PRINCETON STUDIES IN INTERNATIONAL FINANCE NO. 28

International Adjustment, Open Economies, and the Quantity Theory of Money

Arnold Collery

INTERNATIONAL FINANCE SECTION
DEPARTMENT OF ECONOMICS
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INTERNATIONAL ADJUSTMENT, OPEN ECONOMIES, AND THE QUANTITY THEORY OF MONEY

1. INTRODUCTION

The adjustment mechanism in international trade has been a subject of controversy since Hume first suggested its existence. Agreement on certain basic premises, such as the quantity theory of money, has not prevented combatants from disagreement over events likely to cause balance-of-payments deficits or on the mechanism by which they might be eliminated. The controversy carries over into the analysis of exchange depreciation, the battle between absorption and elasticity approaches being the most recent manifestation.

Fundamentals are often neglected, because everyone is sure they are understood. Yet the confusion is so great that balance-of-payments adjustment and exchange-rate variations are even analyzed in models without money. Since the foreign-exchange rate is the price of one money in terms of another, how can anything be said about the behavior of such a price in a world without money? In a world of barter, what possible meaning can be given to a balance-of-payments deficit?

In this paper there is an attempt to return to fundamentals. To do so, we shall first present a quantity-theory model of a closed economy and then extend it to an open economy. The comparative-static, equilibrium propositions implicit in the analysis shall be deduced and consideration given to the conditions necessary for stability. In the end we shall maintain that there are three different approaches that can be and have been taken to explain the stability of the equilibrium distribution of gold, and we shall insist that only one of them is good theory. We shall also show that, under the quantity theory, propositions about the distribution of gold can be easily turned into propositions about the exchange rate when money stocks are inconvertible.

So much has been written on the subject in the last two hundred years that it would be surprising if we had many entirely new propositions to present here. The few propositions that I feel are novel may, as so often is the case, be rediscoveries, as the absorption approach is a rediscovery of Ricardo and his doctrine that gold flows out only when "money is redundant." If this paper makes a contribution to trade theory it will be because it presents a terse, but fairly complete, statement of what the quantity theory implies in an open economy and because it points to one of the main sources of controversy.

2. THE QUANTITY THEORY IN A CLOSED ECONOMY

Assume that output in a closed economy consists of two goods, A and B. Let Q_A and Q_B represent the quantities of these goods produced and P_A and P_B their prices. Money output and income would then equal $P_A Q_A$ plus $P_B Q_B$.

The amount of money that people wish to hold, L, is some fraction, K, of output. If we let p represent P_B / P_A, we have

(1) $L = K P_A (Q_A + p Q_B)$,

where Q_A plus $p\, Q_B$ is real output measured in terms of good A.

In a state of equilibrium desired money balances, L, must equal the stock in existence, M. Therefore, we also have

(2) $L = M$.

The basis of the monetary system is some commodity money; we shall assume gold. The money stock is a multiple, g, of the money gold stock, $P_G G$, where P_G is the price of gold and G is the physical quantity of it. The gold-stock multiplier, g, is equal to or greater than one. Thus,

(3) $M = g P_G G$.

All or only part of $P_G G$ may circulate as money; if some of it does not circulate, it serves as reserves.

If the three equations are solved simultaneously, eliminating L and M, the following equation is obtained:

(4) $P_A K(Q_A + p Q_B) = g P_G G$.

The gold stock, G, is assumed to be independent of its value; a higher value does not increase its production and a lower value does not increase its consumption.[1] Treat K, g, and P_G also as parameters.

[1] If gold were in current production, then either A or B would have to be gold. If we assumed that the A-good was gold, then P_A would equal P_G, and equation (4) would become $K\ (Q_A + p\ Q_B)$ equals $g\ G$. Given K, g, and real output, the equation would determine G. An increase in the demand for money, an increase in K, would have no effect on prices, if relative prices were fixed by constant costs of production. The increased demand for money would simply lead to an expansion of the supply, since G would increase. Changes in the gold-stock multiplier would also leave the price level unchanged, since any change in g would be thwarted by an inversely proportional change in G. There is a necessary qualification, however, to this last proposition. In the long run, G might again rise somewhat because the substitution of cheap money, paper or deposits, for dear money, gold, would free resources, making real output greater than it

Finally, assume that Q_A plus $p\ Q_B$, real output measured in terms of A-good, is constant in equilibrium, given tastes, supplies of the productive factors, and the production functions; Q_A, Q_B, and p are determined by production conditions and consumer preferences and are constant in equilibrium unless the conditions or preferences change. Equation (4) then contains only one endogenous variable, P_A, which is an index of all prices other than of gold. Its equilibrium value is known once g, P_G, G, K, and real output are known.

Any change in the term on the right side of equation (4), given K and real output, would lead to a proportional change in P_A in equilibrium. Since the right side is the supply of money, the price of A-good is proportional to the money supply. And, since we are assuming that relative prices are constant in equilibrium, all prices, other than the price of gold, are proportional to the money stock.

There are three ways the money supply could be increased: by an increase in the gold-stock multiplier, g; by an increase in the price of gold, P_G; or by an increase in the physical stock of monetary gold, G. Thus, a doubling of the gold-stock multiplier, the price of gold, or the physical gold stock would double the price level. A doubling of the price of gold would have no effect, however, on the price level if the gold-stock multiplier were cut in half; the increase in P_G would be offset by a decrease in g, leaving the money stock unchanged.

Any increase in a term on the left side of equation (4), other than P_A itself, would lead to a proportional decrease in P_A. The equilibrium price level is, therefore, inversely proportional to K, the fraction of output the public wishes to hold in the form of money, and real output.

Changes in the equilibrium price level are to be explained by temporary divergences between the demand and supply of money. If g, P_G, or G were to increase or if K or real output were to decrease, there would be an excess supply of money temporarily. The excess supply of money would imply an excess demand for goods. Prices would rise, increasing the demand for money until it again equalled the supply.[2]

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would have been. Finally an increase in the price of gold would raise all prices in proportion, no matter what happened to the gold-stock multiplier, since with constant costs, relative prices would be unchanged. We shall not pursue this analysis further here.

[2] This comparative, static, equilibrium analysis depends on an assumption of stable markets. When an initial equilibrium is disturbed, relative prices could vary during the process of adjustment. If a disturbance of an equilibrium could cause p to rise or fall erratically, the analysis would be of little interest. For

3. THE QUANTITY-THEORY MODEL EXTENDED TO AN OPEN ECONOMY

To convert this model of a closed economy into one for an open economy, assume that there are two countries, *A* and *B*, in which equations (1), (2), and (3) must hold. Country *A* exports *A*-good and Country *B* exports *B*-good. Using superscripts to indicate the country, we have

(4*a*) $P^A_A K^A (Q^A_A + p^A Q^A_B) = g^A P^A_G G^A$ and

(4*b*) $P^B_A K^B (Q^B_A + p^B Q^B_B) = g^B P^B_G G^B.$

The price of foreign exchange in Country *A*, the price of *B*'s money in terms of *A*'s, equals $P^A_G \, / \, P^B_G$. Ignoring all impediments to trade, the price of any good in Country *A* must equal the price of that good in Country *B* multiplied by the price of foreign exchange in *A*. Therefore,

(5) $P^A_A = (P^A_G \, / \, P^B_G)\, P^B_A$ and

(6) $P^A_B = (P^A_G \, / \, P^B_G)\, P^B_B$.

Equations (5) and (6) are equivalent to saying that a unit of gold must be capable of exchanging for the same quantity of either good in either country; gold has the same purchasing power everywhere.

From equations (5) and (6) we learn that $P^A_B \, / \, P^A_A$ equals $P^B_B \, / P^B_A$, so

(7) $p^A = p^B = p,$

where p is the relative price of the *B*-good in either country.

Let us consider first the case of a "small" country, one that can have no significant effect on prices in international markets. Assume that Country *A* is such a small country and that prices in the rest of the world are unaffected by its behavior.

If equations (5) and (7) are substituted into (4*a*), we find that

(8) $$G^A = \frac{K^A \,(Q^A_A + p\, Q^A_B)\, P^B_A}{g^A \qquad P^B_G},$$

where P^B_A, P^B_G, and p are determined outside of Country *A*. Gold reserves in Country *A* are then dependent on *A*'s desired ratio of money to income, K^A, its gold-stock multiplier, g^a, its real output, Q^A_A plus $p \, Q^A_B$, and the purchasing power of gold in the rest of the world, $P^B_A \, / \, P^B_G$. If the demand for money increased in Country *A*, K^A would

stability of relative price, an increase in p must lead to an excess supply of *B*-good and an excess demand for *A*-good.

be greater and the gold stock would increase in equilibrium. If its real income increased, this would also raise its equilibrium gold stock. An increase in the gold-stock multiplier, through say an open-market purchase by the monetary authorities, would reduce its gold holdings. And any increase in prices in the rest of the world relative to the price of gold in *A* would increase *A*'s equilibrium gold stock.

The adjustment from one equilibrium to another can be explained in the following manner. If the desired ratio of money to income increased in *A*, if real income increased in *A*, if its gold-stock multiplier decreased, or if prices increased in the rest of the world relative to the price of gold, the demand for money would temporarily exceed the supply in Country *A*. The excess demand for money would lead to a reduction in expenditures, creating an excess supply of commodities. The goods that could not be sold domestically at unchanged prices would be sold abroad, where the demand for them is virtually infinitely elastic. In exchange for the goods, gold would be received, raising the stock of money until it was again equal to the demand. With prices determined in world markets independently of supply and demand conditions in Country *A*, changes in prices would play no significant role in the adjustment to disequilibrium; a country would gain gold whenever its demand for money exceeded the supply. It would make no sense to ask what mechanism such a gold flow would trigger to prevent the flow from continuing indefinitely, for the movement of gold into the country would be an adjustment mechanism itself. The flow of gold eliminates the cause of it, which was an excess demand for money.

Let us now turn to an alternative analysis, one which is based on the assumption of two interdependent countries, neither of which dominates the other. This is the case that has received most attention in the literature.

Equations (4*a*), (4*b*), (5), (6), and (7) can be solved simultaneously to yield the following equation in which the relative price of *B*-good is the only price that appears.

$$(9)\quad \frac{G^A}{G^B} = \frac{g^B K^A (Q_A^A + p\, Q_B^A)}{g^A K^B (Q_A^B + p\, Q_B^B)}\,.$$

If the total amount of monetary gold held by the two countries is constant—G^A plus G^B is constant—an increase in G^A / G^B implies an increase in G^A and a decrease in G^B. When G^A / G^B has increased, Country A has experienced a balance-of-payments surplus and Country B a deficit.

Country B's terms of trade is p; its reciprocal is A's terms of trade. Assuming for the present that the terms of trade and real output in both countries are constant, several *ceteris paribus* propositions are implicit in equation (9).

First, an increase in the gold-stock multiplier in any country would cause that country to lose gold. If g^a rose, G^A / G^B would fall; Country A would have a temporary balance-of-payments deficit, Country B a surplus. If g^B rose, G^A / G^B would rise; A would have the surplus and B the deficit. An increase in the gold-stock multiplier in any country would also lead to world inflation. Since an increase in g^A implies an increase in G^B, given g^B, P^B_G, K^B, and real output in B unchanged, equation (4*b*) implies that P^B_A would be higher. If P^B_A rises, P^A_A rises proportionally—equation (5). A country's ability to raise the world price level would be limited by its gold stock. A continual increase in the gold-stock multiplier would eventually lead to a loss of all monetary gold. And one country's ability to alter the world price level depends on the acquiescence of the other. If Country A raised g^A, tending to inflate, Country B could simultaneously lower g^B, to prevent inflation. Country B would then gain gold from Country A. In a war of this sort, the country attempting to inflate must eventually lose—it must stop its action, alter its price of gold, or abandon the gold standard, if the rest of the world persists in its anti-inflationary policies.

A second proposition implicit in equation (9) concerns real output. An increase in output in any country would cause that country to gain gold. If $(Q^A_A + p\, Q^A_B)$ rose, G^A / G^B would rise, and if $(Q^B_A + p\, Q^B_B)$ rose, G^A / G^B would fall. An expansion of output in any country would, therefore, generate a balance-of-payments surplus for it. In addition, growing real output in any country would cause prices to fall everywhere. Since the country whose output has not increased would lose gold, its price level would be lower in equilibrium. But if its equilibrium price level were lower so would be that of the other country, if the prices of gold are unchanged. Both these implications of growth depend on an implicit assumption about monetary policy; the gold-stock multipliers are constant. If a growing country raised g in proportion to the growth, the equilibrium distribution of gold would be unchanged and prices would remain the same in both countries. For if g^A

is increased in proportion to an increase in $(Q^A_A + p\ Q^A_B)$, the equilibrium value of $G^A\ /\ G^B$ would remain the same.

A third proposition implicit in equation (9) concerns the price of gold. An increase in the price of gold in one of the countries, devaluation, without a change in the gold-stock multiplier would have no effect on gold holdings; devaluation under these circumstances would not produce a balance-of-payments surplus. Since the equilibrium distribution of gold is determined by equation (9) and since P^A_G and P^B_G do not appear in that equation, changes in gold prices could have no effect on gold distribution. An increase in the price of gold in one country with its gold-stock multiplier unchanged would increase its money stock and prices in proportion and leave unchanged the money stock and prices in the other country. It must be carefully noted, however, that this conclusion also depends on other factors remaining unchanged. If the devaluing country reduced its gold-stock multiplier in proportion to the increase in the price of gold, initially keeping its money stock constant, it would gain gold and in the new equilibrium it would have higher prices. The other country would lose gold and have lower prices. That Country *B* would lose gold if Country *A* reduced g^A is clear from equation (9), as we have shown above. If G^B falls, so does P^B_A, given *B*'s parameters unchanged.

If the devaluing country took even stronger anti-inflationary action, letting *g* fall enough to stabilize prices, then with the price of gold unchanged in the other country, prices would fall in the nondevaluing country in proportion to the devaluation and it would lose even more gold. According to equation (5), if P^A_G is higher and P^B_G and P^A_A unchanged, P^B_A will be proportionally lower.

A final proposition implicit in equation (9) concerns the demand for money. An increase in the amount of money that people wish to hold in any country relative to output would increase that country's equilibrium stock of gold. If K^A increased, $G^A\ /\ G^B$ would increase; Country *A* would have a temporary balance-of-payments surplus; Country *B* a deficit. If K^B increased, $G^A\ /\ G^B$ would decrease; Country *B* would have the surplus and *A* the deficit. In addition, it is clear that an increase in *K* in either country would lead to world deflation. Since an increase in K^A reduces G^B, then, according to equation (4*b*), P^B_A would fall. But if P^B_A falls, P^A_A falls proportionally—equation (5).

If a country was thought likely to raise the price of gold, the demand for money in that country would fall and the demand for money in the other country rise, as speculators got rid of one money to obtain the other. If P^A_G were expected to rise, K^A would fall and K^B would rise; according to equation (9) both changes would redistribute gold toward Country *B*. Country *A* would experience a serious drain on its gold stock. If Country *B* reduced g^B to prevent an expansion of its money stock, the net effect would be a contraction of the world's money supply and world deflation. Assuming Country *B* wished to remain on the gold standard, it might be forced to do what was expected.

4. STABILITY OF THE DISTRIBUTION OF GOLD

The propositions of comparative, static equilibrium considered in the previous section would be of no interest if the equilibrium distribution of gold given by equation (6) were unstable. Which leads us to ask whether G^A / G^B would fall if it were above its equilibrium value, as given by equation (9), and if so, why?

Since we are assuming no impediments to trade, equations (5) and (6) cannot be violated; goods must sell for the same price everywhere when expressed in the same currency. If, therefore, equation (9) does not hold, it must be because equations (4*a*) and (4*b*) are violated. Disequilibrium exists when the demand and supply of money are not equal in both countries.

Imagine that an initial equilibrium is disturbed by some magical redistribution of gold between the two countries; Country *A* gains gold and *B* loses it. With no change in any parameter in equation (9), G^A / G^B would exceed its equilibrium value. What would then happen? It is clearly impermissible to say that the excess supply of money in Country *A* would raise *A*'s prices and the excess demand for money in *B* would lower *B*'s prices, for that would imply that gold could have different values in different countries when there are no impediments to trade. What we can say is that the excess supply of money in Country *A* would lead to an increased demand for goods; the excess demand for money in *B* would lead to a reduced demand for goods. Country *A* would spend its excess money holdings at the same time that Country *B* reduced demand to reestablish its desired money holdings. The excess supply of commodities created by Country *B* would match the excess demand for commodities created by Country *A*. Country *A* would buy the commodities not bought by *B*, and Country *B* would get back its gold. Thus, the equilibrium distribution of gold determined by equation (9) would be stable in the sense that, if a country had more than its equilibrium holdings, its holdings would fall; if it had less, it would rise.[3]

Consider now a less artificial disturbance to equilibrium. We showed in the previous section that an increase in the gold multiplier in any country would reduce its equilibrium gold holdings. If, therefore, g^A increased, in equilibrium G^A would be less and G^B greater. Temporarily, until the adjustment occurred, G^A / G^B would be above its new equilibrium value. How should we explain the decline in G^A / G^B to its new equilibrium value?

The increase in the money supply in Country *A* brought about by the increase in the gold-stock multiplier would generate an excess demand for commodities. Prices would rise in Country *A* and would also rise in Country *B*, since the value of gold must be the same in both countries. The higher prices in Country *B* with no change in its money stock would lead to an excess demand for money; the demand for goods would fall in Country *B*. Some higher price level would exist at which the excess supply of goods in Country *B*, its excess demand for money, would equal the excess demand for goods in Country *A*, its excess supply of money. At that price level, Country *A* would import more than it exports, paying Country *B* for its excess of exports over imports with gold. G^A / G^B would fall.

It would be foolish to ask after the gold movement has occurred what the mechanism is that prevents its continuance. The movement of gold from *A* to *B* is itself an adjustment mechanism, for it comes about in response to an excess supply of money in one country and an excess demand in the other. The movement of gold eliminates both the excess supply and the excess demand. Unless the movement were insufficient or too great to restore equilibrium or unless some new disturbance to equilibrium were to occur, no further gold movement would take place. Insofar as prices are part of the mechanism, it is price movements that cause the gold movements, rather than gold

[3] If the gold-stock multipliers applied instantaneously in each country and were different, prices could initially rise or fall in the adjustment process, depending on whether g^A were greater or less than g^B. If g^A exceeded g^B, the excess demand for goods in *A* would be greater than the excess supply of goods in *B*. Furthermore if the multpliers applied instantaneously, then the initial adjustment could cause G^A / G^B to fall below its equilibrium value and then rise above it again. There could be perpetual oscillations around equilibrium, and it is even possible that the divergences from equilibrium could become greater and greater.

movements causing the prices to change. For it is higher prices that lead to the excess demand for money in Country *B*.

5. INTERNATIONAL TRANSFERS

Assume that Country *B* must make an annual transfer to Country *A*. There are two questions that we shall ask. First, would the transfer necessarily cause Country *B* to lose gold and require some adjustment mechanism to bring it back? Second, if the transfer were actually made in gold, would the gold return, and, if so, by what mechanism?

The equilibrium distribution of the monetary gold stock is given by equation (9). Assuming that an international transfer were made by *B* to *A* and that the assumption on which equation (9) was established were valid, the equilibrium distribution of gold would be unaffected. In the new equilibrium the receiving country would have no more nor less gold or money than it had originally, for nothing in equation (9) is changed. But one may ask if under these circumstances it would have more gold temporarily?

The answer is that it might not. The expected receipt of the transfer in Country *A* could lead to an increased demand for goods. Higher income is expected and none of it, according to equation (4*a*), will be added to money stocks; the demand for goods would, therefore, rise by the entire amount of the transfer. If it did not, money holdings would rise. The expected payment of the transfer could lead to a reduction in the demand for commodities in Country *B*, since lower income is expected and money balances are not to be reduced. Demand must fall by the exact amount of the transfer, or money balances would change. Therefore, Country *A* would demand the goods not bought by Country *B*. *A*'s imports would rise or its exports would fall. Country *A* would demand *B*'s currency to pay for its import surplus, while Country *B* would demand Country *A*'s currency to pay the transfer. Country *B*, the paying country, need never lose gold.

But it is legitimate to ask what would happen if the transfer were paid in gold and demands did not change until money stocks changed. Since we know from equation (9) that the equilibrium distribution of gold is unaltered, there must be some mechanism to return the gold to Country *B*. What is that mechanism? The gold flow would be reversed for the following reason. The gold movement alters the money stock in both countries. In *A*, the receiving country, there would be an excess supply of money. In *B*, the paying country, there would be an excess demand for money. Demand would rise in A and fall in B. Country A would buy more goods, importing more or exporting less. Country B would buy fewer goods, either importing less or exporting more. Country A would give up the gold it received in exchange for goods. Country B would get its gold back by its reduction in expenditures. With Country A expanding demand by the full amount of the transfer and Country B reducing demand by the same amount, there would be no effect on prices in either country.[4]

A plausible case can be made for a permanent transfer leading to a change in the equilibrium distribution of gold. If the demand for money were dependent on income net of transfers, then in equations (4*a*) and (4*b*) the amount of the transfer must be added to real output in A and subtracted from real output in B. If the transfer, T, is represented in terms of A-good, equation (9) would become

$$(9a)\quad \frac{G^A}{G^B}=\frac{g^B K^A (Q^A_A + p\,Q^A_B + T)}{g^A K^B (Q^B_A + p\,Q^B_B - T)}.$$

An increase in T would increase G^A / G^B; Country A, the receiving country, would gain some gold in equilibrium.[5]

If Country A anticipated the receipt of the transfer, it would increase its demand for goods, but not by the amount of the transfer, since with greater net income it would want to hold more money. Country B would reduce its demand for goods by less than the transfer, since it would want to hold less money. Country A would demand more goods and B fewer goods, but by less than the transfer in each case. Country B would, therefore, not develop an export surplus large enough to pay the transfer; and it would lose some gold. If K^A and K^B differed, prices could rise or fall in both countries.

The next period the expenditure of Country A would equal its net income, since desired money balances would have been attained, and, for the same reason, so would Country B's. Forever thereafter Country A would demand more goods and more of B's currency to pay for them than it did in the original equilibrium before the transfer began. Country B would demand fewer goods than in the original equilibrium be-

[4] If the gold-stock multipliers applied instantaneously, temporarily prices could be affected and the system could overadjust.

[5] If we follow Samuelson, who, in a forthcoming article assumes that the marginal utility of leisure is constant, an increase in T would leave real net income unchanged. In that case, the transfer would have no effect on the distribution of gold if demand for money depended on net income, but would if it depended on output.

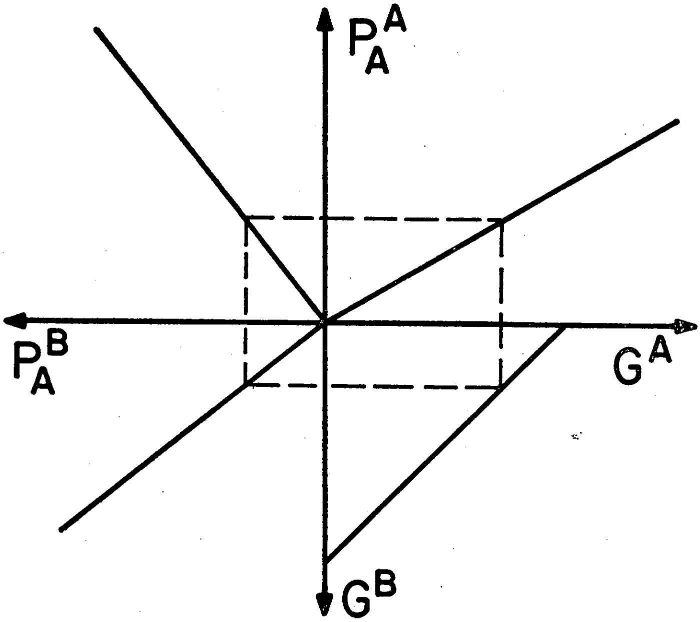
fore the transfer began and would demand A's currency to pay for the transfer. The goods, money, and foreign-exchange markets would all be in equilibrium. Prices need never change significantly anywhere at any time, although they might.[6]

6. A GRAPHIC ANALYSIS

A graphic exposition of the two-country analysis is possible. In Figure 1 there are four functions plotted in four "quadrants." In quad-

FIGURE 1

The Determination of Equilibrium Prices and Gold Distribution in a Two-Country World



With constant gold prices and gold-stock multipliers in Countries A and B, prices in each country are proportional to physical gold stocks as shown in quadrants I and III, and prices in each country are proportional to those in the other as shown in quadrant II. The total gold stock is constant—quadrant IV. The equilibrium values of G^A, G^B, P_A^A, P_A^B are found by inscribing the unique rectangle in the diagram, such that a corner lies on each of the four lines.

[6] Again, the existence of a gold-stock multiplier greater than unity could result in a cyclical adjustment if it applied instantaneously.

rant I, equation (4a) appears. It relates P^A_A to G^A, and its slope, dP^A_A / dG^A, equals $g^A P^A_G$ divided by $K^A(Q^A_A + pQ^A_B)$. A similar function for Country B is plotted in quadrant III. Its slope, dP^B_A / dG^B, is equal to $g^B P^B_G$ divided by $K^B(Q^B_A + pQ^B_B)$. In quadrant II, equation (5) is plotted; its slope, dP^A_A / dP^B_A, equals P^A_G / P^B_B, the price of foreign exchange in Country A.

Finally, the assumption of a fixed international stock of gold is expressed by the line in quadrant IV, where the intercepts are the total physical gold stock and the slope is equal to minus one.

An equilibrium solution is found by inscribing a rectangle in the diagram such that each corner of the rectangle lies on one of the functions. The equilibrium values of the four variables are found at the four points where the rectangle intersects the axes. The reader can test for himself the uniqueness of this solution.

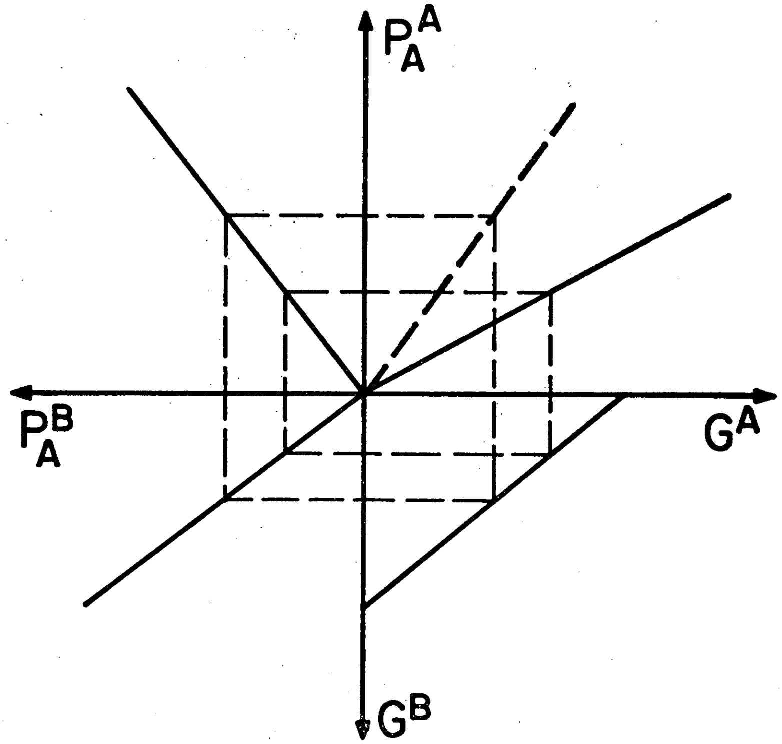
Consider now briefly the consequences of a change in the gold-stock multiplier in one of the countries, say Country A. If g^A rose, then, corresponding to each quantity of gold in A, the money supply and prices would be proportionally higher. Therefore, the value of P^A_A corresponding to each value of G^A would be greater. The slope of the line in quadrant I would increase, and a new equilibrium would be found by inscribing a new rectangle. In Figure 2, an equilibrium before and after an increase in g^A is shown; the dashed line in quadrant I is the relationship between P^A_A and G^A after the increase in g^A. The equilibrium values of P^A_A and P^B_A and G^B increase and G^A falls.

Now consider a change in P^A_G. If Country A devalued, then P^A_G would rise and the slope of the line in quadrant II would be increased in proportion to the devaluation. (In Figure 3 it is assumed that the price of gold in A has doubled.) What about the line in quadrant I? If g^A remained the same, then, corresponding to each value of G^A, M^A would be proportionally greater and so would P^A_A in equilibrium. Therefore, the slope of the line in quadrant I would also increase in proportion to the devaluation, as is also shown in Figure 3. In the new equilibrium, P^A_A would be twice as great, and P^B_A, G^A, and G^B would be unchanged.

In Figure 4 the repercussions of a devaluation in A are also shown. But it is assumed there that g^A is cut in half when P^A_G is doubled, so that the price level corresponding to each value of G^A is the same after the devaluation as it was before. The devaluation under these circumstances raises the gold stock and prices in A and lowers prices and the gold stock in the rest of the world.

FIGURE 2

An Increase in the Gold-stock Multiplier in Country A

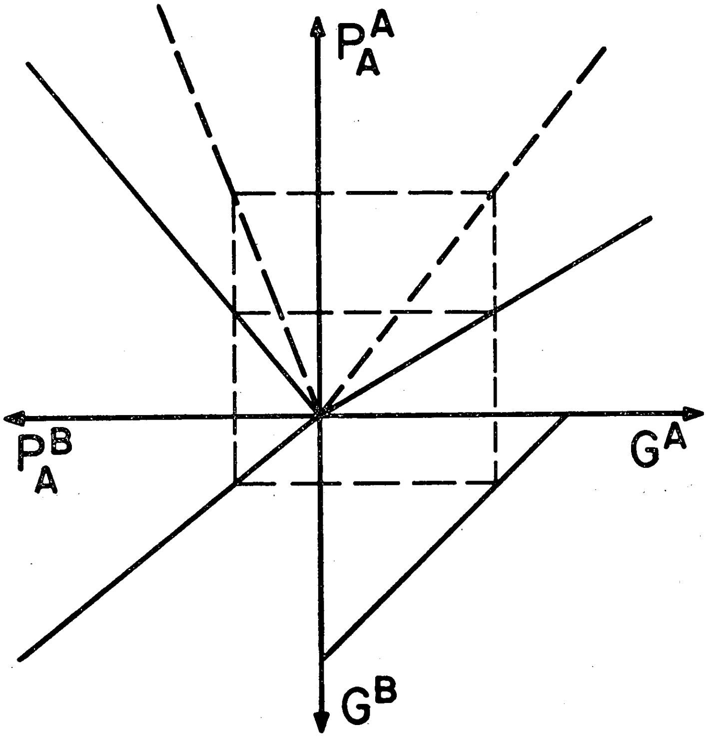


An increase in the gold-stock multiplier in Country *A* results in an upward movement of the line in quadrant I and a new equilibrium.

Finally, consider a transfer that alters the demand for money. If *A* received a transfer from *B* and if the demand for money rose in *A* and fell in *B*, then, given the physical gold stocks in both countries, equilibrium prices would have to be lower in *A* and higher in *B*. Such a case is shown in Figure 5, where the function in the first quadrant moves down and the function in the third quadrant moves up. Country *A*, the receiving country, gains gold in equilibrium and Country *B*, the paying country, loses it. In Figure 5 prices are unchanged in both countries, although they need not be. If the transfer affected the demand for money more in one country than in the other, world prices would be higher or lower depending on whether transfers affect the

FIGURE 3

Devaluation in Country A *with a Constant Gold-stock Multiplier*



A devaluation in Country *A* with a constant gold-stock multiplier results in a proportional upward movement of the lines in quadrants I and II and a new equilibrium.

demand for money relatively less or more in Country *A*, the receiving country, than in *B*.

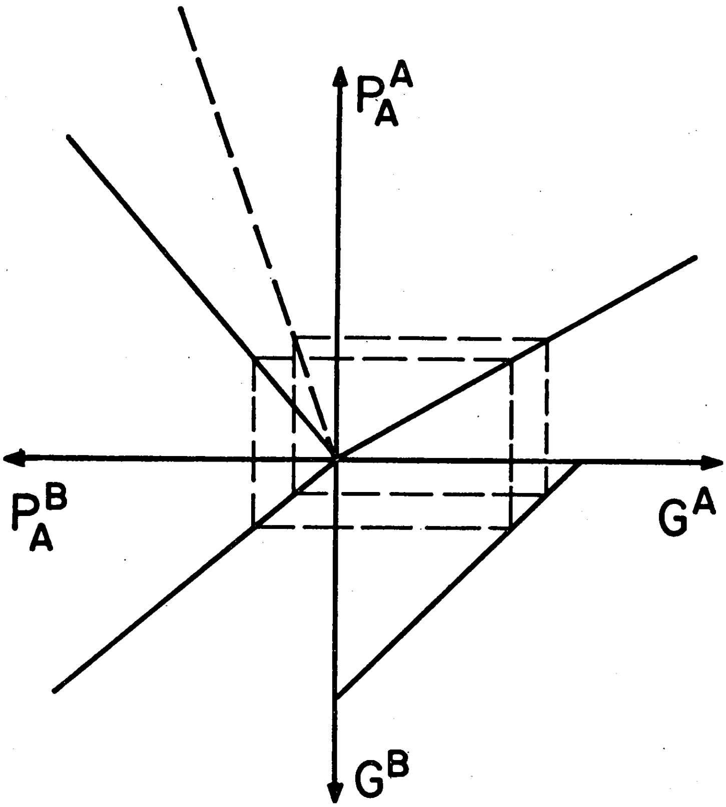
The diagram could also be used to derive the results for the "small-country" case. If Country *A* were the small country, then P_A^B would be constant no matter what the value of G^B; the line in the third quadrant would be horizontal with respect to the G^B axis.

7. TRANSFERS AND THE TERMS OF TRADE

In the above treatment of the quantity theory in an open economy, the terms of trade were assumed constant. If, in the two-country analysis, both countries were incompletely specialized and their marginal

FIGURE 4

Devaluation in Country A with a Proportionally Reduced Gold-stock Multiplier

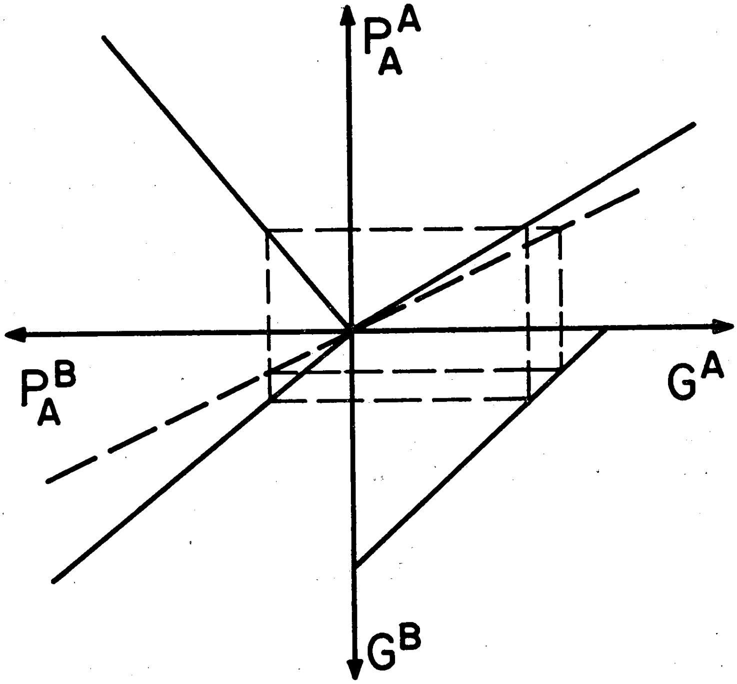


A devaluation in Country *A* with a proportional reduction in its gold-stock multiplier results in an upward movement of the line in quadrant II only and a new equilibrium.

preferences for goods were the same, a transfer from one to the other would not alter relative demands and, therefore, the terms of trade would not change. The previous analysis would require no modification. Furthermore, if only one country were completely specialized and the other country had constant costs, then the terms of trade would be fixed by the cost conditions of the country that is incompletely specialized. Again the previous analysis would be fully applicable.

Figure 5

A Transfer from Country B *to* A *when the Demand for Money Depends on Income Net of Transfers*



A transfer from Country *B* to *A* results in a new relationship between gold and prices in both countries and a new equilibrium.

For, no matter what happened to relative demands, relative prices would not change. What we shall now consider is how the results we obtained would be altered if these conditions did not hold and the terms of trade could change.

If Country *B* pays a transfer annually to Country *A* and if their marginal preferences differ, there would be a change in the composition of demand. If supplies were not perfectly elastic in one of the countries, the price of the good that Country *A* liked relatively well compared to Country *B* would rise and the other price would fall. To determine the effect of this on the equilibrium distribution of gold, consider equation (9*a*). A change in the terms of trade would alter the equilibrium distribution of gold if it altered the ratio of real net income in A to real net income in B, given g^A, g^B, K^A, and K^B. The effect of a change in relative price on a country's real net income measured in terms of one of the goods depends on the relative composition of its output. If we measure real output in terms of A-good, an increase in the value of B-good relative to A-good would have no effect on real output as measured in A-good, if no B-good were produced. It would have the greatest possible effect on output, measured in A-good, if only B-good were produced. Thus, the effect of a change in a country's terms of trade on its real net income depends on the ratio of the output of B-good to net income.

Country A, the receiving country, could gain gold if its terms of trade improved or if they deteriorated, depending on the composition of its output relative to B's. It could lose gold if its terms of trade deteriorated or improved, depending on the same consideration. Consider first the case in which A's terms of trade improve. A transfer from B to A would improve A's terms of trade if on the margin A's preference for its export good were stronger than B's. Under these circumstances p would fall. The decline in p would reduce income measured in A-good in both countries. If Country A produced more B-good relative to net income than did Country B, the ratio of its real net income measured in A-good to B's would fall, and it would gain less gold as a result of the transfer than it would have if its terms of trade had not improved. If Country A produced less B-good relative to real disposable income than did A, then it would gain more gold as a result of the transfer than it would have if its terms of trade had not improved.

If, on the other hand, Country A liked its imported good, B-good, better on the margin than did Country B, then p would rise. The deterioration of A's terms of trade would raise A's real net income relative to B's if A produced more B-good relative to real net income than did Country B. In this case the worsening of A's terms of trade would result in its equilibrium gold stock increasing. If A produced less B relative to income than did Country B, the deterioration in its terms of trade would lower its real net income relative to B's and cause it to gain less gold.[7]

[7] These conclusions can be rigorously obtained as follows. Differentiate $(Q^A_A + p\,Q^A_B + T)/(Q^B_A + p\,Q^B_B - T)$ with respect to p. Since Q^A_A is a function of

There is a special case in which we could immediately infer the effect on gold movements of a change in the terms of trade. Assume both countries are completely specialized, so that Q^A_B and Q^B_A are zero. Then equation (9*a*) becomes

$$(9b) \quad \frac{G^A}{G^B} = \frac{g^B K^A (Q^A_A + T)}{g^A K^B (p Q^B_B - T)}.$$

In this case Country *A* devotes all of its resources to *A*-good and *B* devotes all of its resources to *B*-good. If Country *A* liked its own good relatively best, *p* would fall when *A* received a transfer. Therefore, equation (9*b*) shows that Country *A*'s equilibrium gold stock would rise. The balance-of-payments deficit for Country *B* engendered by the transfer would increase. If Country *A* liked its imported good relatively more on the margin than did *B*, *p* would increase and G^A / G^B would fall. The net effect of the transfer would be a smaller loss of gold for the paying country and possibly even a gain of gold. The generalization that follows from this analysis is that with complete specialization in both countries, the paying country would lose more gold if its terms of trade deteriorated and less if they improved. Under complete specialization, a deterioration of the paying country's terms of trade would not bring back its gold, as is sometimes argued; it would cause more of it to leave.

These conclusions are applicable to changes other than transfers that alter the terms of trade. Consider a change in taste in Country *A*. If *A*'s preference for *B*-good increased, *p* would rise unless one country produced both goods under conditions of constant cost. Country *A* would lose gold if the increase in *p* lowered its real income measured

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Q^A_B and Q^B_A is a function of Q^B_B under conditions of full employment and since their derivatives are equal to the negative of *p*, the result of the differentiation is

$$\left[\frac{Q^A_B}{Q^A_A + p\,Q^A_B + T} - \frac{Q^B_B}{Q^B_A + p\,Q^B_B - T}\right] \left[\frac{Q^A_A + p\,Q^A_B + T}{Q^B_A + p\,Q^B_B - T}\right]$$

The derivative would be positive or negative depending on whether the output of the *B*-good was a larger or smaller fraction of real net income in Country *A* than in Country *B*. If the fractions were the same, changes in the terms of trade would have no effect on the distribution of gold. If they differed, *p* could rise or fall, depending on marginal preferences in the receiving country relative to the paying country. Since the derivative of relative incomes could be positive or negative, the paying country could experience an improvement in its terms of trade and lose or gain gold; it could experience a worsening of its terms of trade and lose or gain gold.

in A-good relative to B's. It would gain gold if the opposite were true. Under complete specialization the first case would be applicable and gold would leave A. At the very least it would be confusing to attribute the change in the terms of trade to the gold movement, for the gold movement occurs because the change in the terms of trade alters relative incomes and the demands for money.

8. TRANSFERS AND DOMESTIC GOODS

We can introduce the existence of domestic goods into the two-product case by assuming that one of the goods, say good B, cannot be traded. P^A_B would no longer bear any relationship to P^B_B, so we must abandon equation (6) and equation (7) which depended on (6). Solving equations (4a), (4b), and (5) simultaneously yields

$$(9c) \quad G^A = \frac{g^B K^A (Q^A_A + p^A Q^A_B + T)}{g^A K^B (Q^B_A + p^B Q^B_B - T)},$$

where p^A is the relative price of the domestic good to the internationally-traded good in Country A and p^B is the relative price of the domestic good to the internationally-traded good in Country B. These relative prices would bear no necessary relationship to each other.

An increase in transfer payments from Country B to Country A would increase the demand for domestic goods in A and reduce them in Country B. If domestic goods were in perfectly elastic supply (constant costs) in both countries, there would be no change in relative prices in equilibrium and the existence of domestic goods would require no alteration in our original conclusions. If we assume, however, that domestic goods are in less than perfectly elastic supply, an increase in a transfer from Country B to Country A would raise p^A and lower p^B, since the demand for domestic goods rises in A and falls in B. Income measured in terms of A-good would rise in A and fall in B. Therefore, the numerator in equation (9c) would rise and the denominator would fall. Country A, the receiving country, would experience a larger influx of gold as a result of the transfer than it would have if there had been no domestic goods. The deterioration in the prices of B's domestic goods relative to internationally-traded goods causes it to sustain a greater loss of gold. It would be clearly wrong to argue that the relative fall in domestic-goods prices in the paying country reduces the balance-of-payments deficits that it would experience as a result of the transfer, for it increases them.

9. DEVALUATION AND THE TERMS OF TRADE

If a country devalued and did not permit its money stock to grow in proportion, we showed earlier—when we assumed that the terms of trade were constant—that it would gain gold. If the terms of trade are variable, must this analysis be modified?

In equilibrium before and after the devaluation each country would be spending exactly its income, ignoring transfers. With the conditions of production unchanged and overall demand unchanged, unless tastes had altered, the demand for each good would be the same in equilibrium after as before the devaluation. There would be no basis, therefore, on which to argue that the terms of trade could change. The net impact, therefore, of a devaluation with a contraction in the gold-stock multiplier is not altered by the possibility of a change in the terms of trade.

In the transition from one equilibrium to another, the terms of trade could vary none the less. The reason the devaluing country gains gold is because the devaluation generates a temporary reduction in its demand and an increase in demand in the other country. If tastes are not the same and if supply curves are upward-sloping, the terms of trade would change in the interval of adjustment. The analysis developed in the two previous sections is applicable here. With different preferences on the margin, if both countries are incompletely specialized, the terms of trade could change in either direction during the interval of adjustment and the initial gold flows produced by the adjustment mechanism could be greater or less than the ultimate movements. If both countries are completely specialized, the devaluing country, where demand falls, would initially experience a smaller inflow of gold than it would ultimately if its terms of trade diminished. And the existence of domestic goods would tend to lower the price of domestic goods relative to internationally-traded goods in the devaluing country and reduce the initial flow of gold below the ultimate flow.

10. STABILITY OF THE TERMS OF TRADE

Any comparative, static, equilibrium model that involves relative prices must assume stability of these relative prices if it is to make predictions. For example, if a simultaneous increase in consumption demand and reduction in investment demand could cause an explosion in the price of consumer goods relative to investment goods, it is not clear that contemporary macroeconomic models would yield valid predictions. In these models it is usually implicitly assumed that relative prices are stable.

Stability of relative price is also essential to the model we have been considering if it is to yield valid predictions. If a slight change in the terms of trade could cause a movement away from equilibrium, the comparative, static conclusions of the model would be of little interest.

If the price of B-good rises relative to A-good, stability requires that this generates an excess supply of B-good and an excess demand for A-good. If both goods were in perfectly elastic supply in one of the countries, this condition would be met no matter what the elasticities of demand. The slightest increase in P would shift all resources used in A-good production to B-good production, creating an excess supply of B-good and an excess demand for A-good.

There is a case of inelastic supplies that has received great attention in the literature. If both countries were completely specialized in one good, so that under full-employment conditions, supply elasticities were zero, Marshall argued that stability of relative price would exist under barter if the sum of the elasticities of demand for imports were greater than one.[8] We do not intend here to deal fully with the conditions necessary for stability of the terms of trade. Let us consider, however, an example in which supply elasticities are zero, and attempt to generalize from it. We shall show that the Marshall Condition is not necessary for stability in an economy with money.

Assume that Country A and Country B are completely specialized and that in the initial equilibrium g^A, g^B, P^A_G, P^A_A, and P^B_B are all unity. Assume further that Q^A_A and Q^B_B are 100. These assumptions imply that initially G^A and G^B are also 100. Finally, assume that initially each country spent one-half of its income on each good, so each country initially consumed 50 units of each good.

What would happen if P^A_A became 1.5 and P^B_B became .75? What would happen if, without any change in any parameter, A's terms of trade doubled? Would they tend to fall back again? According to Marshall's Condition, if the sum of the demand for elasticities for imports were less than one, the terms of trade would be unstable. Let us

[8] Alfred Marshall, *Money, Credit and Commerce* (London: Macmillan, 1923), pp. 353-54. Marshall's Condition properly understood refers to the elasticity of reciprocal-demand curves, which may or may not allow for changes in supply. In the case we consider, the supply elasticities are zero, so only ordinary demand elasticities need be considered.

see if this is so in our example. Assume that Country A's elasticity of demand for imports is zero, while *B*'s elasticity of demand for imports is unity, so that the sum of the elasticities of demand for imports is one.

Since *A*'s elasticity of demand for *B*-good is zero, it would still demand 50 units. Its money income would now be 150, since it produces 100 units of *A*-good and the price has increased to 1.5. To buy the units of *B*-good it must spend 37.5, since each of the 50 units would now cost .75. If Country *A* were to spend its entire income, its expenditures on *A*-good would be 112.5, its money income of 150 less its expenditure of 37.5 on *B*-good, which means at a price of 1.5 it would demand 75 units of its own good. To sum up. After the increase in *A*'s terms of trade, Country *A* would demand 75 units of *A*-good and 50 units of *B*-good, if its expenditures were equal to its income.

Consider now what happens to demand in Country *B*. Since *B*'s elasticity of demand for *A*-good is unity, it would cut its demand in half when the relative price doubled. *B* would demand 25 units of *A*-good. Since each unit would cost it 1.5, it would spend 37.5 on *A*-good, leaving it 37.5 to spend on its own good, since its output and income would now be 75/100ths units of output times a price of .75. It would demand 50 units of *B*-good—37.5 divided by .75. This assumes, of course, that it spends exactly its income. To sum up, Country *B* would demand 25 units of *A*-good and 50 units of *B*-good, if its expenditures equalled its income.

If we add together *A*'s and *B*'s demand for the two goods, we find that the total demand for *A*-good would be 100, as is its supply, and the total demand for *B*-good would be 100, as is its supply. Both markets would be in equilibrium.

In this example, where the sum of the elasticities of demand for imports was unity, an arbitrary movement of the terms of trade away from equilibrium would apparently set up no forces to return it to equilibrium. If we reduced the elasticity of demand in Country *B* for *A*'s good slightly, so that the sum of the import elasticities was less than one, then the demand for *A*-good would be greater and the demand for *B*-good would be less. There would be an excess demand for *A*-good and a deficient demand for *B*-good; the terms of trade would move further from the original equilibrium. If, on the other hand, we increased *A*'s elasticity of demand for imports slightly, so that the sum of the elasticities for imports was greater than unity, there would be an excess supply of *A*-good and an excess demand for *B*-good; the terms of trade would move in the direction of the original equilibrium.

This analysis, which seems to justify Marshall's Condition, overlooks one point, however. The original increase in the price of the *A*-good would lead to an increase in the demand for money in Country *A*. The reduced price of *B*-good would lead to a reduction in the demand for money in Country *B*. Country *A*'s money income has risen and *B*'s has fallen. But under these circumstances, if the sum of the elasticities of demand for imports were unity, the terms of trade would be stable, and even if the sum were less than unity the terms of trade could also be stable. To see that this is true, reconsider the example. If *A*'s elasticity of demand for *B*-good is zero, it would still demand 50 units of *B*-good. But it would not spend the 112.5 of income left over on *A*-good, since it would want to add to money balances. Therefore, Country *A*'s demand for *A*-good would be less than 75.

If Country *B*'s elasticity of demand for imports is still unity, it would demand 25 units of *A*-good. But it would demand more than 50 units of *B*-good, since it would be spending more than its income, because it has excess money balances.

In other words, the total demand for *A* would be less than 100 and the total demand for *B* would be greater than 100. The excess supply of *A* and the excess demand for *B* would lower the price of *A* relative to *B*; the terms of trade would move in the direction of the original equilibrium. The terms of trade would be stable, therefore, if the sum of the import elasticities were unity. They could be stable if the sum were less than unity, depending on how much changes in prices in both countries altered the demand for money.[9]

[9] For a more general and complete discussion of the point made in this section, see: Militiades Chacoliades, "The Classical Theory of International Adjustment: A Restatement," forthcoming in *Econometrica.*

What we have called Marshall's Condition is usually referred to as the Marshall-Lerner Condition. Lerner established the same condition as necessary to create a trade surplus for a country that devalued its currency or lowered its wages and prices. In deriving this condition he assumed that both countries were completely specialized and that in each country output was in perfectly elastic supply with respect to its own prices, given the wage rate. Under these assumptions a depreciation of *A*'s currency would lower the price of *A*-good relative to *B*-good in proportion to *A*'s devaluation, when the prices of the two goods are expressed in the same currency. Under Lerner's assumptions the reciprocal of the exchange rate would be a perfect index of the terms of trade, given wages.

Marshall's result for the stability of the terms of trade, which we have considered for the case of perfectly inelastic supplies, is compatible with Lerner's

11. AN ALTERNATIVE EXPLANATION OF THE MECHANISM OF ADJUSTMENT

In our treatment of the stability of the international distribution of the monetary gold stock we have assumed, in the absence of impediments to trade, that each internationally-traded good would sell for the same price in each country when expressed in the same currency. In other words, we have assumed that gold must buy the same quantity of each good in all markets. When disequilibrium existed, it was because the demand and supply of money were not equal.

Another explanation of stability could be given, although it is an implausible one. It could be assumed that the demand and supply of money must always be equal in each country, but a good could sell for more in one market than in the other. One could assume that equations (4*a*) and (4*b*) must never be violated, but equations (5) and (6) could be.

On this set of assumptions, if gold were redistributed arbitrarily from Country *B* to Country *A*, prices would rise in proportion to the increase in the money supply in *A* and fall in proportion to the reduction in the money supply in *B*. Goods would be more expensive in Country *A* than the same goods in Country *B* in terms of gold. Money would leave Country *A* in search of cheaper commodities in Country *B*, lowering prices in *A* and raising them in *B*. Country *A* would have a balance-of-payments deficit until the value of gold was again the same in both countries. In this analysis it can be said that gold leaves because of a difference in prices and the movement of gold

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result for the balance of payments, which was based on the assumption of perfectly elastic supplies in terms of absolute prices. If money does not matter and if the sum of the elasticities of demand for imports were greater than one, then an increase in the price of *B*-good relative to *A*-good would create an excess demand for *A*-good and an excess supply of *B*-good, as we showed by the example above. If the supplies of both were fixed, perfectly inelastic, then the change in relative price would tend to be reversed: P_B would fall relative to P_A, which is Marshall's result. But, if we follow Lerner and assume that the supplies of both goods are perfectly elastic with respect to their own prices, then, following a depreciation by *A*, the excess demand and excess supply would increase the production of *A*-good and reduce the production of *B*-good. If the marginal propensities to spend out of income in both countries were less than one, then Country *A*, the devaluing country, would end up with an export surplus as it produced more, and Country *B* with an import surplus as it produced less, if trade were initially balanced. This was Lerner's proposition, and, given the assumption on which it is based, it is consistent with Marshall's.

See: Abba P. Lerner, *The Economics of Control* (New York: Macmillan, 1946), pp. 377-79.

alters prices. But it should be noted that it is different prices for the same goods that cause gold movements and which result from gold movements. Although many writers apparently would disagree with me, I believe that this was Hume's position.

12. A THIRD EXPLANATION OF THE MECHANISM OF ADJUSTMENT

If each country were completely specialized there would be a third possible explanation of stability. It would be possible to assume that the demand and supply of money were equal in both countries and that prices of tradable goods were the same in both countries and still explore the repercussions of an arbitrary redistribution of gold. It would be possible, in other words, to assume that equations (4*a*), (4*b*), (5), and (6) were continuously satisfied even though the distribution of gold were not in equilibrium. This could be accomplished by assuming in equations (9), (9*a*), or (9*b*) that p depends on G^A / G^B. If the distribution of gold were out of equilibrium, the demand for money could equal the supply in both countries and goods could sell for the same prices in both countries, but an excess supply of one good could be matched by an excess demand for the other.

The adjustment mechanism would then be described in the following terms. An arbitrary redistribution of gold from Country *B* to Country *A* would lead to a rise in the price of *A*-good and a decline in the price of *B*-good; the price of output in *A* would rise in proportion to the increase in the money stock and the price of output in *B* fall in proportion to the reduction in its money stock. The *A*-good would be more expensive in each country and the *B*-good less expensive.[10] The increase in P_A / P_B, the improvement in *A*'s terms of trade, would alter demand in both countries. If the sum of the demand elasticities for imports were greater than one, there would be an excess demand for *B*-good and an excess supply of *A*-good; money would leave *A*, lowering P_A, while the increase in the money stock in *B* would raise P_B. Since the demand and supply of money were assumed equal throughout, the Marshall Condition comes into its own.

This is undoubtedly a peculiar way of looking at a disturbance. It assumes that if the quantity of money were redistributed between Newcastle and Brighton, the prices of hotel rooms in Brighton would rise in proportion to the increase in the money stock there and the price

[10] If one of the goods were produced in both countries, this would not be possible. Therefore, this analysis crucially depends on the assumption of complete specialization.

of coal would fall in Newcastle in proportion to the loss of money there. Internationally, it assumes that if, on an international gold standard, gold were redistributed from Guatemala to Colombia, the price of bananas would fall in Guatemala in proportion to the decrease in the money stock and the price of coffee rise in Colombia in proportion to the increase in money there.

The analysis is so implausible that it would not deserve any mention here at all if it had not been what Professor Viner and other economists had considered the classical theory of adjustment. Viner wrote in his *Studies* that "in the classical theory, the discussion of the role of variations in prices in the mechanism of adjustment of international balances relates not to relative variations in prices of identical commodities in different markets, but to relative variations in prices of different commodities in the same markets, and primarily to relative variations in prices as between export and import commodities. It concerns itself, therefore, with the effect of disturbances on what are now called the 'terms of trade.' From Hume on, there was general agreement that some or all types of disturbance in international balances would result in changes in the terms of trade, and that these changes would contribute to the restoration of equilibrium."[11]

13. THE MECHANISMS OF ADJUSTMENT COMPARED

We have shown that there are three conceivable ways of explaining why an arbitrary redistribution of gold would lead to the restoration of an original equilibrium. Much of the controversy Viner reviewed in his *Studies* resulted from different writers adopting these different approaches, and it was abetted by some of them failing to specify what they meant by price changes. Did they mean internationally-traded goods would change in price relative to domestic goods? Did they mean that the terms of trade would change? Did they mean that homogeneous goods would sell for different prices in different markets where there were no obstacles to trade?

The comparative-static-equilibrium conditions implied by the quan-

[11] Jacob Viner, *Studies in the Theory of International Trade* (New York: Harper & Row, 1937), page 319. I know of no justification for attributing this analysis to Hume. As with most issues in the history of economic thought, there is no way to resolve it conclusively. But the interested reader may wish to read Hume for himself to see whether Hume's adjustment mechanism depended on gold having different values in different markets or on changes in the terms of trade. See: *David Hume. Writings on Economics,* edited by Eugene Rotwein (London: Thomas Nelson and Sons, Ltd., 1955), p. lvi, footnote 2, and pp. 62-77 and 190-97.

tity theory are independent of which explanation of the adjustment mechanism is used. Assuming that there are no obstacles to trade, the first approach we have considered, however, is surely the best theory. The second assumes that a homogeneous good can have different prices in different markets in the absence of obstacles to trade, and the third, which only makes any sense at all when there is complete specialization, is so silly that its wide acceptance must forever remain one of the puzzles in the history of economic thought.

Although the major purposes of this paper have been accomplished, there are several extensions of the analysis worth considering. We shall turn to them now.

14. INTEREST RATES, THE DEMAND FOR MONEY, AND CAPITAL MOVEMENTS

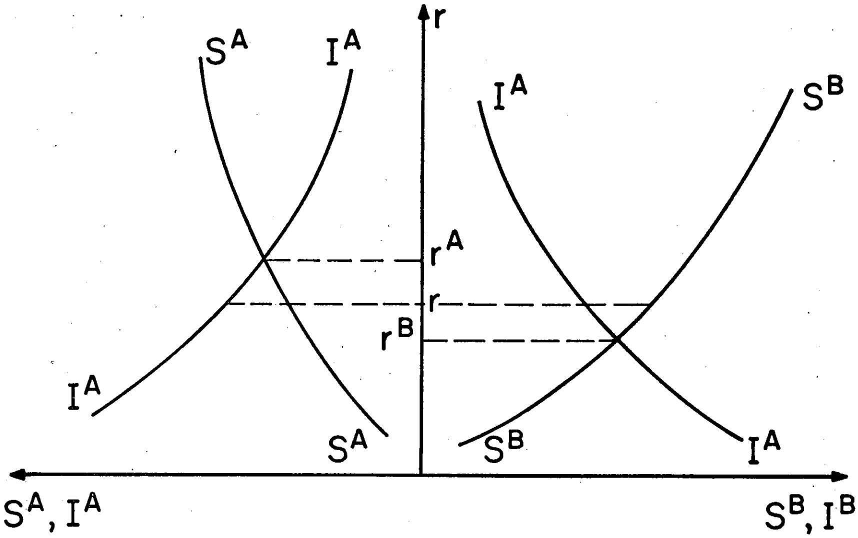
Many modern economists would object to the quantity-theory analysis we have presented so far, since it ignores the influence of the rate of interest on the demand for money. But this relationship need not be left out. The demand for money can be made dependent on the rate of interest by assuming that K is a function of the rate of interest, r. With this assumption introduced into the analysis, any factor that alters the rate of interest would alter the demand for money and could have implications for the equilibrium distribution of the gold stock.

In Figure 6 there are saving and investment-demand functions for Countries A and B. In the absence of capital movements, the equilibrium rates of interest would equate saving and investment demand in each country. In the example in the diagram, the equilibrium rate of interest in A would be r^A and in B it would be r^B. The distribution of gold would depend in part on these rates of interest. If the investment-demand curve in Country A were to increase, the rate of interest would rise in A and K^A would fall. Then according to equation (9), A's equilibrium gold stock would be less; it would experience a temporary balance-of-payments deficit. Since B would gain gold, it would have higher prices in equilibrium and, with the exchange rate unchanged, so would A.

Figure 6 can also be used to analyze the case of perfectly integrated capital markets. If the capital and bonds of Country A were perfect substitutes for those of B, then the equilibrium rate of interest would have to be the same in both countries. In Figure 6 this implies that the rate of interest would be r, the point at which the excess of investment over saving in Country A is equal to the excess of saving

FIGURE 6

The Determination of Interest Rates



If capital markets are entirely separate, interest rates in Countries *A* and *B* would be r^A and r^B, where saving and investment are equal. If there is a single capital market, there would be one interest rate, *r*.

over investment in Country *B*. Country *A* would import capital in an amount equal to these differences.

Consider again the effects of an increase in investment opportunities in Country *A*. Its investment-demand curve would shift out, and at the existing rate of interest there would be an excess demand for goods and an excess supply of securities. The rate of interest would rise until the excess of investment over saving in *A* was again equal to the excess of saving over investment in *B*; in equilibrium, *A* would import more capital. What would be the implications of this for *A*'s balance of payments? Since the interest rate would be higher in *A*, its demand for money would be less. This does not imply that *A* would lose gold, as it did when we considered unrelated capital markets, since the rate of interest would also be higher in *B* and its demand for money less. The numerator and denominator in equation (9) would rise, and no prediction could be made about the equilibrium distribution of gold without knowing the relative responsiveness of the demand for money to the rate of interest in each country. But the reduction in the demand for money in both countries does imply higher world prices for all goods, unless g^A or g^B is reduced.

In Section 7 we examined the implications of changes in the terms of trade on the equilibrium distribution of the gold stock. The dependence of the demand for money on the rate of interest may require a modification of that analysis. If a deterioration of the terms of trade made people feel poorer, they might increase their saving. If capital markets were independent, the rate of interest would fall when the terms of trade deteriorated and the demand for money would increase. This factor alone would tend to increase the gold reserves of the country whose terms of trade have worsened. If capital markets were fully integrated, on the other hand, any change in the rate of interest would alter the demand for money in both countries and would, therefore have an unpredictable effect on the equilibrium distribution of gold.

15. UNEMPLOYMENT AND THE EQUILIBRIUM DISTRIBUTION OF GOLD

Although the previous analysis was restricted to full employment, it is also possible to allow for unemployment and a variable real output. If real output, Q_A plus pQ_B, varied with P_A, given money wages, then the demand for money in Country A would be set equal to $P_A^A K^A f(P_A^A)$ where $f(P_A^A)$ is the function that relates real output to prices. If this function could be approximated by the simplest linear function, then it could be expressed as $\alpha^A P_A^A$, where α^A is a constant. Equation (9) then becomes

$$(9d) \quad \frac{G^A}{G^B} = \frac{g^B K^A \alpha^A P_G^A}{g^A K^B \alpha^B P_G^B},$$

where P_G^A / P_G^B has been substituted for P_A^A / P_A^B—equation (5).

The comparative-static conclusions with respect to the direction of effects on dependent variables are the same as under full employment with two exceptions. An increase in the price of gold, devaluation, now has an effect on the international distribution of gold, even if the gold-stock multiplier remains unchanged. If P_G^A rose, with g^A unchanged, G^A would rise; Country A would gain reserves at the expense of the rest of the world. Since B would lose gold, its money stock would be lower and so would its prices and output. Country A would have more money, higher prices and a greater real output. Devaluation, which would have no effect on the rest of the world under full-employment conditions, would be a beggar-thy-neighbor policy when output depends on the price level.

The other result concerns changes in α^A and α^B. If a country were experiencing wage inflation, then the output level that would correspond to any value of P_A would become smaller through time; α would decrease. If Country A were experiencing relatively more wage inflation than Country B, α^A would fall relative to α^B, and Country A would lose gold to Country B. The country with the greatest rate of wage inflation would experience a loss of reserves. If the money stock were allowed to grow in proportion to the change in α, to protect the employment level, then the loss of gold would be greater, since an increase in g^A relative to g^B also causes A to lose gold.

The analysis with unemployment and a variable interest rate could be examined graphically by a slight modification of Figure 1. An increase in the gold stock, given the value of the gold-stock multiplier, would not lead to a proportional increase in prices, since the interest rate might fall and K rise as the money stock increased and since real output would increase. Therefore, the lines in quadrants I and III would have an elasticity smaller than unity.

16. INCONVERTIBLE MONEY AND FLEXIBLE EXCHANGE RATES

Each proposition we have derived concerning the international distribution of gold has a counterpart in a world of flexible exchange rates and inconvertible money. If a change in a parameter under an international gold standard would cause a country to gain gold, under inconvertible paper it would cause its exchange rate to appreciate. If an action under a gold standard would cause a country to lose gold, it would cause its exchange rate to depreciate under inconvertible money. This theorem we shall now establish.

If we let $\mathcal{E}$ represent the price of A's money in terms of B's, in equilibrium the following equation must hold:

$$(10)\quad P_A^B = \mathcal{E} p_A^A.$$

Treating supplies of money in Countries A and B, M^A and M^B, as parameters in the simplest two-country case, equations (4*a*), (4*b*), and (10) imply

$$(11)\quad \mathcal{E} = \frac{M^B K^A (Q_A^A + pQ_B^A)}{M^A K^B (Q_A^B + pQ_B^B)}.$$

Equation (11) differs from equation (9) in only two respects:

$\mathcal{E}$ replaces G^A / G^G and M^B / M^A replaces g^B / g^A. Under the gold standard an increase in the money stock of Country B relative to Country A would come about as a result of an increase in g^B / g^A. Here it must come about directly as a result of an increase in M^B / M^A. Obviously, changes in the money stock brought about by changes in the price of gold have no counterpart under inconvertible money. We showed that under an international gold standard, an increase in g^B / g^A would cause B to lose gold; G^A / G^B would rise. Under inconvertible money and flexible exchange rates, an increase in M^B / M^A would cause $\mathcal{E}$ to rise; the price of A's money in terms of B's would increase. All the other propositions we obtained about the international distribution of gold have their counterparts. For instance, an increase in the demand for money in B would lower G^A / G^B under the gold standard, and it would lower the cost of A's money in terms of B's under inconvertible paper.

If the existence of transfers were introduced into the equations, the correspondence would still exist. Furthermore, if real output were made dependent on P^A in each country, still propositions about G^A / G^B would have their direct counterparts in propositions about $\mathcal{E}$.

17. NONGOLD RESERVES

There are innumerable ways the quantity-theory analysis could be modified to allow for nongold reserves. As illustrative of the possibilities we have selected two cases for consideration. First, assume that one of the countries, Country B, keeps a fixed proportion of its reserves in claims against the other. Let h be that proportion. Country B's reserves would then be $P^B_G G^B$ plus $(P^B_G / P^A_G)F$, where F would be B's claims against Country A expressed in A's currency and $(P^B_G / P^A_G)F$ would be its claims against A expressed in its own currency. If $(P^B_G / P^A_G)F$ equals h times total reserves, then the reserves of B expressed in its own currency would equal $P^B_G G^B / (1\text{-}h)$ and its money supply would be $g^B P^B_G G^B / (1\text{-}h)$. The equilibrium distribution of gold in the simplest case would then be given by

$$(12) \quad \frac{G^A}{G^B} = \frac{g^B K^A (Q^A_A + pQ^A_B)}{(1\text{-}h) g^A K^B (Q^B_A + pQ^B_B)} .$$

If h is a constant, all the previously obtained comparative-static conclusions would remain valid. There would only be one new result. A reduction in h, the fraction of B's reserves that it keeps in the form of claims against A, would redistribute gold away from A to B. If g^A remained unchanged, the money stock would fall in A, and prices would fall throughout the world. Changes in h, therefore, are an additional possible source of instability.

Consider now an alternative model, one in which h is unity; all of B's reserves are in the form of claims against A. Country A holds the entire gold stock. If G is substituted for G^A in equation (4*a*), we have

$$(13) \quad P_A^A K^A (Q_A^A + pQ_B^A) = g^A P_G^A G.$$

This equation contains only one unknown, P_A^A, and, therefore, determines it when the demand and supply of money are equal.

Consider Country B and equation (4*b*). If $P_G^B G^B$ is replaced by $(P_G^B / P_G^A)F$ and if equation (5) is used to eliminate P_A^B, we have

$$(14) \quad P_A^A K^B (Q_A^B + pQ_B^B) = g^B F.$$

Since the equilibrium value of P_A^A is determined by equation (13), equation (14) determines F, B's claims against A expressed in A's currency. Changes in g^A and K^A then alter prices in Country A and in Country B, while changes in g^B and K^B only affect B's claims against A.

If Country A were inflating, Country B could attempt to prevent the inflation from spreading to its shores by a continuous decrease in g^B. As a consequence, it would develop a chronic balance-of-payments surplus and its claims against A would get larger and larger. If a constant reduction in B's international-reserve multiplier were not possible, it would have no way to stop the inflation so long as it retained the same exchange rate. Since P_A^B equals $(P_G^B / P_G^A)\ P_A^A$ and P_G^A and P_A^A are determined independently of actions by B, any reduction in P_G^B would lower P_A^B. If Country B failed to appreciate when A inflated, its nominal claims against A would grow in proportion to the inflation. It would obtain the additional nominal claims in exchange for an export surplus. Note that this implies a real welfare loss for B, since its export surplus does not lead to an increase in the real value of its claims against A; F / P_A^A remains the same.

If Country A is viewed as the United States and Country B most of the rest of the non-Communist world, this model may be the best simple description of world inflation at the present time.

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