

INTERNATIONAL FINANCE DISCUSSION PAPERS

THE EFFECTS OF THE SUBSTITUTION OF DOLLARS FOR GOLD  
FOR THE DISTRIBUTION OF THE ADJUSTMENT BURDEN AND  
THE CONTROL OF THE WORLD MONEY SUPPLY

by

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The Effects of the Substitution of Dollars for Gold  
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Don E. Roper

The substitution of a fiat money, like dollars, for a commodity money, like gold, in the international activities of national monetary authorities has important consequences for the functioning of the international monetary system. This substitution process has occurred in two areas that, although historically related, can be separated. One substitution process has been the replacement of specie with foreign exchange as the asset used by monetary authorities for stabilizing their exchange rates. As early as the latter part of the 19th century, authorities who were stabilizing the gold values of their currencies by buying and selling gold would occasionally enter the foreign exchange market directly.<sup>1/</sup> By the end of World War II, most of the major countries in the Western world outside the United States had altogether ceased stabilizing exchange rates via the gold market. Most countries are now maintaining fixed exchange rates by direct purchases and sales in the markets for foreign exchange. The other substitution process, about which more is known, has been the partial replacement of gold with interest bearing securities in the international reserves of monetary authorities.

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\* The author has benefited from comments by David Dod, Lance Girton, Dale Henderson, and Charles Siegman.

<sup>1/</sup> Some discussion of these early operations is well as many references are found in Author Bloomfield's "Short Term Capital Movements Under the Pre-1914 Gold Standard," Princeton Studies in International Finance, No. 11 1963. Generally, however, very little attention has been given to the reason why, and the periods when, authorities switched from gold or silver to foreign exchange as an intervention asset. The only work of which I am familiar that addresses this specific question, but which makes only a very tentative beginning, is Ernest Ng's "The Evolution of the Gold Exchange Standard," unpublished M.B.A. thesis, University of California at Berkeley, December, 1971.

This paper presents a theoretical analysis of the effects of the substitution of foreign exchange for an international money, like gold, as the reserve and intervention asset <sup>1/</sup> upon the distribution of the adjustment burden between the center and non-center countries. The world itself is a combination of several systems within the dollar system. For instance, most of the sterling area countries intervene with pounds and hold sterling assets in their reserves. The analysis of this paper is as applicable to the distribution of the adjustment burden between Great Britain and outer-sterling area countries as it is to the adjustment burden between the U.S. and the countries that use dollars for an intervention and reserve asset. However, since the dollar is the dominant key currency, the analysis will only be applied in the dollar system in this paper.

The model employed will consist of two regions that can be labeled the center country, or C, and the rest of the world, R. Sometimes country C will be referred to as the United States and its currency as the dollar. Region R can be regarded as a consolidation of a large number of countries each with their own independent monetary authorities. Such an interpretation of region R will enable us to explain some of the maldistribution of the adjustment burden between the U.S. and the rest of the world.

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<sup>1/</sup> The role of the dollar as an intervention asset can be distinguished from its role as a reserve asset. Whether one role is, in some sense, more fundamental or whether one role led to (or caused) the other is an interesting but difficult question. In order to separate this question from the problem addressed in this paper, the two roles of the dollar have been taken together.

There are several different ways that authorities can adjust to achieve external targets. They can adjust externally through parity changes; they can impose impediments to trade or capital; or they can undertake internal adjustment through changes in interest rates, unemployment, and price levels. Although brief mention will be made of the distribution of adjustment burdens via exchange rates, the paper will be primarily concerned with the distribution of internal adjustments. Impediments to trade and capital movements will not be considered here.

The burdens associated with adjustment to obtain external targets can be defined in two different ways. One way is to define the burden in terms of the costs of unemployment and reallocation of resources. It can also be defined as the costs perceived by the monetary authorities of sacrificing domestic goals (or any other non-external goals) for external considerations. The second definition differs from the first because it weights resource reallocation costs by political representation and some costs (e.g., the possible unemployment of a finance minister following a devaluation<sup>1</sup>) may receive more representation than others. However, the second definition is useful as a measure of the external pressure upon policy formation and it will be employed here for this reason.

Although the adjustment burden has been defined in terms of the many non-external goals that may be sacrificed for external considerations, the level of abstraction in this paper demands that only one internal variable (that can be associated with many of the resource reallocation costs) be traded off against external targets. I have chosen the two

1/ Richard Cooper, "Currency Devaluation in Developing Countries," Princeton Essays in International Finance, No. 86 (June, 1971), found that nearly 30% of the governments fell and nearly 60% of the finance ministers lost their jobs within a year following a devaluation in the 1947-1970 period.

regions' price levels to represent the authorities' domestic concerns. Use of this single-variable index of the burden allows one to conclude that the country that allows the largest adjustment in its price level to obtain external balance is absorbing most of the adjustment burden. The notion of the appropriate distribution of the adjustment burden will be discussed later.

#### A Two Region Model

The model employed in this paper is a well known static macroeconomic model with flexible wages and prices.<sup>1/</sup> Output is determined by the labor market in conjunction with a production function in which the capital stock is assumed fixed. Given output, there are two remaining equations for each economy, the equilibrium conditions for cash balances and for goods and services. The two endogenous variables for each economy are the price level and the interest rate. The two economies are linked together by the balance of trade and payments.

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<sup>1/</sup> A complete discussion of the closed-economy, single-country version of this model is found in Martin Bailey, National Income and the Price Level, (McGraw-Hill, 1962), Chapters II and III.

An important variant of this model is to assume that nominal wages and/or prices are given and allow real income to be determined by demand conditions. The entire argument could be carried out using the variable-income version of the model without affecting the conclusions in any way. The author was stimulated to use the variable-price version of the model after reading Jay Levin's "A Two-Country Model of the Gold Standard," in W. Sellekaerts, ed., Essays in Honor of Jan Tinbergen (Macmillan & Co., 1972). Levin's notation has been followed where possible to acknowledge this fact. However, the way the model is developed and the questions it is used to address are quite different.

The procedure is to first write the equilibrium conditions in the product markets in such a way that the interest rates appear as explicit functions of the other variables and then to substitute the resulting functions into the equilibrium conditions for domestic and foreign cash balances. The final equations depend only upon domestic and foreign prices,  $p$  and  $p'$ , and can be plotted in two dimensions.<sup>1/</sup>

Consider first the equation for domestic goods and services,  $S = I(r) + B(T)$ , where  $S$  = real domestic saving,  $I$  = real domestic investment,  $r$  = the domestic interest rate,  $B$  = balance of trade (measured in terms of domestic goods), and  $T = p/p' =$  the terms of trade or the ratio of the domestic to the foreign price level.<sup>2/</sup> By assuming monotonic functions, the equilibrium condition can be rewritten such that  $r$  is an explicit function of the terms of trade, viz.,  $r = r(T)$ . Assuming that an improvement in the home country's terms of trade (an increase in  $T$ ) worsens the domestic trade balance, then the domestic interest rate must fall (and investment increase) whenever  $T$  rises in order to  $I(r) + B(T)$  to remain equal to the constant  $S$ .<sup>3/</sup> Consequently,  $dr/dT < 0$ . By

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<sup>1/</sup> Sometimes it will be convenient to refer to country C as the domestic or home country and region R as the foreign country.

<sup>2/</sup> Since we will not be concerned with fiscal policy, government expenditures have been omitted from the income identity. One can assume either that government expenditures and taxes are zero or that both government taxes and expenditures are constant and the level of expenditures is included as a constant term in the  $I(\ )$  function. The exchange rate is taken as unity such that  $T$  is only the ratio of the two price levels.

<sup>3/</sup>  $S$  is constant since real savings and consumption are assumed to depend only upon real income and real income is determined by stable labor market conditions and the production function. The model abstracts from price expectations such that  $r$  represents both the nominal and real interest rate.

similar argument, the equilibrium condition for foreign goods and services can be written as  $r' = r'(T)$  where  $dr'/dT > 0$  and primed variables represent the foreign counterparts to domestic variables.<sup>1/</sup>

The conditions for monetary equilibrium can now be considered. It will be assumed that residents of each country hold only those cash balances supplied by their own central banks and that the supply of money is completely determined by central bank policy.<sup>2/</sup> Using the symbols  $L$  and  $M$  to represent the real demand and nominal supply of money, the equilibrium conditions can be written as

$$pL(r) = M \qquad \text{and} \qquad p'L'(r') = M.$$

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

$$(1) \quad pL[r(p/p')] = M$$

$$(2) \quad p'L'[r'(p/p')] = M'.$$

Equations (1) and (2) contain only two endogenous variables,  $p$  and  $p'$ , and two exogenous parameters,  $M$  and  $M'$ . By assuming the functions are linear, (1) and (2) can be drawn as shown in Figure I.

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<sup>1/</sup> By differentiating  $S = I(r) + B(T)$  and  $S' = I'(r') - TB(T)$ ,  $r_T$  ( $= dr/dT$ ) and  $r_T'$  can be derived as  $r_T = -B_T/Y_T$  and  $r_T' = B_T/I_T'$  under the assumption that the trade balance is initially in balance such that  $d(TB(T))/dT = B_T$ . It is assumed that the traditional elasticity condition holds such that  $B_T$  is negative.

<sup>2/</sup> A constant ratio between the monetary base and the money supply is assumed such that one can talk about either aggregate interchangeably.

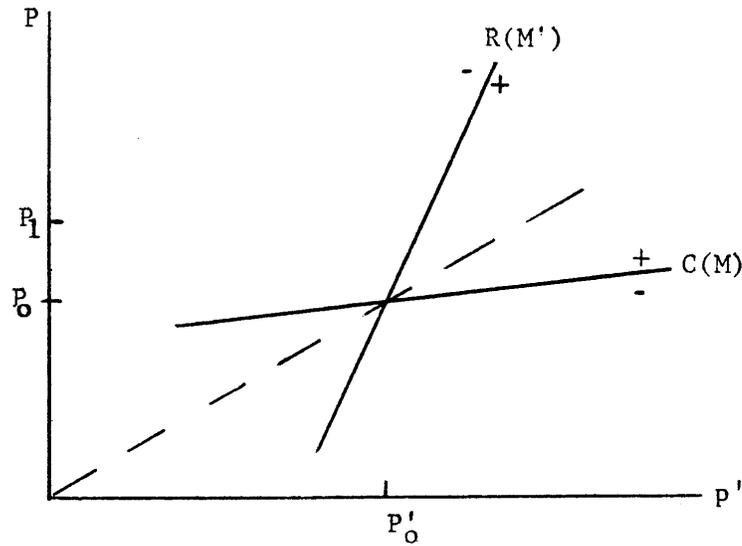


Figure I: Equilibrium in the Home and Foreign Countries

In Figure I, C and R represent the equilibrium conditions for money and goods in the center country and the rest of the world, respectively. C must slope upwards because  $p$  and  $p'$  have opposite effects on domestic equilibrium. Inspection of the equation for C, viz.,  $pL[r(p/p')] = M$ , shows that an increase in  $p$  increases the nominal demand for money directly and indirectly (indirectly, by decreasing  $r$ , and increasing  $L$ ). On the other hand, an increase in  $p'$  lowers  $T$  and thereby decreases the demand for money. Consequently, a plus sign is placed above C to indicate an excess demand for money and a minus sign is placed below C to indicate an excess supply for money in the home country. An analogous argument holds for the slope of and signs placed around the R schedule.

The dotted line in Figure I is a terms-of-trade line and its slope is equal to the value of  $T$ . The slope of C must be less than the slope of the terms-of-trade line for the following reason: Suppose the system begins from an initial position of  $p_0$  and  $p'_0$  and  $p$  increases

to  $p_1$ . In order for equation (1) to continue to hold for a given value of  $M$ ,  $L$  must fall. But the real demand for money can decrease only if  $r$  rises and, since  $dr/dT < 0$ ,  $T$  must fall. Consequently, if prices are increased from  $p_0$  and  $p'_0$ , equilibrium in the center country requires that  $T$  fall such that  $C$  is less steep than the original terms-of-trade line. Once again, an analogous argument would show that  $R$  must be steeper than the dotted line. In short, the effect of each country's own price level outweighs the effect of the foreign price level on domestic equilibrium such that each country's equilibrium schedule is steepest with respect to its own price axis.

The  $C$  and  $R$  lines in Figure I are drawn for given values of  $M$  and  $M'$ , respectively. These schedules can be used to construct another curve which represents the values of  $p$  and  $p'$  corresponding to a constant world money supply,  $W$ . Suppose the domestic money supply is increased and the foreign money supply decreased by the same amounts. This shifts both  $C$  and  $R$  northwest such that their new intersection is at point  $a'$ , as shown in Figure II. By going through other equal-but-opposite changes in  $M$  and  $M'$ , a locus of points or an iso-liquidity line for the world,  $LL$ , can be generated.<sup>1/</sup>

<sup>1/</sup> Mathematically, the iso-liquidity line for the world,  $LL$ , is found by adding equations (1) and (2) to obtain  $pL + p'L' - (M+M') = 0$ . Since the sum of the two excess demands,  $(pL-M) + (p'L'-M')$  is identical to the excess demand for the world money supply (that is,  $(pL-M) + (p'L'-M') = pL + p'L' - W$  is an identity in  $p$  and  $p'$ ), the three curves must intersect at the same point. The slope of  $LL$  will be discussed in detail below.

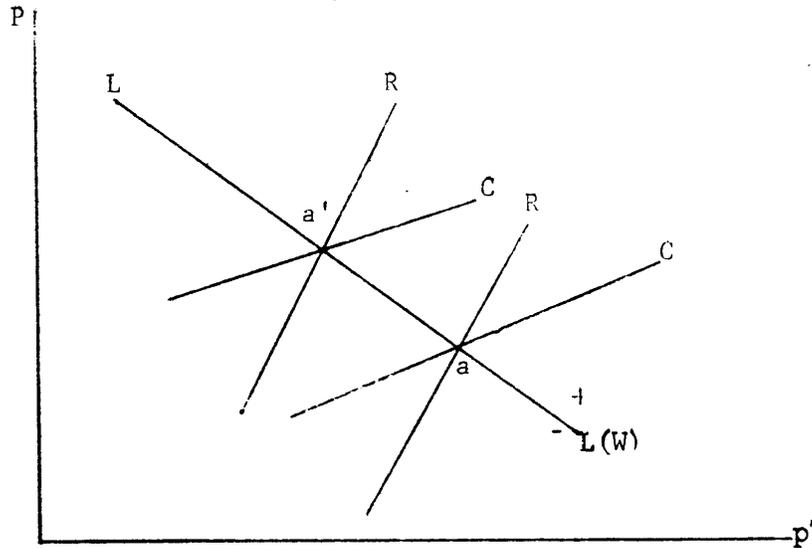


Figure II: Construction of the Iso-World Money Supply Line

To complete the model, the combinations of  $p$  and  $p'$  that yield external balance between the two regions need to be determined. Suppose the center country's payments surplus can be written as a function of the terms of trade and interest rates, viz.,  $b = b(p/p', r, r')$ .<sup>1/</sup> I will assume that the function is linear and that the partial derivatives have the expected signs:  $\partial b / \partial T < 0$ ,  $\partial b / \partial r > 0$ , and  $\partial b / \partial r' < 0$ . If the functions found earlier for  $r$  and  $r'$  are substituted in  $b(\ )$ , we obtain  $b = b[p/p', r(p/p'), r'(p/p')]$ . The condition for payments equilibrium,  $b[\dots] = 0$ , is plotted as the  $\beta$ -line in Figure III. Since  $b$  ultimately depends upon only the terms of trade,  $p/p'$ , the  $\beta$ -schedule must go through

<sup>1/</sup> A specification of the capital account based upon portfolio balance considerations would require that the rates of change rather than the level of interest rates be employed in the  $b(\dots)$  function. However, the flow model of financial capital movements is analytically easier to handle and, since the focus of the paper is not on capital movements and since we are not concerned with dynamic paths of adjustment, the conclusions of the paper are not dependent upon whether the level or rates of change of interest rates are used. In "The Mix of Policies and the Theory of Capital Movements," International Financial Discussion Paper, No. 10, Federal Reserve Board, March, 1972, and in "Macroeconomic Policies and the Distribution of the World Money Supply," Quarterly Journal of Economics, February, 1971, I have tried to give a more complete discussion of the implications of a stock as opposed to a flow model of capital movements.

the origin. The  $\beta$ , C, and R schedules are drawn with a common intersection on the assumption that the value of the exchange rate is such that there exists payments balance at the intersection of C and R.

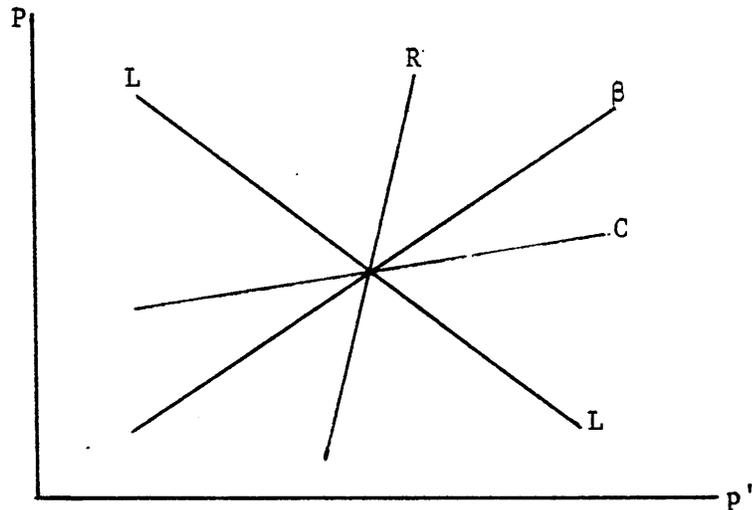


Figure III: The Complete Model with External Balance

Adjustment Under the Gold Standard

The phrase "gold standard" is used here to mean only that gold, or some asset that is not denominated in a national currency, is held in reserves and used for intervention purposes. When national monetary authorities stabilize the gold value of their currencies, they buy and sell gold against their currencies. When a country incurs a payments surplus (i.e., the monetary authorities purchase gold), the country's central bank creates new liabilities against itself and these liabilities become bank reserves or currency in the hands of the public. Under the gold standard system with no net change in nominal world reserves, the other region of the world must be selling gold and cancelling outstanding liabilities against itself. The creation of new liabilities by one central bank and the destruction of liabilities of

the other central bank changes the composition of the world monetary base. Under the assumption that residents of each country hold only cash balances which are denominated in the currency of their respective countries, this change in the composition also implies a change in the distribution of  $W$  from the deficit to the surplus country.<sup>2/</sup>

The model is used to depict adjustment under the gold standard in Figure IV. An external imbalance occurs when the values of  $p$  and  $p'$ , as determined by the intersection of  $C$  and  $R$ , do not lie on the  $\beta$ - schedule. Suppose the system was initially in equilibrium at point  $Q$  in Figure IV and then an increase in specie or gold occurred in the domestic country. This increase in  $M$  (from  $M_0$  to  $M_s$ ) will shift the  $C$  schedule up until it intersects the  $R$  schedule at a point like  $S$ . The consequent increase in the domestic price level and terms of trade causes a deficit for the home country (denoted by the minus sign above the  $C$ -schedule). The balance of payments disequilibrium would redistribute part of the increase in gold from the deficit to the surplus region. This redistributive process would continue until the system moves along  $LL$  from  $S$  to  $E$ .

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<sup>1/</sup> A change in the composition implies a change in the distribution of the world money supply from the deficit to the surplus country whenever the ratio of domestic to foreign currency held by domestic residents is greater than the ratio of domestic to foreign currency held by foreign residents.



proportion to the country sizes. <sup>1/</sup> For instance, if country C is one-half as large as the rest of the world, the slope of LL will be 2 such that C's price level will fall by twice as much as R's price level rises as the

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<sup>1/</sup> Since the equation for LL is the sum of equations (1) and (2) and since  $dW = dM + dM' = 0$  along LL, the linearized version of LL is

$$(3) \quad dpL + L_R r_T (dp - dp') + dp'L' + L'_R r'_T (dp - dp') = dM + dM' = 0$$

where subscripts indicate partial derivatives and dimensions are chosen such that  $p = 1.0 = p'$  initially. By substituting the formulas  $r_T = -B_T/I_R$  and  $r'_T = B'_T/I'_R$  (derived earlier) into (3), the slope of LL can be written as

$$(4) \quad \frac{dp}{dp'} = - \frac{L' + \frac{B_T D}{L}}{L - \frac{B'_T D}{L'}} \quad \text{where } D = (L_R/I_R) - (L'_R/I'_R).$$

$L_R$  and  $I_R$  are proportional to the size of the country but the ratio,  $L_R/I_R$ , and the difference,  $D$ , are invariant to country size. If the regions are identical in structure,  $D = 0$  such that the slope of LL is  $-L'/L$ . The ratio  $L'/L$  is a measure of relative country sizes.

In "A Two-Country Model of the Gold Standard," op. cit., Jay Levin argues that the price level adjustments that result from an international movement of specie might induce the deficit country's price level to rise or the surplus country's price level to fall. In the graphical terminology of this paper, his argument implies that the LL schedule can slope upward. Equation (4) shows that this is possible when the absolute value of  $D$  is very large. The economic reason for this result is as follows:  $D$  is determined by the relative sensitivities of the demand for money and investment to interest rates and these combined sensitivities have an important influence upon the potency of changes in the money supplies upon price levels. If  $D$  is, say, positive, then a given percentage change in the money supply will have a smaller impact upon the price level in C than in region R. If, for instance, C runs a deficit such that gold is redistributed from C to R, the impact of this redistributive process is mildly deflationary in C but quite inflationary in R. But the business expansion in R can feed back through the trade balance and give a stimulus to C. Consequently, the net effect on C can be expansionary such that C's price level can rise despite the fact that C adjusted internally to a payments deficit. In this paper I have assumed that the two regions have a sufficiently similar economic structure -- that the degree to which money matters is not too different between the two regions -- such that the LL schedule always slopes downwards.

system moves down LL. If a world price index were constructed with weights proportional to relative country sizes, the movement along LL would leave the world price level unchanged.<sup>1/</sup>

If the countries play by the rules of the gold standard, a balance of payments disequilibrium redistributes  $W$  such that  $p$  and  $p'$  move along the LL schedule. However, the use of a fiat money rather than a commodity money enables the monetary authorities to sterilize or offset the impact of the external imbalance upon their domestic bank reserves and money supply. If both countries sterilize their payments imbalances, the adjustment mechanism is severed such that the system will remain at point S. This leaves us with a semantic inconsistency, viz., that countries can violate the rules of the gold standard (i.e., sterilize) when they are on the gold standard.

It is important to resolve this inconsistency for the purpose of this paper. On the one hand, the phrase "gold standard" indicates that gold is used as an intervention and reserve asset. This can be contrasted with the phrase "gold exchange standard" which implies that foreign exchange is used as a reserve asset along with gold and as an intervention asset. On the other hand, "playing by the rules of the gold standard" means that a country keeps a stable relation between its international reserves and its money supply. The phrase "gold standard" could be defined such that it includes the requirement of a stable relation between a country's international reserves and money supply. Such a

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<sup>1/</sup> Thus, the gold standard model meets Robert Mundell's criterion for the appropriate division of the burden of adjustment. The argument for Mundell's criterion is given in his article, "The Proper Division of the Burden of International Adjustment," International Economics (Macmillan & Co., 1968), chapter 13.

definition is, I think, atypical, and it does not provide a good contrast with the phrase "gold exchange standard" or "key currency system". Since we want to compare a system in which gold is used as the intervention and reserve asset with a system in which foreign exchange serves these roles, I have retained the phrase "gold standard" and "gold exchange standard" as names of these systems, respectively. In the subsequent analysis, it will be argued that while countries may or may not play by the rules of the game in the gold standard and the gold exchange standard, the incentives are altered as the system moves from one standard to the other.

#### Adjustment Under the Gold Exchange Standard

Under the gold exchange standard, the exchange rate is stabilized, not as a result of both regions intervening with gold, but as a result of direct intervention in the foreign exchange market by the monetary authorities in region R. The rules of the gold standard can still be maintained when a national currency rather than an international asset is used for intervention purposes. Suppose that region R incurs a payments surplus which means (by the definition of "surplus" used in this paper) that they purchase region C's currency in the foreign exchange market. The purchase is financed by issuing new liabilities in the form of commercial bank reserves in R such that R's money supply is increased. If the authorities in R use the acquired foreign exchange to purchase gold from region C, the monetary base in C will decline by the value of C's gold sale. Consequently, the system will again move along LL from S to E. The rules of the gold standard can be followed in a gold exchange standard world.

Suppose, however, that region R uses the acquired foreign exchange to purchase interest bearing securities denominated in currency C. This has the effect of returning the acquired foreign exchange to private circulation such that C's money supply is unaffected. If R's money supply is increased by the surplus and C's money supply remains unchanged, the adjustment burden is forced upon region R. In terms of the graphical analysis, if the system begins from a disequilibrium situation like point S, the R schedule will shift to the right over time and the C schedule will remain stationary as shown in Figure V. As long as R does not sterilize the impact of its payments surplus upon its monetary base, R's money supply will continue to increase from  $M'_S$  to  $M'_N$  until equilibrium is achieved at point N.

The maldistribution of adjustment depicted in Figure V results whenever R does not sterilize and (i) R purchases securities rather than gold from C or (ii) R purchases gold from C but C completely sterilizes. When R purchases securities rather than gold, C does not need to sterilize because, in effect, R has sterilized for C. In case (i), bonds (denominated in C's currency) were purchased by the monetary authorities of region R to enable them to hold their reserves in interest bearing form.<sup>1/</sup> In case (ii), bonds were purchased by the monetary authorities in country C in

1/ In his talk, "Sterilization Policies of the Federal Reserve," at the University of Western Ontario Conference on International Monetary Problems, April, 1972, Ronald McKinnon argued that the U.S. sterilizes its own official settlements deficits even when the non-center surplus countries do not purchase gold or SDRs. Another statement consistent with this argument can be found in a book review by McKinnon in the Journal of International Economics, II (May, 1972), p. 207.

This view arises from the fact that a surplus country usually places a deposit with the Federal Reserve Bank of New York and the Fed purchases dollar denominated assets for the account of the monetary authority of the surplus country. Consequently, whether the surplus country purchases gold or a deposit at the Fed, the New York Bank actually makes the purchases of interest bearing assets. While McKinnon's view is correct, I think it is more useful to regard the non-center countries as sterilizing for the U.S. since they make the decision as to whether they want to hold demand deposits or interest bearing assets and the Federal Reserve only serves an intermediate role.

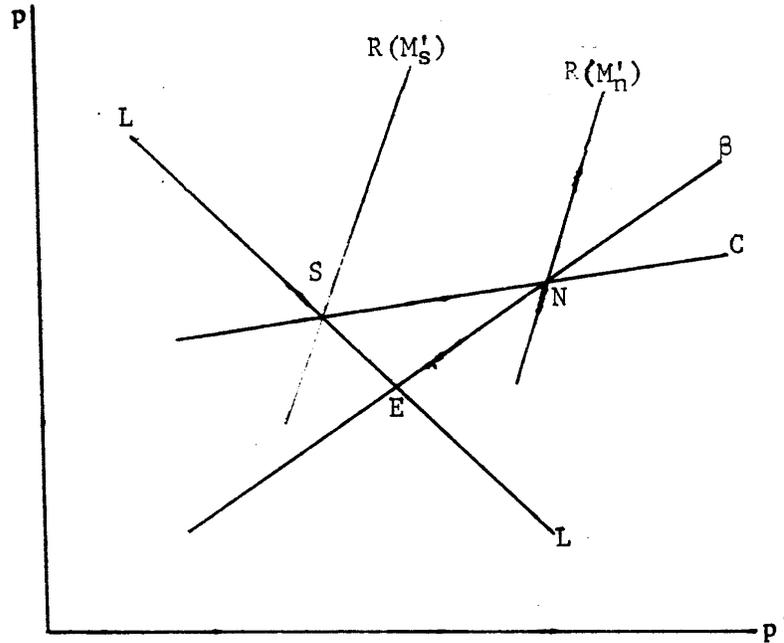


Figure V: Adjustment Burden Borne by Region R

order to sterilize. In other words, the bonds had to be purchased by one monetary authority or the other in order to return the money to circulation. If R purchases the bonds rather than gold, then C is freed from this task and R can be usefully viewed as sterilizing for C.<sup>1/</sup>

<sup>1/</sup> In both cases (i) and (ii) the quantity of bonds (denominated in currency C) available for the private sector to hold diminished. In "A Theoretical Analysis of the Adjustment Process in a Two Country, Portfolio Balance Model," an unpublished manuscript at the Federal Reserve Board, Lance Girton and Dale Henderson have argued that the reduction of the quantity of bonds in country C (and the increase in the quantity of bonds denominated in currency R if region R sterilizes) provides an alternative adjustment mechanism. I tentatively think that interest rate effects upon the private supply of bonds may undermine this alternative adjustment mechanism. Clearly, more work needs to be done in this field.

Comparison of the Gold Exchange and Gold Standards

Changes are introduced in the distribution of both external and internal adjustments to obtain payments equilibrium when the countries in region R switch from the use of gold to dollars. When both regions are intervening with gold, they both have control of and responsibility for the rate of exchange. When the countries in region R intervene with dollars, the exchange rates are associated with and are controlled by the monetary authorities in R. Since parity changes are regarded as failures for the authorities in control, adjustment that occurs externally through parity alterations places a greater burden on the non-center <sup>1/</sup> countries

The alternative to external adjustment through exchange rate movements (or the imposition of impediments to trade or capital) is internal adjustment through changes in interest rates, <sup>2/</sup> price levels, and the terms of trade. To determine whether a region is more or less likely to adjust under the gold-exchange compared with the gold standard,

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<sup>1/</sup> This asymmetric distribution of the adjustment burden can be regarded as the benefit that the center country acquires for relinquishing its proper role in determining exchange rate policy. In a symmetric system the center country would share in both the political costs of rate changes and in determining when the rates are altered.

<sup>2/</sup> The two countries' interest rates are an endogenous part of the model as are the price levels. A graph, identical to those drawn in the text with price levels on the axes, could be constructed with bond prices on the two axes.

one must, under some reasonable assumptions <sup>1/</sup> examine the differences in incentives to pursue sterilization operations.

The important change in sterilization policies that occurs when countries in region R begin intervening with dollars rather than gold is that the non-center countries can sterilize for C. Whether or not the non-center countries buy or sell good or dollar denominated securities depends upon their preferences regarding the composition of their portfolio of international reserves. Given the values of the arguments in their preference functions, if region R desires a dollar to gold ratio of unity, then half of their, say, surplus will be used to purchase gold and the other half of the center country's deficit will be sterilized by R.

On a priori grounds alone, one cannot prove that the non-center countries would desire to hold any significant amount of dollar securities. However, it is well known that most monetary authorities have been attracted by the interest they can get on securities compared to the storage and insurance costs associated with holding gold such that in, say, 1962 the foreign exchange component of free world reserves outside the U.S.

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<sup>1/</sup> In order to compare the incentives to sterilize under the gold exchange and gold standards, other factors that influence sterilization policies need to remain unchanged. These other factors include the conflicts between domestic economic targets and (present and expected) reserve level target. If it is assumed that both regions pursue stable prices and that both regions incur deficits and surpluses with the same frequency and of the same sizes (which implies that net reserves are not growing) over the long run, then the impact of payments imbalance upon internal monetary aggregates is equally inconsistent with both regions' internal domestic goals. The conflict between internal and external goals arises when a country has too many reserves and a surplus or too few reserves and a deficit. Both internal and external goals call for sterilization when a country has too many reserves and a deficit or too few reserves and a surplus. Consequently, it will be assumed that over the long run both regions incur the conflicting and non-conflicting situations with the same frequencies and with the same severity.

was about 50%. Since the non-center countries are prone to held assets denominated in the center country's currency, they are thereby partially sterilizing for the center country and forcing more of the adjustment burden upon themselves.

It may be useful to note a determinant of the foreign exchange component of R's reserves that is usually omitted from discussions on the subject. The non-center countries recognize that when they purchase dollar denominated securities, they are sterilizing the U.S. balance of payments and forcing the burden of adjustment upon themselves. However, from each individual country's viewpoint within R, the amount of securities that they purchase is a small part of C's payments disequilibrium.<sup>1/</sup> Consequently, given the economic sizes of R and C, the larger the number of countries and independent monetary authorities in R, the larger the dollar component of reserves one would expect to find for R as a whole. Similarly, it is within the self interest of a non-center country for the rest of region R to force balance of payments discipline upon the center country although that individual country may choose a very high dollar component of reserves for itself. The argument that a country's desired ratio of dollars to reserves will be inversely related to that country's

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<sup>1/</sup> An external, say, surplus of a non-center country may however, reflect the deficit of other countries in R. The distribution of adjustment burden within R is analytically the same as adjustment within a gold standard area since the countries within R are intervening with an asset that is not denominated in terms of a non-center country's currency. Since the paper is given to examining the differences in adjustment under the gold exchange and gold standards, it is assumed that all the non-center countries have external imbalances with magnitudes proportional to their sizes and of the same sign.

ability to place discipline upon the center country, is consistent with H.A. Hagemann's empirical finding that, the larger an individual country's portion of region R's reserves (an index of its potential disciplinary power), the lower the foreign exchange component of that country's reserves. <sup>1/</sup>

Another important determinant of the composition of R's reserves and the distribution of the burden of adjustment in a key currency system is the likelihood that the key currency will be devalued in terms of gold. The development of the dollar overhang and prospects of inconvertibility during the early 1960's diminished (other factors remaining unchanged) the desired dollar component of reserves. <sup>2/</sup> However, in the latter 1960's,

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<sup>1/</sup> H.A. Hagemann, "Reserve Policies of Central Banks and Their Implications for U.S. balance of Payments Policy," American Economic Review, LIX (March, 1969). For the year 1964, Hagemann found this relationship in a cross section study involving 18 countries, but he did not provide a reason for expecting the relationship.

Contrary to our argument in the text, Hagemann suggested that a country with a large (relative to its GNP) continuous current account deficit "is less likely to reduce its  $D_1/R_1$  [foreign exchange to reserves] ratio than a country with a continuous current account surplus, since such action could lead to restrictions on international capital movements and trade or to deflationary measures in the United States ..." (p. 63). While his multiple regression analysis is consistent with this view, I think the argument fails to distinguish between what is true for region R and what is true for the individual non-center country. If forced to submit an alternative explanation of his empirical finding, I would suggest that those monetary authorities who tend to pursue easy monetary policies over the long run (that lead to current account deficits) also tend to be the authorities that tend to assume more risky (as seen by them) portfolio positions.

<sup>2/</sup> By disaggregating by countries from the early 1950's to 1965, Hagemann, op. cit., found good evidence for 11 countries in a multiple regression study that the foreign exchange component of their reserves was inversely related to the ratio of the U.S. gold stock to outstanding dollar liabilities to official institutions.

inconvertibility started becoming an actuality and, in August, 1971, inconvertibility was officially recognized. Consequently, the early threat of convertibility placed more discipline upon the U.S., but actual inconvertibility forced the burden of adjustment upon the rest of the world. During the late 1960's, the dollar overhang was so severe that the U.S. could turn many countries away from its gold window by arguing that such purchases of gold could start a "run on the bank." Had the non-center countries been united, they might have had the incentive and the ability to prohibit the development of the dollar overhang and force more of the adjustment burden upon the U.S. The scenario that led to the completely asymmetric adjustment burden would have been virtually impossible had the dollar not been used as the intervention and reserve asset.

#### Monetary Policy of the Center Country and the World

As long as monetary policy in the center country takes external problems into consideration, the burden of adjustment is not borne totally by the rest of the world even if the center country's currency is inconvertible. However, it may be useful to assume that region R completely offsets the impact of payments disequilibrium upon country C and trace out the implications of this assumption for world monetary policy.

Suppose that the system is initially in equilibrium at point E in Figure VI, and then the system is disturbed by a change in preferences for financial assets. In particular, suppose that, for given interest rates, residents of country C suddenly want to purchase more foreign assets and/or residents of region R suddenly want to purchase fewer assets

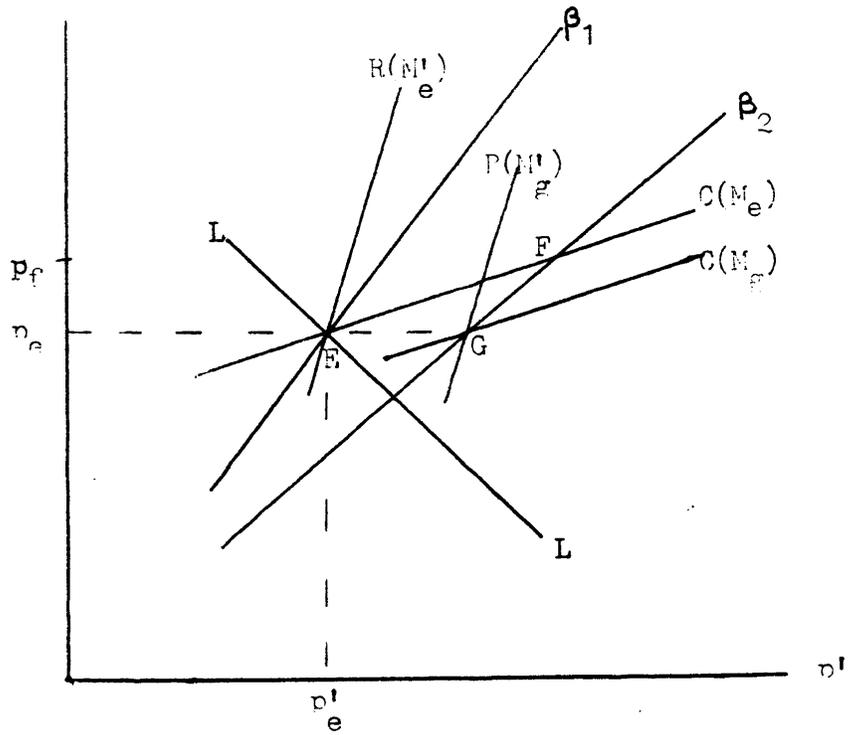


Figure VI: Alternative Monetary Policies

denominated in C's currency. Since  $\partial b / \partial r > 0$  and  $\partial b / \partial r' < 0$ , the balance of payments function,  $b = b[p/p', r(p/p'), r'(p/p')]$ , implies that the initial equilibrium price levels,  $p_e$  and  $p'_e$ , are now associated with a deficit for country C. Consequently, the  $\beta$ -schedule must rotate clockwise from  $\beta_1$  to a position like  $\beta_2$  as shown in Figure VI. If R sterilizes for C but not for itself, the path of adjustment will go from E to F. However, this adjustment path forces the center country's price level up from  $p_e$  to  $p_f$ . The source of this upward pressure is through the balance of trade: As the money supply rises in the surplus region, world expenditures are diverted from foreign to domestic goods placing upward pressure upon the domestic economy. Consequently, if the center country monetary authorities want to keep a stable price level at  $p_e$ , they would have to contract their money supply, not by the full amount called for by the rules of the gold standard, but by an amount like  $(M_e - M_g)$  as depicted in Figure VI.

If the center country tries to stabilize domestic prices, there may still be unwanted expansion in the foreign country as the system moves from E to G. If the rest of world is unable to maintain a stable money supply through sterilization, then the center country has, in corresponding degree, effective control over world monetary policy. Although this control may be thrust upon the center country against its wishes, the fact that it has such control suggests that it should act accordingly. That is,

it should pursue world rather than national objectives.<sup>1/</sup> In the context of this model, the goal would be to stabilize the world price level. As pointed out earlier, if the two regions are identical in economic structure (as opposed to size), then the LL schedule traces out the values of  $p$  and  $p'$  for which the world price level and the world money supply is constant. Consequently, in this pure case, the center country would stabilize the world price level by precisely following the rules of the gold standard and moving along LL. More realistically, of course, the center country and the rest of the world would not be identical in all respects but size. However, we still get the result that, if the center country and non-center countries are not too different in structure, the more the center country tries to contribute toward stabilizing the world price level, the more the center country will have to pursue a policy suggested by the rules of the gold standard.

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<sup>1/</sup> Two of the best known advocates of the idea that the Federal Reserve effectively controls world monetary policy are Professors Charles Kindleberger and Robert Mundell. In "The Euro-Dollar and the Internationalization of United States Monetary Policy," Banca Nazionale Del Lavoro Quarterly Review, March, 1969, Kindleberger repealed his earlier suggestion, that non-Americans be represented on the Federal Open Market Committee, in favor of an international body conducting open market operations in the Euro-dollar market. Mundell has argued that the U.S. controls world monetary policy and should act accordingly. Cf Mundell, "The Crisis Problem," in International Economics, op. cit., Ch. 20; "Toward a Better International Monetary System," Journal of Money, Credit, and Banking, August, 1969, pp. 625-649; and "European and American Monetary Policy," in his Monetary Theory, (Goodyear, 1971), Ch. 16.

### Conclusion

The impact of changes in the intervention asset and reserve policies upon the distribution of the adjustment burden has been examined in the context of a general equilibrium model of the world monetary system. The switch from gold to the dollar as the intervention asset, the policy of holding reserves in interest bearing securities, and the large number of independent monetary authorities outside the U.S. have all contributed to an asymmetry in the adjustment burden. The greater the asymmetry, the more control the U S has over world monetary policy. This control suggests that the U.S. should re-introduce some of the symmetry on its own initiative. Whether the U S. tries only to stabilize its own domestic economy or places some weight upon the stabilization problem for the rest of the world, both objectives imply that the center country should move in the direction, to some degree, of playing by the rules of the gold standard.

But the U.S. did not ask for charge over world monetary policy and, therefore, has a basis for rejecting such responsibility. The alternative is to reintroduce symmetry into the international monetary system whether by reinstating convertibility of the dollar (and arranging the incentives such that the rest of the world takes advantage of the convertibility) or by changing the intervention and reserve assets. Whatever scheme for international monetary reform is adopted, it is clearly desirable to make the system symmetric among countries and, if an agency is to have some control over world monetary policy, it should be deliberately assigned to that agency rather than being inadvertently thrust upon a country as a result of decisions on other matters and historical accidents.