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Towards an Explanation of Simultaneous Inflation-Recession

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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-recession 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.[1] 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.[2]

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 (ΔLog PX) is equal to the percent change in velocity (ΔLog V) plus the percent change in money (ΔLog 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:

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

where the change in nominal income (ΔLog PX) in the current period (t) is a positive function of the weighted sum (Σ) of the change in nominal money supply (ΔLog 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 the change in world money (ΔLog 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.[3] [4]

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.

$$\Delta \text{Log } Pw_t = \underset{(1.0)}{-1.48} + \sum_{1}^{12} \underset{(7.2)}{1.04}\ \Delta \text{Log } Mw_{t-12}$$

(t values below coefficients)

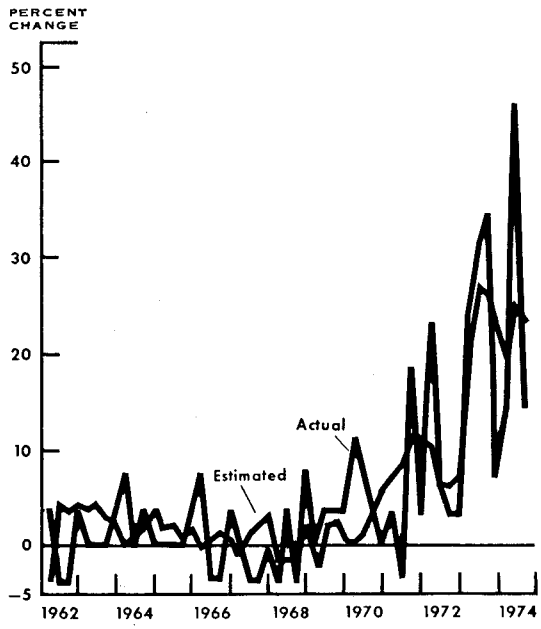
R^2/SE	DW/DF
.57/6.7	2.18/46

ΔLog Pw = Percent change in internationally-traded goods prices, as measured by export prices of developed countries

ΔLog 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.

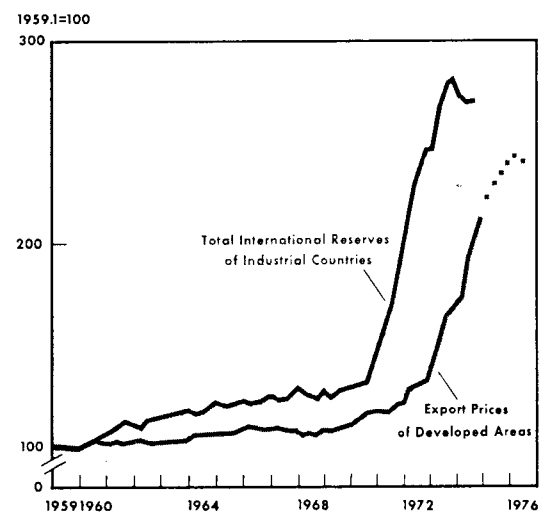
If we assume a continuation of the current no-growth trend in world money—a reasonable assumption in this era of flexible exchange rates —then there are encouraging implications for the near-term outlook for prices of internationally-traded goods. The forecast values through the end of 1975 are shown 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)

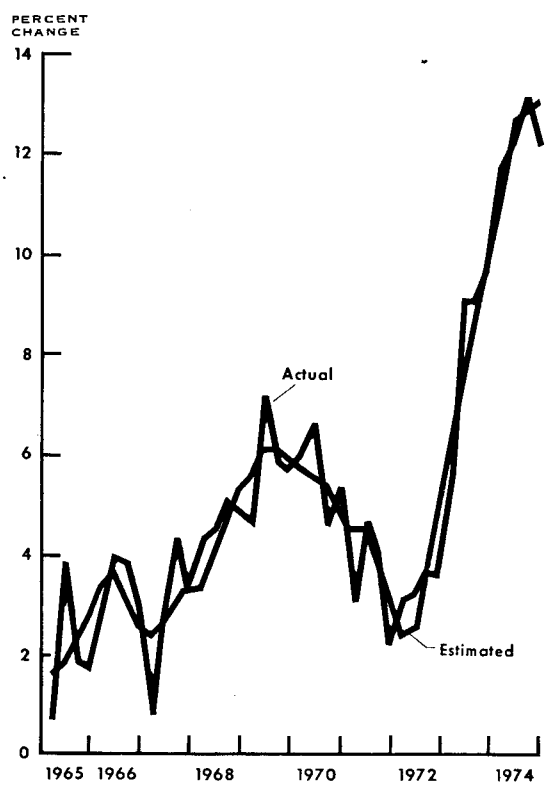
	Constant Term	Quarterly Percent Change: U.S. Money	Quarterly Percent Change: World Money	Quarterly Percent Change: Exchange Rate	R^2/SE	DW/DF
Equation 1	–5.2 (3.2)	$\overset{12}{\Sigma}$1.86 (6.5) 2.08			.53/1.84	.58/33
Equation 2	–4.9 (1.0)	$\overset{12}{\Sigma}$1.78 (8.9) 1.99	$\overset{16}{\Sigma}$.098 (2.5) .66		.90/.86	2.24/29
Equation 3	–4.6 (4.6)	$\overset{12}{\Sigma}$1.74 (8.4) 1.94	$\overset{16}{\Sigma}$.089 (2.2) .60	$\overset{4}{\Sigma}$–.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 measured 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.[5]

Chart 3 U.S. Inflation Rate



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.[6] 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.

Effects of World Money on Domestic Inflation

	Sum Coefficient	*"t" Values*
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

	With World Money (Equation 2)	*Without World Money (Equation 1)*
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

	With World Money (Equation 2)	*Without World Money (Equation 1)*
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.[7]

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:

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

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:

$$\Delta \text{Log}\,(PX)_t = a_o + \Delta \text{Log} \sum_{i=o}^{n} (M)_{t-i}$$

$$+ a_2\ \Delta \text{Log} \sum_{i=o}^{n} (Mw)_{t-i}$$

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.

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

R^2/SE	DW/DF
.30/2.91	1.66/56

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

$$+ \underset{(0.6)}{.022}\ \Delta \text{Log} \sum^{4} (Mw)_{t-4}$$

R^2/SE	DW/DF
.28/2.95	1.65/54

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.[8]

(3)

$$\Delta \text{Log}\,(X) = \underset{(4.8)}{2.20} + \underset{(6.5)}{1.37}\ \Delta \text{Log} \sum^{4} (M/Pus)_{t-4}$$

R^2/SE	DW/DF
.43/2.92	1.79/56

$$(4)\ \Delta \text{Log } X = 2.18 + \underset{(4.7)}{} + \underset{(5.5)}{1.37}\ \Delta \text{Log} \sum_{t-4}^{4} (M/Pus)_{t-4}$$

$$+ \underset{(0.1)}{.01}\ \Delta \text{Log} \sum_{t-4}^{4} (Mw/Pw)_{t-4}$$

R^2/SE .42/2.97 DW/DF 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.

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.