GIUSEPPE TULLIO*

Monetary Equilibrium and Balance-of-Payments Adjustment

An Empirical Test of the U.S. Balance of Payments, 1951–73

INTRODUCTION

SINCE THE 1960s, there has been a renewal of interest in the classical theory of the balance of payments, with important contributions by Johnson [4] and Mundell [7, 8]; the resulting modern version is known as "the monetary approach" to balance-of-payments theory. The pioneering work of Johnson and Mundell has been followed by a number of theoretical refinements and by several empirical tests of the theory for small countries [2]. This paper presents an empirical test of a large country case, viz. the United States in the period 1951–73. Section 1 sets out a simple two-area model of the world from which the U.S. balance-of-payments equation is derived. The empirical tests of this equation are discussed in section 2.

The monetary approach considers balance-of-payments deficits and surpluses as stock adjustments to money market disequilibrium, or as continuous flow disturbances resulting from ongoing stock adjustments. The most important assumptions

*This paper is a revised version of chapter 2 of my doctoral dissertation submitted to the University of Chicago in 1977. I wish to thank the members of my thesis committee—Harry Johnson, Robert Aliber, and Jacob Frenkel—and anonymous referees for helpful suggestions. The views expressed in this paper are my own and in no way involve the Bank of Italy.

GIUSEPPE TULLIO *is economist, Research Department, Bank of Italy.*

0022-2879/79/0279-0068$00.50/0
JOURNAL OF MONEY, CREDIT, AND BANKING, vol. 11, no. 1 (February 1979)

underlying the theory are that arbitrage tends to equate prices across countries and that there exists a demand for money in each area that is a stable function of a few variables. The independent variables of the equation tested in section 2 are therefore the arguments of the money demand and supply functions in the two areas.

Conclusions based on the tests are presented in section 3. The empirical findings confirm the main propositions of the monetary approach. First, monetary policies in the United States and in the rest of the world are important determinants of the U.S. balance of payments. Second, real income growth in the United States exerts a positive impact, and foreign real income growth exerts a negative impact, on the U.S. balance of payments (contrary to a simple Keynesian foreign trade multiplier theory). Third, the effects of changes in price levels, interest rates, and the effective exchange rate of the dollar, operating via the demands for money, dominate opposite effects predicted by competing partial equilibrium theories of the balance of payments, at least for yearly intervals.

1. THE MODEL

The following assumptions hold throughout this section:

1. The world is divided into two currency areas: the United States and Europe.[1] We shall denote the U.S. dollar by \$ and the European currency by £.
2. The two areas are not symmetrical with respect to their reserve policies in the sense that Europe's "central bank" accumulates dollars, but the U.S. central bank does not accumulate the European currency.
3. In each country only one commodity (aggregate output) is produced that is the same in both countries and is tradeable.
4. The exchange rate between the \$ and the £ is fixed, but adjustable.
5. Money and bonds exist in each country and both are internationally tradeable. Since we are only interested in the overall balance of payments, we can concentrate our attention on the money market; by Walras's law, an excess supply of money is equal to an excess demand for the commodity and bonds together, and by definition, this excess demand is equal to the balance-of-payments deficit.

List of Symbols

a = money multiplier
B = U.S. balance of payments expressed in dollars = $dNIR_{US}$
DA = domestic assets of the central bank backing the money supply
G = gold stock
IEE = intra-European exports
IR = international reserves
$L_\$$ = U.S. dollar liabilities that are part of European international reserves
M^D = stock of money demanded

[1] "Europe" here represents the rest of the world.

M^S = stock of money supplied
$NIR = IR - L$ = net international reserves
P_E = price of one unit of output expressed in £
P_{US} = price of one unit of output expressed in $
r = nominal interest rate
χ = exchange rate between the $ and the £, i.e., the price of one $ expressed in £
y = aggregate real output
Y = aggregate output in nominal terms
$\lambda = aDA/M$ fraction of the money stock backed by central bank domestic assets
ρ = real interest rate
d = a first difference; a dot above a variable indicates a rate of change; e.g., $\dot{P}_E = (1/P_E) \cdot (dP_E/dt)$ is the rate of inflation in Europe
η = a demand elasticity

Subscripts E, US, and W below a variable refer to Europe, the United States, and the world, respectively.

The model consists of nine equations:

European money market equilibrium

$$M_E^D \equiv P_E \cdot f(y_E, r_E) = a_E \left[DA_E + IR_E\right] \equiv M_E^S \qquad (1)$$

U.S. money market equilibrium

$$M_{US}^D \equiv P_{US} \cdot g(y_{US}, r_{US}) = a_{US} \left[DA_{US} + IR_{US}\right] - L_\$ \equiv M_{US}^S \qquad (2)$$

European international reserves definition

$$IR_E = \chi G_E + \chi L_\$ \qquad (3)$$

World gold stock definition

$$G_E + G_{US} = G_W \qquad (4)$$

U.S. net international reserves definition

$$NIR_{US} = G_{US} - L_\$ = IR_{US} - L_\$ \qquad (5)$$

European demand for dollar assets

$$L_\$ = K(IEE/Y_E)^\alpha P_{US} \qquad (6)$$

Fisher equation relating real and nominal interest rates

$$r_{US} = \rho + \dot{P}_{US}^* \qquad (7)$$

Perfect capital mobility assumption

$$r_E = r_{US} \qquad (8)$$

Purchasing power parity assumption

$$\chi = P_E/P_{US} \qquad (9)$$

Equations (1) and (2) reflect the assumption of equilibrium in the money markets of Europe and the United States. The terms on the left-hand side of equations (1) and (2) are simple demand functions for money, homogeneous of degree one in prices. The terms on the right-hand side of (1) and (2) are simple money supply functions. The fact that in equation (2) $L_\$$ has been subtracted from a_{US} $[DA_{US} + IR_{US}]$, whereas $L_£$ has not been subtracted from the European money supply, reflects the basic asymmetry of the international monetary system (assumption 2).

Equation (3) defines the stock of European international reserves as the sum of gold and dollars holding, and equation (4) represents the world gold stock constraint. Equation (5) defines the stock of net U.S. international reserves, the first difference of which can be considered as a definition of the U.S. balance of payments. Equation (6) is the European central bank demand for dollar assets as a function of the openness of Europe measured by the ratio of intra-European exports to European income (IEE/Y_E). The demand function for dollars by Europe is assumed to be homogeneous of degree one in prices. K and α are constants. A demand for dollar assets such as (6) can be justified by the lack of a common European currency and little European gold production.

Equation (7) determines U.S. nominal interest rates as the sum of expected inflation and the real rate of interest. Equation (8) reflects the assumption of perfectly integrated capital markets so that nominal interest rates are everywhere the same. Equation (9) reflects the assumption of arbitrage operating in goods markets and tending to equalize price levels at a given exchange rate.

The endogenous variables are P_{US}, P_E, G_{us}, IR_E, G_E, NIR_{US}, $L_\$$, r_{US}, r_E. The policy variables are DA_E, DA_{US}, a_{US}, a_E, IR_{US}, and χ. The variables y_E and y_{US} are assumed to be exogenous and independent of monetary policy.[2] $\dot{P}_{US}^*$ (the expected rate of inflation) and G_W are also given:

Equations (3), (4), and (5) describe the pre-1973 gold-dollar standard. They yield, after differentiation:

$$\frac{1}{\chi}\frac{dIR_E}{dt} = -\frac{dNIR_{US}}{dt}, \qquad (10)$$

[2]The assumption that y_E and y_{US} are exogenously determined (and hence independent of monetary policy) reflects the classical belief in a vertical long-run Phillips curve. It constitutes a major shortcoming of the model. However, it can be justified theoretically on the grounds that our knowledge of the transmission mechanism of monetary policy is still limited, and empirically on the grounds that, even for an economy like that of the United States, the effect of monetary policy on the balance of payments seems to be stronger and faster than the effect on real income. One could also justify the assumption on empirical grounds by noting that, in the period under analysis, the variability of DA_E and DA_{US} has been on average larger than that of y_E and y_{US}.

which says that one areas's balance-of-payments surplus is equal to the other's deficit.

It should be pointed out that the degree of capital market integration, although high and increasing, was not complete during the period 1951–73. Differences in risk and in expected rates of inflation of the two currencies, and the existence of transaction costs, help to explain why equation (8) does not hold perfectly.[3] This can be allowed for in estimation by disregarding equations (7) and (8), and treating r_E and r_{US} as exogenous instead of endogenous variables.

Expressing (1), (2), (6), (9), and (10) in percent changes, one can solve the U.S. balance of payments given the following variables: $\dot{D}A_{US}$, $\dot{D}A_E$, $\dot{a}_{US}$, $\dot{a}_E$, $\dot{y}_E$, $\dot{y}_{US}$, $(I\dot{E}E-\dot{Y}_E)$, $\dot{\chi}$, $\dot{r}_E$, and $\dot{r}_{US}$, where a dot above a variable indicates a rate of change. If there are real world frictions that prevent perfect capital market integration, there are strong reasons to suppose that purchasing power parity does not hold perfectly (equation (9)), though there would be a strong tendency for price levels eventually to converge under fixed exchange rates. Although equation (9) implies that $\dot{\chi} = \dot{P}_E - \dot{P}_{US}$, it is nevertheless realistic to introduce among the independent variables of the balance-of-payments equation the difference in rates of inflation.

Expressing some variables in terms of first differences instead of percent changes,[4] and assuming that income as well as interest elasticities of demand for money are equal in both areas, one obtains:

$$dNIR'_{US} = \dot{a}_E - \dot{a}'_{US} + dDA'_E - dDa'_{US} + \eta fy \left(\frac{\dot{y}_{US}}{\beta} - \dot{y}_E\right) + \eta fr \left(\frac{\dot{r}_{US}}{\beta} - r_E\right) - \alpha(I\dot{E}E - \dot{Y}_E)' + \left(\frac{\dot{1}}{\chi}\right) + (\dot{P}_{US} - \dot{P}_E), \tag{11}$$

where the new variables are

$$dNIR'_{US} = dNIR_{US} \left(\frac{\chi \cdot a_E}{M_E} + \frac{a_{US}}{\beta \cdot M_{US}}\right)$$

$$\dot{a}'_{US} = \frac{\dot{a}_{US}}{\beta} \left(1 + \frac{L_\$}{M_{US}}\right)$$

$$dDA'_E = \frac{a_E}{M_E} dDA_E; \qquad dDA'_{US} = \frac{a_{US}}{\beta \cdot M_{US}} dDA_{US}$$

$$(I\dot{E}E - \dot{Y}_E)' = \frac{L_\$}{\beta \cdot M_{US}} (a_{US} - 1)(I\dot{E}E - \dot{Y}_E) .$$

[3]For similar reasons equation (9) does not hold perfectly; the purchasing power parity assumption implicit in (9) will be relaxed below.

[4]$dNIR'_{US}$ had to be used instead of $N\dot{I}R_{US}$ in empirical work, because NIR_{US} approaches zero in some years of the sample period, which implies that $N\dot{I}R_{US}$ approaches infinity in those years.

The coefficient β is equal to

$$\left(1 - \frac{L_\$}{M_{US}} (a_{US} - 1)\right) .$$

In equation (11), the variables have been redefined in order to take account of structural changes in such parameters as a_E/M_E and a_{US}/M_{US} over the twenty-two-year period of estimation. This is suggested by the nonlinearity of the model. The expected signs of the coefficients of dDA'_E and $\dot{y}_{US}$ are positive, since the surplus of the U.S. balance of payments will be larger, the larger the rate of expansion of European domestic assets and the larger the growth rate of U.S. real income. The expected sign of the coefficient of dDA'_{US} is negative, since any increase in DA'_{US} creates a stock supply of dollars that would be expected to spill over on to domestic and foreign goods and securities causing a deficit in the U.S. balance of payments. The sign of the coefficient of $\dot{y}_E$ is negative, since an increase in $\dot{y}_E$ increases the European demand for money. The positive sign of the coefficient of $(\dot{1}/\chi)$ indicates that the higher the rate of devaluation of the dollar, other exogenous variables being constant, the higher the balance-of-payments surplus, which is what one would expect over the long run. An increase in $\dot{a}'_{US}$ exerts a positive effect on the U.S. money supply and hence a negative one on the U.S. balance of payments; an increase in $\dot{a}_E$ exerts a positive effect on the European supply of money and hence a positive one on the U.S. balance of payments; and the variable $(I\dot{E}E - \dot{Y}_E)'$ influences the European demand for dollars positively and hence the U.S. balance of payments in a negative way. The expected sign of the coefficient of $\dot{r}_{US} - \dot{r}_E$ is negative; with the assumed equal interest elasticities of demand for money in the two areas, a higher level of $\dot{r}_{US}$ than $\dot{r}_E$ means that the quantity of money demanded in the United States is reduced more than in Europe. Finally the theory predicts a positive sign for the coefficient of $(\dot{P}_{US} - \dot{P}_E)$, since only if $(\dot{P}_{US} - \dot{P}_E)$ is positive would the reduction of real money balances be larger in the United States than in Europe in the face of a relative increase in the U.S. inflation rate. The expected coefficients of $(\dot{P}_{US} - \dot{P}_E)$ and $(\dot{1}/\chi)$ are both +1 due to the assumed homogeneity of the demand functions for money. Indeed, if purchasing power parity held perfectly, $(\dot{1}/\chi)$ and $(\dot{P}_{US} - \dot{P}_E)$ would be identical.

2. EMPIRICAL ESTIMATION

In this section ordinary least-squares estimates of equation (11) are presented. The following group of twelve countries was considered as "Europe": Germany, France, United Kingdom, Italy, Belgium, Holland, Denmark, Switzerland, Sweden, Japan, Australia, and Canada.

The U.S. balance of payments was tested using annual data for the period 1951–73.[5] The results are presented in Table 1. Since the attempts to sterilize heavy

[5]Since from 1951 to 1973 β has been only slightly below 1, and has shown little fluctuation, it has been set to 1 to simplify the construction of the variables.

TABLE 1

U.S. BALANCE OF PAYMENTS ON OFFICIAL RESERVE TRANSACTIONS, 1951–73

(ANNUAL DATA)

Number of Regressions	dDA'_{US}	dDA'_{US-1}	dDA'_E	dDA'_{E-1}	$dDA'_{US} - dDA'_E$	$(dDA'_{US} - dDA'_E)_{-1}$	$(\dot{1}/\chi)$	$(I\dot{E}E - \dot{Y}_E)'$	$\dot{y}_E{}^P - \dot{y}_{US}{}^P$	$\dot{P}_{US} - \dot{P}_E$	$\dot{r}_{US} - \dot{r}_E$	R^2 D-W	S.E.
1	−1.02	−1.34	0.45	0.58				−0.86	−1.41			0.86	0.058
	(−2.44)	(−3.44)	(1.96)	(2.25)				(−1.77)	(−2.53)			2.21	
2					−0.78	−0.77	0.63	−1.95	−2.40		−0.30	0.76	0.075
					(−2.82)	(−3.41)	(0.78)	(−2.61)	(−3.61)		(−1.24)	1.62	
3					−0.85	−0.69	0.85	−2.17	−2.02	1.67	−0.14	0.84	0.064
					(−3.58)	(−3.54)	(1.21)	(−3.35)	(−3.44)	(2.67)	(−0.67)	1.95	

Average of absolute values of $dNIR'_{US}$ = 0.105

*Numbers in parentheses are t statistics.

dollar inflows by European countries in the early 1970s might bias the coefficient of dDA'_E, the empirical tests were also performed for the subperiod 1951–70, but are not shown here. The U.S. balance of payments is measured by the change in the international reserves of the United States as defined by the International Monetary Fund minus the change in liabilities to foreign official institutions; y^P indicates permanent real income.[6]

Turning to the results, the coefficient of the variable $\dot{a}'_{US}$ did not turn out to be significantly different from zero. The same holds for the variable $\dot{a}_E$. The European multiplier declined only in 1960, 1961, 1972, and 1973 (by 9.7, 0.1, 2.6, and 1.5 percent respectively). In 1971, when the largest U.S. deficit occurred, it increased instead by 5 percent.

As expected, the constant term was never significantly different from zero and was dropped from the regressions. The variables dDA'_{US} and dDA'_E were lagged to see whether their effects on $dNIR'_{US}$ worked themselves out within a year. It was found that lagged changes in domestic assets of both areas were significant and this was confirmed when dDA'_{US} and dDA'_E were added to form a single independent variable. The sum of the coefficients of dDA'_{US} was approximately twice as large in absolute value as the expected long-run value of 1, whereas the sum of the coefficient of the European variable dDA'_E was not significantly different from its expected value of 1.

The size of the other coefficients closely approximated their expected values. The difference between the rates of change of permanent income was very significant; however, the size of its coefficient was somewhat larger than the average long-run income elasticity of demand for money for the thirteen countries of the "world," as defined.[7] The coefficient of the variable $(\dot{P}_{US} - \dot{P}_E)$ was not significantly different from the expected value of +1. Furthermore its inclusion does not reduce the significance of $(\dot{1}/\chi)$. (Compare regressions 2 and 3.) An increase of $(\dot{P}_{US} - \dot{P}_E)$ reduces the competitiveness of U.S. products and the relative real rate of interest on U.S. financial assets, holding $(\dot{1}/\chi)$ and nominal interest rates constant, which tends to worsen the U.S. balance of payments. This reduction in competitiveness is the balance-of-trade effect of changes in relative price levels, emphasized by the elasticity approach. The evidence suggests that over a one-year period this effect is outweighed by the positive impact of price increases on the balance of payments, working through the reduction of real money balances—the effect emphasized by the monetary approach.

The role of prices of nontraded goods in bringing about this result deserves some attention. The price level for each country is a weighted average of the prices of

[6]Permanent income has been used in the empirical tests for several reasons. First, real income has been assumed to grow exogenously and hence independently of monetary policy, which might not be very realistic on an annual basis. Permanent income is more independent of monetary policy and better reflects the long-term real growth of the economy sustained by population growth and technical change. Second, some authors argue that in the demand for money function, permanent income should be used instead of current income.

[7]The variables $\dot{y}_{US}{}^P$ and $\dot{y}_E{}^P$ were also very significant when introduced separately. In addition, regressions using current U.S. real income (not shown here) yielded a positive and statistically significant income coefficient, which confirms the procyclical nature of the fluctuations of the U.S. balance of payments. Williamson [11, chap. 5] found similar results for the gold standard period.

traded and nontraded goods, which is the correct price deflator in the monetary and financial sectors. The larger the share of the nontraded goods sector, the larger is the scope for divergent price levels between the two countries. It follows that if the nontraded goods sectors are sufficiently large, and if there are real forces at work that tend to change the "internal" price levels (the ratio of the prices of traded to nontraded goods in the two areas) at different speeds, these real forces will tend to have an impact on the balance of payments through changes in $(\dot{P}_{US} - \dot{P}_E)$. Given the high ratio of nontraded goods to traded goods for the U.S. economy, it is quite likely that the variable $(\dot{P}_{US} - \dot{P}_E)$ also reflects the operation of these real forces.

Furthermore, the variable $\dot{r}_{US} - \dot{r}_E$ was found to be significant at approximately the 10 percent level, and the size of its coefficient provides a plausible value for the average long-run interest elasticity of demand for money.[8]

It is interesting to note that by using the variables $(\dot{1}/\chi)$, $(\dot{P}_{US} - \dot{P}_E)$, and $(\dot{r}_{US} - \dot{r}_E)$ together, the size of the coefficient of $(\dot{r}_{US} - \dot{r}_E)$ is halved and becomes insignificant (compare regression 3 with regression 2). This probably reflects the effect of changes in the expected rate of inflation (correlated with $(\dot{P}_{US} - P_E)$ and $(\dot{1}/\chi)$) on interest rates, as implied by equation (7).

The coefficient of $(IEE - Y_E)'$ is an estimate of α (the elasticity of demand for dollars by Europe with respect to the ratio of intra-European exports to European income) and its observed range of 0.86 to 2.17 is plausible. Finally, the coefficient of $(\dot{1}/\chi)$ is somewhat lower than the expected value of 1, possibly because the effect of a change in the exchange rate does not work itself out in one year and because devaluations have tended to occur when deficits have already grown large.

The results for the 1951–70 period were almost the same as for the full sample period and therefore are not presented here.

Similar results are obtained when the U.S. balance of payments is defined to include among U.S. dollars liabilities those liabilities to foreign commercial banks.[9]

3. CONCLUDING COMMENTS

In this paper an equation for the U.S. balance of payments has been derived from a two-area model of the world, which is in the spirit of the monetary approach to the balance of payments. The empirical tests presented in section 2 confirm the main propositions of the monetary approach and support the view that U.S. balance-of-payments deficits and surpluses in the period 1951–73 cannot be understood without explicit reference to monetary policy and money market developments in the United States and the rest of the world.

The tests also throw light on the controversy as to whether a "supply theory" or a "demand theory" of the U.S. deficits in the period is more correct. Supporters of the "supply theory" claim that the deficit was caused by an overexpansion of the U.S. money supply [9]; supporters of the "demand theory" claim that the deficit was caused by an excess demand for dollars by Europe [1]. The regressions reported in section 2 suggest an eclectic conclusion, since the increase in real European income and European domestic assets exerts a significant influence on the U.S. deficit, as does the increase in U.S. real income and domestic assets held by the Federal Reserve System.

One of the major shortcomings of the empirical tests presented is that the coefficient of dDA'_{US} might be biased by the Federal Reserve System's attempts to sterilize balance-of-payments deficits. However, in the institutional framework of the pre-1973 gold dollar standard, the achievement of equilibrium in the balance of payments has on the whole been a secondary target for U.S. monetary authorities compared to that of internal stabilization.

At most, one can say that the U.S. monetary authorities have tried to sterilize gold losses resulting from conversions of dollars for gold by Europe. However, the yearly changes in the U.S. gold stock are, on average, only a relatively small fraction of the average absolute value of the annual balance of payments (11.3 percent if the balance of payments is defined on official reserve transactions). Hence it could be shown that, even assuming full sterilization of gold outflows, the bias of the coefficient of dDA'_{US} in the U.S. balance-of-payments equation would be small. In addition, gold conversions by Europe are largely endogenous, often resulting from previous high dollar flows to Europe and hence from expansionary U.S. monetary policy. Thus, given the international monetary arrangements of the period 1951–73, it is not unrealistic to consider dDA'_{US} as an exogenous variable. In this connection it is interesting to observe that in tests of the Italian balance of payments, under perfectly fixed exchange rates, the coefficient of the change in domestic assets of the central banks of the rest of the world is also substantially larger than expected [10].

More open to criticism is the assumption that dDA'_E is an exogenous variable, since European countries have at times tried to sterilize dollar inflows. Since the unwanted dollar inflows into Europe are concentrated in the early 1970s, when U.S. deficits became really large, the empirical tests were also applied to the subperiod 1951–70, with comparable results.[10] One can therefore conclude that there is strong confirmation of the hypothesis that changes in domestic assets of both the U.S. central bank and central banks in the rest of the world significantly affect the U.S. balance of payments.

APPENDIX: SOURCES OF DATA USED

a_E = European money multiplier. Calculated as a GNP-weighted average of the money multipliers of each European country (a_i), where a_i = (line 34 + line 35)/ line 14 of International Financial Statistics and the GNP

[8]This result implies that the demand for money in both areas is sufficiently sensitive to interest rate changes, if an adjustment period of one year is allowed for, to more than offset the effect of capital movements on the U.S. balance of payments.

[9]A table similar to Table 1 for this particular definition of the U.S. balance of payments is available from the author upon request.

[10]The criticism that the coefficients of the changes in U.S. and European domestic assets are biased because of sterilization policies does not apply to the lagged changes in domestic assets, unless one is willing to make the unrealistic assumptions that the central banks of both areas not only can predict the balance-of-payments outcome one year ahead, but can also sterilize the predicted effects of the balance-of-payments outcome on their money stocks.

weights used are those of 1971, since in 1971 the largest U.S. deficit occurred

$a_{US} = M_{US}^S/H_{US}$ = U.S. money multiplier; M_{US}^S = U.S. money stock (line 34 of IFS); and H_{US} = U.S. high-powered money (line 14)

$DA_E = \Sigma_{i=1}^{12} (DA_i/\chi_i)$; where DA_i = domestic assets of the central bank of country i and χ_i = 1951 exchange rate of country i with respect to the dollar (in order to exclude from DA_E the effect of exchange rate changes)

DA_{US} = Federal Reserve's claims on government (line 12a) plus float (line 13a)

$(\dot{1}/\chi) = -\dot{\chi}$ = weighted rate of devaluation of the dollar with respect to the currencies of the twelve countries of Europe. $\dot{\chi}$ was calculated by subtracting from the rate of change of DA_E the rate of change of a series obtained by using the actual exchange rates in the denominator of DA_E, instead of the 1951 exchange rate

IEE = value of intra-European exports in nominal terms; calculated from direction of international trade

$M_E^S = \Sigma_{i=1}^{12} (M_i^S/\chi_i)$; where M_i^S = money stock of country i, narrowly defined (line 34) and χ_i = 1951 dollar price of currency of country i

$NIR_{US} = IR_{US} - L_\$$ = net international reserves of the United States; IR_{US} = international reserves of the United States (line 1 of IFS); $L_\$$ = dollar liabilities to foreign official institutions (line 4a)

$\dot{P}_E$ = weighted average of the rates of changes of the European consumer price indices (line 64); $y_i/\chi_i y_E$ were used as weights

P_{US} = U.S. consumer price index (line 64)

$\dot{r}_E$ = weighted average of the rates of change of the long-term government bond yields of the twelve European countries; $y_i/\chi_i y_E$ were used as weights. For Japan and Germany line 60b was used (call money rate) because the other was not available

r_{US} = U.S. long-term government bond yield (line 61 of IFS)

$y_{E,t}^P = \Sigma_{s=0}^4 w_s y_{E,t-s}$ = European permanent real income; $\dot{y}_{E,t} = \Sigma_{i=1}^{12} (y_i/\chi_i y_E)\, \dot{y}_i$ and $\dot{y}_i$=rate of change of real income of country i (line 99a divided by line 64 of IFS). The weights $y_i/\chi_i y_E$ were calculated for five years only: 1951, 1956, 1961, 1966, and 1971, and the series $y_{E,t}$ was obtained by applying the series $y_{E,t}$ to $y_{E,1951}$. The weights w_s are the same as for the United States (see below)

$Y_E = \Sigma_{i=1}^{12} (Y_i/X_i)$ = European income in nominal terms, where Y_i = line 99a of IFS and χ_i is the 1951 exchange rate of the currency of country i with respect to the dollar

$y_{US,t}^P = \Sigma_{s=1}^4 w_s y_{US,t-s}$ = U.S. permanent real income, where $y_{US,t-s}$ = GNP at 1963 prices (line 99a divided by line 64 of IFS) at time $t-s$ and $w_0 = 0{,}60$, $w_1 = 0.25$, $w_2 = 0.10$, $w_3 = 0.04$, $w_4 = 0.01$. The above set of geometrically declining weights was chosen arbitrarily and no attempt was made to check the sensitivity of the coefficient of $\dot{y}_E^P - \dot{y}_{US}^P$ in the regressions of Table 1 to the particular set of weights chosen.

LITERATURE CITED

1. Despres, Emil, Charles P. Kindleberger, and Walter S. Salant. "The Dollar and World Liquidity." In *The International Monetary System: Problems and Proposals*, edited by Lawrence H. Officer and Thomas D. Willett. Englewood Cliffs, N.J.: Prentice-Hall, 1969.
2. Frenkel, Jacob A., and Harry G. Johnson, eds. *The Monetary Approach to the Balance of Payments*. London: Allen and Unwin, 1976.
3. International Monetary Fund. *International Financial Statistics*, 1971 and 1972 supplements and various succeeding issues.
4. Johnson, Harry G. "The Monetary Approach to Balance of Payments Theory." In *International Trade and Money*, edited by Michael B. Connolly and Alexander K. Swoboda, pp. 206–24. London: Allen and Unwin, 1973.
5. ———. "Towards a General Theory of the Balance of Payments." In *International Trade and Economic Growth*, edited by Harry G. Johnson, pp. 153–68. London: Allen and Unwin, 1958.
6. Laffer, Arthur. "Monetary Policy and the Balance of Payments." *Journal of Money, Credit, and Banking*, 4 (February 1972), pp. 13–22.
7. Mundell, Robert A. *International Economics*. New York: Macmillan, 1968.
8. ———. *Monetary Theory: Inflation, Interest and Growth in the World Economy*. Pacific Palisades: Goodyear, 1971.
9. Rueff, Jaques. "Increase the Price of Gold." In *The International Monetary System, Problems and Proposals*, edited by Lawrence H. Officer and Thomas D. Willett. Englewood Cliffs, N.J.: Prentice-Hall, 1969.
10. Tullio, Giuseppe. "Monetary Equilibrium and Balance of Payments Adjustment: Empirical Tests of the U.S. and the Italian Balance of Payments." Ph.D. dissertation, University of Chicago, 1977.
11. Williamson, Jeffry G. *American Growth and the Balance of Payments: 1820–1913*. Chapel Hill: University of North Carolina Press, 1964.