

# The International Transmission of Inflation<sup>1</sup>

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The world is passing through the third great inflation of the 20th century. As can be seen from Figure 1, which charts an index of "world" market prices of 28 basic commodities, the first two severe inflations of the century were closely associated with the world wars and their aftermath (including the Korean Conflict after World War II), while the current sharp inflation is basically a peacetime phenomenon, beginning well after the 1965-68 escalation of the war in Vietnam.

Figures 2 and 3 testify to the pervasiveness of the inflation. The fact that inflation has accelerated so widely throughout the world raises the question whether one or a few countries are the source, generating and transmitting inflationary pressure to the rest of the world, or whether the geographic sources are virtually as widespread as the manifestation. The primary aim of this paper is to investigate the transmission of inflation between countries and, in particular, whether exchange-rate flexibility insulates a country from external inflationary pressure. It is not our purpose to inquire into the causes of inflation at its geographic sources.<sup>2</sup> By "inflation" is meant a rise of prices generally, not an increase in a particular price or group of prices such as might result from changes in tastes, in techniques, or in availabilities of particular resources.

## Interdependence and Inflation

The relatively poor grain harvests of 1972 and 1974<sup>3</sup> and the quadrupling of the crude oil price between 1973 and 1974 have led, at least within the more advanced countries, to a heightened sense of economic interdependence and to the view that inflation may be transmitted among nations more readily now than in the past when the world economy presumably was less fully integrated.

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<sup>1</sup>The views in this paper are not necessarily those of the Federal Reserve Bank of Boston. Cynthia Peters and Gary Tsuyuki were research assistants for this project. Parts of this paper draw upon Norman S. Fieleke, "The Worldwide Inflation," *New England Economic Review*, May/June 1976.

<sup>2</sup>For a brief discussion of some possible causes, see *ibid.*, pp. 3-9.

<sup>3</sup>In fact the declines in the production of grain amounted to only about 2 percent in 1972 and 3 percent in 1974, with an increase of 11 percent intervening in 1973; see Fieleke, "The Worldwide Inflation," p. 4.

Not only does it seem plausible that increased integration and increased transmission should go hand-in-hand, but — with fixed-exchange rates, presumably — an increase in integration is often *defined* essentially as an increase in transmission, or as an increase in the ease with which market forces establish uniformity of price movements in different countries for any particular good.<sup>4</sup> Accordingly, the degree of economic integration among countries is sometimes roughly measured by the degree of correspondence between their price movements for identical products; but it is also frequently measured by some ratio of trade between the countries to their total output.<sup>5</sup> While, as the saying goes, “Everyone is free to make his own definitions,” it seems that a ratio of trade to output is a much better index of the extent to which two economies are integrated, in the sense of being interdependent or woven together,<sup>6</sup> than is the degree of correspondence between their price movements, and that correspondence between price movements is the better measure of the extent to which inflation can be transmitted, or of the “openness” of the two economies to each other’s inflation.

To illustrate this point, imagine that there are virtually no transportation costs or governmental barriers to trade between two countries, which maintain a fixed-exchange rate between their currencies and are highly open to the transmission of economic disturbances from each other. In the absence of such disturbances, however, there might be very little commerce between the two because of close similarity in their underlying tastes, techniques, and resource bases; the “interdependence” of two such economies does not run very deep, even though their price movements correspond closely. On the other hand, imagine two other countries which also maintain a fixed-exchange rate but which erect numerous barriers to trade and payments that prevent a close correspondence between price movements for many commodities. In spite of the barriers, these countries might carry on a significant trade in relation to their total output because of substantial differences in tastes, techniques, or resource bases. These two countries are more interdependent than the first two; the interruption of commerce between them would be more disruptive.

If this distinction between interdependence and openness is accepted, the issue raised in the opening sentence of this section is not tautological but is an interesting question for research, because growing interdependence may or may not be accompanied by increasing openness and fuller transmission of inflation.<sup>7</sup> For example, two countries which had always been highly open to

<sup>4</sup>Cf. Fritz Machlup, *A History of Thought on Economic Integration* (New York: Columbia University Press, 1977), pp. 18-21.

<sup>5</sup>For example, see Walter S. Salant, “International Transmission of Inflation,” in *Worldwide Inflation: Theory and Recent Experience*, ed. by Lawrence B. Krause and Walter S. Salant (Washington, D.C.: The Brookings Institution, 1977), pp. 175-79.

<sup>6</sup>A geopolitical evaluation of interdependence would take into account not only trade in relation to output but strategic availability of substitutes for imported key raw materials, etc. Such matters are beyond the scope of this paper.

<sup>7</sup>As interdependence approached its limit, i.e., as a country’s exports rose to absorb nearly all its output, the degree of openness would be approximately measured by the degree of interdependence. In my 1976 paper, “The Worldwide Inflation,” “openness” and “interdependence” were used interchangeably.

Figure 1  
**COMMODITY PRICES, 1900-77**  
(Yearly Averages; 1845-50 = 100)

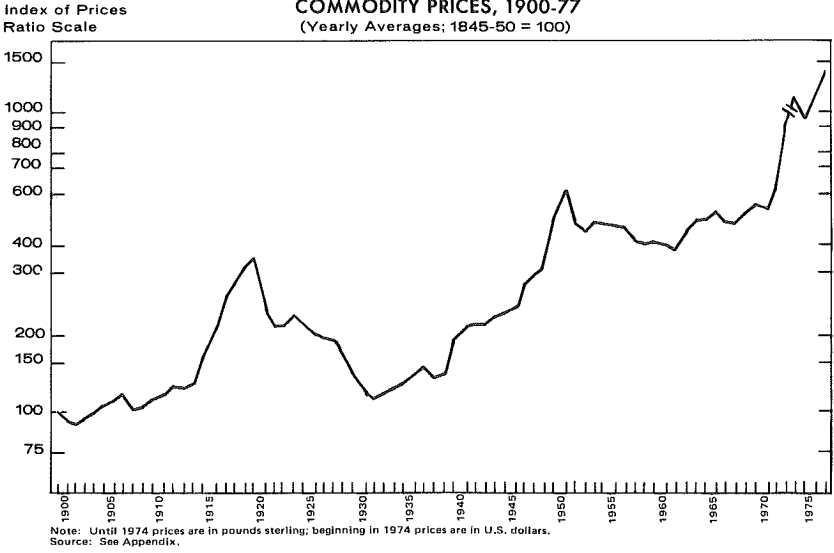


Figure 2  
**CONSUMER PRICES IN SELECTED WORLD AREAS, 1970-77**  
(Yearly Averages; 1970 = 100)

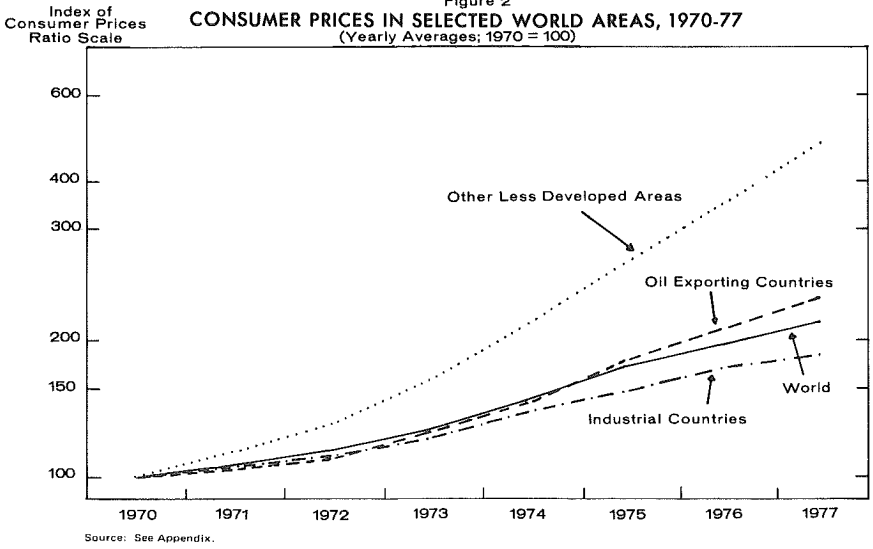
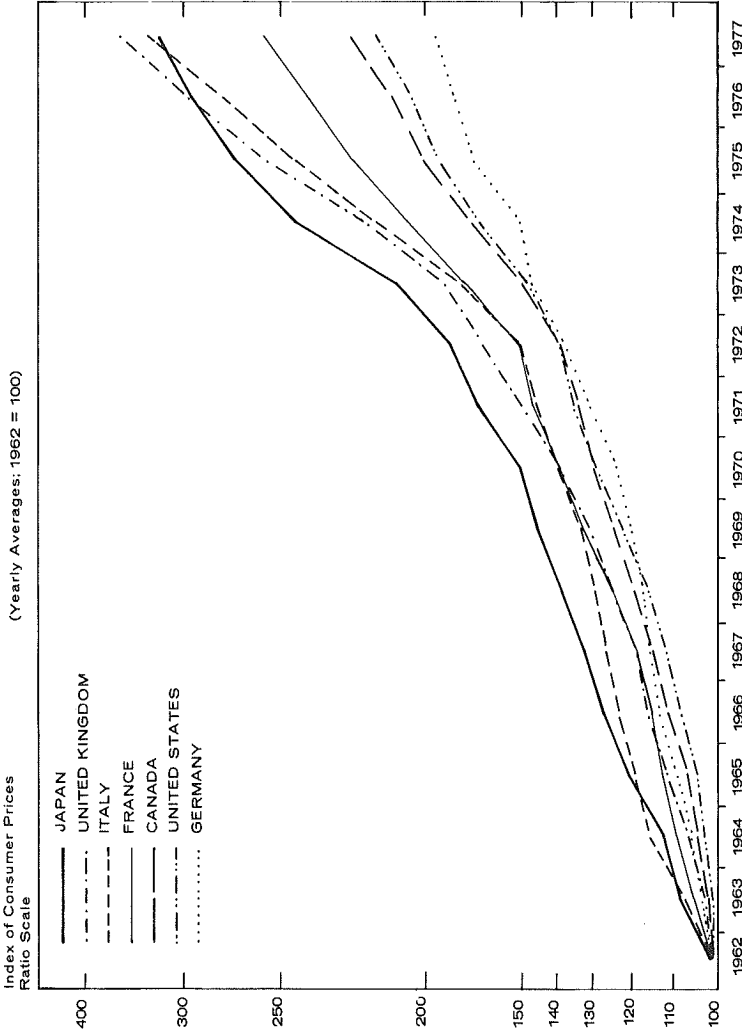


Figure 3  
**CONSUMER PRICES IN SEVEN INDUSTRIAL COUNTRIES, 1962-77**  
(Yearly Averages: 1962 = 100)



Source: See Appendix.

each other might start to trade more heavily with each other because of changes in tastes, techniques, or resource availabilities rather than because of reductions in trade barriers that would bring their prices closer together; on the other hand, an increase in trade relative to output, or in measured interdependence, might well reflect a reduction in trade barriers and be accompanied by greater correspondence of price movements.

The first column of Table 1 suggests that there has indeed been an increase in interdependence among industrial countries since 1960-61. However, the table also shows that the dispersion of consumer price inflation rates among these countries, whether measured by the standard deviation or the coefficient of variation, has risen rather than fallen between 1960-61 and 1976-77.

The relationship between interdependence and inflation can be tested empirically in another way. The argument that growing interdependence draws national inflation rates closer together seems to imply that inflation rates in various countries contribute to "explaining" the inflation of, say, Country A in the proportion that each of those countries trades with Country A, and that the higher the ratio of A's trade to its gross product, the more fully inflation in A can be explained by inflation in the countries with which A trades. More precisely,

$$(1) \quad \dot{P}_a = \frac{X_{ab} + M_{ab}}{X_a + M_a} \dot{P}_b + \frac{X_{ac} + M_{ac}}{X_a + M_a} \dot{P}_c + \dots + \frac{X_{an} + M_{an}}{X_a + M_a} \dot{P}_n,$$

where  $\hat{P} \equiv$  estimated rate of inflation,

$\dot{P} \equiv$  actual rate of inflation,

$X \equiv$  exports,  $M \equiv$  imports,

and the subscripts refer to countries, with  $X_{ab}$  being exports of A to B,  $M_{ab}$  being imports of A from B, and  $X_a$  and  $M_a$  being total exports and imports of A.

The thesis that growing interdependence draws inflation rates closer together implies that this equation should be more accurate in predicting inflation in A, the greater is A's dependence, i.e., the greater is

$$\frac{X_a + M_a}{2GNP_a}$$

other things being equal. More generally, where the subscripts  $i$  and  $j$  refer to countries, one can compute

$$(2) \quad \hat{P}_i = \frac{1}{\sum (X_{ij} + M_{ij})} \sum \dot{P}_j (X_{ij} + M_{ij}), \text{ for all } j.$$

Then the correlation for all  $i$

between  $\frac{|\hat{P}_i - \dot{P}_i|}{\dot{P}_i}$  and  $\frac{1}{2GNP_i} \sum_{\text{all } j} (X_{ij} + M_{ij})$  should be negative if

national inflation rates are influenced by dependence, other things equal. That is to say, the percentage error in estimating a country's inflation rate on the basis of foreign inflation rates should be lower, the greater is the country's measured dependence on foreign countries.

We have in fact computed  $\hat{P}$  for each of the following ten countries: the United States, Japan, Canada, the United Kingdom, France, Germany, Italy, the Netherlands, Sweden, and Denmark. The computation was performed twice for each country, first using consumer price inflation rates for 1962-66 and trade and GNP (or GDP) data for 1964, and then using consumer price inflation rates for 1972-76 and trade and GNP (or GDP) data for 1974. In the computation of  $\hat{P}$  for a country, all of the country's significant trade flows with other countries were included if the associated inflation rate data were available; the percentage of total trade included varied from 70 percent for Japan to 90 percent for the Netherlands.<sup>8</sup>

Completing the computations yielded a simple correlation coefficient of  $-0.55$  for the 1962-66 period and a coefficient of  $-0.21$  for the 1972-76 period. The latter coefficient is not significantly different from zero, while the former is (on a one-tail test at the 5 percent level). The coefficients are of the proper sign, and the decrease in the absolute value of the coefficient between 1962-66 and 1972-76 might be attributable to the greater degree of exchange-rate flexibility in the latter period, as exchange-rate flexibility may allow national inflation rates to diverge more widely.

In the foregoing analysis inflation was measured in terms of consumer price indexes. None of the available price indexes is ideal for international comparisons, if only because of the different weights employed from country to country, but indexes of consumer prices have the advantage of being both fairly comprehensive (including, in particular, many nontraded items) and genuine fixed-weight price indexes. Once trade has been opened, any subsequent reductions in transport costs and other commercial barriers (increases in openness) will shift goods from the nontradable into the tradable sector and thereby leave less room for national inflation rates to diverge, at least with fixed-exchange rates.<sup>9</sup> On the other hand, increases in *interdependence* need not bring national consumer price inflation rates closer together, even with fixed-exchange rates. After the advent of greater exchange-rate flexibility, national consumer price inflation rates in the industrial countries seem to have been uninfluenced by the degree of interdependence, according to the computations based on equation (2), and these inflation rates diverged more widely in spite of a marked prior increase in interdependence, according to the statistics in Table 1.

<sup>8</sup>This procedure is tantamount to assuming that the omitted trade flows and inflation rates are not much different from those included in their impact. Trade data were taken from IMF *Direction of Trade* computer tape, June 1978. All other data are from *International Financial Statistics, 1978 Supplement*, May 1978.

<sup>9</sup>For a somewhat different view, see Walter S. Salant, "International Transmission", p. 174-75. Also cf. R. J. Sweeney and T. D. Willett, "The International Transmission of Inflation: Mechanisms, Issues and Evidence," in *Bank Credit, Money and Inflation in Open Economies*, ed. by Michele Fratianni and Karel Tavernier (Berlin: Duncker & Humblot), p. 445.

Table I  
Interdependence and Dispersion of Consumer Price Change  
for 12 Industrial Countries,<sup>1</sup> Selected Years

Period	Degree of intergroup dependence <sup>2</sup>	Dispersion of percent change in consumer price indexes <sup>3</sup>	
	(1)	Standard deviation (2)	Coefficient of variation (3)
1960 - 1961	0.108	2.0	0.4
1965 - 1966	0.111	2.2	0.3
1970 - 1971	0.126	3.2	0.3
1976 - 1977	0.141	9.3	0.5

<sup>1</sup>The 12 countries are Austria, Canada, France, Germany, Italy, Japan, the Netherlands, Norway, Sweden, Switzerland, the United Kingdom, and the United States. *International Financial Statistics* lists 14 "industrial countries," of which Belgium and Denmark are omitted here for lack of data.

<sup>2</sup>Defined as the simple average of the ratios of trade to GNP (or GDP) for the 12 countries, where each country's trade is defined as half the sum of its exports to and imports from the other 11 countries.

<sup>3</sup>Percent change for 1960-61 is defined as the percent change in the level of the CPI between 1959 and 1961, etc.

Source: International Monetary Fund: *Direction of Trade Annuals*, 1960-64, 1961-65, 1964-68, 1966-70; *Direction of Trade*, May 1978; *International Financial Statistics*, May and August 1978.

**Transmission of Inflation under Fixed- vs. Flexible-Exchange Rates: some general considerations**

Before proceeding to some rather detailed analysis of inflation transmission under fixed- vs. flexible-exchange rates, it may be worthwhile to recall the key elements of the longstanding argument made on behalf of exchange-rate flexibility as a buffer against the international transmission of inflation. First consider the process by which inflation of demand is transmitted under fixed-exchange rates, a process whose essence can be summarized in a few words. If prices in one country (including prices of goods that have been imported) show a tendency to rise more rapidly than in the rest of the world, purchasers in that country will direct their spending toward cheaper goods obtainable abroad, while purchasers in the rest of the world will divert their spending away from the goods exported by the inflating country, so that there will be greater spending on the goods produced in the rest of the world and a rise in the prices of those goods. At the same time, the rest of the world will experience a balance-of-payments surplus, or a net influx of funds from the inflating country, and this influx of money will support (and perhaps magnify) the rise in prices that is taking place.

One argument on behalf of freely flexible-exchange rates is that they put an end to this transmission process. With freely flexible-exchange rates, governments do not buy or sell foreign currency in order to fix exchange rates; therefore, if the residents of a country were to receive more foreign currency (from foreign purchasers of their goods and securities) than they wanted to spend on foreign goods and securities, they would be unable, under flexible rates, to sell the excess to their government in exchange for domestic currency balances with which to bid up domestic prices. On the contrary, in such circumstances, with the supply of foreign exchange in excess of the demand, the price of foreign exchange would fall until market supply was reduced to the level of market demand. To make essentially the same point in a different way, if one country is experiencing inflation and another is not, the increasing demand by the inflating country for the goods of the stable country will operate to bid up the foreign-exchange price of the stable country's currency rather than the domestic prices of the stable country's goods. Therefore, it is asserted, a country with a freely flexible-exchange rate should be able to pick its own rate of inflation, while a country with a fixed-exchange rate cannot do so.<sup>10</sup>

There are counter-arguments, of course. Perhaps the most popular asserts that increased exchange-rate flexibility, rather than allowing countries to pick their own rates of inflation, has instead introduced an inflationary asymmetry into the movements of national prices. To illustrate, suppose that the development of popular new U.S. products results in a tendency toward

<sup>10</sup>See W. M. Corden, *Inflation, Exchange Rates and the World Economy* (Chicago: University of Chicago Press, 1974), p. 66; Gottfried Haberler, "The International Monetary System after Jamaica and Manila" in *Contemporary Economic Problems 1977*, ed. by William Fellner (Washington: American Enterprise Institute, 1977), pp. 251-52; and Harry G. Johnson, *Money, Balance-of-Payments Theory, and the International Monetary Problem*, Essays in International Finance, No. 124 (Princeton, N.J.: Princeton University, 1977), p. 23.



surplus in the U.S. balance of payments, including U.S. payments with the United Kingdom, so that the pound sterling depreciates substantially against the U.S. dollar in the foreign-exchange market. Because the dollar now costs more in terms of pounds sterling and British imports from the United States also cost more in pounds sterling, there is a tendency for prices to rise in the United Kingdom. If the cost of living goes up, British workers may well demand and obtain offsetting wage increases, giving further impetus to inflation. In the United States, on the other hand, wages and prices do not go down significantly — even if the cost of living initially declines as a result of the appreciation of the dollar and the accompanying reduction in the cost of imported goods — mainly because employees will strike rather than accept reductions in wage rates. Therefore, the change in the exchange rate between the dollar and the pound sterling is accompanied by a rise in prices in the United Kingdom, which is denied the option of picking a zero inflation rate, but not by a corresponding decline in prices in the United States, and the net result for the two countries combined is inflation.

While this argument may point out a genuine asymmetry in price behavior, it seems that any such asymmetry must exist under fixed- as well as under flexible-exchange rates.<sup>11</sup> A country whose currency would appreciate under a flexible-exchange-rate regime will instead experience a balance-of-payments surplus if exchange rates are fixed, and a country whose currency would depreciate will instead incur a balance-of-payments deficit. With fixed-exchange rates, then, a surplus country will tend to have inflationary pressure because of the net influx of foreign money, while a deficit country will fail to undergo a corresponding deflation, even though there is a net outflow of funds, because large firms and employee organizations refuse to accept reductions in prices and wages. Just as with flexible-exchange rates, the net result is inflation. In other words, the argument that flexible-exchange rates introduce an inflationary asymmetry into national price movements is itself asymmetrical, for it fails to acknowledge that if prices and wages resist reduction under flexible-exchange rates they will also resist reduction under fixed-exchange rates.

In addition, the claim made on behalf of freely flexible-exchange rates is that they *allow*, not that they *enable*, countries to opt for low rates of inflation. The fundamental point is that under fixed-exchange rates and an open trading system, a country with a low rate of inflation will begin to accrue surpluses if inflation surges in the rest of the world, while with flexible-exchange rates the country will not experience such inflationary surpluses. However, it is not maintained that exchange-rate flexibility makes a government stronger or a populace more willing to bear sacrifices; on the contrary, it may simply make it easier for a country to manufacture its own economic crisis — an exercise of independence not to be advocated, but such an exercise nonetheless.

<sup>11</sup>In a recent study, Morris Goldstein concluded that evidence for five large industrial countries generally failed to reveal such asymmetry. See his "Downward Price Inflexibility, Ratchet Effects, and the Inflationary Impact of Import Price Changes: Some Empirical Evidence," *International Monetary Fund Staff Papers*, XXIV (November, 1977), 569-612.

### Inflation and Internationally Traded Goods

If it is true that countries can pick their own rates of inflation under flexible-exchange rates, it seems that national rates of inflation should have diverged after the abandonment of fixed-exchange rates, for it is unlikely that all countries would independently select the same rate of inflation. Inflation in *this* context should be measured by national changes in the (local currency) prices of internationally traded goods, because it is the national prices of these goods that presumably are linked together by fixed-exchange rates, while the prices of nontraded goods move differently in different countries under fixed-exchange rates if only because of national differences in productivity change.<sup>12</sup> Under flexible-exchange rates, it is asserted, even the link between national prices of traded goods is broken.

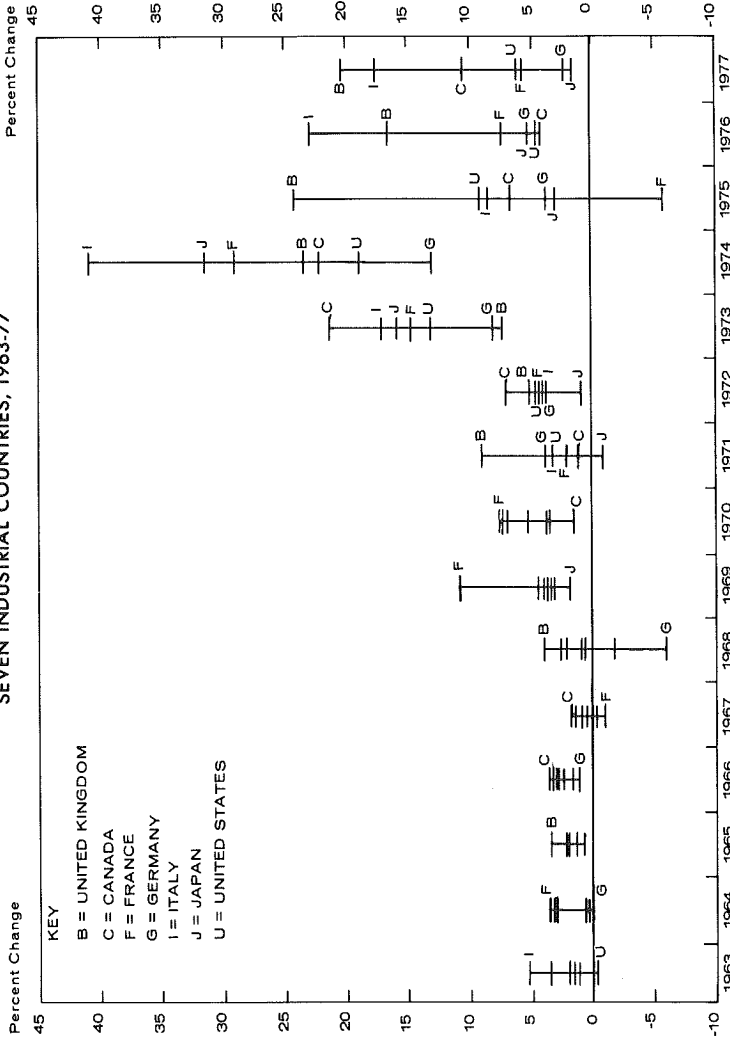
Because wholesale price indexes are relatively heavily weighted with internationally traded goods, an analysis of the dispersion in national rates of change in such indexes under fixed- vs. more flexible-exchange rates may offer some insight. Yearly percentage changes in the wholesale price indexes of seven major industrial countries are plotted in Figure 4, and for each year a vertical line represents the range between the highest and lowest percentage changes. Clearly, the range is much greater since 1973, when fixed-exchange rates were generally abandoned, than during the years when countries tried to maintain fixed-exchange rates. For those who prefer the standard deviation or the coefficient of variation rather than the range as a measure of dispersion, Table 2 shows that the standard deviation of changes in wholesale price indexes also has increased dramatically since the abandonment of fixed-exchange rates, although the same cannot be said of the coefficient of variation. Of course, the differences between national changes in wholesale prices might have become much greater after 1973 if governments had allowed exchange rates to float freely instead of intervening to influence the rates with very sizable foreign-exchange transactions.

While such measures of dispersion in wholesale price indexes may suggest the right conclusion,<sup>13</sup> they are not very satisfying because the indexes include some nontraded items and because the weights employed in the

<sup>12</sup>For example, suppose that under fixed-exchange rates the prices of traded goods in Countries A and B are perfectly stable and that output per man hour is constant in the nontraded goods sectors in both countries and in A's traded sector but is growing by 10 percent per year in B's traded sector. Then wages and prices in the nontraded goods sector in A will be stable, other things being equal. In B, however, the stable price of traded goods coupled with the 10 percent rise in productivity implies that money wages are rising 10 percent per year in the traded sector, so that wages must also rise in the nontraded sector if that sector is to retain its labor force. Rising wages and constant productivity in B's nontraded sector imply rising prices in that sector. See Bela Balassa, "The Purchasing-Power Parity Doctrine: A Reappraisal," *The Journal of Political Economy*, LXXII (December 1964), 584-96, and Ronald I. McKinnon, *Monetary Theory and Controlled Flexibility in the Foreign Exchanges*, Essays in International Finance No. 84 (Princeton, N.J.: Princeton University, 1971), pp. 21-23.

<sup>13</sup>For a brief summary of recent studies on the dispersion of national rates of inflation, see Marina v. N. Whitman, "International Interdependence and the U.S. Economy," in *AEI Studies on Contemporary Economic Problems, 1976*, ed. by William Fellner (Washington, D.C.: American Enterprise Institute for Public Policy Research, 1976), pp. 201-03.

Figure 4  
 YEARLY PERCENT CHANGE IN WHOLESALE PRICES FOR  
 SEVEN INDUSTRIAL COUNTRIES, 1963-77



Source: See Appendix.

Table 2

Yearly Percent Change in Wholesale Prices for Seven Industrial Countries, 1963-1977: Standard Deviation and Coefficient of Variation

<u>Year</u>	<u>Standard deviation</u>	<u>Coefficient of variation</u>
1963	1.8	1.0
1964	1.5	1.0
1965	0.9	0.5
1966	0.9	0.3
1967	1.0	1.9
1968	3.1	10.2
1969	2.6	0.6
1970	2.2	0.4
1971	2.8	0.9
1972	1.7	0.4
1973	4.6	0.3
1974	8.5	0.3
1975	8.2	1.1
1976	6.8	0.7
1977	6.5	0.7

Note: The seven countries are Canada, France, Germany, Italy, Japan, the United Kingdom and the United States.

Source: *International Financial Statistics*, May and August, 1978, except that for Germany the data are from OECD, *Main Economic Indicators*, February and January, 1978, and from OECD staff.

indexes differ radically from country to country.<sup>14</sup> Lacking uniformly weighted aggregative national price indexes for traded goods, we should nonetheless be able to shed some light on the issues at hand by comparing national price variations for individual traded commodities. With the resources available to us, such an examination must be very limited, but it seems worthwhile for two reasons. First, it offers greater precision than does the use of aggregative price indexes employing different or shifting weights. Second, its relevance extends beyond the issue of inflation transmission; if it turns out that national variations in the (national currency) prices of individual goods are poorly correlated under fixed-exchange rates, there will be doubt not only about whether inflation can be transmitted between countries but also about the performance of the goods markets, since efficient markets should equalize the prices of an individual commodity in different nations after allowing for

<sup>14</sup>Irving B. Kravis and Robert E. Lipsey, "Price Behavior in the Light of Balance of Payments Theories," *Journal of International Economics*, 8 (May 1978), 200; Ronald I. McKinnon, *Monetary Theory*, p. 21.

such things as tariffs, transportation and communications costs, and non-equivalence of currencies.<sup>15</sup> Precisely how much allowance should be made for transportation and communications would constitute a study in itself. In David Hume's time sizable differences in price for the same good between national markets may have been eliminated only slowly because of slow communications and transportation — so that the price-specie-flow sequence of balance-of-payments adjustment which he hypothesized may have been appropriate for the 18th century — but in modern times the existence of large price differences would be more surprising. On the other hand, communications and transportation costs do remain high enough that *perfect* price equalization is scarcely to be expected, even in the absence of governmental barriers to trade or various forms of nonprice competition that tend to offset differences in price; anyone who has shopped around within a large U.S. city for a particular car or camera knows that there are appreciable differences in the prices charged by different sellers even within the boundaries of a metropolitan area. The most that can reasonably be expected, then, is fairly close, but not perfect, parallelism between the movements of national prices for a particular traded commodity.

Using the U.S. and German detailed price statistics, we have identified six commodities which have highly similar, if not identical, definitions in both sets of statistics. German prices were chosen for comparison with U.S. prices because there has been substantial change in the mark-dollar exchange rate in recent years and because the German statistics are considered reliable. Figures 5-10 present the selected indexes, each covering a span of ten or more years; for each commodity, the first data plotted are from a period of relatively stable prices for that commodity, on the assumption that stable prices are more likely than rapidly changing prices to represent positions of equilibrium.

Prior to October 1969, there was very little variation in the mark-dollar exchange rate, and in accordance with theory there was fairly close correspondence between the movements of the mark and dollar prices for all six commodities except perhaps raw tobacco. Then the mark was revalued upward by 9.3 percent in October 1969, was allowed to appreciate by 13.6 per-

<sup>15</sup>Several empirical studies of the so-called "law of one price" have recently been completed, primarily for the purpose of partially testing the monetary approach to the balance of payments. These investigations have revealed substantial differences in both national price levels and national price variations for narrowly defined commodity *categories*, after expressing prices in a common currency; however, none of the investigations presents data on individual commodities, and it is not really clear whether the national price differences reported stem from market imperfections or from national differences in the commodity categories. See Peter Isard, "How Far Can We Push the 'Law of One Price'?", *The American Economic Review*, 67 (December 1977), 942-48; J. David Richardson, "Some Empirical Evidence on Commodity Arbitrage and the Law of One Price," *Journal of International Economics*, 8 (May 1978), 341-51; and Irving B. Kravis and Robert E. Lipsey, "Price Behavior."

An earlier study by Robert M. Dunn of six individual commodities marketed in the United States and Canada by oligopolistic firms between 1950-62 also found that the law of one price failed to hold, although Dunn acknowledges that over extended periods the law may hold at least approximately. See his "Flexible Exchange Rates and Traded Goods Prices" in *The Economics of Common Currencies*, ed. by Harry G. Johnson and Alexander K. Swoboda (Cambridge, Mass.: Harvard University Press, 1973), pp. 259-80.

cent between May and December of 1971, was revalued upward by 11.1 percent in February 1973 (reflecting the devaluation of the dollar in that month), and has been allowed to vary widely against the dollar since March 1973, during which period it has risen well above its March 1973 level. As the charts show, during this period of substantial exchange-rate variation prices in Germany and in the United States, measured in the respective national currencies, have diverged widely, again in accordance with expectations, with much lower rates of price increase recorded in Germany. This observation holds for all six commodities, including those not produced within either country, such as cocoa, as well as those produced within both countries, such as pig iron. In other words, information presented in the charts is consistent with the view that countries which opt for exchange-rate flexibility can experience widely different rates of change in the prices of internationally traded goods, and that a country can achieve substantial insulation from outside inflationary (or deflationary) influences by allowing the foreign-exchange value of its currency to vary.<sup>16</sup>

For the purpose of bringing this same evidence to bear on the issue of market performance, the indexes of German mark prices in Figures 5-10 have been multiplied by an index of the dollar/mark exchange rate to yield the "U.S. Dollar-Equivalent of German Mark Price" shown in the figures. Significant inefficiencies might be present if there were wide divergences between this "U.S. Dollar Equivalent" and the "Dollar Price in United States." Such wide divergences do in fact appear for most of the commodities, but factors other than market inefficiency seem primarily responsible. First, note that in Figures 8-10, all of which pertain to industrial commodities, there is a common pattern, with divergences between the U.S. dollar equivalent and the dollar price in the United States developing in the early 1970s and disappearing by 1974 or 1975. For example, the U.S. dollar equivalent of the German mark price for magnesium had risen to nearly 50 percent above the dollar price in the United States in the last half of 1973 but had been overtaken by the dollar price in the United States by the middle of 1974. Even larger percentage divergences appeared and then disappeared for pig iron and steel wire rods. While market inefficiencies may have played a role, the chief explanation of this common pattern surely is the U.S. price control program, which suppressed the prices of many industrial commodities in the United States during the years 1971-73. After the controls were removed, the U.S. prices of magnesium, pig iron, and steel wire rods escalated to the levels previously attained by the U.S. dollar equivalents of German mark prices. This convergence suggests that the German and U.S. markets for each of these commodities is fairly efficiently linked in the absence of such interference as price controls. It also suggests, incidentally, that temporary price controls do not succeed in reducing the long-run rate of inflation.

<sup>16</sup>Simulation with the econometric model RDX2 suggests that Canada has attained such insulation by allowing the foreign-exchange value of its currency to vary. See Alan V. Deardorff and Robert M. Stern, "Modeling the Effects of Foreign Prices on Domestic Price Determination: Some Econometric Evidence and Implications for Theoretical Analysis" (University of Michigan, 1977; processed), 13-16.

FIGURE 5  
INDEXES OF PRICES FOR RAW COFFEE IN GERMANY AND THE UNITED STATES, 1965-77

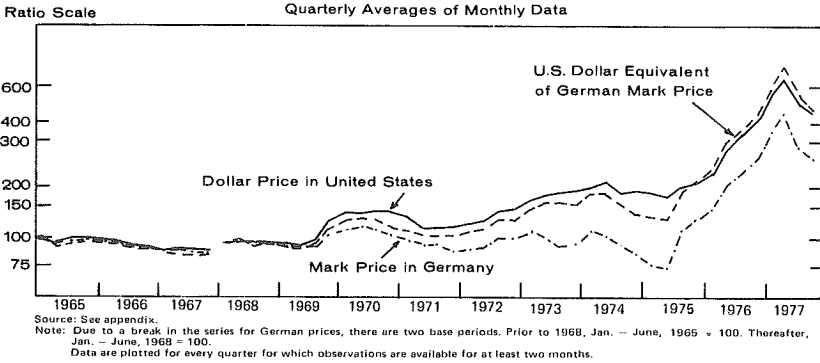


FIGURE 6  
INDEXES OF PRICES FOR RAW COCOA IN GERMANY AND THE UNITED STATES, 1965-77

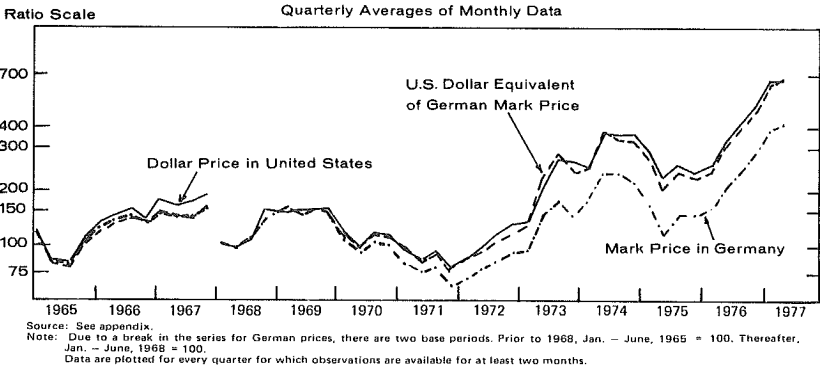


FIGURE 7  
INDEXES OF PRICES FOR RAW TOBACCO IN GERMANY AND THE UNITED STATES, 1966-77

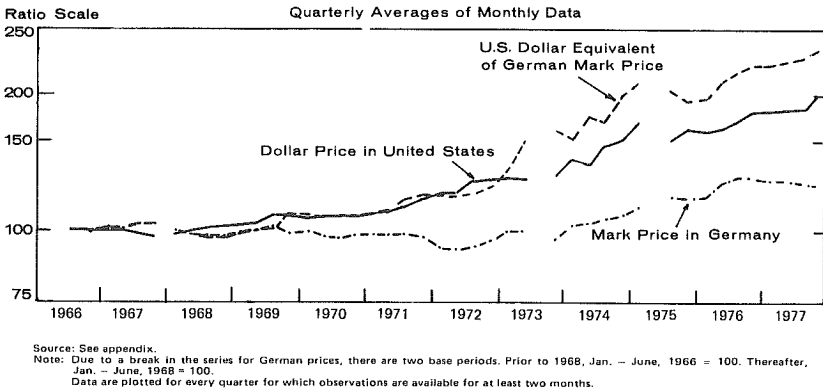
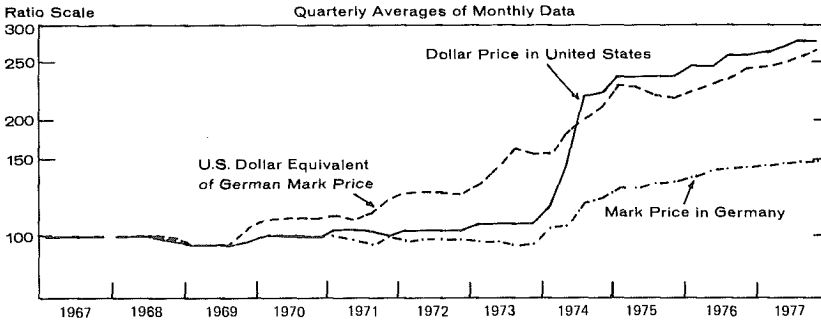


FIGURE 8

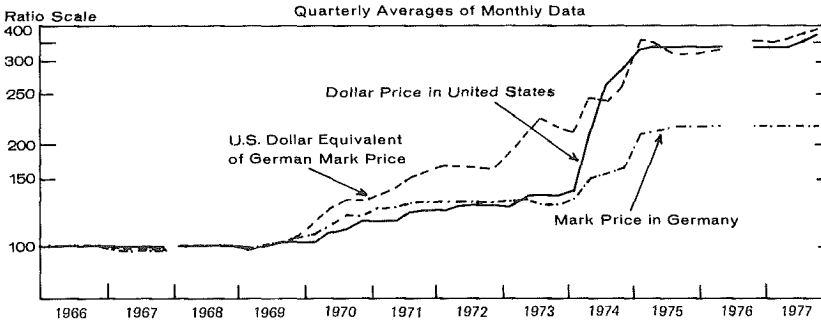
INDEXES OF PRICES FOR MAGNESIUM IN GERMANY AND THE UNITED STATES, 1967-77



Source: See appendix.  
 Note: Due to a break in the series for German prices, there are two base periods. Prior to 1968, Jan. - June, 1967 = 100. Thereafter, Jan. - June, 1968 = 100.  
 Data are plotted for every quarter for which observations are available for at least two months.

FIGURE 9

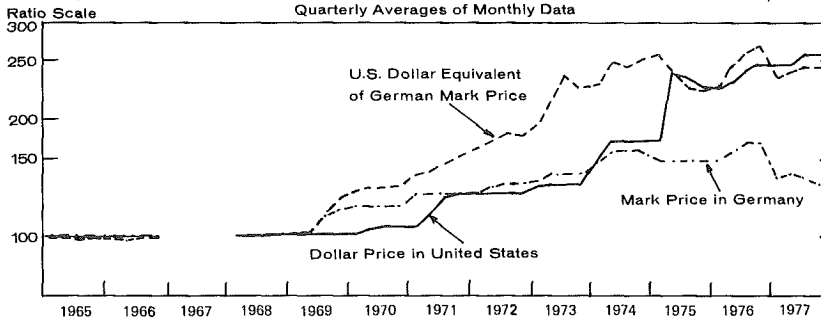
INDEXES OF PRICES FOR PIG IRON IN GERMANY AND THE UNITED STATES, 1966-77



Source: See appendix.  
 Note: Due to a break in the series for German prices, there are two base periods. Prior to 1968, Jan. - June, 1966 = 100. Thereafter, Jan. - June, 1968 = 100.  
 Data are plotted for every quarter for which observations are available for at least two months.

FIGURE 10

INDEXES OF PRICES FOR STEEL WIRE RODS IN GERMANY AND THE UNITED STATES, 1965-77



Source: See appendix.  
 Note: Due to a break in the series for German prices, there are two base periods. Prior to 1968, Jan. - June, 1965 = 100. Thereafter, Jan. - June, 1968 = 100.  
 Data are plotted for every quarter for which observations are available for at least two months.



At this writing we are not able to explain the divergence between the U.S. dollar equivalent of the German mark price and the dollar price in the United States that emerged for raw tobacco in 1973 and that has persisted for the four subsequent years shown in Figure 7. Even in this case, however, the two series have moved in more or less parallel fashion except during 1973.

On balance, although the evidence presented in Figures 5-10 is much too limited to be conclusive, it is consistent with the argument that countries can attain different rates of inflation for internationally traded goods under flexible, but not under fixed, exchange rates. Moreover, even our cursory investigation of market "inefficiencies" indicates the importance of taking into account factors other than market defects which can account for the seeming inefficiencies.<sup>17</sup>

### Nontraded Goods: theory

A study of the international transmission of inflation may begin with goods that move in international trade, but it should not end there. Paradoxically, goods that do *not* cross national borders may also be of considerable importance in the analysis.

Perhaps it is not surprising that the theory of international trade should sometimes slight the goods that do not move in international trade. The classical theory of balance-of-payments adjustment is a case in point; Taussig was the first, in 1917, to argue that balance-of-payments adjustment could require a change in the price of traded goods relative to nontraded goods, a view which Viner also espoused in subsequent work.<sup>18</sup> Further emphasis of the role of nontraded goods appeared in Bertil Ohlin's renowned 1929 critique of Keynes's position on the problem of German war reparations.<sup>19</sup> As was true of Taussig and Viner before him, Ohlin's perceptions regarding nontraded goods arose out of concern with the "transfer problem," namely, the question of how a long-term financial transfer from one country to another becomes converted into an equivalent transfer of goods so that the transferor need not experience a substantial loss of international reserves over any extended period.<sup>20</sup> Unlike Taussig and Viner, however, Ohlin argued that change in the price of nontraded goods relative to traded goods was the primary price adjustment in the transfer process and that any change in the price of exports relative to imports,

<sup>17</sup>These factors include not only price controls but variations in tariffs and other indirect taxes.

<sup>18</sup>Jacob Viner, *Studies in the Theory of International Trade* (1937; reprinted: New York, Augustus M. Kelley, 1965), pp. 319-26. Also see Gottfried von Haberler, *The Theory of International Trade* (1936; New York, Augustus M. Kelley, 1968), pp. 36-37.

<sup>19</sup>Bertil Ohlin, "The Reparation Problem: A Discussion," *Economic Journal*, 39 (June 1929), 172-78 and "A Rejoinder," *Economic Journal*, 39 (September 1929), 400-04.

<sup>20</sup>The fact that the insights of these writers were stimulated by the transfer problem does not at all impair the generality of their insights, for, as Harry Johnson has noted, the methodology applied to the transfer problem can readily be used to analyze any imbalance in international payments; see Harry G. Johnson, *International Trade and Economic Growth* (Cambridge, Mass.: Harvard University Press, 1958), p. 183.

which had preoccupied Taussig and Viner, would be only secondary.<sup>21</sup> Since World War II the role played by nontraded goods in the balance-of-payments adjustment process has been elaborated by a number of authors<sup>22</sup> and has become a crucial component of modern balance-of-payments theory.<sup>23</sup>

The essence of this theorizing, insofar as it relates to this paper, can be stated rather briefly. Posit a closed economy with full employment and without inflation. If the money supply were doubled overnight, one might expect all prices to rise in about the same proportion. Now suppose that the same economy is opened to trade with a second country, that the rate of exchange between the currencies of the two countries is fixed, that there is full equilibrium in all markets, and that the first country is so much smaller than the second that it cannot influence the price of anything it exchanges with the second. Then if the money supply in the small country were doubled, only the prices of its goods which did not enter into trade with the large country would be free to rise; the increase in money spending on importables and exportables would generate a greater quantity of imports and reduce the quantity of exports without affecting their prices and would produce a trade deficit. Thus, in the small country the rise in the relative price of nontraded goods, the rise in the overall price level due to the rise in the absolute price of nontraded goods, and the deterioration of the trade balance would jointly indicate an indigenous rather than imported inflation. Were the country large enough to exert some discernible influence on the prices of traded goods, those prices also

<sup>21</sup>P. M. Oppenheimer, "Non-traded Goods and the Balance of Payments: A Historical Note," *The Journal of Economic Literature*, XII (September 1974), 884. James Meade recently expressed regret that he did not make much greater use in his *Balance of Payments* of the distinction between tradable and nontradable goods emphasized by Ohlin. See James Meade, "The Meaning of 'Internal Balance,'" *The Economic Journal*, 88 (September 1978), 423.

<sup>22</sup>Many works could be cited. Most relevant to this paper are the following: J. E. Meade, *The Theory of International Economic Policy*, Vol. 1: *The Balance of Payments* (London: Oxford University Press, 1951), chap. 18; Randall Hinshaw, "The Effect of Devaluation on the Price Level: Further Comment," *Quarterly Journal of Economics*, LXXII (November 1958), 616-25; W. E. G. Salter, "Internal and External Balance: The Role of Price and Expenditure Effects," *Economic Record*, 35 (August 1959), 226-38; Anne O. Krueger, "The Role of Home Goods and Money in Exchange Rate Adjustments" in *International Trade and Finance: Essays in Honor of Jan Tinberger*, ed. by Willy Sellekaerts (White Plains, N.Y.: International Arts and Sciences Press, 1974), pp. 141-61; Rudiger Dornbusch, "Real and Monetary Aspects of the Effects of Exchange Rate Changes," in *National Monetary Policies and the International Financial System*, ed. by Robert Z. Aliber (Chicago: University of Chicago Press, 1974), pp. 64-81; and W. M. Corden, *Inflation*, chap. 4.

<sup>23</sup>The role of nontraded goods was neglected not only by the classical theory but also by the so-called "elasticities" theory of the foreign exchanges which became popular in the middle of this century. Although the elasticities approach is sometimes equated with the "relative prices" approach, the latter (as developed by Ohlin and the authors cited in the preceding footnote) explicitly placed nontraded goods at the very heart of the analysis, while the former made little or no mention of nontraded goods. For classic expositions of the elasticities approach, see Joan Robinson, "The Foreign Exchanges," *Essays in the Theory of Employment* (2nd ed.; Basil Blackwell, Oxford, 1947), Part III, chap. 1, reprinted in *Readings in the Theory of International Trade*, ed. by Howard S. Ellis and Lloyd A. Metzler (Philadelphia: The Blakiston Co., 1949), pp. 83-103; and Gottfried Haberler, "The Market for Foreign Exchange and the Stability of the Balance of Payments: A Theoretical Analysis," *Kyklos*, vol. 3 (1949), 193-218, reprinted in *International Finance*, ed. by R. N. Cooper (Baltimore, Md.: Penguin Books Inc., 1969), pp. 107-34.

would rise, although not so much as the prices of the country's nontraded goods, and the country would thereby export inflation to its partner. Other things equal, the partner country would experience a rise in the price of traded goods, both absolutely and relative to the price of its nontraded goods, as well as an "improvement" in its trade balance.<sup>24</sup> For this partner country, the rise in the relative price of traded goods, the rise in the general price level due to the rise in the absolute price of traded goods, and the improvement in the trade balance would then jointly signify the importation of inflation from abroad.

This process of inflation transmission clearly constitutes a disequilibrium not only because of the inflation itself and the imbalance in international payments, but also because the price relationship between traded and nontraded goods is disturbed. If there are no further increases in the money supply, the inflation will come to a halt as real money balances in the inflation-exporting country are reduced by the rise in prices and by the outflow of international reserves. At the same time, the price of nontraded goods in this country must fall — not to the original level, but enough to restore the original relationship to the now higher price of traded goods — while in the other country the price of nontraded goods must rise; the underlying premise, of course, is that increases in the money supply, particularly one-time increases, do not bring about permanent and significant changes in relative prices.

If prices of nontraded goods display little downward flexibility in the country that had exported inflation, the country may experience unemployment in industries producing such goods. Devaluation of the country's currency would be an appropriate part of the proper policy response, because devaluation, as is well known, operates to raise the relative price of traded goods. Indeed, had the country allowed the foreign-exchange value of its currency to depreciate simultaneously with the increase in its money supply, no deficit could have arisen in its payments with its trading partner. One widely held theory asserts that under such circumstances there is no transmission of inflation, but that the full price impact is borne by the country in which the inflationary impulse originates.<sup>25</sup> As this country's currency depreciates, the price of traded goods rises along with the price of nontraded goods, so that disturbances to relative prices during the inflation are not so severe.

The case of downward price inflexibility is but one step removed from the case of "cost-push" inflation, and it is easy to extend the theory to cover the latter situation. Suppose that the inflation-exporting country suffers from severe cost-push inflation unaccompanied by increases in the money supply rather than from classic demand-pull inflation fueled by rapid expansion of the money stock. Again, the relative price of nontraded goods will rise in this country if the price of traded goods is constrained by foreign competition

<sup>24</sup>It is sometimes asserted or implied that such an improvement in the trade balance need not occur, on the grounds that the rise in traded goods prices is brought about by "arbitrage" rather than by an increase in foreign demand. But surely such "arbitrage" entails an increase in foreign demand for the country whose prices rise in response to foreign price increases. Cf. Harry G. Johnson, *Money, Balance-of-Payments Theory, and the International Monetary Problem*, p. 20.

<sup>25</sup>See W. M. Corden, *Inflation*, p. 66; Gottfried Haberler, "The International Monetary System after Jamaica and Manila," pp. 251-252, and Harry G. Johnson, *Money*, p. 23.

under a fixed-exchange rate, and the country's trade balance will deteriorate (since the price of traded goods in the country would not be constrained unless residents switched their purchases from traded goods produced domestically to those produced abroad). However, the country will also experience rising unemployment, which will mitigate the deterioration of the trade balance. In the partner country there will be a rise in the relative price of traded goods and an improvement in the trade balance. Devaluation would again be part of the appropriate medicine for the inflation-exporter.

This model of inflation transmission has definite limitations. In particular, the model does not explicitly consider capital flows or the formation of exchange-rate expectations,<sup>26</sup> elements which should be incorporated into a detailed general equilibrium approach. To illustrate the significance of these omissions, we may note that the importation of financial capital into a country might raise the relative price of nontraded items and engender a trade deficit in the country, leading the analyst to conclude (wrongly) that the country was experiencing internally generated inflation. Or, if the country had attracted foreign capital because it in fact was going through an inflationary boom that presented profit opportunities, the corresponding capital outflow from another country might prevent the capital-exporter's currency from appreciating enough to forestall an increase in traded goods prices and a trade surplus in the capital-exporting country; that is, exchange-rate flexibility might not provide full insulation from foreign inflation.<sup>27</sup> In spite of such limitations, the model of inflation transmission outlined in this section has gained much currency and provides at least a springboard for empirical inquiry.

### Nontraded Goods: evidence

In spite of this attention to nontraded goods in the theoretical literature, the theorizing has seldom been tested or utilized in empirical work on the balance-of-payments adjustment process. Perhaps the earliest study of the behavior of nontraded goods prices during balance-of-payments adjustment is Frank Graham's 1922 article focusing on the impact of British loans to the United States and their repayment between 1862 and 1879.<sup>28</sup> In more recent empirical work emphasis has been placed on the consequences for balance-of-payments or exchange-rate adjustment of differences in productivity growth between nontraded and traded goods,<sup>29</sup> and very little is to be found that relates to the theoretical model outlined in the preceding section of this paper. This theoretical model may provide a useful framework for empirical analysis

<sup>26</sup>Rudiger Dornbusch has argued that if expectations are formed by an adaptive process rather than rationally, inflation can be transmitted temporarily even if exchange rates are flexible. See his "The Theory of Flexible Exchange Rates Regimes and Macroeconomic Policy," *The Scandinavian Journal of Economics*, 78 (June 1976), 255-75.

<sup>27</sup>See, for example, Marina v. N. Whitman "International Interdependence and the U.S. Economy," pp. 207-08.

<sup>28</sup>F. D. Graham, "International Trade under Depreciated Paper. The United States, 1862-79," *Quarterly Journal of Economics*, 36 (February 1922), 220-73.

<sup>29</sup>Bela Balassa, "The Purchasing-Power Parity Doctrine," 584-96; Ronald I. McKinnon, *Monetary Theory*, p. 21.

of the transmission of inflation; if not, current theory may be in need of revision.

To apply the theoretical model to actual experience, we must find a measure of the relative price of nontraded goods. This task is complicated by the fact that goods may shift from the nontraded into the traded category with changes in relative national inflationary pressures, in transportation costs, in tastes, and so forth. However, as a practical matter there is very little in the way of available data from which to choose, and for a measure of nontraded goods prices we will use the price index for consumer services, since it is relatively heavily weighted with items that seldom get traded internationally, such as medical care and automobile repair services. The price index for consumer goods (excluding services) is more heavily weighted with internationally traded items and can be directly compared with the price index for consumer services, and it will provide a proxy for the price of traded goods.

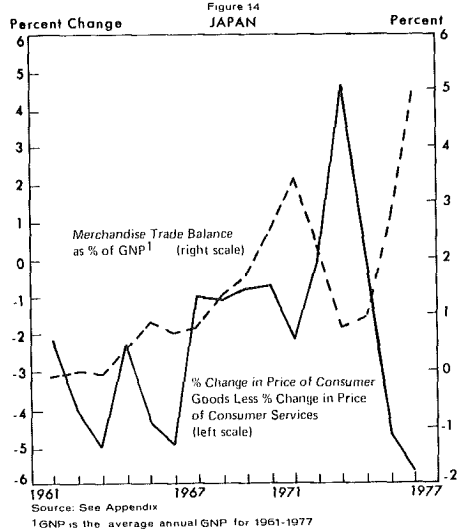
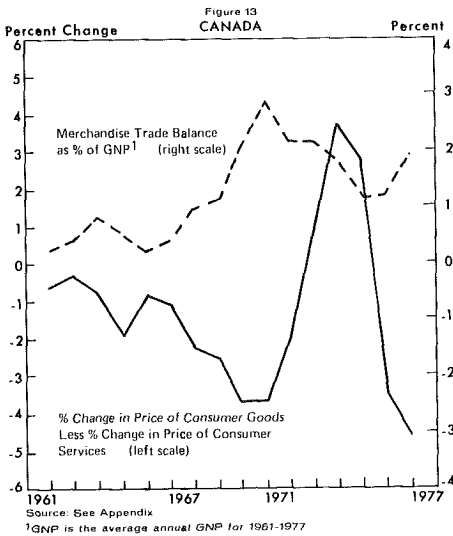
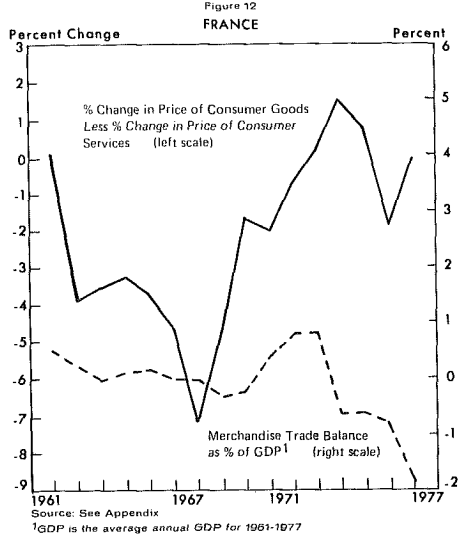
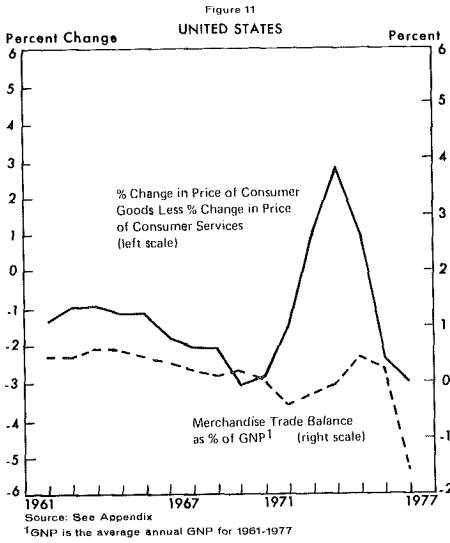
These data on consumer prices, along with data on the merchandise trade balance, have been plotted for seven major countries for the years 1961-77 in Figures 11-17. So as to facilitate comparisons between countries, trade balances are expressed as a percent of average annual GNP or GDP and all charts have about the same range in scales on the vertical axes. After some experimentation, it was discovered that two-year moving averages of the data seemed to reveal trends more clearly.

To begin with, suppose, as is generally believed, that productivity increases are consistently higher in traded goods industries than in the service industries. In that case inflation in the price of goods should proceed at a slower pace than inflation in the price of services, other things being equal, and the price lines on the charts should remain generally in the negative range, as they do. However, it is questionable whether sizable and extended *upswings* or *downswings* in the price lines are to be explained by *changes* in productivity growth in consumer goods relative to services. For example, the price line for the United States (Figure 11) declines steadily from roughly 1964 through 1970, but the rate of productivity growth (presumably largely in goods industries) declined significantly over this period, while a relative rise in productivity growth in the goods industries would be required to account for the decline in the price line. Nor can the decline in the price line in Canada (Figure 13) during the 1960s be explained by an acceleration of productivity growth, as productivity there grew at about the same rate during the second half of the 1960s as in the first half.<sup>30</sup>

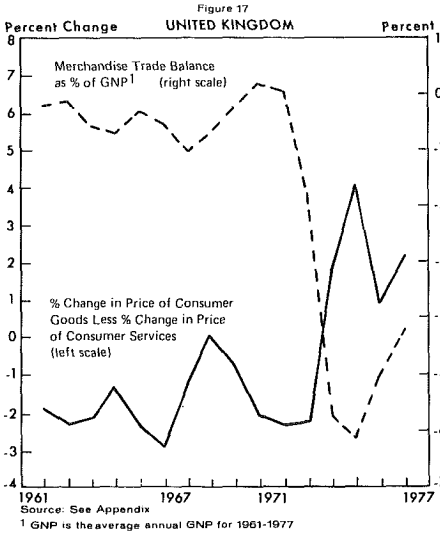
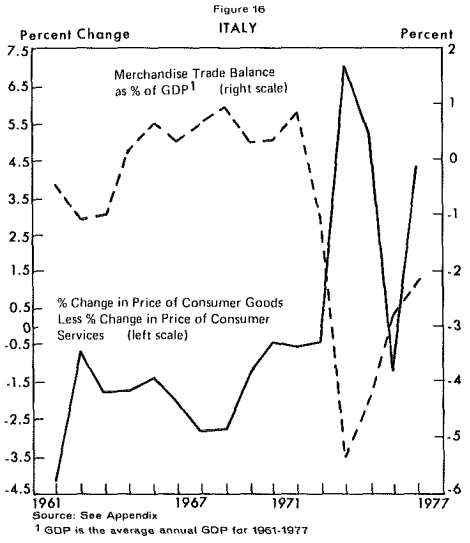
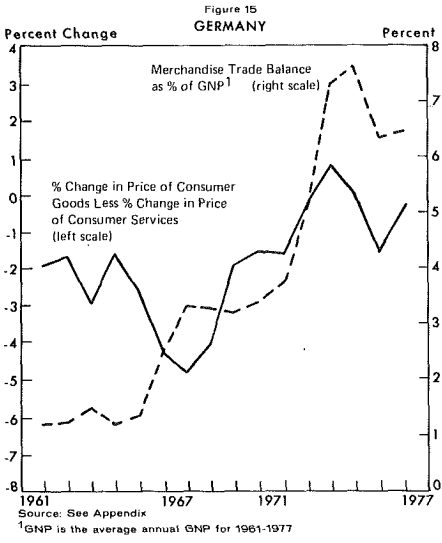
Another possible explanation of the declining price line in the United States from 1964-1970 is that demand was shifting away from traded goods toward nontraded items. However, such a shift in demand would tend to improve the U.S. trade balance, while in fact the balance deteriorated. A third explanation, which is consistent with both the declining price line and the wor-

<sup>30</sup>Patricia Capdevielle and Arthur Neef, "Productivity and Unit Labor Costs in 12 Industrial Countries," *Monthly Labor Review*, November 1974, p. 15. Our 1976 paper, "The Worldwide Inflation," presented a diagram for Canada in which the price line rose, rather than declined, during most of the 1960s. The consumer prices in that diagram were derived from quarterly data which we have found to be defective.

Merchandise Trade Balance and Percent Change  
in Selected Price Indexes for Various Countries, 1961-1977  
(Two-year moving averages)



Merchandise Trade Balance and Percent Change in Selected Price Indexes for Various Countries, 1961-1977  
(Two-year moving averages)



sening of the trade balance, is that the United States was experiencing internally generated inflation, with higher and higher price increases for nontraded items relative to increases for the traded items whose prices were constrained by foreign influences. This explanation, of course, is suggested by the theory in the preceding section; that theory also suggests that the United States, because of its size, may have exported inflation to the rest of the world during this period. Again consistent with the theory, the interruption of this pattern approximately coincides with the advent of somewhat greater exchange-rate flexibility, as the German mark was revalued in 1969, the Canadian dollar was allowed to float fairly freely in the markets beginning in 1970, and a number of major currencies were set afloat briefly in 1971. Similar reasoning suggests that France (Figure 12) was also undergoing an internally generated surge of inflation, and perhaps exporting inflation as well, for several years prior to the devaluation of the franc in 1969.

On the other hand, on the basis of the charts it would be hard to make the case that any of the countries represented was importing inflation for any extended period, although Germany may have done so in the early 1970s and Japan in the late 1960s and first years of the 1970s, since the trade balance was improving and the inflation rate for traded goods was generally rising relative to the inflation rate for nontraded goods in those countries in those years. (In addition, the foreign-exchange reserves of each country surged upward during the years in question.<sup>31</sup>) To be sure, the charts for France and the United States both display the symptoms of imported inflation for short periods, from about 1970-73 in France and from roughly 1972-1974 in the United States. However, in both countries the rise in the relative inflation rate of traded goods and the improvement in the trade balance is to be explained at least partly, if not primarily, by prior devaluations of the home currency rather than by inflationary pressures imposed from abroad; such developments are consistent with the standard theoretical model, for this model implies that an improving trade balance and a rising relative inflation rate for traded items are necessary, but not that they are sufficient, conditions for the existence of imported inflation. In France and the United States the devaluation-induced increase in the relative inflation rate for traded goods operated to improve the balance of trade by shifting domestic consumption away from traded goods and by shifting domestic resources into the production of traded goods, both for export and to replace imports. By contrast, the 1971 upward revaluation of the yen probably contributed to a decline in the relative price of traded goods and a subsequent deterioration in the Japanese balance of trade (Figure 14).

<sup>31</sup>Herring and Marston have argued that Germany successfully sterilized nearly all of its overall payments imbalances, or changes in foreign-exchange reserves, during the 1960s. Our analysis also suggests that Germany did not import inflation in the 1960s, but that it did in the early 1970s. See Richard R. Herring and Richard C. Marston, *National Monetary Policies and International Financial Markets* (Amsterdam: North Holland, 1977), Pt. II. Also see Victor Argy and Pentti J. K. Kouri, "Sterilization Policies and the Volatility in International Reserves," in *National Monetary Policies and the International Financial System*, ed. by Robert Z. Aliber (Chicago: University of Chicago Press, 1974), pp. 209-30.



In sum, the United States and France may have exported inflation during the last half of the 1960s, but among the countries examined only Japan seems to have imported inflation during these years.<sup>32</sup> Of course, countries not scrutinized may also have imported inflation. In addition, there may be lags in transmission, as suggested by the fact that the signs of imported inflation were not manifest for Germany until the early 1970s. Finally, Canada may be so open to the United States that Canadian prices of services as well as goods may be strongly and quickly influenced by prices for corresponding items in the United States as long as the exchange rate is fixed,<sup>33</sup> so that the 1966-1969 decline of the price line in the chart for Canada, roughly contemporaneous with the decline for the United States, may have been caused by the transmission of inflation from the United States to Canada. This phenomenon would not contradict the standard theoretical model, which is relevant only to cases involving a substantial nontraded sector; for Canada, only a small part of the economy may be free from fairly direct influence by commerce with the United States, and that small sector may be quite different from the consumer services sector whose price movements are included in Figure 13. The sharp upward movement of the Canadian trade balance during this period supports the interpretation that Canada was importing inflation, especially since the trade balance improvement was primarily with the United States. In 1970, of course, the Canadian dollar was allowed to float, and the transmission seems to have been interrupted.<sup>34</sup>

For the years following the advent of greater exchange-rate flexibility, perhaps the most noteworthy feature of Figures 11-17 is that all countries represented recorded a sharp increase in the relative inflation rate for traded goods just prior to 1974-75, followed by a decrease in 1974-75. In all likeli-

<sup>32</sup>The fact that the total consumer price index rose as fast or even faster in most other industrial countries than in the United States during the last half of the 1960s (as shown by Figure 3) does not rule out the possibility that the United States was exporting inflation. A small increase for the traded goods component of the U.S. consumer price index might imply roughly the same small increase in traded goods prices in, say, Japan, but imply a much larger increase in the total consumer price index in Japan because of rapid productivity growth in Japan's traded goods industries. (See footnote 12.) This point has been made by a number of writers; see, for example, Marina v. N. Whitman, "International Interdependence and the U.S. Economy", pp. 195-96, and Michael Parkin, "World Inflation, International Relative Prices and Monetary Equilibrium under Fixed Exchange Rates," in *The Political Economy of Monetary Reform*, ed. by Robert Z. Aliber (Montclair, N.J.: Allanheld, Osmun & Co., 1977), pp. 220-42.

<sup>33</sup>Alan V. Deardorff and Robert M. Stern, "Modeling the Effects," pp. 12-15, report simulation results suggesting that the Canadian price of consumer services is much more strongly influenced by foreign prices (under a fixed-exchange rate) than is indicated by the directly estimated elasticity of the Canadian price with respect to foreign prices, and they infer that the Canadian price of consumer services is affected indirectly by the impact of changes in foreign prices on Canadian wages. Similarly, Bordo and Choudhri report difficulty in distinguishing a purely nontraded goods industry in Canada; see Michael David Bordo and Ehsan U. Choudhri, "Price Flexibility and the 'Law of One Price.' Some Evidence on the Relationship between Canadian and U.S. Industrial Prices, 1956-1975" (Carleton University, unpublished), 6-10, 23.

<sup>34</sup>The degree to which inflation may have been transmitted among the countries represented by Figures 11-17 is a question that is not addressed in this paper. There has been enough uncertainty about whether inflation was transmitted at all that an examination of this more basic issue seemed worthwhile.

hood, the grain and oil price increases were largely responsible for the sudden increase, and the subsequent decline probably represents primarily a restoration of more normal price relationships between traded and nontraded items. In this connection, it is well known that exchange-rate flexibility does not insulate countries from *relative* price changes, that is, from structural changes in the relationship between prices of different classes of goods, including changes effected by quasi-tariffs such as the administered oil price hikes. What has been claimed is that exchange-rate flexibility can insulate a country from *general* inflation across the whole spectrum of goods and services. This claim is not contradicted by the evidence on exchange-rate flexibility presented in this paper; however, that evidence is not conclusive, partly because the experience examined is limited to a few years during which there was a disruptive oil crisis and partly because exchange rates have not been allowed to float freely.

### Conclusion

Although by one common measure there has been an increase in interdependence among industrial countries, the closer interdependence has been accompanied by more, rather than less, dispersion of national inflation rates; the growth of interdependence has not brought national rates of inflation closer together. One likely reason is the advent of greater exchange-rate flexibility. Evidence examined in this paper supports the view that exchange-rate flexibility allows divergence of national inflation rates for internationally traded goods. Moreover, empirical application of a well-known balance-of-payments adjustment model emphasizing nontraded goods suggests that the exportation or importation of inflation across national boundaries can be diminished, if not terminated, by the use of exchange-rate flexibility. Flexible-exchange rates have disadvantages, but transmission of inflation may not be one of them.

### Appendix: Sources and Notes for Figures

**Figure 1.** Commodity Prices, 1900-77.

Source: *The Economist*; March 2, 1974, p. 86, September 6, 1975, p. 80, and all issues from July 1976 to the end of December 1977.

**Figure 2.** Consumer Prices in Selected World Areas, 1970-77.

Source: Staff, International Monetary Fund.

**Figure 3.** Consumer Prices in Seven Industrial Countries, 1962-77.

Source: *International Financial Statistics*, May and July 1978.

**Figure 4.** Yearly Percent Change in Wholesale Prices for Seven Industrial Countries, 1963-77.

Source: *International Financial Statistics*, May and July 1978, except for German data which are from OECD, *Main Economic Indicators*, February and June 1978, and from OECD staff.

Data for United Kingdom and for France are for industrial goods.

**Figures 5-10:** Indexes of Prices for Various Commodities in Germany and in the United States.

Source: U.S. prices: U.S. Bureau of Labor Statistics, unpublished machine run.

German prices for pig iron and steel rods: Statistisches Bundesamt, Preise, Löhne, Reihe 3 prior to 1976 and Reihe 2 for 1976 and later years, *Preise und Preisindices für industrielle Produkte*, various issues. Prices for these two commodities are producer's prices.

German prices for raw cocoa and magnesium: Statistisches Bundesamt, Preise, Löhne, Reihe 2 prior to 1976 and Reihe 3 for 1976 and later years, *Index der Grundstoffpreise*. For these two commodities, import prices were used.

German import prices for raw coffee and raw tobacco were obtained from the Statistisches Bundesamt by special request.

Exchange rates used to compute "U.S. Dollar Equivalent of German Mark Price" are from *Federal Reserve Bulletin*, various issues.

In the sources cited above, the German price series for raw cocoa, magnesium, pig iron and steel wire rods are accompanied by the following note: "Starting January 1968, without value added tax or without import sales tax. Until 1967 inclusive of accumulated sales tax or including equalization tax." German prices for raw coffee and raw tobacco are without tax and duty for all years. There was an additional break in the German price series for steel wire rods which necessitated omitting 1967 data from the chart.

**Figures 11-17:** Balance of Trade and Percent Change in Selected Price Indexes for Various Countries, 1961-77.

Source: Except for the United States, trade data are from *International Financial Statistics*, May 1978 and July 1978. Data are valued f.o.b. For France for 1961 only, f.o.b. import data were estimated by multiplying c.i.f. data by 1962 ratio of f.o.b. data to c.i.f. data. For the United States the data sources are *Survey of Current Business*, June 1977; *Business Statistics*, 1975, pp. 109 and 114; and U.S. Commerce Department News wire BEA, 78-30, May 1, 1978. For France and Italy GDP is used in place of GNP.

Consumer price data are from *Main Economic Indicators, Main Economic Indicators Historical Statistics 1955-71* and supplements, and OECD staff. Data for services component of CPI include rent.

## Discussion

Robert M. Stern\*

The subject of world inflation and its transmission among countries is obviously important and yet difficult to analyze. Fieleke is thus to be commended for undertaking this task. His effort is marred, however, because he does not develop a clear and consistent model from which particular hypotheses can be formulated and tested.

His beginning section on interdependence and inflation illustrates this point. There is first some confusion between the meanings attached to the concepts of openness and interdependence. Fieleke considers the ratio of trade to output as a measure of interdependence and the extent to which inflation is transmitted between countries as an indication of openness. I believe that it would be more useful to reverse the concepts. An economy's openness has typically been measured in terms of the ratio of trade to GNP, although the theoretically correct ratio is that of tradables to nontradables. Interdependence accordingly is to be interpreted as the extent to which international transmission of various kinds of economic changes occurs between countries.

This semantic confusion aside, I was not particularly surprised by Fieleke's conclusion, based upon Table 1 and the simple correlations based upon equation (2), that inflation rates in the major industrialized countries have shown more dispersion in recent years with exchange-rate flexibility than previously when exchange rates were pegged. Had Fieleke started with an explicit international macro model that allowed for alternative exchange-rate regimes, he could have hypothesized this result and then determined if the data confirmed his hypothesis. His calculations thus suggest that even though the degree of openness, as measured by the ratio of trade to GNP, has increased, national inflation rates have become more divergent because of the insulation effects of greater exchange-rate flexibility. This conclusion is confirmed also by the price comparisons that Fieleke makes later for particular goods between the United States and West Germany.

In his second section, Fieleke discusses some general considerations regarding the transmission of inflation under alternative exchange-rate regimes. He focuses here on ratchet effects in price behavior that may arise because of downward rigidities in wages and prices. He observes correctly that downward rigidities are not in themselves an attribute of the exchange-rate

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system and that problems may arise therefore whether exchange rates are fixed or flexible. What he fails to address, however, is the nature of the shocks that may occur and their aftermath. Thus, for example, if we assume an exogenous shock takes place and the exchange rate is fixed, any imbalance that occurs will be financed by changes in a country's international reserves. To the extent that reserve changes are sterilized, domestic adjustment will be delayed. If, however, the exchange rate is flexible, it will change instantly. If the rate depreciated and there were downward rigidities, the effects would be transmitted immediately in comparison to the delay that would be experienced with fixed rates and sterilization. Thus, with given downward rigidities, an exogenous shock that causes the exchange rate to change will be more inflationary than if the rate were to remain fixed.

Fieleke's theoretical analysis of nontraded goods raises a number of interesting issues with respect to the transmission of inflation. However, he is not clear on some important details. For example, he traces through the effects of an increase in a country's money supply on the prices of nontradables and tradables domestically and tradables abroad as if this were the only kind of exogenous change that could occur. It is easy to imagine other possible exogenous changes besides an expansion of the money supply, and it is by no means obvious that the domestic and foreign impacts will correspond to those of a monetary shock. This is all the more true if asset markets and expectational factors are taken explicitly into account from the start. Fieleke assumes for the most part that all the important effects will be experienced through the goods market in terms of the expenditure shifts that will occur in response to changes in relative prices. This is not necessarily incorrect, but it is incomplete and can be misleading with regard to the nature of the adjustments that may occur. To cite one particular example, he claims in footnote 24 that commodity arbitrage "entails an increase in foreign demand for the country whose prices rise in response to foreign price increases." Actually, within the tradable-nontradable goods model, the increase in foreign demand will be infinite if the domestic country's tradable goods prices do not rise fully. Another way of saying this is that arbitrage insures that domestic tradable goods prices *do* rise fully. Contrary to Fieleke's statement in the text to which the footnote is appended, an improvement in the trade balance is *not* a necessary condition for this arbitrage to take place. For example, if domestic expenditure rises at the same time, the trade balance could well deteriorate. Fieleke's error is repeated at the top of page 45. The important theoretical point is that arbitrage of prices of perfect substitutes does *not* require that actual flows take place.

The preceding discussion thus raises the question of what is the appropriate model for determining when a country is exporting or importing inflation. The model that Fieleke has chosen is one that assumes that a monetary disturbance will increase the price of nontradables relative to tradables, thus worsening the trade balance. The country will then be exporting inflation, and its trading partners will be importing inflation, which will be manifested in terms of an increase in the price of tradables relative to nontradables and an

improvement in the trade balance. This is not the end of the process, however, for there will be reserve changes if exchange rates are fixed and the rates themselves will change if they are flexible. Such changes in reserves or exchange rates will, of course, have still further effects in the countries involved.

The problem then is how to model a process of continuous change as compared to a single change such as monetary expansion. Because Fieleke has not been able to resolve this difficulty, his empirical analysis of consumer prices and trade balances in Figures 11-17 is inconclusive. To illustrate, using Fieleke's procedure, in a country experiencing excessive monetary expansion, the price of nontradables should rise relative to tradables, the trade balance should worsen, and it would therefore be concluded that the country is exporting inflation. At a subsequent stage when adjustment is taking place, the price of nontradables relative to tradables should return to its initial position and trade balance restored. Surely one could not label this as a case of a country importing inflation. Fieleke's procedure therefore cannot distinguish unambiguously cases of exporting inflation from cases of importing inflation.

In summary, Fieleke has called our attention to the insulating characteristics of flexible rates. This is by no means a new proposition, but it is nevertheless important to document it empirically. His paper is much less successful, however, in its treatment of the transmission process per se. It would be a useful next step if he and others could develop a more comprehensive model that encompassed the many channels by which international transmission can occur. Alan Deardorff and I have outlined such a model in our 1977 review of the evidence on international economic dependence contained in several large national and linked econometric models.<sup>1</sup> We hope that the work going on at the Federal Reserve Board and elsewhere on multicountry models with well-articulated financial sectors and endogenous exchange-rate determination will enhance our understanding of the international transmission of inflation. This type of model development is to be encouraged because simpler approaches such as Fieleke's cannot cope effectively with the complexities of international transmission effects.

<sup>1</sup>Alan V. Deardorff and Robert M. Stern, "International Economic Interdependence: Evidence from Econometric Models," Research Seminar in International Economics, University of Michigan, Seminar Discussion Paper No. 71 (January 28, 1977).

## Response

Norman S. Fieleke

Robert Stern's comment gives me the opportunity to make several points related to my paper.

Perhaps it will be helpful to note that Stern's "theoretically correct" definition of openness as the ratio of tradables to nontradables is included in the concept of openness used in my paper, for the paper argues that openness to external inflation results from low commercial barriers (including transportation costs) — *i.e.*, *from a high ratio of tradables to nontradables* — and from fixity of the exchange rate; low commercial barriers and fixed-exchange rates produce close correspondence between national movements in uniformly weighted general price indexes.<sup>1</sup> What should be emphasized is that the ratio of tradable to nontradable goods is not at all the same thing as the ratio of actually traded goods (exports and imports) to nontraded goods, or as the ratio of trade to GNP, which need not, in theory, rise with openness. Reasoning along these lines, I did not define interdependence as the transmission of economic changes, because there might be high transmission to one economy of disturbances in the other (due to absence of commercial barriers, etc.) even though the two economies might be so similar that, absent such disturbances, there would be so little trade between them that one would scarcely be affected by the obliteration of the other; it seems peculiar to speak of two such economies as highly dependent on each other.

With respect to rigidities, ratchet effects, and all that, it does seem that under a fixed-exchange rate sterilization may buy some time; but it should also be noted that a currency depreciation and any associated increase in tradables prices must persist for some time before becoming fully built-in in the form of higher wages (since wage contracts generally are fairly long term), so that a temporary shock may produce only a temporary depreciation which does not raise prices in the long run. Also, sterilization may not be a feasible option unless the reserve inflows are small in relation to the economy, in which case the equivalent exchange-rate change might also be relatively small. Finally, sterilization does not shield a country from increases in tradable goods prices determined in foreign markets.

It is true that my theoretical analysis traces through the effects of an increase in the money supply — but not as if this were the only kind of exogen-

<sup>1</sup>With low commercial barriers but without a fixed-exchange rate, a country's internal relative prices remain highly open to foreign influences, but, as is argued at length in the paper, its general price level is not so easily influenced; with insurmountable barriers to international transactions, both relative prices and the general price level would be insulated.

ous change that could occur. The analysis also deals with general cost-push inflation unaccompanied by increases in the money supply.

On the matter of "arbitrage," my paper merely posits that with fixed-exchange rates an inflation in a large country will not only raise prices in other countries but improve their trade balances with the inflating country. It is hard to accept as a working hypothesis some concept of "arbitrage" which asserts that a country's prices will rise in sympathy with generalized inflation abroad without any associated international flows.<sup>2</sup>

Certainly the model employed in Figures 11-17 has important limitations (as would be the case for any other abstract theoretical model), and some if not all of the limitations were pointed out in various places in my paper. Nothing more was claimed for the model than that it identifies necessary, but not sufficient, conditions (p. 49) for showing that generally rising *prices* are being transmitted between countries (provided the countries involved have significant nontradable sectors). If those necessary conditions could not be detected with the (imperfect) data available, there would be at least a presumption that inflation was not being transmitted, a finding which would be of some interest; if the necessary conditions were detected, then the proper approach — which I could pursue only a little way in the paper — would be to investigate whether those conditions were produced by factors other than the transmission of inflation. More elaborate models might be useful, but perhaps such models can occasionally be improved by ascertaining the reasons for any inconsistencies between their results and the results obtained from smaller models.

<sup>2</sup>Of course, a government might undertake inflationary measures designed to prevent a trade-balance improvement or balance-of-payments surplus with another inflating country, but in that case the government is generating its own inflation rather than waiting for it to be imported.