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Stabilization Policy in World Context

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"Whatever our views about desirable behavior . . . they can never legitimately be applied to the situation of a single country which is part of an international economic system, and any attempt to do so is likely in the long-run and for the world as a whole to be an additional source of instability."

F. A. Hayek, 1937.

One of the more painful lessons that economists, businessmen and policymakers learned in the first half of the 1970's was that their domestic economic environment is influenced not only by stabilization policy at home, but also by developments in other countries. Inflation in the U.S. in the 1973-74 period was higher because inflation was a worldwide phenomenon. The recession in 1974-75 was more serious because it was a worldwide phenomenon. In short, the synchronous development of inflation and recession has made the U.S. economy more unstable than it was in the 1950's and 1960's.

The purpose of this article is to explain how stabilization policies in the rest of the world could impact on the U.S. economy to frustrate domestic stabilization goals. According to one interpretation, "supply shocks" associated with the oil price rise, agricultural shortfalls, and other natural calamities have contributed to the inflation, but this is only a partial explanation. Rather, expansionary stabilization policies in the rest of the world were a major source of the acceleration in U.S. inflation in 1973-74, and expansionary policies abroad in the last year and a half could set the stage for some reacceleration of U.S. inflation in 1977.[1]

In Section I, we develop a simple model which provides a consistent explanation of how expansionary stabilization policies in the rest of the world can lead to higher domestic inflation and lower domestic real output growth than would be warranted by domestic policy alone. In Section II, we present empirical evidence in support of this model. In Section III, we evaluate the potential impact of recent world and domestic monetary policies on U.S. inflation in 1977 and beyond, and in a concluding section consider the implications of this analysis for making national stabilization policies in a world environment. A technical appendix provides a mathematical exposition of the model and its application to the U.K. and Germany.

The term "stabilization policy" refers here to traditional monetary and fiscal policy tools of aggregate demand management. In both the theoretical and empirical sections of this article, monetary policy will be given the primary consideration. This focus does not imply that fiscal policy is an inferior policy tool. However, over the historical period considered here, monetary policy has shown the greater variance and hence its impact on aggregate demand is more amenable to empirical testing.

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I. The Basic Model

We can model the impact of world and domestic stabilization policies on short-run domestic equilibrium by drawing together elements of a monetary analysis of world inflation and a Keynesian analysis of national-income determination. Specifically, the model is based on the following relationships:

1. Domestic nominal aggregate demand is determined by domestic monetary and fiscal policy according to the standard Keynesian LM/IS analysis. Given constant stocks of capital and labor, and a constant level of technology, real aggregate supply is determined by the price level and the nominal wage rate. Internal balance is achieved when aggregate demand is equal to aggregate supply. Abstracting from capital flows, external balance is defined as the equality of exports and imports. Thus the equilibrium conditions for internal and external balance are identical.

2. Each country faces an elastic world demand for the internationally traded goods it produces, with the price level determined by the aggregate of world monetary policies.[2] We assume that no single country has a significant impact on the world demand for internationally traded goods. Furthermore, each country is assumed to have effective control over its domestic money stock, both under fixed and flexible exchange rates.[3]

3. By the "law of one price," the domestic price of internationally traded goods is jointly determined by world prices in foreign currency and the exchange rate between domestic and foreign currencies.

4. Money wages are rigid downwards but adjust upwards with a rise in the domestic price level. Hence, if exchange rates are "sticky" in the short run, for reasons to be explored below, world price inflation will be translated into domestic price inflation and then into domestic wage inflation.

According to this model, if a number of major countries uniformly follow expansionary monetary polices, the result will be increased demand for internationally traded goods, and a rise in the world price of traded goods. In the absence of exchange - rate adjustment, traded - goods prices will rise even in the country which has not participated in the expansionary policy.

Why, under flexible exchange rates, doesn't exchange-rate appreciation offset the world price rise? The simplest explanation is that world inflation will increase import and export prices proportionately, and hence will have no initial substitution (terms of trade) effect.[4] With no substitution effect, only the income effect will operate on the exchange rate. The higher domestic price level will reduce the real money stock, inducing a decline in real aggregate demand for goods, including imports. The exchange rate will appreciate in response to the resulting trade surplus. Only at this point will the movement in the exchange rate operate to offset the impact of the rise in world prices on domestic prices. While this income effect is powerful, most studies suggest that it requires a year or more to unfold. In addition, it operates only after the higher world price is passed through to higher domestic prices.

If nothing else happened, the unusual rise in domestic prices would be temporary. A trade surplus would eventually emerge, and the exchange rate would appreciate to reduce the domestic relative price of traded goods to nontraded goods. However, this result will not occur if there is an induced increase in money wages during the period when domestic prices are higher. Higher money wages will shift the aggregate supply curve upward, in the sense that for each level of output, the unit cost of production or supply price will be higher. The resulting equilibrium of aggregate demand and supply will be at a lower level of real output and a higher level of prices than would be expected from domestic monetary policy alone. In this case the relative price of traded and nontraded goods is reestablished by a rise in nontraded goods prices.

Thus expansionary policies in the rest of the world[5] can lead to both a higher inflation rate

and a higher unemployment rate in the U.S. than would have otherwise occurred. By the same token, when other countries stop following expansionary policies, the U.S. inflation rate will decline to a level consistent with strictly domestic demand and supply considerations. The deceleration of traded-goods prices will reduce domestic inflation. Then, with a given aggregate demand, real income will rise, leading to an increase in real demand for output and a decline in unemployment.

This explanation of the interaction between world and domestic stabilization policies helps to reconcile a number of apparently conflicting explanations of the current inflation. It provides a method to link the traditional aggregate-demand analysis with both world-monetary and cost-push explanations of inflation, along the following lines.

(1) Domestic monetary and fiscal policies explain shifts in nominal aggregate demand if there is a stable relationship between nominal monetary and fiscal policies and nominal income. However, the split between prices and output cannot be explained by aggregate-demand analysis alone, but must also take into account the shifts in aggregate supply.

(2) The rest of the world's monetary policies can explain the process whereby inflation in internationally traded goods directly (if temporarily) adds to domestic inflation, and thus can explain how the Phillips curve, which relates inflation to output (or unemployment), can break down under certain circumstances.

(3) The response of domestic wages to domestic inflationary pressures (which can be viewed as a cost-push element) determines the extent to which world inflation is permanently or only temporarily translated into domestic inflation.

Four empirical propositions underlie this analysis.

1. The aggregate of stabilization (largely monetary) policies of the major industrial countries determines the prices of internationally traded goods.

2. The domestic price index (which is a weighted average of traded and non-traded goods prices) responds to both domestic and world monetary-policy actions.

3. The permanency of the impact of world prices on domestic prices depends upon the wage response to increases in domestic prices.

4. Domestic monetary and fiscal policies determine domestic aggregate demand but not the split between prices and output.

We shall now proceed to investigate the validity of each of these propositions.

II. Testing the Model

Standard regression techniques were used to estimate the functional relationships implied by the propositions developed in Section I. The source for all raw data, except where otherwise noted, was *International Financial Statistics* published by the International Monetary Fund. The data covered the period 1960.2 through 1975.3, which included a period of fixed exchange rates until 1973.1 and largely floating rates thereafter.

All equations were estimated in quarterly percentage-change format. This should be kept in mind in evaluating the quality of the statistical results. With this type of computation, the percent of explained variance (R^2) will be in the 40-to-80 percent range rather than the 90-to-99 percent range common to equations estimated in level form. By using change rather than level data, we omit the variance to be explained by trend (thus reducing R^2), leaving only the cyclical and random component. Actually the random component is magnified, because the change data add the random element in the two adjacent level observations. As the equation is not expected to explain random movement, this further reduces the R^2. The superior measure of "good fit" in this case is the standard error (SE) which has the same meaning in both level and change form.

World Inflation and World Money

Our key hypothesis states that the price level

of internationally traded goods is a positive function of the nominal world money supply, which serves as a summary measure of the world's monetary stabilization policies. To test our hypothesis, we regress percentage changes in world prices on percentage changes in nominal world money.

The world price level is defined empirically to be the index of export prices of industrial countries expressed in U.S. dollars. There are several reasons for this definition. Since industrial countries predominate in world trade, they collectively determine the price level of internationally traded goods and therefore the world inflation rate. Secondly, data for industrial countries are the most complete and most reliable data available. Finally, a definition in terms of U.S. dollars removes the need to introduce the exchange rate explicitly into the empirical analysis, although the measure of world prices will obviously be influenced by exchange-rate movements.

The world money supply is defined to be the weighted average of the money supplies of ten major industrial countries. The money supply of each individual country is defined in terms of M_1, currency in circulation plus demand deposits. To convert different M_1 values into a common denominator, quarter-to-quarter rates of change are computed and a weighted sum of the changes calculated for each quarter. The weights represent each country's proportionate share in 1975 of the total trade of industrial countries.[6] These weights are adopted because, in view of the distinction between traded and non-traded goods, the impact of domestic demand-management policies on world prices will depend on the extent to which the country engages in trade.

A second-degree polynominal distributed-lag equation was estimated, linking quarterly percentage changes of world prices with quarterly percentage changes of world money supply. World money supply was lagged over 12 quarters. The results are summarized below (t-statistics in parenthesis).

$$\Delta \text{ Log } Pw_t = \underset{(3.9)}{-27.1} + \sum_{(5.1)}^{12} 3.59 \; \Delta \text{ Log } Mw_{t-12}$$

R^2/SE .40/9.49 DW/DF 1.53/48

Δ Log Pw = Percent change in international traded goods prices, measured by export prices of industrial countries.

Δ Log Mw = Percent change in world money supply, measured by weighted average percent change of M_1 in 10 industrial countries.

The Durbin-Watson statistic indicates the presence of serial correlation, which suggests that an important explanatory variable may have been omitted from the estimation. We hypothesized that world prices would depend positively on nominal world money supply and negatively on real world income or output, but we do not have a suitable proxy for the latter variable.

In view of the unusually large quarterly variation in our measure of international prices, the predicted value of world prices differed substantially from the actual value on a quarter-to-quarter basis. For the period from 1973.3 to 1974.3, for example, errors ranged from a high of 32 percent to a low of 4 percent.

Period	Actual Value	Predicted Value	Error
1973.3	41	27	−14
1973.4	6	26	+20
1974.1	17	24	+ 7
1974.2	52	20	−32
1974.3	14	18	+ 4
Average	26	23	− 3

However, the average rate of increase in international prices over this period was 26 percent, and the equation performed reasonably well by predicting an inflation rate which averaged 23 percent over the period. Thus, the average error for the total of the five quarters was only 3 percent—less than any quarter-to-quarter error because of the tendency of quarterly errors to offset each other.[7]

Our estimation indicates that a one-percent increase in world money-supply growth will, over a period of about three years, add 3½

percent to world price inflation, or an average of just under one percent a year. The very high negative constant term implies that a world money-supply growth rate of approximately 7½ percent is necessary to achieve rough world price stability (27.1/3.59 = 7.5). A world money-supply growth rate less than 7½ percent would lead to world price deflation. This agrees with what we observe empirically. Between 1960 and 1970 world money growth averaged between 7 and 8 percent, and during this period world prices remained relatively stable (Charts 2 and 3).

National Income and Domestic Monetary-Fiscal Policies

The model presented in Section I assumed that domestic aggregate demand, measured by nominal national income, is positively related to domestic nominal money supply and nominal government expenditure. If the nominal aggregate demand function is linear homogeneous, then aggregate demand in real terms, measured by real income, would be positively related to the real money stock and real government expenditures. We test these two relationships by estimating percentage changes in nominal (real) income as a second degree polynominal distributed lag of nominal (real) money stock and government expenditure. In each estimation, explanatory variables are lagged over four quarters.

$$\Delta \text{Log } Y_t = \underset{(1.23)}{2.28} + \underset{(3.85)}{\sum_{4}^{1.04}} \Delta \text{Log } M_{t-4} + \underset{(0.23)}{\sum_{4}^{0.3}} \Delta \text{Log } G$$

R^2/SE .34/3.17 DW/DF 1.99/46

$$\Delta \text{Log } Y^*_t = \underset{(5.18)}{2.52} + \underset{(6.92)}{\sum_{4}^{0.97}} \Delta \text{Log } M^*_{t-4} + \underset{(0.36)}{\sum_{4}^{0.04}} \Delta \text{Log } G^*$$

R^2/SE .60/2.81 DW/DF 1.97/46

Δ Log Y = percent change in nominal income, measured by GNP in current dollars

Δ Log M = percent change in money supply, measured by M_1

Δ Log G = percent change in government expenditures in current dollars

An asterisk (*) indicates a real variable, defined by dividing the nominal variable by the GNP price deflator.

When the equation is estimated in nominal form, the sum of coefficients on nominal money supply is statistically significant. The sum of coefficients on government expenditure has the right sign but its t-statistic is insignificant; however, the inclusion of this variable improves the overall fit of the equation.[8] Only 34 percent of the observed variance of nominal income is explained by the equation. However, as income is measured on a quarter-to-quarter basis, the "random element" is magnified relative to the cyclical element, thus reducing the amount of total variance which the independent variables are expected to explain. The relatively low standard error (around three percent) indicates that the fit is reasonably good, and the fact that the Durbin-Watson statistic is close to two in value suggests that all the systematic movement in income has been accounted for.

When the equation is estimated in the real form, the coefficients remain approximately the same (supporting the hypothesis of homogeneity) but their statistical significance increases. The equation explains 60 percent of the variance in real aggregate demand, and the standard error of the estimates is slightly lower than in the nominal version. Dividing the equation through by a common price index which exhibits a large systematic variation increases the percentage of total variance which is systematic and reduces the percentage which is random. The fit of the equation improves as a result.

Our estimates indicate that income is approximately proportional to the money supply. That is, a one-percent increase in money supply leads to about a one-percent increase in aggregate demand. The factor of proportionality (income velocity) is approximately 2.5 whether the equation is estimated in real or in nominal form. Moreover, the relatively short lag with which changes in money-supply growth influence the growth of aggregate demand, indicates that the demand side of the economy adjusts very quickly, i.e. the economy moves along the aggregate-demand curve rather than off it.

The assumption of unit elasticity for the aggregate-demand curve implies that nominal

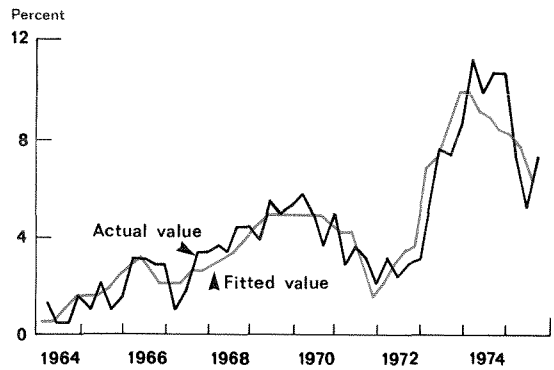
income will be constant at any point along a given demand curve. In other words, nominal income cannot change unless there is an underlying shift in the demand curve. Thus we may interpret our estimation of aggregate demand in nominal form as a measure of the shift in the aggregate-demand curve resulting from changes in domestic monetary-fiscal policies. By the same token, we interpret our estimation of the aggregate-demand equation in real form as a measurement of movements along the demand curve resulting from a change in the real money stock, with the nominal money stock held constant. To put it another way, an increase in the price level will decrease real money supply, inducing a decrease in aggregate demand for real goods, i.e., a movement along the demand curve. This interpretation, which is consistent with the evidence, allows us to distinguish *shifts in* the aggregate demand curve from *movements along* the curve. This will prove helpful in Section III, because it will allow us to sidestep the assumption of a stable Phillips curve in analyzing the trade-off between inflation and unemployment.

World and Domestic Monetary Policies and the Domestic Price Level

In Section I, we argued that the domestic price level could be influenced by monetary policy in the rest of the world as well as by domestic stabilization policies. Two alternative reduced-form tests can be applied to confirm this proposition. The common independent variable in each of these tests is the domestic money stock. This variable measures the impact of domestic stabilization action, and its inclusion is based on the proposition that inflation is in the long run a monetary phenomenon. The other influence on domestic inflation (as postulated in Section I) is world money growth, operating through the prices of internationally traded goods. This influence can be estimated either by adding world money directly as an independent variable affecting domestic prices, or by adding internationally traded goods prices to the domestic price equation. Both approaches were tested and gave roughly the same results. Only the latter version is reported below (Chart 1).

Chart 1

U.S. Inflation Rate



Source: Federal Reserve Bank of San Francisco—**IFS** data.

$$\Delta \text{Log CPI} = \underset{(3.9)}{-3.57} - \underset{(5.8)}{3.35}\ \text{DUM} + \underset{(7.4)}{\sum 1.49}\ \Delta \text{Log } M_{t-12} + \underset{(5.3)}{\sum 0.16}\ \Delta \text{Log } Pw_{t-4}$$

$$R^2/SE \quad .87/1.11$$
$$DW/DE \quad 1.66/41$$

The equation explains 87 percent of the variance in the U.S. inflation rate. For every one-percent increase in the U.S. money stock (M_1) over the current and twelve past quarters, the U.S. inflation rate (CPI) will increase by 1.5 percent. For every one-percent increase in international inflation over the past four quarters, the U.S. inflation rate will increase by .16 percent. This lag reflects the time delay that is typically observed between changes in wholesale prices (by which international prices are measured) and changes in retail prices (by which domestic prices are measured).

A dummy variable (DUM) was added to the equation to account for Phases I and II of the price-control period (August 15, 1971 to December 1972). Our estimate suggests that, as a result of controls, the annual U.S. inflation rate was 3.3 percent lower over the 5½-quarter period than would otherwise have been the case. Removal of controls probably pushed up

the U.S. inflation rate in following periods, but this is not incorporated in our equation because of timing problems. The adjustment did not necessarily have to occur immediately after the end of Phase II controls. Phase III lasted through 1973, and market conditions may have caused the adjustment to extend over an even longer period. The error pattern in the estimated equation (as shown in Chart 1) suggests that much of the adjustment occurred in 1974.

This equation was also estimated for the wholesale price index. The results are summarized below.

$$\Delta \text{Log WPI} = \underset{(3.0)}{7.0} - \underset{(1.6)}{3.4}\text{DUM} + \sum_{(3.7)}^{8} 1.98\ \Delta \text{ Log } M_{t-8}$$

$$+ \sum_{(4.8)}^{2} .41\ \Delta \text{ LogPw}_{t-2}$$

$$\bar{R}^2/\overline{SE} \quad .63/4.15$$
$$DW/DF \quad 1.88/43$$

The results differ from those in the CPI equation in ways one would expect. The time lag between changes in the money stock and world prices and changes in the WPI are shorter, reflecting the fact that wholesale prices tend to move earlier in the cycle than do retail prices. The coefficient in world prices was much larger (.41 vs. .16) because the weight of internationally traded goods is much larger in the WPI than in the CPI.

Effect of Prices on Wages

In Section 1 and more explicitly in Appendix I, the responsiveness of exchange rates to differential (U.S. and world) inflation rates is related to the speed and completeness of the response of nominal wages to changes in prices. If this adjustment occurs quickly and completely—i.e. if the short run wage-price elasticity is unity—then the higher domestic prices induced by higher international prices will be permanent. The higher supply price of output will prevent an export surplus from developing and will frustrate any exchange-rate appreciation. Without such appreciation, there will be no offset to world inflation and the higher domestic prices will be permanent.

A very simple test was conducted to measure the influence of prices on wages, the former being measured by the CPI and the latter by an hourly-earnings index. If wages rise at the average rate of productivity plus some proportion of the rate of domestic inflation—and if we assume, as a first approximation, that average productivity growth is constant—then we can relate a distributed lag of past price changes to current wage changes. The number of lag quarters required for the coefficient relating prices to wages to approximate unity is crucial. The shorter the lag, the larger and more permanent will be the effect of world prices on domestic prices. The results for the U.S. are given below.

$$\Delta \text{log } W = \underset{(2.1)}{1.75} + \sum_{(5.0)}^{12} .90\ \Delta \text{ log Pus}_{t-12}$$

$$\bar{R}^2/\overline{SE} \quad .45/2.3$$
$$DW/DE \quad 2.40/43$$

After 12 quarters (3 years), 90 percent of the original past inflation is reflected in U.S. wages. Longer lags do not increase the size of the coefficient. About 60 percent of the impact is achieved in the first year, and 80 percent by the end of the second year.

The critical period for the impact of domestic inflation on domestic wages is one year because, as discussed above, this is the length of the period over which aggregate-demand adjustment takes place. Over a longer period, income effects can create an export surplus, thus causing the exchange rate to appreciate and to offset the effects of world inflation. The share of internationally traded goods in the CPI market basket is approximately 25 percent—60 percent of which is .15, a number very close to the .16 coefficient on world prices in our estimated equation explaining domestic inflation. Similarly, 60 percent of the share of internationally traded goods prices in the WPI is .30, which is somewhat smaller than the estimated coefficient of .41.

Summary of Empirical Findings

(1) World money supply, as a summary measure of world monetary stabilization poli-

cies, is an important factor explaining the price of internationally traded goods. Our estimates indicate that over a period of three years every one-percent increase in world money supply growth in excess of 7.5 percent will add 3½ percent to international inflation. This magnified effect of world money supply on world prices provides support to the hypothesis that a simultaneous expansion of aggregate demand by industrial countries, resulting from synchronized money expansion, leads to a more than proportional increase in world prices. The implications of the hypothesis are explored in Section III.

(2) Domestic monetary and fiscal policy is an important determinant of domestic aggregate demand, with a relatively short lag of about one year. An increase in domestic money supply growth will increase domestic aggregate demand proportionately. On the other hand, changes in the real money stock will induce a movement along a given aggregate demand schedule of unit elasticity. An increase in prices, from whatever source, will decrease the real money stock and lead to a proportional reduction in the demand for real output after about one year.

(3) Both domestic money supply and world inflation exert significant influences on the domestic rate of inflation, although the importance of domestic monetary policy is proportionately larger. A one - percent increase in world inflation will, over a period of one year, add a .16-percent increase to the domestic CPI and .41 percent to the domestic WPI. In contrast, a one-percent domestic monetary expansion will, over a period of two years, add 1.5 percent to the domestic CPI and 2.0 percent to the WPI.

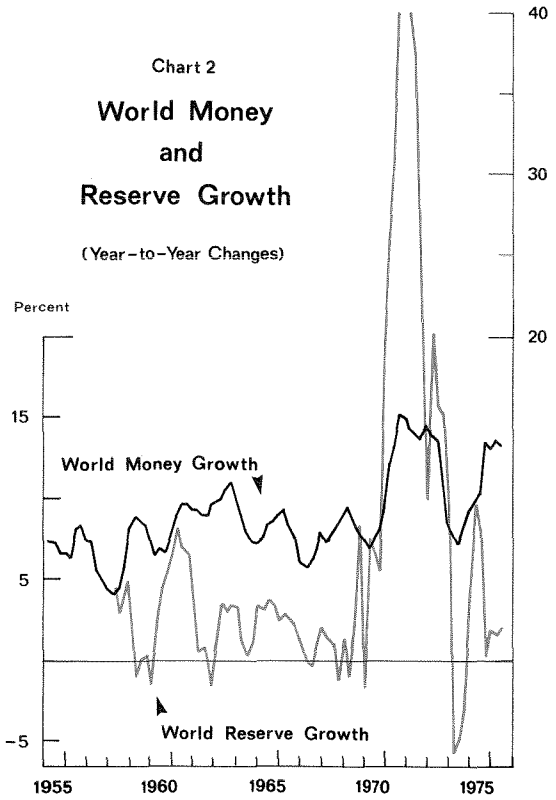
(4) Wages will respond to domestic inflation over a relatively long three-year period. However, in the critical first year—when it influences the extent of the impact of world inflation on domestic inflation—about 60 percent of the higher CPI will be reflected in higher wages.

III. Implications for the Future

The previous discussion suggests that expansionary monetary policies in the rest of the world can have perverse effects on a domestic economy. When one country acts in relative isolation to control domestic aggregate demand, it can, at least in the intermediate period of a business cycle, trade along the Phillips curve and gain an increase in output at the expense of an increase in the inflation rate. However, when many countries are operating in concert (whether by design or accident), the net effect on a domestic economy could be a higher inflation rate with little or no favorable impact on output or employment.

During the 1950's and 60's, industrial countries largely conducted their stabilization policies in isolation from others, reflecting their lack of synchronization of policies. Typically, when one country was in an easy-money phase, other countries were in a tight-money phase of the cycle. The net effect was relative stability in the growth of world aggregate demand.

The environment of the early 1970's was different. Most major industrial countries followed tight and easy monetary polices in a uniform pattern. This increased synchronization of monetary policy is illustrated in Chart 1, which shows the weighted-average money growth rate of 10 major industrial countries over the 1955-76 period. In the period through 1970, the world money stock grew at a relatively stable rate in the 7-8 percent range. While in individual countries money growth showed strong cyclical patterns—because they were in different phases of the cycle—the average money growth was relatively stable. Only in the 1970's was this pattern of stability broken. From 1971 through early 1973, world money stock accelerated to a 13-percent growth rate, but then it decelerated in 1973-74 to a 9-percent rate. Finally, in 1975 through mid-1976, it reaccelerated to approximately a 12-percent growth rate. This instability resulted from the synchronized pattern of monetary ex-



Source: Federal Reserve Bank of San Francisco—IFS data.

pansion of industrial countries during the 1970's.

Why Synchronized Monetary Cycles?

The acceleration in world money growth in the 1970-75 period was associated with the breakdown of the Bretton Woods fixed exchange-rate system.[9] Previously, countries other than the U.S. maintained the international value of their national currencies at a fixed rate by buying and selling dollars in the foreign-exchange market. This policy worked well for most countries in the period through the mid-1960's. But then the U.S. inflation rate accelerated, and the resulting balance-of-payments deficit increased the supply of dollars to the rest of the world relative to demand. The problem came to a head in August 1971, when the U.S. suspended convertibility of the dollar into gold for foreign central banks. While this event led to an exchange-rate adjustment (the so-called Smithsonian agreement in December 1971), most central banks still attempted to maintain fixed values of their national currency in terms of dollars. However, this policy required buying an increasingly large amount of dollar assets in response to the widespread attempts by private citizens (both here and abroad) to shift their portfolios out of dollars—first into the stronger currencies like the German mark and Japanese yen, and eventually into the currencies of almost all other industrial countries.

The international reserves of industrial countries grew at a relatively stable 7-percent rate from 1958 to 1970, but from that point to early 1973, as foreign central banks monetized dollar inflows, they expanded their holdings both of international reserves and of domestic money (Chart 2). Yet when most central banks collectively abandoned the fixed-rate regime in March 1973, there was an abrupt deceleration in the growth of international-reserve holdings. Within a short time, central banks returned the growth rates of their domestic money stocks to more normal levels. However, just as the acceleration in money led to a worldwide business cycle boom and inflation, so deceleration in money led to a worldwide business recession and a rise in unemployment to the highest levels since the 1930's.

Central banks have usually responded in the past to high unemployment rates by following an easy monetary policy, especially when there were no balance-of-payments constraints to interfere with that goal.[10] The same was true in 1975-76, as most countries reacted to high unemployment with a simultaneous domestic monetary expansion which then brought about another expansion in the world money stock.

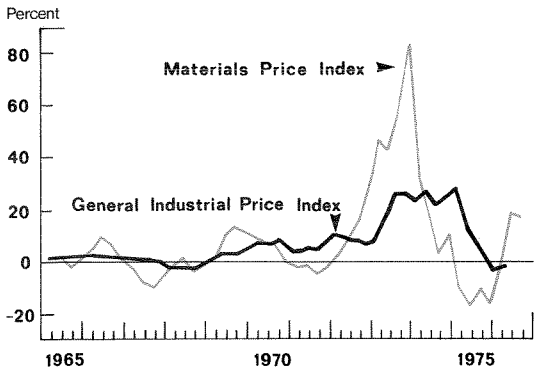
Consequences of a Synchronized Cycle

This instability in the average growth of world money was accompanied, with an average lag of about eight quarters, by greater instability in the prices of internationally traded goods. This relationship is seen in Chart 3. The broad-gauge measure of international prices was relatively stable in the 1950's and '60's, accelerated sharply in late 1972 and early

Chart 3

World Materials and General Industrial Prices

(Year-to-Year Changes)



Source: Materials Price: **The Economist** commodity price ($) index.
General Industrial Price: **IFS** index of export prices of industrial countries.

1973, decelerated sharply in 1975, and continued low in the first half of 1976.

Meanwhile, sensitive materials prices tended to move ahead of the general body of international prices. Materials prices generally move in a more dramatic fashion than the prices of other goods, reflecting the relatively inelastic short-run demand and supply for such goods. This greater price variance can, at times, give misleading signals as to the future course of other international prices. For example, sensitive materials prices increased 15 percent between late 1968 and late 1969, but were not followed by an equally substantial rise in other international prices. Eventually, the materials price increase was reversed. However, in 1972 this index provided a reliable leading indicator of a rise in the broader index of international prices—and in 1974 it foreshadowed the decline in general international prices. In each case the lead was about one year.

The current rise in materials prices raises the question of whether it is a prelude to another bout of international inflation or a random gyration soon to be reversed. The model developed here suggests that international inflation will, in fact, accelerate again in 1977. The reason is that the current rise in materials prices was preceded by a rise in the world money stock, as was the case in 1972, but not in 1968. If the lags between world money and international prices are stable, we would expect that a rise in prices of internationally traded goods will occur in 1977.

The duration of the rise in international prices depends upon the future growth in the world money stock. Given the lags in the system, however, a 10- to 14-percent rate of international price inflation in 1977 seems to be already determined by past monetary policies. This is in contrast with the negative rate of inflation in 1976 and the 26-percent inflation rate in 1974.

What do these international price developments imply for U.S. inflation in 1977? The model suggests that—contrary to general economic opinion—flexible exchange rates may *not* completely isolate a country from international inflation. The size of the inflation will depend upon the extent of the rise in internationally traded goods prices and upon the share of such goods in the domestic price index. On the basis of the estimates of Section II, the Wholesale Price Index (WPI) would rise 7 to 8 percent in 1977 versus a 4-percent annual rate in the first nine months of 1976. The Consumer Price Index (CPI) would rise 6 to 7 percent in 1977 versus a 5½ percent annual rate in the first nine months of 1976.

Compared to the 1973-74 experience, the impact of international inflation on U.S. inflation is expected to be relatively modest in 1977. However, the impact would be large by the standards of the 1950's and '60's, and could increase in later years. The table below summarizes the impact on U.S. prices of alternative world money growth rates.

U.S. Inflation Forecast
(Assume U.S. M_1 = 5 percent)

	World M_1 = 8%		World M_1 = 12%	
	CPI	WPI	CPI	WPI
1978	5.5	5.5	6.0	8.5
1979	4.5	3.0	6.0	8.5
1980	4.0	3.0	6.5	9.0

On the assumptions of a 5-percent growth in domestic M_1 and an 8-percent growth in world M_1 (the average of the 1960's) world prices would be stable and the U.S. inflation rate would be dominated by strictly domestic considerations. By the end of the decade, the CPI would rise at about a 4-percent rate and the WPI at about a 3-percent rate.[11] If world M_1 growth continues at 12 percent, then the longer-term trend in the U.S. CPI will be in the 6- to 6½-percent range and the WPI in the 8½- to 9-percent range.[12]

Conclusion

What implications can policymakers derive from this analysis? One possible implication is that policymakers should respond to imported inflation by expanding domestic aggregate demand sufficiently so that the higher prices will not induce a fall in real output. Even if a country cannot control its domestic inflation rate, it can at least control its domestic unemployment rate with appropriately stimulative stabilization policy.

This policy inference, however, is incomplete and therefore misleading. While it may be desirable for any one country to follow domestic stabilization policies to offset the effects of imported inflation, if all countries followed such a policy simultaneously the result would be explosive inflation. The expansion in world money supply would lead to an even larger world business-cycle expansion and pressures on internationally traded goods prices—and therefore to higher rates of imported inflation. To avoid the unemployment consequences predicted by the Phillips curve would require even further monetary ease, which on the aggregate of all countries would further aggravate the inflation rate.

In this context we have a "game theory" solution. If any one country took action in isolation it could achieve an unambiguous improvement in its situation by following an easy monetary policy. However, if all countries engaged in that practice, all would be worse off than before, in the sense that they would experience a higher rate of inflation with the same rate of unemployment. Thus, the optimal stabilization strategy in this world context would be for all governments to agree to follow moderate monetary policies. While this course would prevent any country which acts alone from improving its unemployment rate as fast as might otherwise be the case, the world as a whole would experience a deceleration in inflation with a given unemployment rate.

This clearly suggests that in an interdependent world, with its close ties in real and financial markets, the degree of monetary independence expected under flexible exchange rates has been circumscribed in a significant way. This provides a rationale for increased international cooperation, along the lines attempted at the economic summit conferences in Puerto Rico in June of this year and at Rambouillet in November 1975.

FOOTNOTES

1. This argument was presented by one of the authors in another context in the Spring 1975 issue of the **Review.** See M. W. Keran "Toward an Explanation of Simultaneous Inflation-Recession."

2. This relationship may be derived from the monetary theory of the balance of payments, which states that world prices are determined by the stock equilibrium condition of equality between world demand and supply of money balances. The excess of the growth rate of nominal world money supply over the growth rate of real world money demand determines the world rate of inflation. H. J. Johnson, "The Monetary Approach to Balance-of-Payments Theory," **Journal of Financial and Quantitative Analysis,** March 1972, J. A. Frenkel and H. G. Johnson, eds., **The Monetary Approach to the Balance of Payments,** University of Toronto Press, 1976, and R. Dornbusch, "The Theory of Flexible Exchange Rate Regimes and Macroeconomic Policy," **Scandinavian Journal of Economics** (forthcoming).

3. This assumption contrasts with that of the monetary theory of the balance of payments. It may be justified as follows: In a world of flexible exchange rates, monetary independence is achieved automatically through the absence of central-bank intervention in the foreign-exchange market. In a world of fixed exchange rates, this is achieved by central banks imposing capital market controls to such an extent that domestic and foreign financial markets are independent of each other over the relevant period of analysis, i.e. the business cycle. It may be argued that the experience of the early 1970's makes this assumption unrealistic. However, we would argue that when loss of domestic monetary control became a significant problem, central banks took actions to retain their monetary independence by moving to a flexible-exchange rate regime in March 1973.

4. An alternative explanation is that real net exports do increase, but that this is offset by a disproportionate

change in import and export prices. The latter explanation is perhaps more realistic in the case of those developed countries which import raw materials and export finished products. Since raw materials have a relatively less elastic short-run supply response to changes in demand than do finished products, raw-material prices will rise before finished-product prices. The temporary adverse shift in the terms of trade could offset the real export surplus and leave the nominal trade balance temporarily unchanged.

5. More precisely, in the case being considered, world stabilization policies lead to an expansion of world aggregate demand which exceeds the expansion of domestic aggregate demand. This is the most relevant case in terms of the U.S. in the 1970's. For formal analysis of this, as well as of the reverse case, see Appendix I.

6. The countries and their respective weights are: Belgium (.060), Canada (.071), France (.108), Germany (.166), Italy (.074), Japan (.115), Netherlands (.071), Switzerland (.027), United Kingdom (.099), United States (.213). The weights do not sum to one due to rounding. The weights are derived from export and import trade shares in 1975.

7. These observations represent an extreme example of a fairly common phenomenon in estimating "change" equations where the random element is large. These equations are more successful in forecasting the average value of the dependent variable than in forecasting the individual quarters.

8. An F-test indicates that the improved fit gained from the inclusion of this variable is significant at the .05 level.

9. See M. Keran, "An Appropriate International Currency: Gold, Dollars, or SDR?," Federal Reserve Bank of St. Louis, **Review,** August 1972 (Reprint 78), and D. I. Meiselman, "Worldwide Inflation: A Monetarist View," **The Phenomenon of Worldwide Inflation,** American Enterprise Institute, 1975.

10. Balance-of-payments constraints were eased in late 1974 for two reasons: (1) most industrial nations had an historically high level of international reserves at that time, and (2) flexible exchange rates were seen as a device to avoid traditional balance-of-payments consequences of easy money.

11. The differential reflects the lower productivity growth in the service industries (which have a larger weight in the CPI) than in the goods industries (which have a higher weight in the WPI).

12. The differential is due to the CPI's lower international-trade component, which more than offsets the lower productivity growth in the service industries.

APPENDIX I

Stabilization Policy in a World Context

This appendix formalizes the model presented in Section I. Since this paper concentrates on monetary variables, the model is simplified by assuming that both domestic nominal government expenditure and real world income are constant. To further facilitate exposition, it is assumed that all goods are internationally traded, although this assumption does not alter qualitative results.

The model is summarized by a system of six equations in six unknowns:

$$Pw = \alpha_0 \, M_w^{\alpha} \qquad \alpha_0,\ \alpha>0 \tag{1}$$

$$P = EPw \tag{2}$$

$$Y = \beta_0 \, M \qquad \beta_0 > 0 \tag{3}$$

$$Q = \gamma_0 \left(P/W\right)^{\gamma} \qquad \gamma_0,\ \gamma>0 \tag{4}$$

$$PQ = Y \tag{5}$$

$$W = MAX\ \{\delta_0 P^{\delta},\ \delta_0\} \qquad \delta_0>0,\ 0\leq\delta\leq 1 \tag{6}$$

where Mw and M are exogenous world and domestic money supplies, respectively, Pw and P are world and domestic price levels, E is the exchange rate in domestic currency, Y is domestic nominal income, Q is real domestic output, and W is the nominal wage.

Equation (1) expresses the world price level as a positive function of world money supply. In Equation (2) world and domestic price levels are linked by the exchange rate due to goods arbitrage. Equation (3) states that nominal income is determined by domestic monetary policy. This specification implies that the elasticity of the aggregate demand curve is unity. Equation (4) expresses aggregate supply as a function of the price level relative to the nominal wage. This particular specification is based on the assumptions of an aggregate Cobb-Douglas production function and profit maximization by competitive firms. Equation (5) is implied by an assumption of flexible exchange rates. Abstracting from capital flows and central bank interventions, net exports must be zero, in which case domestic aggregate demand and supply are equal.* Finally, Equation (6) states that wages are flexible upward, rising with prices, but rigid downwards. The term δ_0 may be thought of as the initial wage level. As a result of downward wage rigidity, the labor market does not necessarily clear and output may vary over the short run.

Upon differentiating, substituting, and rearranging, we arrive at the following relationships (lower case letters are logarithmic differentials):

$$p = \frac{\gamma}{1+\gamma}\left(\frac{m}{\gamma} + w\right) \tag{7}$$

$$q = \frac{\gamma}{1+\gamma}\left(m - w\right) \tag{8}$$

$$e = p - p_w \tag{9}$$

*Under fixed exchange rates or a managed float, (5) is replaced by

$$PQ - Y = R \tag{5'}$$

where R is a reserve flow (a policy parameter). Since positive net exports add directly to income, equation (3) then becomes

$$Y = \beta_0 M + \beta_1 (PQ-Y) = \beta_0 M + \beta_1 R. \tag{3'}$$

$$p_w = \alpha m_w \quad (10)$$

$$w = \text{MAX}\ \{\delta p, o\} \quad (11)$$

Equations (7) and (8) indicate that domestic equilibrium price and output depend on domestic demand management policy, measured by nominal money growth, and also on nominal wage movements. The former causes a shift in the aggregate demand curve and the latter a shift in the aggregate supply curve.

We go on to consider the cases of first a simple domestic monetary expansion, and then a simultaneous domestic and world monetary expansion. Domestic and world money supplies have been assumed to be independent of each other.

Domestic Monetary Expansion

Since domestic monetary expansion places upward pressure on the price level, Equation (11) becomes

$$w = \delta p \quad (11')$$

Substituting (11') into (7) and (8), and solving yields for $m > o$:

$$p = \frac{m}{1+\gamma(1-\delta)} > 0 \quad (12)$$

$$q = \left(\frac{\gamma(1-\delta)}{1+\gamma(1-\delta)}\right) m \geq o \quad (13)$$

$$e = p \quad (14)$$

A domestic monetary expansion will have a positive inflation effect and a non-negative output effect. Domestic inflation is offset by proportional exchange rate depreciation. An interesting result here is that the closer the wage-price elasticity (δ) is to unity, the higher will be the inflation-depreciation effect and the lower will be the real output effect. In the limiting case where, $\delta = 1$ the output effect is zero.

A short-run relationship between the change in output and inflation is derived by combining (12) and (13) to yield:

$$q = (1-\delta)\ \gamma\ p \quad (15)$$

As long as wages do not completely adjust to prices $(0 \leq \delta < 1)$ there is a short-run trade-off between inflation and output growth. The slope of this trade-off is related positively to γ , labor's share in output.

Simultaneous Domestic and World Monetary Expansion

Now consider a simultaneous monetary expansion at both the domestic and world level. If equations (7) - (11) were solved simultaneously for all endogenous variables, the solution would be exactly the same as the case of a simple domestic monetary expansion, except that the exchange rate would depreciate less or possibly even appreciate due to world price inflation.

$$e = p - p_w = \frac{m}{1+\gamma(1-\delta)} - \alpha m_w \quad (14')$$

If, on the other hand, endogenous variables adjust at different speeds to shocks to the system, then these conclusions could be altered. In particular, suppose that wages and prices adjust quickly relative to the exchange rate.* Then world price inflation would have no initial impact on the exchange rate, but would be translated into proportionately higher domestic prices through (2) and then higher wages through (6). The initial domestic price inflation is a disequilibrium phenomenon and will eventually be partially offset by exchange-rate appreciation as the real sector begins to adjust to the price rise. Wages, however, will remain permanently higher because of the assumption of downward rigidity.

The extent of wage inflation in the economy will therefore depend on the interaction of world and domestic monetary policies. If world price inflation exceeds the domestic inflation rate warranted by domestic monetary policy, then wage inflation will be proportional to world price inflation. If, on the other hand, the world inflation rate is less than or equal to that warranted by domestic policy, then wage inflation will be proportional to domestic price inflation. World price inflation is given by equation (10), while domestic inflation warranted by domestic monetary policy is given by equation (12). The appropriate wage adjustment equation for a simultaneous domestic and world monetary expansion is therefore

$$w = \text{MAX}\ \{\delta\alpha m_w, \frac{\delta m}{1+\gamma(1-\delta)}\}\ ,\ \text{for}\ m_w,\ m \geq o \quad (16)$$

Let $\theta = 1/(\alpha+\alpha\gamma(1-\delta))$. . In the case where $m_w \leq \theta m$ world inflation is less than or equal to that warranted by domestic policy—equilibrium is defined by equations (12), (13), and (14'). The more interesting case is where $m_w > \theta m$ world inflation exceeds that warranted by domestic policy. Then combining (7)-(10) and (16) yields for $m_w,\ m > o$.

$$p = \frac{\gamma}{1+\gamma}\left(\frac{m}{\gamma} + \delta\alpha m_w\right) > o \quad (17)$$

$$q = \frac{\gamma}{1+\gamma}\left(m - \delta\alpha m_w\right) \quad (18)$$

*For an explanation of why the exchange rate might be sticky, see Section I, p. 4.

$$e = \frac{1}{1+\gamma}\left(m - \frac{m_w}{\theta}\right) < 0 \qquad (19)$$

Domestic inflation is higher and domestic output expansion is lower than in the case of a simple monetary expansion, or in the case where $m_w \leq \theta m$. The exchange rate will unambiguously appreciate. If the wage-price elasticity (δ) is sufficiently close to unity, the output effect will be negative.

APPENDIX II

Evidence from Other Countries: The Case of the U.K. and Germany

The model developed above suggests that the impact of international inflation on the domestic price level depends upon (1) the share of internationally traded goods in the domestic price index and (2) the responsiveness of domestic wages to domestic prices. Both influences work to increase the impact of international inflation on domestic prices.[1]

Wages and Prices

In the body of this article the response of wages to prices was estimated using U.S. data. The results suggest that over a period of 3 years every 1-percent increase in consumer prices leads to a .9-percent increase in wages. Sixty percent of the wage increase occurs in the first year. Similar equations are estimated for the U.K. and Germany. Nominal wages are determined primarily by the growth in labor productivity and the rise in consumer prices. If productivity grows at a relatively constant rate, then an equation estimating changes in wages in response to changes in prices would as a first-order approximation give information on both sets of determinants. The constant term would show the growth in wages with respect to productivity, and the coefficient on the price variable would show the growth in nominal wages with respect to the rate of inflation.

On the basis of postwar economic history, one would expect that the coefficient relating wages to prices to be larger in the case of the U.K. than in the case of Germany. In the U.K. the strong labor-union movement has exercised its power systematically to protect the real wages of its members from the effects of inflation.[2] In Germany, on the other hand, the labor unions have been less militant. While German wages have risen faster than German prices in the last 15 years, labor unions apparently have not tried to use their power to vary wages substantially in response to inflation. The estimated equations for the U.K. and Germany are given below.[3]

U.K.

$$\Delta \log W = \underset{(1.4)}{3.0} + \sum_{2}^{} \underset{(5.9)}{1.01}\ \Delta \log P_{t-2}$$

R^2/SE .39/7.49
DW/DE 1.67/45

Germany

$$\Delta \log W = \underset{(4.3)}{8.3} + \sum_{8}^{} \underset{(.04)}{.018}\ \Delta \log P_{t-8}$$

R^2/DE .13/5.55
DW/DE 1.99/42

These equations are estimated over the period 1960.2 to 1976.3. In the case of the U.K., it takes two quarters for the full effects of a rise in the domestic price level to be transmitted to nominal wages. When longer lags are estimated, the coefficient rises above unity. The minimum standard error for this equation is achieved with a lag of eight quarters and a coefficient value of 1.39. This implies that money wages in the U.K. respond on average by more than the rate of inflation.[4] For Germany the coefficient relating domestic inflation to domestic wage rates was insignificant for all lagged periods investigated. The result presented was the lagged pattern (t-8) with the minimum standard error.

These results suggest that international inflation is almost completely transmitted to U.K. prices, but that it has a much smaller impact on German domestic prices. We can confirm this conjecture directly by estimating domestic price equations for both countries.

U.K.

$$\Delta \log CPI = \underset{(2.2)}{3.1} + \sum_{8}^{} \underset{(0.7)}{0.15}\ \Delta \log M_{t-8} + \sum_{4}^{} \underset{(5.5)}{.61}\ \Delta \log Pw_{t-4}$$

R^2/SE .65/4.76
DW/DE 2.10/38

Germany

$$\Delta \log CPI = \underset{(0.6)}{-1.0} + \sum_{12}^{} \underset{(2.4)}{.38}\ \Delta \log M_{t-12} + \sum_{4}^{} \underset{(3.6)}{.15}\ \Delta \log Pw_{t-4}$$

R^2/SE .38/2.44
DW/DE 1.61/42

The equation for each country is identical to the specification in the test for the U.S. inflation rate. For the U.K. the international inflation variable has a large and significant coefficient. For every 1-percent increase in international inflation (measured in a dollar-denominated index) over the previous four quarters, U.K. CPI inflation will increase .61 percent. In the German case a 1-per-

cent increase in international prices leads to a .15 percent increase in domestic prices. Germany is almost as open an economy as the U.K. but its world inflation coefficient is much lower (.15 versus .61). A rough measure of the share of international goods in a country is the share of exports plus imports to GNP. For 1975 the share for Germany was 54 percent, and for the U.K. 56 percent.

These results are consistent with the wage equations presented above. Since German wages are less sensitive to domestic inflation than U.K. wages, a such smaller proportion of the international inflation will "stick" in Germany.

APPENDIX FOOTNOTES

1. A third influence is the speed of response of real income to changes in real money balances. Earlier work by one of the authors suggests that such response is relatively uniform across countries in the range of one to one and a half years. M. W. Keran, "Selecting a Monetary Indicator," Federal Reserve Bank of St. Louis, September 1970 (Reprint No. 59).
2. Sir John Hicks, "What's Wrong with Monetarism," *Lloyds Bank Review*, October 1975.
3. P is the consumer price index for both countries. W is an index of average monthly wages for the U.K. and an index of hourly earnings for Germany. International Monetary Fund, *International Financial Statistics* (computer tape).
4. This is explained partially by institutional factors. During 1973-74 the combination of domestic price control and threshold wage agreements in a world inflationary situation caused real wages to rise on trend. For a fuller explanation, see Marcus H. Muller, "Can a Rise in Import Prices be Inflationary and Deflationary? Economists and the U.K. Inflation, 1973-74" *American Economic Review*, September 1976.