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# World Inflation

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Inflation seriously undermined the world economy in the first half of the 1970's. In the industrial areas of the world, consumer prices increased at a 5-percent annual rate in the 1971-72 period, and later accelerated even further, eventually rising by 13 percent in 1974. The price performance was even worse in developing countries, where the average rate of consumer-price inflation rose from 10 percent in 1971 to 30 percent in 1974. The severity of this problem, in both practical and analytical terms, thus has stimulated economists to make new efforts to link the two worlds of theory and policy—witness the articles in this issue. These papers are built around a common theme—the factors which have made the inflation worldwide in nature. Although providing no final answers, they highlight the crucial inflation issues and thereby help extend the current dialogue on one of the world's most intractable problems.

In the first article, Edward S. Shaw argues, "The inflation was a monetary phenomenon. Money was supplied in excessive quantities everywhere, and its value or purchasing power decayed." He formalizes his analysis with a model of world inflation, wherein government deficits of the reserve-center country (the U.S.) generate an excess supply of dollars, which under a system of fixed exchange rates then inflate the money supplies of other countries. The model is first used to explain the overall price stability of the 1958-65 period, and then to explain the collapse of the fixed-exchange-rate system in the following decade.

Shaw also notes the potential difficulties for

price stability under the new regime of floating exchange rates. With no change in policies, the United States could release through its budget deficits the inflationary pressures that were previously absorbed, under Bretton Woods, by growth in worldwide demand for dollar reserves. He concludes that the result could be inflation at rates even faster than those recently experienced in this country.

Michael W. Keran highlights those elements in the current body of economic theory which might help explain the unusual combination of inflation and recession which now besets the world in general and the U.S. in particular. First, the inflation. An unprecedented expansion in international reserves—the dollar-overhang problem—occurred prior to the early-1973 breakdown of the system of fixed-exchange-rates. This led to a simultaneous increase in the domestic money stocks of most of the world's industrial nations, resulting in a massive worldwide boom and then a massive worldwide inflation. Yet because of the worldwide nature of this process, the magnitude of inflation in any one country was greater than it otherwise would have been—because in addition to the traditional impact of an expanding domestic money stock on domestic prices, there was also the impact of rest-of-the-world inflation on domestic prices through the mechanism of internationally-traded goods. On the basis of data for six industrial countries (including the U.S.) Keran presents evidence that the recent inflation phenomenon can only be explained by considering both international and domestic monetary de-

velopments.

Rest-of-the-world inflation also helps explain the recession phenomenon, operating through existing relationships between the domestic money stock and domestic income. Given the growth in the domestic nominal money stock, a larger - than - expected domestic inflation imported from outside will reduce *real* money balances by more than otherwise expected, and thus will temporarily reduce real income. With this unprecedented (if temporary) gap between real and nominal income, we experience simultaneous inflation and recession. "How long will this state of affairs continue? As long as the growth rates of real and nominal money are on divergent courses"—which depends today on the course of world inflation.

In another paper, Hang-sheng Cheng and Nicholas P. Sargen develop a monetarist model to examine the effectiveness of central-bank policy for combatting imported inflation. They note that the impact of imported inflation on domestic prices depends critically on the degree of openness of the economy, which in turn is determined by the substitutability between domestic products and foreign products on the one hand, and the ratio of imports to domestic expenditures on the other. Depending on the degree of openness, the central bank can exert at least partial control over the domestic money supply. Even in the case of a highly open economy, domestic credit expansion or contraction will affect the domestic money supply, as a result of induced changes in the domestic demand for money which are brought about by changes in real expenditures and domestic prices. Hence, the central bank could, under specified circumstances, utilize domestic credit policy for combatting imported inflation.

Cheng and Sargen test their model by analyzing 1948-73 data for eight Pacific Basin countries with varying degrees of dependence on trade, levels of development, and rates of inflation. The results suggest that imported inflation contributed significantly to domestic inflation in nearly all of the countries in the sample, with the impact more apparent in developed countries than in the developing countries of the region. At the same time, independent monetary policy appears to have been less feasible for the developed countries than for the developing countries.

Joseph Bisignano in his contribution emphasizes the increasing monetary interdependence among nations. First, a high degree of correlation exists among short-term interest rates of various countries, reflecting the rapid rise and integration of capital and money markets. In addition, changes in the U.S. monetary base significantly influence the money supplies of almost all major industrial countries. This finding appears logical, given the acceleration in the rate of growth of the U.S. monetary base, and given the commitment by most nations (until recently) to a system of fixed exchange rates.

Bisignano then proceeds to develop a monetary interpretation of the balance of payments. This approach requires a money-demand equation, a money-supply equation, an equation positing the equality of those two variables, and an equation defining the balance of payments as the change in the foreign-asset component of the monetary base. This monetary approach is essentially a theory of equilibrium restoration between money demand and supply in open economies. The analysis hinges crucially on the empirical stability of monetary-base demand, which was statistically verifiable over the 1966-73 period.

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# International Money and International Inflation: 1958-1973

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Edward S. Shaw\*

Inflation on an international scale was negligible or modest into the early 1960's. Then it accelerated, slowly through 1965, progressively faster to the explosive climax of 1973-74. The eclipse of price-level stability has been explained in a variety of ways. One explanation blames traumatic phenomena of commodity supply, including crop failures and aggressive policies of the petroleum oligopoly. Another points to social conflict. Factors such as these did generate blips or bubbles in price levels, but they do not account for the prolonged surge of inflation.

The inflation was a monetary phenomenon. Money was supplied in excessive quantities everywhere, and its value or purchasing power decayed. Prime responsibility for excess money lies with the fiscal-monetary policies of the United States. Fiscal deficits of the American government generated an increasing stock of Treasury debt. Market prices bid for the debt by the Federal Reserve and other national monetary authorities drew virtually all of the debt into the authorities' portfolios, and "high powered" or "reserve" money increased correspondingly. The linkage of monetary systems by the arrangements of Bretton Wood guaranteed the subservience of "small" monetary systems to policies of the American Treasury and central

bank. Every monetary system expanded its national money supply on the basis of accumulating reserves. Then holders of money responded as they always do to excess money supplies, by speeding up their turnover rate or velocity of money expenditure. The pace of growth in these expenditures was progressively faster than the pace of growth in real outputs of goods and services. Accelerating inflation and the collapse of Bretton Woods were the only possible outcomes.

The first section below develops a model that formalizes the fiscal-monetary explanation of world inflation in a context of fixed foreign-exchange rates. There is a center country that imposes inflationary shocks, and there are small countries that contribute their shares to the upward sweep of price levels. The model is adapted to the regime of Bretton Woods. The second section explores briefly the experience of the United States as center and of eight other countries as satellites during 1958-65. In those years, by good luck or sound judgment, growth of nominal money hewed quite closely to growth in real money demanded by private sectors, and the result was stability in markets for goods, securities, and foreign exchange. The third section has to do with the years 1966-73 that terminated in the collapse of Bretton Woods. The fourth section explores briefly potentials for inflation in the center country after foreign-exchange rates have been floated.

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\*Edward S. Shaw was Visiting Scholar at the Federal Reserve Bank of San Francisco (1974-75), following his retirement as Professor of Economics at Stanford University.

## I. Elements of the Inflationary Process

The equilibrium growth path of the world's price level depends on the relative growth paths of nominal money supplied and real money demanded.

$$(1) \quad p^w = m_s^w - \bar{m}_d^w$$

$p^w$  = rate of change in the world price level in terms of the center numeraire

$m_s^w$  = rate of change in the world nominal money supply in terms of the center numeraire

$\bar{m}_d^w$  = rate of change in real money demanded in the world economy.

$t^u$  = growth rate of international monetary reserves held by the monetary authority of the center country.

$t^o$  = growth rate of international monetary reserves held by the monetary authorities of the satellites.

$r^u$  = actual and desired ratio of domestic non-reserve assets to reserves in the monetary system of the center country.

$r^o$  = actual and desired ratio of domestic non-reserve assets to reserves in the monetary systems of the satellite countries.

A relative rise in the growth rate of nominal money increases the rate of inflation though, in the short run, some of the adjustment occurs in growth rates of output and of real money demanded.

Equation (2) elaborates upon (1), distinguishing the growth paths of the center or large country (u) and the satellite or small countries (o). Equilibrium is assumed for every member of the bloc; foreign-exchange rates are normalized at unity; and all goods are classified as tradeables.

$$(2) \quad p^w = [s_u(m_s^u) + s_o(m_s^o)] - [s_u(\bar{m}_d^u) + s_o(\bar{m}_d^o)]$$

$s_u$  and  $s_o$  = country weights, summing to unity.<sup>1</sup>

Equation (3) elaborates upon (2), presenting the determinants of growth in nominal money.\*

$$(3) \quad s_u \left( m_s^u \right) + s_o \left( m_s^o \right) = s_u \left( t^u + \frac{d(r^u)}{1+r^u} \right) + s_o \left( t^o + \frac{d(r^o)}{1+r^o} \right)$$

\*The term  $d(\ )$  in the following equations is the differential of the function ( ).

It is assumed that monetary systems, in acquiring reserve and non-reserve assets, issue only money—or that issues of money are in constant proportion to issues of, say, time and savings deposits and certificates of deposit. International reserves may include physical stocks of gold, priced in the center's numeraire, and SDR's as well. However, the analysis below takes it for granted, in general, that these reserve components do not grow. The component that will concern us most is (T), interest-bearing debt of the center's government at nominal value. This is a policy variable, its growth rate (t) depending on growth in the center government's real deficit and the rate of inflation.

$$(4) \quad t = e + p^w$$

$e$  = growth rate of the real debt of the center government.

The ratios (r) of domestic credit to reserves are also a policy variable. The assumption will be that ( $r^u$ ) is constant but that ( $r^o$ ) may be changed by monetary authorities in small countries. Their decisions may be explained in this fashion:

$$(5) \quad r^o = r^o(y^o, v^o, p^w)$$

$y^o$  = growth rate of permanent income in the satellite countries.

$v^o$  = growth rate of real imports into the satellite countries.

Equation (5) suggests that portfolio preference on the part of small monetary systems shifts away from reserve assets to domestic credit accordingly as the negative yield ( $p^w$ ) on the former increases and as positive yields on the latter are generated by speedier growth of output ( $y^o$ ). It suggests also that demand for reserve assets, relative to domestic credit, tends to increase with growth of international trade ( $v$ ).

Equations (6) and (7) complete specifications for the supply component of equation (2).

$$(6) \quad t^o = m_s^o - \frac{d(r^o)}{1+r^o}$$

$$(7) \quad t^u = t - s_o \frac{t^o}{s_w}$$

These equations allocate growth in monetary reserves between satellite and center monetary systems. Equation (6) indicates that satellite monetary authorities may accommodate as little or as much as they wish of the center government's deficit finance. They may resist importation of reserves, displacing reserves with domestic credit and raising ( $r^o$ ) in the manner, say, of Japan. They may welcome reserve inflows and economize on domestic credit, at low values of ( $r^o$ ), in the style of The Netherlands. Equation (7) indicates that the monetary authority of the center country is the residual buyer of its government's debt issues. It establishes and defends a rate of interest for government securities that is low enough, relative to other rates of interest, to repel demand for (T) by the non-monetary sector of the world economic system.

Equation (8) elaborates upon the demand element of equation (2).

$$(8) \quad s_u(\bar{m}_d^u) + s_o(\bar{m}_d^o) = s_u(\eta_y^u y^u - \eta_p^u p^w) + s_o(\eta_y^o y^o - \eta_p^o p^w)$$

$\eta_y y$  = response of growth in real money demanded to growth in perma-

nent income.

$\eta_p p^w$  = response of growth in real money demanded to inflation.

The ( $\eta_y$ ) in this equation is the income elasticity of demand for money, and ( $\eta_p p^w$ ) is the inflation elasticity. We suppose that real rates of interest are constant and that expected inflation is equal to actual inflation. Nominal rates of interest, suppressed in this model, vary with ( $p^w$ ). If one were to trace a temporal path defined partly by (8), he would observe a redistribution of the world's real money balances, a larger share accruing in countries with high growth rates of real income, and with low sensitivity, on the part of the money-holders, to inflation.

We have now a very small model to guide analysis of inflation in 1958-73. There are three equations. One is equation (2), expanded by (3), (4), (5) and (8). The others are (6) and (7). The three endogenous variables, determined by the model, are ( $p^w$ ), ( $t^o$ ), and ( $t^u$ ). Instruments of policy are the fiscal-monetary instrument of the center country ( $t$ ) and the portfolio-choice instrument of the satellites ( $r^o$ ). Other instruments will be introduced informally, including the foreign-exchange rate between center and satellites and the issuance of SDR's.

Compression of the model to only three equations has its analytical costs. For example, one does not observe explicitly that the nominal money stock and its growth rate in the center country are not determined exclusively by the monetary authority of the center. Given ( $t$ ) and the international pattern of demand for real money, ( $m_s^w$ ) is determined partly by the portfolio choices of foreign monetary authorities. High values of ( $r^o$ ) imply relatively large stocks of money in the center, low values of ( $r^o$ ) relatively small stocks in the center. The world's nominal money supply and the supply in each country are at the mercy of decisions by all monetary authorities.

In an harmonious monetary world, with constant foreign-exchange rates, monetary authorities would wield their control instruments in a mutually satisfactory way. The center would manage ( $t$ ) and ( $r^u$ ); the satellites would man-

age ( $r^o$ ); and everyone would be satisfied with paths taken by nominal money and the price level. The rate of inflation everywhere is at the mercy of monetary expansion anywhere, but a consensus about the optimal inflation rate can hold the monetary community together.<sup>2</sup>

There is some risk of excessive instability in the integrated monetary world when the monetary authority of the center watches over ( $r^u$ ) only and neglects changes in the constellation of reserve and domestic-credit ratios in small countries. If its conception of its role is myopic, fixed only upon domestic monetary developments, the possibility is not negligible that concerted changes abroad in desired portfolio ratios of small monetary systems will induce important changes in world growth rates of money and prices. When foreign-exchange rates are fixed, the center ignores monetary policies in small countries at some peril to world stability.<sup>3</sup>

The source of instability that concerns us most originates with the center, mainly through an increase in ( $t$ ) but potentially as well through an increase of ( $r^u$ ). One recalls that ( $t$ ) is the growth rate for primary debt ( $T$ ) of the center's fiscal authority, the variable reserve asset of the world's monetary system.<sup>4</sup> The initial disturbance on the markets for reserves and money caused by an increase in ( $t$ ) may be absorbed smoothly by the world's monetary system. Perhaps as the result of coincidental increases in world trade flows ( $v$ ), there may be reductions in desired domestic-credit ratios of small countries that limit the multiplicative impact on money supplies. Again, concurrent growth of permanent incomes ( $y$ ) may draw increments of nominal money into real money balances at an essentially stable rate of price inflation. That is to say, declines in ( $r^o$ ) and increases in ( $\bar{m}_d^o$ ) may neutralize acceleration of ( $t$ ).

Sustained and accelerated growth in ( $T$ ), combined with unfortunate but not improbable monetary policies in the center and its satellites, however, has ominous potentialities for the world monetary system.<sup>5</sup> Growth in the nominal value of international reserves has been described in equation (4), repeated here:

$$(9) \quad t = e + p^w$$

With ( $p^w$ ) initially at zero, the center government may be driven by political considerations, perhaps by a war, into acceleration in growth of its real debt ( $e$ ) and correspondingly in ( $t$ ). The center monetary authority, trying to inhibit an upward sweep of domestic rates of interest, can be expected to increase open-market purchases and ( $t^u$ ). Inevitably international balances of payment would transmit some of the growth in ( $t$ ) to small monetary systems. The effect can be to reduce their domestic-credit ratios below desired levels and so to accelerate their monetization of domestic credit. Some increase in the rate of inflation must occur, and then ( $t$ ) must increase again. Nominal rates of interest, responding to growth in ( $p^w$ ), must rise and induce faster monetization of deficits in the center, given the illusion of the center monetary authority that there is no difference between real and nominal rates of interest. The likelihood of dramatic growth in the world's money supply and price level is not small for any large increase in ( $e$ ). Needless to say, an initial reduction of ( $e$ ) could precipitate cumulative deflation. The real fiscal objectives of the center and its monetary policies, together with portfolio preferences of small monetary systems, have a common and interacting bias toward monetary instability.

This scenario of fiscal and monetary instability is still incomplete. Growth of ( $e$ ), ( $t$ ), ( $m_s^w$ ), and ( $p^w$ ) must be expected, on the basis of equation (8), to induce some decline in the world growth rate of real money demanded and some increase in the growth rate of money's velocity. Moneyholders respond to the inflation tax by the obvious strategem of demanding slower growth in real money balances. Any decline in ( $\bar{m}_d^o$ ) must push inflation along still faster, according to equation (1), and contribute to the quickening growth of nominal fiscal deficits, nominal reserves, and nominal money supplies. Money-holders, too, have a role in the explosive sequence.

The stage now is set for the collapse of international monetary arrangements. Monetary systems of small countries cannot give vent to their



portfolio preference for domestic over international assets by accelerating domestic credit expansion, because the inflationary outcome would be intolerable. Specific interventions on capital markets, goods markets, and the foreign exchanges are too costly in investment and trade distortions. The only acceptable way of preserving relative price-level stability and desired portfolio balance is simultaneously to depreciate the center country's currency at some rate ( $\dot{f}$ ) and to raise ( $r^o$ ). We may introduce the new instrument of monetary control ( $f$ ) into our model:

$$(10) \quad p^o = p^w - \dot{f}$$

$$(11) \quad p^o = m_s^o - \bar{m}_d^o$$

$$(12) \quad m_s^o = t^o - \dot{f} + \frac{d(r^o)}{1+r^o}$$

$\dot{f}$  = rate of change in price of the center money in terms of the numeraire of the small economy.

The moves for independence of the small economy reduce accumulation of reserves there and increase ( $t^o$ ), the rate of growth of high-powered money in the center. The consequence for the center, given budgetary policy, is necessarily still more rapid inflation. Presumably the time must come when, out of despair over its own inflation-

ary experience, the center reduces the growth rate of its real budget deficit. Fixed foreign-exchange rates provide an opportunity for the center country to induce world-wide inflation. Floating exchange rates permit small countries to choose their own price-level paths and may induce the erstwhile center country not to heap inflationary abuse upon its own monetary system.

It may be helpful to reiterate the real aspects of inflation and monetary crisis. The crisis we have synthesized is initiated by a fiscal decision in the center country for a real budget deficit, financed by seignorage and inflation-tax revenues. Excess real money balances induce substitutions by private sectors against money in favor of wealth in other forms and perhaps of consumption. Unbalanced portfolios induce substitutions by small monetary systems against international reserves in favor of claims on domestic wealth, and they may induce changes in the relative price of the center currency. The crisis is a real phenomenon. However, it could not happen except for one capitulation to money-illusion, the "low" interest-rate policy of the center's monetary authority. That policy prevents the diversion of (T) away from monetary systems and the monetary base.

## II. Bretton Woods in Bloom: 1958-65

In this section, we undertake an informal analysis of international monetary experience, applying the model of the preceding section. The analysis relates to just the United States and eight "small" countries. It covers the period when monetary experience was serene, 1958-65, and when only a few factors were in sight that might disturb that serenity. Table I provides a few insights into the real and monetary contours of the period.

Growth in real incomes and in trading during these years induced growth in real money demanded: the velocity data suggest that the growth rate of real money balances exceeded the growth rate of real income in most cases. This meant, of course, that the international mone-

tary system was realizing efficiency gains from money-deepening. Stability of nominal rates of interest suggests that demand for real money was not damped by accelerating inflationary expectations. Such expectations were missing, of course, because monetary authorities, including the United States as center and others as satellites, constrained growth of nominal money to modest levels. Demand - pull by money - holders for monetary expansion was being accommodated by monetary authorities at essentially stable price levels.

Patterns of change in portfolio preference among monetary systems, between international reserves and domestic credit, are suggested in Table II.

**Table I**  
**Growth Experience in Nine Countries: 1958-1965<sup>1</sup>**

	United States	Belgium	Canada	France	Germany	Italy	Japan	Netherlands	Switzerland
<b>Growth Rates of Nominal Money</b>									
1958-61	1.7	3.5	5.8	10.8	11.1	12.2	16.1	6.8	8.7
1962-65	3.3	7.6	9.0	13.1	8.9	13.6	19.4	8.7	8.4
<b>Growth Rates of Real GNP</b>									
1958-61	2.4	2.9	3.0	5.2	7.7	6.5	11.0	4.0	4.6
1962-65	5.6	5.2	6.3	6.0	5.0	4.5	8.8	5.4	4.8
<b>Growth Rates of GNP Deflator</b>									
1958-61	1.8	1.0	1.3	6.1	2.9	1.7	3.3	2.2	2.9
1962-65	1.5	3.4	2.2	4.3	3.9	6.1	4.5	5.5	4.7
<b>Change in Money's Velocity</b>									
1958-61	+	+	-	+	-	-	-	-	-
1962-65	+	+	-	-	0	-	-	+	+
<b>Growth Rates of Imports</b>									
1958-61	2.3	5.2	0.1	2.0	9.8	9.2	7.9	5.5	8.4
1962-65	10.3	11.4	8.8	11.7	12.4	9.0	8.9	10.1	8.1
<b>Government Bond Rates of Interest (end of year)</b>									
1957	3.5	6.0	4.2	5.9	7.5	6.8	8.4	4.6	3.6
1961	3.9	5.9	5.1	5.1	6.0	5.2	7.3	3.9	3.0
1965	4.2	6.4	5.2	5.3	6.7	6.7	5.5	5.2	4.0

<sup>1</sup>Federal Reserve Bank of St. Louis, *Rates of Change in Economic Data for Ten Industrial Countries*; International Monetary Fund, *International Financial Statistics*.

**Table II<sup>1</sup>**  
**Ratios of Foreign Assets to Domestic Credit in the Monetary Systems of Nine Countries: 1958-1961 and 1962-1965**

	1958-1961	1962-1965	1958-1965
United States	9.2%	5.6%	
Belgium	37.3	29.8	
Canada	17.2	20.3	
France	8.6	17.8	
Germany	21.3	16.1	
Italy	16.3	10.8	
Japan	4.0	1.6	
Netherlands	85.0	64.6	
Switzerland	25.6	23.1	
Average excluding United States	26.9	23.0	25.0%

Source: *International Financial Statistics*. The percentages are four-year averages of end-of-year data.

Monetary systems of the small countries supplied growth domestically in nominal money by acquiring both foreign assets, primarily gold and U.S. dollars, and domestic assets. Evidently there were substantial differences among countries in their relative tastes for reserves, on the one hand, and claims against domestic wealth, on the other. At the extreme, Japan may have economized on reserves because its growth rate of output and, correspondingly, rates of return on domestic wealth were high, while The Netherlands, facing lower opportunity costs of holding reserves and having a higher proportion of imports to national output, preferred a lower ( $r^o$ ). Between 1958-61 and 1962-65, there was a small shift, on the average, away from reserves. However, since the only significant adjustment in a foreign-exchange price of U.S. dollars during the second interval was positive (Canada), appreciating the U.S. dollar, one does not sense a growing aversion to reserves.

The role of the United States, as center of the

international monetary system, is indicated in Table III.

Growth in permanent income, imports, and real money balances induced demand by small countries for international reserves, and the United States responded by export of \$15.6 billion, 60 percent of it in gold and the remainder in liquid external liabilities. Catering to demand abroad for reserves, the United States permitted its own reserve base of gold to erode. The vehicle for international reserve transfers was, of course, the international balance of payments. Net demands by small monetary systems upon the United States for reserves were associated, during 1958-65, with net demands upon the United States for goods and services. Economic growth abroad and military objectives as well required not only an input of high-powered money but an input too of goods and services for consumption and investment. Inevitably these net demands for reserves, goods, and services were associated with net supplies, through "bond" markets, of securities to the United States. Demand for these securities in the center country is explained by the relative attractiveness of investment opportunities abroad that one can sense in the relatively high growth rates of output and income there and in the relatively high rates of interest on government bonds. Growing demands for real money, reserves, and

goods abroad were financed by growing supplies of securities to the center.

Deficits and debt-issues of the American federal government supplied to the Federal Reserve, through its open-market operations, the assets that it demanded in replacement of gold lost to abroad (\$9.4 billion) and the assets that it demanded for creation of domestic currency and reserves of commercial banks in this country (\$9.5 billion). They supplied, too, growth of \$6.2 billion in reserves of small monetary systems. Some \$25 billion of debt were floated by the Treasury of the United States to domestic and foreign monetary authorities, \$15 billion to other lenders: interest-rate policies of the Federal Reserve did not preempt, for the portfolios of monetary authorities, the entire issue of Treasury debt. One notes that there was no upward drift of fiscal deficits during 1958-65. Demands for money, gold, and debt of the United States government were stimulated by growth of the world's economy, and the demands were satisfied at relatively stable prices for goods, securities, and foreign exchange.

The smooth accommodation of world monetary expansion to economic growth yielded a variety of gains in economic efficiency. For one, stable expectations regarding price levels and foreign-exchange rates encouraged the use of dollars as a vehicle for settlements in world

**Table III<sup>1</sup>**  
**International and Fiscal Position of the United States:**  
**1958-1961 and 1962-1965**  
**(\$ billions)**

	1958-1961	1962-1965	Total
<b>International</b>			
Change in international reserves	-6.1	-3.3	-9.4
Change in external liquid liabilities to monetary authorities and governments	2.7	3.5	6.2
<b>Total export of reserves</b>	<b>8.8</b>	<b>6.8</b>	<b>15.6</b>
<b>Fiscal</b>			
Deficits of the federal government	18.3	19.4	37.7
Increase in debt of the federal government	25.0	14.2	39.2
<b>Monetary</b>			
Federal Reserve purchases of federal debt	6.0	12.9	18.9

<sup>1</sup>*International Financial Statistics.*

**Table IV<sup>1</sup>**  
**Growth Experience in Nine Countries: 1966-1973**

	United States	Belgium	Canada	France	Germany	Italy	Japan	Netherlands	Switzerland
<b>Growth Rates of Nominal Money</b>									
1966-69	5.4	5.5	9.7	6.4	6.4	14.2	15.7	8.2	7.4
1970-73	6.3	10.2	14.3	9.0	9.5	21.3	23.0	12.8	10.2
<b>Growth Rates of Real GNP</b>									
1966-69	4.1	4.3	5.4	5.7	4.4	6.2	12.5	4.2	3.6
1970-73	3.7	5.2	5.2	5.8	4.1	3.8	9.1	5.8	4.7
<b>Growth Rates of GNP Deflator</b>									
1966-69	3.7	3.7	4.0	4.3	2.6	2.7	4.2	4.8	4.0
1970-73	4.7	6.0	5.1	5.9	6.8	7.4	7.1	8.0	7.8
<b>Change in Money's Velocity</b>									
1966-69	+	+	-	+	+	-	+	+	+
1970-73	+	+	-	+	+	-	-	0	+
<b>Growth Rate of Imports</b>									
1966-69	13.6	11.4	12.7	13.9	9.3	14.0	16.4	10.3	9.4
1970-73	18.2	21.7	15.5	21.2	21.6	22.2	26.4	22.4	21.7
<b>Government Bond Rates of Interest (end of year)</b>									
1965	4.2	6.4	5.2	5.3	6.7	6.9	5.5	5.2	4.0
1969	6.1	7.2	7.6	7.6	6.8	6.9	6.3	7.5	4.9
1973	6.3	7.4	7.6	8.3	9.3	7.4	9.0	7.8	5.6

<sup>1</sup>Federal Reserve Bank of St. Louis, *Rates of Change in Economic Data for Ten Industrial Countries*; International Monetary Fund, *International Financial Statistics*.

trade: economies of a common currency were realized. Again, growth in international capital flows at stable price levels and exchange rates induced substantial reform in the capital markets of small countries, presumably with greater efficiency of allocation for savings in the monetary area. Third, a market developed among savers in small countries for non-monetary claims against American financial institutions. This country performed as a financial intermediary, buying foreign investments at risk and absorbing foreign savings in its own issues of assets that appeared to be safer, at stable foreign-exchange rates. Fourth, stable monetary growth, investment opportunities in small countries, and imperfections of capital markets there opened the Eurodollar route to better savings alloca-

tions. Some dollar payments to abroad did not accumulate in reserve bases of monetary systems. Instead, private holders deposited them with commercial banks, where they provided the reserve base for Eurodollar loans and a superstructure of term deposit accounts.

There were a few clouds in the generally clear skies of 1958-65. Each represented a problem of portfolio distortion. There was potentiality of excess demand for gold in monetary portfolios, but steps were taken to satisfy this demand by issuance of SDR's. There was concern in some small countries that the flow of their securities to the United States, in payment for goods as well as for monetary reserves, would compromise too much national ownership of

national wealth. It worried the United States that capital outflow would impede domestic capital accumulation and impose unacceptable losses of gold. It is not clear that American

authorities understood the role of fiscal deficits and of capital outflows in satisfying external demands for money and for monetary reserves.

### III. Bretton Woods Plowed Under: 1966-73

In this second interval, the United States sharply increased (e), the growth rate of its real fiscal debt, and (t), its supply of government debt to monetary reserves. Moreover, it adopted a number of inefficient interventions in flows of international trade and payments. The only possible outcome was collapse of the international monetary system.

Table IV, an extension of Table I, reports a few aspects of 1966-73.

There is no mistaking the acceleration of growth, from 1958-65 to 1966-73, in nominal money for all countries, save Germany, represented in Table IV. At the same time, growth rates of real GNP were giving little or no lift to growth in real money demanded, and paths of interest rates indicate that inflationary expectations were damping demand for real money. On balance, money's velocity rose. The only possible outcome, of course, was higher rates of growth in GNP deflators. During 1966-73, demand-pull upon growth of nominal money at stable prices was diminishing. Supply-push took over, with faster inflation the result.

Faster growth in nominal money emanated from both satellite countries and the center. For the former, as Table V suggests, there was a notable shift of portfolio preference away from reserves to domestic credit: desired and actual ( $r^o$ ) increased. It is useful to compare Tables V and II.

Data for money's velocity tell us that private sectors in small countries were economizing on real money balances, shifting to other forms of wealth. The data of Table V tell us that monetary systems in small countries were trying to economize on international reserves—and succeeding. Both low-powered and high-powered money were in disfavor: the growth rate of ( $\bar{m}^o$ ) declined and the growth rates of desired

and actual domestic-credit ratios increased. The latter cannot be explained by the paths of permanent income and imports. The explanation must be expectations of decay in the dollar's foreign-exchange value and resistance against the flow of seignorage and inflation-tax revenues to the United States.

Distaste for international reserves, on the part of small countries, is attested by declines in the

**Table V<sup>1</sup>**  
**Ratios of Foreign Assets to Domestic**  
**Credit in the Monetary Systems**  
**of Nine Countries: 1958-1973**  
**(percent)**

	1966- 1969	1970- 1973	1966- 1973	1958- 1965
United States	3.7	2.3	3.0	7.4
Belgium	21.3	19.8	20.5	33.6
Canada	18.2	17.6	17.9	18.6
France	11.1	5.9	8.5	13.2
Germany	13.8	13.9	13.8	18.7
Italy	10.5	5.7	7.1	13.5
Japan	1.8	4.4	3.1	2.8
Netherlands	30.6	26.7	28.7	74.8
Switzerland	20.4	20.8	20.6	24.4
Average excluding United States (unweighted)	16.0	14.3	15.1	25.0

<sup>1</sup>*International Financial Statistics*. The percentages are averages of end-of-year data.

ratios of foreign assets to domestic credit. It is attested also by extensive adjustments in foreign-exchange rates for the dollar during 1966-73. Each of the eight countries in Table V reduced the price of the dollar in terms of the domestic numeraire. Germany was the first, in 1969. Canada and The Netherland followed in 1970. The others revalued repetitively in 1971-73. The portfolio shift against dollars became a flight. It will be recalled that, during 1958-65, changes in the prices of dollars were few and all but one were positive. In the earlier years, (r<sup>o</sup>) and (f) were stable, while in the later years (r<sup>o</sup>) rose and (f) fell.

Table VI, an extension of Table III, bears on the role of the United States in the inflation of 1966-73. It explains in broad terms the growth of (t) that small countries attempted to resist.

Deficits and debt of the American federal government increased by roughly the same order of magnitude during 1966-69 as during the eight years 1958-65, but these increases were modest in comparison with those of 1970-73 when growth of both (e) and (p<sup>w</sup>) accelerated. All of the growth in federal debt found its way into portfolios of monetary authorities during 1966-73, with the Federal Reserve absorbing \$43 billion and foreign authorities \$51 billion.

Private sectors wanted none of it at the monetary authorities' support prices. Aside from its exports of federal debt, the United States shipped to its satellites close to \$3 billions in gold and SDR's. Additional increments to high-powered money abroad as well as in this country included growth in balances of SDR's, from initial allocations, and capital gains on gold stocks as official prices of gold increased. "Avalanche" is rather too mild as a description of growth that occurred in reserves of the world's monetary system.

One criterion of efficient monetary policy in a center country is moderation in the average growth of reserves that it supplies. The United States satisfied this criterion in 1958-65 and violated it in 1966-73. A second criterion is stability in the growth rate of reserves. The United States satisfied this criterion in 1958-65 and violated it in 1966-73. During the two intervals of eight years each, average annual increases of America's external liquid liabilities to monetary authorities and governments were, successively, \$8 billion and \$16 billion. The average annual deviations from mean growth of external liquid liabilities were, successively, 40 percent and 68 percent. Stop-go policies in the United States during the later interval produced

**Table VI<sup>1</sup>**  
**International and Fiscal Position of the United States:**  
**1958-1965 and 1966-1973**  
 (\$ billions)

	1966-1969	1970-1973	Total 1966-1973	Total 1958-1965
<b>International</b>				
Change in international reserves	-1.5	-2.6	-4.1	-9.4
Change in external liquid liabilities to monetary authorities and governments	0.6	50.8	51.4	6.2
<b>Total export of reserves</b>	2.1	53.4	55.5	15.6
<b>Fiscal</b>				
Deficits of the federal government	34.4	63.5	97.9	37.7
Increase in debt of the federal government	23.0	65.5	88.5	39.2
<b>Monetary</b>				
Federal Reserve purchases of federal debt	16.1	26.6	42.7	18.9

Source: *International Financial Statistics*.

an erratic pattern of growth in international reserves, money supplies, and actual relative to desired levels of ( $r^o$ ). It may be a fair presumption that the collapse of Bretton Woods reflected, in part, an attempt by small countries to escape not just the escalation of monetary reserves but instability in growth of reserves and in the impact of monetary pressures on growth in price levels and output as well.

It is a third criterion of efficient monetary policy that the monetary authorities abstain from specific interventions in various markets as ways of preventing or undoing damage done by policies affecting money. This criterion was violated with increasing frequency by both the United States and the small countries during 1966-73, and awkward results of the specific interventions appear to have been one more reason for the demise of the Bretton Woods. The intervention that comes first to mind is the imposition of price controls, through successive "phases," over goods and labor in the United States from 1971. Its monetary effects are patent in equations (13) and (14), written for this country only:

$$(13) \quad m_s^u - p^{uc} = \bar{m}_d^u + \bar{m}_d^{ui}$$

$$(14) \quad p^{uc} = p^u - p^{ur}$$

$m_s^u$  = rate of growth in nominal money.

$\bar{m}_d^u$  = rate of growth in real money demanded.

$\bar{m}_d^{ui}$  = rate of growth in excess real money balances.

$p^u$  = rate of inflation without price controls.

$p^{uc}$  = rate of inflation with price controls.

$p^{ur}$  = repressed inflation.

Fiscal and monetary policy, without price ceilings, would have produced a rate of inflation ( $p^u$ ). Interventions reduced the rate of inflation temporarily to ( $p^{uc}$ ), and repressed inflation was

( $p^{ur}$ ). At ceiling prices, real money balances demanded increased at the rate of ( $\bar{m}_d^u$ ). Because real money balances supplied increased even faster, involuntary holdings increased at the rate ( $\bar{m}_d^{ui}$ ). Repressed inflation and excess real money are twin aspects of the same distortion. Of course, growth in real money demanded was reduced by price controls accordingly as they inhibited growth in real income.

Inevitably, given the pace of growth in nominal money, the interventions in goods and labor markets failed. When they were withdrawn, step by step, money-holders set about to eliminate undesired real balances by spending them. Then, of course, inflation repressed became inflation realized. This burst of growth in the price level must have done its bit to diminish growth in real money demanded, so that inflation realized over-compensated for repression. The mean rate of inflation has been higher since 1970 than it would have been in the absence of price and wage controls.

Federal Reserve administration of Regulation Q was another destabilizing intervention. When rapid growth in monetary reserves and domestic-credit ratios generated inflation, expectations of inflation, and rising open-market rates of interest, ceilings upon deposit rates in the United States generated substantial flows of short-term capital, private and governmental, to small monetary systems and the Eurodollar markets. The accumulations of dollar claims abroad were sensitive not only to interest-rate differentials but also to anticipations regarding change in foreign-exchange prices of dollars. They shifted between countries and, within any one country, between central bank and commercial banks. Administration of Regulation Q aggravated instability in the Bretton Woods regime.

Other interventions were applied on markets for goods, capital and foreign exchange by both the center and its satellites. There were "voluntary" credit restraints on capital exports, interest equalization taxes, discriminatory taxes and deposit-rate regulations on capital imports, two-tier foreign-exchange markets for current and capital transactions, and other specific measures

to cope with the general malaise of monetary instability. Authorities of small monetary systems speculated overtly on the foreign exchanges. The result, of course, was to sacrifice gains in efficiency that had emerged from monetary unification under Bretton Woods. As these gains were sacrificed, the social benefit of staying with stable exchange rates and tolerating unstable inflationary pressures evaporated.

As one reviews the sorry tale of Bretton Woods, he may wonder why the small countries stayed with the regime as long as they did. One answer might be a stubborn faith of monetary authorities in some small countries that the balance-of-payments constraint, imposed by a fixed

foreign-exchange price for the dollar, would inhibit virulent domestic pressures toward inflation. These authorities may have chosen the lesser of two evils, imported inflation rather than indigenous inflation. Another answer might be that export sectors in small countries were opposed to revaluations of domestic currencies against the dollar. If some small countries did have selfish interests in staying with Bretton Woods, why should the burden of guilt for world inflation be put upon the United States? The appropriate rejoinder seems to be, "Why is credit due to the United States for exploiting the gullibility and vulnerability of its trading partners?"

#### IV. A Sequel to Bretton Woods

A dour pessimist might generate a bleak forecast of inflation for the United States, using an adaptation of the model in Section I. With no change in its fiscal-monetary policies, the United States could release within its own boundaries the inflationary pressures that were absorbed, under Bretton Woods, by growth in demand for dollar reserves worldwide. The result would be inflation here at rates faster than the rates of 1970-73.

In the new world of floating foreign-exchange rates the singular inflation paths, we may suppose, ( $t^0$ ) falls to zero and each small country selects some domestic asset, with growth rate ( $x$ ), as the monetary base. Then price levels for the United States and any small country, ( $p^u$ ) and ( $p^0$ ), behave as follows:

$$(14) \quad p^u = \left( \frac{t + d(r^u)}{1+r^u} \right) - \bar{m}_d^u$$

$$(15) \quad p^0 = \left( \frac{x + d(r^0)}{1+r^0} \right) - \bar{m}_d^0$$

Growth of the foreign-exchange rate is the link between "local" inflation rates:

$$(16) \quad \dot{f} = p^u - p^0$$

The growth rate of ( $t$ ) depends on the real expenditure objectives of government in the United States and on the rate selected for the inflation tax ( $p^u$ ). If ( $t$ ) is no less in the new regime than in the old, the level of ( $p^u$ ) can be notably higher. No longer is there growth demand abroad for some part of ( $t^0$ ) of ( $t$ ). No longer is growth abroad in real money demanded a "leakage" for ( $t$ ). The full force of fiscal-monetary indiscretion hits the American monetary system, its price level, and the price of dollars on the foreign exchanges.



## FOOTNOTES

1. Country weights may change over time if real growth rates differ between countries. If the satellite is Japan and the United States is the center, ( $s^o$ ) rises and ( $s^u$ ) declines. Then a larger share of growth in nominal and real money accrues to the satellite. The formal analysis here neglects the role of international balances of payments in changing allocations of growth in nominal money.

2. A "small" disturbance may be initiated by a satellite. Its portfolio preference may shift from reserves to domestic credit: it prefers to direct more of national savings to domestic wealth and less to reserve accumulation and so to finance of the center's fiscal deficit. The effect is to repel reserves from the satellite to other parts of the monetary community, to raise the average level of ( $r^o$ ) of domestic credit ratios, and to increase the world growth rate of nominal money. Assuming a constant growth rate of reserves ( $t$ ), one can indicate the expansionary impact in this adaptation of equation (3):

$$d(m_s^w) = \frac{d(r^o)}{1+r^o}$$

An increase in any ( $r^o$ ) would be damped, one imagines, by a subsequent increase in imports ( $v^o$ ) that would shift portfolio preference in the small country back toward reserves. In the context of stable monetary policies by the center country and other satellites, the one small economy is unlikely to change its desired domestic credit ratio substantially.

It is imaginable that a "large" disturbance of the world's money supply could be touched off by simultaneous impulses in a number of small countries. Their monetary authorities would set targets for ( $r^o$ ) above actual levels, inducing domestic excess supplies of reserves and excess demands for goods and securities. Their excess supplies of reserves would spill into the monetary systems of other small countries and of the center country. Then actual levels of ( $r^o$ ) would rise to the target levels. In time, the disturbance would be absorbed in higher growth rates of the world's money supply and price level. Of course, the disturbance might have a deflationary tilt, with desired domestic-credit ratios falling relative to existing ratios. Then reserves would be drawn to the economies that express demand for reserves and, unless other economies simultaneously increased their desired domestic-credit ratios or unless the center increases the growth rate of reserves, growth rates of the world money supply and price level would decline.

3. A "large" disturbance could also originate on the market for money rather than on markets for reserves and domestic credit. For whatever reason, perhaps an increase in the growth rates of real income, accelerated growth in real money demanded could impose excess demand for money. The result would be a decline in the inflation rate, accompanied by more or less prolonged instability in output and employment, unless monetary authorities responded to the public's "demand-pull" with faster growth of the money supply. For stability of the inflation rate, the appropriate response, of course, is an increase in ( $t$ ) or ( $r^o$ ) that adjusts ( $m_s^w$ ) to ( $\bar{m}_s^w$ ). If monetary systems in small countries prefer not to increase domestic-credit ratios, perhaps because of concurrent growth in international trading, the center authority should acknowledge its

critical role by raising ( $t$ ) or ( $r^u$ ) or both. Either instrument of world monetary control can clear excess demands for money and reserves, provided that no special obstacles are put in the way of adaptative adjustments in international balances of payments.

A "large" disturbance can originate in markets for goods as we know from the petroleum episode of 1973-74. One effect is to reduce the growth rate of income ( $y$ ) and of real money balances demanded ( $\bar{m}^d$ ) in petroleum-importing countries and, as a result, to generate excess supply of money with potentialities for accelerated inflation. In principle, growth in real money demanded by petroleum exporters could sustain monetary equilibrium on the initial price-level path, but that would be an improbable coincidence. OPEC might prefer monetary reserves so that, given ( $r^o$ ), the world would be threatened with a deflationary episode. One solution would involve an increase in ( $t$ ) by the center monetary authority. Since OPEC demand for reserves could be unstable, the preferred solution may be to supply OPEC or any comparable oligopolist with a non-monetary financial asset. Then the outcome would be some increase in the world's inflation rate and some transfer of the world's non-monetary wealth.

4. The primary debt of the center's fiscal authority ( $T$ ) is an obvious source of fiscal revenues. Disposal of ( $T$ ) into portfolios of the world's monetary system yields seignorage to the center's fiscal authority. If the monetary expansion exceeds growth in real money demanded, there are revenues from an inflation tax. These revenues are a temptation to fiscal-monetary indiscretion in the center country when government expenditures have risen along a steep incline and when there is resistance to increases of conventional tax bases and tax rates as well as to increases in interest rates paid on ( $T$ ). They flow not from domestic money-holders alone but also from money-holders in small countries whose monetary systems accumulate ( $T$ ) through international balances of payments with the center.

Collection of seignorage and the inflation tax by the center need not be deliberately exploitative. Fiscal deficits may be financed initially on the security markets of the center. The increments of ( $T$ ) may flow to the center monetary authority when interest rates are driven above its target levels. Then monetary expansion in the center induces the disequilibria in markets for goods and securities which drive abroad the share of growth in ( $T$ ) that small monetary systems desire on the higher expansion path of the world's money supply. The fiscal authority of the center issues debt and the center monetary authority, abiding by a policy guideline without exploitative intent, collects domestically and abroad the revenues of seignorage and the inflation tax.

5. If growth in ( $T$ ) is sustained and accelerated, resistances develop. Monetary authorities in small countries may express preference for transfers of gold from the center in substitution for transfers of ( $T$ ). One expects the center monetary authority to respond by closing its "gold window." Small countries may demand higher interest compensation from the center for their portfolios of ( $T$ ) so that the center receives smaller flows of seignorage and inflation-tax revenues. Authorities, both in small countries and the center, may impose micro-interventions that tend to inhibit growth in real incomes. These can include specific controls over trade in goods, securities, and foreign exchange. Their net monetary effects, through reductions in ( $\bar{m}_s^w$ ) are inflationary.

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# Towards an Explanation of Simultaneous Inflation-Recession

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Michael W. Keran

Economics is a behavioral science. As such, there is a close interactive relationship between economic fact and economic theory. At present, there is some disarray in the economics profession because of the apparently large gap which exists between fact and theory. The emergence of unprecedented worldwide inflation in conjunction with unprecedented worldwide recession appears to be inconsistent with the theoretical apparatus which economists use to analyze the economy and provide policy advice.

There have been other periods in history when an equally large gap has arisen between fact and theory. Indeed, such periods have usually been followed by major developments in economic theory which have explained the phenomena, thereby closing the gap and advancing the science of economics. For example, the Keynesian theory of national-income determination arose in response to the apparent inability of the then-dominant classical theory to explain the Great Depression of the 1930's. Simultaneously, the Keynesian theory provided a rationale and incentive to develop and expand the national-income accounts, thus giving us such useful statistical concepts as GNP, the price deflator and real income. More recently, the re-emergence of elements of the classical theory of income determination under the monetarist banner has grown out of the apparent inability of the now dominant Keynesian theory to explain the inflation since the mid-1960's.

The present circumstance of simultaneous inflation and recession cannot be fully explained by either the standard Keynesian or the standard monetarist analyses. The Keynesian model can handle the recession, but not the inflation; while the monetarist tools can handle the inflation but not the recession. The Keynesian models failed to anticipate the depth of the recession and the monetarist models the heights of the inflation. Indeed, the developments of the past two years were totally unforeseen by economic forecasters of both the Keynesian and monetarist persuasions.

Faced with this apparent vacuum, a number of ad-hoc explanations have been put forward to explain the current inflation-recession. The most widely repeated explanation concerns "special supply conditions" associated with the exercise of monopoly power by Arab oil producers, the shift in the Humboldt current and consequent disappearance of Peruvian anchovies, and the series of bad harvests in Europe and the United States. This explanation essentially says that the aggregate supply of goods and services available to the world has been reduced, leading to both higher prices and a smaller output. This explanation is consistent with the facts we have observed. However, the decline in aggregate supply has amounted to no more than 1-to-2 percent and has been only a relatively short-term phenomenon, while the increase in inflation has been in the 6-to-8 percent

range over a two-year period. It would seem that these supply phenomena are simply not large enough to explain the magnitudes of either the inflation or the recession.

A second ad hoc explanation concerns the impact of wage and price controls. This argument asserts that the inflation rate in the U.S. was below what it otherwise would have been in 1971-72 because of wage and price controls, and that the spurt in inflation was higher than otherwise would have been the case in 1973-74 because of the unwinding of those controls. But this explanation, while consistent with U.S. data, does not explain the worldwide inflation-recession phenomenon we are currently experiencing.

The approach in this paper is to see if existing economic theory is capable of explaining the inflation-recession phenomenon. The conclusion is that the simultaneous worldwide inflation-re-

cession is consistent with the existing body of economic theory. There are three links in this argument. First, the new monetary theory of the balance of payments provides the basis for explaining world inflation. Second, the importance of internationally-traded goods in determining domestic price levels is far more important than had previously been believed. Third, given one and two above, the monetary theory of national income determination explains the recession.

This paper does not present a formal theoretical integration of the three elements mentioned above. Rather, it suggests the lines of causal relationships which are consistent with the theory and presents evidence which supports this type of linkage. The first section summarizes the theoretical elements in the simultaneous inflation-recession case, and that is followed by a section which examines the empirical evidence.

## 1. An Explanation of Inflation-Recession Phenomenon

Preceding the early-1973 breakdown of the international monetary system of fixed exchange rates, there was an unprecedented expansion in international reserves — the so-called dollar overhang problem. This led to the simultaneous increase in the domestic money stocks of most of the industrial nations of the world. The result was a period of unprecedented worldwide business-cycle boom, followed by an unprecedented worldwide inflation. The magnitude of the inflation in any given country was greater than it would otherwise have been because of the worldwide nature of the inflation. Two forces contributed to inflation in each country. First was the traditional impact of an expanding domestic money stock on domestic prices. Second was the effect of the rest of the world's inflation on domestic prices, operating through the mechanism of internationally-traded goods. The latter element had not been significant in earlier postwar periods because the industrial nations

of the world had not previously exhibited a pattern of synchronous business-cycle expansion. This worldwide inflation element had a substantial impact even in the U.S., which has a relatively small share of its product prices determined in world markets.

This "rest of the world" element in domestic inflation also helps explain the unprecedented size of the domestic recession. First of all, the monetary theory of national-income determination links domestic money and domestic income. Changes in the nominal money stock, operating through the equation of exchange and a stable velocity function determine nominal income. In the short run—a business cycle of two-to-three years duration—the real money stock determines real income. (In the long run, real output depends upon real inputs of capital, labor, and technology.)

Given the growth in the domestic nominal money stock, a larger than expected domestic

inflation—in this case because of inflation in the rest of the world—will reduce real money balances by more than would have otherwise been expected, and thereby will temporarily reduce real income. Put another way, the unprecedented gap between real and nominal money balances induced in part by inflation elsewhere will lead to an unprecedented (if temporary), gap between real and nominal income in this country. Thus we have simultaneous inflation and recession.

How long will this state of affairs continue? As long as growth rates of real and nominal money are on divergent courses. This divergence in the current circumstances depends upon the course of world inflation. Present evidence suggests that the world inflation rate has come down substantially since last year and that it will not be renewed in the foreseeable future, that is, in the next 18 months or so. This implies that the unprecedented period of inflation-recession is at least temporarily coming to an end. The remainder of this section develops this explanation in greater detail.

### **World inflation**

The factor which makes this inflation different from other 20th-century inflations is its pervasive international character. No country in the world has been exempt from its effects. Thus, it would seem logical that an international monetary approach to analyzing this inflation experience might prove promising. This is especially so considering that the traditional national monetarist approach has not appeared to explain the present case.

Fortunately, in recent years a monetary theory of the balance of payments has arisen to provide an analytical framework for viewing inflation in an international context. The principal authors of this approach are Robert Mundell of Columbia University and Harry Johnson of the University of Chicago. It is beyond the scope and intent of this paper to explain the theory, except to emphasize that, within the context of this model, internationally traded goods prices are determined in a world market.

The theory is presented in terms of the world

supply and demand for money. The demand for real money balances is a positive function of the growth in world income. The supply of world nominal money balances is a function of the collective decisions of the world's central banks. If, the nominal money stock grows at a faster rate than the real demand for money balances there will be an increase in the world price level. On the reasonable assumption of a relatively constant growth in the world demand for real money balances, variations in the growth of the world nominal money supply would lead to proportional variations in world prices.

In order to convert this theory into a testable hypothesis we must distinguish between internationally traded goods, whose prices are determined by world supply and demand factors, from domestic non-traded goods whose prices are determined domestically. With this modification, it can be asserted that the (properly defined) world price level will move proportionally with world money.

The world money stock exploded between 1970 and early 1973, and this was followed by an upsurge in world prices from 1973 through early 1975. The reason for the 1970-73 explosion in world money has been well documented and explained in other studies.<sup>1</sup> It is only necessary to point out here that it was not due to the collective madness of the world's central banks, but rather because of their following a behavior pattern which had been wholly reasonable in the previous two decades but which became unreasonable only in the special circumstances of the early 1970's.

In the Bretton Woods era of fixed exchange rates (1945 - 71), countries other than the United States maintained the international values of their national currencies by buying and selling dollars in the foreign-exchange market. This worked well when the world demand for dollars as an international currency was matched by only a moderate increase in the supply of dollars. However, starting with the acceleration of the U.S. inflation rate in the mid-1960's, the supply of dollars to the rest of the world increased relative to the demand for dollars (espe-

cially by private foreigners). The problem came to a head in 1971 when the United States suspended dollar convertibility into gold. But throughout this period, most central banks attempted to maintain the fixed dollar value of their national currency by absorbing an increasingly larger amount of dollar assets, in response to the actions of private citizens (American as well as foreign) as they shifted their portfolios out of dollars and into foreign currencies, beginning with the stronger currencies such as the German deutschemark and the Japanese yen. The foreign central banks' monetization of this dollar inflow expanded both their holdings of international reserves and their domestic money supplies.

Central banks collectively abandoned the fixed-rate regime only in March 1973 at which point the growth in international reserves abruptly ended. They each took this step in order to regain control of their domestic money supply. However, the action was so long delayed that it could not forestall the inflation in internationally-traded goods which we are now experiencing.

### **From world to domestic inflation**

How does the world inflation affect the domestic inflation in individual countries? The link is both straightforward and complex. In each country the domestic price level is, by definition, a weighted average of first, the prices of internationally traded goods which are produced and/or consumed in that country, and second, the prices of domestic goods which cannot be traded internationally because of transportation costs or other reasons. The weights depend upon the size of the country and its proximity to its trading partners. The argument presented here asserts that just as world money growth determines the prices of internationally-traded goods, so domestic money growth determines the prices of domestic non-traded goods. The weighted sum of traded and nontraded goods determines the domestic price level. Thus, the appropriate specification of a domestic price equation should include not only the domestic

money supply but also the world money supply.<sup>2</sup>

There are a number of dimensions to this argument, both theoretical and practical, which must be considered before the proposition sketched above can be accepted. First, the practical considerations. In the past, equations estimating domestic prices have been relatively successful without including international money as an independent argument. Why must such variables now be incorporated to have a successful price equation? The answer is that the variance in international money growth has only become significant in recent years. Its trend growth has been just sufficient to meet growing international transactions demand with no price increase. Thus, in models which estimated prices before 1973, the exclusion of international money did not result in a serious misspecification because that source of variance in prices was insignificant.

There is a more substantial theoretical question about including foreign money in a domestic price equation. If world money is rising faster than domestic money and, therefore, world prices are rising faster than domestic prices, this should lead to a balance-of-trade surplus—and thus, in the current period of flexible exchange rates to an appreciation of the domestic currency which offsets the influence of the world price rise. In this context, while world money determines prices of internationally-traded goods, it would not have any effect on prices stated in the domestic currency in a period of flexible exchange rates.

While this argument has theoretical merit, it has not been important during the period under consideration. 1) The exchange rate responds not only to trade but also to capital flows. The latter were especially important in determining the international value of the dollar (and therefore of other currencies as well) after the introduction of floating rates in March 1973. The demand for dollars as an element in the international stock of money was then reduced as foreign dollar holders attempted to move out of dollars and into other currencies. This has been a significant element in at least temporarily al-

tering the value of the dollar. 2) The nature of world inflation is such that—except for oil—prices of both exports and imports of most industrial countries have risen roughly in proportion. Thus, the (non-oil) terms of trade have not shifted substantially since floating exchange rates were adopted.

As a result of these two factors, the accelerating world rate of inflation did not lead to offsetting exchange-rate movements, so that most of the effects of the inflation in internationally-traded goods could be transmitted to the domestic economy. In the empirical section of this paper, a separate test for the effects of exchange-rate movements on domestic prices is estimated. The results indicate that such movements did not have a significant influence over the period tested (1965-74).

### Money and income

Monetary theory assigns a strategic role to the domestic money stock in determining aggregate demand. The discussion presented above and the evidence presented in the next section in regard to the role of world money on domestic prices do not invalidate those relationships. The dollar is still the medium of exchange within the confines of the United States and all transactions must be cleared in the market place in terms of that numeraire.

The financial constraints on an economy imposed by the availability of the domestic money supply can only be changed if for legal or practical reasons an increasing share of transactions in any given country are carried out with something other than the domestic numeraire. The influence of world money and world prices on the domestic economy will operate only through their effects on the supply of, and demand for, internationally-traded goods—not through their effects on the desired or actual cash balances available in a particular country.

The monetary theory of national-income determination can be summarized by the equation of exchange.

$$MV = PX$$

where M is money

V is velocity

P is the price index

X is the level of real income

All values are measured in terms of the domestic currency. The desired level of cash balances can only be satisfied with domestic money holdings, as such holdings represent both the *de jure* numeraire and the *de facto* unit of account. The equation of exchange can be rewritten in log terms.

$$\text{Log } M + \text{Log } V = \text{Log } (PX)$$

Taking first differences and rearranging terms we have

$$\Delta \text{Log } (PX) = \Delta \text{Log } V + \Delta \text{Log } (M)$$

By definition the percent change in nominal GNP ( $\Delta \text{Log } PX$ ) is equal to the percent change in velocity ( $\Delta \text{Log } V$ ) plus the percent change in money ( $\Delta \text{Log } M$ ).

If the secular and cyclical movement in velocity is stable, then there will be a stable relation between money and income. This relationship can be estimated by the following reduced-form equation:

$$\Delta \text{Log } (PX)_t = a_0 + a_1 \Delta \text{Log } \sum_{i=0}^n M_{t-i}$$

where the change in nominal income ( $\Delta \text{Log } PX$ ) in the current period (t) is a positive function of the weighted sum ( $\Sigma$ ) of the change in nominal money supply ( $\Delta \text{Log } M$ ) in current and past (n) time periods.

We would expect that the equation would be as statistically significant in the last two years of accelerating inflation as it was in previous periods. We would also expect that adding the change in world money ( $\Delta \text{Log } Mw$ ) would not be statistically significant or improve the fit of the equation.

## II. The Evidence

In this section propositions developed above are examined with the aid of standard statistical testing procedures. First we consider the evidence relating world money to world prices. Second, we consider the evidence of the effects of world and domestic money on domestic prices, and third, the effects of world and domestic money on domestic income.

### World inflation

To test the international-monetary explanation of world inflation, we need to have measures of both world money and world prices. To limit the discussion we will rather arbitrarily confine ourselves to examining developed countries, because in view of their dominance of international trade, it is their behavior which collectively determines the prices of internationally-traded goods.

We define world prices not as the weighted average of the domestic prices of all countries, but rather as the average of the prices of goods which are traded in international markets. This measure is designed to focus attention on the markets which are worldwide in nature, and which thus represent a common influence on the domestic prices of all countries. The statistical series which most closely approximates this concept is the export price (unit value) index of industrial goods of developed countries measured in dollars, as published by the United Nations.

Our measure of world money is influenced by similar considerations. One can make a number of plausible approximations of an appropriate world money variable; however, the criteria for selection should be first, a time series which can be measured in the same unit of account as the price series (that is, dollars) and second, a time series which can be associated with prices of internationally-traded goods.

The time series which most closely measure the effect of world monetary influences on prices

of internationally-traded goods is the sum total of international reserves held by developed countries. This series, measured in dollars, is published monthly by the International Monetary Fund. In addition to providing a useful summary of the international sources of domestic money expansion in industrial countries, this series has the advantage that central banks traditionally follow easy money policies in periods when reserves are rising and tight-money policies in periods when reserves are falling. This means that central banks will not usually attempt to offset completely the effects of international reserves on the domestic money stock.

On balance, then, it is reasonable to test whether the international-reserves series is an appropriate measure of world monetary influence on prices of internationally-traded goods.<sup>3 4</sup>

An equation linking the quarterly rates of change in "world money" and "world prices" was estimated in log linear terms with data from 1962.1 to 1974.3. The results are summarized below and the actual and estimated values are plotted in Chart I.

$$\Delta \text{Log Pw}_t = -1.48 + \sum_{i=1}^3 1.04 \Delta \text{Log Mw}_{t-i} \quad (1.0) \quad (7.2)$$

(t values below coefficients)

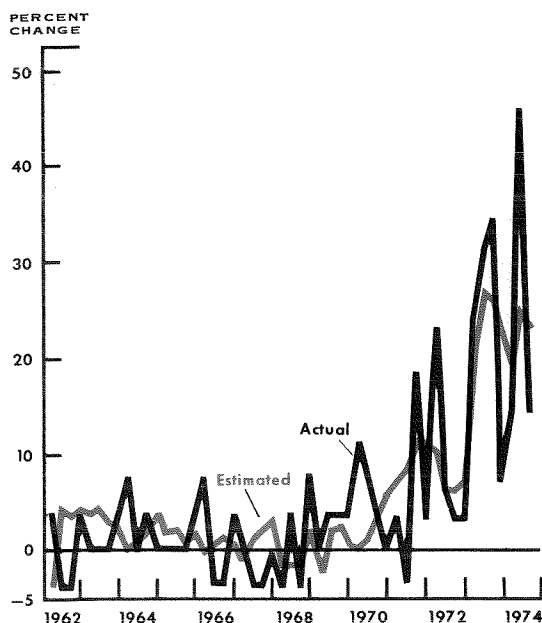
R <sup>2</sup> /SE	DW/DF
.57/6.7	2.18/46

$\Delta \text{Log Pw}$  = Percent change in internationally-traded goods prices, as measured by export prices of developed countries

$\Delta \text{Log Mw}$  = Percent change in international money as measured in international reserves of developed countries.

## Export Prices of Developed Countries

Chart 1



This equation explains 57 percent of the variance in the quarterly percentage change in world prices as a distributed lag of the current and twelve past quarterly changes in values of international money. A 1.0-percent increase in international money over the past twelve quarters leads approximately to a 1.1-percent increase in world prices. The length of the lag period (12 quarters) is consistent with the lags observed in equations relating domestic money to domestic prices.

It is interesting to note that prices of internationally-traded goods rose less than 4 percent over the entire 1965-69 period. But thereafter, from 1970.1 through 1974.3, such prices rose by almost 90 percent. This pattern was preceded by a similar movement in international money, with an average lag of six quarters. World money grew by a very modest 7 percent from 1963.2 through 1968.2 but then exploded in a sharp 98-percent rise in the period 1968.2 through 1973.1. World money thereafter has shown no significant growth.

If we assume a continuation of the current

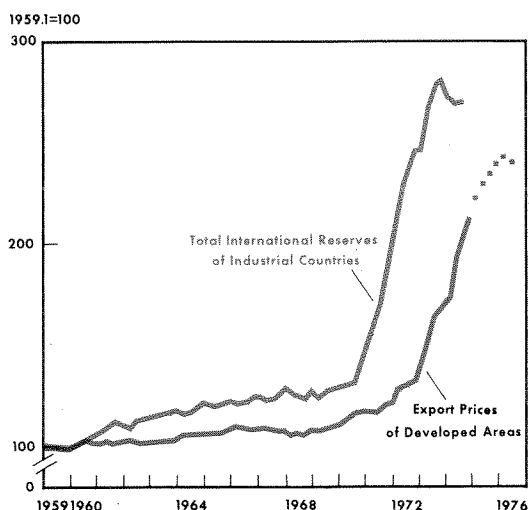
no-growth trend in world money—a reasonable assumption in this era of flexible exchange rates—then there are encouraging implications for the near-term outlook for prices of internationally-traded goods. The forecast values through the end of 1975 are shown in Chart 2. Yet given the long lags between money and prices and the rapid rise in international money through early 1973, the deceleration in prices is starting from a very high rate, and some element of world inflation will continue through the end of 1975.

### From world to domestic inflation

In the preceding Section I, it was argued that the domestic inflation rate in any one country can be influenced by the rate of inflation in the rest of the world. Specifically, internationally-traded goods, whose prices are determined in world markets, can either increase or decrease what would otherwise be the domestic inflation rate.

Focussing on the monetary side, the proper specification of an equation explaining domestic inflation would in this context include both domestic and world money as explanatory variables. In addition it would be useful to test the possibility that variations in exchange rates

Chart 2





might offset all or part of the effects of world money on domestic prices. (The exchange rate is not, strictly speaking, an independent variable. Rather its value is strongly influenced by the differential growth rates of world and domestic money.)

Since the assertion of the influence of world money on domestic prices is a new proposition, evidence of its impact on other countries than the U.S. would strengthen the case. The influence of world inflation on domestic prices should be even more apparent abroad than in the U.S., which is one of the most closed economies in the world. A total of six countries are investigated in this study—Belgium, France, Japan, Germany, the United Kingdom and the United States. The results for the U.S. are presented first and discussed in detail. The results for the other countries are presented in summary form here, with details available on request from the author.

Three different empirical tests were made to explain the inflation rate, measured by the consumer price index, in each country: 1) current

and lagged values of domestic money as the determinant of domestic prices; 2) current and lagged values of domestic and world money as the determinant of domestic prices; 3) current and lagged values of domestic and world money, and the effective exchange rate of the domestic currency in foreign exchange markets, as the determinant of domestic prices.

All three equations were estimated with quarterly data from 1965.1 to 1974.2 for each country. The results for the U.S. are summarized in Table 1. In equation 1, U.S. prices are estimated as a function of U.S. money supply alone. For every 1.0-percent increase in the U.S. money supply in the current and twelve preceding quarters, the consumer price index rises by approximately 1.9 percent in the current quarter. However, if the money supply does not grow at all the CPI falls at a 5.2-percent annual rate per quarter. The low Durbin-Watson (DW) statistic (.53) means that there are systematic errors between actual and estimated values of U.S. prices. One possible interpretation is that U.S. prices are also affected by another variable

**Table 1**  
**Factors Determining U.S. Prices**  
**(Quarterly Percent Change in CPI from 1965.1 to 1974.2)**

	Constant Term	Quarterly Percent Change			R <sup>2</sup> /SE	DW/DF
		U.S. Money	World Money	Exchange Rate		
Equation 1	-5.2 (3.2)	<sup>12</sup> $\Sigma$ 1.86 (6.5) 2.08			.53/1.84	.58/33
Equation 2	-4.9 (1.0)	<sup>12</sup> $\Sigma$ 1.78 (8.9) 1.99	<sup>16</sup> $\Sigma$ .098 (2.5) .66		.90/.86	2.24/29
Equation 3	-4.6 (4.6)	<sup>12</sup> $\Sigma$ 1.74 (8.4) 1.94	<sup>16</sup> $\Sigma$ .089 (2.2) .60	<sup>4</sup> $\Sigma$ -.136 (-1.3) -.36	.90/.87	2.32/27

Note: The first number in each box is the estimated coefficient.  
The second (in parentheses) is the t value.  
The third is the beta coefficient.

which has been omitted from the equation.

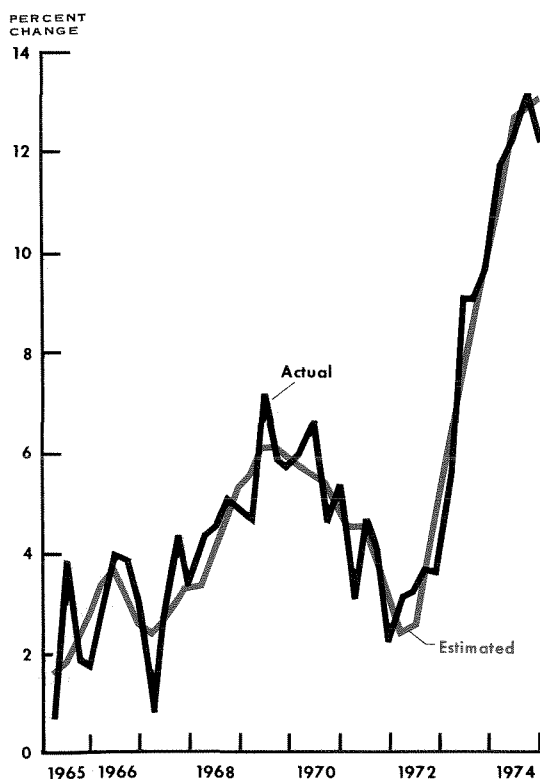
As a result, the next stage in the analysis was to incorporate the growth in world money as well as the U.S. money supply in estimating U.S. prices. These results are summarized in equation 2 of Table 1. They indicate that the effects of U.S. money on U.S. prices are approximately the same as in equation 1. However, adding world money improves the statistical significance of the equation, and interestingly enough also improves the statistical significance of the coefficient on U.S. money. The explained variance ( $R^2$ ) is increased from 53 percent to 90 percent while the standard error is reduced from 1.84 to .86. Of even greater importance, the degree of systematic error between actual and estimated values of U.S. inflation (as mea-

sured by the Durbin-Watson statistic) is eliminated. World money thus clearly satisfies the conditions of the omitted variable in equation 1. Equation 2 has superior statistical properties to equation 1—and as shown in Chart 3, Equation 2, accurately forecasts both the slowing in U.S. inflation in 1971-72 and the sharp acceleration in U.S. inflation in 1973-74.<sup>5</sup>

The final question to be considered is whether the movements in the international exchange value of the dollar tended to reduce the impact of world inflation on the U.S. price level. As discussed above, when prices of internationally-traded goods rise relative to domestic goods the United States tends to shift towards the consumption of domestic goods and the production of internationally-traded goods. This then tends to improve our trade balance—appreciating the international value of the dollar and offsetting the effects of world inflation on the domestic price level. This possibility is tested in equation 3 of Table 1 where the value of the dollar against eleven major trading partners is added as an additional explanatory variable.<sup>6</sup> The exchange rate does not contribute significantly to explaining U.S. prices over the estimated period. The sign on the exchange rate coefficient is as expected—negative—but it is not statistically significant. In addition, it does not reduce the unexplained variance in the equation or lower the standard error after adjusting for the degrees of freedom consumed by this additional variable. To summarize, it seems clear that the virtual explosion in the prices of internationally-traded goods has had a major upward effect on the U.S. price level, and this effect has not been significantly mitigated by exchange-rate movements during the period under review.

The same three equations estimated with U.S. data were also estimated with data from five other industrial countries. The effect of world money on domestic prices was even more substantial in these other countries than in the U.S. The results are indicated in the following table, which shows the sum coefficient for world money in equation (2) for each country and the associated  $t$  values.

Chart 3 U.S. Inflation Rate



### Effects of World Money on Domestic Inflation

	<i>Sum Coefficient</i>	<i>"t" Values</i>
Belgium	.570	4.2
France	.640	4.9
Germany	.189	2.1
Japan	.312	3.1
United Kingdom	.936	2.8
United States	.098	2.5

All sum coefficients were estimated on the basis of a 16-quarter lag of world money on domestic prices and, as indicated by the *t* values, were all statistically significant at the 95-percent confidence level. The pattern of the lag structure (not shown) was also quite similar for all six countries—a relatively small effect in the first 8 quarters and a larger effect for the second 8 quarters. The striking difference among the countries was in the size of the sum coefficients relating world money to domestic inflation. The largest country, the U.S., had the smallest coefficient. Germany and Japan had the next smallest coefficient, while the U.K., which has been historically open to foreign trade, had the largest coefficient. France and Belgium were in the middle but closer to the U.K. results. This finding is roughly as one would expect. The largest national economy is the least affected and the most open economy the most affected, by world inflationary developments.

Another measure of the impact of world money on domestic prices is obtained by comparing the DW statistics, with and without world money—that is, by comparing equation 2 with equation 1.

#### Durbin-Watson (DW) Statistics

	<i>With World Money (Equation 2)</i>	<i>Without World Money (Equation 1)</i>
Belgium	1.45	.83
France	1.75	.79
Germany	2.08	1.86
Japan	2.40	.40
United Kingdom	1.93	1.34
United States	2.24	.58
Average DW	1.98	.97

The relatively low DW statistic in equation 1 suggests that there is systematic error between actual and estimated values of domestic inflation when world money is left out of the analysis. This systematic error suggests the absence of a significant explanatory variable in equation 1. When world money is added (equation 2), the DW statistic is increased for all six countries, which suggests that this variable has reduced the degree of systematic error in the equation explaining domestic inflation. In all but one case (Germany) there is a substantial degree of systematic error when world money is excluded. Only in Belgium's case is there any indication that systematic error continues to be present with the inclusion of world money—and even in that case there is substantial improvement in the DW statistic with the addition of the world money variable. On average for all six countries, the DW statistic increased from approximately 1.0 to approximately 2.0 by including the world money variable.

A final significant measure is the increased amount of domestic inflation explained by the addition of the world money variable. This is shown by comparing the  $R^2$  statistic for the equation without world money (equation 1) to that with world money (equation 2).

#### Percentage of Explained Variance ( $R^2$ ) With and Without World Money

	<i>With World Money (Equation 2)</i>	<i>Without World Money (Equation 1)</i>
Belgium	.74	.46
France	.76	.37
Germany	.72	.72
Japan	.93	.40
United Kingdom	.55	.28
United States	.90	.53
Average	.77	.46

On average the degree of variance in domestic inflation which is explained is increased from 46 percent without world money to 77 percent with world money. In all but one case (Germany),

there is a substantial improvement in the explained variance of domestic inflation.<sup>7</sup>

In summary, we can say that the inclusion of a world money variable satisfies three important conditions with respect to domestic inflation.

- 1) Its effect is as expected—positive and statistically significant.
- 2) It substantially reduces or eliminates the systematic error between actual and estimated values of domestic inflation.
- 3) It substantially improves the amount of variance in domestic inflation explained by the equation.

On the basis of these three propositions, which are satisfied for a group of major industrial countries we can tentatively accept the proposition that domestic inflation is explained by world as well as domestic monetary influences.

### Money and income

The third and final relationship to be tested is that between money and income. In Section I it was shown that the relationship between domestic money and domestic income could be tested by the following reduced-form equation:

$$\Delta \text{Log} (\text{PX})_t = a_0 + a_1 \Delta \text{Log} \sum_{i=0}^n M_{t-i}$$

Where (PX) is domestic income (in nominal value) and M is domestic money. To test whether world money affects domestic income, it is only necessary to add an additional explanatory variable. The reduced form equation in this case would be as follows:

$$\Delta \text{Log} (\text{PX})_t = a_0 + \Delta \text{Log} \sum_{i=0}^n (M)_{t-i} + a_2 \Delta \text{Log} \sum_{i=0}^n (\text{Mw})_{t-i}$$

Where Mw is the measure of world money.

The results of estimating these two equations are presented below on the basis of quarterly percentage changes from 1960.1 to 1974.4.

$$(1) \Delta \text{Log} (\text{PX})_t = 3.55 + .877 \Delta \text{Log} \sum_{i=0}^4 (M)_{t-i} \quad (3.0) \quad (5.1)$$

$$\begin{array}{cc} R^2/SE & DW/DF \\ .30/2.91 & 1.66/56 \end{array}$$

$$(2) \Delta \text{Log} (\text{PX})_t = 3.56 + .837 \Delta \text{Log} \sum_{i=0}^4 (M)_{t-i} \quad (4.0) \quad (4.3)$$

$$+ .022 \Delta \text{Log} \sum_{i=0}^4 (\text{Mw})_{t-i} \quad (0.6)$$

$$\begin{array}{cc} R^2/SE & DW/DF \\ .28/2.95 & 1.65/54 \end{array}$$

Equation 1 relates to U.S. money to U.S. income, both in nominal terms. For every 1.0-percent rise in U.S. money stock there is approximately a 0.9-percent rise in U.S. income measured by GNP. This equation explains approximately one third of the change in GNP since 1960.

Equation 2 is identical to Equation 1 except that the percentage change in world money is an additional explanatory variable. The world money coefficient in this case is not statistically significant. In fact, the addition of world money to the equation slightly reduces the amount of variance in GNP explained by the equation.

The relation between money and income can also be estimated in real terms. While it is recognized that over the long term real GNP is primarily a function of capital, labor and technology, its utilization over the business cycle is influenced by monetary factors. In equation 3, U.S. money is related to U.S. income (measured by GNP)—both in real terms, i.e. divided by the GNP price deflator. In equation 4, U.S. and world real money are related to U.S. real income. Real world money is equal to nominal world money divided by the world price index.<sup>8</sup>

$$(3) \Delta \text{Log} (X) = 2.20 + 1.37 \Delta \text{Log} \sum_{i=0}^4 (M/\text{Pus})_{t-i} \quad (4.8) \quad (6.5)$$

$$\begin{array}{cc} R^2/SE & DW/DF \\ .43/2.92 & 1.79/56 \end{array}$$

$$(4) \Delta \text{Log } X = 2.18 + 1.37 \Delta \text{Log } \sum^4 (M/P_{us})_{t-4} \quad (4.7)$$

$$+ .01 \Delta \text{Log } \sum^4 (Mw/Pw)_{t-4} \quad (5.5)$$

(0.1)	R <sup>2</sup> /SE	DW/DF
	.42/2.97	1.80/54

The results for equations 3 and 4 in real terms are similar to the results in equation 1 and 2 in nominal terms. The real world money variable is not statistically significant, and it reduces the variance in real GNP from that explained by real U.S. money alone.

### III. Summary and Conclusions

The purpose of this paper has been to consider whether the simultaneous inflation-recession can be explained on the basis of current theoretical and statistical tools. The results presented here suggest that it can. Without in any way going beyond the current state of the arts, either in economic theory or statistical estimation techniques, this paper shows that the rate of inflation in prices of internationally-traded goods can be explained by the worldwide expansion in international money as measured by the reserves of the major developed countries. This inflation in turn has a direct effect on the domestic price level. Thus the appropriate specification of the monetary source of domestic inflation must include not only domestic but also world monetary influences. The magnitude of the world monetary influence on domestic prices is roughly proportional to the degree of openness of the economy in terms of its dependence on internationally-traded goods.

In spite of the strong influence which world money thus exerts on domestic prices, it does not have a statistically significant effect on domestic income—at least with respect to the United States. The domestic money stock continues to be the medium of exchange within the confines of each individual country, and all transactions must be cleared in the market place in terms of this numeraire. The influence of world money on world prices operates only through its effect on the supply and demand for internationally-traded goods—not through its effects on desired or actual cash balances available in the domestic economy.

This study suggests that when there is a major shift in the world inflation rate the domestic economy cannot remain isolated from it even in

a period of flexible exchange rates. Now, flexible rates permit the Central Bank to control the domestic money stock and therefore the level of nominal domestic income. However, in a period of substantial world inflation, the split between nominal and real income will be strongly dependent on developments outside the domestic economy. If an increase in world prices leads to a rise in the domestic price level in excess of what would have been expected on the basis of strictly domestic considerations—as during 1973-74—this situation will cause a contraction in the real volume of transactions which holders of U.S. dollar balances can conduct. The counterpart of this is that when prices rise faster than nominal income there will be a contraction in real income, leading to a contraction in real spending and real output. The result will be an unprecedented gap between nominal and real income, so that the country experiences a period of simultaneous inflation and recession. Specifically, the inflation has come from the high level of domestic and world money growth experienced over the last three to four years, while the recession has occurred because of the inflation-related contraction in real money growth experienced over the last few quarters.

We live in an increasingly interdependent world, as reflected in the rise of multinational corporations and international banking institutions. This development has added significantly to the ability of the world economy to provide a better standard of living for all. However, this increased degree of interdependence has reduced the ability of individual national governments to control economic developments within their own borders. In a world of increased specialization among countries, the influence of internation-

ally-traded goods on the domestic economy is rapidly expanding. Thus, when world monetary developments lead to an explosion in prices of

these goods, the impact on individual countries can be substantial. We have been observing such an impact for the past two years.

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#### FOOTNOTES

1. See for example, M. W. Keran: "An Appropriate International Currency—Gold, Dollars, or SDR's?," *Federal Reserve Bank of St. Louis Review*, August 1972.
2. An alternative specification would have domestic prices determined by internationally-traded goods (directly) and the domestic money supply. Estimates made on this basis explain the data about as well as the results reported in this paper. However, since it is assumed that domestic prices include prices of internationally-traded goods and also affect international prices, the estimates suffer from simultaneous-equation bias. The reduced-form specification with world and domestic money explaining domestic prices does not suffer from this defect.
3. If the world stays on a flexible-exchange-rate regime for a substantial period of time (say beyond 1975), then international reserves will show little change and the information content of this series as a measure of monetary influences on prices of internationally-traded goods may be lost. In that case we would have to move toward an alternative measure of international monetary influences, such as the sum of domestic money growth of all developed nations.
4. Another reasonable measure of world money would include the assets of the Eurodollar market. Conceptually, Eurodollars should be included if they are a monetary asset—primarily a means of payment. But Eurodollars should not be included if they are primarily a form of credit—a financial intermediary between savers and investors. In practice, Eurodollars have the characteristics of both money and credit, so it becomes essentially an empirical question as to which dominates. Our tests on the U.S. price data

did not support the addition of Eurodollars as an element of world money.

5. The natural question which these results raise is whether the underforecasting of inflation during the last two years is simply the mirror image of overforecasting inflation during the previous two years. The suppression of inflation in 1971-72 can be explained by wage and price controls. Now that controls have been eliminated, it could be argued that we are merely observing the market adjustment in prices which was suppressed during the control period. This explanation ignores the fact that the 1973-74 inflation was worldwide in scope. In this context, an explanation which fits a wide range of country observations is superior to one which is unique to the United States.

6. The U.S. dollar devaluation in percentage terms is computed on the basis of the changes in the exchange rates between the U.S. dollar and eleven major foreign currencies since May 1970. These currencies are those of the United Kingdom, Canada, France, West Germany, Switzerland, Netherlands, Belgium, Italy, Japan, Australia and Sweden. Changes in these exchange rates are weighted by the respective countries' shares in U.S. foreign trade during 1969, using both exports and imports.

7. The exchange rate effect on domestic income was not significant in any of the six countries except Japan. Even in this case the exchange rate added little to the explained variance of domestic inflation.

8. Real world money was also divided by the U.S. GNP price deflator. The results (not shown) were almost identical to those reported in equation 4.

#### NEW PUBLICATION AVAILABLE

The San Francisco Federal Reserve Bank has published **PACIFIC BASIN ECONOMIC INDICATORS**—a compendium of quarterly statistics giving annual rate of change data for 13 Pacific Basin countries for the 1970-74 period. The data cover the following areas: money supply, international reserves, consumer prices, wholesale prices, manufacturing employment, industrial production, nominal gross national product, real gross national product, imports and exports. The countries included in the survey are Australia, Canada, China, Hong Kong, Indonesia, Japan, Korea, Malaysia, New Zealand, Philippines, Singapore, Thailand, and United States.

Readers interested in obtaining a copy of **PACIFIC BASIN ECONOMIC INDICATORS** should address requests to Public Information Section, Federal Reserve Bank of San Francisco, P.O. Box 7702, San Francisco, Ca. 94120. Telephone (415) 397-1137.

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# Central-Bank Policy Towards Inflation

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Hang-Sheng Cheng and Nicholas P. Sargen

Two basic approaches to the question of imported inflation can be found in the recent literature. The first, which might be called cost-push, views the rise in import prices as raising the cost of imports and, hence, domestic prices.<sup>1</sup> The second approach, which might be called world-monetarist, regards the world price level as determined by the world demand and supply of money. To the extent that national economies are closely integrated through trade, capital flows, and fixed exchange rates, world inflation will spread to all such economies and result in general price increases.<sup>2</sup> Both approaches reach a common conclusion: a national central bank cannot do much to stabilize the domestic level, in the absence of a freely floating exchange rate of the national currency.

This paper calls attention to the special assumptions upon which the validity of that policy conclusion depends. In general, when the assumptions are relaxed, the central bank is no longer viewed as totally helpless in coping with imported inflation. Instead, under certain specified circumstances, it could be quite effective in stabilizing domestic prices in the face of price increases abroad.

By equating cost increases with price increases, the cost-push approach focuses exclusively on the supply side of the market, and thus ignores any (domestic or foreign) adjustments on the demand side. In failing to distinguish between individual price increases and general-price-level increases, this approach also ignores the aggregate-budget constraint on market de-

mand. Rising import prices lead to a general price increase only if permitted by central-bank policy, which influences aggregate demand through its control over the domestic money supply. Cost-push thus implicitly assumes an accommodating monetary policy, which validates any tendency for domestic prices to rise as a result of import-price increases. Since the cost-push approach does not present a complete theory, dealing as it does with only one side of the market, we shall ignore it in the rest of this paper and consider only the monetarist approach.

The world-monetarists argue that in an open economy the national central bank has no control over the domestic money supply, so long as exchange rates are not freely flexible. The conclusion follows from the assumption of homogeneous products throughout the world, so that the domestic price level in an "open economy" cannot diverge very far from the world price level.<sup>3</sup> The homogeneous-products assumption, thus, defines away the very problem this paper is focused upon.

At issue is not the theoretical validity of the monetarist approach, which we do not dispute, but rather its general applicability. Despite the rapid integration of the world economy in the last thirty years, inflation rates have varied widely from country to country even during an era of relatively stable exchange rates. The following table shows the dispersion of consumer-price changes in two selected periods for 41 major industrial and developing nations:

<i>Average annual rates of change (%)</i>		
<i>All Countries<sup>4</sup></i>	<i>1950-63</i>	<i>1963-72</i>
1. Weighted mean . . . . .	3.85	5.08
2. Coefficient of variation . . . . .	1.29	1.04
3. Range of variation . . . . .	-0.6 to 38.1	1.2 to 35.2
<i>Industrial Countries (14)</i>		
1. Weighted mean . . . . .	2.79	3.96
2. Coefficient of variation . . . . .	0.55	0.20
3. Range of variation . . . . .	1.8 to 5.4	3.1 to 6.0
<i>Developing Countries (27)</i>		
1. Weighted mean . . . . .	9.41	10.74
2. Coefficient of variation . . . . .	1.47	1.43
3. Range of variation . . . . .	-0.6 to 38.1	1.2 to 35.2

Source: Based on data in International Monetary Fund, *International Financial Statistics*, various issues.

The data indicate a high degree of variation of inflation rates among the 41 countries in both periods, 1950-63 and 1963-72. However, this variation was much smaller among the industrial countries than among the developing countries. Moreover, between the first and second periods, national inflation rates converged markedly among the industrial countries, but not among the developing nations. It appears that, at least for developing countries, international economic integration is far from perfect, and international product differentiation is the norm rather than the exception.

These observations point to the need for a further elaboration of the world-monetarist approach so as to account for this wide dispersion of national inflation rates. We should explicitly

take into account both product differentiation and its implications for domestic monetary policy.

The next section presents a simple monetarist model that attempts to incorporate some of these considerations. It shows that the national central bank is not necessarily helpless in coping with imported inflation, and that the effectiveness of domestic monetary policy for price stabilization depends critically on the degree of openness of the economy—measured by the elasticity of substitution between domestic and foreign products on the one hand and by the ratio of imports to GNP on the other.<sup>5</sup> Secondly, it decomposes the impact of imported inflation on domestic price level into a “monetary effect” and a “resource effect,” and shows that mere sterilization of reserve increases in order to offset the “monetary effect” would be insufficient for domestic-price stabilization, as it ignores the “resource effect” of imported inflation.

Finally, by generalizing the world-monetarist model to the case of differentiated products, the analysis provides an explanation of the international dispersion of national inflation rates in a way not accounted for in the version of the model which assumes homogeneous products.

The final section presents a series of empirical tests of the model, utilizing data for eight Pacific Basin countries for the period 1948-73. The model provides a satisfactory explanation of the domestic inflation in most of those countries, with imported inflation playing a significant role in nearly all eight. The results lend support to the view that the developing nations have a greater monetary independence for combating imported inflation than the developed countries do.

## I. Two-Sector Monetarist Model of Imported Inflation

### A) The model and analysis

The model consists of nine equations, six definitional and three behavioral. Readers who are interested only in the policy implications, not the formal analysis, may skip this sub-section and go to the next. The symbols used are explained along with the equations.

- (1)  $M = ky * P$
- (2)  $P \equiv (d/y *) P_d + (m/y *) EP_m$
- (3)  $M \equiv R + C$
- (4)  $R \equiv R_o + P_d x - EP_m m$
- (5)  $x = x(T)$
- (6)  $m = m(T)$



$$(7) \quad T \equiv P_d/EP_m$$

$$(8) \quad y \equiv y^* + x - m/T$$

$$(9) \quad y^* \equiv d + m/T$$

Equation (1) states that in equilibrium the money supply is equal to the nominal amount of money demand, the latter being proportional to the nominal amount of domestic expenditure. It is a variant of the familiar quantity equation  $MV=PQ$ , where  $V$  is the income velocity of money, and  $Q$  the national output. Equation (1) sets  $k=1/V$  and changes  $Q$  to real domestic expenditure.<sup>6</sup> Equation (2) defines the index of domestic-expenditure prices as a weighted average of the domestic-product and foreign-product prices, the weights being the proportions of domestic expenditure spent on the respective products. Equation (3) abstracts from the fractional-reserve system and defines the money supply as the sum of the foreign reserves and domestic credits in the central bank's portfolio. Equation (4) states that the foreign reserves at the end of the period equal the amount at the beginning of the period plus the trade balance during the period, assuming no net international capital flows. Equations (5) and (6) assume both national output and world output to be given, so that the world's demand for the nation's exports and the nation's demand for imports are functions only of the terms of trade. Equation (7) then defines the terms of trade as the ratio of the price of the domestic product to that of the foreign product, both stated in terms of the national currency. Equation (8) defines national output to be equal to domestic expenditure plus exports minus imports, all stated in equivalent units of the domestic product. Equation (9) defines domestic expenditure as the sum of domestic spending for both domestic product and foreign product, both in equivalent units of the domestic product.

To facilitate analysis, set the units of measurement and initial conditions such that initially  $P = P_d = P_m = E = 1$ , and the trade balance is zero. Then, by assuming a fixed exchange rate, and upon differentiating and substituting, we obtain the following relations:

$$(10) \quad dP = dM/M_o - dy^*/y^*_o,$$

$$(11) \quad dM^s = dC + (x' - m' + m_o) dT, \\ x' < 0 \text{ and } m' > 0,$$

$$(12) \quad dy^* = (-x' + m' - m_o) dT,$$

$$(13) \quad dT = dP_d - dP_m,$$

$$\text{and (14) } dP = (d/y^*)_o dP_d + (m/y^*)_o dP_m,$$

where  $x'$  and  $m'$  are the derivatives of  $x$  and  $m$  with respect to  $T$ , and the subscript  $o$  indicates the initial value.

### Imported inflation in the absence of domestic credit expansion

By setting  $dC = 0$ , equations (10)–(14) can be solved to obtain:

$$(15) \quad dP = (\overline{ME} + \overline{re}) (dP_d - dP_m)$$

$$\text{where (16) } \overline{ME} \equiv -(x' - m' + m_o) / M_o,$$

$$\text{and (17) } \overline{re} \equiv -(x' - m' + m_o) / y^*_o.$$

Equation (15) shows that the “terms-of-trade effect” of imported inflation on the domestic price level may be decomposed into a “monetary effect” ( $\overline{ME}$ ) and a “resource effect” ( $\overline{re}$ ). The former indicates the change in central-bank foreign reserves as a ratio of the initial domestic money supply resulting from a change in the terms of trade. The result is positive in the normal case where the elasticities of export demand and import demand are sufficiently large such that the trade balance improves with a fall in the terms of trade.<sup>7</sup> The latter equation measures the net proportionate change in the nation's real domestic expenditure, measured in equivalent units of domestic product, resulting from changes in exports and imports induced by a change in the terms of trade.<sup>8</sup> Thus, a trade surplus resulting from a rise in import prices would be inflationary, because of the induced domestic monetary expansion coupled with a resultant drain of resources from the economy.

Equations (14) and (15) can be solved jointly to obtain  $dP$  and  $dP_d$  as functions of  $dP_m$  only:

$$(18) dP_d = (1 - 1/A) dP_m$$

$$(19) dP = [1 - (1/A) (d/y^*)_o] dP_m,$$

where (20)  $A \equiv \overline{ME} + \overline{re} + (d/y^*)_o$ .

Equations (18)–(20) indicate that the impact of imported inflation on the domestic prices depends systematically on the extent of the “monetary effect” and “resource effect” on the one hand, and the size of the import ratio (i.e. imports divided by domestic expenditure) on the other. The former effects are directly related to the elasticities of substitution between foreign and domestic products such that when these products are highly homogeneous—i.e. when the elasticities of substitution between the two products in the import-demand and export-demand functions are both very large— $dP$  and  $dP_d$  will both approach  $dP_m$ . The same result is obtained in the world-monetarist approach under the assumption of perfectly homogeneous products worldwide.

The import ratio  $(m/y^*)_o$ , or its complement  $(d/y^*)_o$ , also enters into Equations (18) and (19). Other things being equal, the larger the import ratio, the larger will be the impact of imported inflation on domestic prices.

Equations (18) and (19) enable us to distinguish between the determination of the national-output price (say, the GNP deflator) and the determination of the national-expenditure price (say, the consumer-price index). This distinction is significant to an open economy with domestic products that are not perfectly homogeneous with foreign products.

### Effectiveness of national monetary policy

To what extent can a central bank in an open economy effectively control the domestic money supply and thereby maintain domestic price stability in the face of imported inflation? By setting  $dP_m=0$ , equations (10)–(14) can be solved to obtain:

$$(21) dM = (1 - \overline{ME}/A)dC > 0,$$

$$\text{and (22) } dR = -(\overline{ME}/A)dC,$$

which state that expansions (or contractions) in central-bank domestic credit will be partially effective in expanding (or contracting) domestic money supply—but not fully effective, because of the resultant reserve loss (or gain).<sup>10</sup>

If the central bank has at least partial control over the domestic money supply, how should domestic credit be adjusted to check imported inflation?

By setting  $dP=0$ , we obtain from equation (10)–(14):

$$(23) dC/M_o^s = - \left( \frac{\overline{ME} + \overline{re}}{d/y^*} \right) dP_m$$

which states that in the normal case where a trade surplus results from inflation abroad, the central bank should be able to maintain domestic price stability by contracting domestic credit. Moreover, the required credit contraction is the larger, the more closely the domestic product and the foreign product are substitutes, and the larger is the ratio of imports to domestic expenditures.

### B) Policy implications

The analytical results, stated in equations (19), (20), (21), and (23) above, may be summarized as follows:

a) In the absence of domestic credit expansion or contraction, the impact of imported inflation on domestic prices depends systematically on the “degree of openness” of the economy, which in turn is determined by the substitutability between domestic products and foreign products on the one hand, and the ratio of imports to domestic expenditures on the other. Operationally, product substitutability is reflected in the size of the induced change in the country’s trade balance relative to both its domestic money supply and domestic expenditures. The larger the sum of these two ratios, and the larger the ratio of imports to domestic expenditures, the larger will be the impact of import-price increases on domestic prices. Only in the extreme case, where both the induced change in the trade balance and the import ratio are very large, will import-price increases be *fully*

reflected in domestic-price increases.

b) The central bank in an open economy can have at least partial control over the domestic money supply, again depending upon the "degree of openness" of the economy as defined above. However, even in a highly open economy, domestic credit expansion or contraction will affect domestic money supply as a result of induced changes in the domestic demand for money which are brought about by changes in real expenditures and domestic prices.

c) Hence, the central bank could effectively use domestic-credit policy for combating imported inflation. However, the usual prescription of a simple "sterilization policy"—whereby central-bank domestic credits are adjusted merely to offset fluctuations in its foreign assets—would not be sufficient for achieving domestic price stability. The reason is that this prescription fails to take into account the "resource effect" of imported inflation (i.e. the reduction in supply of goods to the domestic economy).

The above analysis deals only with the efficacy of central-bank price-stabilization policy in an open economy. Its *feasibility* and *desirability* are separate matters.

First, the duration of inflation abroad may be critical in determining a central bank's ability to continue using domestic-credit policy for offsetting imported inflation. Such a policy is apt to be more viable when the problem of foreign inflation is short-run rather than long-run in nature.

Second, central-bank policy instruments are still quite rudimentary in many developing countries. Open-market operations are often infeasible where central banks hold few marketable domestic assets, especially in countries where the development of domestic money mar-

kets has been stifled by an official low-interest-rate policy. Central-bank discount policy is often ineffective at a time when the banking sector is already awash with liquidity arising from balance-of-payments surpluses. Adjustments in reserve requirements are sometimes subject to statutory ceilings. For lack of alternatives, many central banks have relied largely on moral suasion to control the growth of domestic credit. Altogether, the room for maneuver is frequently limited.

Thirdly, even if a central bank is well endowed with flexible policy instruments, a policy of systematic sterilization of foreign assets through domestic-credit contraction is tantamount to a deliberate switch from domestic assets to foreign assets in the central bank's portfolio. Given the amount of national savings, this implies a substitution of investments in liquid foreign assets for domestic capital formation.<sup>11</sup> The desirability of such a policy may be questioned, especially where national savings are very limited and act as a constraint on economic development.

The effectiveness of central-bank policy for price stabilization thus depends upon circumstances. Central banks generally should be able to use domestic-credit policy to maintain domestic price stability a) when inflation abroad is of relatively short duration, b) when the economy is relatively "closed" in the sense defined in this paper, and c) when the central bank is able to employ flexible domestic-credit policy. However, both the feasibility and the desirability of such policy action may be doubtful when none of these conditions is fulfilled. In this situation, domestic price stability may not be feasible without adjusting the exchange rate of the national currency.<sup>12</sup>

## II. Empirical Tests for Pacific Basin Countries

How well does the monetarist model we have described explain the inflationary experiences of countries with fairly open economies? To answer this question, we analyzed 1948-73 data for eight Pacific Basin countries with varying degrees of dependence on trade, levels of development, and rates of inflation.<sup>13</sup> Using regres-

sion procedures, we attempted to answer these questions:

(1) Is inflation in the Pacific Basin countries a monetary phenomenon consistent with the quantity equation  $MV = PQ$ ?

(2) Has imported inflation significantly affected inflation rates in those countries? That is to say,

in terms of the quantity equation, have changes in  $P_m$  significantly affected  $P$ ?

(3) Can central banks control the money supply and thereby combat imported inflation, if the exchange rates for their respective currencies are not freely floating—i.e., is  $M$  controllable by the monetary authorities?

To test the first proposition, we rearranged terms in the quantity equation to obtain  $P = MV/Q$ . Taking logarithms and differentiating with respect to time, we obtain<sup>14</sup>

$$(24) \quad \dot{P} = \dot{M} + \dot{V} - \dot{Q}$$

Hence, one would expect changes in the money supply to have a positive effect on domestic prices, and changes in real domestic expenditure (or output) to have a negative effect. Since changes in the money supply may be offset by changes in velocity, however, it is also important to test our assumption of stable velocity.

The first set of regressions reported in Table 1 is based on equation (10), which is a variant of equation (24), and is of the general form:

$$(25) \quad \dot{P} = a_0 + a_1 \dot{M}_{-1} + a_2 \dot{M}_{-2} + \dots + a_n \dot{y}^* \text{ (or } \dot{y})$$

where:

$\dot{P}$  = annual percent change in the CPI index,  
 $\dot{M}$  = annual percent change in domestic money supply (currency and demand deposits; subscript denotes number of years lagged),

$\dot{y}^*$  = annual percent change in real domestic expenditure (measured in constant 1963 dollars),

$\dot{y}$  = annual percent change in real GNP (measured in constant 1963 dollars).

With this format, any change in velocity will be captured by the constant term. In addition, this specification permits the money supply to affect prices with lags, whereas our formal model posits instantaneous adjustment.<sup>15</sup> Both real GNP and real domestic expenditure were tried as explanatory variables, and the best results are presented in Table 1.

On the whole, this very simple specification works quite well for all countries except New Zealand. Except for the latter, the regression

equation explains between 40 to 80 percent of the variation in inflation rates; all the variables have correct signs; the constant term is insignificant (implying no changes in velocity); and the Durbin-Watson statistics are reasonably good. At least one money-supply variable is statistically significant in every case but New Zealand, and a lag of two years typically generates the best results. Not surprisingly, the regression results with the real-income or real-expenditure variables do not differ significantly, and in subsequent regressions we only report the results using real output as the explanatory variable.

To test the imported-inflation hypothesis, we added an import-price term to equation (25) to obtain

$$(26) \quad \dot{P} = a_0 + a_1 \dot{M}_{-1} + a_2 \dot{M}_{-2} + \dots + a_m \dot{P}_m + a_y \dot{y}$$

where:

$\dot{P}_m$  = annual percent change in the import price index in the current period (or in some cases lagged one year).

$\dot{C}$  = annual percent change in central-bank domestic assets.

Part (b) of Table 1 reports the results when the money supply is included as an explanatory variable. The import-price variable is highly significant and positive for the three developed countries (Australia, Japan, and New Zealand) as well as for the Philippines; it is significant about the 10-percent level for all remaining countries except Malaysia. Thus, imported inflation appears to have been a significant factor contributing to domestic inflation in nearly all these countries during the 1948-73 period.

Moreover, the addition of the import-price term tends to reduce the coefficients of the money-supply variables as well as the values of the  $t$  statistic associated with them. This is not surprising, since we would expect rising import prices normally to increase a country's foreign-exchange reserves, and thereby lead to an expansion in its money supply—provided no offsetting action were undertaken by the monetary authorities. Thus, changes in import prices and

**Table 1**  
**(a) Regression Results With Import Prices Excluded**

$$\dot{P} = \alpha_0 + \alpha_1 \dot{M}_{-1} + \alpha_2 \dot{M}_{-2} + \dots + \alpha_n \dot{y} \text{ (or } \dot{y}^*)$$

COUNTRY	$\alpha_0$	$\dot{M}_{-1}$	$\dot{M}_{-2}$	$\dot{y}$	$\dot{y}^*$	$\bar{R}^2/D.W.$	D.F.
Australia	.23 (.43)	.43** (5.44)	.41** (5.30)		-.08 (.68)	.79 1.61	19
Republic of China	6.18* (1.76)	.09 (.73)	.22** (2.32)	-.77** (2.87)		.41 2.22	17
Japan	-.49 (.26)	.14** (2.16)	.19** (2.74)		-.05 (.44)	.45 1.47	16
Korea	3.51 (.50)	.07 (.47)	.32** (2.44)	-2.55 (.57)		.51 1.84	16
Malaysia	.83 (.12)	.11* (1.93)	.16** (2.94)		-.15** (2.94)	.54 2.60	12
New Zealand	4.16** (5.09)	.06 (.61)	.05 (.50)	-.02 (.57)		0 .72	19
Philippines	2.22 (1.44)	.43** (5.00)	.15** (2.27)		-.51** (3.67)	.77 2.06	18
Thailand	-.66 (.33)	.18 (1.36)	.35** (3.38)	-.11 (.91)		.50 1.83	18

**(b) Regression Results with Import Prices Included**

$$\dot{P} = \alpha_0 + \alpha_1 \dot{M}_{-1} + \alpha_2 \dot{M}_{-2} + \dots + \alpha_m \dot{y} + \alpha_n \dot{P}_m$$

COUNTRY	$\alpha_0$	$\dot{M}_{-1}$	$\dot{M}_{-2}$	$\dot{y}$	$\dot{P}_m$	$\bar{R}^2/D.W.$	D.F.
Australia	-.13 (.22)	.21** (3.89)	.18** (2.98)	.19** (2.19)	.58** (6.03)	.93 2.52	18
Republic of China	13.9** (3.81)	-.02 (.21)	.08 (.84)	-1.11** (4.66)	.10 (1.62)	.55 1.96	15
Japan	2.44 (1.27)	.13** (2.05)	.14** (2.05)	-.20 (1.58)	.32** (6.32)	.70 .96	18
Korea	9.87 (1.26)	-.09 (.64)	.14 (1.24)	-.22 (.80)	.35 (1.74)	.43 1.57	8
Malaysia	.79 (.94)	.08 (1.34)	.11 (1.67)	-.22** (2.73)	.04 (.23)	.49 2.53	11
New Zealand	2.53** (2.62)	.11 (1.48)	-.03 (.35)	.08 (.62)	.40** (3.98)	.44 1.81	17
Philippines	1.19 (.80)	.27** (2.45)	.23** (3.53)	-.38** (2.49)	.25** (2.97)	.77 1.52	17
Thailand	-1.16 (.56)	.16 (.95)	.39** (2.48)	-.10 (.74)	.20 (1.73)	.35 1.85	15

t statistics in parentheses

\*\* Statistically significant at the 5% level

\* Statistically significant at the 10% level

in the money supply are not truly independent of each other.

The critical issue for policy purposes is whether the money supply can be controlled. If changes in domestic credit are fully offset by changes in international reserves, monetary policy is ineffective in combating imported inflation. As a simple test of this proposition, we ran the following regression for each country:<sup>16</sup>

$$(27) \quad \dot{R}_i = a_0 + a_1 \dot{R}_w + a_2 \dot{C}_i + a_3 \dot{E}_{-1}$$

where:

$\dot{R}_i$  = percent change in central-bank foreign assets of country *i*.

$\dot{R}_w$  = percent change in world international reserves.

$\dot{C}_i$  = percent change in central-bank domestic assets.

$\dot{E}_{-1}$  = percent change in the exchange rate (domestic currency units / U.S. dollar) lagged one year.

The domestic-credit variable had large negative coefficients which were statistically significant for the three developed countries (Australia, Japan, and New Zealand). For the developing countries, either the variable was statistically insignificant (China, Malaysia, Philippines), or its coefficient was positive (Korea) or negative but small (Thailand). The world-reserve variable was also highly significant for the developed countries, but not for the developing countries. Thus, the results suggest that independent monetary policy under a fixed-exchange-rate regime may be more difficult for developed countries than for the developing countries.<sup>17</sup>

*In conclusion*, the following inferences may be drawn from the regression results:

- (1) A monetarist model helps explain the magnitude of inflation in the Pacific Basin region.
- (2) During 1948-73, imported inflation appears to have contributed significantly to domestic inflation in nearly all Pacific

**Table 2**  
**Regression Results For Reserve Changes**

$$\dot{R}_i = \alpha_0 + \alpha_1 \dot{R}_w + \alpha_2 \dot{C}_i + \alpha_3 \dot{E}_{-1}$$

COUNTRY	$\alpha_0$	$\dot{R}_w$	$\dot{C}_i$	$\dot{E}_{-1}$	$\bar{R}^2/D.W.$	D.F.
Australia	5.69 (1.27)	.93** (2.74)	-.79** (5.91)	-.15 (.63)	.87 1.64	10
Republic of China	32.4** (2.68)	.24 (.25)	-.25 (.95)	-.32 (.57)	0 1.95	17
Japan	13.35** (2.13)	3.64** (7.15)	-.89** (5.39)	6.82** (3.77)	.82 2.40	16
Korea	38.5* (1.81)	-2.18 (1.46)	1.09** (3.17)	-.43* (1.91)	.29 2.13	19
Malaysia	2.91 (.88)	.21 (1.18)	.07 (1.57)	-2.9** (2.3)	.30 2.20	10
New Zealand	4.32 (.52)	2.43** (3.48)	.64* (1.83)	1.08** (2.17)	.46 2.40	20
Philippines	-94.90 (1.03)	8.50 (1.29)	1.69 (.40)	-.93 (.35)	0 1.97	20
Thailand	11.74** (4.18)	-.12 (.57)	-.12* (2.06)	-4.26 (1.07)	.24 1.37	13

t statistics in parentheses

\*\* Statistically significant at the 5% level

\* Statistically significant at the 10% level.

Basin countries examined.

- (3) Imported inflation appears to have affected domestic prices more strongly in the developed countries than in the developing countries in the region. Since the latter countries tend to have larger import ratios than the former, this finding illustrates the danger of relying on the import ratio as the sole measure of the degree of "openness" of a national economy.

- (4) Independent monetary policy also appears to be less feasible for the developed countries than for the developing countries in the sample. This finding helps explain the wider dispersion of inflation rates among the developing countries than among the developed countries, to the extent that the developing countries are less well integrated into the world economy.

#### FOOTNOTES

1. Turnovsky, S. J. and Andre Kaspura, "An Analysis of Imported Inflation in a Short-Run Macroeconomic Model," *Canadian Journal of Economics*, 7 (August 1974).

Kwack, Sung, "Price Linkages in an Interdependent World Economy: Price Responses to Exchange Rate and Activity Changes," paper prepared for the NBER Conference on Research in Income and Wealth, "Price Behavior: 1965-1974," November 21-23, 1974 in Washington, D.C.

2. Shinkai, Yoichi, "A Model of Imported Inflation," *Journal of Political Economy*, 81 (July-August 1973).

3. The world-monetarist approach dates back to David Hume in the eighteenth century. Its modern revival arises from the writings of Harry G. Johnson and Robert A. Mundell. It is important to note that Johnson's model is a balance-of-payments model, and the focus of Mundell's analysis is on the "seigniorage" problem. Neither of these articles expressly dealt with the determination of the domestic price-level.

Johnson, Harry G., "The Monetarist Approach to Balance of Payments Theory," in his *Further Essays in Monetary Economics* (Harvard University press, 1973).

Mundell, Robert C., "Seigniorage and the Optimum World Central Bank," in his *Monetary Theory: Inflation, Interest, and Growth in the World Economy* (Goodyear, 1971).

4. The 41 countries are Austria, Belgium, Canada, Denmark, France, Germany, Italy, Japan, Netherlands, Norway, Sweden, Switzerland, The United Kingdom, The United States (industrial countries); Argentina, Australia, Brazil, Chile, China (Republic of), Colombia, Egypt, Finland, Greece, Iceland, India, Iran, Ireland, Israel, Korea, Malaysia, Mexico, New Zealand, Pakistan, Philippines, Portugal, South Africa, Spain, Sri Lanka, Thailand, Turkey, and Venezuela (developing countries).

5. Intuitively, the product-differentiation concept should be extended to cover differentiation between domestic and foreign financial assets. That, however, has not been accomplished in this model, which for simplicity abstracts from international capital flows. The implicit assumption is that, for the majority of countries today, the substitutability between foreign and domestic financial assets is so small that the domestic capital market may be considered virtually insulated from foreign capital markets. Nevertheless, the abstraction from international capital flows remains a major shortcoming of the model for application to other circumstances.

6. Note that the traditional monetary theory assumes the demand for real balances to be a function of real income or wealth, not real expenditures. In equation (1), we emphasize the motive for holding domestic money as for anti-

ipated or potential expenditures at home, including those on both domestic and imported products, but excluding foreigners' purchases of the country's exports. The shift in emphasis will have implications on the type of price indices dealt with in the model, as to be shown below.

7. The "monetary effect" becomes negative, i.e., a reserve drain instead of a reserve gain, when the initial volume of imports is sufficiently large such that the enhanced import cost resulting from higher import prices exceeds the sum of the induced increase in exports and reduction in imports. An illustration of the case is the large trade deficits sustained by many countries as a result of the 1973 increases in oil-import prices. In such instances, since the "monetary effect" and the "resource effect" must always be in the same direction, the import price increases are deflationary, rather than inflationary to the economy.

8. Note that although the measurement of changes in real income is beset with the index-number problems, the "resource effect" as defined in this paper—being a ratio of the trade balance to the initial domestic expenditure—is devoid of such problems. It is, thus, a concept as fully operational as that of the "monetary effect." The outflow of real resources induced by inflation abroad corresponds to the "seigniorage effect" in Mundell's model. See Mundell (1971).

9. Formal relationships between the "monetary effect" and "resource effect" and the elasticities of substitution may be derived as follows: From aggregate-utility functions of a constant-elasticity-of-substitution type (CES function), both the export demand and import demand can be expressed as functions of the terms of trade. Their partial derivatives with respect to the terms of trade are positively related to the elasticities of substitution.

10. Equation (21) suggests that domestic credit expansion will have a positive effect on domestic money supply, regardless of the degree of openness of the economy. The result is at variance with that obtained from world-monetarist models, which hold that the national central bank cannot control the domestic money supply in an open economy, since domestic credit expansion will be exactly offset by foreign-reserve losses. The difference arises from the fact that (i) we assume product differentiation, whereas the world-monetarist models assume homogeneous products; and (ii) the demand for real balances is a function of real domestic expenditure in our model, but a function of real national income in the world-monetarist models. The result is that a domestic-credit expansion in our model brings forth a rise in the nominal demand for money through an import surplus (i.e.  $dy^*/dC > 0$ ) and a rise in the domestic-expenditure prices ( $dP/dC > 0$ ), both of which will induce the public to hold a larger amount of the

domestic money. In contrast, by assuming homogeneous products, the world-monetarist models rule out any induced changes in the domestic-price level; by relating demand for real balances to real income, rather than real expenditure, they also preclude any effects changes in trade balance might have on the demand for real balances.

11. Shaw, Edward, "International Money and International Inflation: 1958-1973," Federal Reserve Bank of San Francisco, *Business Review*, this issue.

12. It can be shown, by letting E to vary so as to set dR to zero, that a nation can be completely insulated from inflation abroad under freely floating exchange rates.

13. The eight countries included in the sample, along with three key economic indicators, are listed below:

Country	Imports/GNP (1972)	Per Capita Income (1972)	CPI Inflation Rate (1960-72)
Australia	0.15	US \$2,980	3.0%
Republic of China	0.43	490	3.3
Japan	0.08	2,320	5.8
Korea	0.26	320	13.0
Malaysia	0.45	430	1.2
New Zealand	0.23	2,560	4.6
Philippines	0.17	220	6.5
Thailand	0.21	220	2.2

Sources: International Monetary Fund, *International Financial Statistics*, March 1975; Asian Development Bank, *Key Indicators of Developing Members Countries of ADB*, October 1974; and International Bank for Reconstruction and Development, *World Bank Atlas*, 1974.

14. Harberger, Arnold C., "Some Notes on Inflation," in *Inflation and Growth in Latin America*, Werner Baer and Isaac Kerstenetsky, eds. (Yale University Press, 1964).

Vogel, Robert C., "The Dynamics of inflation in Latin America, 1950-1969," *American Economic Review*, 64 (March 1974).

Meiselman, David, "Worldwide Inflation: A Monetarist View," American Enterprise Institute paper, 1974.

In each case the authors were interested in explaining inflation in Latin America and assumed that the domestic money supply was subject to the control of the national monetary authorities.

15. Current changes in the money supply are not included as an explanatory variable, since the data on prices are annual averages, whereas the money-supply data are for end-of-years. Inclusion of the current period's money supply would be equivalent to having changes in prices lead changes in money supply by six months on average.

16. Johnson's specification actually compares growth in domestic credit in the individual country to that in the rest of the world, and includes a comparable real income variable. We found the latter variable to be insignificant in most cases, however.

17. The results, however, are suggestive but not conclusive, since an equally plausible explanation might be that the developed countries pursued a deliberate sterilization policy, whereas the developing countries did not. See, for instance, the article by Joseph Bisignano in this issue.

## Appendix:

### Symbols used in the model.

#### Endogenous variables

- M: money supply.
- $y^*$ : real domestic expenditure expressed in units of domestic product.
- P: index of domestic-expenditure prices.
- d: real national expenditure on the domestic product.
- m: volume of imports.
- x: volume of exports.
- $P_d$ : price of domestic product.
- R: foreign reserves in the central bank's portfolio.
- T: the nation's terms of trade, i.e., the ratio of its export price to its import price, both in terms of the national currency.

#### Exogenous variables:

- y: real national output in units of domestic product.
- $R_0$ : central bank's foreign-reserve holding at the beginning of the period.
- C: domestic credits extended by the central bank.
- E: exchange rate of the national currency per unit of foreign currency.
- $P_m$ : price of foreign product.

#### Parameter

- k: positive constant



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# The Interdependence of National Monetary Policies

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Joseph Bisignano\*

Of all commodities money is the most fungible. Consequently, the price of money—which is the rate of inflation—and the price of credit (money's liability counterpart) which is measured by interest rates—"tend" to similar values across domestic and international boundaries. With the increasing integration of domestic and international money and capital markets, it is unusual to see financial assets with similar risk characteristics trading at different interest yields for any length of time. A related, but different, result of money's fungibility is the fact that central bank monetary actions in one country can affect the money supply in another country under a system of imperfectly flexible exchange rates.

This article will outline some of the monetary interconnections among nations and specify in a simple fashion the results of these interrelations. We will first consider the degree of correlation among short-term interest rates of several countries. Next we will describe the composition of foreign monetary bases, and the connection of this composition to the monetary theory of the balance of payments. Finally we will consider the degree of impact of changes in the U.S. monetary base on changes in foreign money supplies, along with estimates of the demand for monetary-base money.

## Some obvious interdependencies

The rapid rise and integration of capital and money markets in the postwar period, combined with the spectacular growth of the Eurocurrency market since the early 1960's, have led to inter-related movements among financial assets of like maturity and risk elements. Table 1 presents a simple correlation matrix for the period 1959.1 to 1973.4, depicting the correlations among various types of short-term interest rates—Treasury bill rates for eight countries as well as the three-month Eurodollar rate. The interest rates used are quarterly averages. In most cases we see very high correlation between foreign interest rates and the interest rate on U.S. Treasury bills. As we might expect, changes in U.S. and Canadian interest rates are highly correlated, but changes in U.S. and U.K. rates are equally highly correlated and the same is only slightly less true for rates in the U.S. and Germany.

There are a number of reasons for this close correlation. The most important is that in a world of relatively free capital markets assets denominated in different currencies serve as potential substitutes in the portfolios of private wealth-holders. In addition, countries may be pursuing similar monetary policies, which result in similar impacts on market-determined interest rates. Indeed, the balance of payments represents, in one definition, the change in a nation's international reserves, and domestic monetary policies are often undertaken in response to

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\*I wish to thank Scott Nason for his research assistance.

changes in the balance of payments. The predominant reasons for this interrelationship among international interest rates include the growth of international capital markets and the relaxation of constraints on capital flows. In cases where governments have instituted domestic impediments to capital flows, international offsets to these impediments have then arisen, viz., the Eurocurrency market.

In addition to the interest-rate correlation, price indices also are correlated internationally. Because other countries formerly pegged their exchange rates to the dollar (within narrow bonds), any significant U.S. balance-of-payments deficits—caused, say, by an increase in price inflation within the U.S.—had to result in other countries purchasing dollars in the foreign-exchange markets. But, as we shall see below, such purchases of dollars added to the foreign-exchange reserves of foreign central banks. Table 2 displays the rapid upswing in official foreign-exchange holdings of eleven developed nations between 1968 and 1974. Germany and Japan, with their rapid real economic growth, experienced large demands for real money balances, which were at least partially satisfied through the accumulation of foreign-exchange reserves. The share of domestic money demand satisfied from foreign sources in a regime of fixed exchange rates depends upon the growth in the world money supply. (See the companion article by Shaw for details.) The U.S., as the major source of international reserves increased its

dollar liabilities to foreign official institutions from \$17 billion in 1968 to \$71 billion in 1974. Because foreign-exchange reserves represent a major component of the monetary bases of foreign central banks, foreign money supplies necessarily had to expand, except where central banks could offset inflows of foreign-exchange reserves.

### Composition of foreign monetary base

The money supply is similarly defined in this and most other countries. In the U.S., the narrowly defined money supply ( $M_1$ ) is composed of currency and coin plus demand deposits held by the public. In the U.K., the  $M_1$  money supply is composed of notes and coin plus sterling current accounts held by the public. However, the assets of the respective central banks—the Federal Reserve and the Bank of England—which support the reserves held by the commercial banks, are different in one important respect. The principal foreign component of this monetary base in the U.S. is the gold stock, while in the U.K. and other foreign countries the central bank's holdings of foreign assets make up a significant share of the sources of the monetary base. Since the money supply used by the public is "supported" by the central bank's monetary base, control of the monetary base is essential if a country is to control its money supply and its rate of inflation.

This simple point provides a monetary connection through the balance of payments to other

**Table 1**  
**Correlation Matrix**  
**for Change in Eurodollar Rate and Treasury Bill Rate of Various Countries**

	United States	United Kingdom	Canada	Italy	Germany	Japan	Australia	Netherlands	Euro
United States	1.000000								
United Kingdom	.801860	1.000000							
Canada	.788500	.599957	1.000000						
Italy	.471451	.395329	.122251	1.000000					
Germany	.645567	.545940	.299815	.632305	1.000000				
Japan	.334773	.200238	.624185	-.104926	.295214	1.000000			
Australia	.389175	.501618	.164727	.638102	.700282	.364275	1.000000		
Netherlands	.670903	.690429	.608011	.350920	.686181	.691753	.719916	1.000000	
Euro	.923835	.717829	.711332	.537490	.682429	.318161	.518629	.704486	1.000000

Note: Euro is the 3-month Euro-dollar rate. All other figures are the Treasury bill rates for the country indicated.

countries. Consider the assets of a foreign central bank, composed of domestic assets (e.g., government securities, loans to commercial banks) and foreign assets—which are counter-balanced by central bank liabilities, the equivalent in the U.S. of member-bank reserves, in some countries called “central bank money.” Hence we have

$$(1) \quad D + R = B$$

where  $D$  = domestic assets of the central bank,

$R$  = foreign assets of the central bank (usually denominated in dollars)

$B$  = monetary base of the central bank (central bank money).

The monetary base ( $B$ ) is linked to the domestic money supply ( $M$ ) by the relationship

$$(2) \quad M = mB$$

where  $m$  is the money multiplier, which can be decomposed into its components which reflect financial preferences of the public and the banking system.

Consider a change in equation (1), that is

$$(3) \quad \Delta D + \Delta R = \Delta B$$

or

$$(4) \quad \Delta R = \Delta B - \Delta D$$

**Table 2**  
**Official Foreign Exchange Reserve Holdings**  
**and U.S. Official Liabilities**  
**(Billions of U.S. Dollars: End of Period)**

	1968	1969	1970	1971	1972	1973	1974
U.K.	0.9	1.1	1.2	5.1	4.1	4.7	4.9
Canada	2.0	1.8	3.0	4.1	4.4	3.9	3.8
Germany	3.9	2.7	8.5	12.6	17.2	25.1	24.0
Japan	2.3	2.6	3.2	13.8	16.5	10.2	11.3
France	0.3	0.3	1.3	3.6	5.1	3.7	3.8
Italy	1.5	1.2	2.1	3.0	2.2	2.2	3.2
Australia	0.9	0.7	1.1	2.7	5.4	4.9	3.6
Netherlands	0.3	0.4	0.8	0.4	1.4	3.3	3.5
Sweden	0.4	0.4	0.4	0.7	1.1	2.0	1.2
Norway	0.6	0.6	0.6	1.0	1.1	1.3	1.7
Denmark	0.2	0.3	0.4	0.5	0.6	1.0	0.6
U.S. Official Liabilities	17.3	16.0	23.8	50.7	57.5	69.6	70.8

Source: *International Financial Statistics*, various issues.

where  $\Delta$  represents the incremental change in each variable.  $\Delta R$  represents the change in a country's holdings of foreign-exchange reserves and corresponds to one definition of the balance of payments. Thus for a given time interval, say a quarter,  $\Delta R$  would be the balance of payments in a given quarter,  $\Delta B$  the change in the monetary base in that quarter and  $\Delta D$  the change in domestic assets held by the central bank. If the monetary authorities have complete control over  $D$ , the domestic asset component of the monetary base—for example, through control over open market operations or lending to commercial banks—they may attempt to offset movements in the foreign-exchange-reserve component of the monetary base. This would obvi-

**Table 3**  
**Dependent Variable = Change**  
**in Domestic Assets**  
**Sample Period = 1966-I - 1973-IV**

Country	c	$\Delta$ Foreign Assets	$\rho$	$R^2$	D.W.
U.K.	126.06 (2.30)*	-1.1307 (-8.79)	.4844 (3.03)	.8533	2.26
Canada	.1486 (3.77)	-1.0466 (-15.1)	.5703 (2.80)	.8808	2.09
Italy	315.17 (5.61)	-.60699 (-2.65)	.2336 (1.32)	.2498	2.11
Germany	1.0256 (1.64)	-.5906 (-6.46)	.0784 (.431)	.5823	1.98
Japan	626.97 (2.03)	-.87039 (-24.6)	.9446 (15.8)	.9673	1.94
France	2.1286 (3.19)	-.86465 (-3.58)	-.3929 (-2.34)	.2493	1.90
Australia	.090681 (3.13)	-.98522 (-14.7)	.4475 (2.74)	.8943	2.04
Netherlands	.08310 (1.48)	-.80451 (-9.59)	-.5542 (-3.65)	.8099	1.66
Sweden	.19822 (7.98)	-.87293 (-19.2)	-.2509 (-1.42)	.9099	1.82
Norway	.12940 (3.03)	-1.0010 (-8.59)	-.2394 (-1.35)	.7372	2.18
Denmark	.03127 (.299)	-.8203 (-5.71)	.1579 (.8758)	.5357	2.05

$\rho$  = serial correlation coefficient

D.W. = Durbin-Watson statistic

c = constant term

$R^2$  is adjusted for degrees of freedom.

\*t—statistics in parentheses

ously imply a negative correlation between  $\Delta D$  and  $\Delta R$ .

The causal relation could work in the other direction. That is, capital flows may offset the conscious central bank decision regarding the desired change in  $D$ , the domestic component of the monetary base. Assume, for example, that the monetary authorities decide not to satisfy all the apparent demand for money. This would imply that the increase in the domestic component of the monetary base would be sufficient to satisfy only part of the demand for money, driving up domestic interest rates. The resulting increase in interest rate differentials, however, would cause the excess demand for money to be satisfied from abroad through an induced capital inflow and a balance of payments surplus. In this case the balance of payments would reflect the fact that domestic money demand exceeded domestic money supply. When the excess demand for money was satisfied the balance of payments would revert back to zero. Thus a negative relationship between  $\Delta R$  and  $\Delta D$  is consistent with either of the in-

terpretations presented above.

Table 3 indicates that for the period 1966I to 1973IV, the change in the domestic component of the monetary base of eleven industrial countries was very significantly and negatively related to the movement in their foreign component. The overall goodness of fit in these simple regressions is generally very good, in most cases explaining over 70 percent of the variation in the change in the domestic component of the eleven foreign monetary bases. In several cases also, the coefficients on the change in the foreign-asset portion of the respective monetary bases are very close to unity. This gives the optimistic impression, if we take these regressions at face value, that foreign monetary authorities were able, within a quarter, to offset a very substantial portion of the change in their monetary bases induced by balance-of-payments movements. However if we reverse the relationship, explaining the change in the foreign component, we obtain very similar results, indicating that changes in the domestic component of the base give rise to offsetting

**Table 4**  
Dependent Variable =  $\Delta M$  (Change in Money Supply) Sample Period 1966-I - 1973-IV

Country	T-Bill Rate	$\Delta$ U.S. Base	DUM	SPEC	c	$\bar{Q}$	$\bar{R}^2$	D.W.
U.K.	-80.8449 (-4.46)	163.926 (2.51)	102.087 (.623)	141.445 (1.20)	517.711 (3.48)	.0064 (.035)	.5210	2.00
Canada	-.1381 (2.76)	.4520 (2.87)	-.3127 (-.835)	-.597 (-2.48)	.7018 (1.78)	-.2195 (-1.23)	.4313	2.04
Italy	288.302 (3.86)	378.412 (1.50)	-300.803 (-.728)	511.224 (1.30)	-889.030 (-2.33)	-.4089 (-2.45)	.4675	2.18
Germany	-.4410 (-1.74)	2.6359 (2.75)	1.4270 (.494)	-3.3346 (-2.01)	.8345 (.538)	-.4174 (-2.52)	.2035	2.06
Japan	-554.445 (-2.17)	118.114 (.566)	-4705.2 (-11.029)	213.613 (.580)	3875.15 (2.63)	.5671 (3.77)	.8624	1.78
France**	(-.58895) (-1.18)	3.2251 (2.15)	8.7882 (2.13)	4.6724 (1.30)	4.5642 (.987)	.00437 (.024)	.2721	1.98
Australia	-.02342 (-.783)	.01319 (.300)	-.23557 (-2.66)	.23268 (2.84)	.20845 (1.56)	.1621 (.900)	.5342	1.85
Netherlands	-.15157 (-2.12)	.71778 (3.69)	-1.1637 (-2.52)	-1.1910 (-3.75)	.66528 (1.40)	-.2277 (-1.28)	.5398	1.85
Sweden	-.009529 (-4.52)	.096892 (1.17)	-.43853 (-2.67)	.11949 (.736)	.27643 (1.42)	-.5332 (-3.45)	.2998	2.13
Norway**	.03212 (1.19)	.24352 (2.83)	—	.5515 (2.56)	-.1135 (-.453)	-.4110 (-2.47)	.3875	2.46
Denmark**	-.00904 (-.088)	.6601 (2.04)	—	.01617 (.020)	.07305 (.077)	-.2836 (-1.62)	.0560	1.97

\*\*Interest rates = 3-mo. Euro. dollar rate.

movements in the foreign component. Thus, we cannot infer to what extent central banks were successful in offsetting foreign-exchange flows by simply observing the high correlation between the domestic and foreign components of the monetary base. We need additional information to determine the direction of causality.

If foreign central banks during the 1966-73 period were indeed capable of sterilizing foreign-exchange influences on their monetary bases, we should not expect changes in the monetary base of the United States, the country to which other countries pegged their exchange rate for much of the sample period, to strongly influence those foreign money supplies. Yet this is not the case. Table 4 relates the change in the money supplies of eleven industrial countries to their own short-term interest rate; the change in the U.S. monetary base (measured in U.S. dollars), a constant and several dummy

variables.<sup>1</sup> The change in the U.S. monetary base is statistically significant in the majority of cases. U.S. monetary base changes should not be consistently significant for nations which were successful in repelling dollar inflows throughout this period, a period in which there was a sharp upward increase in the trend rate of growth in the U.S. monetary base.

Our results suggest that changes in the U.S. monetary base significantly influenced the money supplies of most major industrial countries except Japan. If the equations in Table 4 are appended to include changes in foreign as well as U.S. monetary bases, the U.S. base still remains significant. In several cases—the U.K., Canada, and France in particular—the foreign country's monetary base fails to be significantly significant (Table 5). These results would indicate that foreign countries were less than completely successful in sterilizing the foreign influence on their monetary bases and money supplies.

**Table 5**  
Dependent Variable =  $\Delta M$  (change in money supply) Sample Period 1966-I – 1973-IV

Country	$\Delta$ Base	$r_{T-BILLS}$	$\Delta$ U.S.*		SPEC	c	$\rho$	$\bar{R}^2$	D.W.
			Base	DUM					
U.K.	.0854 (.28)	-84.43 (3.56)	155.12 (2.04)	141.263 (.63)	130.941 (1.07)	543.992 (2.85)	-.019 (-.107)	.5023	2.01
Canada	1.0794 (1.43)	-.1307 (2.84)	.3618 (2.16)	-.0371 (.09)	-.6314 (2.83)	.6237 (1.71)	-.336 (-1.95)	.4468	2.13
Italy	1.5611 (4.02)	188.966 (3.12)	317.959 (1.68)	-487.583 (1.56)	377.916 (1.28)	-722.835 (2.53)	-.521 (-3.35)	.6641	2.17
Germany	.3944 (3.15)	-.3896 (1.88)	1.6937 (2.00)	2.0224 (.83)	-4.00 (2.91)	1.0712 (.84)	-.506 (-3.21)	.4083	2.32
Japan	1.0119 (1.89)	-453.401 (1.99)	123.333 (.61)	-4753.77 (11.35)	94.4863 (.26)	3014.66 (2.20)	.429 (2.60)	.8728	1.78
France**	-.10863 (-.763)	-.63288 (-1.13)	2.9810 (1.84)	10.294 (2.45)	4.8985 (1.26)	5.3583 (1.04)	-.1229 (.678)	.2544	2.03
Australia	.5351 (3.20)	-.0196 (.85)	.0058 (.17)	-.2103 (2.67)	.1829 (2.69)	.1579 (1.57)	-.057 (-.312)	.6509	2.04
Netherlands	.7161 (6.10)	-.1124 (1.98)	.6402 (4.39)	-.9163 (2.62)	-1.1661 (4.69)	.4525 (1.24)	.051 (.277)	.8034	1.99
Sweden	.60767 (2.03)	.003736 (.183)	.03947 (.485)	-.53809 (-3.41)	.07778 (.513)	.14435 (.758)	-.5783 (-3.88)	.3759	2.25
Norway**	.3976 (1.68)	.07349 (2.94)	.4218 (3.88)	—	-.2552 (-1.35)	-.6275 (-2.49)	-.038 (-2.28)	.3211	2.23
Denmark**	.2635 (.711)	-.01434 (-.174)	.4568 (1.29)	—	.7267 (1.19)	.2805 (.337)	-.041 (-2.48)	.0839	2.16

\*U.S. Base measured in U.S. dollars.

\*\* $r$  = 3-mo. Euro-dollar rate.

SPEC = dummy variable for periods 1972IV-1973II. 45

It should not be surprising to find that changes in the U.S. monetary base were significant in explaining changes in foreign money supplies. Given the commitment by most nations to a system of fixed exchange rates, and given the continual rise in the rate of growth of the U.S. monetary base (from 2.0 percent in 1959-62 to 8.1 percent in 1973) it was not simply chance that most industrial nations experienced rapid increases in the rates of growth of their money supplies. The evidence seems to indicate that while these nations in the short run could sterilize some of the undesired increase in the monetary base induced via the balance of payments, they could not achieve long-run sterilization. Academic opinion also shifted during this period, bringing on a revival of primarily monetary interpretations of balance-of-payments phenomena. To that subject we now turn.

### Money and the balance of payments

In its most rudimentary form, a monetary interpretation of the balance of payments requires a money demand equation, a money supply equation, an equation positing the equality of money demand and money supply (that is, money market equilibrium) and lastly, an equation defining the balance of payments as the change in the foreign asset component of the monetary base. The balance of payments, either through the flow of goods or the flow of capital, augments or diminishes the stock of foreign-exchange reserves of a nation, and hence the nation's monetary base. In equilibrium the demand for money must equal the supply, thus the balance of payments must also be zero. If the balance of payments is in surplus there must be excess demand for money; if it is in deficit, there is an excess supply of money. The balance of payments is the mechanism through which equality of money demand and supply is achieved.

The thing to be emphasized in this interpretation is that a non-zero balance of payments is a disequilibrium phenomenon. Variations in the balance of payments represent the flood gates

through which equilibrium in the money market is restored. What then determines whether a country will have an excess demand or excess supply of money?

The functional components of the monetary base demand and supply determine the balance of payments and, simultaneously, the existence of excess demand or supply in the money market. Note that when we refer to "money" here we are referring to the monetary base. However, since money used by the public—say, demand deposits plus currency—is institutionally linked to the monetary base, our analysis implicitly concerns the excess demand and supply of money in the hands of the public.

**Table 6**  
**Dependent Variable = log (Monetary Base)**  
**Sample Period = 1966-I - 1973-IV**

	log y	log r	c	Q	R <sup>2</sup>	D.W.
U.S.	.8409 (39.1)	-.0424 (-3.00)	-1.368 (-9.44)	.2192 (1.67)	.9907	1.97
U.K.	.6692 (9.78)	.1880 (4.54)	.5616 (.749)	.6270 (4.41)	.9628	1.88
Canada	1.0625 (12.0)	-.0443 (-1.87)	-3.0014 (-7.38)	.8548 (9.02)	.9937	2.03
Italy	.2063 (3.16)	-.0441 (-1.04)	7.6100 (9.94)	.9662 (20.5)	.9937	1.90
Germany	1.3358 (8.33)	-.01758 (-.348)	-4.5014 (-4.38)	.7901 (7.06)	.9793	2.31
Japan	1.2418 (21.5)	.09842 (1.34)	-7.1474 (-9.48)	.8155 (7.72)	.9975	2.25
France	-.1085 (-.784)	.1135* (1.95)	5.7253 (5.22)	.9740 (23.5)	.9503	2.00
Australia	1.0918 (11.4)	-.0544 (-.874)	-2.6408 (-8.60)	.8136 (7.66)	.9902	1.84
Netherlands	.4864 (17.3)	-.0690 (-4.55)	.1567 (1.15)	.3483 (2.03)	.9625	2.03
Sweden†	.7898 (17.7)	-.04780 (-2.22)	-1.4830 (-6.87)	.4014 (2.06)	.9766	1.73
Norway	.7592 (21.9)	-.0569* (-2.39)	-.00550 (-.056)	.2550 (1.41)	.9683	1.94
Denmark	.1636 (.807)	.09161* (1.10)	1.0352 (1.06)	.8065 (7.47)	.7677	1.84

†For period 1966.1-1971.4 r = domestic short-term interest rate  
 \*3-mo. Euro-dollar rate y = aggregate output (GNP or GDP)

Base money demand can be simply stated as a function of aggregate income and some summary measure of interest rates. Base money supply is composed of a domestic credit component which is determined by the central bank, and a foreign asset component for the non-reserve center country. The domestic component of the monetary base may be thought of as the variable the monetary authorities control in order to influence domestic credit market conditions and the public's holdings of money. The primary means by which the monetary authorities control this domestic component vary from country to country, some using discount-rate policy, others open market operations or reserve requirements.

Consider an example where we begin with the equality of base money demand and supply. The balance of payments is zero. (Recall that we are assuming a world with imperfectly flexible exchange rates.) The central bank, desiring to achieve some income or interest rate or even balance-of-payments objective (the objective is of little significance), increases the domestic component of the monetary base. There now exists an excess supply of base money. The increase in base money, operating through central-bank domestic credit operations, will result in a fall

in domestic interest rates and a rise in income generating a capital outflow and a trade deficit. The consequent decrease in international reserves will then offset the increase of domestic credit on the monetary base. When, after some period of time, equilibrium is restored to the money market, it will have been achieved through the avenue of the balance of payments. Indeed, the decline in the country's reserve holdings would be *exactly* equal to the conscious increase in the domestic component of the monetary base.

Ultimately, then, the money supply of the country under consideration does *not* change. However, what does increase is the *world money stock*, for now other countries hold the reserves that were lost by the domestic-credit-expanding nation.<sup>2</sup> A non-reserve center country can determine the composition of its monetary base, but its total monetary base and money supply are determined by their interactions with other countries—thus, its money supply becomes an endogenous variable, rather than a variable determined by the nation's own monetary authorities.<sup>3</sup>

### Monetary base demand

As we normally think of an aggregate demand for money by the public as a function of income, interest rates and other explanatory variables, we can similarly conceive of a demand for monetary base. The demand for monetary base money can be thought of as a "derived demand," in the sense that it derives from the demand for money held by the public. This derived demand for monetary base also relates to the stability of the multiplier connecting the monetary base to the money supply used by the public, this multiplier capturing a large number of money and reserve preferences of the public and the banking system.

The statistical validity of the monetary theory of the balance of payments depends crucially on the stability of its underlying behavioral equations—in its most rudimentary form, the demand and supply functions for monetary base. We will consider here only the demand for monetary

**Table 7**  
**Tests of Stability Of Regression Coefficients**  
**for Monetary Base Demand Equations\***

Country	F-statistic
U.S.	2.48
U.K.	2.96
Canada	7.74
Italy	3.71
Germany	3.34
Japan	7.63
France	4.98
Netherlands	2.66
Sweden	1.66
Norway	0.97
Denmark	2.28
Australia	3.07

\*The critical value of the F-statistic at the 99% confidence level is 4.31 for all except Sweden.

Tests conducted by splitting sample pound in half and testing for statistical changes over the two sub-sample periods.

base. The demand for monetary base was specified as a function of the level of aggregate output ( $y$ )—GNP in most cases, gross domestic product (GDP) in others—and a representative short-term interest rate ( $r$ ). A log-form demand equation was estimated for eleven countries, with the results appearing in Table 6. The results for Italy, France and Denmark were poor, in the sense that the coefficient on the income term was either extremely small, statistically insignificant, or both. However, these results should be discounted to some extent because we did not have quarterly GDP data for those and several other countries, so that quarterly data were generated by interpolating from annual regressions of GDP on retail sales and industrial production, weighted by prices.

For the remaining monetary base demand equations, we found that the coefficients on the income and interest-rate variable were not very different from those found for demand equations for money held by the public (demand deposits and currency). Income elasticities, measured by the coefficient on the aggregate-output variable, were in most cases between 0.75 and 1.25, about what would be expected a priori. The coefficient on the interest rate variable was generally negative (as expected) but positive and significant in the case of the U.K. For the majority of cases, the elasticity of base-money demand with respect to interest rates was relatively small, a result not atypical of those seen for the demand for money held by the public.

To test the stability of the monetary base demand equations, the sample period was divided evenly and separate regressions were estimated over these subsample periods. The conventional F-test for stability of the equation over the entire sample period was performed, as seen in Table 7. Regressions were also run using multiplicative and additive dummy variables in addition to the original explanatory variables, permitting us to test shifts in a particular coefficient. These latter regressions (not reported here) showed significant differences in the income elasticity of monetary base demand between the periods 1966-69 and 1970-73 for Canada, France, Ger-

many, Japan and The Netherlands. In terms of the general F-test for stability, the hypothesis of stable demand equations over the entire period was rejected in the case of Canada, Japan and France.

While a number of qualifications can be made about the formulation of the base demand equations, and in particular about the quality of the data, the available evidence partially supports the hypothesis that monetary base demand equations remained stable over the 1966-73 period.<sup>4</sup> Monetary theories of the balance of payments are essentially theories of equilibrium restoration between money demand and supply in open economies. As we have seen, this analysis hinges crucially on the empirical stability of monetary-base demand. Our analysis *thus lends empirical support to monetary* interpretations of balance-of-payments phenomena.

## Conclusion

The monetary theory of the balance of payments has revived interest in explaining balance of payments phenomena by concentrating on the means by which equilibrium between demand and supply for money is achieved under a system of less than perfectly floating exchange rates. In addition, it has emphasized the relationship between domestic credit creation by a central bank and the simultaneous creation of world money—those international reserves the domestic credit expanding country loses which are absorbed by the rest of the world. This paper concludes that there is some statistical evidence to support such interpretations.

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## FOOTNOTES

1. The dummy variable SPEC is unity for the period 1972.4-1973.2. The dummy variable DUM is different for different countries; for example, it is unity for the period of the French civil turmoil in 1968.2.
2. As Michael Keran has shown in his article, the world stock of foreign exchange reserves, one measure of a world money stock, contributed significantly to the increase in world prices in the last several years.
3. This point is developed in the companion article by Edward S. Shaw.
4. In most cases monetary-base data were obtained from the IMF'S *International Financial Statistics*, and were seasonally adjusted using the Census X-11 program.