up reserves (this, of course, will have some effect on spending) and then transfer the increased reserves to the transferee. In terms of the diagrams, the tighter monetary policy effects a movement upward and to the left along the XX curve to create an external disequilibrium until enough reserves have been accumulated to make the transfer. Since this policy will also result in a lower terms of trade, or a reduced level of employment, in the transferring country, this stereotype lends increased support to the logic of Keynes's position in his controversy with Ohlin in the inter-World War period.

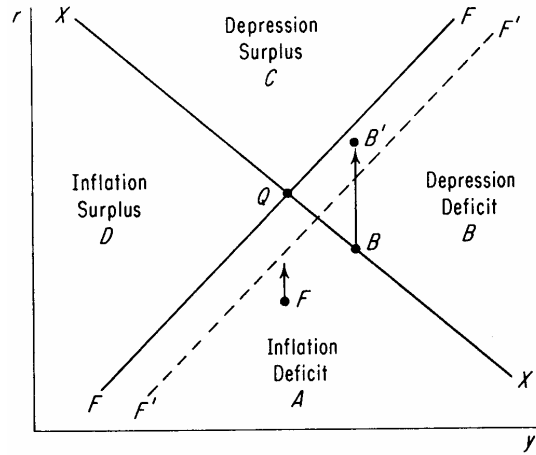


Figure 15-5.

The four quadrants outline the four types of disequilibrium. The point F was roughly the position of France before devaluation in 1958, and also the kind of disequilibrium applying in Europe after World War II. The point B represents the United Kingdom in the summer of 1957 before the rise in bank rate in September to establish the point B' with some unemployment.

pressure in the goods-and-services market, and a deficit or surplus in the balance of payments: Quadrant A was the situation applying to Britain, France, Italy, and Canada in the early post-World War II years; quadrant B applied to Britain in the late 1920s and early 1930s as well as the United States in recent years; quadrant C applied to the United States in the 1930s and to the Federal Republic of Germany in the early 1950s; and quadrant D applied to the Federal Republic in recent years, Italy in 1958-1959, and the United States in the late 1940s and early 1950s.¹³

¹³ See Harrod ([23], chap. 152) for a similar treatment. This characterization is complicated by the asymmetrical nature of changes in money income. An economy, with external deficit and deflationary tension, could be brought back into "equilibrium" by a reduction in money income; but it would not be a full employment level of income because downward movements of money income in manufacturing countries are almost always accompanied by increasing unemployment. On the other hand, an economy with external surplus and inflationary pressure needs a rise in money income to restore equilibrium: This would imply a desirable increase in output and employment if the initial situation were one of unemployment, but an undesirable increase in wages and prices if the economy were already at full employment. In other words, reductions in money income must always be ruled out if full employment gets top priority; while increases in money income are always desirable for an underemployed economy, and permissible or not for a fully employed economy depending on the attitude of the authorities toward a higher price level.

In exceptional cases monetary policy alone is sufficient to restore internal and external balance. Consider point F in Figure 15–5; at F there is inflationary pressure and external deficit, a situation applying to France before the devaluation in late 1958. In the absence of government action, money income would increase through a rise in prices, and the external deficit would be aggravated. The correct policy here is a simple increase in the rate of interest, a policy that relieves both inflationary pressure and corrects the external deficit.

But a simple policy (involving a change in only one instrument) would not generally be sufficient; in the diagram only those disequilibria characterized by points on a vertical line through Q can be corrected by monetary policy alone; all other points necessitate at least a dual policy. Consider, for example, the situation in the United Kingdom in the summer of 1957: there was approximate internal balance at reasonably full employment, but also an external deficit that had been aggravated by speculation against the pound in favor of the mark. This situation is represented by the point B . Now, in late September the authorities raised the bank rate to 7 per cent, an action that corrected the speculative outflow (shifting the FF curve to the right) and converted the external deficit into a surplus. But this policy did not restore over-all balance; it resulted in some deflationary tension and unemployment. (The new situation is represented by the point B' .) To prevent changes in money income, then, an additional policy should have been pursued; the monetary instrument is not sufficient.

Consider now a situation where, say, the United States, has initial full employment and balance-of-payments equilibrium, and assume that this equilibrium is disturbed by a round of price and wage increases surpassing that of foreign countries. From point Q in Figure 15–6 the price level rises and the central bank eases the monetary situation to prevent this increase from being manifested in unemployment, establishing a new equilibrium in the goods market at the point Q' . But Q' is a point of balance-of-payments deficit, and if this is large, and threatens to continue, speculative capital outflows from the United States will occur, further aggravating the situation (shifting the FF schedule progressively upward and to the left), and ultimately demanding corrective action. What is the range of policy choices available?

1. By far the simplest corrective action is a reduction in foreign aid or private capital exports, reduction in the latter being effected by, say, removal of government subsidies and insurance to capital exporters. This shifts the FF schedule downward and to the right, establishing Q' as a point of balance-of-payments equilibrium. This policy has the advantage of simplicity, but it might conflict with other political and economic goals of the United States.

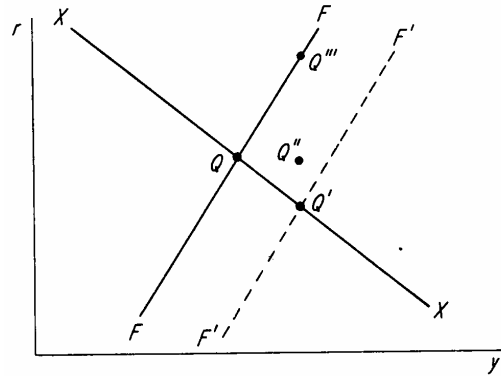


Figure 15-6.

Wage increases and easy money lead to the situation at Q' . A reduction in foreign aid would shift FF to $F'F'$; devaluation or trade control would shift both curves so that they intersect at Q'' ; while increased local expenditure combined with tight money would effect the equilibrium Q''' .

2. Any policy that acts directly on the balance of trade, as distinct from the balance of payments on capital account, shifts both the internal balance and foreign schedules. Tariffs, quotas, export subsidies, and devaluation would result in a new intersection of the two schedules at a point such as Q'' , necessarily above Q' . These policies would therefore have to be accompanied by tighter monetary policy to prevent the inflationary pressure of the improved trade balance from being dissipated in price increases. (Another way of saying the same thing is that a tighter monetary policy would create recessive tension that could be alleviated by policies that improve the trade balance.)
3. Somewhat paradoxically, an increase in government spending (on home goods) or a reduction in taxes (which affects primarily spending on home goods)—in short, a budget deficit—would provide another means of reestablishing equilibrium. Both these policies create inflationary pressure (shifting the XX curve upward and to the right) and therefore permit a higher rate of interest—hence a greater capital inflow (or smaller outflow)—consistent with full employment. To put it differently, an increase in the rate of interest to the point Q''' would restore external equilibrium but cause unemployment; the increase in government spending or the reduction in taxes can then be thought of as ordinary fiscal policy designed to maintain full employment.¹⁴

¹⁴ This policy mix is developed more explicitly in the following chapter.

Two limitations of this policy are at once evident. In the first place the deficit has been cured by borrowing, usually a temporary solution. And second, the domestic rate of investment is lower (because the rate of interest is higher) than at Q , a factor that may conflict with the policy aim of maximizing the rate of growth of the private sector of the economy.

4. Finally, one could consider various devices aimed at altering the private flow of short-term funds between countries: official transactions in the forward exchange market, differential treatment of foreign domestic bank deposits, and different interest rates paid on foreign-held and domestically held Treasury bills. These devices are usually only temporary expedients and are often difficult to enforce.

Chapter 16 / *The Appropriate Use of Monetary and Fiscal Policy under Fixed Exchange Rates*¹

This paper deals with the problem of achieving internal stability and balance-of-payments equilibrium in a country that considers it inadvisable to alter the exchange rate or to impose trade controls. It is assumed that monetary and fiscal policy can be used as independent instruments to attain the two objectives if capital flows are responsive to interest-rate differentials, but it is concluded that it is a matter of extreme importance how the policies are paired with the objectives. Specifically, it is argued that monetary policy ought to be aimed at external objectives and fiscal policy at internal objectives, and that failure to follow this prescription can make the disequilibrium situation worse than before the policy changes were introduced.

The practical implication of the theory, when stabilization measures are limited to monetary policy and fiscal policy, is that a surplus country experiencing inflationary pressure should ease monetary conditions and raise taxes (or reduce government spending), and that a deficit country suffering from unemployment should tighten interest rates and lower taxes (or increase government spending).²

The Conditions of Equilibrium

Internal balance requires that aggregate demand for domestic output be equal to aggregate supply of domestic output at full employment. If this condition is not fulfilled, there will be inflationary pressure or recessionary potential according to whether aggregate demand respectively exceeds or falls short of full employment output. It will be assumed here that, during transitory periods of disequilibrium, inventories are running down, or accumulating,

¹ Reprinted from: *IMF Staff Papers*, 70-79 (March 1962).

² This policy has been suggested, and to a limited extent implemented, elsewhere. See, for example, [11].

in excess of desired changes, according to whether the disequilibrium reflects a state of inflationary or recessionary potential.

External balance implies that the balance of trade equals (net) capital exports at the fixed exchange parity. If the balance of trade exceeds capital exports, there will be a balance-of-payments surplus and a tendency for the exchange rate to appreciate, which the central bank restrains by accumulating stocks of foreign exchange. And likewise, if the balance of trade falls short of capital exports, there will be a balance of payments deficit and a tendency for the exchange rate to depreciate, which the central bank prevents by dispensing with stocks of foreign exchange.

In what follows it is assumed that all foreign policies and export demand are given, that the balance of trade worsens as the level of domestic expenditure increases, and that capital flows are responsive to interest-rate differentials. Then domestic expenditure can be assumed to depend only on fiscal policy (the budget surplus) and monetary policy (the interest rate) at the full-employment level of output. The complete system can thus be given a geometric interpretation in the two policy variables, the interest rate and the budget surplus³ (Figure 16–1).

In the diagram, the *FF* line, which will be referred to as the *foreign-balance schedule*, traces the locus of pairs of interest rates and budget surpluses (at the level of income compatible with full employment) along which the balance of payments is in equilibrium. This schedule has a negative slope because an increase in the interest rate, by reducing capital exports and lowering domestic expenditure and hence imports, improves the balance of payments; whereas a decrease in the budget surplus, by raising domestic expenditure and hence imports, worsens the balance of payments. Thus, from any point on the schedule an increase in the rate of interest would cause an external surplus, which would have to be compensated by a reduction in the budget surplus to restore equilibrium. Points above and to the right of the foreign-balance schedule refer to balance-of-payments surpluses, while points below and to the left of the schedule represent balance-of-payments deficits.

A similar construction can be applied to the conditions representing internal

³ The assumptions could be made less restrictive without detracting from the generality of the conclusions. Thus an assumption that capital imports directly affect domestic expenditure, as in theoretical transfer analysis, would reinforce the conclusions. Even the (plausible) assumption that, in addition to capital flows, capital indebtedness is responsive to the rate of interest (to take account of the “stock” nature of much of international floating capital) would not change the conclusions, although it would affect the quantitative extent of the policy changes required.

Note, however, that I have implicitly assumed away strong “Pigou” effects, speculation on international markets that is related to the size of the (positive or negative) budget surplus, forward rate movements that more than offset interest-rate-differential changes (an unlikely occurrence), and concern about the precise composition of the balance of payments; the last assumption may mean that the method of achieving equilibrium suggested below is desirable only in the short run.

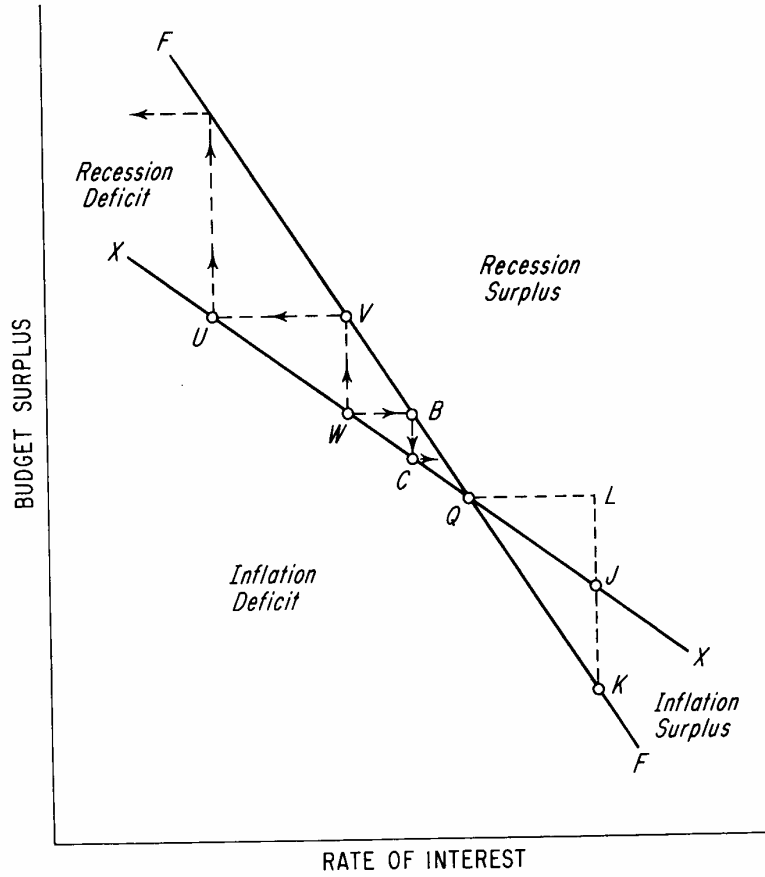


Figure 16-1.

balance. The *XX* line, or *internal-balance schedule*, is the locus of pairs of interest rates and budget surpluses that permits continuing full employment equilibrium in the market for goods and services. Along this schedule, full-employment output is equal to aggregate demand for output, or, what amounts to the same condition, home demand for domestic goods is equal to full-employment output less exports. There is, therefore, only one level of home demand for domestic goods consistent with full employment and the given level of exports, and this implies that expenditure must be constant along *XX*. The internal-balance line must therefore have a negative slope, because increases in the interest rate are associated with decreases in the budget surplus, in order to maintain domestic expenditure constant.

Both the internal-balance and the foreign-balance schedules thus have negative slopes. But it is necessary also to compare the steepness of the slopes. Which of the schedules is steeper?

It can be demonstrated that FF must be steeper than XX if capital is even slightly mobile, and by an amount that depends both on the responsiveness of international capital flows to the rate of interest and on the marginal propensity to import. The absolute slope of the internal-balance schedule XX is the ratio between the responsiveness of domestic expenditure to the rate of interest and the responsiveness of domestic expenditure to the budget surplus. Now, if it is assumed for a moment that capital exports are constant, the balance of payments depends only on expenditure, because exports are assumed constant and imports depend only on expenditure. In other words, if capital exports are constant, the slope of FF also is the ratio between the responsiveness of domestic expenditure to the rate of interest and the responsiveness of such expenditure to the budget surplus. Therefore, apart from the effects of changes in capital exports, the two slopes are the same. It is then possible to see that the responsiveness of capital exports to the rate of interest makes the slope of FF greater in absolute value than the slope of XX .⁴

Consider, for example, what happens to an initial situation of overall equilibrium at Q as this equilibrium is disturbed by an increase in the rate of interest equal to QL . Because of the higher rate of interest, there would be deflationary pressure and a balance-of-payments surplus at the point L . If the budget surplus is now lowered, the deflationary pressure can be eliminated at a point like J on the internal-balance schedule. But at J , expenditure is the same as it was at Q , and this means that imports, and hence the balance of *trade*, must be the same as at Q . The balance of *payments* is therefore in surplus at J because of capital imports attracted by the higher rate of interest; this makes necessary a further reduction in the budget surplus in order to bring the balance of payments again into equilibrium. It follows, then, that the point K on the foreign-balance schedule is below the point J on the internal-balance schedule and that FF is steeper than XX . It can then also be concluded that the absolute difference in slopes is greater, the more mobile is capital (because this causes a larger external surplus at J) and the lower is the marginal propensity to import (because this necessitates a larger budget deficit to correct any given external surplus).⁵

⁴ Both the absolute and relative values of the slopes depend on the particular fiscal policy in question. The discussion here applies to income tax reductions, because that instrument tends to be neutral as between home and foreign spending. The conclusions would be strengthened or weakened, respectively, as the particular fiscal policy was biased toward or against home goods; the more the change in the budget surplus results from a change in spending on home goods, the greater is the difference between the slopes of XX and FF .

⁵ The assumption that imports depend only on expenditure, while the latter depends partially on the rate of interest, means that imports are affected by the rate of interest,

In Figure 16–1, the two schedules separate four quadrants, distinguished from one another by the conditions of internal imbalance and external disequilibrium. Only at the point where the schedules intersect are the policy variables in equilibrium.

Two Systems of Policy Response

Consider now two possible policy systems determining the behavior of fiscal policy and monetary policy when internal and external balance have not been simultaneously achieved. The government can adjust monetary policy to the requirements of internal stability, and fiscal policy to the needs of external balance, or it can use fiscal policy for purposes of internal stability and monetary policy for purposes of external balance.

It will be demonstrated first that the policy system in which the interest rate is used for internal stability, and fiscal policy is used for external equilibrium, is an unstable system. Consider, for example, a situation of full employment combined with a balance-of-payments deficit, represented by the point W . To correct the deficit by fiscal policy, the budget surplus must be raised from that indicated by W to that given by V . At V there will be equilibrium in the balance of payments, but the increased budget surplus will have caused recessionary pressure. If now the threatening unemployment is to be prevented by monetary policy, the rate of interest must be lowered from that indicated by V to that described by U . But at U there is again a balance-of-payments deficit, which in turn necessitates a further increase in the budget surplus. The process continues with the interest rate and the budget surplus moving ever further from equilibrium.⁶

To show formally that the system is unstable, it is sufficient to note that the payments deficit at U , after the first round of policy changes, exceeds the deficit at W . This is evident as it is known that the balance of *trade* at U and

although the *share* of imports in expenditure is not. This assumption could be relaxed without fundamentally altering the results, although an exception—remote in practice but possible in theory—does arise, if import goods are highly responsive to the rate of interest while home goods are not, capital flows are only slightly responsive to the rate of interest, and the marginal propensity to buy imports is high relative to the marginal propensity to buy home goods. Under these conditions, it is possible that XX may be steeper than FF . More formally, then, it is necessary to limit the present conclusions to countries in which the ratio of the effect of budget policy on the balance of payments to its effect on domestic excess demand is less than the ratio of the effect of the interest rate on the balance of payments to its effect on excess demand.

⁶ It need hardly be mentioned that the demonstration of instability in this instance (or of stability in the subsequent analysis) is not dependent upon the particular assumption that the government corrects imbalance first in one sector and then in the other, an assumption that is made only for expositional convenience. The conclusions follow, for example, even if the authorities simultaneously adjust fiscal and monetary policies.

W is the same but, because of the lower rate of interest, the balance of *payments* at U is worse. It follows that this type of policy reaction is unstable.

On the other hand, the opposite type of policy response is stable. Suppose that the authorities adjust the interest rate to correspond to the needs of external equilibrium and adjust fiscal policy to maintain internal stability. Then, from the same disequilibrium point W , the rate of interest would be raised to B , thereby correcting the external deficit. But the tendency toward unemployment generated by the restrictive credit policy must now be corrected by a reduction in the budget surplus or increase in the budget deficit. At C there is again internal balance and a balance-of-payments deficit, as at W . But it is now possible to see that the deficit at C is *less* than the deficit at W . This follows, as before, because the balance of *trade* at C is identical with that at W , but, because the rate of interest is higher at C , the balance of *payments* deficit must be less. The system is therefore stable.

The diagrammatic argument can be absorbed at once when it is realized that at W —or anywhere in the quadrant representing a deficit and recession—the interest rate is lower, and the budget surplus is higher, than is appropriate to the overall equilibrium at Q . The use of fiscal policy for external balance, and monetary policy for internal balance, drives the interest rate and budget surplus farther away from equilibrium, whereas the alternative system moves the instruments closer to equilibrium.

The same argument applies to an initial disequilibrium in the opposite quadrant, representing inflationary pressure and external surplus. To restore equilibrium, the interest rate must be reduced, and fiscal policy must be made more restrictive. Only if monetary policy is used for the external purpose, and fiscal policy for the internal purpose, will correction of the disequilibrium automatically ensue.⁷

In the other two quadrants, monetary and fiscal policies will be moving in the same direction under either system of policy response, because both tighter monetary policy and an increased budget surplus correct inflationary pressure and external deficit, and both easier monetary policy and a reduced budget surplus tend to alleviate recession and external surplus. The distinction between the two policy systems appears less important in these phases of the international trade cycle; it nevertheless remains, since inaccurate information about the exact location of the point Q could propel the situation into one of the quadrants involving either recession and deficit or inflation and surplus.⁸

⁷ Even if the authorities do not wish to pair instruments and targets, they can use the information provided by the analysis to determine the relation between *actual* policies and *equilibrium* policies. Thus, situations of deficit and recession imply that the budget surplus is too high and the interest rate is too low, while situations of surplus and inflation imply the opposite. In this manner, appropriate policies can be determined by observable situations of target disequilibria.

⁸ The system can be generalized for a two-country world by assuming that the other adjusts fiscal policy to maintain internal stability. The only difference in the conclusion

Principles of Policy

It has been demonstrated that, in countries where employment and balance-of-payments policies are restricted to monetary and fiscal instruments, monetary policy should be reserved for attaining the desired level of the balance of payments and fiscal policy for preserving internal stability. The opposite system would lead to a progressively worsening unemployment and balance-of-payments situation.

The explanation can be related to what I have elsewhere [71] called the principle of effective market classification: Policies should be paired with the objectives on which they have the most influence. If this principle is not followed, there will develop a tendency either for a cyclical approach to equilibrium or for instability.

The incorrect use of fiscal policy for external purposes and monetary policy for internal stability violates the principle of effective market classification, because the ratio of the effect of the rate of interest on internal stability to its effect on the balance of payments is less than the ratio of the effect of fiscal policy on internal stability to its effect on the balance of payments.

On a still more general level, we have the principle that Tinbergen has made famous—that to attain a given number of independent targets there must be at least an equal number of instruments [100]. Tinbergen's principle is concerned with the *existence* and *location* of a solution to the system. It does not assert that any given set of policy responses will, in fact, lead to that solution. To assert this, it is necessary to investigate the stability properties of a dynamic system. In this respect, the principle of effective market classification is a necessary companion to Tinbergen's principle.

is that the conditions of dynamic stability of the adjustment process are slightly more restrictive, requiring that the marginal propensities to import be, *on the average*, no greater than one half; this is the usual assumption necessary to rule out any “reverse transfer” that is due to policies affecting expenditure.

Chapter 17 / *Flexible Exchange Rates and Employment Policy*¹

The theory of employment that grew out of the Great Depression was not long in influencing government policy makers and revolutionizing older concepts of fiscal policy. The most important of Keynes' practical lessons—that policies that promote investment and exports and inhibit saving and imports increase employment and output—has now hardened into a dogma and filtered down into almost all the elementary textbooks. The lesson, by and large, was a good one, but the dogma presents the danger that the lesson might be uncritically applied in situations where other government policies render it invalid. This chapter is concerned with the most important exception to the rule.

The mercantilist element in Keynesian policies is definitely *inapplicable* to countries whose central banks do not peg the price of foreign exchange or gold. Tariffs, trade controls, and export subsidies are likely to *worsen* employment and output in all those situations in which, with a fixed exchange rate, they would improve employment and output. Moreover, if exchange rates are flexible, an increase in investment or government spending, and a reduction in saving or taxation, will have a substantially different effect on employment than that predicted by the traditional foreign trade multiplier. The reason lies in the fact that equilibrium in the balance of payments is automatically maintained by variations in the price of foreign exchange.

These simple truths have already been anticipated in the theoretical literature by the argument that, under flexible exchange rates, depression in one country may transmit inflation instead of depression to other countries.² Yet there remains a serious gap in the literature since the explicit implications of the argument for employment policy have not been explored, nor are they

¹ Adapted from: *Can. Jour. Econ. Pol. Sci.*, **27**, 509–517 (Nov. 1961).

² The important articles by Laursen and Metzler [42] and Harberger [20] aroused extensive comment in the literature, especially appertaining to the relation between changes in the, terms of trade and saving. A useful survey of the literature on the subject has been given by Johnson [32].

sufficiently appreciated by government authorities.³ Consequently, I shall examine the effects of fiscal policy, monetary policy, and commercial policy of the level of employment in an economy whose exchange rate is substantially free, and contrast the results with those that would obtain under a system with a fixed exchange rate.

Stability Conditions of the Model

For the open economy under consideration to be in equilibrium, two conditions must be met: The demand for goods and services must equal the supply of goods and services, and there must be equilibrium in the balance of payments. The first condition will obtain when output is equal to the sum of domestic expenditure and the trade balance, and the second condition will be satisfied when the trade balance deficit equals net capital imports.

We assume that while capital imports and exports may depend on interest rates at home and abroad, the latter are parameters determined by monetary policy. We assume further that foreign incomes are given during the period under consideration, and that output at home is perfectly elastic up to the point of full employment. These assumptions have the advantage of reducing the system to two equilibrium conditions in two variables, the level of output (correlated with the level of employment) and the exchange rate (defined as the price of foreign currency in terms of domestic currency).⁴ The system is represented in Figure 17–1.

The *XX* curve traces the locus of exchange rates and output at which the demand for goods and services is equal to the supply of goods and services. This schedule has a positive slope because an increase in output creates an excess supply of goods and services, whereas an increase in the price of foreign exchange creates an excess demand for goods and services. Consequently, an increase in output must be associated with an increase in the price of foreign exchange for excess demand to remain zero. Similarly, the *FF* schedule traces the locus of exchange rates and output along which the balance of payments is in equilibrium. This curve also has a positive slope because an increase in the price of foreign exchange improves the balance of payments while an increase in income worsens it, and this means that increases in the price of foreign exchange must be accompanied by increases in output if the balance of payments is to remain constant. Both the internal-balance schedule and the foreign-balance schedule have positive slopes.

This information, however, is not yet sufficient to determine the effects on

³ It is sufficient to refer to the views of the (former) Governor of the Bank of Canada, J. E. Coyne, who (when Canada had a flexible exchange rate) argued that less reliance should be placed on fiscal and monetary policy, and more reliance should be placed on commercial policy, to improve employment in Canada.

⁴ This model builds on the work of Laursen and Metzler [42].

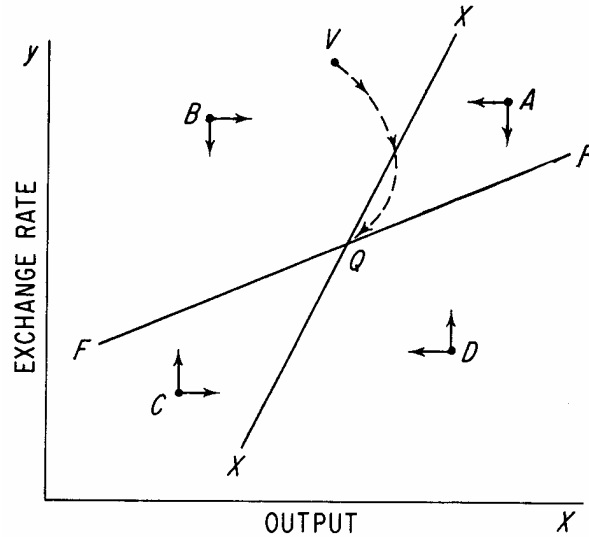


Figure 17-1. Stable Case.

income and the exchange rate of most policy changes; it is also necessary to know which of the two slopes is steeper. The simplest way to deduce this is to examine the conditions of dynamic stability. On the dynamic postulates that incomes rises or falls depending on whether there is excess demand or excess supply in the market for goods and services, and that the price of foreign exchange rises or falls depending on whether there is a deficit or surplus in the balance of payments, it is readily shown that the slope of the internal-balance schedule must exceed the slope of the foreign-balance schedule if the system is to be stable.

To show this, consider the four quadrants in Figures 17-1 and 17-2, separated from one another by different conditions of excess demand or supply in the goods and foreign exchange markets. In both diagrams there is excess demand or excess supply in the goods market, depending on whether output (the exchange rate) is west (north) or east (south), respectively, of the XX line; and there is a balance-of-payments deficit or surplus depending on whether the exchange rate (output) is, respectively, south (east) or north (west) of the FF line. According to the two dynamic postulates, then, the exchange rate and the level of output will be moving in the directions indicated by the arrows in each quadrant from any of the points A , B , C , or D in Figure 17-1, and the points A' , B' , C' , and D' in Figure 17-2.

In Figure 17-1 it is readily seen that one of the arrows always points in the direction of the equilibrium Q from any of the points in the diagram, so the situation in Figure 17-1 is stable; this can be verified by following the path of the exchange rate-output complex from any point such as V . It will either

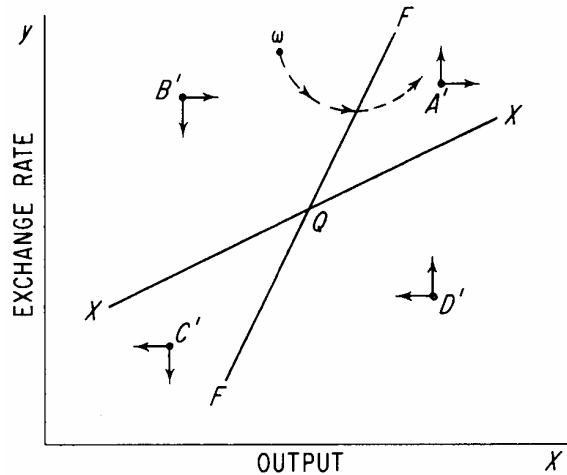


Figure 17-2. Unstable Case.

The XX lines trace the conditions for internal balance, and the FF schedules the conditions for external balance. The situation in Figure 17-1 is stable because the slope of XX exceeds the slope of FF , and the situation in Figure 17-2 is unstable because the opposite is the case. Output is assumed to be correlated with employment.

proceed directly to equilibrium or get trapped in one of the two quadrants in which both arrows point towards equilibrium. In Figure 17-2, on the other hand, the arrows in two of the quadrants both point away from equilibrium, so the situation represented in that diagram is unstable; from a point such as W the exchange rate-output complex will get trapped in one of the two quadrants in which both the exchange rate and income are moving away from the equilibrium (unless the point Q were attained by accident).

The only difference between the situations in Figures 17-1 and 17-2 is that the slope of XX exceeds the slope of FF in the former, whereas the slope of FF exceeds the slope of XX in the latter. A necessary condition for stability⁵ is therefore that the slope of XX exceed the slope of FF . In what follows we assume that the stability conditions are satisfied and make use of the information thus gained to determine the effects of fiscal, monetary, and commercial policy on the level of employment and output.

Fiscal Policy and Employment

I shall define fiscal policy as a budget deficit (surplus) created by an increase (decrease) in government spending on home goods or a decrease (increase) in

⁵ See section 1 of the Appendix.

taxes which primarily affect spending on home goods. Then fiscal policy will significantly affect only the position of the internal-balance schedule.⁶

At the initial exchange rate and level of output, a budget deficit will not change the balance of payments, but it will create an excess demand for goods and services. To correct this excess demand, the level of output would have to be increased or the exchange rate (the price of foreign currency) would have to fall: This means that the XX schedule (Figure 17-3) shifts down and to the right. The new equilibrium, determined by the intersection of the original FF schedule and the new internal-balance schedule, $X'X'$, is at Q' , where the level of output is higher and the price of foreign exchange has increased.

The increase in output is greater than that indicated by the foreign trade multiplier. The change in output given by the multiplier is y_1y_2 , because that is the increase in income necessary to eliminate the excess demand caused by the change in spending at a constant exchange rate. But at the point P there is a deficit in the balance of payments that, under the flexible exchange system, will be eliminated by a depreciation of the home currency, and this in turn will create excess demand in the goods market and thus induce successive rounds of income increases and exchange rate changes until the point Q' is reached.

A budget deficit mainly affecting spending on home goods will create an expansion of output equal to that indicated by the Keynesian foreign trade multiplier *plus* an additional amount due to the elimination of the foreign

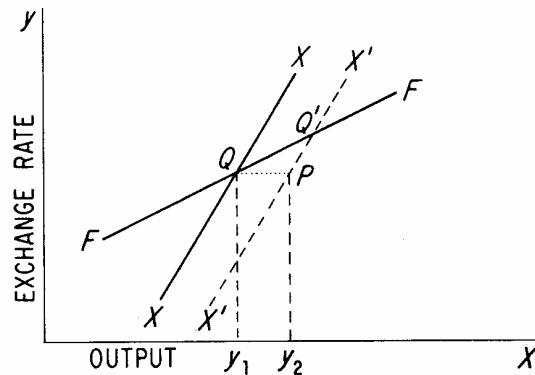


Figure 17-3. The Effect of Fiscal Policy on Employment.

An increase in government spending or a reduction in taxes creates, at constant output, an excess demand for goods and services, so the XX internal balance schedule moves to $X'X'$, effecting a new equilibrium at Q' . The increase in output given by the Keynesian multiplier is QP or y_1y_2 , which is less than the increase in output from Q to Q' , because of the depreciation of the exchange rate.

⁶ See section 2 of the Appendix.

imbalance by the depreciation of the exchange rate. Fiscal policy is therefore more effective in improving employment under a system of flexible exchange rates than under a system of fixed exchange rates.⁷

Monetary Policy and Employment

Monetary policy is in reality extremely complicated with many side effects, depending in part on how it is implemented. We shall assume that it takes the form of a reduction (increase) in interest rates, and that its main impact is to increase investment and reduce capital imports.

The reduction in interest rates increases the excess demand for domestic goods and therefore shifts the internal balance schedule to the right. It also reduces capital imports or increases capital exports and so creates a deficit in the balance of payments, shifting the FF schedule upward and to the left. The new equilibrium must therefore be above the FF line and to the right of the XX line, determined by the intersection of $X'X'$ and $F'F'$, at Q' (Figure 17-4).

The increased effectiveness of monetary policy under flexible exchange rates is apparent. There are two reasons for this: First, the increased investment occasioned by the lower interest rate has a greater multiplier effect on employment, as in the case of fiscal policy, because leakage through foreign

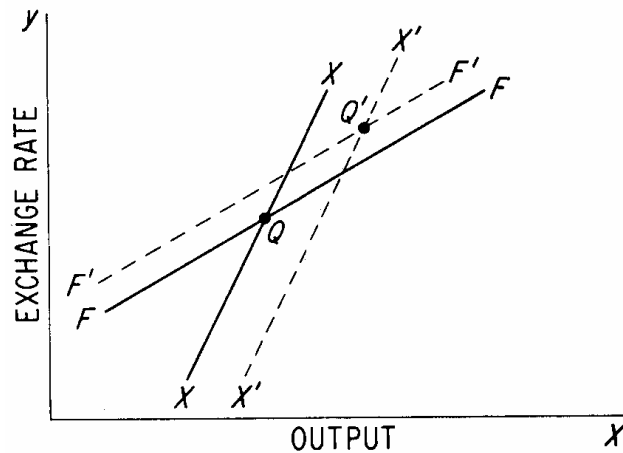


Figure 17-4. The Effect of Monetary Policy on Employment.

A reduction in interest rates creates an excess demand for goods and services, shifting XX to $X'X'$, and occasions decreased capital imports, shifting FF to $F'F'$, establishing Q' as the new equilibrium. Shifts in the import *schedules* as a result of the capital movement are ignored.

⁷ This conclusion is strictly valid only in the case of capital immobility. See the discussion in Chapter 18.

trade is eliminated; and, second, the increased export of capital, or reduced import of capital, further lowers the exchange rate and permits a greater trade balance surplus, or a lower trade balance deficit. The size of the final gain in employment of course depends on the responsiveness of investment to the interest rate, the import content of investment spending, and the responsiveness of capital movements to the interest rate.

Commercial Policy and Employment

Define commercial policy to be any policy that restricts imports or promotes exports without directly affecting the level of saving or investment. Such a policy affects both the internal and external balance schedules.

The effect on the internal balance schedule is similar to that of fiscal policy, shifting it downward and to the right. It also affects the balance of payments directly and so shifts the foreign balance schedule downward and to the right since, at the same exchange rate, the level of income would have to be higher, and at the same level of income the exchange rate would have to be lower to overcome the deficit. Both schedules shift in the same direction.

This is not yet sufficient to determine the direction of change in the exchange rate and the level of output; it is also necessary to know the extent of the shift in the two schedules. It is easily shown, however, that the FF schedule must shift to the right by more than the XX curve, because the initial (Keynesian) multiplier effect on income is insufficient to eliminate the balance-of-payments surplus; at R on the new XX schedule there is a balance-of-payments surplus that can only be eliminated by a further increase in income. The point S on the $F'F'$ schedule must be to the right of the point R on the $X'X'$ line, and this means that the price of foreign exchange must decline (Figure 17-5).

To find out whether national output increases or decreases we need to know whether the FF schedule shifts downward by more or less than the XX curve; in other words, it is necessary to determine the changes in excess demand and the balance of payments on the tentative assumption that output remains constant. If output remains constant, a fall in the price of foreign exchange would be required to restore external balance; the new exchange rate would have to be that indicated by a point such as W below Q . But this change in the exchange rate relieves excess demand in the internal market equal to the change in the balance of payments *plus* its effect on the excess of income over expenditure. If we now assume that investment is unchanged, the higher level of real income due to the improved terms of trade is likely to increase saving and reduce expenditure. On this argument there must be an excess supply of goods at the point W , which is another way of saying that the point T on the XX schedule must be above W on the FF schedule. This implies that the intersection of the two schedules must be below and to the left of T and W , and

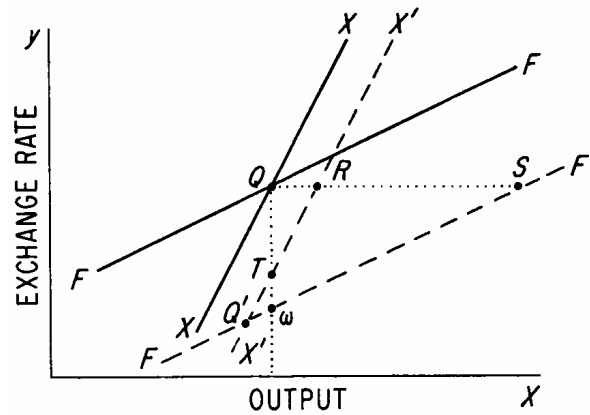


Figure 17-5. The Effect of Commercial Policy on Employment.

A reduction in imports or an increase in exports shift both XX and FF downward and to the right. But $F'F'$ shifts to the right by more than $X'X'$, so the price of foreign exchange falls, and $X'X'$ shifts downward by less than $F'F'$, so output and employment fall. Commercial policy is deflationary.

that the new equilibrium level of output is lower than before the commercial policy was introduced. Commercial policy thus tends to be deflationary! The complete export multiplier, which takes into account changes in the exchange rate, is negative.⁸

Conclusions

Subject to the limitations of the restrictive assumptions of the model,⁹ the following conclusions emerge:

1. Fiscal policy is more effective under flexible exchange rates than under fixed exchange rates because leakages through foreign trade are closed by changes in the exchange rate; an increase in spending causes income expansion and internal deficits that, through depreciation, produce further income expansion.

⁸ The validity of this conclusion depends on the argument, due to Laursen-Metzler and Harberger, that saving is a positive function of the terms of trade, an argument to which I would subscribe. If the reader prefers to assume that saving is independent of the terms of trade, the conclusions of the present paper would not be undermined, for its purpose is only to show that commercial policy cannot be relied upon to improve employment, not that more *liberal* trade policies necessarily improve employment.

⁹ See Chapter 18 for more discussion, especially the modification of my conclusion regarding the effectiveness of fiscal policy in the case where capital is mobile internationally.

2. Monetary policy is, a fortiori, more effective because the multiplier effect of the increased investment is greater, and because the reduction in capital imports induces further depreciation and income expansion.
3. Commercial policy, on the other hand, is less effective under flexible exchange rates than under fixed exchange rates and will even act in the opposite direction; more restrictive trade policies will aggravate unemployment because the multiplier effect of a change in the trade balance is dissipated by changes in the exchange rate, leaving a terms-of-trade effect with deflationary consequences.

The policy implications of these conclusions are evident: Countries with flexible exchange rates should rely more on financial policy to correct large-scale unemployment and should dispense completely with the illusion that commercial policy of a restrictive nature is likely to increase employment.¹⁰

APPENDIX

I.

The system is in equilibrium when the excess demand for home goods and services X is zero, and the balance of payments F is in equilibrium. Assuming that both X and F depend on the level of output y and the price of foreign exchange π , the system, in equilibrium, can be written symbolically as follows:

$$X(y, \pi) = 0, \quad (1)$$

$$F(y, \pi) = 0. \quad (2)$$

Differentiation of (1) and (2) yields the slopes of the home-balance schedule XX and the foreign-balance schedule FF :

$$\left(\frac{d\pi}{dy} \right)_{X=0} = - \frac{X_y}{X_\pi} \quad (3)$$

$$\left(\frac{d\pi}{dy} \right)_{F=0} = - \frac{F_y}{F_\pi} \quad (4)$$

¹⁰ Policy implications of theoretical studies need to be qualified before direct application to particular countries. In Canada two facts are especially important. One is multi-regionalism, which means that employment may not be directly correlated in different regions under a system of flexible exchange rates. (See the argument in Chapter 12.) The other factor that must be considered is the "ultrastabilizing" nature of speculation described by Rhomberg [85]; if speculative capital movements stabilize the exchange rate, the traditional conclusions may hold.

where the subscripts refer to partial differentiation of F and X with respect to the variable appearing in the subscript. Empirical and deductive reasoning shows that $X_y < 0$, $X_n > 0$, $F_y < 0$, and $F_\pi > 0$, assuming that the sum of the elasticities of demand for imports is greater than unity.

On the assumption that income rises in proportion to excess demand for goods and services, and that the exchange rate depreciates in proportion to the balance of payments deficit, the dynamic system, explaining the motion of the variables when the system is not in equilibrium, can be described as follows:

$$\frac{dy}{dt} = k_1 X(y, \pi) \quad (5)$$

$$\frac{d\pi}{dt} = -k_2 F(y, \pi) \quad (6)$$

where the k indicates the speed of the reaction. By linearizing Equations (5) and (6) in a Taylor series, and, finding the roots of the resulting characteristic equation, it is readily shown that, given the assumed signs of the partial derivatives, the condition that the slope of XX exceed the slope of FF is both necessary and sufficient for stability. This condition is a generalized version of the Laursen-Metzler stability criterion, and the Harberger condition for successful devaluation, when foreign income effects are ignored. More detailed explanation of the dynamic system taking movements of income in two countries into account can be found in the Laursen and Metzler paper [42].

II.

The simplest way to derive the effects of commercial policy, monetary policy, and fiscal policy on the equilibrium values of national output and the exchange rate is to differentiate the static equations (1) and (2) with respect to a parameter, α , introduced into these equations for purposes of analysis. The solutions are

$$\frac{dy}{d\alpha} = \frac{-(\partial X / \partial \alpha) F_\pi + (\partial F / \partial \alpha) X_\pi}{X_y F_\pi - F_y X_\pi} \quad (7)$$

$$\frac{d\pi}{d\alpha} = \frac{(\partial X / \partial \alpha) F_y - (\partial F / \partial \alpha) X_y}{X_y F_\pi - F_y X_\pi}. \quad (8)$$

The results of the text follow from appropriate substitution into the coefficients $\partial X / \partial \alpha$ and $\partial F / \partial \alpha$ of the three policies, since the sign of the denominator is given by the stability condition.

Chapter 18 / *Capital Mobility and Stabilization Policy under Fixed and Flexible Exchange Rates*¹

The world is still a closed economy, but its regions and countries are becoming increasingly open. The trend, manifested in both freer movement of goods and increased mobility of capital, has been stimulated by the dismantling of trade and exchange controls in Europe, the gradual erosion of the real burden of tariff protection, and the stability, unparalleled since 1914, of the exchange rates. The international economic climate has changed in the direction of financial integration² and this has important implications for economic policy.

My paper concerns the theoretical and practical implications of the increased mobility of capital. To present my conclusions in the simplest possible way, and to bring the implications for policy into sharpest relief, I assume the extreme degree of mobility that prevails when a country cannot maintain an interest rate different from the general level prevailing abroad. This assumption will overstate the case, but it has the merit of posing a stereotype toward which international financial relations seem to be heading. At the same time it might be argued that the assumption is not far from the truth in those financial centers of which Zurich, Amsterdam, and Brussels may be taken as examples, where the authorities already recognize their lessening ability to dominate money market conditions and insulate them from foreign influences. It should also have a high degree of relevance to a country like Canada, whose financial markets are dominated to a great degree by the vast New York market.

¹ Adapted from: *Can. Jour. Econ. Pol. Sci.*, **29**, 475–485 (Nov. 1963).

² See Ingram [27] for a valuable analysis of financial integration under fixed exchange rates, Johnson [37] for a discussion of some of the advantages of closing the exchange rate margins, Kindleberger [39], for a discussion of competition among financial centers as integration proceeds, and McLeod [53] for a theoretical discussion of related topics.

Sectoral and Market Equilibrium Conditions

The assumption of perfect capital mobility can be taken to mean that all securities in the system are perfect substitutes. Because different currencies are involved, this implies that existing exchange rates are expected to persist indefinitely (even when the exchange rate is not pegged) and that spot and forward exchange rates are identical. All the complications associated with speculation, the forward market, and exchange-rate margins are thereby assumed not to exist.

To focus attention on policies affecting the level of employment, we assume unemployed resources, constant returns to scale, and fixed money wage rates; this means that the supply of domestic output is elastic and its price level constant. We assume further that saving and taxes rise with income, that the balance of trade depends only on income and the exchange rate, that investment depends on the rate of interest, and that the demand for money depends only on income and the rate of interest. Our last assumption is that the country under consideration is too small to influence foreign incomes or the world level of interest rates.

Monetary policy will be assumed to take the form of open market purchases of securities, and *fiscal policy* the form of an increase in government spending (on home goods) financed by an increase in the public debt. Floating exchange rates result when the monetary authorities do not intervene in the exchange market, and fixed exchange rates when they intervene to buy and sell international reserves at a fixed price.

It will be helpful, in the following discussion, to bear in mind the distinction between conditions of *sectoral* and *market* equilibria (illustrated in Table 18–1). There is a set of sectoral restraints (described by the rows in the table) that show how expenditure in each sector of the open-economy is financed: A budget deficit ($G - T$) in the *government* sector is financed by an increase in the public debt or a reduction in government cash balances (dishoarding); an excess of investment over saving ($I - S$) in the *private* sector is financed by net private borrowing or a reduction in privately held money balances; a trade balance deficit ($M - X$) in the *foreign* sector³ is financed by capital imports or a reduction in international reserves; and, finally, an excess of purchases over sales of domestic assets of the banking sector is financed by an increase in the monetary liabilities of the banking system (the money supply) or by a reduction in foreign exchange reserves. For simplicity of exposition, we shall assume that there is, initially, no lending between the sectors.

There is also a set of market restraints (described by columns in the table) that refer to the condition that demand and supply of each object of exchange

³ The foreign sector refers to all the transactions of the country as a whole with respect to the outside world.

Table 18-1

Market Sector	Goods	Securities	Money	International Reserves	
Government	$T - G$	+ Government borrowing	+ Government dishoarding	+ ^{*1}	= 0
	+	+	+	+	+
Private	$S - I$	+ Private borrowing	+ Private dishoarding	+ ^{*2}	= 0
	+	+	+	+	+
Foreign	$M - X$	+ Capital outflow	+ ^{*3}	+ Increase in reserves	= 0
	+	+	+	+	+
Banking	^{*4}	+ Open market sales	+ Monetary expansion	+ Foreign exchange sales	= 0
	0	+	0	+	0
					= 0

* Negligible or ignored items: (1) would refer to Treasury holdings of foreign exchange; (2) to the nonbank public's holdings of foreign exchange; (3) to foreigners' holdings of domestic money (domestic currency is not a "key" currency); and (4) to the net contribution of the banking system to goods account. In the analysis, government dishoarding will also be assumed zero.

Note that if the entries are defined as *ex ante* or *planned* magnitudes both the horizontal and vertical sums to zero are *equilibrium conditions*, but if they are defined as *ex post* or *realized* magnitudes the sums to zero are *identities*. Note also that the rows could be disaggregated, making special distinctions between households and firms, commercial and central banks, etc., down to each individual spending unit, just as the columns could be multiplied to distinguish between different classes of goods, money, and securities.

be equal. The *goods-and-services* market is in equilibrium when the difference between investment and saving is equal to the sum of the budget surplus and the trade balance deficit. The *capital* market is in equilibrium when foreigners and domestic banks are willing to accumulate the increase in net debt of the government and the public. The *foreign exchange* market is in equilibrium when the actual increase in reserves is equal to the rate (which may be positive or negative) at which the central bank wants to buy reserves.⁴ And the *money* market is in equilibrium when the community is willing to accumulate the increase in the money supply offered by the banking system. We shall assume also that, initially, each market is in equilibrium.

⁴ For certain purposes it would be more elegant to define a separate market for foreign goods as distinct from domestic goods, but the present approach is satisfactory for the purpose on hand.

Policies under Flexible Exchange Rates

Under flexible exchange rates the central bank does not intervene to fix a given exchange rate, although this need not preclude autonomous purchases and sales of foreign exchange.

MONETARY POLICY

Consider the effect of an open market purchase of domestic securities in the context of a flexible-exchange-rate system. This results in an increase in bank reserves, a multiple expansion of money and credit, and downward pressure on the rate of interest. But the interest rate is prevented from falling by an outflow of capital, which causes a deficit in the balance of payments, and a depreciation of the exchange rate. In turn, the exchange-rate depreciation (normally) improves the balance of trade and stimulates, by the multiplier process, income and employment. A new equilibrium is established when income has risen sufficiently to induce the domestic community to hold the increased stock of money created by the banking system. Because interest rates are unaltered, this means that income must rise in proportion to the increase in the money supply, the factor of proportionality being the given ratio of income and money (income velocity).

In the new equilibrium private saving and taxes will have increased as a consequence of the increase in income, and this implies both net private lending and retirement of government debt. Equilibrium in the capital market then requires equality between the sum of the net private lending plus debt retirement, and the rate of capital exports, which in conjunction with the requirement of balance-of-payments equilibrium, implies a balance of trade surplus. Monetary policy therefore has a strong effect on the level of income and employment, not because it alters the rate of interest, but because it induces a capital outflow, depreciates the exchange rate, and causes an export surplus.⁵

It will now be shown that central bank operations in the foreign exchange market (“open market operations” in foreign exchange) can be considered an alternative form of monetary policy. Suppose the central bank buys foreign reserves (gold or foreign currency) with domestic money. This increases bank reserves, causing a multiple expansion of the money supply. The monetary expansion puts downward pressure on the interest rate and induces a capital outflow, further depreciating the exchange rate and creating an export surplus, which in turn increases, through the multiplier effect, income, and employment. Eventually, when income has increased sufficiently to induce the community to hold the increased stock of money, the income-generating process ceases and all sectors are again in equilibrium, with the increased

⁵ Caves has arrived at essentially the same result [6].

saving and taxes financing the capital outflow. This conclusion is virtually the same as the conclusion earlier reached regarding monetary policy, with the single important difference that *foreign* assets of the banks are increased in the case of foreign exchange policy while *domestic* assets are increased in the case of monetary policy. Foreign exchange policy, like monetary policy, becomes a forceful tool of stabilization policy under flexible exchange rates.

FISCAL POLICY

Assume an increase in government spending financed by government borrowing. The increased spending creates an excess demand for goods and tends to raise income. But this would increase the demand for money, raise interest rates, attract a capital inflow, and appreciate the exchange rate, which in turn would have a depressing effect on income. In fact, therefore, the negative effect on income of exchange-rate appreciation has to offset exactly the positive multiplier effect on income of the original increase in government spending. Income cannot change unless the money supply or interest rates change, and because the former is constant in the absence of central bank action and the latter is fixed by the world level of interest rates, income remains fixed. Since income is constant, saving and taxes are unchanged, which means, because of the condition that the goods market be in equilibrium, that the change in government spending is equal to the import surplus. In turn, the flexible exchange rate implies balance-of-payments equilibrium and therefore a capital inflow equal to the import surplus. Thus, both capital and goods market equilibria are assured by equality between the rate of increase in the public debt and the rate of capital imports, and between the budget deficit and the import surplus. Fiscal policy thus completely loses its force as a domestic stabilizer when the exchange rate is allowed to fluctuate and the money supply is held constant. Just as monetary policy derives its importance as a domestic stabilizer from its influence on capital flows and the exchange rate, so fiscal policy is frustrated in its effects by these same considerations.

Policies under Fixed Exchange Rates

Under fixed exchange rates the central bank intervenes in the exchange market by buying and selling reserves at the exchange parity; as already noted the exchange margins are assumed to be zero.

MONETARY POLICY

A central bank purchase of securities creates excess reserves and puts downward pressure on the interest rate. But a fall in the interest rate is prevented by a capital outflow, and this worsens the balance of payments. To prevent the exchange rate from falling, the central bank intervenes in the market, selling foreign exchange and buying domestic money. The process continues until

the accumulated foreign exchange deficit is equal to the open market purchase and the money supply is restored to its original level.

This shows that monetary policy under fixed exchange rates has no sustainable effect on the level of income. The increase in the money supply arising from open market purchases is returned to the central bank through its exchange stabilization operations. What the central bank has in fact done is to purchase securities initially for money, and then buy money with foreign exchange, the monetary effects of the combined operations canceling. The only final effect of the open market purchase is an equivalent fall in foreign exchange reserves: The central bank has simply traded domestic assets for foreign assets.

FISCAL POLICY

Assume an increase in government spending superimposed on the foreign exchange policy of pegging the exchange rate. The increased spending has a multiplier effect upon income, increasing saving, taxes, and imports. Taxes increase by less than the increase in government spending, so the government supplies securities at a rate equal to the budget deficit, whereas the private sector absorbs securities at a rate equal to the increase in saving.

After the new equilibrium is established, both the goods and capital markets must be in balance. In the goods market the budget deficit has as its counterpart the sum of the excess private saving over investment and the balance-of-trade deficit, which implies that the induced balance-of-trade deficit is less than the budget deficit. In the capital market the private and foreign sectors must be willing to accumulate the new flow of government issues. But, because the excess private saving is equal to the flow of private lending, and because the budget deficit equals the flow of new government issues, capital market equilibrium requires that the import deficit be exactly balanced by a capital inflow, so that there is balance-of-payments equilibrium after all adjustments have taken place.

There will nevertheless be a change in foreign exchange reserves. Before the flow equilibrium is established the demand for money will increase, at a constant interest rate, in proportion to the increase in income. To acquire the needed liquidity the private sector sells securities and this puts upward pressure on the interest rate and attracts foreign capital. This improves the balance of payments temporarily, forcing the central bank to intervene by buying foreign reserves and increasing the money supply. The money supply is therefore increased indirectly through the back door of exchange rate policy. Foreign exchange reserves accumulate by the full amount of the increased cash reserves needed by the banking system to supply the increased money demanded by the public as a consequence of the increase in income.

Other Policy Combinations

Other cases deserve attention in view of their prominence in policy discussion. In the following cases it is assumed that exchange rates are fixed.

DEFICIT FINANCE

An important special case of combined operations of monetary, fiscal, and exchange policies is central bank financing of budget deficits (deficit finance) under fixed exchange rates. As before, the increase in government spending yields a multiplier effect on income. In the new equilibrium there is a budget deficit, an excess of saving over investment, and a balance-of-trade deficit. The government issues securities at a rate equal to the budget deficit and these are (by assumption) taken up by the central bank. Capital market equilibrium therefore requires that the net flow demand for securities on the part of the private sector be equal to the net capital outflow.

It is easy to see that in the new equilibrium the balance-of-payments deficit and the consequent rate at which reserves are falling is exactly equal to the budget deficit and to the rate at which the central bank is buying government securities. Because the capital outflow is equal to the excess of saving over investment, and the loss of reserves is equal to the balance-of-payments deficit, which is the sum of the trade deficit and the capital outflow, reserves fall at a rate equal to the sum of the import deficit and the excess of saving over investment. Then because this sum equals the budget deficit, by the condition of equilibrium in the goods market, it follows that reserves fall at a rate equal to the budget deficit. The budget is entirely at the expense of reserves.

There is, however, in this instance, too, an initial stock-adjustment process. As income increases the demand for money grows, and the private sector dispenses with stocks of securities, causing a capital inflow and an increase in reserves. This increase in reserves is a once-and-for-all inflow equal to the increase in cash reserves necessary for the banks to satisfy the increased demand for money. The rate of fall in reserves takes place, therefore, from a higher initial level.

THE NONVIABILITY OF STERILIZATION OPERATIONS

Sterilization (or neutralization) policy is a specific combination of monetary and exchange policy. When the central bank buys or sells foreign exchange the money supply increases or decreases. The purpose of sterilization policy is to offset this effect. The mechanism is for the central bank to sell securities at the same rate that it is buying foreign exchange, and to buy securities at the same rate that it is selling foreign exchange. In reality, therefore, neutralization policy involves an exchange of foreign reserves and bonds. The exchange rate is stabilized by buying and selling reserves in exchange for securities.

Suppose the government increases spending during a time when neutralization policy is being followed. The increase in spending would normally have a multiplier effect on income. But this would increase the demand for money and put upward pressure on interest rates as the private sector dispenses with holdings of securities; this would cause a capital inflow and induce a balance-of-payments surplus. But now the authorities, in their rate-pegging operation, buy foreign exchange and simultaneously sell securities, thus putting added pressure on interest rates and accelerating the inflow of capital without satisfying the increased demand for money. The system has now become inconsistent, for goods market equilibrium requires an increase in income, but an increase in income can take place only if either the money supply expands or interest rates rise. The capital inflow prevents interest rates from rising and the neutralization policy inhibits the money supply from expanding. Something has to give, and it must either be the money supply or the exchange rate. If the central bank sells securities at the same rate as it is buying reserves, it cannot buy reserves at a rate fast enough to keep the exchange rate from appreciating. And if the central bank buys reserves at a rate fast enough to stabilize the exchange rate, it cannot sell securities fast enough to keep the money supply constant. Either the exchange rate appreciates or money income rises.

In a similar way it can be shown that, from an initial position of equilibrium, open market operations (monetary policy) lead to an inconsistent and overdetermined result. A purchase of securities by the central bank would cause a capital outflow, balance-of-payments deficit, and sales of foreign exchange by the central bank. The restrictive monetary impact of the foreign exchange sales are then offset by further open market purchases that induce further sales of foreign exchange. The process repeats itself at an accelerating speed. There is no new equilibrium because the public wants to hold just so much money, and the central bank's attempt to alter this equilibrium simply results in a fall in reserves. The sterilization procedures merely perpetuate the self-generating process until exchange reserves are exhausted, or until the world level of interest rates falls.

Diagrammatic Illustration

These results can be illustrated by diagrams similar to those I have used for analysis of related problems.⁶ In the top quadrant of both Figures 18–1

⁶ See the preceding chapters. In Chapter 17 the main purpose was to show that commercial policy—import restriction or export promotion—was ineffective under flexible exchange rates. It was also argued that *both* monetary and fiscal policies are more effective under flexible exchange rates than under fixed exchange rates. The apparent conflict with the present analysis lies in the different definition of monetary and fiscal policy and in the extreme assumption in the present paper of perfect capital mobility. In Chapters 16 and 17 fiscal policy was taken to be an increase in government spending with interest

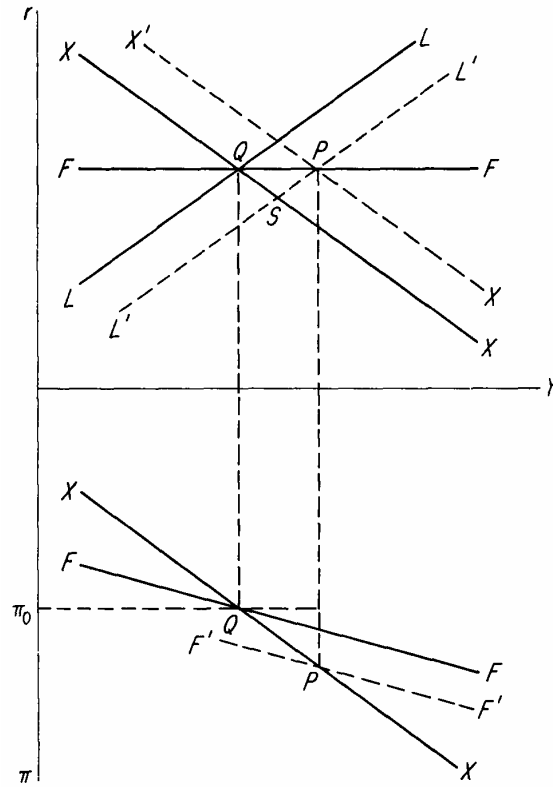


Figure 18-1. Monetary Policy.

rates maintained constant by the central bank, while capital inflows were assumed to be a function of the rate of interest alone; in other words, no capital inflow takes place (because the domestic interest rate is constant) while the money supply is allowed to expand in proportion to the increase in income induced by the more expansive fiscal policy. In the present chapter we have defined fiscal policy as an increase in government spending financed by government bond issues with *no* change in the money supply. In both cases the underlying model is (in essence) the same and would yield the same results if the same assumptions were made about capital mobility and the same definitions were used.

It may puzzle the reader why I went to some length to alter the definitions of monetary and fiscal policy and thus to bring about a seemingly artificial difference between the conclusions based purely upon different definitions. The reason is that monetary policy cannot in any meaningful sense be defined as an alteration in the interest rate when capital is perfectly mobile, because the authorities cannot change the market rate of interest. Nor can monetary policy be defined, under conditions of perfect capital mobility, as an increase in the money supply, since the central bank has no power over the money supply either (except in transitory positions of disequilibrium) when the exchange rate is fixed. The central bank has, on the other hand, the ability to conduct an open market operation (which only temporarily changes the money supply) and that is the basis of my choice of this definition of monetary policy for the present analysis.

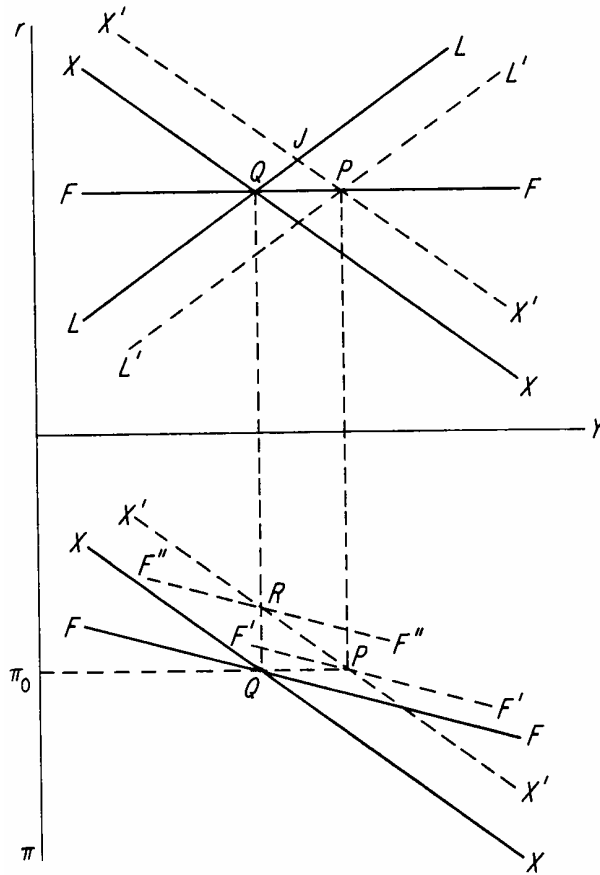


Figure 18-2. Fiscal Policy.

and 18-2, XX plots the relation between the interest rate and income (given the exchange rate) along which there is no excess demand in the goods-and-services market (internal balance); LL describes a similar relation for the money market; and FF gives the external-balance condition that is dominated by the world level of interest rates. Analogously in the bottom quadrants, XX plots internal balance and FF external balance as functions of income and the exchange rate. The internal-balance line in the top quadrant applies only for the given exchange rate represented by π_0 in the bottom quadrant, and the external-balance schedule in the bottom quadrant applies only for the initial rate of capital imports (assumed to be zero).

Consider the effects of monetary policy (Figure 18-1). From Q an increase in the money supply shifts LL in the upper quadrant to LL' , implying at the original interest rate and income level (at Q) excess liquidity; this causes a

capital outflow. Under flexible exchange rates FF in the lower quadrant shifts downward to $F'F'$, and the improvement in the trade balance increases income and employment as XX in the top quadrant is pushed by the devaluation toward $X'X'$. The new equilibrium is at P , with an improved trade balance and greater capital outflow (or lessened inflow).

With the exchange rate fixed at π_0 , however, the increase in the money supply merely creates excess liquidity, an export of capital, a balance-of-payments deficit, and a reduction in the money supply with no shift in XX in the top quadrant. The line $L'L'$ returns to its original position and Q is restored as equilibrium at a lower level of reserves; Q is the only possible equilibrium consistent with both FF and XX , so the money supply will adapt to it if it is allowed to. But if the increase in the money supply is accompanied by *sterilization* operations, that is, if $L'L'$ is maintained, there can be no equilibrium. The central bank buys securities, gold flows out, and the central bank buys more securities. Because the exchange rate is maintained at π_0 , XX in the top quadrant is unaffected, as is FF . The attempt of the central bank to maintain $L'L'$ cannot satisfy both the conditions that the interest rate remain at the world level and that the new equilibrium be on XX . Either the exchange rate must change (shifting XX to $X'X'$) or the attempt to maintain $L'L'$ by sterilization operations must be abandoned.

Consider next the case of fiscal policy (Figure 18–2). An increase in government spending shifts XX to $X'X'$ in both quadrants. At the fixed exchange rate π_0 this increases income and increases the demand for money. Interest rates tend to rise, capital is attracted from abroad, the balance of payments improves, and the money supply increases, eventually establishing $L'L'$ as the new money curve. After this instantaneous “stock adjustment,” process capital is attracted from abroad sufficiently to establish $F'F'$ as the new foreign balance line, with the equilibrium P in both quadrants.

Under flexible rates, however, the money supply remains constant. The increased spending puts upward pressure on interest rates and appreciates the exchange rate. FF therefore shifts to $F''F''$, establishing R as the new equilibrium. At R the price of foreign exchange is lower but output and employment are unchanged.

Again, if the exchange rate is fixed *and* the authorities attempt to sterilize the initial gold inflow, one of the policies must fail, because the new equilibrium (P) on FF and $X'X'$ in the upper quadrant is consistent only if the money supply is allowed to expand. Obviously, the points J and P cannot be maintained simultaneously.

Certain qualifications or extensions to the analysis should be mentioned. The demand for money is likely to depend upon the exchange rate in addition to the interest rate and the level of income; this would reduce the effectiveness of a given change in the quantity of money, and increase the effectiveness of fiscal policy on income and employment under flexible exchange rates, while, of course, it has no significance in the case of fixed exchange rates.

Another possible influence is the real balance effect, but this cannot alter in any essential way the final result: Income rises, under flexible exchange rates, in proportion to the increase in the money supply, whereas income remains unchanged, in the case of fixed exchange rates, because the quantity of money does not increase.

A further factor that might be considered is the negative effect of changes in the exchange rate upon the level of saving. Again there is no important alteration in the results: Although the budget deficit arising from increased government spending under flexible exchange rates is then partly financed by an increase in saving of the private sector, the conclusions regarding changes in the level of output and employment are unaltered.

The conclusions, of course, have not made any allowance for growth. Because of growth, the money supply will normally be increased at a rate more or less commensurate with the growth of the economy; my conclusions are, so to speak, superimposed on the growth situation. Moreover, many of our actual observations about the economic world are observations of disequilibrium positions; it is clearly possible to alter the money supply (under fixed exchange rates) if there is excess or deficient liquidity, although even this is in practice unnecessary since we can be assured, as we were as long ago as the days of Ricardo, that the money supply will automatically settle down to its equilibrium level. In any case these observations do not vitiate the principles we have been trying to elucidate.

Conclusions

We have demonstrated that perfect capital mobility implies different concepts of stabilization policy from those to which we have become accustomed in the post-World War II period. Monetary policy has no impact on employment under fixed exchange rates, whereas fiscal policy has no effect on employment under flexible exchange rates. On the other hand, fiscal policy can have an effect on employment under fixed exchange rates (if the Keynesian model is valid), whereas monetary policy has a strong effect on employment under flexible exchange rates (classical quantity theory conclusions hold).

Another implication of the analysis is that monetary policy under fixed exchange rates becomes a device for altering the levels of reserves, whereas fiscal policy under flexible exchange rates becomes a device for altering the balance of trade, both policies leaving unaffected the level of output and employment. Under fixed exchange rates, open market operations by the central bank result in equal changes in the gold stock, open market purchases causing it to decline and open market sales causing it to increase. And under flexible exchange rates, budget deficits or surpluses induced by changes in taxes or government spending cause corresponding changes in the trade balance.

Gold sterilization policies make no sense in a world of fixed exchange rates

and perfect capital mobility and will ultimately lead to the breakdown of the fixed exchange system. In the absence of gold sterilization, as we have seen, an attempt of the central bank to alter the money supply is frustrated by capital outflows and automatically offsetting monetary changes through the exchange equalization operations; this is running water into a sink that is filled to the brim, causing the water to spill over the edges at the same rate that it is coming out of the tap.⁷ But sterilization operations are analogous to trying to prevent the water from spilling out, even though the sink is full and water is still pouring out of the tap.

If my assumptions about capital mobility were valid in Canada,⁸ it would mean that expansive fiscal policy under flexible exchange rates was of little help in increasing employment because of the ensuing inflow of capital, which kept the exchange rate high and induced a balance of trade deficit: We should have observed a zero or very small multiplier. By the same token, now that Canada has adopted a fixed exchange system, we should not reason from earlier negative experience about the size of the multiplier and conclude that the multiplier is *now* low: Although a reduction in the budget deficit under flexible rates would have helped the trade balance without too much damage to employment, a reduction in the budget deficit today could be expected to have a sizable impact on excess demand and unemployment.

Of course, the assumption of perfect capital mobility is not literally valid; my conclusions are black and white rather than dark and light grey. To the extent that Canada can maintain an interest-rate equilibrium different from that of the United States, without strong capital inflows, fiscal expansion can be expected to play *some* role in employment policy under flexible exchange rates, and monetary policy can have *some* influence on employment and output under fixed exchange rates. But if this possibility exists for us today, we can conjecture that it will exist to a lesser extent in the future.

APPENDIX

*The World Economy*⁹

A World Model

This chapter has analyzed the effect of stabilization policies on employment and income in an economy that is assumed to be small in relation to the rest of the world. The purpose of this appendix is to generalize the results by

⁷ John Exter has used a reservoir simile [13].

⁸ See the accounts of the Canadian experience by Barber [3] and Johnson [36].

⁹ Adapted from: *Can. Jour. Econ. Pol. Sci.* **30**, 421–431 (Aug. 1964).

taking into account repercussion effects and altering the assumption that the country pursuing the policy is small. The primary complication this involves is that world interest rates may no longer be taken as given. This complication can best be introduced in the context of a mathematical model of the world economy.

For simplicity we assume that the level of external reserves in the world as a whole is constant. We shall also include government spending and taxing under “investment” and “saving.” The last simplification of course entails no important loss of generality, whereas the first is readily modified.

The following notation is used:

y = income	L = demand for money
I = investment	R = foreign exchange reserves
S = saving	r = interest rate
B = balance of trade	π = foreign exchange rate
M = money supply	W = world reserves
D = domestic assets of the banking system	

This notation will be used both for the home country, represented without superscript, and, for the rest of the world, denoted by a superscript. (The exchange rate π is defined as the price of a unit of the home currency in terms of foreign currency with $\pi = 1$ initially by appropriate choice of units.)

We can now write seven equations expressing the system in a world context. First, we have two equations specifying that the flow market for goods and services in each country is in equilibrium:

$$I(r) + \bar{I} - S(y) + B(y, y', \pi) = 0. \quad (1)$$

This condition ensures that the current supply of goods and services equals the current demand, where \bar{I} is a parameter representing an autonomous element in the investment schedule, separated for purposes of analysis:

$$I'(r) - S'(y') - B(y, y', \pi) = 0. \quad (2)$$

This equation is analogous to (1) except that it refers to equilibrium in the market for current production in the rest of the world, its balance of trade being equal, but opposite in sign, to the balance of trade of the home country. Note that the interest rates at home and abroad are assumed to be equal because of our assumption that capital markets are integrated.

The next two equations ensure that the demand for money is equal to the supply of money in each country:

$$M = L(r, y). \quad (3)$$

$$M' = L'(r, y'). \quad (4)$$

where the demand for money, L , is assumed to depend upon the interest rate and domestic income.

The next two equations specify the identity between assets and liabilities of the monetary sector [assets are distinguished as between foreign (R) and domestic (D) claims]:

$$M = \bar{D} + R. \quad (5)$$

\bar{D} is taken as a policy-determined parameter:

$$M' = \bar{D}' + R'. \quad (6)$$

This equation is analogous to (5).

The last equation fixes the level of reserves in the world:

$$R + R' = \bar{W}. \quad (7)$$

\bar{W} is the level of world reserves, assumed to be constant.

These seven equations contain eight unknowns: r , y , y' , π , R , R' , M , and M' ; and four parameters: \bar{I} , \bar{D} , \bar{D}' , and \bar{W} . When π is specified, as in the fixed-exchange-rate system, or when one of the R 's is known, as in the flexible-exchange-rate system, the results become determinate.

Fixed Exchange Rates and Relative Size

Let us first analyze the fixed-exchange-rate system. M , M' , and R' can be eliminated from the system and equations (5 to 7) dropped. Differentiation of the remaining four equations with $d\pi = 0$ (because the exchange rate is fixed) results in

$$\begin{bmatrix} -(s+m) & m' & I_r & 0 \\ m & -(s'+m') & I_r' & 0 \\ L_y & 0 & L_r & -1 \\ 0 & L_y' & L_r' & 1 \end{bmatrix} \begin{bmatrix} dy \\ dy' \\ dr \\ dR \end{bmatrix} = \begin{bmatrix} -d\bar{I} \\ 0 \\ d\bar{D} \\ 0 \end{bmatrix}$$

where s , s' , m , and m' are the marginal propensities to save and import at home and abroad, and I_r , I_r' , L_y , L_y' , L_r , and L_r' are the partial derivatives of investment and the demand for money with respect to the variable appearing in the subscript. We can assume $d\bar{I}' = d\bar{D}' = 0$.

Our primary interest is in the effect of a change in investment (or government spending) ($d\bar{I}$) and an open market operation ($d\bar{D}$) on the equilibrium

levels of income at home and abroad. The solutions for dy/dI , dy'/dI , $dy'/d\bar{D}$ and $dy/d\bar{D}$ are as follows:

$$\frac{dy}{d\bar{I}} = \frac{(s'+m')(L_r + L'_r) + I'_r L'_y}{\Delta_1} \quad \frac{dy}{d\bar{D}} = \frac{m'(I_r + I'_r) + s' I_r}{\Delta_1}$$

$$\frac{dy'}{d\bar{I}} = \frac{m(L_r + L'_r) - L'_y I'_r}{\Delta_1} \quad \frac{dy'}{d\bar{D}} = \frac{m(I_r + I'_r) + s I'_r}{\Delta_1}$$

where

$$\Delta_1 \equiv \begin{vmatrix} -(s+m) & m' & I_r & 0 \\ m & -(s'+m') & I'_r & 0 \\ L_y & 0 & L_r & -1 \\ 0 & L'_y & L'_r & 1 \end{vmatrix} < 0$$

assuming the usual signs of the partial derivations: $s > 0$, $m > 0$, $L_y > 0$, $L_r < 0$, etc. It then follows that

$$\frac{dy}{dI} > 0 \quad \frac{dy}{dD} > 0$$

$$\frac{dy'}{dI} < 0 \quad \frac{dy'}{dD} > 0.$$

In other words, an increase in investment or government spending increases income at home, but may increase or decrease income abroad; whereas an open market purchase at home necessarily increases both income at home and income abroad.

The results are, perhaps, surprising. According to traditional theory a boom in one country is normally transmitted abroad, under fixed exchange rates, through the international multiplier. But the above result shows that an increase in investment or government spending at home increases income at home but may either increase or decrease income abroad.¹⁰

The difference in results is due to capital mobility and allowance for the income-specie-flow international-adjustment mechanism. Expansion at home causes higher income, increased imports, tighter money-market conditions, and a capital inflow. The exports of the rest of the world rise with an expansionary effect, but there is an offset because of higher interest rates and

¹⁰ The reader can verify that this possibility is not ruled out by the conditions of dynamic stability under the postulates that incomes move in proportion to excess demands and that world interest rates rise in proportion to the excess world demand for money.

reduced investment spending; the final result depends upon which effect is greater. In general, it can be said that the more money that is released from idle balances due to the higher interest rates, the less money that is demanded at home as income expands, the smaller is the effect of higher interest rates on investment; and the lower is the home propensity to import, the less likely it is that income in the rest of the world will fall. But it cannot be asserted that expansionary fiscal policies at home tend to raise income in the rest of the world under fixed exchange rates when capital is mobile, or that booms and depressions are necessarily transmitted from one country to another.

The analysis of open market operations appears to conflict with the results of the previous discussion. But here the question of size becomes important. An expansionary monetary policy at home brings about some reduction in interest rates throughout the world. But, if the country is very small, the only important effect of the monetary policy on domestic income is through its prior effect upon foreign income. In the expression for $dy/d\bar{D}$ the term I_r becomes negligible in relation to I'_r as the home country becomes insignificant in size in relation to the rest of the world. Monetary policy quickly becomes generalized in its effect: A \$1 open market purchase in a small country has the same effect on the world money supply and world investment as a \$1 open market purchase in a large country. This means that the stabilization effect of monetary policy in a small country depends upon its impact on income in the rest of the world; and if the marginal propensity to import abroad is proportionately slight, such a policy would quickly run into the practical limitation that exchange reserves are not inexhaustible.

Flexible Exchange Rates and Relative Size

Let us now analyze the flexible exchange system. If we eliminate M and M' from the system of equations (1) to (7) and hold \bar{D}' , \bar{R} , and \bar{R}' constant, we get, after differentiation, the following expression:

$$\begin{bmatrix} -(s+m) & m' & I_r & B_\pi \\ m & -(s'+m') & I'_r & -B_\pi \\ L_y & 0 & L_r & 0 \\ 0 & L'_y & L'_r & 0 \end{bmatrix} \begin{bmatrix} dy \\ dy' \\ dr \\ d\pi \end{bmatrix} = \begin{bmatrix} -d\bar{I} \\ 0 \\ d\bar{D} \\ 0 \end{bmatrix}$$

where B_π is the change in the home country's balance of trade due to an appreciation of its currency; with the sum of the import demand elasticities exceeding unity this term is negative.

The solutions of concern to us are the following:

$$\frac{dy}{d\bar{I}} = \frac{L'_y L_r}{\Delta_2} \quad \frac{dy}{d\bar{D}} = \frac{s' L_r + L'_y (I_r + I'_r)}{\Delta_2}$$

$$\frac{dy'}{d\bar{I}} = \frac{L_y L'_r}{\Delta_2} \quad \frac{dy'}{d\bar{D}} = \frac{-s L'_r}{\Delta_2}$$

where

$$\Delta_2 = -\frac{1}{B_\pi} \begin{vmatrix} -(s+m) & m' & I_r & B_\pi \\ m & -(s'+m') & I'_r & -B_\pi \\ L_y & 0 & L_r & 0 \\ 0 & L'_y & L'_r & 0 \end{vmatrix} < 0.$$

It follows that

$$\frac{dy}{d\bar{I}} > 0 \quad \frac{dy}{d\bar{D}} > 0$$

$$\frac{dy'}{d\bar{I}} > 0 \quad \frac{dy'}{d\bar{D}} < 0$$

In other words, expansive fiscal policy (or investment) increases income both at home and abroad, whereas monetary expansion increases it at home and decreases it abroad.

Once again these conclusions contain surprises. According to traditional theory, an investment boom in one country is not transmitted abroad under flexible exchange rates. My results show that there is a transmission mechanism at work when capital is mobile. The traditional theory, that expansion in one country causes an increase in imports, currency depreciation, and no change in the trade balance, is crucially dependent upon the assumption of capital immobility. But when capital is mobile, and account is taken of the monetary system, an expansion of investment will put pressure on the money and capital markets, increase interest rates, attract foreign capital, and appreciate (or ameliorate the depreciation of) the domestic currency. It cannot, therefore, be asserted that a country is automatically immunized by its flexible exchange rate from business cycle disturbances originating abroad.

These results can be related to the conclusion of my previous discussion. I argued that fiscal policy would have no effect upon domestic income when capital is mobile and the exchange rate is flexible. The conclusion is valid if the country is a small one; for in that case, the term L_r in the expression for $dy/d\bar{I}$ is negligible in relation to the other terms. This may also be seen by

converting the expression $dy/d\bar{I}$ (which is dimensionless) into one based entirely on magnitudes which are dimensionless:

$$S + \frac{S'\eta_y\eta_r'}{\alpha\eta_y'\eta_r'} + \frac{\eta_y}{\alpha\eta_r} (\varepsilon\alpha\sigma + \varepsilon'\sigma') \frac{dy}{d\bar{I}} = \frac{\alpha\eta_y'\eta_r}{\alpha s\eta_r\eta_y' + s'\eta_y\eta_r' + \eta_y\eta_y'(\varepsilon\alpha\sigma + \varepsilon'\sigma')}$$

where η_y = income elasticity of demand for money
 η_r = interest elasticity of demand for money
 ε = interest elasticity of investment
 σ = share of investment in income
 α = ratio of home income to foreign income

with primed terms denoting similar relations in the rest of the world. As the home country (hypothetically) becomes smaller in relation to the rest of the world $\alpha \rightarrow 0$; and as $\alpha \rightarrow 0$, $dy/d\bar{I} \rightarrow 0$. This verifies our conclusion that a very small country will find fiscal policy useless for income-stabilization purposes under flexible rates and capital mobility.

There is an interesting counterpart to this, however, in the impact of a small country's domestic fiscal policy upon the rest of the world. Putting the expression for $dy'/d\bar{I}$ into a dimensionless form we have

$$\frac{dy'}{d\bar{I}} = \frac{1}{s' + (\eta_y'/\eta_r') \{ \alpha [s(\eta_r/\eta_y) + \varepsilon\sigma] + \varepsilon'\sigma' \}}.$$

As $\alpha \rightarrow 0$,

$$\frac{dy'}{d\bar{I}} = \frac{1}{s' + (\eta_y'/\eta_r')\varepsilon'\sigma'},$$

the closed economy multiplier (with a monetary constraint) in the rest of the world. *The major employment-creating effects of fiscal policy in a small country accrue to the rest of the world!*

Fiscal policy in a large country, however, can be effective for a domestic stabilization. This is seen by making α progressively larger. As a $\alpha \rightarrow \infty$,

$$\frac{dy}{d\bar{I}} \rightarrow \frac{1}{s + (\eta_r/\eta_y)\varepsilon\sigma}. \quad \text{and} \quad \frac{dy'}{d\bar{I}} \rightarrow 0.$$

In other words, if a large country engages in fiscal policy the bulk of the expansionary effects accrue to it and very little spills over to benefit the rest of the world, the exact opposite of the situation for a small country.

The combined results may be conveniently summarized by noting that the ratio of the two multipliers, $dy/d\bar{I}$ and $dy'/d\bar{I}$, is simply

$$\frac{dy/d\bar{I}}{dy'/d\bar{I}} = \alpha \frac{\eta_r/\eta_y}{\eta_r'/\eta_y'}.$$

If it is assumed that income and interest elasticities of demand for money are similar in magnitude (and there is no reason to expect them to be affected in any important way by size per se), the ratio of the multipliers reduces to the ratio of incomes.

Turning to monetary policy, it may be noted that an open market purchase raises income at home and lowers income abroad, and for this reason it is sometimes assailed as a beggar-my-neighbor policy. However, unless there is a substantial difference between the marginal propensities to save in the two countries, the additional income created in the expanding country exceeds the loss of income to the rest of the world.

Further insight into the effect of monetary policy is given by a consideration of the size of the home country relative to the rest of the world. In the previous discussion we concluded that an open market purchase in a small country results in a proportionate increase in income, the factor of proportionality being income velocity. That this is true when the rest of the world is taken into account is seen by rewriting the expression for dy/dD in the following form:

$$\frac{dy}{dD} = \frac{1}{L_y} \frac{s'\eta'_r + \eta'_y(\alpha\varepsilon\sigma + \varepsilon'\sigma')}{s\eta'_r + \eta'_y(\alpha\varepsilon\sigma + \varepsilon'\sigma') + \alpha s\eta_r(\eta'_y/\eta_y)}$$

It follows that when α , the ratio of the outputs, approaches zero, the expression for $dy/d\bar{D}$ approaches $1/L_y$, the “marginal” income velocity. When the country is small it gets the maximum benefit from monetary policy, and the depressing effect on the rest of the world is correspondingly greatest. The analogous expression for the rest of the world is

$$\frac{dy'}{d\bar{D}} = \frac{1}{L_y} \frac{s\eta'_r\eta_y}{\alpha s\eta_r\eta'_y + s'\eta'_r\eta_y + \eta_y\eta'_y(\alpha\varepsilon\sigma + \varepsilon'\sigma')}$$

and it is easy to see that a reduction α raises the absolute value of $dy'/d\bar{D}$.

The corollary of this is that as the home country becomes large relative to the foreign country, monetary policy has a smaller influence on home income and a correspondingly weaker depressing effect upon foreign income. From the above expressions it is clear that as α becomes very large, the negative effect upon foreign income approaches zero, while the positive effect upon domestic income is reduced from $1/L_y$ to

$$\frac{1}{L_y} \frac{1}{1 + (s/\varepsilon\sigma)(\eta_r/\eta_y)}$$

as $\alpha \rightarrow \infty$.

The International Transmission of Cycles

The conclusions of this chapter must be interpreted as special cases of the present results. Specifically:

1. When a country is small and repercussion effects are ignored, fiscal policy under fixed exchange rates has a normal Keynesian effect upon employment. When the rest of the world is taken into account, the results hold except that allowance must be made for a dampening effect of an increase in the world level of interest rates, which could have the effect of lowering income abroad. A corollary of this is that business cycles at home may or may not be transmitted abroad when full account is taken of the monetary mechanism of balance-of-payments adjustment.
2. Monetary policy in a small country would have no impact upon employment when repercussion effects are ignored because of the automatic and equal loss of foreign exchange reserves; open market operations would not alter the domestic money supply. However, when account is taken of behavior in the rest of the world, some influence on domestic income must remain, because the world level of interest rates falls. But even for a small country the major effect of the monetary policy on employment will come about through interactions with the rest of the world. Monetary expansion gets quickly generalized and a small country only gets a proportionately small share in the benefits from world monetary expansion.
3. Fiscal policy in a small country has no effect upon employment when the exchange rate is flexible; this conclusion remains valid when interactions with the rest of the world are brought into account. It does not hold, however, for large countries. An interesting conclusion is that fiscal policy in a small country has no effect upon income at home, but it has an ordinary multiplier effect on income in the rest of the world. Conversely, fiscal policy in a large country has a large effect upon employment at home but a negligible influence upon employment in the rest of the world. The ratio of the multipliers, in fact, conforms closely to the ratio of the incomes, unless considerable disparities exist between income and interest elasticities of demand for money in the two countries.
4. Under flexible exchange rates monetary policy in a small country would have a "classical" effect upon income in the sense that income increases in proportion to the open market operation. A corollary of this is that it also has a considerable influence in the opposite direction on foreign income. But as the size of the country is made (hypothetically) large relative to the rest of the world, the high degree of effectiveness of monetary policy is diminished, and so is its opposite impact on the rest of the world.

Concluding Remarks

It is hardly necessary to say that the conclusions of this chapter and appendix are subject, as always, to the limitations of the model from which they have been derived. I trust the logic is correct and that the assumption set implies the solution set. But applicability of the model to practical policy is a jump, and can only be made, responsibly, after due account is taken of the host of details that apply in any actual situation. I have already mentioned above the importance of the polar assumption of capital mobility. It should also be apparent that the analysis is short-run in character and this neglects long-run consideration of changes in the capital stock and the level of indebtedness. There is another consideration, however, that deserves more explicit mention.

This consideration refers to the definition of income used in the savings and import functions of each country. A capital flow from one country to another reduces “disposable” income in one country and increases it in the other country, giving rise to expenditure effects of the Ohlin-type discussed in Chapter 2 of this book.

These direct expenditure effects mean that the rate of lending will directly affect the balance of trade, thereby reducing the initial disequilibrium created by a capital flow and limiting the need for residual corrective adjustments in the money supplies and employment levels or exchange rates of the two countries.

The theoretical implication of taking account of these direct expenditure effects is to reduce the impact on employment of fiscal policy under fixed exchange rates as compared to the situation applying when these effects are absent. The conclusion that monetary policy is relatively ineffective under fixed exchange rates, as compared to flexible exchange rates, remains valid, but fiscal policy under both fixed and flexible exchange rates, for a small country, becomes a weaker means of achieving alterations in the level of output.

The incorporation of these expenditure effects into the Keynesian international trade model is important theoretically because it illustrates, more powerfully than is implied by my original 1963 article, the similarity between the conclusions reached by classical and Keynesian methods, when all relevant effects have been incorporated. For a small country fiscal policy, under either fixed or flexible exchange rates, alters the balance of trade but does not necessarily improve the level of output and employment. Monetary policy under a system of fixed exchange rates becomes a means of altering the level of reserves of a (small) country, whereas monetary policy under a system of flexible exchange rates becomes a means of adjusting the price level and, therefore, if money wage rates are rigid, the level of employment and output.

Chapter 19 / *The Cost of Exchange Crises and the Problem of Sterling*¹

Definition of Cost

What is the “pure” cost of an exchange crisis? I am pretty sure this question has not been answered satisfactorily; in fact, I am not aware that it has ever been posed in a way that would allow an exact answer. But every country in the world has experienced exchange crisis at one time or another. The British in particular have specialized in it every few years and the man on the street has surely felt some of its consequences in his personal life.

We could cite some obvious costs at random: disruption of long-run plans, controls, unemployment, retarded growth, diplomatic concessions, loss of face and reputation. These costs are felt by the public and they may well be the most important costs in terms of their effect on the long-run structure of society. They are not, however, what I have in mind when I speak of the cost of an exchange crisis. They are rather the costs of financing or correcting the deficit in the balance of payments that usually accompanies the crisis. These are costs of great importance, but I want to limit the notion of “pure” cost to something more specific.

By “pure cost” I mean the loss of real income induced by pessimistic expectations about the future exchange value of the currency. Pure cost is the cost of an attitude about the currency, and such an attitude has both short-run and long-run effects. The short-run cost is measurable and specific, and the long-run cost is sociological and intangible.

The Short-Run Cost

Let us consider first the short-run cost. To identify its nature suppose some exogenous event causes pessimistic anticipations about the exchange value of

the currency (pounds). This causes an increase in the supply of (and a decrease in the demand for) assets whose income streams are denominated in pounds (currency, bonds); and a corresponding increase in the demand for (and decrease in the supply of) assets whose income streams are denominated in other things (goods, equities, dollars). There is a shift from pound-denominated assets to assets denominated in other things.

I abstract from the exchange margin, for present purposes, by assuming that the central bank pegs the spot pound against the dollar at a single rate. This means that the Bank of England, when confronted with outward speculation, must accept all the spot pounds offered to it against dollars to prevent depreciation.

The excess demand for assets not denominated in pounds is ultimately reflected in an excess demand for dollars. This applies not only to any initial increase in demand for dollar assets, but also to the increased demand for real assets (goods, and claims to goods), which, after putting a slight upward pressure on domestic prices, induces additional imports and drains the reserves of the Bank.

I assume that the Bank does not fix any forward rates so that forward pounds can (as they will) fall to a discount. The interest rate on sterling assets goes up so that a sterling bill, the income from which is payable in sterling, will yield a higher pound interest yield than equities or assets denominated in dollars. The pure cost of the exchange speculation is therefore the inconvenience and resource loss implicit in adjustments that will be made because of this forward discount.

To explore the substitution effects creating the pure cost, we shall use a diagram (Figure 19-1). Let the abscissa measure sterling-denominated assets and the ordinate interest rates. Let *LL* relate the quantity of non-interest-bearing sterling assets that anyone in Britain or the rest of the world would

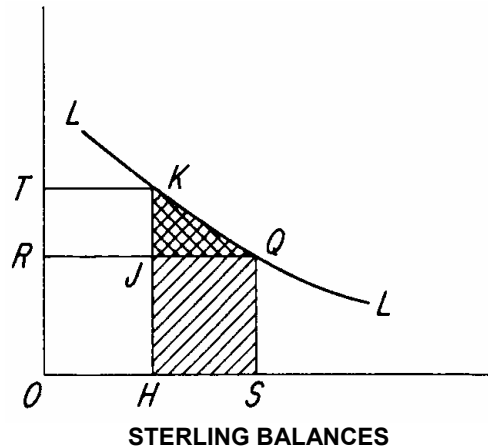


Figure 19-1.

wish to hold at various interest rates prevailing in the rest of the world. Thus, at the sterling interest rate SQ , the world would want to hold OS of sterling assets, whereas at the interest rate HK , only OH of sterling balances would be held.

Let us suppose now that the return on nonsterling assets—goods and dollars, etc.—is given at the level OR . We assume that activities in the sterling market are not large enough to affect the interest rate on real assets and the interest rate prevailing in the world as a whole. (Only a minor adjustment is needed to allow for changes in world interest rates, but no principles are altered, so it is unnecessary to introduce this complication.) At the interest rate $OR-SQ$ the equilibrium quantity of sterling balances outstanding will be OS .

Now let us consider the effects of a shift of demand against sterling such that sterling assets must pay a higher yield than that of other assets because of pessimistic expectations about the future value of sterling. I assume these pessimistic expectations can be summarized in a discount on forward sterling such as to increase the interest rate that must be paid on all assets denominated in sterling. Suppose this discount is JK , so that the interest rate on all sterling-denominated assets rises to $OT = HK$. The new equilibrium quantity of sterling held (outside the central bank) thus falls by HS to OH . Only at that level of sterling balances will the gap JK reflect the discount on forward sterling assets and the higher rate of interest that must be paid on sterling-denominated assets in contrast to dollar- or goods-denominated assets.

What is the mechanism by which the price of sterling is maintained? Clearly the Bank of England must buy up the excess supply of sterling, HS , selling an equivalent quantity of dollars. The public thus gives up HS of sterling to the central bank and gets the equivalent in dollars back. But sterling holders pay a cost for this.

The cost is the excess of the area $HKQS$ over the area $HJQS$. The value of the sterling balances held by the public, expressed as a sum per year, has been reduced by $HKQS$. But they have acquired dollars yielding a yearly income of $HJQS$, off-setting part of the loss. The difference JKQ is the pure private cost to sterling holders of the original cause of the increased uncertainty. It is the cost implicit in the reduction in usefulness of sterling as a unit of account and contract, and a medium of exchange, and is reflected in the inconvenience to the public of having to use dollars or goods, or else seek forward cover, in functions to which sterling, apart from the uncertainty, is better suited.

It would be quite erroneous, however, to suppose that the net cost JKQ represents the whole of the pure cost of the crisis to Britain. The cost JKQ can be looked on as the cost to the world as a whole of the British exchange crisis, but the cost to Britain itself will be substantially larger, inasmuch as income will be transferred to the rest of the world.

Let us suppose, for simplicity, that only British citizens hold pounds, and that the Bank of England holds only dollars in its reserves. Then we can interpret the shift in sterling holdings after the uncertainty crisis begins as a transfer of dollars from the Bank of England to British citizens. Although British citizens will have lost real income of an amount $HKQS$, and gained $HJQS$, the gain has been achieved at the expense of the Bank of England's stock of dollars. If the social advantage of the Bank of England's dollar reserve is no less than the social advantage of equivalent private holdings (and we might ordinarily suppose it to be greater), the gross gain of $HJQS$ by private citizens would be canceled by the gross loss of $HJQS$ by the Bank of England, so that the true cost to Britain as a whole is the total area $HKQS$ and not simply JKQ .

This may be seen somewhat more directly by supposing that the Bank of England maintains its reserves intact after the change in uncertainty, by replenishing its reserve losses through borrowing dollars. It can borrow internationally at the interest rate OR if it issues dollar-denominated debts (or the interest rate OT if it issues debts denominated in sterling). The Bank thus pays an interest cost to the rest of the world equal to $HJQS$. Thus private citizens seem to lose only JKQ , but the Bank of England has to pay an additional interest of $HJQS$, and to finance this payment the government would have to raise revenue from its citizens of $HJQS$. Thus Britain as a whole loses $HKQS$.

The nature of the gain to the rest of the world may not be apparent from this transaction. To be precise we have to examine the problem more deeply and take account of the other side of the Bank's transaction. The Bank of England will initially have lost dollars, but it has also reduced its sterling liabilities. The two assets, however, are not on the same footing. Currency can be produced at very little cost relative to real assets, so little that we may as well assume the costs to be zero. (To be sure notes have to be replaced periodically, and there are bookkeeping costs to servicing deposits, but these are small enough, in proportion to value of currency issued, to neglect.) I abstract, therefore, from the costs of producing money and assume that sterling balances represent an interest-free loan to the government.

What is true for sterling is also true for dollars. Like the Bank of England, the U.S. central bank (or the government) gets a seigniorage gain from the issue of non-interest-bearing dollars. It is this feature of the system that permits us to say that the area $HJQS$ represents a transfer of real income from Britain to the rest of the world.¹

¹ This assumes that the shift out of sterling balances is entirely toward dollars. Insofar as the shift is toward real assets the gain to the rest of the world is smaller, and the welfare loss to the world as a whole is correspondingly greater. It did not appear worthwhile to hinder the exposition of this or the following section with a discussion of the relative rates of substitution among goods, foreign exchange, and domestic currency, since no new principle is involved.

Thus British citizens hold dollar (or real) assets to perform the functions formerly performed by pounds. As we saw, sterling holders lose on balance JKQ , but the Bank of England, to replenish its dollar reserves, borrows at the international interest rate OR , dollars that are costless, from the point of view of the United States, to produce. Apart from the welfare loss to the world as a whole of JKQ , the uncertainty crisis has resulted in the substitution of dollars for pounds and transferred to the rest of the world a seigniorage gain that formerly accrued to Britain.

Analogy to a Depreciating Exchange Rate

The methods we introduced in the last section by which the Bank of England replenished its reserves by international borrowing is by no means implausible. An exogenous occurrence that carried pessimistic expectations, if allowed to weaken the reserve position of the Bank, would feed upon itself aggravating speculative pessimism and the costs of the crisis.

A perpetual discount on the forward value of a currency, however, is hard to imagine if the spot rate is indeed fixed, unless the monetary authorities manage uncertainty in such a way as to create perpetual doubt about their ability to manage the country's financial affairs. The state of disequilibrium represented by Figure 19-1 is likely to be a permanent state only if the currency is undergoing active depreciation.

Suppose, for example, we ignore growth and assume that the Bank of England expands the supply of pounds each year by a given percentage while it at the same time allows the spot rate to float. Then, with no change in the monetary policies of the rest of the world, the value of sterling will depreciate in terms of dollars and goods at the rate of monetary expansion after an initial adjustment of the exchange rate and the sterling balances. In Figure 19-1, if the prices of dollars and goods are expected to go up at the rate RT , an initial flight from sterling to other things would reduce the desired level of *real* sterling balances to OH , a shift that this time would be accomplished by a once-and-for-all increase in the sterling price of goods and dollars. After this adjustment was complete, the real value of sterling balances would be maintained at OH with a forward discount on sterling equal to the annual percentage rate RT . The area $RTKJ$ would represent both the real value of new issues of sterling and the depreciation of existing sterling balances.²

In the present case the expectation of depreciation is realized, whereas in the case studied in the preceding section they are unrealized. But the striking fact is that the cost to the country is in both cases the same. That is to say, a country that allows a persistent discount on its forward currency to develop

² The analogy to Bailey's argument [2] is apparent. For subsequent developments see Mundell [75], [77].

suffers the same real cost as one that allows its currency to depreciate over time through excessive monetary expansion at the rate implicit in the forward discount.

The nature of the pure cost can be understood in the context of a single bank in a country in which banking is not regulated. If a bank managed its affairs in such a way as to generate uncertainty about the convertibility of its deposits at a fixed price into legal tender, some customers would shift all their deposits, while most customers would shift some of their deposits to other banks, forcing the bank to borrow additional reserves. There would result an inconvenience to the customers, and a real cost to the shareholders as the manager of the bank had to borrow, or reduce lending, in order to replenish reserves. The analogy is exact, and to reduce the costs involved in weak banks represents one of the original purposes behind bank regulation. And just as banks have traditionally banded together to merge weak banks with strong banks, so the international community of central banks bands together to thwart an attack on any single currency.

Saving the Cost

The problem we now pose is whether there is a method by which the cost of the exchange crisis can be reduced. This raises the question of the nature of the uncertainty discount on sterling-denominated assets. We have seen how the uncertainty premium can raise the interest rate on all assets denominated in sterling. As we have seen, this represents a real cost, and the question is whether there is any government policy that can eliminate this real cost.

The first issue to be considered is the question of the nature of the uncertainty premium. If sterling is to be devalued in fact, then immediate devaluation may well be the appropriate policy. After devaluation the discount on forward sterling will be eliminated and elimination of the discount on forward sterling will be achieved, reducing the annual cost of holding sterling balances. In fact, this presents a very strong argument in favor of rapid adjustment to crises as opposed to slow adjustment, where slow adjustment involves a continual discount. Other things equal, rapid adjustment of any deficit prompting the speculation is preferable to long-drawn-out adjustment.

Let us suppose, however, that the authorities are in fact determined to maintain the existing sterling rate. Then is there any need for the country to pay the annual cost represented in Figure 19–1 by the area *HKQS*?

The answer is no. Insofar as the authorities have control over the spot value of sterling they can also control the forward value of sterling. They can peg forward sterling, buying and selling it at a fixed rate. If an uncertainty premium does appear, the authorities can go into the exchange market and

eliminate it by offering forward dollars at the same rate they offer for spot dollars.

Such a policy of course raises the demand for spot sterling. Sterling in effect becomes a perfect substitute for dollar and real assets from the point of view of exchange risk and will yield a rate of return equal to that of other assets. To attract sterling holders the Bank of England can buy forward sterling at the rate needed to restore the original level of sterling balances OS , eliminating the transfer and the cost of the outward speculation to the British economy.

What are the risks of such a policy? One of the risks which at first appears troublesome is the reluctance of a central bank to hold commitments to purchase forward sterling against dollars when it lacks the dollars to back up its commitment. That is to say, suppose that as a result of the uncertainty premium, and the ensuing exchange crisis, the reduction in the demand for pounds held outside the Bank of England is of the amount HS . To restore the original level of balances the Bank of England would have to cover HS of sterling balances by making commitments to buy HS of various pound maturities in the forward markets. This implies that on certain specific dates in the future the Bank of England will have to supply dollars and take in exchange pounds in order to fulfill its commitments. But how can it do so if it lacks the dollars to deliver? Would it not have to buy or borrow a corresponding quantity of spot dollars every time it makes a forward commitment?

The answer is no. When a participant in the market makes contracts with the Bank of England to sell forward pounds and buy forward dollars it is in a position analogous to the Bank in the sense that it must have pounds to deliver on a specific date. If the other side of the market in fact held dollars and did not hold the pounds to deliver on this date, it would have to get them. The demand for spot pounds in the market would increase automatically, providing the exchange the authorities need to cover its own commitments. The transactions cancel out.

Again we may suppose the other side of the market is already in possession of the pounds, and Bank authorities must then get dollars from the market and there is no immediately off-setting transaction by the other side of the market. But even this does not present any problem. If the transactor on the other side of the market is holding pounds, he will need to use them to deliver on his forward contract. The Bank of England needs dollars to keep its opposite forward commitment, but it will be able to exchange spot dollars from its working balances for the pounds given up by the private transactor. In turn the private transactor will want to replenish his pound balances by selling dollars, which will find their way back to the Bank of England. Again there is no problem with respect to the ability of the Bank of England to honor its forward commitments without holding an equivalent quantity of spot dollars against all forward contracts in sterling. By pegging the forward

exchange rate the Bank can wipe out the pure costs of uncertainty crises by shouldering the exchange risk itself, correcting the erroneous anticipations of sterling holders and inducing a larger private holding of outstanding balances.

A fixed spot and forward rate—fixed at identical values—is the analogue to a common currency from the point of view of exchange risk. As long as the relation between spot and forward exchange rates is rigid, spot and forward exchange can be regarded as perfect substitutes for one another, and as long as both are rigid in terms of foreign currency, spot and forward domestic exchange is a perfect substitute for foreign exchange; the market can then be analyzed as a single market as if there were a common currency used by the countries under consideration.

It is tempting to conclude from this proposition that a policy of keeping spot and forward rates together and fixed to a foreign currency, such as the dollar, would eventually result in one or the other currencies being used for both internal and external transactions. If spot and forward sterling are rigidly fixed to the dollar, what would prevent the British public from using dollars entirely for domestic purposes? Alternatively, what would prevent the rest of the world from using pounds entirely for their local as well as international transactions?

This prospect does not appear very likely, or very imminent in the case of two such important world currencies as the dollar and sterling. But it does raise a question with respect to the viability of less important currencies, and we may as well attempt to provide an answer to why, at least in the short run, two currencies would be likely to remain in circulation side by side despite the fact that they are perfect substitutes from the point of view of their exchange values. To do so we must look more closely at the services currencies provide.

A currency provides liquidity services to the holder but the liquidity of all currencies is not the same, despite the equivalent exchange value in organized markets. We can see this in the case of components of domestic money supplies. A United States savings account, for example, while readily exchangeable for a demand deposit or cash at a bank, is of no direct use in purchasing a meal except after the transactions cost of making the conversion at a local bank has been borne. Even a demand deposit is not “liquid” with respect to purchases in places that do not accept checks.

Different degrees of liquidity exist also in the case of the external use of a currency. Despite its sound reputation as a safe asset among financial experts, the Swiss franc cannot readily be used as a medium of exchange (outside banks) in Andorra; the Deutschmark or the lira is not acceptable for purchases in Ditchley; even the dollar, despite its familiarity, imposes on the user in a foreign country a transaction cost that must be borne by the payer or receiver.

It is for this reason—the fact that different currencies have different attributes

—that two currencies can remain in circulation side by side without one at once pressing out the other. Just as foreign travelers usually keep in their billfolds batches of different currencies, so professional traders and financiers keep bank accounts in different countries. This analysis applies in the short run.

Adjustment Policies

In the long run, however, certain currencies achieve worldwide reputations. Usage breeds familiarity and familiarity breeds acceptability, so the distinctions between currencies tend to disappear as the liquidity value widens. Thus the pound sterling and the dollar are both acceptable foreign currencies in Andorra and the dollar is also acceptable at Ditchley, as experience and habit have created confidence and knowledge about its exchangeability. The process of expansion of a currency is closely akin to the expansion of a language. For acceptability both parties must recognize it as currency, and familiarity and contact—repetitive transactions—increase that acceptability. In Arrow's phrase we “learn by doing,” and this learning principle is applicable to the world of currencies.

Sterling became the *lingua franca*—to mix metaphors—in the nineteenth century. Such is the indelibility of routine that, despite the chaotic uncertainty that has confronted sterling since 1914, it still remains one of the world's most important currencies over certain domains, as a unit of contract, a unit of account, a medium of exchange, and a store of value.

After 1945, of course, the dollar began to replace sterling as a central bank reserve asset, and, with its great reputation, the dollar began to overtake sterling also in its role as a vehicle currency, increasingly used by travellers and private traders. World War II popularized the dollar and postwar tourism made the dollar familiar in every corner of Europe, almost as important, indeed, as was sterling before 1940. As sterling gradually receded behind the wall around the sterling area the role of the dollar gradually expanded, its mere presence generating, through the learning process, the basis for further expansion.

The process is reversible even though it takes decades. The revolution in communications is accelerating the process. The international usage of a currency builds its reputation by a gradual process, and this reputation can be destroyed only after new technological substitutes or a great deal of mismanagement. It will take a long time, for example, before the measures undertaken by the U.S. government to undermine confidence in the free convertibility of the dollar have an effect on its international transactions, just as it took a long time before the decline in the tradition of expert central banking in Britain could undermine the international reputation of the pound.

In the short run, as we have argued, a policy of intervention in the forward

market to eliminate any discount on sterling caused by uncertainty can eliminate the social cost to the country as a whole. But, of course, the bet that the authorities make on the pound has to be a good bet, and it can only be a good bet if proper adjustment policies are implemented. In the long run a currency like sterling can regain its international reputation and stature only by using a mechanism of adjustment in which actual and potential sterling holders have confidence.

Given fixed exchange rates between sterling and the dollar, there is only one mechanism of adjustment that is both efficient and effective. That is the system in which the supply of sterling is contracted when there is an excess of supply over demand against dollars outside the Bank of England, and in which the supply is expanded when there is an excess of demand over supply. In other words, when the Bank of England is losing foreign exchange it should allow the supply of sterling to contract, and when it is gaining foreign exchange it should allow the supply of sterling to expand.

I recognize that this principle would involve a radical departure from current British policy. Under present circumstances when the Bank of England sells foreign exchange (it would make no difference if we spoke of gold) and buys up sterling, the exchange equalization account immediately buys up government debts, replacing the sterling that was previously sold to the Bank of England. The effect is to leave the excess supply of sterling still in the market to feed further demand for foreign exchange, or else further demand for goods and securities and thus an indirect demand for foreign exchange. In other words, the British authorities follow the principles of a disequilibrium system.

Of course, when the situation builds up into a crisis, after the Bank of England has replaced a substantial part of its foreign assets by domestic assets, the bank rate will be raised and some reduction in the rate of monetary expansion will be allowed. But the harm is already done and the crisis is out in the open as speculation feeds on itself.

The Bank's present policy is much like that of a private bank, which, whenever it loses reserves and an equal deposit, buys securities in an attempt to preserve its original deposits. The bank would quickly be in trouble unless the mere act of providing the additional credit created a corresponding increase in the demand for its deposits. That is conceivable if the bank is a monopolist but it is inconceivable for one bank among many.

A system by which the supply of sterling is allowed to conform to the reserves of the Bank of England could, in principle, allow some discretion for the authorities to finance part of any inventory-import cycle out of reserves. But the mechanism has to be carefully controlled and it cannot be interfered with in any circumstance likely to retard the rebuilding of a banking reputation. The memory of 20 years of periodic sterling crises cannot be wiped out in a day, and confidence in the mechanism itself must be rebuilt.

Chapter 20 / *The Crisis Problem*¹

Meaning of Crisis

“Crisis” implies a disequilibrium, and therefore a change, so severe that it threatens to undermine the stability of parameters hitherto regarded as constants. In economics the threatened parameters are usually institutional structures or fixed points within a structure. In our context the institutional structure is the present international monetary “system,” and crisis implies a threat to the maintenance of a fixed point within the system.

Is the gold exchange standard a “system”? A system is an aggregation of diverse entities united by regular interaction according to a form of control. The gold exchange standard can be identified as a system if we can perceive the order in the interaction of its components and outline the form of control. We shall argue first that a system of control can be identified in the gold exchange standard and that it therefore qualifies as a system.

“Collapse” is the breakdown of order, the subversion of an institutional parameter, and crisis is impending collapse. Collapse can come about either because certain boundary conditions are reached, or because the control mechanism is such that the equilibrium of the system is an unstable one. We shall refer to the first threat as a “structural crisis” and the second as a “control crisis,” and attempt an explicit formulation of both concepts in the context of the gold exchange standard.

The “crisis problem” is the problem of preventing a threat of collapse from materializing, and thus the problem of preserving the institutional structure. Its purpose is conservative in substance and therefore excludes solutions based on flexible exchange rates, the gold standard, a dollar standard, or a supranational central bank, all of which alter institutional equations in the present system. That does not mean these panaceas are undesirable, but only that they lie outside the mandate of the crisis problem.

¹ Presented to the Chicago Conference on International Monetary Problems, September 22–25, 1966. To be reprinted in *Monetary Problems of the International Economy* (R. A. Mundell and A. Swoboda, eds.). Chicago: University of Chicago Press.

Rules of the System

To identify the order—the rules of the game—in the gold exchange standard, and explore its consequences, we have to know the rules under which it is operated. The rules constitute a combination of laws, commitments, conventions, and gentlemen's agreements by which the inner country (the United States) pegs its currency (the dollar) to gold and the outer countries (Europe) peg their currencies to the dollar, either directly, or indirectly through a secondary reserve currency like the pound sterling or the franc. This means that the United States acts as *residual* buyer or seller of gold, whereas Europe acts as a *residual* buyer or seller of dollars. The United States has to take up (supply) any excess supply of (demand for) gold offered to it and Europe has to take up (supply) any excess of dollars offered (demanded) on exchange markets.

The boundary conditions of the system are given by the U.S. stock of gold and Europe's stock of dollars; the United States and Europe, respectively, cannot supply gold or dollars they lack. But there is an asymmetry in these conditions, because, as long as gold and dollars can be exchanged at the United States Treasury, Europe has access to additional dollars in exchange for gold. The total reserves (dollars and gold) of Europe therefore constitute its boundary condition, whereas the gold reserve of the United States represents its constraint.

Control of the system rests on U.S. monetary policy, on the one hand, and Europe's gold-dollar portfolio on the other. When the United States expands the dollar supply it puts upward pressure on world incomes and prices—directly, because of interest rate effects and spending changes in the United States, and indirectly because of increases in European reserves. Similarly, when the United States contracts the dollar supply, it puts downward pressure on world prices.

Europe's gold-dollar portfolio is the other control variable. When Europe converts dollars into gold it weakens the U.S. reserve position and stimulates or compels a monetary contraction² and when it converts gold into dollars it strengthens the reserve position and permits or compels a monetary expansion. Europe's gold-purchase policy thus influences U.S. monetary policy, while the latter “determines” world prices and incomes. When U.S. monetary policy is forcing inflation on the rest of the world, Europe can stimulate or compel a contraction by gold purchases; and when U.S. monetary policy is deflationary, Europe can entice an expansion by gold sales.

We may thus express the control mechanism of the system as follows: The

² I shall speak throughout of “expansion” and “contraction” and rising and falling prices rather than increases or decreases in the rate of expansion or contraction of money and prices, but the reader should have no difficulty in making his own translation into a growing economy.

United States expands or contracts its monetary policy according to whether its gold position is excessive or deficient, and Europe buys or sells gold from the United States according to whether U.S. policy is causing inflation or deflation. The gold exchange standard therefore constitutes a “system” and it is with its implications that we must now be concerned.

Operation of the System

The system can be formulated in precise mathematical terms. The purpose of doing so, of course, is not to lend an impression of spurious precision to central bank behavior.³ The purpose is rather to, be explicit about the possibilities inherent in the mechanism, and to see what help the formulation is in uncovering possibilities easily missed by unaided intuition.⁴

Figure 20–1 plots Europe gold holdings (G) on the abscissa and U.S. dollar liabilities (D) on the ordinate. Given the stock of gold in the world as a whole, the line R_1R_2 plots the relation between Europe's gold holdings (and therefore U.S. gold holdings as the residual) and U.S. dollar liabilities, which preserves the U.S. gold-reserve ratio at its desired level. Thus if Europe holds OR_1 of gold, none is left over for the United States and dollar liabilities must be zero, whereas if Europe holds no gold (so that the United States holds it all), U.S. dollar liabilities are OR_2 . (Given one dollar's worth of gold as the unit in which gold is measured, the slope of R_1R_2 , with a negative sign, is the reciprocal of the U.S. reserve ratio, which is assumed to be less than 1.⁵)

The line P_1P_2 plots the relation between Europe's gold holdings and U.S. dollar liabilities that preserves a given money supply (composed of dollars and gold) in the world as a whole, and therefore (supposing no lags) a given level of prices or incomes. Thus a dollar supply of OP_2 would be exactly sufficient to maintain a given level of prices so Europe's gold holdings would have to be zero to preserve that price level; and, similarly, if the dollar supply were nil, gold holdings in Europe would have to be OP_1 . The slope of P_1P_2 (with negative sign) is the reciprocal of the dollar price of gold, which, as already noted, is taken to be unity.

The two lines represent targets of policy. When the U.S. reserve ratio is below (above) the desired ratio, which is the case whenever D is above (below) R_1R_2 , U.S. authorities will reduce (increase) D ; and when the world money

³ I know of no central banker who would like to think that his actions can be expressed in a system of differential equations.

⁴ Mathematical formulation of the system, however, and formal proofs about its behavior are reserved for the Mathematical Appendix.

⁵ D may be taken to represent the aggregate supply of nongold money in the world as a whole, rather than simply the foreign central bank holdings of dollars, since we are not concerned here with exchange margins, imperfect substitutability of one currency for the other, or more than one currency area, while the gold stock, equal to OR_1 , can readily be adjusted to take into account private gold hoarding.

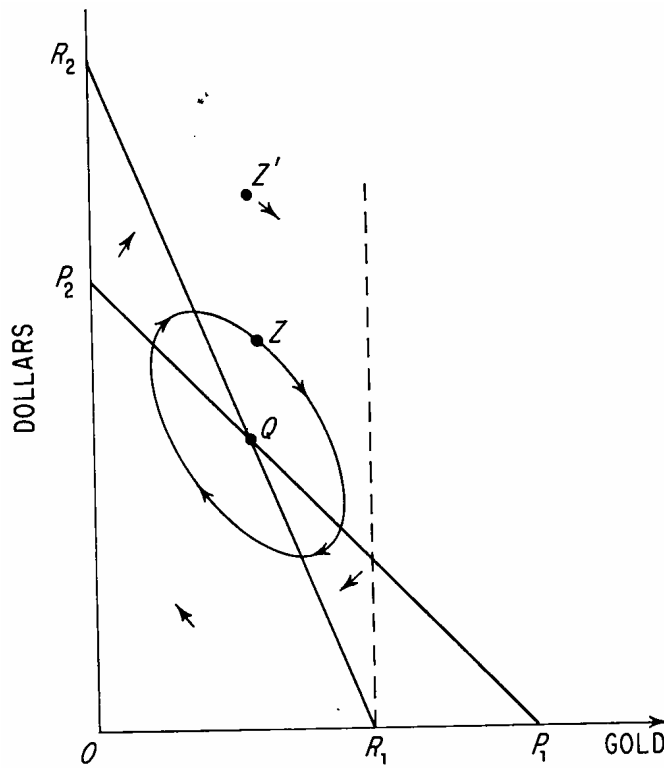


Figure 20-1

supply is above (below) that which preserves the price level implied by P_1P_2 , which is the case whenever G is right (left) of P_1P_2 , Europe will purchase (sell) gold to encourage restraint or expansion in the U.S. We thus get “direction forces” at each point in the diagram indicated, in each quadrant, by arrows.

Control Crisis

It may be seen at once that the system may be stable or unstable, depending on the intensity of the forces acting on the control variables. Let α be the rate of dollar expansion in the United States expressed as a proportion of excess gold reserves; let β be the rate of gold purchases in Europe expressed as a proportion of the excess of the world money supply over its equilibrium level; and let μ , be the gold-dollar equilibrium reserve ratio in the United States. Then, assuming α , β , and μ are constant, the system is stable or unstable according to whether

$$\frac{\alpha}{\beta} \lessgtr \frac{1}{\mu}.$$

[In the borderline case, the system, from an initial point in the graph such as Z , would oscillate hopelessly (and elliptically) around the equilibrium Q .] Thus if $\mu = 25$ per cent, U.S. monetary contraction must be more than four times European gold purchases; if this were not the case the world money supply would increase (decrease) when the price level was too high and the dollar supply overexpanded (underexpanded).

The system might break down even in the event that it is otherwise stable. Boundary constraints are given by the axes and by a vertical line from R_1 . Hitting the latter boundary would imply a suspension of gold payments in the United States—structural collapse—or a cessation of the rules of the game. Thus it is entirely possible that, given a sufficiently large disequilibrium such as that indicated by the point Z' , the system could break down because it hits the barrier where the U.S. runs out of gold.

There are means of easing the situation, thus reducing the risk of crisis. A higher U.S. reserve ratio, a reduction in the European β variable, or an increase in the U.S. α variable would diminish the risks of instability, as would an increase in μ . An increase in the price of gold would move the gold barrier from R_1 to the right, flattening both R_1R_2 and P_1P_2 . There is, however, an easier way.

Reversal of Control

The easier way is to reverse the control variables. A strongly stable system, in the sense that it will always reach the equilibrium price level and gold supply, can be created if the United States governs its monetary policy by the need for a stable price level in the world, and Europe's gold purchase policy is determined by the need to preserve a given gold ratio in the United States. Specifically, if the United States contracts the dollar supply whenever world prices are above equilibrium, and expands the dollar supply whenever they are below equilibrium, and if Europe buys gold when the United States has an excessive reserve, and sells it whenever U.S. reserves are deficient, equilibrating forces are assured. The policy mix in the diagram would be reversed and the arrows would point toward equilibrium.

The theoretical explanation is the usual one—the *principle of effective market classification*. European gold policy has a comparative advantage in affecting the U.S. gold stock and U.S. monetary policy has a comparative advantage in determining the level of world prices.

Conclusions

The present system has crisis-laden features if it is run in such a way that Europe tries to protect itself against U.S. inflation by reducing the U.S.

gold reserve, and the United States tries to protect itself against gold losses or gains by tight or expansive monetary policies. On the other hand, the gold exchange standard has strong built-in stabilizers if it is run so that the United States tries to protect Europe (and itself) against inflation or depression, and Europe tries to protect the United States against excesses or shortfalls of gold. The optimal policy is a good-neighbor policy, the epitome of central bank cooperation.

In practice this means that the United States would have to concern itself, under the gold exchange standard, with global stability, whereas Europe would have to concern itself with the U.S. reserve position, using its own gold to empty into (take out of) the London market when hoarding increases (diminishes). To this end an enlargement of the London gold pool might be helpful.⁶ That approach—tame as it is—would be my solution to the crisis problem.

APPENDIX A

Alternative Dynamic Mechanisms

Let \bar{G} be the world gold stock and G the stock held in Europe, so that $\bar{G} - G$ is the stock held in the United States; then excess gold reserves in the United States are $\bar{G} - G - \mu D$, where D denotes dollar liabilities and μ the fractional reserve ratio. Let M be the world stock of money consistent with the equilibrium price level, so that $G + D - M$ is the amount of money in excess of its equilibrium quantity. Then what choices of the parameters α , β , γ , and δ will make the following dynamic system stable?

$$\dot{D} = \alpha[\bar{G} - G - \mu D] - \gamma[G + D - M]$$

$$\dot{G} = \delta[\bar{G} - G - \mu D] + \beta[G + D - M].$$

Suppose first that $\gamma = \delta = 0$. Then, redefining D and G as discrepancies from their equilibrium values, the characteristic equation is

$$\lambda^2 + (\mu\alpha - \beta)\lambda + \alpha\beta(1 - \mu) = 0$$

and the characteristic roots will have negative real parts, assuming $\mu < 1$, only if

$$\mu\alpha - \beta > 0$$

⁶ The pool would be excessive if it drew an undesired amount out of public hoards; the important rule is to keep a “balance of uncertainty” in play.

as noted in the text. On the other hand, if $\alpha = \beta = 0$, the characteristic equation is

$$\lambda^2 + (\gamma + \delta)\lambda + \gamma\delta(1 - \mu) = 0$$

which must be stable. In fact, since the discriminant

$$(\gamma - \delta)^2 + 4\gamma\delta\mu > 0$$

a cyclical solution is impossible.

APPENDIX B

*A Monetary Truce*⁷

“Monetary Truce” is perhaps an overly dramatic way of expressing the need for a change in monetary relations between Europe and America. Of course, Prime Minister Wilson has characterized these relations as a “monetary war” and if he is right I am not being overly dramatic at all. A truce can be prelude to a peace treaty, much needed in the international monetary area. But it is the terms of the truce, rather than the details of a treaty, that I want to emphasize. These terms have to have strong roots in the existing system and yet not foreclose on the most attractive options of the future.

The international monetary system has been in trouble in one way or another for half a century. Prior to 1914 the major nations had alternated between gold and silver and bimetallic standards, but by 1870 gold ruled the roost. Gold was the anonymous monarch in a world of creative nationalism, and it counted for more than a mere medium of exchange and contract; it symbolized internationalism and the rule of international law. Like any sovereign it had its detractors, but these were inconsequential as long as sterling, the power behind the throne, was accorded the respect due the currency of the greatest financial power. National currencies were equal, but sterling was more equal than the others.

The war changed all that. Besides shattering the illusions of a generation brought up to expect continuity and progress as the patrimony of the greatest organized culture the world has ever known, the European civil war destroyed the fabric of the international order—an order that symbolized, in the economic sphere, the harmony of interest binding trading nations together. The

⁷ Remarks delivered to the Federal Reserve Bank of New York (March 15, 1967).

gold standard broke down in all countries except the United States while the bitterness the prolonged war stamped on an entire generation set the stage for a harsh and ill-conceived treaty.

Neither political nor monetary order could be restored on the old basis. America had remained on gold and on her was laid the heavy responsibility of picking up the pieces. Benjamin Strong and Montague Norman had made valiant attempts to reinstate the old system and spent many fateful hours together reorganizing the currencies of Eastern Europe. But currencies had depreciated in terms of goods and Britain's fatal error of 1925 left not only the pound in jeopardy, but also the gold base of the international monetary system. The weakness might have occurred in any event, but the undervaluation of the franc in 1926 sealed the fate of the pound and the international system. The system collapsed in 1931, and all the king's horses could not put it together again. By the time of the tripartite agreement of 1936 it was too late; totalitarianism had spread over the continent, and Europe was never afterward to be the same.

The system built up at Bretton Woods was an attempt to correct the mistakes of the interwar period. But the IMF was not strong enough in experience or reputation to replace the authority of the major center countries. The real power behind the IMF system became the dollar.

In a technical sense and in fact, the United States became the center of the international monetary system. First, the United States became the sole country pegging its currency to gold; in this sense the dollar became the *key currency*. Second, and partly because of the first reason, other countries pegged their currencies in relation to the dollar, either directly or through the pound, franc, or escudo; in this sense the dollar became the primary *intervention currency*. Third, dollars became increasingly used as an international asset for central banks; in this sense the dollar became the primary *reserve currency*. Fourth, the dollar became increasingly used for trading operations as a currency of contract; in this sense the dollar, along with the pound, became the primary *vehicle currency*. Fifth, and finally, the dollar was increasingly used as the currency of quotation; in this sense the dollar became the main *currency of account*. In these five roles the dollar became the currency that was "more equal" than any other.

After the war no one doubted the strength of the dollar and dollars were accumulated by central banks as being better than gold because of the interest that could be earned and because the dollar was the currency of intervention in the exchange markets. As postwar recovery proceeded, the European countries developed balance of payments surpluses they needed to rebuild their reserves. The surpluses were taken out in both dollars and gold as no one doubted the ability of the United States to convert dollars into gold. But after 1958, after the European currencies had become convertible and

increasingly strong, the United States “deficit,” which in the early '50's had averaged \$1 billion, jumped to \$3 billion. Awareness of the implications for convertibility of the dollar became apparent, and central banks took a closer look at their portfolios. Since that time the United States has run a deficit of over \$2 billion of which, on the average, about half was taken in gold and half in dollars. But many central banks held dollars merely because they did not want to embarrass the United States. Involuntary dollar holdings mounted until France led the way to a “declaration of independence.” After the spring of 1965 she began converting her entire surpluses into gold. Other countries followed France's lead and the United States dollar liabilities to foreign central banks effectively stopped growing at the end of 1964.

In the meantime the United States had initiated an extremely complicated sequence of maneuvers designed to correct the balance of payments. Concealed export subsidies, tax reforms, changes in offshore procurement policies, hidden protectionist devices, controls on international bank credit, reductions in foreign aid, taxes on outward capital flows, reductions in duty-free tourist allowances, new laws on gold-hoarding, and “voluntary controls” on capital exports. The arguments advanced in favor of these policies read like an enumeration of all the partial equilibrium mercantilist fallacies that have ever been invented, as if Hume, Smith, Ricardo, Mill, Marshall, Taussig, Keynes, Viner, Haberler, and Machlup had never existed. They reflect the wholly erroneous view that the balance of payments can be viewed piece by piece, rather than as an integral part of a complete system; that if you plug one “hole”—and you surely can—an excess supply of money will as if by magic suddenly get “excess-demanded,” and not remain in this system to put pressure on spending somewhere else.

It would be an exaggeration to say that European economists argue as if Say's Law is always right, whereas American economists argue as if it were always wrong, but there is something to it. At any rate the assumption that the demand for money is equal to the supply of money is a more appropriate simplification over the time span of balance of payments adjustment than the assumption, implicit in many partial equilibrium approaches, that it is always different. Whenever the two are the same, the balance of payments can be regarded as the excess of hoarding over credit creation and the only measures that can improve the balance of payments are those that increase hoarding relative to credit creation. That is why rapid growth is closely associated with balance of payments surpluses and why the measures the United States have undertaken to correct the balance of payments have been unsuccessful: Looked at individually they have had very little effect on hoarding.

Up until recently the European position has been that the United States should correct her deficit and then make an agreement on international monetary reform, probably through creating a new reserve asset, whereas

the United States' position has been to talk about reform before correcting the deficit. The issue has apparently now been decided and discussions about reform are going ahead. It would, however, be a mistake to pin too much hope for stability on the outcome of current negotiations.

I am not sure that this is generally realized, and so it may be worth taking a few moments to see why. The usual assumption is that European countries can be persuaded to hold the dollars accumulated as a consequence of past deficits, but that they are unwilling at this stage to increase their dollar holdings further. Yet the appetite for increase in total liquidity credit continues unabated so that a new reserve asset has to be created to fill the gap. If, for example, about \$2.5 billion of new reserves is needed each year, and only, say \$0.5 billion will be left over from the gold market, after private hoarding is satisfied, there is a \$2 billion gap. If countries in the rest of the world are willing to accumulate, say \$1 billion in dollars, an annual creation of the new reserve unit of \$1 billion would fill the gap.

There are problems connected with the creation of a new reserve unit: These involve the problems of keeping different assets circulating in the system at the same time without bringing Gresham's Law into play. But I am sure these problems can be worked out satisfactorily. They are technical details and our main problems are more fundamental.

The fundamental problem as I see it is that the creation of a new reserve unit would leave unsolved both the gold problem and the problem of world stability and yet create the illusion that the problems have been solved. In this way the creation of a new reserve unit, although perhaps harmless in itself, would aggravate, rather than ameliorate, our problems in the event of a crisis if it created a false sense of security or allowed the monetary authorities of the world to discard a system which, until now, has worked reasonably well.

So be it. But how serious would a crisis be? It is here that we need to consider past attitudes.

In the event of a run on the dollar associated with outward speculation or a domestic recession, the United States would have essentially four courses of action.

1. It could pay out all its gold and then let other countries do what they want with their exchange rates. One must remember that the United States pegs only to gold, not to other currencies, and after other central banks have taken all the United States' gold they would have either to accept any excess dollars at the given rate or to let their currencies appreciate. In my view they would continue to peg to the dollar at the existing rate.

2. It could put an embargo on gold and force other countries to make a decision about their exchange rates at once. In this event there is less chance that they would support the dollar, but in my view that is still their most likely course of action.

3. It could put on exchange controls or the equivalent in taxes on capital flows or trade.

4. It could tighten monetary policy to induce a reduction in domestic spending beyond what would be desirable for the domestic economy. This is hardly likely for both economic and political reasons, and there would be little if any support for such a policy in any interest group in the country.

In my view the first choice would be the best, provided the government did not allow itself to be later persuaded into raising the price of gold. After all it would not be a good bargain for the United States to sell its remaining \$12 billion of gold and then buy it back at twice the price. If it intended at some future time to raise the price it would be better to do so while it still had its gold left!

However, far more preferable to answering this question is finding a way to avoid the problem of crisis altogether.

As I see it there are at least two essential and widely accepted goals of policy in the international sphere. These are maintenance of the present price of gold, and a full employment, noninflationary level of world expenditure. I have put them in the reverse order of importance.

To achieve these two goals we must have two instruments. Indeed, we have them. The instrument for stabilizing the price of gold is the combined gold stock of the central banks; if we count only the major banks it amounts to over \$30 billion, whereas if we count all central bank gold it amounts to over \$40 billion. Current annual supply has averaged over \$1 billion, not counting Russian sales, whereas private demand has been usually substantially below \$1 billion leaving a modest balance of a few hundred million dollars for central bank acquisition. Last year (1966) was an exception, when private demand exceeded supply, and this year could be an exception too, depending on how effectively those in favor of an increased price can influence the market. Last year's jump in private demand cannot be accounted for by an increased use in arts and industry; a substantial bulk of it has been simply a hoarding demand that would come back to the market when (and if) speculators recognize that central bankers are seriously determined to commit their gold stocks at the present price. The mere act itself would quiet the London market, and my own guess is that the withdrawal from it of the major purchasers of gold—the central banks—would be sufficient to push the London price toward the floor.

The point to be emphasized is that the central bankers have dominated the market for the past 30 years. They have been buyers, holding up the gold price. There is not the slightest doubt about their collective ability to keep the price where it is. Even if, to take the most improbable situation—and I do not for a moment believe it at all likely—private demand were to exceed supply for each of the next 30 years by as much as \$1 billion (this would be an

incredible increase in private demand) the central banks would still have \$10 billion left to steady the market. I only emphasize it because one hears nowadays a lot of wild talk about control of the gold market being taken out of the hands of the monetary authorities. Sometimes it is expressed in a more guarded form, namely that control might be taken out of the hands of a particular authority, the United States. In this more guarded form the statement is less implausible. But it is still true that the United States has ample gold to stabilize the price for years to come if it had only private demand to contend with. It is almost inconceivable that \$12 billions of gold could be absorbed by the private markets in addition to the private supply, over the next 20 years.

The point is indisputable, therefore, that the threat to the system is based on the potential actions of the monetary authorities themselves, pouncing on one another's reserves. The private market can be steadied by central bank gold but one country at least has to be prepared to perform the role of pegging the price of the private market and its ability to do so depends on the reactions in other central banks.

Currently the Bank of England does the pegging—in the first instance. It feeds gold into or takes gold out of the private market to steady the price, but it shifts the whole burden of this onto the United States, which is committed to exchanging gold for monetary purposes. In the London gold market gold is exchanged for dollars and when the price rises to, say, somewhere between \$35.12 and \$35.20 the Bank of England feeds gold into the market, getting dollars in exchange, which it then converts into gold in New York. At one remove, therefore, the United States in effect pegs the private London market and bears the entire burden of any excess private demand for gold besides any excess demand bought by the Bank of England on the account of other central banks.

The United States could relinquish this role as residual supplier in favor of some other country. But no other country has been willing to commit itself to buy and sell gold freely as prescribed in the IMF Article IV-4-b. Other countries buy and sell dollars or fix their exchange rates to countries that buy and sell dollars.

The United States does not have control of its gold stocks. That is determined, in effect, by other central banks because they can at any instant exchange gold for dollars or dollars for gold. It follows then that, if the United States is to continue to be able to act as residual supplier, other central banks must permit it to do so by leaving a large enough stock of gold in the hands of the United States. They can always do this by varying, collectively, the ratio of gold and dollars in their reserves.

The instrument, therefore, by which the private gold price must be maintained is the gold-dollar ratios of the central banks in the rest of the world. They must use that ratio to ensure that the United States has sufficient gold

to feed the Bank of England, and through the Bank of England, the London gold market. In effect, Europe would shoulder the burden of acting as residual buyer and seller. Whether that instrument is available depends entirely, of course, on the consent of monetary authorities in the rest of the world; it is out of the hands of the United States' monetary authorities.

To satisfy the second requirement of the system—a full employment non-inflationary level of expenditure—we need an additional variable. The variable required is the supply of money in the world as a whole, and a most important influence on this is the level of international reserves. When there is a world recession we should have a mechanism to increase the supply of reserves, and when there is inflationary pressure, we must have a mechanism to decrease the supply of reserves. To put it more exactly to correspond to a world in which growth is taking place, the rate at which reserves are expanding must be accelerated when there is danger of world recession, and decelerated when there is danger of world inflation. What instrument is available to accomplish this objective?

Clearly it is not the supply of gold. As we have already seen the central banks have to act passively with respect to the gold market if they are to stabilize the price. Not much can be done about the rate of physical production of gold so that, once the goal of a fixed gold price is established, the gold reserves of the system are already predetermined.

Under the present institutional arrangements the only variable available is the supply of foreign exchange reserves. But we are not free to choose any currency at random. The dollar is the key currency and thus the currency “needed” for intervention in the exchange market; United States gold reserves also perform, as we have seen, the buffer stock function, at one remove from the Bank of England. The supply of dollars is, therefore, the only variable that is left to stabilize the level of world expenditure.

According to the “rules of the game” I am proposing—and I propose it as an intermediate-run solution to the present impasse—United States' monetary policy would have the responsibility of ensuring an appropriate level of world demand while countries outside the United States—essentially the remaining members of the Group of Eleven—would allow their gold-dollar ratios to adjust in such a way as to ensure that the United States' gold stock remains sufficient to continue buying and selling gold freely. The dynamic properties of the system are such that it would be highly stable provided that each group—the United States and the other members of the Group of Ten—was willing to act according to those rules. These are the terms I suggest for a monetary truce.

What are the prospects for such a truce? In my opinion they are not nearly as hopeless as critics have implied since I first suggested this set of rules for the

consideration of the Joint Economic Committee last September. First, let us look at it from the point of view of any sacrifices the United States would have to make. The Federal Reserve System would have to survey economic conditions outside as well as inside the United States in formulating its monetary policy. Upon noticing a general weakening of world demand the Open Market Committee would have to take steps toward monetary ease; at the outset of inflationary pressures they would have to move toward restraint. To what extent is this likely to conflict with United States' interests?

When the world as a whole is inflating, as it was in 1965, the United States would have to move more strongly to restraint; and when the world as a whole is moving toward recession the United States would have to move toward ease. In these cases there is a harmony of interests for the United States and Europe. What is good for the United States is also good for Europe and vice versa.

Problems arise when Europe is undergoing a boom and America has excessive unemployment, or when Europe is in a state of recession and America is experiencing an inflationary boom. In this case (assuming no change in exchange rates) a compromise solution would have to be reached. What should be the basis of that compromise ?

Theoretically, if the goal is to stabilize prices, American interests should be weighed, in proportion to European interests, according to the ratio of American production to European production. This would mean that, in the first case cited, United States monetary expansion should be somewhat less rapid than suggested by United States interests alone, but more rapid than suggested by European interests; whereas in the second case United States monetary expansion would be more rapid than suggested by United States interests alone, but less rapid than in European interests. Because United States production is over half of the combined outputs, this would not involve a great sacrifice for the United States.

These conflicts can be attenuated by the use of fiscal policy compensations for monetary policy in the short run, while more basic adjustments involving changes in the rates at which wages are expanding in relation to productivity are being worked out. If strict adherence to world price stability is not feasible, and it is desired to have instead a slight upward trend in world prices to conform to the expectations generated in the past, somewhat more weight should be placed, with respect to United States monetary policy, on that part of the world in recession.

Turning now to European interests, Europe would lose something in control, and gain something in stability. Europe would have had a right to be more vocal in opposing United States monetary expansion in 1965 and fiscal excesses in 1966. She would have a right to express an interest in a policy of monetary ease in 1967, if that turns out to be desirable. At the same time Europe would give up the right to determine, autonomously, her gold-dollar

ratio, at least within the range at which it threatens the stability of the system as a whole.

I am not blind to the political realities and conventions that now exist. France may already have committed herself to a course of action from which she cannot or will not depart; Switzerland goes her own way; Britain and Holland have their gold conventions. But unanimity is not necessary. It is sufficient that signals be expressed in gold policy within the range of safety for the system as a whole and these signals not be ignored by the United States monetary authorities. I doubt that anything as formal as Kindleberger's suggestion that Europeans be represented on the Open Market Committee would be feasible or necessary; but an observer status should not unduly threaten United States monetary sovereignty.

Both Europe and America share in the world goals of correcting world demand and fixing the price of gold. It is clear how United States monetary policy determines the world price level. But it should also be clear that the task of fixing the gold price has in fact been shifted onto Europe. Let us look at that feature of the system more closely.

Suppose United States gold reserves are at some minimum level consistent with the balance of speculative pressures in the gold market, and that there is an autonomous shift in the private market from dollars into gold. The price of gold in London would rise; the Bank of England would sell gold and get dollars and convert them at the United States Treasury. Under the present system this would induce cumulative speculation against the dollar, but under the system I propose, Europe would at once convert gold into dollars. Similarly, when there is an excess supply of gold in the London market Europe would accumulate gold. In effect, therefore, Europe instead of America becomes the residual gold supplier and demander, taking over that function currently performed by the United States. The interesting point, however, is that this shift has been achieved without any change in institutional arrangements.

The advantages I would claim for this approach to the world monetary problem is that it is rooted in tradition and yet points the way to more fundamental reform later on. It builds onto existing arrangements and outlines a path for developments toward a more formal world central banking arrangement in the future.

I will not go into the possible developments at this stage. Suffice it for me to say that a possible next step following a tacit agreement on this is a European reserve pool and a purely European asset, with European Certificates based on its gold stock. At the end of this stage we could go on to the creation of an IMF or world central bank liability based on gold, dollars, and the newly created European Certificates. Europe and America would thus be equal partners at the stage when and if we get to a world central bank in the hopefully not too distant future.

I would rather not conclude on this note, however. To get to the long run we have to get through the short run and that will take careful maneuvering over the next few years. That is why I have stressed the need for a truce rather than a treaty. There is, I believe, no feasible alternative to the system, but this, I am afraid, is not a sufficient condition to guarantee its success. It may be that Europe will not stand for a solution on these lines. If that is so, the United States will be faced with troublesome choices. It may be that the United States is overcommitted and will not restrain inflation. If that is so Europe will be faced with troublesome choices.

The choices will not be, indeed, so difficult from the point of view of the United States' selfish interest. The United States, after all, is far less vulnerable than is Europe to a breakdown of existing arrangements. The cost to the United States is rather of a different sort. It involves the breakdown of order in a world in which the United States has a great emotional stake, to which its reputation is committed and toward which it has assumed a deep responsibility. One of the casualties of the breakdown of the system might well be the Common Market, and while that organization is less popular in the United States than it looked through the rose-colored glasses worn at its beginning its merits probably still outweigh its defects. It would be a mistake to imagine that De Gaulle is France and that France is Europe. Europe is struggling to create, out of its past disorder, a common personality, partly in imitation of, partly in irritation at, the United States. Whatever the disappointment Americans may feel over the Europe of the 1960's that they helped father, it is a vast improvement over the Europe of the other decades.

Chapter 21 / *Hicksian Stability, Currency Markets, and the Pure Theory of Economic Policy*^{1,2}

The stability analysis introduced by Hicks has been one of the most successful failures in economic theory. Originally developed to integrate static and dynamical general equilibrium theory, it was used by Hicks ([24], p. 62) as a bridge between dynamics and comparative statics:

The laws of change of the price system, like the laws of change of individual demand, have to be derived from stability conditions. We first examine what conditions are necessary in order that a given equilibrium system should be stable; then we make an assumption of regularity; that positions in the neighbourhood of the equilibrium position will be stable also; and thence we deduce rules about the way in which the price-system will react to changes in tastes and resources.

But the stability conditions were not founded on an explicitly formulated dynamic system. Hicks had defined stability along conventional lines:

In order that equilibrium should be stable, it is necessary that a slight movement away from the equilibrium position should set up forces tending to restore equilibrium. . . .

but concluded that stability requires that

. . . a rise in price makes supply greater than demand, a fall in price demand greater than supply.

This is indeed the stability condition corresponding to a dynamic system in which excess demand causes a rise in price, but, as Samuelson pointed out, the proposition is not explicitly derived as the condition of convergence of

¹ Adapted from: a forthcoming article in *Essays in Honor of Sir John R. Hicks* (N. Wolfe, ed.).

² I am happy to acknowledge many helpful conversations on the subject matter of this chapter with J. C. Weldon of McGill University.

such a dynamical system. The problem may be considered trivial in the case of a single market,³ but it raises difficulties in analysis and interpretation in the case of multiple exchange (exchange of more than two commodities), as Hicks foresaw ([24], p. 66):

What do we mean by stability in multiple exchange? Clearly, as before, that a fall in the price of X in terms of the standard commodity will make the demand for X greater than the supply. But are we to suppose that it must have this effect (a) when the prices of other commodities are given, or (b) when other prices are adjusted so as to preserve equilibrium in the other markets?

To resolve the difficulty Hicks introduced his concepts of *perfect* and *imperfect stability*. He noted first that it was necessary to distinguish a series of conditions—that a rise in the price of X will make supply greater than demand (1) all other prices being given, (2) allowing for the price of Y being adjusted to maintain equilibrium in the Y market, (3) allowing for the prices of Y and Z being adjusted, and so on, until all prices have been adjusted. He then defined as *imperfectly stable* a system in which a rise in price of a commodity causes excess supply for the commodity after all repercussions are allowed for, and as *perfectly stable* a system in which a rise in price causes excess supply regardless of how many other prices are adjusted to attain equilibrium values in their respective markets.⁴

Samuelson [88] criticized Hicks' concept of stability on the grounds, as stated above, that "stability conditions are not deduced from a dynamic model, except implicitly." Hicksian stability is not equivalent to "true"

³ Strictly, the problem is not trivial even in the case of exchange of two commodities; first, because of complications associated with the possibility of time derivatives of various orders of price changes entering the excess demand (X) functions, in a system such as $X(P, p, p, \dots) = 0$; second, because of nonlinearities in the excess demand function; and, third, because market exchange of two commodities among many people may involve adjustments of quantities toward budget constraints, giving rise to the more complicated dynamics such as Marshall postulated in his foreign trade analysis.

⁴ Let $X_i = X_i(p_1, \dots, p_n)$ be the excess demand functions for commodities $i = 1, \dots, n$. By differentiation $dX_i = \sum_{j=1}^n b_{ij} dp_j$, where $b_{ij} = \partial X_i / \partial p_j$. Solving for the dp_i we get

$$dp_i = \sum_{j=1}^n (\Delta_{ji} / \Delta) dX_j,$$

where Δ is the determinant of the system and Δ_{ji} its first cofactors.

When all other prices adapt so that every $dX_j = 0$ except dX_i , we have the solutions $dp_i = (\Delta_{ii} / \Delta) dX_i$; if various prices k, \dots, n , are held constant with respect to the numéraire we get instead

$$dp_i = \frac{\Delta_{ii, kk, \dots, nn}}{\Delta_{kk, \dots, nn}} dx_i.$$

Imperfect stability requires that $\Delta_{ii} / \Delta < 0$ for $i = 1, \dots, n$, whereas perfect stability requires that $\Delta_{ii, kk, \dots, sm} / \Delta_{kk, \dots, sm} < 0$ for any subset of commodities k, \dots, n , excluding commodity i . The Hicksian perfect stability conditions are thus

$$\frac{\Delta}{\Delta_{ii}} < 0; \frac{\Delta_{ii}}{\Delta_{ii, jj}} < 0; \frac{\Delta_{ii, jj}}{\Delta_{ii, jj, kk}} < 0; \dots b_{ii} < 0,$$

the first condition being the condition of imperfect stability.

dynamic stability, and the Hicks conditions are neither necessary nor sufficient for the convergence of the dynamical system implicit in Hicks' dynamics, that is, the dynamic system Samuelson postulated as the "natural extension" of the Walrasian system. True dynamic stability requires that the roots of the characteristic equation of the dynamic system have negative real parts, and this requirement is not equivalent to the Hicks conditions.⁵

Samuelson's criticism undermined the logic of Hicks' method. But the conditions of stability produced by that method retained an important place in the literature. Samuelson had already observed that the Hicks conditions were equivalent to the conditions of "true" dynamic stability in the symmetrical case. Metzler showed that they were equivalent in the case of gross substitutes, and also necessary (but not sufficient) for stability to be independent of the speeds of adjustment (Metzler [62]).⁶ Morishima proved that they were equivalent for certain classes of complements. They are also sufficient conditions for convergence of any *nonoscillating* system, since Hicksian (perfect) stability implies the absence of positive real roots. They are, moreover, conditions that, if not satisfied, yield anomalous comparative statics results, and thus seem at least to be necessary conditions for useful applications of the correspondence principle, at least in the context of analysis of the Walrasian system. Thus, even though Hicks' *method* seems to lack theoretical justification,⁷ the Hicks *stability conditions* produced by that method have proved exceedingly useful.

How can a wrong method yield useful results? Leaving aside coincidence, the answer may lie in the two-way character of the correspondence principle. Samuelson [89] had observed that

not only can the investigation of the dynamic stability of a system yield fruitful theorems in statical analysis, but also known properties of a (com-

⁵ It is slightly ironic that Marshall in his 1879 manuscript on foreign trade utilized the link between dynamics processes and stability, but not explicitly the link between stability and comparative statics, whereas Hicks utilized the link between stability and comparative statics but not the link between dynamics and stability. Samuelson used both links in his integration of dynamics and statics.

⁶ Actually, Metzler's example (p. 285) that the Hicks conditions are not sufficient for stability to be independent of the speeds of adjustment contains a numerical error that mars his demonstration [the second cubic of his footnote 12 should read $\lambda^3 + 4\lambda^2 + 3.4\lambda + 13.2 = 0$ instead of $\lambda^3 + 4\lambda^2 + 2.6\lambda + 13.2 = 0$ and in the first (correct) cubic the Routh conditions are satisfied]. But a slight adjustment to his counterexample can nevertheless demonstrate his point. If, for example, speeds are chosen so that, in his terminology, $k_1 = k_3 = 1$, giving the cubic $\lambda^3 + (2 + k_2)\lambda^2 + (1 + 1.2k_2)\lambda + 6.6k_2 = 0$, the Routh conditions will not be satisfied for values of k_2 somewhat less than 1.

⁷ In this connection Samuelson writes ([88], p. 554): "In principle the Hicks procedure is clearly wrong, although in some empirical cases it may be useful to make the hypothesis that the equilibrium is stable even without the 'equilibrating action' of some variable which may be arbitrarily held constant." Samuelson provides an example in connection with the Keynesian system later in his paper.

parative) statical system can be utilized to derive information concerning the dynamic properties of a system.

When Hicks is specifying the signs of changes in excess demands when a given price is put above or below its equilibrium value, various subsets of other prices remaining constant, he is at the same time implying specific comparative statics results. Provided these results correspond to *known* properties of a statical system the conditions implied should be related to stability conditions if the *reciprocal* character of the correspondence principle is valid.

Another reason why the *Hicks method* may appear more reasonable than Samuelson's original criticism of it suggests is that our knowledge of the precise laws governing dynamical systems is scanty. The empirical "output" according to the methodology of the correspondence principle is a set of comparative statics results, while the empirical "input" is (a) the nature of the dynamic processes, and (b) the assumption of stability. Acceptance of (b) is the essence of the correspondence principle, but how are we to determine (a)?

Consider, for example, the following alternative expressions for dynamical systems:

$$X_i(p_1, \dots, p_n; \dot{p}_i) = 0 \quad (i = 1, \dots, n) \quad (1)$$

$$X_i(p_1, \dots, p_n; \dot{p}_1, \dots, \dot{p}_n) = 0 \quad (i = 1, \dots, n) \quad (2)$$

$$X_i(p_1, \dots, p_n; \dot{p}_1, \dots, \dot{p}_n; \ddot{P}_1, \dots, p_n; \dots) = 0 \quad (i = 1, \dots, n). \quad (3)$$

To each of these systems there will correspond a different set of stability conditions. System (1) is a version of that used by Samuelson to prove that the Hicks conditions are neither necessary nor sufficient for stability. Yet, as he himself noted, more complete generalizations such as (2) and (3) can be developed with different consequences for comparative statics. There is, therefore, an element of arbitrariness in the specification of dynamic systems in the absence of empirical information and there may on these grounds be a pragmatic justification for Hicks' method of developing "stability conditions" that are "timeless." The Samuelson criterion is completely general and is an appropriate methodological approach, but for purposes of yielding practical results generality often implies emptiness.

The purpose of this chapter is to show that the Hicksian stability analysis is a useful contribution to the integration of statical and dynamical theory. First, we shall show that the perfect and imperfect stability conditions do correspond to the dynamic stability conditions of *some* dynamic processes, irrespective of the pattern of signs of the price-matrix. Second, we shall argue

that, despite their usefulness in the form Hicks presented them, the perfect stability conditions are not completely general, since they do not yield the information obtained by extending his method to the commodity “adopted” as the standard commodity. Third, we shall show that generalized conditions can be obtained by interpreting his device of holding subsets of prices constant with respect to the standard commodity as an arbitrary method of forming various composite commodity groupings. Further, we shall show that dynamic systems that fail to satisfy the generalized conditions will be unstable at *some* speeds of adjustment when a different commodity is adopted as the standard commodity in the dynamic system. And finally, we shall discuss the usefulness of the generalized Hicks conditions in devising dynamical rules for the *hyperstability* of “policy systems.”⁸ The illustrative examples are all taken from the theory of foreign exchange markets, but the results, of course, apply to any generalized system.

The Hicks Conditions and Sliding Parities

Our first task is to show that the Hicks conditions do, in a sense, correspond to the conditions of convergence of some dynamic systems. Let us take as an example a problem in devaluation theory. We can describe a closed static equilibrium system of $n + 1$ currencies with prices (exchange rates) expressed in terms of currency 0, denoted by p_1, \dots, p_n , as follows:

$$B_i = B_i(p_1, \dots, p_n) = 0 \quad (i = 1, \dots, n) \quad (4)$$

where B_i is the balance of payments of the i th country. In equilibrium each $B_i = 0$, while near the equilibrium we can write the system (4) as follows:

$$B_i = \sum_{j=1}^n b_{ij}(p_j - p_j^0) \quad (i = 1, \dots, n) \quad (5)$$

after expanding B_i in a Taylor series and omitting nonlinear terms.

Now let us suppose that the exchange rate of one country, say the r th country, appreciates in proportion to its balance of payments surplus according to the law

$$\dot{P}_r = k_r \sum_{j=1}^n b_{rj}(p_j - p_j^0) \quad (6)$$

⁸ See, for example, Mundell [73] and the references there to the principle of effective market classification.

while all other exchange rates adjust instantaneously to equilibrium. The solution of the differential system (6) is

$$p_r = p_r^0 + A_r \exp\left(k_r \frac{\Delta}{\Delta_{rr}} t\right) \quad (7)$$

where A_r is a constant that depends only on initial conditions,

$$\Delta \equiv \begin{vmatrix} b_{11} & b_{12} & \cdots & b_{1n} \\ b_{21} & b_{22} & \cdots & b_{2n} \\ \vdots & & & \vdots \\ b_{n1} & b_{n2} & \cdots & b_{nn} \end{vmatrix};$$

and Δ_{rr} is the cofactor (principal minor) of the element in its r th row and r th column.

For the dynamic process implied in (7) to be stable it is necessary and sufficient that $\Delta/\Delta_{rr} < 0$. But this condition is precisely (for the analogous problem in the Walrasian system) the Hicksian condition of imperfect stability for the r th currency; and when the method is applied to each currency (in succession, not simultaneously), we have the complete Hicksian conditions of imperfect stability:

$$\Delta / \Delta_{rr} < 0 \quad \text{for } r = 1, \dots, n. \quad (8)$$

A similar analysis can help to show the usefulness of the Hicks conditions of perfect stability. Suppose that one exchange rate, say p_i , is held constant (relative to the numéraire). This amounts to dropping the i th row and column from Δ , so that if the original experiment were repeated, this time with the i th exchange rate constant, we would get, instead of (7),

$$p_r = p_r^0 + A_r \exp\left(k_r \frac{\Delta_{ii}}{\Delta_{ii,rr}} t\right) \quad (9)$$

and the stability condition $\Delta_{ii}/\Delta_{ii,rr} < 0$, which is one of the Hicksian conditions of perfect stability. Proceeding along these lines, holding one or another set of prices constant, we get the complete Hicks conditions of perfect stability.

But does this dynamic process have any economic plausibility? Are we not, as Samuelson argued, allowing “arbitrary modification of the dynamical equations of motion”? The answer is, in a sense, yes. But this can be the exact method needed in the theory of policy, where our purpose is to *design* stable dynamic systems.

As an example, we might be interested in examining aspects of the stability of an exchange-rate system such as that recently advocated by sixteen distinguished academic economists [14]—a sliding parity system (with widened exchange-rate margins).⁹ Is it not precisely a set of conditions such as the Hicks conditions that would be involved? We might ask, first, what would happen if, say, Britain (which we shall identify with country 1) adopted a sliding parity system while a subset of other countries ($2, \dots, j$) allowed their exchange rates to float, and the remaining countries, k, \dots, n , kept their rates pegged to, say, the U.S. dollar (the currency of country 0). Then, if we suppose that balances of payments of countries whose rates float adjust instantaneously while the pound adjusts slowly, the path of the pound over time would be

$$p_i = p_i^0 + A \exp\left(k_i \frac{\Delta_{kk, \dots, nn}}{\Delta_{11kk, \dots, nn}} t\right) \quad (10)$$

for which knowledge of the Hicks conditions would be directly relevant. Thus the particular form of the dynamic system adopted—which countries are left out and which are left in—would depend on which of the Hicks conditions are satisfied. The Hicks method does, therefore, have a role to play in dynamic aspects of the theory of economic policy.

The Asymmetrical Position of the Standard Currency

The Hicks *conditions*, however, are not exactly what we need for the theory of economic policy, because, as we shall see, they are incomplete even in terms of Hicks' own method. In the experiments Hicks conducts to derive his stability conditions he accords the numéraire—the standard commodity—a special role. In this section we shall consider the precise deficiencies in the statical information provided by the Hicks conditions. This is best established by considering the comparative statics theorems implied by the Hicks conditions. Consider the equilibrium system

$$B_i(p_1, \dots, p_n; \alpha) = 0 \quad (i = 1, \dots, n) \quad (11)$$

where, again, the B_i 's are balances of payments, the p 's are exchange rates, and α is a parameter.

Differentiation of (11) with respect to α yields

$$\sum_{j=1}^n b_{ij} \frac{dp_j}{d\alpha} = -\frac{\partial B_i}{\partial \alpha} \quad (i = 1, \dots, n) \quad (12)$$

⁹ See page 111 for a list of economists who signed the petition.

and the solutions for the exchange-rate changes are

$$\frac{dp_i}{d\alpha} = -\sum_{j=1}^n \frac{\partial B_j}{\partial \alpha} \frac{\Delta_{ji}}{\Delta} \quad (i = 1, \dots, n) \quad (13)$$

Now consider an increase in demand for the currency of country i such that $\partial B_i / \partial \alpha > 0$; while the excess demand for every other currency, at given exchange rates, is unchanged ($\partial B_i / \partial \alpha = 0$ for $i \neq j$). Then, instead of (13), we have simply

$$\frac{dp_i}{d\alpha} = -\frac{\partial B_i}{\partial \alpha} \frac{\Delta_{ii}}{\Delta}. \quad (14)$$

By the Hicks conditions of imperfect stability $\Delta_{ii}/\Delta < 0$, so $\partial B_i / \partial \alpha > 0$ implies $dp_i/d\alpha > 0$. Thus an increase in demand for the currency of the i th country raises the price of that currency after adjustment of all other exchange rates has been allowed for.

Similar implications follow from the conditions of perfect stability if we hold various subsets of other exchange rates constant relative to the numéraire. If, for example, the exchange rates of countries k, \dots, n are held constant, we get, instead of (14), the equation

$$\frac{dp_i}{d\alpha} = -\frac{\partial B_i}{\partial \alpha} \frac{\Delta_{ii, kk, \dots, nn}}{\Delta_{kk, \dots, nn}} > 0, \quad (15)$$

the inequality being an implication of one of the conditions of perfect stability.

How can an increase in demand occur in a closed system? Clearly only at the expense of other commodities (currencies) in the system. Cournot's law (or Walras' law in the context of the Walrasian system) ensures that

$$\sum_{i=0}^n \frac{\partial B_i}{\partial \alpha} \equiv 0 \quad (16)$$

where the summation, it should be emphasized, extends over *all* the commodities. The interpretation of (14) is therefore that an increase in demand for (say) pounds (the currency of country i) at the expense of dollars raises the dollar price of the pound. Now if other exchange rates are held constant relative to the dollar, the proposition holds, if the Hicksian perfect stability conditions are satisfied, when the shift of demand is interpreted as being from the dollar and all currencies whose exchange rates are kept fixed to the dollar. Note, however, that the Hicks conditions do not give us the sign of

$$\frac{dp_j}{d\alpha} = -\frac{\partial B_i}{\partial \alpha} \frac{\Delta_{ij}}{\Delta} \quad (17)$$

so that we cannot specify, on the grounds of the Hicks conditions alone, whether a shift of demand from dollars to pounds raises or lowers the price of (say) the franc relative to the dollar.

But now we are in a position to see the narrow form of the mathematical implications of the Hicks conditions. Consider a shift of demand from the franc (currency j) to the pound (currency i). Then $\partial B_s / \partial \alpha = 0$ for $s \neq i, j$, while $\partial B_i / \partial \alpha = -\partial B_j / \partial \alpha > 0$ in view of (16); with no loss of generality we can make $\partial B_i / \partial \alpha = -\partial B_j / \partial \alpha = 1$. Substitution in (13) then gives the change in the dollar price of the pound and the franc:

$$\frac{dp_i}{d\alpha} = -\frac{\Delta_{ii} - \Delta_{jj}}{\Delta} \quad (18)$$

$$\frac{dp_j}{d\alpha} = -\frac{\Delta_{ii} - \Delta_{jj}}{\Delta} \quad (19)$$

The Hicks conditions do not provide us with the sign of either (18) or (19), nor, by analogy to (17), should we expect them to. But, by analogy with (14), we should expect the difference

$$\frac{dp_i}{d\alpha} - \frac{dp_j}{d\alpha} = -\frac{\Delta_{ii} - \Delta_{jj} - \Delta_{ij} + \Delta_{jj}}{\Delta} \quad (20)$$

to be unambiguous in sign for any system in which units are chosen so that each $p_s = 1$, initially. When demand shifts from the franc to the pound, we should not expect to be able to predict the sign of the change in the *dollar* price of the pound or franc, but we should be able to determine, on the basis of the Hicks conditions, the sign of the change in the *franc* price of the pound, the expression given in (20). But the Hicks conditions are no help here, and this means that Hicks has not developed the mathematical implications of extending his method to the standard commodity.

The same information problem applies, a fortiori, when various subsets of prices are held constant. An implication of the Hicks condition of perfect stability is that a shift of demand onto pounds raises the price of the pound even when various currencies remain pegged to the dollar; this amounts to treating the dollar and the other currencies pegged to it as a *composite* currency. By analogy the price of the pound should rise when demand shifts from a currency other than the dollar, say, the franc, while other currencies (for example, the mark) are pegged to the *franc*.

Thus consider a shift of demand, at constant exchange rates, among three currencies i, j , and k , such that

$$\frac{\partial B_i}{\partial \alpha} + \frac{\partial B_j}{\partial \alpha} + \frac{\partial B_k}{\partial \alpha} \equiv 0$$

and every other $\partial B_i / \partial \alpha = 0$. Then, from (13), we have

$$\frac{dp_i}{d\alpha} = -\frac{\partial B_i}{\partial \alpha} \frac{\Delta_{ii}}{\Delta} - \frac{\partial B_j}{\partial \alpha} \frac{\Delta_{ji}}{\Delta} - \frac{\partial B_k}{\partial \alpha} \frac{\Delta_{ki}}{\Delta} \quad (21)$$

$$\frac{dp_j}{d\alpha} = -\frac{\partial B_i}{\partial \alpha} \frac{\Delta_{ij}}{\Delta} - \frac{\partial B_j}{\partial \alpha} \frac{\Delta_{jj}}{\Delta} - \frac{\partial B_k}{\partial \alpha} \frac{\Delta_{kj}}{\Delta} \quad (22)$$

$$\frac{dp_k}{d\alpha} = -\frac{\partial B_i}{\partial \alpha} \frac{\Delta_{ik}}{\Delta} - \frac{\partial B_j}{\partial \alpha} \frac{\Delta_{jk}}{\Delta} - \frac{\partial B_k}{\partial \alpha} \frac{\Delta_{kk}}{\Delta}. \quad (23)$$

Applying the restrictions that $dp_j/d\alpha = dp_k/d\alpha \equiv dp_{jk}/d\alpha$ and setting

$$\frac{\partial B_i}{\partial \alpha} = 1 = -\frac{\partial B_j}{\partial \alpha} - \frac{\partial B_k}{\partial \alpha},$$

we can deduce the change in price of the pound relative to the mark and franc. The result is

$$\frac{dp_i}{d\alpha} - \frac{dp_{jk}}{d\alpha} = \frac{A}{\Delta(\Delta_{jj} - \Delta_{jk} - \Delta_{kj} + \Delta_{kk})} \quad (24)$$

where A is the sum of the cofactors of the elements in the following matrix:

$$\begin{bmatrix} \Delta_{ii} & \Delta_{ij} & \Delta_{ik} \\ \Delta_{ji} & \Delta_{jj} & \Delta_{jk} \\ \Delta_{ki} & \Delta_{kj} & \Delta_{kk} \end{bmatrix}$$

The cofactor of, say, the element Δ_{jk} can be related to the second cofactors of Δ by Jacobi's ratio theorem,

$$-\begin{vmatrix} \Delta_{ii} & \Delta_{ij} \\ \Delta_{ki} & \Delta_{kj} \end{vmatrix} = -\Delta\Delta_{ii,kj}$$

so that A/Δ can be written entirely as the sum of second cofactors, and (24) can be rewritten

$$\frac{dp_i}{d\alpha} - \frac{dp_{jk}}{d\alpha} = -\frac{\begin{pmatrix} \Delta_{jj,kk} - \Delta_{ki,kk} + \Delta_{ji,kj} \\ \Delta_{ij,kk} + \Delta_{ii,kk} - \Delta_{ii,kj} \\ \Delta_{ij,jk} - \Delta_{ii,jk} + \Delta_{ii,jj} \end{pmatrix}}{\begin{pmatrix} \Delta_{jj} - \Delta_{jk} \\ -\Delta_{kj} + \Delta_{kk} \end{pmatrix}} > 0. \quad (25)$$

The inequality sign should hold if an increase in demand for one country's currency occurs at the expense of *any* other country, one other currency price remaining constant relative to that country. But the mathematical information is not given to us by the Hicks conditions. The reason is that the mathematical implications of the Hicks method have not been developed with respect to the currency adopted as numéraire.¹⁰

Generalization of the Hicks Conditions

When we do extend Hicks' method to make it "symmetrical" with respect to the numéraire (appreciating, say, the pound relative to, say, the *franc*, allowing various subsets of other currency markets to adjust), we get, of course, a set of conditions that specifies the signs of terms like those in (20) and (25). Along with the Hicks conditions, which can be written

$$\frac{\Delta}{\Delta_{ii}} < 0; \frac{\Delta_{ii}}{\Delta_{ii,jj}} < 0; \frac{\Delta_{ii,jj}}{\Delta_{ii,jj,kk}} < 0; \dots \quad (26)$$

we get supplementary conditions of the form

$$\frac{\Delta}{\begin{pmatrix} \Delta_{ii} - \Delta_{ij} \\ -\Delta_{ji} + \Delta_{jj} \end{pmatrix}} < 0; \frac{\begin{pmatrix} \Delta_{ii} - \Delta_{ij} \\ -\Delta_{ji} + \Delta_{jj} \end{pmatrix}}{\begin{pmatrix} \Delta_{jj,kk} - \Delta_{ji,kk} + \Delta_{ji,kj} \\ -\Delta_{ij,kk} + \Delta_{ii,kk} - \Delta_{ii,kj} \\ \Delta_{ij,jk} - \Delta_{ii,jk} + \Delta_{ii,jj} \end{pmatrix}} < 0; \dots \quad (27)$$

[The next term requires that the ratio of the denominator of the second ratio and the sum of sixteen third minors be negative, and so on for successive ratios. The last term in the conditions of (27) specifies that the sum of the $(n - 1)$ th minors (n^2 in number) be negative. But the $(n - 1)$ th minors are equivalent to the elements in the original determinant, so the last condition simply requires that the sum of all the elements in the original determinant Δ be negative.]

This suggests an alternative—and simpler—way of developing the generalized conditions. Consider the augmented determinant

$$B \equiv \begin{vmatrix} b_{00} & b_{01} & \dots & b_{0n} \\ b_{10} & b_{11} & \dots & b_{1n} \\ \vdots & \vdots & \ddots & \vdots \\ b_{n0} & b_{n1} & \dots & b_{nn} \end{vmatrix} \quad (28)$$

¹⁰ This is perhaps apparent immediately, since the Hicks conditions can be expressed in terms of the commodity chosen as numéraire, the excess demand for which is never allowed to go to zero. On this point (but without apparent recognition of its implications) see Lange ([41], p. 92).

formed by bordering Δ with its column and row sums, with a change of sign, so that

$$\sum_{j=1}^n b_{ij} = -b_{i0} \quad \sum_{j=1}^n b_{ij} = -b_{0j} \quad b_{00} = \sum_{j=1}^n \sum_{i=1}^n b_{ij}. \quad (29)$$

Then the extended Hicks conditions can be stated simply as the requirement that principal minors of B arranged in successive order oscillate in sign, except for the (singular) determinant B itself.¹¹

Because the elements in the augmented determinant B are interdependent the generalized conditions can be expressed entirely in terms of the elements of the “normalized” determinant Δ . The supplemental conditions are

$$b_{00} < 0; \begin{vmatrix} b_{00} & b_{0i} \\ b_{i0} & b_{ii} \end{vmatrix} > 0; \begin{vmatrix} b_{00} & b_{0i} & b_{0j} \\ b_{i0} & b_{ii} & b_{ij} \\ b_{j0} & b_{ji} & b_{jj} \end{vmatrix} < 0; \text{ etc.}, \quad (30)$$

but in view of (29) these may be rewritten, in terms of elements excluding the 0th currency, as

$$\sum_{i=1}^n \sum_{j=1}^n b_{ij} < 0; \begin{vmatrix} \sum_{\substack{s=1 \\ s \neq i}}^n \sum_{\substack{r=1 \\ r \neq i}}^n b_{rs} & \sum_{\substack{s=1 \\ s \neq i}}^n b_{si} \\ \sum_{\substack{s=1 \\ s \neq i}}^n b_{is} & b_{ii} \end{vmatrix} > 0; \text{ etc.} \quad (31)$$

with the last condition reducing to the basic determinant Δ itself. These forms are equivalent to (30) and imply the signs of the ratios in (27).

This representation has the intuitive appeal of starting with the matrix of *all* the currencies in the system.¹² Thus, instead of omitting the numéraire

¹¹ More compactly, we can state the conditions as requiring that every first minor of B be “Hicksian.” Not all the conditions are independent, however, since $B_{00} \equiv B_{11} \equiv \dots \equiv B_{nn}$ in view of the characteristics of B .

¹² One might think that Hicks really intended his conditions to extend over the entire range of excess demand coefficients (including the numéraire); this would be incorrect, since the last (augmented) determinant is singular. Alternatively, it might be thought that Hicks intended the conditions to apply no matter what commodity were taken as numéraire. The latter interpretation seems to be fortified by a footnote which states ([24], p. 75): “[this] can be seen at once if we adopt the device of treating X (momentarily) as the standard commodity, and therefore regarding the increased demand for X as an increased supply of the old standard commodity m ” If this device were adopted to derive the Hicks conditions it would indeed result in conditions equivalent to the above stability conditions. Yet this interpretation would conflict, not only with all subsequent interpretations of the Hicks conditions by other writers on stability, but also with Hicks’ own explicit statement in the Mathematical Appendix (p. 315), which specifies that the conditions must hold “for the market in every X_r ($r = 1, 2, 3, \dots, n - 1$)”; that is, the

currency at the outset, we start with a nonnormalized system of $n + 1$ currencies, exchange rates being expressed in terms of an abstract unit of account (for example, IMF par values), and apply the Hicks conditions allowing each currency the role of numéraire in turn.

Currency Areas

The above conditions are more general than the Hicks conditions. Yet they still do not exhaust the information inherent in the Hicks methodology. The Hicks method of holding various subsets of prices constant with respect to one another can be regarded as a device for constructing “composite commodities”; in the present context of currencies, we shall describe them as “currency areas.” Now if we apply the Hicks method to a system based on arbitrary arrangements of countries in the currency areas, we get a further generalization of the results obtained by Hicks. When, for example, the mark is pegged to the dollar (the numéraire), the dollar and mark constitute a currency area. But there is no reason to restrict the formation of currency areas in a unidirectional attachment to the dollar. A group of currencies could be “attached” to the pound or the franc or any other currency, in principle. More importantly, we can then allow entire currency areas to appreciate and require that the balance of payments of the areas worsen, while various subsets of other currencies in the currency areas remain unchanged.¹³

The remarkable fact is that the conditions resulting from making arbitrary currency alignments among the (nondollar) countries and applying the Hicks method to the resulting matrix incorporate the conditions just developed as a special case. Thus consider the denominator of the first term in (27),

$$\begin{pmatrix} \Delta_{ii} - \Delta_{ij} \\ -\Delta_{ji} + \Delta_{jj} \end{pmatrix}$$

This term is the result of combining the i th and j th currencies together to form a currency area of those two countries. With no loss of generality we can write

market for the numéraire (the n th commodity) is omitted. In any case his discussion on pages 68–71 fails to make the point clear, while his third graph in Figure 16, which he asserts is stable, is actually totally stable only if the line along which there is zero excess demand for the standard commodity (not drawn in his figures) is inelastic referred to the abscissa. The discussion is not completely clear, however, and I am therefore inclined to interpret Hicks as actually intending to give full coverage to the numéraire but not completing the mathematical implications of doing so.

¹³ I have considered the problem of “optimum” currency areas in terms of its attributes for stabilization policy, optimum exploitation of the functions of money, and so on in Chapter 12; the present analysis suggests an additional criterion in terms of stability conditions.

$i = 1$ and $j = 2$. Then if the first and second rows and columns are replaced by their combined rows and columns, we have

$$\begin{vmatrix} b_{11} + b_{12} & b_{13} \dots b_{1n} \\ + b_{21} + b_{22} & b_{23} \dots b_{2n} \\ b_{31} + b_{32} & b_{33} \dots b_{3n} \\ \vdots & \vdots \\ b_{n1} + b_{n2} & b_{n3} \dots b_{nn} \end{vmatrix} \equiv \Delta_{11} - \Delta_{12} - \Delta_{21} + \Delta_{22}$$

as can be proved by straightforward expansion. Similarly, it can be shown that the denominator of the second term in (27) is the determinant formed by replacing the i th, j th, and k th rows and columns of Δ by the amalgamated row and column.

When we now carry out Hicks' method for arbitrary arrangements of currency areas, extended over the whole range of currencies, we get a new set of conditions on the original ($n \times n$) price matrix. These conditions can be expressed in a triangular arrangement of principal minors as follows:

$$\begin{aligned} & b_{ii} < 0; \\ & \begin{vmatrix} b_{ii} & b_{ij} \\ b_{ji} & b_{jj} \end{vmatrix} > 0; \begin{vmatrix} b_{ii} + b_{ij} \\ + b_{ji} + b_{jj} \end{vmatrix} < 0; \\ & \begin{vmatrix} b_{ii} & b_{ij} & b_{ik} \\ b_{ji} & b_{jj} & b_{jk} \\ b_{ki} & b_{kj} & b_{kk} \end{vmatrix} < 0; + \begin{vmatrix} b_{ii} + b_{ij} & b_{ik} \\ + b_{ji} + b_{jj} & b_{jk} \\ + b_{ki} + b_{kj} & b_{kk} \end{vmatrix} > 0; \begin{vmatrix} b_{ii} + b_{ij} + b_{ik} \\ + b_{ji} + b_{jj} + b_{jk} \\ + b_{ki} + b_{kj} + b_{kk} \end{vmatrix} < 0; \\ & \text{etc. (32)} \end{aligned}$$

The conditions on the left side of the stability triangle are the conditions of perfect stability Hicks developed; they do not provide the information implicit in extending the analysis to the numéraire commodity. The conditions on the base of the triangle result from extending the Hicksian method to the numéraire; they ignore the experiments resulting from allowing currency areas to appreciate. Finally, the conditions on the right side of the triangle are the conditions applicable when various sets of prices are raised in the same proportion, other prices remaining constant. More generally, the Hicks conditions on the left correspond to Hicksian adjustments when each currency (commodity) is treated in isolation; the adjacent conditions to their right are the Hicksian conditions when in the i th and j th goods move in the same

proportion; and so on. The entire set of conditions are needed if the logic of Hicks' method is carried out to the bitter end.¹⁴

The General Conditions and Dynamic Stability

An important implication of the general conditions is that a system satisfying the Hicks conditions, but not the general conditions, will be stable or unstable depending on which currency is adopted as the key currency.¹⁵ Consider, for example, a world of three currencies, dollars (currency 0), pounds (currency 1), and francs (currency 2), and suppose that the balances of payments of the three countries are related to exchange rates according to the equations

$$\begin{aligned} B_0 &= 0.5p_0 + 1.5p_1 - 2p_2 \\ B_1 &= -p_0 - 2p_1 + 3p_2 \\ B_2 &= 0.5p_0 + 0.5p_1 - p_2 \end{aligned} \quad (33)$$

where the exchange rates are defined in, and the B_i are expressed in, an abstract unit of account (IMF par value units). (Equilibrium exchange rates are unity or any multiple of unity, as the system is homogenous of degree 0.)

Let us consider a dynamic system in which the dollar is constant with respect to its par value so that the dollar becomes the effective numéraire. Let the par values of the pound and franc adjust in proportion to B_1 and B_2 , respectively. We then have the following dynamic system:

$$\begin{aligned} \dot{p}_1 &= k_1(-\bar{p}_0 - 2p_1 + 3p_2) \\ \dot{p}_2 &= k_2(-0.5\bar{p}_0 + 0.5p_1 - p_2). \end{aligned} \quad (34a)$$

¹⁴ Stability conditions should, in principle, be “invariants” in the sense that they are independent of the choice of units in which commodities are measured; this corresponds to Lange's “principle of invariance” ([41], p. 103). The above stability conditions are invariants only if, as is assumed in the case of the foreign exchange market analysis, the b_{ij} 's are all measured in equivalent currency units.

In the general case, however, where prices respond to excess demands denominated in physical quantity units, the units in which $b_{ij}(j = 1, \dots, n)$ is measured differ from the units in which $b_{ij}(j = 1, \dots, n)$ is measured. This means that invariant stability conditions require that each row of every stability determinant involving the sum of elements be multiplied by an arbitrary number reflecting units of measurement. Thus “unit-invariant” stability in the general case involves the sign of terms such as

$$\begin{pmatrix} k_i b_{ii} + k_i b_{ij} \\ + k_j b_{ji} + k_j b_{jj} \end{pmatrix} < 0.$$

For arbitrary values of k_i and k_j extended over the entire range of the $(n + 1) \times (n + 1)$ - B determinant, and given the homogeneity postulate, the general conditions then imply that all goods are gross substitutes.

¹⁵ From a historical point of view, it is somewhat amusing that although the Hicks conditions are not symmetrical with respect to the commodity chosen as numéraire, neither are the (normalized) dynamic systems used to refute the validity of the Hicks conditions as true dynamic stability conditions.

In this system, the Hicks conditions of perfect stability, narrowly interpreted, are satisfied (since $b_{11} = -2 < 0$, $b_{22} = -1 < 0$), and

$$\begin{vmatrix} b_{11} & b_{12} \\ b_{21} & b_{22} \end{vmatrix} = 0.5 > 0$$

and the system is dynamically stable regardless of the (positive and finite) values of k_1 and k_2 .

Consider, however, a system in which the par value of the franc is fixed so that it becomes the “key currency” instead of the dollar. The dynamic system then becomes

$$\begin{aligned} \dot{p}_0 &= k_0(0.5 p_0 + 1.5 p_1 - 2 \bar{p}_2) \\ \dot{p}_1 &= k_1(-p_0 - 2 p_1 + 3 \bar{p}_2) \end{aligned} \tag{34b}$$

for which the Hicks conditions are not satisfied. It is dynamically stable or unstable according to whether $k_0 \square 4k_1$

This result could be predicted at once by applying the general conditions as given in the stability triangle (32). The sum of the coefficients in (34a) are positive, so the general conditions are not satisfied.

The general conditions are necessary conditions for a system to be stable regardless of the currency (commodity) chosen as key currency (standard commodity) and regardless of how quickly the various exchange rates adapt to disequilibrium. This proposition is perfectly general in the sense that it is valid in the n -currency case.¹⁶

Hicksian Stability and the Theory of Economic Policy

I shall conclude this book by showing how the Hicks conditions, extended as above, can be useful in devising dynamic mechanisms that are “strongly stable.” The problem could be approached from the direction of the correspondence principle, which, in a narrow version of it, suggests that we apply to comparative statics the conditions that the characteristic equation of the systems have negative real parts. The justification for this narrow version lies in the observation that the systems we know are not characterized by instability. But there is no reason, in principle, why stronger conditions could not be applied. We could, following Hicks (and Samuelson), require that the system be stable no matter which subsets of market variables are held constant. Alternatively, we could use conditions that the roots be real or complex according to whether we observe cycles in the system under investigation.¹⁷ If, for example, we observe an absence of cycles in the real world,

¹⁶ The proof in the general case follows by analogy to the proof of Metzler ([62], pp. 280–285) when his method is extended to include the augmented system.

¹⁷ I have applied this method to the problem of disentangling lags in expectational and cash balance adjustments [77].

we know at once that the Hicks conditions are sufficient conditions for dynamic stability.

In the theory of policy (under incomplete information) the problem is often to choose among different dynamic systems, or different degrees of centralization of a given dynamic system; this is often expressed in terms of allocating, dynamically, instruments to targets (the problem of effective market classification), and we may want to construct *strongly* stable systems: first, because systems near the borderline of stability may become unstable if disturbed by outside shocks; second, because the cost of adjustment may be higher if the system, even though stable, oscillates in its approach to equilibrium; third, because slight errors in manipulating rates of changes in instrumental variables (interest rates, exchange rates, and so on) may turn a weakly stable system into an unstable system; and, finally, because the time involved in approaching equilibrium may be less under strongly stable systems and rapid adjustment may be preferred to slow adjustment.

We can consider, therefore, the problem of choosing a dynamic control mechanism with “hyperstable” properties, in the sense that variables rise or fall whenever they are out of equilibrium, and show how the Hicks conditions can be of some help in constructing such a system when the precise location of an equilibrium is not known.

We take again as our example an international currency system. In a general hyperstable system it will be necessary to vary exchange rates, taking into account the balances of payments of each country. The problem is to find the weights each central bank should give their own balance of payments disequilibrium and that of the other countries.

Let B_i represent, as before, the balance of payments of the i th country, dependent upon the n exchange rates, according to the equation

$$B_i = \sum_{j=1}^n b_{ij}(p_j - p_j^0) \quad (i = 1, \dots, n). \quad (35)$$

The problem is to find the values of the k_{ij} 's in

$$\frac{dp_i}{dt} = \sum_{j=1}^n k_{ij} B_j \quad (i = 1, \dots, n) \quad (36)$$

that will make the system hyperstable. (The “speed” k_{ij} can be interpreted as the weight that country i has to give to the condition of the balance of payments of the j th country in adjusting its own exchange rate.)

It is readily shown that the system (36) is hyperstable if the k 's are chosen so that

$$k_{ij} = \alpha_i \frac{\Delta_{ji}}{\Delta} \quad (i, j, -1, \dots, n) \quad (37)$$

where α_i is a negative real constant and the Δ_{ji} 's are, as before, the cofactors of Δ . The condition (37) means that the hyperstable speeds are weighted elements of the inverse of the price matrix.

To prove this proposition we need to prove that the dynamic system

$$\dot{p}_i = \alpha_i \sum_{j=1}^n \frac{\Delta_{ji}}{\Delta} B_j \quad (i = 1, \dots, n) \quad (38)$$

is hyperstable. Substituting for B_i from (35) gives us

$$\dot{p}_i = \alpha_i \sum_{j=1}^n \sum_{k=1}^n \frac{\Delta_{ji}}{\Delta} b_{jk} (p_k - p_k^0) \quad (i = 1, \dots, n) \quad (39)$$

But, from the properties of any determinant, the typical term

$$\sum_{j=1}^n \frac{\Delta_{ji}}{\Delta} b_{jk}$$

has a value of unity for $k = i$ and a value of zero for $k \neq i$. The system (39) therefore reduces to

$$\dot{p}_i = \alpha_i (p_i - p_i^0) \quad (40)$$

which is necessarily hyperstable for any $\alpha_i < 0$ since it has a solution¹⁸

$$p_i = p_i^0 + A e^{\alpha_i t}. \quad (41)$$

It is instructive to write out the hyperstable system (38) in detail to see clearly the implications of Hicksian perfect stability for dynamics:

$$\begin{aligned} \dot{p}_1 &= \alpha_1 \frac{\Delta_{11}}{\Delta} B_1 + \alpha_1 \frac{\Delta_{21}}{\Delta} B_2 + \dots + \alpha_1 \frac{\Delta_{n1}}{\Delta} B_n \\ \dot{p}_2 &= \alpha_2 \frac{\Delta_{12}}{\Delta} B_1 + \alpha_2 \frac{\Delta_{22}}{\Delta} B_2 + \dots + \alpha_2 \frac{\Delta_{n2}}{\Delta} B_n \\ &\vdots \\ \dot{p}_n &= \alpha_n \frac{\Delta_{1n}}{\Delta} B_1 + \alpha_n \frac{\Delta_{2n}}{\Delta} B_2 + \dots + \alpha_n \frac{\Delta_{nn}}{\Delta} B_n. \end{aligned} \quad (42)$$

¹⁸ More directly the matrix equation $\dot{p} = k B \alpha (p - p^0)$ reduces to $\dot{p} = \alpha (p - p^0)$ if $k = B^{-1}$.

The usefulness of this result lies not so much in providing a policy maker with the rules of adjustment, since there is no problem if the basic matrix is known, and the rule gives insufficient information if the basic matrix is not known. The point is rather that pieces of information about the inverse may be sufficient to distract policy makers from mistakes, and that conditions like the Hicks conditions may be a sufficient guide to the relative importance to be attached to particular instruments.

We shall also find it convenient to consider a reduced system in which we choose the α_i , the *rate* at which each p_i is restored to equilibrium (with a negative sign), to be equal to the corresponding Hicksian conditions of imperfect stability as given in (8), that is, we equate

$$\alpha_i = \frac{\Delta}{\Delta_{ii}} < 0 \quad (43)$$

to get

$$\begin{aligned} \dot{p}_1 &= B_1 + \frac{\Delta_{21}}{\Delta_{11}} B_2 + \dots + \frac{\Delta_{n1}}{\Delta_{11}} B_n \\ \dot{p}_2 &= \frac{\Delta_{12}}{\Delta_{22}} B_1 + B_2 + \dots + \frac{\Delta_{n2}}{\Delta_{22}} B_n \\ &\vdots \\ \dot{p}_n &= \frac{\Delta_{1n}}{\Delta_{nn}} B_1 + \frac{\Delta_{2n}}{\Delta_{nn}} B_2 + \dots + B_n. \end{aligned} \quad (44)$$

Two observations can immediately be made about (44). First, if the elements of the inverse matrix all have the same sign, hyperstability implies that positive weights be assigned to each balance of payments. Thus, "Britain" should depreciate (appreciate) more rapidly the greater the deficits (surpluses) in the balance of payments of other countries, for any given deficit in her own balance (this implies corresponding changes in the U.S. balance). But from Mosak's theorem the elements in the inverse will all have the same sign if the original currency matrix $[b_{ij}]$ is a gross substitute matrix provided $[b_{ij}]$ is Hicksian; and it will be Hicksian provided the dollar is also (reciprocally) a substitute for all other currencies.

The second point to notice about (44) is that "Britain" should attach less weight to the balance of payments of other countries' currencies than to her own balance if currencies are all substitutes for one another; this follows because every ratio $\Delta_{ji}/\Delta_{ii} < 1$ for $j \neq i$.¹⁹

Leaving now the special case of the gross substitutes to return to the more general case represented by equations (42), we can find immediate implications of the Hicks conditions. First, if the Hicks conditions are satisfied, "normal" adjustments are implied in the sense that, *ceteris paribus*, a deficit in a country's balance of payments suggests depreciation and a surplus appreciation; this follows because every $k_{ii} = \Delta_{ii}/\Delta > 0$ given the Hicks conditions of imperfect stability and $\alpha_i < 0$.

But more than this can be said. The following identities have to hold, from our definitions and Jacobi's ratio theorem:

$$\begin{vmatrix} k_{ii} & k_{ij} \\ k_{ji} & k_{jj} \end{vmatrix} = \alpha_i \alpha_j \begin{vmatrix} \Delta_{ii} & \Delta_{ij} \\ \Delta_{ji} & \Delta_{jj} \end{vmatrix} \equiv \alpha_i \alpha_j \Delta \Delta_{ii, jj} > 0 \quad (45)$$

¹⁹ I have discussed the implications of this condition in some detail [78].

the inequality following at once from the Hicks conditions of perfect stability. Proceeding to the last term we have

$$\begin{vmatrix} k_{11} & \cdots & k_{1n} \\ \vdots & & \vdots \\ k_{n1} & \cdots & k_{nn} \end{vmatrix} = \alpha_1 \cdots \alpha_n \begin{vmatrix} \Delta_{11} & \cdots & \Delta_{1n} \\ \vdots & & \vdots \\ \Delta_{n1} & \cdots & \Delta_{nn} \end{vmatrix} \equiv \alpha_1 \cdots \alpha_n \Delta (-1)^n > 0. \quad (46)$$

More generally, if the basic matrix $[b_{ij}]$ is Hicksian, the matrix of the speeds required for hyperstability must satisfy the conditions that every principal minor be positive, that is,

$$k_{ii} > 0; \begin{vmatrix} k_{ii} & k_{ij} \\ k_{ji} & k_{jj} \end{vmatrix} > 0; \text{ etc.} \quad (47)$$

Analogous conditions hold for the extended Hicks conditions if the system is to be hyperstable regardless of the currency used as the key currency. In this sense the Hicks conditions alone are sufficient to establish in a weak sense the correctness of exchange rate policies directed at correcting “own” balances of payments.

These developments conform to the conclusions of economic intuition; indeed, they may be interpreted as bringing the mathematical treatment of the subject closer to the level of common sense. They nevertheless suggest that the Hicksian stability analysis is not lacking in significance for the integration of dynamical and static theory.^{20 21}

²⁰ Even the gap between the true dynamic stability and Hicksian stability may be bridged by integrating Hicksian stability conditions with the “Samuelson–Le Châtelier principle” (see, for example, Samuelson [93]) which can be expressed entirely in terms of the Hicksian determinants. Hicksian stability and dynamic stability mesh together under appropriate conditions of gross substitutes, gross complements, and symmetry, a common link being sign symmetry; and sign symmetry of the inverse of the basic Hicksian matrix is sufficient for at least one of the Le Châtelier conditions to hold ($\Delta\Delta_{ii,jj} - \Delta_{ii}\Delta_{jj} < 0$ if Δ_{ij} and Δ_{ji} have the same sign).

²¹ A further implication of the Hicks conditions was called to my attention by Daniel McFadden, who had proved, in a paper presented at the 1963 Econometrica Society meetings in Boston, Massachusetts, that if the Hicks conditions of perfect stability are satisfied, a stable dynamic system of the form $\dot{p} = KB(p - p^0)$ can always be found for a diagonal K matrix with positive diagonal coefficients; the result also holds in the global form. Prior to McFadden's result, and unknown to him, a local version of the theorem had been published; see Fisher and Fuller [15].

In the context of the currency problem discussed above, the theorem means that if the Hicks conditions are satisfied, it is always possible to find a stable dynamic system in which exchange rates are adjusted to “own” balances of payments only.

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