# PRICE BEHAVIOR IN THE LIGHT OF BALANCE OF PAYMENTS THEORIES

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# PRICE BEHAVIOR IN THE LIGHT OF BALANCE OF PAYMENTS THEORIES*

Irving B. Kravis and Robert E. Lipsey

The purpose of this paper is to describe the behavior of that subset of prices and price indexes that is relevant to the theory of balance of payments adjustment. The theoretical writings on the balance of payments may be viewed at this juncture as falling into two main groups -- the "standard" theories and the more recent monetary theories. Each of these is examined to determine the assumptions and predictions made about particular kinds of prices, and the empirical evidence regarding these prices is then set out. Although some assessment of the theories -- solely from the price aspect -- is offered, the emphasis is on the price structure and price behavior that ought to be captured in a satisfactory theory of the mechanisms of international adjustment. For pragmatic reasons, attention is placed mainly on the theory relating to exchange rate changes rather than on the explanation of adjustment with fixed exchange rates.

## The Theories

The standard theories which held sway in the 1950's and 1960's consisted of three major components -- the price elasticity, multiplier and absorption approaches.** Emphasis on one or the other of these approaches differed with the time, the purpose and the analyst, but as time went on it was more and more unusual to find reliance placed on one to the exclusion of the others.

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*This paper draws on earlier studies carried out with support from the National Science Foundation and the U.S. Department of Commerce. The views reported here do not necessarily reflect those of either agency.

**These approaches are set forth in the well known contributions by Viner, Robinson, Metzler, and Alexander. See J. Viner, Studies in the Theory of International Trade (New York: Harper & Brothers, 1937), especially pp. 314-326; J. Robinson, "The Foreign Exchanges," Essays in the Theory of Employment, Second Edition, reprinted in Readings in the Theory of International Trade (Philadelphia: Blakiston, 1949); L. Metzler, "The Theory of International Trade," in H. Ellis, ed., A Survey of Contemporary Economics (Philadelphia: Blakiston, 1949); and S. Alexander, "Effects of a Devaluation on a Trade Balance," American Economic Review, December 1952. For an effort to cope with all three of these strands of the "standard" theory for didactic purposes, see C. Kindleberger, International Economics, 4th edition (Homewood, Ill.: Irwin Publishing Co., 1968).

The monetary theories, much more cohesive but still varying in some important details from one writer to another, were advanced largely by R. Mundell and H.G. Johnson and their students, beginning in the late 1960s. These theories regard the balance of payments as a monetary phenomenon, and in contrast to the standard model tend to minimize the effects that balance of payments adjustments per se can have on relative prices and quantities traded.*

Prices in the standard theory

Prices, which concern us here, are viewed very differently in the two sets of theories. Curiously enough, the standard theory, in which prices play an important role, is silent on the nature of the world price structure. For its purposes, prices (after due allowance for transfer costs) may or may not be the same for identical goods in different countries, and there may or may not be discriminatory pricing between domestic sales and exports or between exports to different destinations.

In the elasticity approach, the part of the standard package for which prices play the most central role, the basic assumption is that exchange rate changes can produce changes in the prices of one country's goods relative to those of another country's, and that these price changes are the key factors in inducing quantity changes that adjust values of exports and imports and hence the balance

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*An early exposition was by H.G. Johnson, "The Monetary Approach to Balance of Payments Theory" in his Further Essays in Monetary Economics (London: George Allen & Unwin, 1972). See also A. Collery, International Adjustment, Open Economies, and the Quantity Theory of Money, Princeton Studies in International Finance, No. 28 (Princeton, 1971); v.N. Whitman, "Global Monetarism and the Monetary Approach to Balance of Payments," with comments by W.H. Branson, D.I. Fand, L.B. Krause, and W.S. Salant in Brookings Papers on Economic Activity, 3: 1975; H.G. Johnson, "The Monetary Approach to Balance of Payments Theory: A Diagrammatic Analysis," The Manchester School, September 1975; and J.A. Frenkel and H.G. Johnson entitled The Monetary Approach to the Balance of Payments (Toronto and Buffalo: University of Toronto Press, 1976). The last volume contains empirical as well as theoretical essays; see also S.P. Magee, "The Empirical Evidence on the Monetary Approach to the Balance of Payments and Exchange Rates," American Economic Review, May 1976.

of trade. The analysis is devoted to an account of the elasticity conditions which will lead to an improvement of the balance of payments following a depreciation of the currency.

More specifically, the implications of the standard approach for the behavior for prices and for price-induced quantity changes following an exchange rate change may be set out as follows:

1. The own-currency prices of both export- and import-type goods will rise in the depreciating country and/or fall in the appreciating country relative to nontraded goods prices.

2. These price shifts induce increased net exports from the depreciating country. Also, the price changes should lead to an increase in the ratio of exports to production and a decrease in the ratio of imports to domestic absorption.

3. The terms of trade (the ratio of the export price index to the import price index) are likely to deteriorate for the depreciating country, although this is not inevitable. The outcome depends on the pattern of the elasticities, but since a country is apt to be more specialized in its exports than in its imports, the depreciation is more apt to lower the world prices of its exports than the world prices of its imports.

4. The overall price level of the depreciating country adjusted for the exchange rate change will diminish relative to that of the appreciating country. This follows from #1 if the prices of tradables are the same everywhere or if their price changes are more closely linked than the price changes for nontradables in different countries.

5. The price shifts will lead to changes in the commodity composition of exports and imports. Even uniform (in proportion to exchange rate changes) changes in all traded goods prices (as in a small price-taking country) would lead to different quantity changes for the various traded goods because of

differences in the elasticities of substitution between traded and nontraded goods in both production and consumption.

6. For a country which is sufficiently important in at least some commodities either as a buyer or seller, own-currency price changes following a depreciation will not be uniform across all traded goods. The more important the country is in a particular commodity market, the less, other things being equal, will the own-currency price change as a result of the depreciation and the more will the world price(s) alter. Thus both the price structure of the depreciating country and that of the rest of the world should change when an important country appreciates or depreciates.

The possibility, left open in the elasticity approach, that prices of traded goods need not be identical in different countries provides somewhat more scope for terms of trade changes, particularly if there is incomplete specialization (in the sense that each country produces some of the goods it imports).

The price predictions of the standard approach to a devaluation may, conceivably, not turn out to be correct either because there are important omitted variables or because it is based on the wrong view of price behavior. By its concentration on micro-prices, the elasticity approach neglects the macroeconomic variables taken into account in the absorption and monetary approaches. Its predictions may not come to pass if validating macroeconomic policies are not followed, and if appropriate policies are followed it may be difficult to separate the effects

of those policies from the effects of the balance of payments deficit or of the devaluation. With respect to price behavior, the law of one price may operate to make impossible some of the relative price changes (more on this point below).

Prices in the monetary theory

The price behavior anticipated by the monetary theory is very different. The general price level is given a central role since it determines the real value of nominal assets including money and internationally traded debt.* Because there is assumed to be a perfect international market for assets, at least for the advanced industrial countries, changes in price levels in domestic currency have to be offset by changes in exchange rates -- that is, the purchasing power parity theory of exchange rates holds.

Relative prices are therefore assigned no role or a purely transitory one.** This is accomplished by a fairly rigorous specification of the nature of the world price structure. In its purest form the monetary theory holds all prices -- of nontradables as well as tradables -- to be identical (after allowance for transfer costs). When the theory is focussed on price changes it maintains that the price levels of the countries move together rigidly. This law of one price applies particularly among the more industrialized countries which are viewed as constituting a single well integrated market. Prices of traded goods are held together because there is very high substitutability among the products of the industrial countries

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*Frenkel and Johnson, op. cit., "Introductory Essay," p. 23.

**"... since the analysis is concerned largely with general price and level movements that restore the initial real equilibrium of the economy, there are no changes in the relative prices of nontraded goods to worry about (and changes can only be transitory, part of the mechanism of restoration of monetary equilibrium)." H.G. Johnson in Frenkel and Johnson, op. cit., p. 263.

and arbitrage or even the threat of arbitrage keeps prices uniform. The prices of nontraded goods are kept in line by the substantial substitutability that exists between traded and nontraded goods in consumption and among the inputs for traded and nontraded goods in production.* This across the board application of the law of one price enables the monetary theory to enjoy simultaneously the virtues of great simplicity and of great power: if prices must be the same the world over, any changes in the domestic supply of money not offset by changes in the domestic demand for money can only find an outlet in the balance of payments; people will not hold more money than they want, and an excess supply, for example, will be spent on foreign goods or foreign assets thus creating a balance of payments deficit.

For practical purposes, however, most writers of the monetary school apply the law of one price only to tradables and take account of the possibility that the prices of nontraded goods may differ between countries, although it is sometimes asserted and in other cases implied that these differences are transitory

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*"... the monetary models almost invariably assume ... that a country's price level is pegged to the world price level and must move rigidly in line with it. One justification for this assumption is that, at least among the advanced industrial countries, industrial competition is so pervasive that elasticities of substitution among the industrial products approximate more closely to infinity than to the relatively low numbers implicit in the standard model." Johnson (1972), pp. 235-36.

"... even if goods cannot be traded, the factors used in producing them generally can be, in the sense that in the relevant run of time a barber has the alternative of being a machine tool operator producing machinery or consumers durable goods for export, or instead of imports, and the price of haircuts must be such as to give the barber labor earnings comparable to the wages paid in exporting (and import competing) industries. Secondly, even where there are no comprehensive direct links between costs of production of tradable and non-tradable goods,... the prices of non-traded goods will be linked to the prices of tradables through tastes, supply conditions, and the overall budget constraint, and fixed given the other factors and the relation between domestic expenditure and income." J.A. Frenkel and H.G. Johnson, op. cit., "Introductory Essay," pp. 27-28.

and that they will disappear in long run equilibrium.* In the short run or transition period depreciation lowers the price of nontraded goods at home and raises their price abroad and induces substitution just as in the elasticity approach. Indeed,

> "... while ... short run equilibrium is characterized by an exchange of traded goods for real balances and hence the absorption effects of a devaluation are emphasized, the role of the relative price of home goods is nevertheless crucial in the adjustment mechanism."**

Traded goods are still subject to the law of one price, a specification that is not in the least essential to the standard theory but which is usually assumed as a matter of course by elasticity theorists. A balance of payments disturbance arising out of monetary causes will not bring about any change in the terms of trade in the new equilibrium as compared to the old one; in the course of the adjustment process the terms of trade for a depreciating country may either improve or worsen.

Comparisons of price behavior in the two theories

What then are the similarities and differences between the two sets of pre-

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* "The existence of non-traded goods does, however, become relevant in the empirical application of the theory, in both the static case when prices may differ from the prediction of simple purchasing power theory owing to differences in the money prices and expenditure weights of such goods between countries, and the dynamic case of growth of productivity at different rates in the traded and non-traded sectors, which implies different price trends in the two sectors when factor mobility equalizes factor prices between them." Frenkel and Johnson, ibid., p. 28.

"To put the point more extremely than is necessary for present purposes, in a general equilibrium of prices the fixing of any one price by trade determines all the rest. The adjustment to the real equilibrium of relative prices, which must be achieved eventually, can be quick or slow. The monetary theory assumes that it is quick." D.N. McCloskey and J.R. Zecker, "How the Gold Standard Worked, 1880-1913," in Frenkel and Johnson, op. cit., p. 376.

** R. Dornbusch, "Devaluation, Money, and Nontraded Goods," American Economic Review, December 1973, p. 880. This paper is reprinted in Frenkel and Johnson with the comment in the preface that it disposes "... conclusively of the criticism that the monetary approach is limited by its assumption that there is a world market price for all goods produced." (Op. cit., p. 11.)

dictions? To a considerable degree, the two theories stress different aspects of price (and quantity) behavior and are more like ships that pass each other in the night than like ships that collide head on. The elasticity approach concentrates on the short run process of adjustment. It stresses the real changes that are the consequences of exchange rate changes: there are shifts in the overall volume of traded goods, changes in the quantity composition of exports and imports, and changes in price structures with respect to (a) traded versus nontraded goods, (b) various traded goods both in own-currency and in foreign currency prices when a large country alters its exchange rate, and, possibly (c) the terms of trade. There is nothing in the elasticity theory to suggest that these changes are temporary.

The monetary theory concentrates on the long run equilibrium position. It anticipates that the law of one price will have wide application -- even to nontraded goods after a lag. When exchange rates change, prices will adjust quickly so as to maintain the world-wide equality of prices for individual products. There is because of this quick adjustment little opportunity for quantity changes, and those that do occur are apt to be temporary. The monetary approach thus tends to minimize the possibility of changes in the quantity composition of exports and imports or in their price structure.

Not all of the other changes anticipated by the elasticity approach would be inconsistent with the monetary theory. Temporary changes in the relationship of traded to nontraded goods prices are accepted. Even changes in price structure, especially if they were identical in own currency and world prices, would appear more to limit the sweeping simplicity of the theory than to challenge it on grounds that are fundamental to it.

Although the elasticity writers talk of the "short run" process of adjustment and the monetary writers of the "long run," this betokens a difference in the stages of the economic process that are the focus of inquiry, rather than a difference in the duration of the time periods under consideration. Most analysts using the elasticity approach would expect the adjustment process to work itself out in a period of say 2 to 5 years. As for the "long run" of the monetary school, one adherent, M. Mussa, writes that since "the horizon of the policy maker is typically much shorter than a decade" and also because of problems of "sorting out empirical relationships which involve very long lags, "... the advocacy of a monetary approach to the balance of payments necessarily involves the assertion that these 'longer-run consequences' materialize within a time horizon of two or three years."* Hence there is not much difference between the calendar time periods dealt with by the two approaches, but the elasticity writers focus on the changes within the period while the monetary writers stress the equilibrium conditions that must emerge at the end of the period, given the controlling role of monetary factors in setting off the adjustments.** Within the adjustment period, in the more realistic versions of the theory, there can be temporary deviations from the behavior of prices that characterise equilibrium situations. For example, changes in the traded/nontraded price ratios in opposite directions in deficit and surplus countries may interfere with the close correlation between price level movements generally expected.***

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* M. Mussa, "Tariffs and the Balance of Payments: A Monetary Approach," in Frenkel and Johnson, op. cit., p. 193. R.T. Selden has suggested a 3 or 4 year period. R.T. Selden, "Monetary Growth and the Long-Run Rate of Inflation," American Economic Review, May 1975, p. 125.

** A basic feature of the monetary approach, Mussa writes, is "a concentration on the longer-run consequences of policy and parametric changes for the behavior of the balance of payments, coupled with an eclectic view of the processes through which these longer-run consequences come about." Op. cit., p. 193.

*** Johnson (1975), p. 248.

We have not tried to set out all the contrasts between the two appraoches. Our focus on prices has led us to ignore some very important differences in predictions -- as, for example, the anticipation of the standard theory that growth produces balance of payments deficits while the monetary approach reaches the opposite conclusion.

A potentially important omission in both of the theories, already alluded to, is the lack of any attention to the possibility of price discrimination in international trade. In previous work, the present authors suggested there is in fact widespread price discrimination and that this leads to a further price-related mechanism of adjustment.* A depreciation of the exchange rate will appear to a firm able to price differently in home and foreign markets as a rise in foreign demand (in terms of its home currency). This will enable the firm to raise its export price (still in home currency) relative to its domestic price, and the resulting improvement in profit margins in export relative to domestic sales will lead it to shift its sales towards exports.** An appreciation will have the opposite effect of shifting sales away from the foreign to the home market. The balance of payments consequences of these shifts can of course be readily assessed in terms of the elasticities of supply and demand and the macroeconomic conditions considered in the standard approach.

## From Theory to Measurement: Some Questions

It is evident that a testing of the alternative theories would take us far beyond the realm of prices into the behavior of traded quantities and of macro

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*I.B. Kravis and R.E. Lipsey, "Export Prices and the Transmission of Inflation," American Economic Review, February 1977.

**For an absorption-type approach turning on profit margins, see W. Ethier, "An Allocational View of Devaluation," Discussion Paper #309, July 1975, Department of Economics, University of Pennsylvania.

variables including domestic money stocks, international reserves and capital movements.

Our aim, as we said at the outset, is much more modest. It is to examine the behavior of prices in the light of the assumptions and predictions made about prices in the two sets of writings about the balance of payments. Some of these views of prices are what might be called "end-product" or "final outcome" views -- that is, they are assumptions or predictions about price relationships that should be observable since they refer to what is supposed to exist at any moment of time; all the interdependencies are assumed to have worked themselves out to produce the result that will always be found in the real world. The application of the law of one price to traded goods, for example, falls in this category. In other instances, the movements of prices or changes in price relationships that are observable at a moment of time are not independent of other (non-balance of payments) variables and an examination of such prices outside of an econometric model which takes the interrelationships into account is of more limited value. The predictions of the elasticity approach tend to fall in this category. They depend on validating macroeconomic policies which may or may not be followed; if validating policies are not pursued the effects may be offset and if they are followed they may dominate the outcome.

We nevertheless present the evidence on the behavior of the relevant price variables. A main reason for this is that relative to the volume of theoretical writings on the balance of payments -- all of which must make some hypotheses and/or predictions about price behavior -- there has been remarkably little empirical work on prices in connection with the mechanism of adjustment, and much of the work that has been done has been based on unsatisfactory data. We think it worth while therefore to set out the evidence -- some of which has not been available before or if available not assembled for the purpose -- even

though part of it requires analysis beyond what we attempt here before its bearing on different theories can be fully assessed.

More specifically, we shall concentrate on two aspects of the price behavior discussed in balance of payments literature -- the law of one price and the behavior of relative prices. The "relative" prices that are found in the literature and that concern us are (a) prices in one country vis a vis those in another, (b) export prices relative to import prices and (c) tradables prices relative to nontradables prices.

As is so often the case, difficulties are encountered in designing empirical measurements that match the theoretical concepts. These difficulties, largely of a definitional character are found at every level of aggregation that has come into our discussion of the theories: the meaning of the general level of prices; the definition of the various subsets of goods, particularly traded and nontraded goods; and the definition of individual products or product categories.

Price levels

In the theoretical discussions of relative price movements, it is often adequate to carry on the discussion in terms of a one-commodity model. For empirical purposes it is natural to regard a general price index as the matching measure, but this creates difficulties about some of the arguments about prices. When the law of one price is involved in such models, for example, it is not clear whether we should take the meaning to be that (a) the time to time movement of the prices of identical commodities must be the same in all countries after adjustment for exchange rate changes, or that (b) the exchange-rate-adjusted movements in overall price levels in different countries must be identical (i.e., that the purchasing power theory of exchange rates is valid). Since the overall price movement of any country has to be some kind of weighted average of the

movement of individual prices, both (a) and (b) cannot be true simultaneously unless the relative importance of commodities is the same in each country or unless all commodities have identical price movements.

If we are to compare price level changes, we must choose among three measures -- GDP implicit deflators, wholesale prices and consumer prices. All suffer, for purposes of international comparisons of price movements, from the fact that the methods used in their preparation, and sometimes the constituent elements as well, differ from one country to another.

Of the three, the GDP implicit deflator has the strongest claim to represent a general measure of a country's price level.* It is based on a conceptual framework that assigns an appropriate weight to each good, whatever the classification chosen -- as for example, between tradables and nontradables. Wholesale price indexes, historically the most widely used in comparisons of price level changes,** have no clear conceptual framework, as their official producers are sometimes candid enough to say.*** Because of this lack they are probably more subject to international differences in scope than either implicit deflators or consumer

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*This seems to be the view also of Officer who has recently produced a comprehensive review of the purchasing power parity literature, including parities based on costs as well as on the several price indexes. See L.H. Officer, "The Purchasing Power Parity Theory of Exchange Rates: A Review Article," IMF Staff Papers, March 1976.

**See Officer's survey of empirical studies, op. cit., pp. 33-49. An important reason is of course that GDP deflators were not widely available before World War II.

***"Though general wholesale price indexes have been calculated by many countries for years there is no precise answer to the question of what such an index measures. This is so because the index cannot be associated with any adequately definable value aggregate." Statistics Canada, Prices and Price Indexes, July 1975, p. 94.

price indexes.* However, the wholesale price indexes of the different countries are similar in that they include a higher proportion of tradables -- concentrating as they do on commodities -- than either the implicit deflators or the consumer price indexes. Since the time to time movements of tradables are presumably more similar in different countries than are nontradables, wholesale price indexes may be expected to be biased in the direction of uniformity of price movements. Another source for such bias is that the indexes usually overweight primary products and often completely omit highly differentiated products.

Consumer price indexes are not subject to the same conceptual deficiencies as wholesale price indexes but they provide partial rather than comprehensive measures of price level changes.** In 1970, for example, private consumption represented only 51 percent of GDP in Japan and from 54 to 64 percent in Germany (F.R.), France, U.K., Italy and the U.S.*** Consumer price indexes do, of course, include services as well as commodities, but since they typically exclude publicly financed services, their scope varies from one country to another in accordance with the division between household and public financing of certain services such

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*For example, the French wholesale price index in the late 1960s did not include prices for machinery or equipment whereas these categories made up 28 percent of the weights in the German index of producers prices of industrial products. Neither the French index nor the German index included food or agricultural products while in the Italian index of wholesale prices, 29 percent of the weights consisted of agricultural products and products of the food and related industries, and another 19 percent, products of agricultural manufacturing industries other than foodstuffs. The indexes of Japan, the United States, and the United Kingdom were more comprehensive in their commodity coverage. Practices also differed among the countries with respect to the inclusion of mining and quarrying, electricity, and in the treatment of complicated engineering goods ranging from transistors to ship building. See the brief descriptions of the indexes in the 1972 Supplement to the Statistical Yearbook and Monthly Bulletin of Statistics, United Nations, New York, 1974, (ST/ESA/STAT/SER.S/SUPPL.1).

**However, see the case made by Professor Houthakker for the use of consumer prices in connection with the purchasing power parity theory. H. Houthakker, "Exchange Rate Adjustment," Factors Affecting the U.S. Balance of Payments, Joint Economic Committee, 87th Congress, 2nd Session, December 14, 1962, pp. 289-304. See also P. Samuelson's comment on this in his "Theoretical Notes on Trade Problems," Review of Economics and Statistics, May 1964, pp. 150-152, and Officer's review, Op. cit., pp. 23-24.

***Calculated from IMF International Financial Statistics, January 1976.

as health and education.*

The scope of implicit deflators is more likely to be similar since they are pegged in the main to a common accounting framework (the U.N. System of National Accounts**). Differences are greater when it comes to practices for factoring the current value series into price and quantity changes.*** With respect to consumption, however, the similarities are more striking than the differences. The virtually universal practice is to use appropriate component series of the consumer an wholesale price indexes to deflate expenditures at a relatively disaggregated level. Differences tend to be greatest in problem areas such as rents and in capital formatic and government final expenditures; in some of these areas quantity indicators are occasionally used to produce quantity indexes and the price indexes are then derived from the expenditure ratios. Where, as is more usual, price indexes are used, the nature of the price series upon which reliance is placed varies widely. The diversity is particularly great for construction where input prices are employed in some cases and a list of finished construction outputs in other cases, the list differing in composition from one country to another.

All these individual price series are used to deflate disaggregated expenditure

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*There are also some important differences in weights. For many of the countries including France, Germany and Italy, around 45 percent of the weights are represented by food, beverages, and tobacco. In the U.S. index, these categories account for less than a quarter of the weights. Rent and household operation made up 15 percent of the weights in Italy, 25 percent in Germany, and 33 percent in the U.S. U.N., Supplement....

**U.N., A System of National Accounts, Series F, No. 2, Rev. 3 (New York: United Nations, 1968). For most of the period under study, the data for most of the industrialized countries are based on the 1953 version of the SNA (System of National Accounts).

***Report of the Secretary General, Country Practices in National Accounting at Constant Prices, U.N. Economic and Social Council, Statistical Commission (Geneva: United Nations, 24 May 1974 (E/CN.3/464) and a follow-up document with the same title by the Secretariat, 23 May 1975 (ST/ESA/STAT.79). The implicit deflators for GDP as a whole used in the following sections are, except when noted otherwise, the "correlative price indexes" reported in the U.N. yearbooks of national accounts statistics. (See note on p. 33.)

components. The resulting detailed constant price series are aggregated to obtain GDP, and the implicit GDP deflator is then derived by the division of this constant price series into the current price series. The effect is to produce a current weighted (Paasche) price index for each period which is not in principle comparable with the index for any other period except the base period. This is a nicety with respect to which we shall follow a well beaten path in ignoring.

From the standpoint of the monetary approach, the chief factor influencing the choice among the three indexes would appear to be the one that is most relevant to the demand for money. If the demand for money is conceived of mainly in terms of households, the consumer price index, even with its differences in coverage arising from differences in the financing of services such as health and education, is the most appropriate index. It is perhaps for this reason widely used in the writings of the monetary school,* but even from the standpoint of the demand for money balances the GDP deflator has the advantage of taking at least some account of the non-household holders of money.**

Specialized subsets of goods

For empirical purposes it is necessary to have an operational definition of traded and nontraded goods and of exports and imports. One easy solution for exports and imports is to assume that each country is completely specialized in a particular set of exports. This assumption was embodied in Viner's interpretation of the classical theory of the adjustment mechanism: "... the role of variations

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*See, for example, the empirical essays in Frenkel and Johnson, op. cit.

**In the U.S. at the end of 1974 households held 63 percent of demand deposits and currency, and 77 percent of time and savings accounts of commercial banks. (Flow of Funds, Assets and Liabilities Outstanding: 1974, Board of Governors, Federal Reserve System, May 1975.)

in prices ... relates not to relative variations in prices of identical commodities in different markets, but to relative variations in prices of different commodities in the same markets, and primarily to relative variations in prices as between export and import commodities."* Disturbances to international equilibrium thus resulted in changes in the terms of trade which helped restore the equilibrium.

This simple solution is not satisfactory for major industrial countries like the U.S. or Germany because some goods may appear on both the export and import lists at different times or even at the same time; there are likely to be continual changes in the lists of commodities that are exported or imported, both additions and deletions occurring each year.

Also, there is a need to distinguish between traded and nontraded goods. Viner proposed to define a domestic commodity as one that does not ordinarily cross a national frontier and whose price is not tied so directly to the prices of similar products abroad that the differential between the domestic and the foreign price approximates the cost of transportation.** The implementation of this definition would be very onerous since it would require a price comparison for each good before it could be categorized. Also, the definition has the disadvantage that it might lead to the classification as domestic goods of internationally traded commodities for

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*Viner (1937), p. 319. See also his Canada's Balance of International Indebtedness, 1900-1913 (Cambridge: Harvard University Press, 1924), p. 206f. Collery regards this explanation as "implausible" and "silly". "Internationally it assumes that if, on an international gold standard, gold were redistributed from Guatemala to Colombia, the price of bananas would fall in Guatemala in proportion to the decrease in the money stock and the price of coffee would rise in Colombia in proportion to the increase in money there." (op. cit., pp. 26-27). However, earlier Collery recognizes that a change in relative demand (e.g., following a transfer from one country to another) could alter the terms of trade if the marginal preferences of the two countries were different and if supplies were not perfectly elastic in one of the countries. However, Collery denies that changes in the terms of trade would contribute to the restoration of equilibrium as Viner held.

**Viner (1937), p. 326.

which discriminating pricing prevails.

Recently Aukrust has suggested that the appropriate distinction is between "exposed" and "sheltered" industries, the former consisting of those that market their products abroad or face foreign competition on domestic markets and the latter consisting of those that are relatively free of foreign price competition.* From the standpoint of tracing the transmission of price effects this puts the emphasis where it belongs, although if one is concerned with production consequences the distinctions between the absorption of home-produced and import goods and between production for the home and foreign markets may still be important.

There are several devices for coping with these definitional problems in empirical work. One way is to select certain categories of goods for which separate price indexes are available and which clearly fall in one class or the other. Services, for example, may be treated as archetypal nontraded goods and manufactures as archetypal traded goods. Within manufactures, producers durables constitute a category which are apt to be more traded relative to their production than most other manufactures. Agricultural products, which are also widely traded, have the disadvantage that the industrial countries maintain substantial market barriers. Another possibility is to divide all of GDP into "commodities" consisting of the output of agriculture, manufacturing, mining, and/possibly construction on the one hand, and "services" consisting of the rest of GDP on the other hand; commodities could then be regarded as tradables and services as nontradables.

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*O. Aukrust, "PRIM: A Model of the Price and Income Distribution Mechanism of an Open Economy," Review of Income and Wealth, Series 16, No. 1.

An alternative is to include all commodities and to weigh each individual commodity by its relative importance in domestic shipments, exports and imports, respectively, in turn. This procedure would produce a different price index for each of the three classes. Its disadvantage is that it may not be sensitive enough to distinguish clearly the alternative price movements of the three groups of commodities; this failure is more likely to occur if the weights for the three classes are similar. Another disadvantage is that it assumes that the wholesale prices are adequate indicators of the prices of imports and exports. We have reason to believe, as will be seen, that this assumption is unwarranted, but it still may be claimed that the domestic prices of those goods that are traded are more correlated with their own prices in international trade than are the domestic prices of nontraded goods with the prices of traded products.

Another method, found in the literature, is to use the ratio of the GDP implicit deflator (or sometimes of the consumer price index) to the wholesale price index as an indicator of the movement of the nontradables/tradables price ratio on the ground that the wholesale price index is more heavily weighted with tradable goods.

Finally, there are a few cases in which genuine export and import price indexes (not unit value*) indexes are available. It is then possible to use the implicit deflator or the general wholesale price index, or the component of that index relating to domestic prices if available, to represent nontraded goods in comparison with the export and import price indexes.

Defining individual commodities

Although a recent interpretation of Hume holds that his view of the adjustment mechanism involved different prices for the same goods in different countries,**

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*For the defects of unit value indexes as measure of price movements, see I. Kravis and R. Lipsey, Price Competitiveness in World Trade (New York: National Bureau of Economic Research, 1971), pp. 4-5. Many studies dealing with the matters treated here are flawed by treating export and import unit value series as though they were price series.

**Collery, op. cit., pp. 25-26.

it is almost always taken for granted in discussions of balance of payments theory that the law of one price applies to traded goods. This, as previously noted, is an essential assumption for the monetary approach but not for the elasticity approach even though writers using an elasticity framework usually make the same assumption as a matter of course. Price differences attributable to transfer costs (transport costs, duties, etc.) are, of course, allowed for, but since these costs can usually be assumed to vary little relative to the product price over a short span of years, identical traded goods are taken to have the same price movements in all countries. The swift price adjustments anticipated by the monetary theory imply that exchange rate changes should not alter the price relationships among different countries of the world when prices are converted to a common currency at the prevailing rates of exchange of each day.

As part of our investigation of the applicability of the law of one price, we shall present evidence below pointing to substantial differences in price levels and movements for goods in the same 4- or even 5-digit SITC categories* when exported by different countries or when sold at home and abroad by the same country. For example, German export prices (in dollar terms; i.e., adjusted for exchange rate changes) for "locks, padlocks and keys therefor of miscellaneous metal" (SITC 698.1) rose by 104.9 percent between 1970 and 1974 while U.S. export prices rose by 23.3 percent. Is this evidence that the law of one price does not apply here? One possibility is to answer this question in the negative or at least to reserve judgment on the ground that the

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*United Nations, Standard International Trade Classification, Revised, Statistical Papers, Series M, No. 34 (New York: United Nations, 1961).

internal composition of the exports within the category may differ between Germany and the U.S. One could go even further and define products or commodities in such a way that any price difference between two items means that they are different goods. Such a decision would not be entirely unreasonable; differences in the terms of sale -- credit, delivery dates, before and after sales service, etc. -- may involve such different bundles of benefits in two purchases even of physically identical goods that the prices would not be the same even under perfect competition.

But this would be to make the law of one price prevail by assumption, and would in any event salvage little for the monetary approach notion of speedy price adjustments for traded goods. The composition of the exports of two countries for the same 4-digit category may in actual fact differ, and this may produce some differences in the price indexes for the category as between the two countries. But even if the differences in price movements stem entirely from differences in composition, the large differences such as the one cited above and those found below for other 4-digit categories, including "pumps and centrifuges" and "tractors other than road tractors" do not point to the high degree of substitutability between the exports of major industrial countries that is assumed in the monetary approach. At the disaggregated level, our decision to treat the things falling within 4- or 5-digit SITC categories as like products would not appear to bias the results against the monetary approach.

Criterion of similarity of price movements

This discussion brings us to another thorny question that need not be answered in theoretical discussions but for which a criterion is required in empirical work. In theory, it is enough to say that price movements are or are

not the same, but when we examine actual price series we find various degrees of similarity. How alike do prices or price movements have to be so that we can say they satisfy the law of one price?

A number of studies directed at the empirical testing of the monetary theory of the balance of payments answer this question by comparing the similarity of the behavior of prices in different nations with the similarity of price behavior for similar commodities in different regions;* the inter-regional variation of prices in an economy considered to be highly integrated such as that of the United States is used as a standard against which international price variation may be measured. If it is found that the similarity of price movements in different countries is as great as the similarity of price movements within different regions of the country taken as the standard, it is concluded that the international economy is as integrated as the domestic economy of the standard country. This measure of the openness or the degree of integration of national economies may have its uses (as, for example, in explaining the relationship between commercial policy and economic growth), but it has its limits as an empirical test of the monetary theory of the balance of payments. Where the similarity of price movements is low, both within the standard country and among countries, the monetary theory may apply to neither type of situation. There is ample scope not only for differential price movements but also for price-induced changes in real variables such as flows of goods and unemployment.

Indeed, even high coefficients of correlation may conceal shifts in relationships that are economically important. For example, the $\bar{r}^2$ between annual changes in German export prices and in German domestic prices for manufactured products

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*See D. McCloskey and R. Zecher, "How the Gold Standard Worked, 1880-1913," J. Frankel and H.G. Johnson (eds.), The Monetary Approach to the Balance of Payments, (London: Allen and Unwin; Pacific Palisades, Calif.: Goodyear, 1975).

between 1954 and 1974 is 0.92. Despite the high correlation, however, the ratio of export to domestic prices varied over an 8 percent range (taking the relationship in 1963 as the base, the high was 105.8 in 1956 and the low 97.8 in 1973). This seems small, but, as we have argued elsewhere, the variations were large enough relative to profits/sales ratios to make substantial differences in the relative profitability of exports and domestic sales and hence to produce significant shifts in exports relative to domestic shipments.*

This suggests that the criterion of the similarity or dissimilarity of price movements might be an analytical one, based on the impact of the differences on quantity changes. If the divergence in the price movements of, say, German and U.S. exports were great

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*The German domestic prices in this comparison were re-aggregated from the most detailed level available with the use of 1963 German export weights. Kravis and Lipsey, "Export Prices and the Transmission of Inflation," American Economic Review, February 1977.

enough to produce a shift in relative quantities, we could say that the price movements could be regarded as different for practical purposes. We would still be faced with the issue of how big the quantity change could be and still have the price differences not violate the law of one price. Also, owing to product to product differences in demand elasticities, we would be in the position of judging differently the same percentage deviation between different pairs of (for example) German and American export prices.

In the empirical work which follows, we do not attempt to apply a fixed criterion for assessing whether the data do or do not conform to the law of one price. We offer our judgment in each case and cite the quantitative criteria suggested by others where we have found some, but regard as our main contribution a clear presentation of the differences so that each reader will be able to form his own opinion.

The identification of historical periods for the observation of price behavior

A study of price behavior during the adjustment process under fixed exchange rates would be faced with the very difficult task of identifying historical periods of exchange rate equilibria and interim periods when the adjustment mechanism was supposed to be operating. We try to avoid this briar patch by concentrating on the effects of exchange rate changes.

For the standard approach, the period following an exchange rate change is the period when the expected price changes are supposed to occur. The behavior of the terms of trade, the relationships of nontraded goods prices relative to traded goods prices, and the behavior of real variables in the adjustment process can all be studied as far as the elasticity approach is concerned for periods following exchange rate changes.

Some attention is given in the literature also to the period before the exchange rate change during which, it is often held, there will be a growing overvaluation of the currency. One would expect thefore to observe in the period preceeding an exchange rate change, prices in the depreciating country rising relative to prices in appreciating countries.

Our criterion for identifying appreciations or depreciations was a change in the annual average exchange rate of at least 3 percent from one year to the next. Once a change this large was identified, years on either side were included in the period of change if the year-to-year changes were in the same direction and at least 1 percent. For the periods preceeding and following the period of change in the exchange rate we have chosen both 3- and 5-year periods for study. These choices are intended to constitute periods long enough to determine wheter the price effects produced by the exchange rate changes are offset quickly or at least after the adjustment process has worked itself out as the monetary approach predicts. The 3-year period probably is the more appropriate measure of the "long run" from this standpoint, while the 5-year period may be regarded as the outer limit.

Much of the price behavior anticipated in the more sweeping versions of the monetary theory of the balance of payments represents ongoing phenomena that should be observable both within and outside of periods of balance of payments adjustment. Prices are to move identically in different countries whether the balance of payments is in equilibrium or in the process of adjustment. In its more careful form, however, the monetary theory stresses the rapid adjustment of prices and confines its predictions about the similarity of price movements to equilibrium periods. Testing this version of the theory would require the identification of periods of balance of payments equilibrium. The strategy we have adopted is

is simply to compare price movements for a number of different arbitrarily chosen intervals varying in duration from 2 to 10 years.

## Price Levels and Changes in Price Levels

We begin our empirical work at the most aggregative level -- dealing with overall price levels -- and then go on to sectoral prices and prices for detailed commodity categories. In each sector we assert our conclusions as headings and follow with the argument.

What we want to know about price levels or changes in them is whether they conform to the law of one price or whether it is possible for the price levels of different countries to alter in relation to one another for balance of payments reasons or as a result of exchange rate changes.

Inquiries about the law of one price with respect to price levels have a long history in the form of studies of purchasing power parity. We venture a fresh examination of the subject for three reasons: (1) The results of past studies have been, as a recent reviewer has noted,* contradictory; (2) most of the past studies have used wholesale or consumer price indexes which are less appropriate measures of price levels than GDP deflators, and (3) we can draw on some new data that throw some new light on the issue.

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*Officer, op. cit.

There are substantial differences in absolute price levels for GDP

We need not dwell long on the fact that there are substantial international differences in absolute price levels. This long familiar phenomenon was first documented in a GNP framework in the OEEC studies of the early 1950s* and has been reaffirmed in a recent U.N. work.**

The U.N. materials are the source of the data in Table 1. Price levels*** and real product per capita compared with those of the U.S. based on each country's own weights are presented in the first four columns of the table and those based on U.S. weights in the last four. The data are in index form with the U.S. = 100. The countries are arrayed in order of increasing real GDP per capita using own weights.

A glance at the GDP quantity and price comparisons in either set of data (columns 1 and 2 or columns 5 and 6) shows that there are wide differences in price levels. In terms of U.S.-weighted data,**** the variation in price levels

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*M. Gilbert and I. Kravis, An International Comparison of National Products and Purchasing Power of Currencies--A Study of the United States, the United Kingdom, France, Germany, and Italy (Paris: Organization for European Economic Cooperation, 1954); M. Gilbert and Associates, Comparative National Products and Private Levels: A Study of Western Europe and the United States (Paris: OEEC, 1958).

**The reference is to the United Nations International Comparison Project (ICP) carried on by the United Nations Statistical Office with the support of the World Bank. The report on the first phase of the work covering 10 countries with a 1970 reference date is I. Kravis, Z. Kenessey, A. Heston and R. Summers, A System of International Comparisons of Gross Product and Purchasing Power (Baltimore: Johns Hopkins University Press, 1975).

***The price level indexes are obtained by dividing purchasing power parities (number of units of foreign currency required to purchase what one dollar will buy) by the prevailing exchange rate (foreign currency per dollar).

****These have the advantage of coming closer to the comparison of prices for a basket of goods that is identical for all the pairs. However, they also have certain disadvantages for our purposes that will shortly be made clear. With respect to the point about variation in price levels, it is, in any case, greater in the own-weighted data.

ranges from 48 in India to 100 in the U.S. with the next highest price level country being Germany at 95. Even among the industrialized countries the range is from 76 in Japan to 100 in the U.S., a difference of more than 30 percent.

It should be mentioned that the positive association between price levels and GDP per capita, which Ricardo anticipated and which Balassa recently showed to exist on the basis of data of industrialized countries,* is confirmed here for a sample of 10 countries that includes both industrialized and developing countries. The relationship is summarized in the following equation (t-ratios in parentheses).**

$$(1) \qquad \ln P_{GDP} = \underset{(17.4)}{3.69} + \underset{(2.9)}{0.168} \ln GDP \qquad \bar{r}^2 = .49$$

where $P_{GDP}$ is the price level for GDP (column 6) and GDP refers to real GDP per capita (column 5).

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*"...the prices of home commodities, and those of great bulk though of comparatively small value, are, independently of other causes, higher in those countries where manufactures flourish." D. Ricardo, The Principles of Economy and Taxation (London: J.M. Dent & Sons, Ltd., 1911), p. 87. The passage appears in Chapter VII, "On Foreign Trade," and is part of a more extended argument holding that "...the value of money is never the same in any two countries" (p. 88). For Balassa's contribution, see B. Balassa, "The Purchasing Power Parity Doctrine: A Reappraisal," Journal of Political Economy, December 1964, pp. 584-596. J. Viner, Studies in the Theory of International Trade (New York and London: Harpers and Brothers, 1937), p. 315, and D. Usher, "The Transport Bias in Comparisons of National Income," Economica, May 1963, also contributed to this line of reasoning. See I. Kravis, A. Heston, and R. Summers, "Real GDP per Capita for More than One Hundred Countries," Discussion Paper No. 391, Department of Economics, University of Pennsylvania.

**Matters are improved in this respect when the own-weighted data are examined. In the own-weighted data the coefficient of real GDP is 0.341 and the $\bar{r}^2$ is .85.

Table 1

Real Per Capita GDP and Relative Price Levels, 1970

U.S. = 100

| Country | Own Weights | | | | U.S. Weights | | | |
|---|---|---|---|---|---|---|---|---|
| | Real GDP per capita | Price Levels | | | Real GDP per capita | Price levels | | |
| | | GDP | Traded goods | Nontraded goods | | GDP | Traded goods | Nontraded goods |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Kenya | 4.0 | 34.9 | 58.5 | 22.3 | 8.6 | 74.2 | 96.7 | 48.9 |
| India | 4.3 | 24.0 | 46.8 | 10.3 | 8.5 | 47.6 | 74.4 | 17.3 |
| Colombia | 11.0 | 31.8 | 57.6 | 21.0 | 22.0 | 62.0 | 91.6 | 28.6 |
| Hungary | 33.0 | 44.7 | 62.7 | 30.7 | 48.0 | 66.0 | 95.0 | 33.0 |
| Italy | 43.0 | 66.2 | 84.0 | 50.4 | 54.0 | 82.9 | 107.0 | 55.5 |
| Japan | 55.0 | 61.1 | 82.5 | 46.4 | 68.0 | 76.4 | 95.3 | 55.0 |
| United Kingdom | 58.0 | 65.8 | 83.3 | 50.2 | 68.0 | 77.8 | 97.0 | 55.9 |
| Germany, F.R. | 67.0 | 79.8 | 99.2 | 60.9 | 80.0 | 95.4 | 114.5 | 73.5 |
| France | 68.0 | 73.8 | 83.4 | 63.4 | 82.0 | 89.1 | 105.9 | 70.4 |
| United States | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |

Source: I.B. Kravis, Z. Kenessey, A. Heston, and R. Summers, A System of International Comparisons of Gross Product and Purchasing Power, Baltimore: Johns Hopkins University Press, 1975.

Price relationships among major industrial countries, as indicated by comparisons of absolute price levels, changed as much as 25 to 30 percent in some cases between 1950 and 1970.

Given that there are differences in price levels, an important question is what happens to these differences through time. If they are altered, is it only because of changes in long run structural factors, such as relative GDP per capita, or do long run and short run balance of payments factors -- trade flows and capital movements -- also affect them? It is, of course, easier to answer the question of whether they change than to say why they change.

It is convenient to discuss the changes against a framework of naive purchasing power parity (PPP) theory and then return to the assessment of the significance of the findings both for monetary theory, and, more incidentally, purchasing power parity theory.

In its naive form the PPP theory denies that relative price levels change; when there are differential movements in the price levels of a pair of countries, the rate of exchange will tend to adjust so as to maintain the PPP relationship $\frac{(P_A/P_B)_t}{(P_A/P_B)_0} = 1$, where the Ps refer to price levels, A and B to countries and the subscripts t and 0 to a current period and a base period respectively. Note that the Ps represent purchasing power parities (currency units per U.S. dollar) divided by the exchange rate (currency units per U.S. dollar*). If the naive PPP theory turns out to be valid, the monetary theory is supported; if it is not, the matter has to be considered further.

We can draw on careful price level comparisons to test conformance to this relationship for the years 1950 and 1970. The

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*Or per the currency of any other reference country that may be selected.

data for 1950 are from OEEC studies and those for 1970 from the U.N. work, both of which have already been referred to.

The 1950 and 1970 comparisons are set out in Table 2 for six European countries vis a vis the U.S. The PPPs and the Ps for 1950 and 1970, and the observed 1970/1950 PPP relationship are given. Using the U.S. weighted data,* we see that although European price levels were still below that of the U.S. in 1970, they were in the main closer to the U.S. level than they had been in 1950 (compare columns 9 and 11). (But note that the 1950 price comparisons relate to the 1950 GNP basket, while those of 1970 relate to the 1970 GDP basket.) The relative change over the 20 year period, what we have called the PPP relationship, is set out in column 13. For 3 countries the numbers are close to 1.00 as the naive theory would predict. For others they deviate by at least 10 percent. Because the deviations are not always in the same direction, the PPP relationships for pairs not involving the U.S. -- not calculated in the table -- are sometimes far from 1.00; those for Netherland/Italy, Netherland/U.K. and Germany/Italy are 1.34, 1.26 and 1.22, respectively.**

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*As previously noted, these have the advantage of referring to a fixed basket of goods. However, it is not clear whether the balance of theoretical considerations favor U.S.- or own-weighted data. In the PPP literature, some writers have favored own-weights on the ground that price parity should be regarded as being based on parity of unit factor cost. See Officer, op. cit., p. 15. Even if this argument were accepted, the case for its application to the data in Table 2 would be weakened by the fact that they are based on price comparisons for final expenditures and thus on what the country absorbs rather than on what the country produces (as it would be if the comparisons were based on prices of the outputs of the industries of each country).

**For all countries except Belgium, the deviation from the purchasing power parity result is greater when the country's own basket of goods is used than with the U.S. basket (see column 14). This may be attributable to the fact that the own-weighted GDPs shifted substantially towards the U.S. bundle of goods for which European prices were more expensive. The shift towards the U.S. bundle has been documented for France, Germany, Italy and the U.K. See I. Kravis, Z. Kenessey, A. Heston, and R. Summers, op. cit., p. 268.

Table 2

Purchasing Power Parities, Exchange Rates, Price Levels, and Real Product Per Capita, Six Countries Relative to the U.S., 1950 and 1970

| | Currency Unit | Exchange Rate (Currency units per U.S.$) | | | Purchasing power parities (Currency units per U.S.$) | | | |
|---|---|---|---|---|---|---|---|---|
| | | | | | 1950 | | 1970 | |
| | | 1950 | 1970 | 1970/1950 | U.S. weights | Own weights | U.S. weights | Own weights |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) |
| Germany | D. Mark | 4.20 | 3.66 | .871 | 3.63 | 2.52 | 3.49 | 2.92 |
| Netherlands | Guilder | 3.80 | 3.62 | .953 | 2.76 | 1.96 | 3.18 | 2.42 |
| Belgium | B. Franc | 50.2 | 50.0 | .996 | 45.0 | 37.0 | 46.8 | 36.8 |
| Italy | Lira | 625. | 625. | 1.000 | 577. | 328. | 518. | 414. |
| U.K. | £ | .357 | .4167 | 1.167 | .288 | .218 | .324 | .274 |
| France | F. Franc | 3.50 | 5.554 | 1.587 | 313. | 223. | 5.20 | 4.11 |

| | Price Levels in Dollars (U.S.=100) | | | | PPP Relationship 1970/1950 | |
|---|---|---|---|---|---|---|
| | 1950 | | 1970 | | | |
| | U.S. weights | Own weights | U.S. weights | Own weights | U.S. weights | Own weights |
| | (9) | (10) | (11) | (12) | (13) | (14) |
| Germany | 86.4 | 60.0 | 95.4 | 79.9 | 1.10 | 1.33 |
| Netherlands | 72.6 | 51.6 | 88.1 | 66.9 | 1.21 | 1.30 |
| Belgium | 89.6 | 73.7 | 93.6 | 73.6 | 1.04 | 1.00 |
| Italy | 92.3 | 52.5 | 82.8 | 66.2 | .90 | 1.26 |
| U.K. | 80.7 | 61.1 | 77.8 | 65.8 | .96 | 1.08 |
| France | 89.4 | 63.7 | 93.6 | 74.0 | 1.05 | 1.16 |

Sources:
Column 2 Gilbert and Kravis, Op. cit.; Gilbert and Associates, op. cit., Table 5.
Column 3 International Comparison Project.
Column 4 Column 3 ÷ Column 2
Columns 5, 6 Gilbert and Kravis, op. cit., Table 4; Gilbert and Associates, op. cit., Table 5.
Columns 7, 8 International Comparison Project
Columns 9-12 Purchasing power parities divided by exchange rate.
Columns 13,14 1970 price levels divided by 1950 (col. 13 = col. 11 ÷ Col. 9; col. 14 = col. 12 ÷ col. 10).

Changes in price levels as measured by implicit deflators also show some substantial deviations from the PPP relationship

Another and somewhat more usual way of analyzing changes in exchange-rate-adjusted price levels is to use time to time indexes to measure price changes between periods. The greater abundance of such data gives us more freedom in coverage of time periods and countries. As noted earlier, this wider coverage comes at a cost since the methods used in different countries in making price indexes and sometimes the scope of the indexes vary widely.

In Table 3, we draw on the wider availability of implicit deflators to add 5 other countries to our sample of developed countries.* The PPP relationships tend to be well above 1.00. For 1970/50 (column 16) they are over 1.30 in 3 out of 10 cases. For the countries that also appear in Table 2, the results are similar.**

The availability of the PPP relationships for the subperiods of the 1950s (column 15) and 1960s (column 14) provides an opportunity to examine a somewhat les less strict or naive version of PPP theory which holds that there are some deviations from a PPP of 1 but that these are soon reversed. In fact, the deviations from 1.00 in these two subperiods are substantial though not as great in most cases as for 1970/1950 or 1973/1970. As this implies, there is no consistent tendency for the deviations of the 1950s to reverse themselves in the 1960s; in 4 of the 9 comparisons with the U.S. the deviation of the 1950's grew larger during the 1960's and in the same direction. Matters are little better when all possible pairs of countries are considered; in 17 of the 45 pairs*** the deviation of the 1950's grew larger during the 1960s (and in the same direction), in another 12 the deviation was in the opposite direction but even larger and in 15 pairs the 1970/1960 index was closer to 1.00 than the 1960/1950 index; 29 of the cases, therefore, do not support the PPP theory.

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*All the industrialized countries were included for which trouble-free continuous series could be found in various issues of the U.N. Yearbook of National Accounts Statistics. Main reliance was placed on the 1957, 1966, 1970 and 1974 issues. However, the U.S. implicit deflators for GDP were taken from Table 7.15 of the official U.S. national accounts tables in order to utilize revised data that were not yet published in the U.N. source.

**The PPP relationships for 1970/50 tend to be more similar, as we might expect, to the own-weighted Table 2 indexes than to the U.S.-weighted indexes.

***There are 10 countries for which indexes are available both in the 1950s and 1960s; hence 45 pairs. For one pair, Denmark-Germany, the PPP relationship was .97 in both periods.

Table 3

7/29/76

Changes in Exchange Rates and in GDP Implicit Deflators,
Selected Periods: 1950-1970

| | Exchange Rate Index | | | | GDP Implicit Deflator | | | | Relative Deflators (U.S.=100) | | | | PPP Relationship | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | 1973/70 (1) | 1970/60 (2) | 1960/50 (3) | 1970/50 (4) | 1973/70 (5) | 1970/60 (6) | 1960/50 (7) | 1970/50 (8) | 1973/70 (9) | 1970/60 (10) | 1960/50 (11) | 1970/50 (12) | 1973/70 (13) | 1970/60 (14) | 1960/50 (15) | 1970/50 (16) |
| Belgium | 78.2 | 99.6 | 99.2 | 98.8 | 119.5 | 140.1 | 122.5 | 171.5 | 103.2 | 105.2 | 95.8 | 100.6 | 1.32 | 1.06 | .97 | 1.02 |
| Canada | 95.8 | 107.6 | 89.1 | 95.8 | 116.2 | 134.0 | 136.1 | 182.5 | 100.8 | 100.6 | 106.4 | 107.1 | 1.05 | .93 | 1.19 | 1.12 |
| Denmark | 80.4 | 108.8 | 99.9 | 108.7 | 126.0 | 179.9 | 138.7 | 249.4 | 108.8 | 135.1 | 108.4 | 146.4 | 1.35 | 1.24 | 1.09 | 1.35 |
| France | 80.3 | 112.6 | 140.2 | 157.9 | 120.5 | 154.6 | 190.9 | 295.0 | 104.1 | 116.1 | 149.3 | 173.1 | 1.30 | 1.03 | 1.06 | 1.10 |
| Germany | 72.6 | 87.4 | 99.4 | 86.9 | 121.0 | 140.6 | 133.9 | 188.3 | 104.5 | 105.6 | 104.7 | 110.5 | 1.44 | 1.21 | 1.05 | 1.27 |
| Italy | 93.0 | 101.0 | 99.4 | 100.4 | 124.3 | 154.8 | 129.5 | 200.4 | 107.3 | 116.2 | 101.3 | 117.6 | 1.15 | 1.15 | 1.02 | 1.17 |
| Japan | 75.8 | 99.5 | 99.7 | 99.2 | 122.1 | 163.0 | n.a. | n.a. | 105.4 | 122.4 | n.a. | n.a. | 1.39 | 1.23 | n.a. | n.a. |
| Netherlands | 76.9 | 95.9 | 99.0 | 94.9 | 128.0 | 163.7 | 139.2 | 227.8 | 110.5 | 122.9 | 108.8 | 133.7 | 1.44 | 1.28 | 1.10 | 1.41 |
| Norway | 80.4 | 100.2 | 100.0 | 100.2 | 120.6 | 157.5 | n.a. | n.a. | 104.1 | 118.2 | n.a. | n.a. | 1.29 | 1.18 | n.a. | n.a. |
| Sweden | 84.1 | 100.3 | 99.9 | 100.2 | 120.7 | 154.8 | 161.9 | 250.6 | 104.2 | 116.2 | 126.6 | 147.1 | 1.24 | 1.16 | 1.27 | 1.47 |
| U.K. | 97.6 | 117.2 | 99.7 | 116.9 | 126.2 | 151.5 | 148.0 | 224.2 | 109.0 | 113.7 | 115.7 | 131.6 | 1.12 | .97 | 1.16 | 1.13 |
| U.S. | 100.0 | 100.0 | 100.0 | 100.0 | 115.8 | 133.2 | 127.9 | 170.4 | 100.0 | 100.0 | 100.0 | 100.0 | 1.00 | 1.00 | 1.00 | 1.00 |

Cols 1-4: Indexes of annual average foreign currency units per U.S. dollar; IMF data.

Cols 5-8: Correlative price indexes for GDP as reported in the U.N. Yearbook of National Account Statistics.

Cols 9-12: Cols 5-8 relative to the U.S.

Cols 13-16: Cols 9-12 divided by cols 1-4. The price index of each country relative to the U.S. divided by an index of the number of units of its currency exchanging for one U.S. dollar. The PPP relationship equals 1.00 when relative inflation is precisely offset by exchange rate changes; it is less than 1.00 when exchange rate adjusted prices have fallen relative to U.S. prices and more than 1.00 when they have risen.

However, the terminal years of the periods in Table 3 were selected for reasons of statistical convenience and not to represent the equilibrium periods between which the PPP relationship is expected to conform to unity in the monetary and purchasing power parity writings.

We have therefore examined the PPP relationships vis a vis the U.S. of the countries in Table 3 for all possible 2, 3, 4, 7, and 10 year periods between 1950 and 1970. The results are summarized in Table 4 in terms of the frequency distribution of the deviations from the PPP relationship. It is evident that the anticipated PPP relationship tends to hold for short time spans, though cases of deviations of 10 percent or more can be found. Over longer periods of years, relative price levels tend to drift farther apart. For the 2 year periods, for example, exchange rate adjusted price levels deviated from the U.S. price level by 20 percent or more in only 1% of the observations and changed by 5 percent or less relative to the U.S. in three-quarters of the cases. At the other extreme, for the 10 year periods, only 14% of the relationships had changed by as little as 5% and one-fifth had changed by 20% or more. The drift becomes more pronounced if the time span is expanded past 1970.

In Table 5 we compare the indexes of PPP relationships of Table 3 based on GDP implicit deflators with corresponding indexes based on wholesale prices and on consumer prices. Those based on wholesale prices tend to be closer to 1.00 than those based on implicit deflators or than those based on consumers prices. Even in the wholesale-price-based series, however, large deviations can be found particularly when relationships between pairs of countries, not including the U.S., are taken into account (36 percent in the 1950s for Norway-Italy and 18 percent in the 1960s for Sweden-Japan).

Finally, we show in Table 6 the results of still another way of guaging the similarity of price movements -- correlation analysis. The annual percentage

Table 4

Size of absolute deviations of change in GDP deflator from PPP relationship, 11 countries[a] vis a vis the U.S., various periods, 1950-70

| Duration of period (1) | Number of Periods[b] (2) | Number of Observations[c] (3) | % of cases in which absolute deviation[d] was ≥20% (4) | 10-19.9% (5) | 5-9.9% (6) | <5% (7) |
|---|---|---|---|---|---|---|
| 2 | 19 | 202 | 1 | 5 | 19 | 74 |
| 3 | 18 | 191 | 1 | 15 | 21 | 63 |
| 4 | 17 | 180 | 1 | 24 | 22 | 53 |
| 7 | 14 | 147 | 10 | 32 | 32 | 27 |
| 10 | 11 | 114 | 20 | 42 | 24 | 14 |

[a] See Table 3 for list of countries.

[b] The first period starts in all cases with 1950.

[c] Would be 11 times number of periods except for fact that available deflators for Japan start with 1955 and for Norway with 1952.

[d] This is the deviation from the PPP relationship, described in the notes to Table 3, without regard to sign.

Table 5

PPP Relationships[ø] Derived from Time to Time Price Indexes,

Selected Periods, 12 Countries, 1950-1973

| | 1973/70 | | | 1970/60 | | | 1960/50 | | | 1970/50 | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | GDP implicit deflator | Wholesale price index | Consumer price index | GDP implicit deflator | Wholesale price index | Consumer price index | GDP implicit deflator | Wholesale price index | Consumer price index | GDP implicit deflator | Wholesale price index | Consumer price index |
| Belgium | 1.32 | 1.22 | 1.32 | 1.06 | 1.05 | 1.03 | .97 | .95 | .99 | 1.02 | 1.00 | 1.02 |
| Canada | 1.05 | 1.13 | 1.06 | .93 | .99 | .93 | 1.19 | 1.06 | 1.13 | 1.12 | 1.05 | 1.05 |
| Denmark | 1.35 | 1.27 | 1.34 | 1.24 | 1.06 | 1.24 | 1.09 | 1.07 | 1.12 | 1.35 | 1.13 | 1.39 |
| France | 1.30 | 1.25 | 1.31 | 1.03 | 1.03 | 1.02 | 1.06 | 1.02 | 1.00 | 1.10 | 1.05 | 1.02 |
| Germany | 1.44 | 1.29 | 1.43 | 1.21 | 1.07 | 1.12 | 1.05 | 1.06 | .98 | 1.27 | 1.13 | 1.11 |
| Italy | 1.15 | 1.11 | 1.15 | 1.15 | 1.10 | 1.11 | 1.02 | .92 | 1.09 | 1.17 | 1.01 | 1.22 |
| Japan | 1.39 | 1.25 | 1.44 | 1.23 | .98 | 1.35 | n.a. | 1.22 | 1.20 | n.a. | 1.20 | 1.62 |
| Netherlands | 1.44 | 1.26 | 1.42 | 1.28 | 1.13 | 1.18 | 1.10 | 1.04 | 1.11 | 1.41 | 1.17 | 1.32 |
| Norway | 1.29 | 1.19 | 1.33 | 1.18 | 1.10 | 1.18 | n.a. | 1.25 | 1.27 | n.a. | 1.38 | 1.50 |
| Sweden | 1.24 | 1.18 | 1.27 | 1.16 | 1.16 | 1.13 | 1.27 | 1.22 | 1.28 | 1.47 | 1.40 | 1.44 |
| U.K. | 1.12 | 1.03 | 1/15 | .97 | .99 | .97 | 1.16 | 1.15 | 1.22 | 1.13 | 1.14 | 1.18 |
| U.S. | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 | 1.00 |

[ø] The price index of each country relative to the U.S. divided by an index of the number of units of its currency exchanging for one U.S. dollar. The PPP relationship equals 1.00 when relative inflation is precisely offset by exchange rate changes; it is less than 1.00 when exchange rate adjusted prices have fallen relative to U.S. prices and more than 1.00 when they have risen.

Source: GDP implicit deflators are the correlative price indexes reported in the U.N. Yearbook of National Accounts Statistics; other indexes are from IMF International Financial Statistics, except for U.S. data which are from Table 7.15 of the official U.S. national accounts tables.

Table 6

Mean Coefficients of Correlation between Annual Percentage Price Changes, Industrial Countries, 1950-73*

| | GDP Implicit Deflator (10) | | Wholesale Prices (12) | | Consumer Prices (12) | |
|---|---|---|---|---|---|---|
| | unadj | adj | unadj | adj | unadj | adj |
| Belgium | .75(9) | .75(9) | .86(11) | .89(11) | .74(11) | .78(11) |
| Canada | .70(9) | .46(7) | .73(11) | .88(11) | .75(11) | .53(11) |
| Denmark | .58(8) | .67(8) | .89(11) | .91(11) | .57(10) | .73(11) |
| France | .49(7) | .65(9) | .77(11) | .88(11) | .49(8) | .72(11) |
| Germany | .71(9) | .71(9) | .82(11) | .87(11) | .72(11) | .75(11) |
| Italy | .56(8) | .67(8) | .78(11) | .85(11) | .67(11) | .73(11) |
| Japan | n.a. | n.a. | .83(11) | .88(11) | .58(10) | .75(11) |
| Netherlands | .67(9) | .72(9) | .86(11) | .90(11) | .64(10) | .76(11) |
| Norway | n.a. | n.a. | .81(11) | .89(11) | .66(11) | .79(11) |
| Sweden | .65(9) | .70(9) | .86(11) | .89(11) | .71(11) | .80(11) |
| U.K. | .60(9) | .44(8) | .81(11) | .64(11) | .64(11) | .49(10) |
| U.S. | .61(9) | .54(8) | .80(11) | .86(11) | .69(11) | .59(10) |

*The price changes of each possible pair of countries were correlated. To save space, only the means of each country's coefficients of correlation with the others are presented. The numbers in parentheses in the captions are the numbers of countries included in the correlations. The entries in the table represent the simple means of the n-1 correlation coefficients with (in parentheses) the number of these coefficients that were large enough to meet a .05 level significance test.

The columns headed "unadj" contain the average coefficients of correlation between the original price series of each country; in the columns headed "adj" the price series were adjusted for exchange rate changes (i.e., converted to dollar terms) before correlation.

price change for each country for 1950-73 was correlated with each of the other countries.* In order to economize on space we present for each country only the average of its correlation coefficients with all the other countries and the number of cases (in brackets) in which the coefficient was significant at the .05 level. Note that the correlations are higher and more often significant for the exchange rate adjusted price changes than for price changes in local currencies, higher for wholesale prices than for consumer prices and higher for consumer prices than for implicit deflators.** The average correlations for adjusted implicit deflators vary from 0.44 to 0.75, high enough, as we further suggest below, to indicate that there are links between national prices but not high enough to suggest that they are "rigid".

The comparisons of price levels at different times and of the movement of price indexes relative to exchange rates lead to the conclusion that while the price levels of different countries are indeed linked together, the links are looser than described in the monetary approach to the balance of payments.

In assessing the significance of the data in Tables 2 to 6 for the PPP theory and for the monetary approach to the balance of payments, two kinds of questions arise. One is whether the deviations are big enough to damage or discredit the theories and the other is whether they can be explained away.

Each analyst will have to decide in the light of his own purposes whether the

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*All years, including those in which exchange rates were changed were included. Years of change should conceivably have been excluded on the ground that prices might have adjusted though not simultaneously. However, exclusion of years of change for either member of each pair would greatly reduce the number of observations. From Table 7 below, which gives periods of exchange rate changes for industrial countries, it can be seen that only 1953-55 and 1963-65 were years not involved in changes even as initial or terminal years.

**Data for 1950-70 produce the same conclusions though the r's are slightly lower.

PPP relationships fall close enough to 1.00 to satisfy the theories.* As a matter of general judgment we express our own opinion that the results do not support the notion of a tightly integrated international price structure. The record of exchange-rate-adjusted price changes after the end of the pegged exchange rate system in the early 1970s shows that price levels can move apart sharply without very rapid correction through arbitrage. The large German deviation from the PPP shown in Table 2 for 1970/50 did not, for example, reverse itself, but grew larger in the ensuing years.**

On the other hand, the data do suggest that the usual -- though not necessary -- situation is one in which short period movements in GDP price levels are close together.

Our findings appear to be less reconcilable with the monetary approach with its emphasis on the quick arbitrage of prices, than with the PPP theory, which from its beginnings in Cassel's writings made allowances for various short or long run factors that could cause a divergence from the PPP relationship. For example, the large differences observed since 1970 would appear to constitute strong evidence against the quick adjustment hypothesis of the monetary approach, but could be explained away by PPP theorists on grounds of an unsatisfactory base year, brevity of the period, or real changes in one or another of the countries.

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* We have encountered comments by several authorities on the size of deviations from the PPP relationship that may be worth mentioning: H. Houthakker is reported recently to have offered the view that a deviation of 10 percent, as an example, told little about the probable movement of exchange rates, implying that larger ones would. (Brookings Papers on Economic Activity, 3: 1975, p. 552). Officer cites Haberler as expressing doubt that an equilibrium rate would differ by more than 15 to 20 percent from PPP "under normal circumstances" and H.G. Johnson as expressing the view that "...the exchange rates of the major countries do not depart very far (typically less than 20 percent) from purchasing power parity." (Op. cit., pp. 25 and 26).

** In terms of GNP deflators (available in the June 1976 issue of International Financial Statistics) the PPP relationship for Germany was as follows for each year taken relative to 1970:

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| 1969 | .92 | 1971 | 1.08 | 1973 | 1.42 | 1975 | 1.50 |
| 1970 | 1.00 | 1972 | 1.19 | 1974 | 1.43 | | |

Account must be taken too of the structural influence on relative price levels of income levels as indicated in equation 1 above.* It seems that this relationship should not provide any basic difficulties for the monetary approach though the idea that nontradables are brought into alignment in the long run would have to be given up in favor of the concept of a changing norm for nontraded/traded goods prices in different countries. It would, however, be more difficult to incorporate this relationship in the PPP theory.**

During the period 1950-70, appreciations tended to be followed by relative price level increases and depreciations, with less uniformity, by relative price level decreases.

If price levels can differ and can also change in different directions, what role do changes in the balance of payments situation play in influencing the degree and direction of price level movements? A firm answer to this question would require careful study of each country first to identify periods of deficit and surplus and secondly to measure relative price level movements before, during and after the disequilibrium period. Account would have to be taken of policies pursued at home and abroad that might tend to obscure the impact of the disequilibrium on the behavior of prices, particularly the effects of domestic monetary and fiscal policies and of the balance of payments position and price level changes of the country's main trading partners.

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If the main explanation for differences in price levels resides in differences in per capita income, then the countries in Table 2 that went the farthest in diminishing their income gap vis a vis the U.S. should also have experienced the greatest reduction in the price difference. There is some evidence in support of this when the changes in own-weighted price indexes (column 12 minus column 10) are plotted against changes in the U.S.-weighted real income indexes; the relationship is less clear cut in the scatter diagram involving U.S.-weighted price indexes and own-weighted income indexes.

This is the judgment given by Officer although no one can say for sure where the line should be drawn between additional variables that may legitimately be added to PPP to explain exchange rates and those that so alter the character of the relationship that it should no longer be regarded as a PPP theory. See Officer, op. cit., pp. 3-4 and 22.

We do not attempt such careful country studies here, but merely examine the behavior of prices in the cases of appreciations or depreciations by industrial countries.* A change in the exchange rate during the period 1950-70 may be taken as prima facie evidence of the prior existence of a disequilibrium. Was there, in view of the widely different circumstances and of the different policies followed after the exchange rate change, any reasonably consistent outcome with respect to relative price levels?

Of course, at the moment of depreciation the entire price level will appear to the rest of the world to be lower than it was before by the amount of the depreciation, and the opposite is the case in an appreciation.** The issue is how long this shift in relative price levels lasts in the world as it actually works. If all prices, tradables and nontradables, adjust very quickly to the world price level, then the impact of depreciations and appreciations on relative price levels can only be very brief. Tradable goods can be expected to rise in terms of local

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*If one were looking at adjustments with exchange rates that remain fixed, price movements might be compared for countries with a great diversity of balance of payments experience over a long period of time. Among the countries of Table 2, Germany and the U.K. are in this respect at opposite extremes, the former with persistent surpluses during the period 1950-70 and the latter with constantly recurring deficits. The data in Table 2 (columns 13 and 14) do show that the German price level rose substantially more than the U.K. price level, both taken after adjustment for exchange rate changes (i.e., in dollar terms). Indeed Germany and the Netherlands, which like Germany found it necessary to appreciate during the period, had larger price rises than any other country in the table.

These data do not, however, lend consistent support to the hypothesis that relative price levels tend to rise with persistent surpluses and to fall with persistent deficits. For one thing, they are not unequivocal in showing that U.K. prices rose less than those of Belgium and Italy which had favorable balance of payments historie What is worse is that when subperiods are examined (see Table 4), U.K. prices are seen to have risen more in the 1950's (though not in the 1960's) than those of Germany (and also of the Netherlands) despite the difference in balance of payments tendencies.

**Assuming for the moment that all prices including those of exports are quoted in terms of the home currency.

currency more readily than nontradables; they will, perhaps sooner rather than later, conform to their world price levels or at least adjust towards those levels. However, to the extent that nontradable goods remain unchanged in price or adjust only partially, the average price level of a depreciating country will be reduced and that of an appreciating country will be increased (from the viewpoint of the outside world after taking account of the exchange rate change). Whatever these basic tendencies toward price adjustments are, price movements up or down may be abetted or hindered by monetary and fiscal policies followed after the exchange rate changes; these may be in a direction that reinforces the exchange rate change or they may be in the opposite direction.

Account must be taken also of the price changes that preceeded the exchange rate change and presumably played a part in bringing it about. The elasticity writers would ordinarily expect to observe a rise in relative price levels immediately preceeding exchange rate depreciations and a fall in relative price levels immediately preceeding exchange rate appreciation.* These prior changes would be expected particularly in the prices of tradables.

In order to examine these questions, we have set out in Table 7 all the cases in which changes of 3 percent or more in annual average exchange rates that occurred for the industrialized countries during the period 1950-70 and for which implicit deflators could also be obtained from the U.N. Yearbook of National Account Statistics.

Annual rates of change both in local currency prices (Part B) and in exchange-rate-adjusted prices (Part A) are shown for four periods: (a) the 3 years preceeding the exchange rate change, (b) the period of the change,** (c) the period of change plus

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*"Ordinarily", because they would not rule out exchange rate changes brought about as a result of speculation.

**See page 24 for definition.

the ensuing 3 years, and (d) the period of change plus the ensuing 5 years. The price indexes are taken relative to "world" price indexes; the latter are calculated from the prices of 16 industrial countries using as weights the relative importance of their currencies in the initial composition of IMF Special Drawing Rights (SDR's).*

Turning first to the years preceeding appreciations, the data in local currency (Part B, column 3) do not show any strong or consistent tendency for prices to decline relative to the world average prior to appreciations and to rise prior to depreciation Either shifts in relative price levels were not involved in the development of these balance of payments disequilibriums or we should focus on some subset of prices, such as tradable goods. We return to the last point in the following section dealing with sectoral prices.

Our main concern is in any case with the change in the GDP price level for the period of change and its sequels. For this purpose, we concentrate on the exchange-rate-adjusted price movements relative to the world (Part A).

In four of the five appreciations where we have data on prices 3 and 5 years after the period of exchange rate change, the price level was higher relative to the world than at the initial year shown in the table (columns 5 and 6).

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*IBRD, Finance and Development, December 1974, p. 19.

Table 7

Price Changes in Connection with Appreciations and Depreciations of Industrialized Countries, 1950-1970

A. In U.S. Dollars

| Country | Period of Change | Percent of Appreciation (+) or Depreciation (-) | GDP Implicit Deflator: Beginning of Period relative to 3 yrs. earlier | GDP Implicit Deflator: Relative to beginning of period of change: End of Period | GDP Implicit Deflator: Relative to beginning of period of change: 3 yrs. after end of period | GDP Implicit Deflator: Relative to beginning of period of change: 5 yrs. after end of period | Wholesale Price Index: Beginning of Period relative to 3 yrs. earlier | Wholesale Price Index: Relative to beginning of Period of Change: End of Period | Wholesale Price Index: Relative to beginning of Period of Change: 3 yrs. after end of period | Wholesale Price Index: Relative to beginning of Period of Change: 5 yrs. after end of period | Exchange Rate Index Appreciation (>1.0) or depreciation (<1.0): Beginning of Period relative to 3 yrs. earlier | Exchange Rate Index Appreciation (>1.0) or depreciation (<1.0): Relative to beginning of period: End of Period | Exchange Rate Index Appreciation (>1.0) or depreciation (<1.0): Relative to beginning of period: 3 yrs. after end of period | Exchange Rate Index Appreciation (>1.0) or depreciation (<1.0): Relative to beginning of period: 5 yrs. after end of period |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) | (11) | (12) | (13) | (14) |
| **Appreciations** | | | | | | | | | | | | | | |
| Canada | 1950-52 | +11.1 | - | 1.14 | 1.12 | 1.15 | - | 1.01 | 0.98 | 0.99 | - | 1.11 | 1.10 | 1.14 |
| Canada | 1969-70 | + 3.1 | 1.02 | 1.01 | 0.89 | 0.99 | 1.06 | 0.99 | 0.99 | 1.03 | 1.00 | 1.03 | 1.08 | |
| Germany | 1960-61 | + 3.7 | 1.04 | 1.05 | 1.07 | 1.06 | 1.02 | 1.04 | 1.04 | 1.03 | 1.01 | 1.04 | 1.05 | 1.04 |
| Germany | 1968-70 | + 9.4 | 0.98 | 1.09 | 1.31 | - | 0.94 | 1.07 | 1.22 | - | 1.00 | 1.09 | 1.51 | - |
| Netherlands | 1960-61 | + 3.8 | 1.03 | 1.03 | 1.11 | 1.15 | 0.99 | 1.02 | 1.08 | 1.11 | 1.01 | 1.04 | 1.05 | 1.04 |
| **Depreciations** | | | | | | | | | | | | | | |
| Canada | 1960-62 | - 9.2 | 0.99 | 0.88 | 0.85 | 0.86 | 1.01 | 0.93 | 0.91 | 1.04 | 0.99 | 0.91 | 0.90 | 0.90 |
| Denmark | 1966-68 | - 7.7 | 1.08 | 0.98 | 0.99 | 1.13 | 1.02 | 0.97 | 0.98 | 1.10 | 1.00 | 0.92 | 0.93 | 1.15 |
| France | 1956-59 | -28.6 | 0.99 | 0.85 | 0.88 | 0.91 | 0.99 | 0.87 | 0.92 | 0.96 | 1.00 | 0.71 | 0.71 | 0.71 |
| France | 1968-70 | -10.3 | 1.00 | 0.92 | 0.99 | - | 0.97 | 0.98 | 1.08 | - | 0.99 | 0.90 | 0.90 | - |
| U.K. | 1966-68 | -14.3 | 1.02 | 0.88 | 0.92 | 0.83 | 1.02 | 0.91 | 0.98 | 0.84 | 1.00 | 0.86 | 0.87 | 0.88 |

Table 7 (cont'd.)

B. In Local Currencies

| Country | Period of Change | Percent of Appreciation (+) or Depreciation (-) | GDP Implicit Deflator | | | | Wholesale Price Index | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Beginning of Period relative to 3 yrs. earlier | Relative to beginning of Period of Change | | | Beginning of Period relative to 3 yrs. earlier | Relative to beginning of Period of Change | | |
| | | | | End of Period | 3 yrs. after end of period | 5 yrs. after end of period | | End of Period | 3 yrs. after end of period | 5 yrs. after end of period |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| **Appreciations** | | | | | | | | | | |
| Canada | 1950-52 | +11.1 | - | 1.03 | 1.03 | 1.03 | - | 0.91 | 0.90 | 0.88 |
| Canada | 1969-70 | + 3.1 | 1.00 | 0.99 | 0.95 | 1.01 | 1.04 | 0.97 | 1.05 | 1.06 |
| Germany | 1960-61 | + 3.7 | 1.00 | 1.02 | 1.02 | 1.02 | 0.99 | 1.01 | 0.99 | 0.98 |
| Germany | 1968-70 | + 9.4 | 0.96 | 1.00 | 1.00 | - | 0.92 | 0.99 | 0.93 | - |
| Netherlands | 1960-61 | + 3.8 | 0.96 | 1.00 | 1.06 | 1.11 | 0.96 | 0.98 | 1.03 | 1.07 |
| **Depreciations** | | | | | | | | | | |
| Canada | 1960-62 | - 9.2 | 0.98 | 0.97 | 0.95 | 0.96 | 1.00 | 1.02 | 1.01 | 1.04 |
| Denmark | 1966-68 | - 7.7 | 1.08 | 1.04 | 1.06 | 1.11 | 1.02 | 1.03 | 1.06 | 1.08 |
| France | 1956-59 | -28.6 | 1.00 | 1.16 | 1.20 | 1.24 | 0.99 | 1.20 | 1.27 | 1.31 |
| France | 1968-70 | -10.3 | 1.00 | 1.03 | 1.03 | - | 0.96 | 1.09 | 1.11 | - |
| U.K. | 1966-68 | -14.3 | 1.02 | 1.01 | 1.05 | 1.07 | 1.02 | 1.04 | 1.12 | 1.08 |

Notes to Table 7

Part A

Col. 1: All periods were included in which there was a change in the average annual exchange rate of at least 3 percent from one year to the next. Once a change this large was identified, years on either side were included in the period of change if the year-to-year changes were in the same direction and at least 1 percent.

Col. 2: Exchange rates are annual average of daily dollar prices from IMF converted to an index of foreign currency units per dollar. Percent change is computed from the formula $(I_0/I_1)-1$, where $I_0$ is the index at the beginning of the period and $I_1$ is the index at the end of the period.

Col. 3 - 6: $(I_1/I_0)$, where I is an index of the GDP implicit deflator of the given country, divided by its exchange rate index referred to in note to col. 2, relative to a SDR (Special Drawing Rights)-weighted average of exchange-rate-adjusted GDP implicit deflators of 16 industrial countries, and the subscripts 0 and 1 refer to the initial and terminal years.

Col. 7 - 10: As in col. 3 - 6, except that given country wholesale price indexes and SDR-weighted average of wholesale price indices are used.

Col. 11 - 14: $(I_0/I_1)$ where I is an index of exchange rates described in note to col. 2 and subscripts 0 and 1 refer to initial and terminal years.

Part B

Col. 2: Same as col. 2 in Part A.

Col. 3 - 6: $(I_1/I_0)$ where I is an index of the GDP implicit deflator of the given country, relative to a SDR weighted average of GDP implicit deflators of 16 industrial countries and the subscripts 0 and 1 refer to the initial and terminal years.

Col. 7 - 10: As in col. 3 - 6, except that given country and SDR weighted average of wholesale price indices are used.

The data on the 5 depreciations in Part A show a tendency for relative price levels in terms of implicit deflators to be lower 3 and 5 years after the exchange rate change than before. In only one case -- Denmark after 5 years -- was the relative price level measured in this way higher than before, and in this instance the reason was an exchange rate appreciation (see column 14).

These findings are very different from the expectations of a simple monetary model which would call for changes in local currency prices (Part B) exactly offsetting exchange rate changes and for no changes in relative price levels in dollar terms (i.e., columns 3 to 10 in Part A should have entries of 1.00). Again we see -- here in the context of exchange rate changes -- that relative price levels can and sometimes do shift by substantial amounts that are not quickly arbitraged away. The directi of these shifts over short periods in the incidents we have examined tends to be consistent with the direction that the reasoning of the standard model would lead us to expect from the exchange rate changes, but we have not established any causal connection. It seems unlikely, for example, that the 15 percent increase in the Dutch implicit deflator (in dollars) relative to the appreciation of approximately 4 percent could have been due in large part to the exchange rate change.

## The Behavior of Prices in Different Sectors

We are concerned in this section with the price levels and price movements of tradables relative to nontradables,and within tradables of exports relative to imports. Almost all of the theories of the adjustment mechanism provide for shifts in the tradable/nontradable price ratio, but the elasticity approach is more hospitable to changes in the commodity terms of trade (export prices relative to import prices) than the monetary approach. The differences between export and domestic prices of the same goods, almost universally ignored, will be treated in the next section dealing with the behavior of prices for individual kinds of commodities.

We start with price level comparisons for nontradables and tradables, and then move on to changes in prices for these two categories and in the terms of trade.

Price level differences for nontradables are larger than for GDP as a whole.

The main explanation for the association between price levels and per capita incomes summarized in equation 1, it has been suggested*, lies in the differential impact of high wages in high income (high productivity) countries upon the prices of commodities and the prices of services. The tradability of commodities tends to produce international product price equalization; differences in productivity between high and low income countries will simply lead to wage differences. For services, however, productivity differentials tend to be smaller and the high wages of the high productivity countries lead to higher prices for the purchasers; unlike the commodity sector, there is little or no trade in services and country to country differences in service prices are thus possible.

If this explanation is valid we should expect to find that the price levels for the nontradable components of final expenditures on GDP should vary according to real GDP per capita while prices for the tradable components should be alike.

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*The recent currency of this idea is attributable to Balassa, op. cit., and Usher, op. cit. See also P. Samuelson, "Theoretical Notes on Trade Problems," Review of Economics and Statistics, Vol. 46, May 1964, pp. 145-154. However, Viner's interpretation of Ricardo's reasoning with respect to the passage cited in the footnote on p. 27 and of certain other writings of Ricardo is essentially the same as Balassa's argument. Viner, op. cit., p. 315.

The expectations about the nontradables are met by the data for the 10 countries listed in Table 1. When the service components of final expenditures (including such things as barber shops and beauty parlors, governmental services and health services) are combined with construction to form a nontraded goods component,* price levels (using U.S. weights) range from 17 percent in India to 100 percent in the U.S. with the next highest price level being found in Germany at 74 percent. It is true also that the price levels for nontraded goods are positively correlated with GDP per capita:**

$$(2) \qquad \ln P_{\text{nontraded}} = \underset{(4.9)}{2.46} + \underset{(2.7)}{0.372} \ln \text{GDP} \qquad r^{-2} = .45$$

where the data are drawn from Table 1 (columns 8 and 5).

Price levels for tradables seem also to vary though not so widely.

The expectations with respect to tradables are not however met. For the total goods components, consisting of consumers commodities and producers durable goods, the range of price indexes runs from 74 percent for India to 114 percent for Germany. The dispersion of the price levels is clearly smaller than in the case of the nontradables. Not only are traded goods prices in the other countries closer to American prices of the same goods as compared to nontraded goods, but also the dispersion of the price indexes among the 9 countries other than the U.S. is smaller for the traded goods than for nontraded goods. Nevertheless, the differences are not trivial even among the industrial countries; traded goods prices are around 20 percent higher in Germany than in Japan and the U.K..

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*There is some unavoidable arbitrariness in classifying all final expenditures into one or the other of these two classes of goods. Electricity, for example, has been treated as a traded good in the data in Table 1. Also, some service categories have cost structures that are 100 percent labor costs (domestic services) while others have important commodity components (public transportation).

**For own-weighted indexes, the coefficient of real GDP per capita is 0.484 and $r^{-2}$ is .83.

Furthermore, even the tradable price levels tend to be correlated positively with per capita income:

$$(3) \qquad \ln P_{traded} = \underset{(32.5)}{4.23} + \underset{(2.7)}{0.095} \ln GDP \qquad \bar{r}^2 = .45$$

The slope is, however, smaller than for nontradables.*

Thus, not only do price levels differ substantially when the whole aggregate of goods entering into GDP is taken into account but the level of prices for the kinds of goods that can enter international trade is also subject to a substantial variation. Part of the reason may be that the prices we are comparing, prices to domestic final purchasers, contain some local service elements even for tradable goods. For example, wheat shipped to India and to Germany at identical prices from the U.S. would probably cost the German consumer more than his Indian counterpart simply because internal costs of distribution and transportation are higher in Germany; at least, that would be the case if German wages were higher than Indian wages in a proportion greater than the extent to which German productivity in distribution and transportation exceeds Indian productivity. It is doubtful,however, that all the difference can be explained in this way; German prices for traded goods were more than 50 percent higher than Indian prices. It seems likely that some of the difference is caused also by the local production of tradable goods at lower costs in India than in Germany. There is also the possibility that wheat shipped to India may be invoiced at a lower fob price than wheat shipped to Germany. This is clearly the case for concessional wheat sales. Are there other commodities for which price discriminating

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*For the own-weighted data, the coefficient of real GDP per capita is 0.191 and $\bar{r}^2$ is .78.

sellers find it advantageous to sell to poor countries at lower prices? We do not know the answer to this question. The claims of the poor countries, mainly relating to machinery prices, has been that the opposite is usually the case -- that is, that they are charged higher prices than the industrial countries.

Another possible explanation may be that many of the final product expenditure categories we have included with traded goods, such as manufactured food products, for example, may in some or most countries have a very small traded content. At least some monetary theorists would, however, expect arbitrage or the possibility of arbitrage to equalize prices in these cases (after allowance for transport costs).

We - . accept the indication of equation 3 that even tradables tend to be more expensive in higher income countries, a view that will be bolstered by evidence in the section on individual product groups that price levels can differ at even a more disaggregated level and even among industrialized countries.* One of the problems in assessing the role of the nontradables/tradables price ratio in balance of payments adjustments is the secular tendency for the ratio to rise.

The cross section relationship between the ratio of nontradables to tradables and per capita income seems to apply also to intertemporal relationships within countries. The usual explanation is that the ratio is pushed up by the tendency for more rapid increases in productivity to occur in traded than in nontraded goods while at the same time competition in each national labor market imposes equal wage changes in the two sets of industries.** The high labor content of nontradables, with their large service component, and the greater pressures of world competition in the tradables sector are among the reasons often cited for the differential productivity trends.

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*For a fuller treatment of the extent of international price differences for both traded and nontraded goods and a discussion of the reasons for the differences, see I.B. Kravis, A. Heston and R. Summers, "Real GDP per Capita for More than One Hundred Countries," Discussion Paper No. 391, Department of Economics, University of Pennsylvania.

**However, the explanation of price trends in the two sets of industries may not be so simple; Kendrick's productivity studies indicate that in the U.S. between 1948 and 1966 at least, some components of nontraded goods including transportation and communication enjoyed higher rates of growth in real product per unit of labor than manufacturing (and even trade had a growth rate equal to that of manufacturing). Cf. J.W. Kendrick, Postwar Productivity Trends in the U.S., 1948-1969, Table 5.2 (New York: National Bureau of Economic Research, 1973). For an adverse conclusion on the extent to which differential trends in productivity explain relative movements in exchange-rate-converted price levels, see L.H. Officer, "The Productivity Bias in Purchasing Power Parity: An Econometric Investigation," IMF Staff Papers, November 1976.

Table 8

Measures of Nontradables/Tradables Relative Price Changes

| | 1970/52 | 1970/60 | 1973/60 | 1973/70 | 1973/52 |
|---|---|---|---|---|---|
| Australia | | | | | |
| Wholesale price index/import price index | 142[a] | 105[b] | | | |
| Goods produced at home/goods principally imported | 168[a] | 109[b] | | | |
| Norway | | | | | |
| Price index for total consumption/export price index | 166[c] | 133[d] | | | |
| Price index for total consumption/import price index | 159[c] | 136[d] | | | |
| Germany | | | | | |
| Wholesale price index/export price index | | 95 | 97 | 102 | |
| Wholesale price index/import price index | | 107 | 109 | 101 | |
| Implicit deflators: services/commodities[e] | 132 | 115 | 130 | 112 | 149 |
| United Kingdom | | | | | |
| Implicit deflators: services/commodities[e] | 137 | 132 | 130 | 99 | 135 |
| United States | | | | | |
| Implicit deflators: services/commodities[e] | 126 | 115 | 114 | 99 | 125 |

.. 1968/50

. 1968/60

. 1969/49

. 1969/60

. "Services" include the whole of GDP except the commodity producing sectors -- agriculture, mining, construction and manufacturing.

Whatever the reasons, the secular tendency for the nontradables/tradables price ratio to rise is evident in Table 8 for all five of the advanced countries for which we have been able to get some indication of this relationship over time. There is some evidence in favor of the hypothesis that the nontradables/tradables price ratio rises as a result of an appreciation and falls as a result of a depreciation.

As one means of examining the behavior of this ratio in connection with the balance of payments, we may turn back to Table 7 where we included wholesale price indexes with this purpose in mind. Since wholesale price indexes are more narrowly focussed on tradable goods than the GDP deflators, we should be able to infer the behavior of the nontradables/tradables price ratio from the relative movements of the GDP deflators and the wholesale price indexes.

After the appreciations, the rise in the implicit deflators is larger in 4 out of 5 cases than the rise in the wholesale price indexes (compare in Part A columns 4 and 8, 5 and 9, and 6 and 10). The implication is that the nontradable-tradable ratio rose, but since movements in this direction may be presumed to be the trend we cannot be sure that it was the appreciation that produced this result. In a few cases, the differences are large enough and the period brief enough (in the 1950-52 Canadian appreciation, for example) to hazard the inference that the appreciation was responsible but in other cases the difference was only a few percentage points and such a view is not warranted.

After the depreciations the decline in the implicit deflators is greater, again in 4 out of 5 cases, than the decline in the wholesale prices. In these instances the nontradables/tradables price ratio fell despite its underlying upward trend.

The data thus give a substantial measure of support to the expectations of relative price changes following depreciations, and appear to be consistent with

expectations about price changes following appreciations. Conformance in this case may be more safely attributable to the exchange rate changes themselves than in the case of the movements of the overall price levels considered in the earlier discussion of Table 7.

Another approach to the examination of the effect of exchange rate changes on the nontradable/tradable price ratio is to concentrate on the period 1970-73, when there were large changes in exchange rates. It is not implausible to believe that within so short a period the effects of these exchange rate changes upon price structure dominated the effects of different growth rates. When eight countries for which sector implicit deflators were readily available are arrayed as in Table 9 in order of diminishing appreciation of their currencies relative to the U.S. dollar, there is a clear tendency for the relative prices of services (nontradables) to rise the most in countries that appreciated most. The table uses implicit deflators for various sectors to form two measures of service/nonservice (nontradable/tradable) prices: (a) the ratio of the deflator for community services (i.e., health, education, etc. but not trade or public administration) to the deflator for manufacturing (column 6); and (b) the ratio of the deflator for all services (i.e., noncommodity sectors) to the deflator for the commodity producing sectors (column 9).* Germany and Belgium, with the largest appreciations, had the largest increases in relative prices of services (nontradables) by either measure. On the other hand, the relative price movements in the other 6 countries do not fall so neatly in line.

In the one case in which we have both an exchange rate change and genuine measures of export and import prices, Germany, the commodity terms of trade have moved as expected by the elasticity approach.

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*Agriculture, mining, manufacturing and construction.

Table 9

Changes in Exchange Rates and Implicit Deflators
for Selected Economic Sectors, 8 Countries, 1970-73

| | 1973/1970 | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|
| | | Implicit Deflators | | | | | | | |
| | Exchange rate FC/$ (1) | Community Services (2) | Construction (3) | Agriculture & Mining (4) | Manufac-turing (5) | Services/ Manufact. (2)÷(5)=(6) | All Services (7) | All Commodities (8) | Services/ Commodities (7)÷(8)=(9) |
| Germany | .726 | 110 | 101 | 98 | 94 | 1.17 | 107 | 95 | 1.13 |
| Belgium | .782 | 104 | 106 | 102 | 92 | 1.13 | 104 | 95 | 1.09 |
| Denmark | .804 | 102 | 101 | 110 | 94 | 1.09 | 98 | 98 | 1.00 |
| Sweden | .841 | 96 | 93 | 93 | 101 | 0.95 | 99 | 101 | 0.98 |
| Italy | .930 | 100 | 103 | 110 | 96 | 1.04 | 101 | 100 | 1.01 |
| Canada | .958 | 103 | 103 | 119 | 96 | 1.07 | 99 | 102 | 0.97 |
| U.K. | .976 | 98 | 119 | 108 | 98 | 1.00 | 101 | 102 | 0.99 |
| U.S. | 1.000 | 101 | 107 | 134 | 94 | 1.07 | 101 | 102 | 0.99 |

Sectoral deflators for each country have been normalized by dividing by the implicit deflator for total GDP.

Based on data in the U.N. Yearbook of National Account Statistics, 1974.

The terms of trade of Germany, the ratio of the export price index to the import price index, are shown for the period 1960-73 in Table 10. The major movements of the terms of trade were associated with the 1960-62 appreciation and with the continuous appreciation of the mark beginning in 1969. In both episodes the terms of trade increase, as anticipated by the standard theory. The fall in the terms of trade in 1973 when the exchange rate appreciated further, which was untoward, may reflect the rise in oil prices.

## E. The Behavior of Tradable Goods Prices*

It is almost always assumed that whatever may be true about the prices of home goods, the prices for internationally traded commodities must be identical in different markets. We have already shown that in fact the prices of tradables vary substantially in countries with different per capita incomes. Here we investigate the application of the law of one price to exports originating in different countries of comparable stages of development and to goods originating in a single country but sold both at home and abroad.

There are reasons for believing that there may be substantial deviations from the law of one price even for traded goods.

For the prices of internationally traded goods to be identical in different markets transport costs must be zero or equal for each given product from all origins to each destination, or each traded good must have only one source of supply. If these conditions are not met, there must be some differences in prices of internationally traded goods either at each destination for goods with different origins or at the various points of origin for goods with a single destination.

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*Some materials in this section have been taken from "Export Prices and Exchange Rates," a paper prepared for the U.S. Department of State by Irving B. Kravis, Robert E. Lipsey and Eliot Kalter.

Table 10

German Exchange Rate and Price Indexes, 1960-73

| | Exchange rate index DM/$ | Implicit deflator | Price Indexes: Producers price index | Exports | Imports | Exports/Imports |
|---|---|---|---|---|---|---|
| | (1) | (2) | (3) | (4) | (5) | (6) |
| 1960 | 114.4 | 71.7 | 91.6 | 87.3 | 98.2 | 88.9 |
| 1 | 110.2 | 74.1 | 92.1 | 87.0 | 94.3 | 92.3 |
| 2 | 109.7 | 77.2 | 93.9 | 87.1 | 93.5 | 93.2 |
| 3 | 109.4 | 79.6 | 94.4 | 87.2 | 95.4 | 91.4 |
| 4 | 109.0 | 81.8 | 95.4 | 89.3 | 97.0 | 92.1 |
| 1965 | 109.6 | 84.7 | 97.6 | 91.3 | 99.4 | 91.9 |
| 6 | 109.7 | 87.7 | 99.3 | 93.3 | 101.2 | 92.2 |
| 7 | 109.4 | 88.8 | 98.5 | 93.2 | 99.0 | 94.1 |
| 8 | 109.5 | 90.1 | 93.2 | 92.2 | 98.6 | 93.5 |
| 9 | 107.6 | 93.4 | 95.3 | 97.0 | 101.0 | 96.0 |
| 1970 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1 | 95.4 | 107.8 | 104.3 | 103.4 | 100.4 | 103.0 |
| 2 | 87.5 | 114.2 | 107.0 | 105.5 | 99.8 | 105.7 |
| 3 | 72.6 | 121.0 | 114.1 | 112.3 | 112.6 | 99.7 |
| Following 3.7% appreciation in 1960-61:[V] | | | | | | |
| 1964/1960* | | 115.0 | 104.1 | 102.3 | 98.8 | 103.6 |
| 1966/1960** | | 123.3 | 108.4 | 106.9 | 103.1 | 103.7 |
| Following 9.4% appreciation in 1968-70:[V] | | | | | | |
| 1973/1968* | | 134.3 | 122.4 | 121.8 | 114.2 | 106.6 |
| Entire period | | | | | | |
| 1973/1960 | | 170.2 | 124.6 | 128.6 | 114.7 | 112.1 |

*Three years after end of period relative to beginning.

**Five years after end of period relative to beginning.

Col 1: IMF annual average
Col 7: U.N. Yearbooks of National Account Statistics
Cols 3-6: Wirtschaft und Statistik (1969-1973), Statistiches Jarbusch (1960-1969)

[V]The percentages refer to the changes in yearly averages. Actually the 1960-61 appreciation in exchange was from 4.2 DM to 4.0 DM to the dollar, in March 1961. This represents a 4.8 percent appreciation using the formula given in the notes to Col. 2, Table 7.

There are, however, more weighty reasons -- both static and dynamic -- for expecting departures from the law of one price. A static circumstance giving rise to price discrimination between destinations is that in at least some sectors there are oligopolistic firms facing different elasticities of demand at home and in each foreign market; profit maximizing behavior would lead such firms to charge lower prices in the markets characterized by more elastic demand. The possibility of price differences among different exporters from the same or different countries is abetted by the existence of product differentiation both in terms of physical characteristics relating to appearance and performance, and in terms of various service elements such as before-and after-sale advice and service, credit terms and speed of delivery.* Oligopoly strategies aimed at maintaining a certain price position relative to rivals may produce price discrimination when the constellation of rivals differs from market to market or when the exchange rates of different destination countries move differently with respect to the oligopolist's home currency. Such behavior would be warranted if the oligopolist regards his long run profit maximization in a market as being jeopardized by a loss of market share (a form of capital).

In addition, dynamic factors associated with changes in comparative advantage and changing market shares make it possible for one source of supply to be selling at lower prices over protracted periods of time. Selling at a low price is, after all, the traditional way of breaking into a market and expanding market shares. Shifts in trade shares in individual product classes and broad groups of products are continually occurring. In the decade of the 1960s, for example, the share of Japan in "world" manufactured exports rose by more than 70 percent while that of the U.K. dropped by more than a fourth and that of the U.S. by more than a tenth.** If such shifts are prolonged and frequent, disequilibrium situations in which markets have not fully adjusted to changes in comparative advantage may be the norm rather than the exception. The files of the U.S. International Trade Commission (formerly the Tariff Commission) and of like bodies in other countries are full of

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*See Kravis and Lipsey, "Export Prices and the Transmission of Inflation," American Economic Review, February 1977 and Price Competitiveness in World Trade (New York: National Bureau of Economic Research, 1971), p. 47f.

**The share comparisons are for the years 1960 and 1970; the "world" consists of the 14 major industrial countries. See U.S. Department of Commerce, International Economic Indicators and Competitive Trends, June 1976, p. 57.

claims that foreign sellers are undercutting domestic producers in home markets, and such claims are not infrequently accompanied by expanding foreign shares in domestic markets.

Lack of knowledge, uncertainty regarding the reliability of new suppliers, the reluctance to give up a satisfactory relationship with customary suppliers and commitments to a given type of equipment because of previous purchases or stocks of spare parts may all explain the failure of buyers to respond immediately to price differences. They may explain too why it may be necessary for price differences of a substantial and/or prolonged character to exist if sellers hope to overcome the inertia of buyers in patronizing customary sources.

There are, therefore, reasons for believing that there will be notable departures from the uniformity of prices and also, since the causal conditions alter through time, in the uniformity of price changes. The evidence on this point is far from voluminous, but it tends to emerge from almost any careful set of international price comparisons.

Prices may differ substantially for competitive products exported by different countries.

Documentation of the existence of substantial differences in the export prices of different countries may be found in the previously cited National Bureau study by the present authors dealing with international price competitiveness for manufactured metals and metal products.* While some

*Kravis and Lipsey, Price Competitiveness in World Trade (New York: National Bureau of Economic Research, 1971). The price differences in the data cited are increased by the inclusion in some price comparisons of offer prices--that is, the lowest prices offered by each country other than the one actually making the sale. These prices do not represent actual transaction prices. While we think they do belong in measures of international price competitiveness, we would exclude them for present purposes if we could. Such offer price data were most important in the electrical machinery category where such heavy equipment is customarily sold through bidding arrangements; they played but a small role in the price measurements for iron and steel.

differences were found in all 6 of the 2-digit SITC* categories included in the study, the largest differences were in iron and steel (SITC Division 67). In 1963, Japanese prices averaged 30 percent less than those of the U.S., German prices 24 percent less and the U.K. prices 22 percent less.** Table 11 shows frequency distributions of price differences from the U.S. for individual 3- and 4-digit SITC categories falling within the iron and steel (SITC 67), non-electrical machinery (SITC 71) and electrical machinery (SITC 72) divisions. For iron and steel, the individual differences though clustered around the averages cited above, were as large as 43 percent for Japan in the case of iron and steel wire (SITC 677) and 40 percent for Germany in the cases of bars and rods (SITC 673.2) and tube and pipe fittings (SITC 678.5). These differences persisted more or less over the entire period covered by the study, 1953-64. The period was one in which the U.S. share in the iron and steel exports of the 21 OECD countries declined from 19 percent to 10 percent and that of the U.K. from 14 percent to 9 percent, while the German share rose from 12 to 18 percent and the Japanese share from 5 to 14 percent. Similar, though less dramatic differences in prices and changes in shares were found in non-electrical machinery and electrical machinery.*** For this period, at least, notable and even substantial

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*Standard International Trade Classification, Revised, Statistical Papers, Series M, No. 34 (New York: United Nations, 1961).

**Relative prices of each iron and steel product in this comparison are weighted by the importance of each product in 1963 exports of OECD countries. The country composition of the OECD has varied; the statistics in the source cited refer to 18 European countries and the U.S., Canada, and Japan.

***The data referred to in this and the two preceding sentences may be found in Kravis and Lipsey, Price Competitiveness in World Trade (New York: National Bureau of Economic Research, 1971), in Table 2.4 and Appendix Tables B-1, B-45, and E-1.

Table 11

Frequency Distribution of Percentage Differences of Export Prices of U.K., Germany and Japan from U.S. Export Prices for 3- and 4-digit SITC Categories, 1963

| Percentage difference from U.S. price | Number of 3- and 4-digit categories | | |
|---|---|---|---|
| | U.K. | Germany | Japan |
| 67 Iron and Steel | | | |
| -40 to -49.99 | | | 2 |
| -30 to -39.99 | 2 | 4 | 2 |
| -20 to -29.99 | 5 | 5 | 3 |
| -10 to -19.99 | 2 | 1 | |
| -5 to -9.99 | 1 | | |
| Number of categories compared | 10 | 10 | 7 |
| 71 Machinery other than electric | | | |
| -30 to -39.99 | 1 | | |
| -20 to -29.99 | 5 | 4 | 2 |
| -10 to -19.99 | 9 | 4 | |
| -5 to -9.99 | 5 | 7 | 1 |
| -0 to +4.99 | 3 | 3 | 1 |
| +5 to +9.99 | 1 | 1 | |
| +10 to +19.99 | | 1 | |
| Number of categories compared | 27 | 24 | 4 |
| 72 Electric Machinery | | | |
| -30 to -39.99 | | | 1 |
| -20 to -29.99 | | | 3 |
| -10 to -19.99 | 3 | 2 | 3 |
| -5 to -9.99 | | 2 | |
| -0.1 to -4.99 | | 2 | 1 |
| 0 to +4.99 | 1 | | |
| +5 to +9.99 | 3 | 1 | |
| +10 to +19.99 | | 2 | |
| +20 to +29.99 | 2 | | |
| Number of categories compared | 9 | 9 | 8 |

N.B. In some instances overlapping 3- and 4-digit categories have both been included in the above frequency distributions.

Source: Kravis and Lipsey, Price Competitiveness in World Trade (New York: National Bureau of Economic Research, 1971), Table 2.4 and Appendix E.

price differences persisted while the low price sellers gradually expanded their market shares and the high priced sellers saw their shares contract.

The time to time movement of export prices of comparable goods from different countries sometimes differs substantially.

The dearth of data on export prices* is slowly being remedied, but long series of comparable export prices for two or more countries are still rare. Using a combination of data reported upon in our earlier work (1971) and official German and U.S. export price data, we are now able to compare German and U.S. export prices for machinery and equipment (SITC 7) over the period 1954-75 (see Table 12). From 1954 to 1969, when the D.M./dollar exchange rate was relatively stable (varying within a 7 percent range), the annual ratios of German to U.S. export prices, both taken in dollar terms, varied within a 10 percent range. Beginning in 1969, however, the mark began to appreciate, and most of its rise was passed through to German dollar export prices. The German/U.S. export price ratio was 45.5 percent higher in 1975 than in 1969; the German export price in DM increased by 44.3 percent and the $/DM rate by 59.7 percent compared to a rise in U.S. export prices of 58.4 percent. As this implies, there is very little similarity between the changes in German and U.S. export prices when both are expressed in dollars.

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*No one should be misled about the abundance of export price indexes by the rather irresponsible tendency of international agencies to collect unit value indexes from different countries and to publish them under the heading of "price" indexes. The IMF has done this for years in its International Financial Statistics (see, for example, pages 32-33 of the September 1975 issue). After representation by one of the present authors, the relevant table in a recent issue (January 1977, pages 34-35) uses the term "unit values" parenthetically once in a two page spread where the term "prices" appears twice in major titles and 6 times in chart titles. A note at the back of the issue (page 404) explains that virtually none of the series for the more than 80 countries included is an export price or an import price series.

Table 12

German and U.S. Domestic and Export Price Indexes
for Machinery and Equipment (SITC 7), 1953-75

| Year | German prices | | Exchange Rate | German prices | U.S. prices | | Export/ Domestic | Export/ Domestic | U.S. price competitiveness | |
|---|---|---|---|---|---|---|---|---|---|---|
| | Domestic | Export (DM) | $/DM | Export ($) | Domestic | Export | German | U.S. | From indexes | From matched detailed data |
| | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) | (10) |
| 1953 | 87.0 | NA | 95.0 | NA | 85.7 | 85.3 | NA | 99.5 | NA | 97.7 |
| 1954 | 85.0 | 87.9 | 95.0 | 83.5 | 85.9 | 85.2 | 103.4 | 99.2 | 98.0 | 97.4 |
| 1955 | 85.0 | 88.6 | 94.8 | 84.0 | 86.0 | 85.1 | 104.2 | 99.0 | 98.7 | 99.4 |
| 1956 | 87.2 | 90.6 | 94.9 | 86.0 | 89.5 | 88.0 | 103.9 | 98.3 | 97.7 | 97.6 |
| 1957 | 89.6 | 92.7 | 94.9 | 88.0 | 93.7 | 92.2 | 103.5 | 98.4 | 95.4 | 95.8 |
| 1958 | 90.5 | 94.0 | 95.1 | 89.4 | 95.6 | 93.9 | 103.9 | 98.2 | 95.2 | 94.9 |
| 1959 | 89.9 | 94.1 | 95.4 | 89.8 | 97.9 | 95.9 | 104.7 | 98.0 | 93.6 | 93.2 |
| 1960 | 91.4 | 95.4 | 95.6 | 91.2 | 98.5 | 97.3 | 104.4 | 98.8 | 93.7 | 92.7 |
| 1961 | 94.1 | 97.4 | 99.2 | 96.6 | 98.6 | 97.6 | 103.5 | 99.0 | 99.0 | 97.7 |
| 1962 | 99.2 | 99.2 | 99.7 | 98.9 | 99.8 | 99.1 | 100.0 | 99.3 | 99.8 | 99.1 |
| 1963 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 | 100.0 |
| 1964 | 101.7 | 101.4 | 100.3 | 101.7 | 101.5 | 101.4 | 99.7 | 99.9 | 100.3 | 99.0 |
| 1965 | 104.8 | 104.4 | 99.8 | 104.2 | 103.0 | 102.8 | 99.6 | 99.8 | 101.4 | 100.3 |
| 1966 | 108.0 | 107.2 | 99.7 | 106.9 | 106.5 | 104.1 | 99.3 | 97.7 | 102.7 | 99.2 |
| 1967 | 107.9 | 108.1 | 100.0 | 108.1 | 109.7 | 107.8 | 100.2 | 98.3 | 100.3 | 95.1 |
| 1968 | 107.9 | 107.7 | 99.9 | 107.6 | 113.3 | 110.6 | 99.8 | 97.6 | 97.3 | 92.0 |
| 1969 | 109.8 | 112.2 | 101.7 | 114.1 | 116.8 | 114.8 | 102.2 | 98.3 | 99.4 | 95.3 |
| 1970 | 118.5 | 117.3 | 109.4 | 128.3 | 122.3 | 120.2 | 99.0 | 98.3 | 106.7 | 103.6 |
| 1971 | 127.3 | 125.2 | 114.7 | 143.6 | 127.4 | 125.5 | 98.4 | 98.5 | 114.4 | 111.7 |
| 1972 | 133.0 | 130.1 | 125.0 | 162.6 | 130.6 | 128.6 | 97.8 | 98.5 | 126.4 | 122.8 |
| 1973 | 139.8 | 136.9 | 150.5 | 206.0 | 134.4 | 133.5 | 97.9 | 99.3 | 154.3 | 148.0 |
| 1974 | 153.9 | 148.5 | 154.1 | 228.8 | 150.4 | 154.7 | 96.5 | 102.9 | 147.9 | 143.2 |
| 1975 | 166.3[a] | 161.9[a] | 162.4 | 262.9 | 175.1 | 181.8 | 97.4 | 103.8 | 144.6 | NA |

[a] Extrapolated

Cols. 1 & 2: NBER
Col. 3: IMF period averages
Col. 4: Cols. 2 X 3
Cols. 5 & 6: NBER
Col. 7: Cols. 2 ÷ 1
Col. 8: Cols. 6 ÷ 5
Col. 9: Cols. 4 ÷ 6
Col. 10: NBER (aggregation of ratio of German to U.S. export price indexes at detailed levels)

Notes to Table 12

Cols. 1 and 2: Indexes are aggregations from individual commodity export and domestic price series. The individual price series are first put in the form $P_t/P_{t-1}$ and then combined without weighting into indexes for SITC 4-digit subgroups. These 4-digit indexes are then weighted by 1963 German exports for aggregation to higher levels. The discontinuity in the export price index at the time of the shift to the value-added tax was treated by assuming no change in price during the month of the shift in the tax system. The extrapolations to 1975 were based on combinations of published group indexes as follows:

Domestic price is a weighted index of the following group indexes of the "Index der Erzeugerpreise industrielle Produkte"
Maschinenbauerzeugnisse
Strassenfahrzeuge
Elektrotechnische Erzeugnisse
with weights taken from the export price index.

Export price is a weighted index of the following group indexes of the Index der Ausfuhrpreise"
Maschinenbauerzeugnisse (einschl. Lokomotiven und Ackerschlepper)
Strassenfahrzeuge (ohne Ackerschlepper)
Elektrotechnische Erzeugnisse
with weights of .50637, .29078, and .20286 respectively, based on the weighting for the index on 1962=100.

Price data are from the following sources, all published by Statistisches Bundesamt, Wiesbaden:

Preise, Löhne, Wirtschaftsrechnungen
Reihe 1, Preise und Preisindizes für Aussenhandelsgüter
Reihe 3, Preise und Preisindizes für industrielle Produkte, Index der Erzeugerpreise
Reihe 8, Index der Grosshandelsverkaufspreise
Statistisches Jahrbuch für die Bundesrepublik Deutschland, 1971, pp. 431, 432, 449; 1967, pp. 445, 446, 463.
Wirtschaft und Statistik , Nov. 1976.

Col. 3: Annual average exchange rates, IMF.

Col. 4: Col. 2 x Col. 3.

Cols. 5 and 6: Domestic price data are BLS wholesale price indexes for specific commodities aggregated without weighting into 4-digit SITC classes. Export price data are BLS export price indexes for 4-digit SITC subgroups and 5-digit SITC items, extended back to 1953, where possible, by indexes from Irving B. Kravis and Robert E. Lipsey, Price Competitiveness in World Trade, NBER, 1971, with interpolations for 1954-56 and 1958-60 as described for Germany in Kravis and Lipsey, "International Trade Prices and Price Proxies," in The Role of the Computer in Economic and Social Research in Latin America, NBER, 1974. The number of export

series ranges from 8 in 1953 to 22 in 1975 and only those domestic price series falling within the groups covered by the export price series are included in the domestic price index. We are indebted to Eliot Kalter for the selection and matching of export and domestic price data.

In calculating the 3-digit export and domestic price indexes, each 4-digit subgroup was given its weight in U.S. exports in 1963. Each 3-digit group was given its weight in U.S. exports in aggregating to 2-digit classes except when the coverage of 4-digit subgroups was less than 40 per cent of the value of exports in the 3-digit group, in which case only the weight of the covered 4-digit subgroups was used. The same procedure was followed in aggregating from the 2-digit to the 1-digit level (SITC 7 as a whole).

Two 4-digit export price indexes available in the original sources were omitted in this calculation, and the corresponding domestic price series were therefore also dropped. One was the BLS series for SITC 729.3 and the other was the NBER series for 722.1. In the case of SITC 729.3 the BLS export price index is dominated by semiconductors while the wholesale price index is heavily weighted with television tubes. Therefore the two were considered to be not comparable. In the case of SITC 722.1, from 1953 to 1964, the NBER "international price index" is constructed from domestic transactions prices while the BLS domestic price index is apparently based on list prices, which differed greatly (see Kravis and Lipsey, Price Competitiveness, pp. 408-421). Thus the relationship between them is mainly that of transactions prices to list prices rather than of export to domestic prices.

Col. 7: Col. 2 ÷ Col. 1.

Col. 8: Col. 6 ÷ Col. 5.

Col. 9: Col. 4 ÷ Col. 6.

Col. 10: Each German export price index in dollars at the 4-digit level is divided by the corresponding U.S. export price index and the resulting relative price indexes are aggregated up to 3-digit, 2-digit, and 1-digit levels using as weights total OECD exports in 1963.

In Table 13 the results of a comparison for 9 detailed (4-digit SITC) component categories of SITC are presented. Because the categories for which export price series are published in the official German and U.S. sources are not always the same, these were the only components for which we were able to match German and U.S. export price series quite closely over long periods (10 to 21 years). The correlations between percentage changes in German and U.S. export prices are low, and in only three subgroups (tractors, heating and cooling equipment, and powered tools) is the slope coefficient significant at the 5% level or better. The ratio of the index of German export prices to the index of U.S. export prices drifted far from 100 (see columns 3-6).

The differences in prices in dollar terms, relative to 1970, were large in the period preceding 1970 (see columns 8 and 9) but they became even larger subsequently when the mark began to appreciate sharply. In 1974, German export prices for the 9 categories ranged from 21 to 58 percent higher relative to U.S. export prices than they had been in 1970. If this was an effect of the DM appreciation, it was not a fleeting one. Most of the 41 percent increase in the dollar price of the mark that occurred between 1970 and 1974 had taken place by 1973; between 1973 and 1974, the increase was only 2 percent.

A question that arises for these and other comparisons of different price series concerns the extent to which two series differ because (a) the prices of identical products moved differently in different origins (or destinations) or (b) the two series, though bearing the same descriptive title, are actually composed

Table 13

Characteristics of U.S. Indexes of Price Competitiveness Relative to Germany,[#] 1954-1974

| SITC Category | | Entire period | | | | | | 1954-70 | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | | | Number of annual indexes[**] | | | | | | | |
| Code | Description | $r^{-2}$ | Total | Differing from 100 by more than 5% | Differing from 100 by more than 10% | Highest index | Lowest index | $r^{-2}$ | Highest index | Lowest index |
| | | (1) | (2) | (3) | (4) | (5) | (6) | (7) | (8) | (9) |
| 711.5 | Internal Combusion Engines (exc. aircraft) | .09 | 21 | 20 | 17 | 143 | 82 | .08 | 100 | 82 |
| 712.5 | Tractors (exc. road tractors for trac/ trail comb.) | .39* | 21 | 5 | 2 | 129 | 96 | .23* | 107 | 96 |
| 715.1 | Machine tools for working metals | .004 | 18 | 17 | 16 | 143 | 70 | -.07 | 100 | 70 |
| 717.1 | Textile machinery | -.03 | 10 | 9 | 4 | 143 | 86 | | | |
| 719.1 | Heating & cooling equipment | .20* | 21 | 20 | 12 | 143 | 85 | .08 | 100 | 85 |
| 719.2 | Pumps & centrifuges | .01 | 21 | 20 | 17 | 161 | 74 | -.07 | 100 | 74 |
| 719.5 | Powered tools, n.e.s. | .29* | 10 | 9 | 9 | 163 | 76 | | | |
| 719.8 | Machinery & mechanical appliances, n.e.s. | -.14 | 10 | 9 | 6 | 148 | 88 | | | |
| 722.1 | Electric power machinery | .04 | 21 | 18 | 14 | 132 | 51 | .06 | 105 | 51 |

[#]Index of German export prices (in dollars) divided by index of U.S. export prices, both indexes with a 1970 base, times 100. All columns refer to this index of price competitiveness, except columns 1 and 7 which refer to correlations between German and U.S. export price indexes.

*Slope coefficient significant (in one-tail test) at 5% level.

Source: Kravis and Lipsey, Price Competitiveness in World Trade (New York: National Bureau of Economic Research, 1971) and "Export Prices and the Transmission of Inflation," American Economic Review, February 1977; U.S. Bureau of Labor Statistics, press releases on U.S. export and import price indexes; and Wirtschaft und Statistik, various issues. For source of data on last row, see note on page 69.

of different sets of goods. Recent work at the U.S. Bureau of Labor Statistics throws some light on this question. Suomela and Perez-Lopex of the BLS staff drew upon the export price series for individual commodities to match the commodity composition of a selected number of categories for which German export price series were available.* By weighting the U.S. individual series with the German export weights, they produced more closely matching U.S. and German export price series than previously available. Their results, presented as annual indexes of price competitiveness by taking the ratio of the German to the U.S. series, are reproduced in Table 14.** (Since the German and U.S. domestic price movements for machinery generally (SITC 7) were very similar (see columns 1 and 5 of Table 12, the exchange rate changes are once again seen to dominate the large shifts in relative German/U.S. export prices.)

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*John W. Suomela and Jorge F. Perez-Lopez, "Measuring Changes in U.S. Price Competitiveness," presented at the Atlantic Economic Conference, Washington, D.C., September 12-13, 1975 (processed). U.S. series were apparently selected to represent each "subcategory" included in the category. The subcategories were defined in terms of 7-digit U.S. Schedule B or 6-digit Brussels Tariff Nomenclature (BTN) classes. The categories themselves are approximately 4-digit BTN classes.

**It is reassuring to note that Suomela and Perez-Lopez, who based these relative changes on especially matched U.S. and German price series, obtain results which compare closely to the relative price changes based on the less perfectly matched published series. This is the case, at least, for the three categories (out of the six they used) for which we can find roughly comparable published German and U.S. series:

Indexes of U.S. Price Competitiveness Relative to Germany

| | 1969/65 | 1973/69 |
|---|---|---|
| A. Internal combustion engines | 101.8 | 167.6 |
| B. Internal combustion engines other than aircraft (711.5) | 103.3 | 166.6 |
| A. Machine tools for working metals | 95.9 | 174.6 |
| B. Machine tools for working metals (715.1) | 99.4 | 179.0 |
| A. Pumps and compressors | 92.4 | 177.2 |
| B. Pumps and centrifuges (719.2) | 95.9 | 181.1 |

Line A: from Suomela and Perez-Lopez
Line B: from published German and U.S. sources (SITC categories in parentheses).

Table 14

Indexes of U.S. Price Competitiveness Relative to Germany*

Selected Categories, June 1964-73

(June 1967=100)

| Category | JUNE | | | | | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| | 1964 | 1965 | 1966 | 1967 | 1968 | 1969 | 1970 | 1971 | 1972 | 1973 |
| 1. Internal combustion engines | 96.7 | 97.2 | 100.3 | 100.0 | 98.5 | 98.4 | 107.5 | 113.2 | 128.2 | 164.9 |
| 2. Agricultural machinery | 103.9 | 104.3 | 102.0 | 100.0 | 107.0 | 106.3 | 114.8 | 132.2 | 147.7 | 190.0 |
| 3. Machine tools for working metals | 101.5 | 100.9 | 100.5 | 100.0 | 94.1 | 97.3 | 114.9 | 127.5 | 137.9 | 169.9 |
| 3a. Metal cutting machinery | 103.8 | 102.1 | 101.6 | 100.0 | 94.2 | 98.4 | 114.5 | 128.5 | 141.9 | 174.7 |
| 3b. Metal working machinery | 97.8 | 97.9 | 97.8 | 100.0 | 93.7 | 95.2 | 116.1 | 125.2 | 128.9 | 159.5 |
| 4. Earthmoving equipment | 102.9 | 103.4 | 99.9 | 100.0 | 103.5 | 105.7 | 111.7 | 128.2 | 131.1 | 159.9 |
| 5. Mining equipment | 102.4 | 101.5 | 100.3 | 100.0 | 100.5 | 100.3 | 109.8 | 115.0 | 127.2 | 153.6 |
| 6. Pumps and compressors | 102.9 | 101.6 | 101.3 | 100.0 | 96.3 | 95.1 | 109.0 | 116.5 | 136.4 | 168.5 |
| Exchange rate (index of U.S. cents per D.M.) | 100.2 | 99.5 | 99.4 | 100.0 | 99.6 | 99.5 | 109.6 | 114.4 | 125.6 | 154.4 |

* Ratio of German export price indexes to U.S. export price indexes. (A rise in the ratio betokens an increase in U.S. price competitiveness.)

Source: John W. Suomela and Jorge F. Perez-Lopez, "Measuring Changes in U.S. Price Competitiveness," Bureau of Labor Statistics, September 1975.

The results from these closely matched price series confirm our earlier findings that substantial relative price changes can and sometimes do occur. From 1964 to 1967 relatively small differences are found in the index of price competitiveness but between 1967 and 1968 half of the series reveal shifts of 5 percent or more and beginning in 1969, when exchange rates began to change substantially, year to year changes are common. Furthermore, the relative price changes did not cancel out over time. From 1964 through 1969 they ranged up to 7.6 percent and all but one were over 2 percent.

When exchange rates were moving rapidly, between 1969 and 1973, the relative price movements were far greater, up to 29 percent in a year and cumulating to over 60 percent in most cases.

In the period of stable exchange rates, prior to 1970, the largest divergences from unity in the indexes of price competitiveness were 6 or 7 percent. (For example, between 1967 and 1968 German agricultural machinery export prices rose by 7 percent relative to those of the U.S.).

Of course, it is still possible that the individual product varieties differ between German and U.S. exports even after the improved matching by Suomela and Perez-Lopez. Our own view is that the comparisons are between like products which are in competition with one another but that for reasons given earlier market arbitrage does not necessarily operate to prevent very substantial differences in export price movements between major competing countries. However, as we argued in an earlier section, any claim that substitutability between the exports of the advanced countries is high can hardly be maintained without expecting that it will be high within such narrow product groups as are found in the previous text table. Whether the series we have cited are regarded as comparing German and U.S. export prices for identical or for different products, they constitute strong evidence against the price assumptions of the monetary approach.*

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*Attention may be called to an effort to compare export trends for all commodities which is not treated in the text because U.S. export prices had to be supplemented by wholesale price data. The quarterly indexes in the original source have been averaged to produce the following annual indexes of price competitiveness (ratios of export price indexes):

| | U.S. with respect to Germany | U.S. with respect to Japan | Germany with respect to Japan |
|---|---|---|---|
| 1970 | 100 | 100 | 100 |
| 1973 | 112 | 101 | 90 |
| 1974 | 109 | 103 | 95 |
| 1975 | 113 | 93 | 83 |

The data do not support the proposition that the price movements of different countries, especially of major competitors, must be the same. German competitiveness fell with respect to both the U.S. and Japan, by 12 percent in 1975 compared with 1970 in the first case and 17 percent in the second:

Source: U.S. Bureau of Labor Statistics, "The Measurement of Export Price Trends from the Industrial Countries to OPEC," January 1976, (revised and updated May 1976). A background paper prepared by the Bureau of Labor Statistics for the meeting of experts on measuring OECD export prices to OPEC, OECD, Paris, February 5-6, 1976.

A given seller may charge different prices for a given product to different destinations.

There is also persistent evidence that price discrimination by sellers to different markets is quite common in international trade. References to such discrimination are continually appearing in the business and financial press, and occasionally there is an official finding of discriminatory pricing.*

Although we did not solicit information about domestic pricing policies in the National Bureau study referred to above, about half of the 121 U.S. sellers that gave us price information, nevertheless indicated what their pricing policies were. Of these, about half stated that their foreign and domestic prices differed.** The information obtained from these and other sellers and buyers, including some from abroad, suggested that price differentiation between various markets was more widely practiced by European suppliers than by U.S. firms and still more by Japanese exporters.

More systematic evidence about the existence of price discrimination for traded goods may be obtained by comparing the German and U.S. export price series with their corresponding wholesale price series.

For machinery and transport equipment (SITC 7) as a whole we may compare the German and U.S. export indexes set out earlier (Table 12) with domestic (wholesale) price indexes constructed by combining the individual wholesale price series to an aggregate index with the aid of each country's export weights. Thus the effect of

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*For example, it was recently reported that the Common Market fined a glass producer for selling insulating fiber glass in Germany at a price 40 percent higher than that charged in the Benelux countries and another firm for maintaining music record prices in Germany 50 percent higher than in France. It was also reported that a fruit company was selling bananas in rich Common Market countries at twice the price charged in poorer ones. New York Times, 17 January 1976.

**Differences in attributable to higher packaging expenses for preparing goods for overseas shipment were not counted as price differences.

different goods composition in exports and in domestic sales has been sharply reduced, and the remaining (within 4-digit SITC category) room for compositional differences is subject to our remarks in the previous section about the implications of the existence or non-existence of substitutability of different bundles of goods falling within a detailed (4-digit) category.

The range of variation in the export/domestic price ratio was 6.4 percent for the U.S. (see column 8 of Table 12) and 8.5 percent of Germany (see column 7). Are these ranges of variation sufficiently small so that we may judge export and domestic prices to move identically? One way of answering this question that has often been followed is to regress one price series against the other and to demand for a judgment in favor of identity not only an $r^2$ that is equal or close to 1 but also a constant term that is insignificantly different from zero and a slope coefficient that is insignificantly different from one. The two sets of series do not pass these tests unequivocally. The $\bar{r}^2$ for the annual percentage changes in the U.S. wholesale price index and the percentage changes in the U.S. export price index is 0.95 and the $\bar{r}^2$ for the corresponding German pair is 0.80* The latter is significantly different from 1 at the 5% level. Both the U.S. and German equations satisfy the condition

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*The equations, with t-values in parentheses, are:

$$P_{USX} = \underset{(.08)}{-.2432} + \underset{(20.1)}{1.1398}\, P_{USD} \qquad \bar{r}^2 = .95,\ D.W. = 2.10$$

$$P_{USD} = \underset{(1.5)}{+.3620} + \underset{(20.1)}{0.8379}\, P_{USX} \qquad \bar{r}^2 = .95,\ D.W. = 2.19$$

$$P_{GX(DM)} = \underset{(1.2)}{+.4611} + \underset{(8.9)}{0.7662}\, P_{GD(DM)} \qquad \bar{r}^2 = .80,\ D.W. = 2.13$$

$$P_{GD(DM)} = \underset{(0.3)}{+.1481} + \underset{(8.9)}{1.0536}\, P_{GX(DM)} \qquad \bar{r}^2 = .80,\ D.W. = 2.43$$

where the subscript G refers to Germany, US to the U.S., D to domestic (wholesale) prices, X to export prices, DM to deutschemarks, and $ to U.S. dollars.

that the constant term be insignificantly different from zero. However, the slope coefficients in the U.S. equations are significantly different from one (at the 5% level) and the same is true for Germany when export prices are taken as the dependent variable though not in the opposite case.

It is in any case questionable whether reliance should be placed on a statistical test. The differences may not be large enough to be picked up by a statistical test yet be economically important. Although variations of less than 10 percent in the export/domestic price ratio over a 20 year period may appear to be quite modest, when account is taken of profit/sales ratios -- which for U.S. corporations producing SITC 7 products were around 4 percent in 1970 -- such swings imply large shifts in the profitability of exports and domestic sales. As we have pointed out elsewhere, both U.S. and German data provide evidence of associated changes in exports relative to domestic shipments (Kravis and Lipsey, 1977).

At a less aggregated level, evidence about the existence of price discrimination between domestic and export sales of traded goods may be obtained from comparisons between export and domestic price series in an earlier paper* in which we compared changes in export prices for four countries (Germany, Japan, U.K. and U.S.) with those in domestic prices over the one- and four-year spans calculated in the Price Competitiveness book. It was found that in more than two-thirds of the cases the difference between export and domestic price changes was 4½ percentage points or more, far from identical changes. The correlation between the two price movements was also fairly low -- below .50 -- and it was low for each of the four countries, each time period, and each SITC division included.

For the U.S., we can now report on the results of a very detailed matching of annual export and domestic price data for the period 1968-76 carried out in the Bureau of Labor Statistics by Eliot Kalter. Sixteen 4- and 5-digit SITC categories were included; all were within the SITC machinery divisions, 12 of them in machinery other than electri (SITC 71) and the other 4 in electrical machinery (SITC 72). The basic materials consisted of wholesale price series at the 8-digit level in the classification used for the wholesale price index and of unpublished export price series for 7-digit Schedule B categories. Within each 4-digit category a wholesale price index was calculated as an unweighted average of the 8-digit series assigned to that classification and an export price index was correspondingly computed as an unweighted

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*Irving B. Kravis and Robert E. Lipsey, "International Trade Prices and Price Proxies," in Nancy D. Ruggles, Ed., The Role of the Computer in Economic and Social Research in Latin America, NBER, 1974.

average of the indexes of the 7-digit categories that fell within the scope of the 4-digit group.*

The index numbers were expressed as year to year price relatives (the index for a given year being divided by the index for the previous year) and it was in this form, yielding eight observations, that the export price series and wholesale price series for each of 16 4- or 5-digit SITC categories were correlated.

The coefficients of determination do not suggest identity between domestic and export price changes: 12 of the 16 are .75 or below. (See Table 15.) The ratio of the export price index to the wholesale price index strayed over a 20 percent range or greater during the nine year period in over half the categories. Variations greater than 30 percent were found in many cases and the lowest range was 7 percent.

Kalter's careful matching of U.S. wholesale and export price series on a detailed basis covers only a relatively short span of years. A less perfect set of 10 matches, 9 of them among those studied by Kalter, extends over periods of 17

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*Only 8-digit wholesale price series and 7-digit export price series which could be matched were included; wholesale price series for which matching export price series were unavailable were excluded even though the series belonged within the 4- or 5-digit category and the same restriction was imposed on the export price series. This requirement produces more comparable wholesale and export price indexes at the 4- and 5-digit level even though the measure of the movement of each type of price is probably less reliable than that which would be produced by the inclusion of all of each type of series in the derivation of the 4- or 5-digit averages regardless of the ability to match. Kalter also tried restricting the 4- and 5-digit price indexes to those 8-digit wholesale price categories and 7-digit export price categories for which data were available in every year during the period 1967-76. This eliminated a large number of the 8-digit wholesale price series and of the 7-digit export price series and thus tended to produce erratic results sometimes based on only one matched series, whereas there were usually from 5 to 12 series if series were included even if they were not available for every single year.

## Table 15

## Comparisons of Year-to-Year Changes in U.S. Wholesale and Export Price Indexes for Selected Detailed Categories, 1968-76

| SITC Category Code | Description | $\bar{r}^2$ (1) | Number of years in which ratio of wholesale to export price index differed from unity by more than 5% (2) | 10% (3) | Ratio of wholesale to export price index: Highest Ratio (4) | Lowest Ratio (5) | Range (percentage points) (6) |
|---|---|---|---|---|---|---|---|
| 711.5 | Internal combustion engines (exc. aircraft) | .89 | 0 | 0 | 1.04 | .96 | 8 |
| 712.1 | Agricultural machinery for cultivating soil | .75 | 3 | 0 | 1.19 | .95 | 24 |
| 712.2 | Agricultural machinery for harvest, threshing, sorting | .65 | 7 | 6 | 1.09 | .82 | 27 |
| 712.5 | Tractors (exc. road) | .64 | 3 | 0 | 1.08 | .93 | 15 |
| 715.1 | Machine tools for working metals | .91 | 3 | 0 | 1.06 | .97 | 9 |
| 718.2 | Printing & Bookbinding machinery | -.01 | 7 | 6 | 1.09 | .82 | 27 |
| 718.42 | Excavating, levelling, boring, etc. machinery | .95 | 2 | 0 | 1.02 | .94 | 8 |
| 719.1 | Heating & cooling equipment | .50 | 7 | 6 | 1.26 | .93 | 33 |
| 719.2 | Pumps & centrifuges | .50 | 8 | 8 | 1.51 | .84 | 67 |
| 719.32 | Fork lift trucks | .67 | 7 | 7 | 1.31 | .92 | 39 |
| 719.5 | Powered tools, n.e.s. | .58 | 3 | 0 | 1.03 | .91 | 12 |
| 719.92 | Taps, cocks, valves | .91 | 4 | 3 | 1.02 | .81 | 21 |
| 722.1 | Electric Power machinery | .75 | 6 | 6 | 1.22 | .81 | 41 |
| 722.2 | Electrical apparatus for making, breaking elec. circuits | .60 | 4 | 3 | 1.34 | .93 | 41 |
| 725.0 | Domestic electrical equipment | .56 | 0 | 0 | 1.03 | .96 | 7 |
| 729.52 | Other electrical measuring & controlling instruments & apparatus | .30 | 6 | 0 | 1.09 | .94 | 15 |

Source: Eliot Kalter

to 22 years ending in 1974. They are based on NBER indexes up to 1964 and on published BLS indexes for the subsequent years.

The results, presented in Table 16, are broadly consistent with the findings based on the more detailed matchings. We would expect these data to show a weaker relationship between wholesale and export prices both because the matchings are crude and because they extend far past the period of sharp inflation when the strong upward movements of most prices tended to increase the correlations. Contrary to our expectations, they show a stronger relationship and somewhat smaller deviations of one from the other for the indexes that cover the post-1970 period:

| | Average $\bar{r}^2$ | Average range of ratio (percentage points) |
|---|---|---|
| Detailed commodities (Table 15) | .63 | 25 |
| 4-digit subgroups (Table 16) | | |
| All available years | .72 | 20 |
| 1953-1970 | .39 | 11 |

The data that cover only the earlier period of more stable prices and exchange rates show smaller deviations but also a much weaker relationship between the two. Thus, whatever the period and no matter how carefully the export price series are matched with the domestic price series, as far as we can go in that direction, export prices and domestic prices do not generally reveal identical movements; although they resemble each other, there are sometimes large discrepancies in year-to-year changes. Furthermore, moving toward refinement of the comparisons does not appear to reduce the discrepancies between the two types of prices.

For the matching of German export and domestic price series for 4-digit SITC categories, we had to rely on published export and wholesale price data. The 69 matches, which cover the whole range of manufactures, are too numerous to present in detail and we merely summarize their behavior in Table 17. About 40 of the series begin in the mid 1950's and the others in the early 1960's; the terminal year is usually 1974 but in about a third of the cases it is a year or two earlier.

Table 16

Comparisons of Year-to-Year Changes in U.S. Wholesale and Export Price Indexes for Selected 4-Digit SITC Categories

| SITC Category | | 1953-74 or Maximum Period Available | | | | | | | 1953-1970 | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | | | Number of years in which difference is more than* | | | Ratio of wholesale to export price index | | | Ratio of wholesale to export price index | | | |
| Code | Description | $r^{-2}$ (1) | Total (2) | 5% (3) | 10% (4) | High (5) | Low (6) | Range (percentage points) (7) | $r^{-2}$ (8) | High (9) | Low (10) | Range (percentage points) (11) |
| 711.5 | Internal Combusion Engines (exc. aircraft) | .86 | 23 | 0 | 0 | 1.05 | .97 | 8 | .41 | 1.05 | .97 | 8 |
| 712.1 | Agricultural Machinery & appl. for cultivating | .74 | 23 | 2 | 1 | 1.19 | .95 | 24 | .38 | 1.04 | .98 | 6 |
| 712.2 | Agricultural Machinery & appl. for harvest, thresh, sorting | .69 | 23 | 9 | 3 | 1.10 | .87 | 23 | .15 | 1.10 | .99 | 11 |
| 712.5 | Tractors (exc. road tractors for tractor/ trailer combinations | .76 | 23 | 4 | 3 | 1.17 | .95 | 22 | .32 | 1.00 | .95 | 5 |
| 715.1 | Machine tools for working metals | .82 | 19 | 2 | 0 | 1.01 | .94 | 7 | .34 | 1.01 | .95 | 6 |
| 719.1 | Heating & cooling equipment | .90 | 23 | 8 | 0 | 1.08 | .99 | 9 | .64 | 1.08 | .99 | 9 |
| 719.2 | Pumps & centrifuges | .86 | 23 | 18 | 5 | 1.17 | .88 | 29 | .65 | 1.17 | 1.00 | 17 |
| 722.2 | Elec. apparatus for making, breaking cir. | .64 | 19 | 14 | 10 | 1.33 | 1.00 | 33 | .12 | 1.24 | 1.00 | 24 |
| 724.1 | TV receivers | .14 | 23 | 16 | 3 | 1.02 | .84 | 18 | .20 | 1.02 | .91 | 11 |
| 725.0 | Domestic electrical equipment | .82 | 24 | 14 | 9 | 1.07 | .85 | 22 | .44 | 1.00 | .85 | 15 |

*Number of years in which the ratio of the export to the wholesale price index differed from unity by more than

Table 17

Summary of Comparisons of German Export and Domestic Prices

for 69 4-digit SITC Categories

| | | No. of Categories | Slope coefficient significant at .05 level | $r^{-2}$ | | | High/low ratio of export to domestic index | | |
|---|---|---|---|---|---|---|---|---|---|
| | | | | <.50 | .50-.74 | ≥.75 | <1.25 | 1.25-1.49 | ≥1.50 |
| 5 | Chemicals | 3 | 1 | 2 | 1 | 0 | 2 | 1 | 0 |
| 6 | Manufactures classified by material | 30 | 23 | 18 | 10 | 2 | 14 | 13 | 3 |
| 7 | Machinery and transport equipment | 24 | 19 | 11 | 12 | 1 | 20 | 3 | 1 |
| 8 | Miscellaneous manufactures | 12 | 6 | 9 | 2 | 1 | 6 | 5 | 1 |
| | Total | 69 | 49 | 40 | 25 | 4 | 42 | 22 | 5 |

The correlations of year-to-year percentage changes in export and domestic prices were not often high. In only four of the matches was $\bar{r}^2$ over .75 and in well over half of the comparisons it was under .50. The three columns on the right of Table 17 show that the ratio of the wholesale to the export price index often varied substantially. As previously noted, even a high correlation does not preclude what may be economically significant variations between the two indexes. For example, for worked copper and its alloys (SITC 682.2), which had the highest $\bar{r}^2$ (.91), the ratio of the export to the domestic price index deviated from 1.00 by as much as 24 percent in the thirteen year period for which the two series could be matched.

If attention is confined to the period terminating in 1970, the case for identical movements of German domestic and export prices is still weaker. In the 49 categories for which at least ten year-to-year price changes were available only 6 $\bar{r}^2$s were as high as .50.

Thus it seems fairly clear from the data presented in this section that for Germany, as for the United States, export price movements can and do differ substantially from domestic price movements for the same or similar commodities.

## Summary and Conclusions

The view of price behavior that emerges from this survey does not correspond precisely to either of the two major paradigms about prices, the one set out by the standard theory and the other by the monetary approach to the balance of payments.

Partly because the specifications for price behavior of the monetary approach are more demanding, the picture we have painted is more at variance with the expectations of that approach. Using a GDP framework for measurement, we find that price levels differ significantly among countries and even price level movements for industrial countries sometimes differ substantially over both short (3 to 10

years) and long (20 years) periods of time. There also can be and sometimes are substantial differences between the export prices of one country and those of others for the same goods. Export prices for like goods from different countries often change substantially relative to each other and for a given country export and domestic prices for the same kinds of goods differ and do not necessarily change identically from year to year.

Price level movements following exchange rate changes did on the other hand tend to conform to the expectations of the elasticity approach, rising with appreciations and falling with depreciations. In the one case in which terms of trade could be associated with exchange rate changes (Germany), the terms of trade improved with appreciations. The monetary approach tends to deny that such a change will occur while the elasticity approach generally expects this result without requiring it.

With respect to changes in the nontradables/tradables price ratio, expected in most versions of the standard theory and in some versions of the monetary approach, our investigations uncovered some evidence of changes in the predicted direction, but the data are muddied by the secular upward trend in the ratio and it is difficult to separate out the influence of balance of payments causes on the ratio. We are inclined to the view that the ratio does play the role cast for it, but our rather simple marshalling of the data does not give consistent support to this view.

Improved data and a better knowledge of the methods underlying the data we have used -- especially for the implicit deflators of the different countries -- may conceivably lead to different conclusions on some points, but we think it unlikely that the high degree of national and international commodity arbitrage that many versions of the monetarist theory of the balance of payments contemplate is typical of the real world. This is not to deny that the price structures of the

advanced industrial countries are linked together, but it is to suggest that the links are loose rather than rigid. The substantial price differences for like products which we have found to exist may be subject to slow erosion as buyers adjust to them, but new disturbances continuously appear. New sellers who seek to enter markets or existing sellers whose costs are lowered and seek to expand their shares may offer substantially lower prices. Changes in the alignment of exchange rates among the major industrial exporting countries push sellers who wish to maintain acquired positions in different markets into discriminatory pricing. Markets may work in the textbook fashion but slowly rather than instantaneously and new shifts in comparative advantage prevent the achievement of an equilibrium that would correspond to any given static set of supply and demand forces.

Each theorist must decide how far to permit an impact of this real price world on his model. It seems to us that, as far as commodities are concerned, an adequate model has to take into account the leeway that each country -- even one that is highly integrated into the world economy — is given for independent money and fiscal policies by the imperfections of markets and the complexities of price behavior.