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TOWARDS AN EXPLANATION OF NATIONAL PRICE LEVELS

Irving B. Kravis

Robert E. Lipsey

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ABSTRACT

The purpose of this paper is to call attention to the need for a theory of comparative national price levels and to explore some of the elements that seem to belong to such a theory. Most theoretical discussions have maintained that national price levels tend towards equality and focus on presumably temporary divergences from equality. Yet strong evidence has been accumulating that there are large and long-standing differences in price levels, the highest of which are more than twice those of countries with the lowest prices.

Long-run price level differences are most clearly related to levels of real per capita output, with richer countries having higher price levels. These differences have been explained as resulting from greater advantages in productivity for the wealthier countries in goods production, mostly tradable, than in services production, mostly nontradable. The differences in relative productivity may be in total factor productivity or only in labor productivity, reflecting the greater capital intensity of goods production and possibly a higher elasticity of substitution between capital and labor in goods production.

We find in the empirical analysis that a large part of the differences in price levels can be explained by structural factors such as real GDP per capita, the degree of openness of the economy, and the share of nontradable goods in output. The only non-structural factor emerging from a preliminary analysis of several of these was the rate of growth of the quantity of money.

Irving B. Kravis
Department of Economics
University of Pennsylvania
Philadelphia, PA 19174
(215) 898-5692

Robert E. Lipsey
National Bureau of Economic Research
269 Mercer Street
New York, NY 10003
(212) 598-3533

Towards an Explanation of National Price Levels

I. Introduction

The main purpose of this paper is to call attention to the need for a theory of comparative national price levels and to explore some of the elements that seem to belong to such a theory.[1]

It is overstating the case to claim that a theory of comparative price levels does not exist, but the exaggeration is not great. As will be seen in the next section, the theoretical discussions most prominent in the literature have maintained that price levels tend towards equality. They have thus directed attention to what have been regarded as temporary divergences from equal (exchange-rate-converted) price levels, and diverted attention away from the need to explain large and systematic differences in national price levels that actually exist. The reality and extent of these differences may be seen in the summary data presented in Table 1 (p. 9) for 1975 for the 34 countries included in Phase III of the International Comparison Project (ICP). The figures indicate that GDP price levels in high income countries were more than double those of countries with very low incomes.

II. Antecedents

The great majority of discussions of price levels by economists has assumed that price level differences are evidence of disequilibrium and has been concerned with the mechanism by which deviations from equilibrium are erased. An early treatment of price levels along these lines may be found in the course of David Hume's exposition of the factors determining the distribution of specie. Hume concentrated more on the mechanism by which disequilibrium differences in price levels would be adjusted than on an effort to describe the nature of the equilibrium levels themselves. Indeed, he was sufficiently vague about the relationship between price levels to have been subsequently interpreted by some writers as an early advocate of the law of one price and by others as describing changes in relative price levels as part of the adjustment process. (Collery, 1971, pp. 25-26).

In the very large literature on the adjustment mechanism relying on price elasticities, which may be regarded as a logical outgrowth of Hume's work, the nature of the world price structure has seldom, if ever, been clearly specified. In much of this work the basic assumption has been that changes in exchange rates could alter the price of one country's goods relative to those of another country and consequently produce changes in the balance of trade. But it has been rarely, if ever, specified whether prices for identical goods do or do not have to be the same (after allowance for transfer costs) in different countries (Kravis and Lipsey, 1978).

Price levels also play a prominent role in the purchasing power parity theory of exchange rates. Since the main thrust of the theory is that exchange rates will adjust so as to equalize price levels (or changes in

price levels), price level differences are regarded as deviations from normal conditions. It is true that Cassel recognized that exchange rates could deviate from purchasing power parity owing to an unequal impact of the trade restrictions imposed by different countries on exports and imports, and, in the short run, to capital movements and expectations (Cassel, 1922, pp. 147-162; Holmes, 1967). But purchasing power parities remained as the "normal" exchange rates (Cassel, 1922, p. 156) and even these qualifications were often lost sight of in the writing of subsequent supporters of the theory.

In recent years, the purchasing power parity theory has been revived as part of the monetary approach to the theory of the balance of payments. Once again, the main purpose of the theory was not to explain price levels. Rather a "law of one price" was invoked to help demonstrate the dominant role of the supply of money in determining balance of payments deficits and surpluses and exchange rate changes. The law of one price, it may be noted, has usually been held to apply particularly among the more industrialized countries and particularly to traded goods. In some versions of the monetary approach, differences in the relative prices of home goods were given a crucial though transient role in the adjustment mechanism (Frenkel and Johnson, 1976; Whitman, 1975).

Mention may also be made of a very different though less extensive literature in which contrary assumptions were made about the possibility of price level differences. The reference here is to writings on export-led growth, particularly those advancing the hypothesis of export-led growth for advanced industrial countries. In one variant, the idea of export-led growth for such countries, with their varied exports, rests on the assumption that relative national price levels are not necessarily determined as

endogenous variables but rather that the price level can be used as a policy instrument. A widely held interpretation of the rapid recovery and growth of western Europe after World War II was based on a reading of events along these lines (Lamfalussy, 1963). Alternatively, cost-reducing technological change may improve a country's price competitiveness and though the price level is not held down as a matter of deliberate policy, the result, under a system of fixed exchange rates, may be price-induced export-led growth[2] (Beckerman, 1965, p. 46).

Despite the dominant tendency to treat price levels as an incidental facet of balance of payments and exchange rate problems, structural explanations of price level differences did appear. The kernel of the idea that price levels might be a function of real per capita income is found in a statement by Ricardo that home goods would be more expensive "in those countries where manufactures flourish" (Ricardo, 1817). A reasonably full account of a real theory of comparative national price levels was set out by Harrod (1939) in the 1930's and restated by Balassa (1964) and Aukrust (1970) after World War II.[3] All these writers assumed that at least as a first approximation internationally traded goods would tend to obey the law of one price. That is, local currency prices of of tradable goods were proportional to exchange rates. Each set out in a fairly complex way what has been called the "differential productivity model" (Kravis, Heston, and Summers, 1978a). The essence of the model lies in differences in price formation and in productivity for traded and nontraded goods. Prices for traded goods are set in world markets while prices for nontraded goods are determined in the home market. With similar prices for traded goods in all countries, wages in the industries producing traded goods in each country will depend on productivity. The wage level established in the traded

goods industries prevails also in the nontraded goods industries, but international productivity differences are smaller for such industries. This means that in poor countries the low wages established in the low-productivity traded goods industries will apply also to the not-so-low productivity nontraded goods industries. The consequence will be low prices in low income countries for nontraded goods. Since the price level is a weighted average of traded and nontraded goods prices, price levels will tend to be lower in low income than in high income countries.

Harrod (1939, p. 62) also stressed an additional point of great importance: retail prices (and by implication final product prices for all commodities) are amalgams of prices of traded and nontraded goods. Indeed, it is not easy to think of a traded good that reaches its final purchaser without the addition of nontraded services such as distribution and local transport. This substantially widens the possible gap for differences in national price levels. Jones and Purvis (1981) have recently explored this source of differences in national price levels more systematically. They put forth a model in which each country transforms imported inputs into final goods by adding nontraded inputs. The imported inputs are obtained in exchange for exports which are used as inputs for the production of final goods in other countries; in these countries final products are produced by adding nontradable factors to these imports of intermediate goods. Even if the law of one price is assumed to apply to "middle products" - the traded inputs - it does not necessarily follow that the same law will hold for final product prices.[4]

Balassa (1964) and Clague and Tanzi (1972) were among the first to draw on new statistical studies of purchasing power and of comparative levels of real per capita GDP which provided direct comparisons of price levels.

These studies began to appear in the 1950's; the most recent is the source of the data in Table 1.[5] For the most part this work concentrated on the empirical problems of measurement rather than on explanation of the differences observed.[6]

The availability of more reliable comparisons of real per capita GDP for a limited number of countries naturally raised the possibility of using the relationship between exchange-rate-converted (nominal) and purchasing-power-converted (real) GDPs to extend the real comparisons to other countries. At first these short cut methods simply turned on the relationship of nominal (n) to real (r) GDP as revealed in the benchmark studies; this relationship was used to estimate r from the n of each non-benchmark country.[7] Subsequently, searches were undertaken for factors other than n which could explain r.[8] Although these efforts were usually cast in terms of a search for the relationship between real GDP per capita and exchange-rate-converted GDP per capita, relative price levels are implied by this relationship.

III. Defining National Price Levels for Comparative Purposes

These relationships may be clearly seen by calling attention to the basic approach to international income and product comparisons used in Gilbert and Kravis and all the major ensuing studies. The comparisons rest on the identity: price (P) times quantity (Q) equals expenditure (PQ). For a pair of countries, j and b (the latter the numeraire country), for a single good:

$$(1) \quad \frac{P_j}{P_b} \times \frac{Q_j}{Q_b} = \frac{P_j Q_j}{P_b Q_b}$$

where the Ps are in each country's own currency. If a quantity comparison (Q_j/Q_b) could easily be made for each good in a way that would involve identical or at least equivalent qualities, deriving comparative GDPs would then simply be a matter of finding a suitable method of aggregating the quantity ratios. In practice quantity comparisons are very difficult to make, owing in no small degree to the fact that the most disaggregated data with which it is feasible to work in international comparisons of GDP relate not to individual products but to detailed categories (e.g., men's footwear) which contain a variety of products and sometimes a quite heterogeneous collection (e.g., women's dresses). For most detailed categories, the matching and sampling problems become much more manageable if one tries to obtain a sample set of price comparisons (P_j/P_b).[9] Thus the typical procedure in international GDP comparisons is to get an average P_j/P_b ratio for each category, and, taking advantage of (1), to derive the Q_j/Q_b ratio by dividing the price ratio into the expenditure ratio. The expenditures are available (or at least obtainable) from each country's national accounts data.

In the absence of such a comparative price study, the Ps and Qs are unknown, and all that can be done for comparative purposes is to convert the expenditures to a common currency via the exchange rate. For example, where PQ = GDP in own currency, and $e_{j/b}$ is the number of units of j currency that are required to buy one unit of b's currency on the foreign exchange market, a GDP comparison is obtained by:

$$(2) \quad \frac{\Sigma P_j Q_j}{\Sigma P_b Q_b} \div e_{j/b} = n$$

This indeed is still the most common way of comparing GDP among countries; it is used, for example, in the standard compilations of comparative GDPs published by the United Nations and the World Bank. This approach implicitly assumes that $P_j/P_b = e_{j/b}$; that is, the relative purchasing powers of the currencies are reflected in the exchange rate.

If the latter equality holds, exchange-rate converted prices in the two countries are equal; there is only a world price level and national price levels are all the same. In fact, the equality does not hold; the purchasing power of a currency relative to a numeraire currency may in certain cases be two or three times the exchange rate (see Table 1), and comparisons based on exchange rate conversions are often far from the mark. If $P_j/P_b > e_{j/b}$ prices in j are higher than in b and an exchange rate conversion will overstate j's real GDP relative to b's; if $P_j/P_b < e_{j/b}$ prices in j are lower than in b and an exchange rate conversion will understate j's real GDP (r). If P_j/P_b is known for every category of GDP, r can be obtained:

$$(3) \quad \frac{\Sigma P_j Q_j}{\Sigma P_b Q_b} \div PPP_{j/b} = r$$

where the purchasing power parity $PPP_{j/b}$ is an appropriately weighted average of the P_j/P_b s.

$PPP_{j/b}$ is expressed in terms of units of j's currency per unit of b's. Prices may be more conveniently compared by dividing the $P_{j/b}$ or the PPPs by the exchange rate:

$$(4) \quad \frac{P_j}{P_b} \div e_{j/b} = PL_{j/b}$$

where $PL_{j/b}$ is j's price level expressed as a ratio of b's. PL may be compared for both detailed category levels and for aggregations such as GDP.

TABLE 1

National Price Levels for 34 Countries Classified by Real GDP per Capita, 1975 (U.S. = 100)

Income Class	No. of Countries (1)	Real GDP per Capita Range (2)	Real GDP per Capita Mean (3)	Nominal GDP per Capita (Mean) (4)	GDP Price Level (Mean) (5)
1	8	Less than 15	9.0	3.7	40.7
2	6	15-29.9	23.1	12.1	51.7
3	6	30-44.9	37.3	24.2	64.5
4	4	45-59.9	52.4	38.7	73.6
5	9	60-89.9	76.0	82.3	107.4
6	1	90 & over	100.0	100.0	100.0

Notes:

Col. (1): The countries in each class are:
1. Malawi, Kenya, India, Pakistan, Sri Lanka, Zambia, Thailand, Philippines
2. Korea, Malysia, Colombia, Jamaica, Syria, Brazil
3. Romania, Mexico, Yugoslavia, Iran, Uruguay, Ireland
4. Hungary, Poland, Italy, Spain
5. U.K., Japan, Austria, Netherlands, Belgium, France Luxembourg, Denmark, Germany
6. U.S.A.

Cols. (2) and (3): GDP converted to dollars at purchasing power parities
Col. (4): GDP converted to dollars at exchange rates
Col. (5): PPP for GDP divided by the exchange rate. See Section III of text.
Means of columns (3) - (5) are simple arithmetic averages.

Source: Kravis, Heston, and Summers (1982).

The use of the national accounts framework provides the answers to some important conceptual questions that plagued early efforts to produce an operational definition of the "general price level" (Snyder, 1928; Keynes, 1930, pp. 76-94). What prices to include and what weights to assign to each price fall into place once it is decided to base the comparisons on the national accounts concept of final expenditure on GDP. Each price is, in principle, the weighted national average price; that is, it is the P_j that is embedded in the national accounts expenditure figure P_jQ_j. The weights are determined by relative importance in expenditures on GDP. There are to be sure problems about how the weights of the different countries will enter into the weights used in the comparison, but at least the conceptual problem of what data to start with at the country level is clearly resolved.[10]

The concept of a national price level is a relative one; the prices of the goods comprising the GDP of any country in any period have no absolute meaning. There is no meaningful average price of a unit of GDP. The concept of a national price level is of interest only when it is intended to compare price levels in two or more different situations. The reference point for the study of the price level of a given country is some other country or group of countries. The average price comparison that is sought is between sets of prices separated in space.

The difficulties posed for the comparison of national price levels by the existence of different currency units, is, as indicated in (4), circumvented by converting the price or purchasing power parity relationship to a price level comparison by dividing by the exchange rate. The fact that national price levels can be compared only by converting prices to a common currency by means of exchange rates calls attention to the very close

connection between price levels and exchange rates. The economic links will be discussed further on, but some aspects of the statistical constructs that link the two variables may be usefully treated at this point.

In the literature on the determination of exchange rates and also in that dealing with purchasing power parity theory the term "real exchange rate" is often encountered. The reference is usually to an index of exchange rate changes (for currency j relative to a numeraire country, b) corrected for relative price changes.[11] That is, country j's index of the real exchange rate (IRER) in year t, taking year o as a base and country b as the numeraire country, is:

$$(5) \quad IRER^{t/o}_{j/b} = \frac{e^t_j}{e^o_j} \div \left(\frac{p^t_j}{p^o_j} \div \frac{p^t_b}{p^o_b} \right)$$

The IRER involves the same terms as the index of relative price levels converted to a common currency (IRPL), but the two are not identical. IRPL, the index of price level movements adjusted for exchange rate changes, is the reciprocal of the IRER. For country j relative to country b in the year t, taking the year 0 as the base year, IRPL is:

$$(6) \quad IRPL^{t/o}_{j/b} = \left(\frac{p^t_j}{p^o_j} \div \frac{e^t_j}{e^o_j} \right) \div \frac{p^t_b}{p^o_b}$$

The concept of price levels used in the present study (PL) is based on the price level in a given country during a given period, taken

relative to the price level of a numeraire country at the same period of time. PL is formed by the numerator terms in (6):

$$(7) \quad PL_j^t = (p_j^t \div e_j^t) \div p_b^t$$

The terms to the right of the equal sign correspond, of course, to the form given in (4), $p_j^t/p_b^t \div e^t$

For present purposes, the b in (7) refers to a single numeraire country, the U.S. The choice of the U.S. as a numeraire rather than some other country does not affect the results except in a trivial scaling sense.[12]

IV. Elements in a Theory of National Price Levels

The elements that determine differences in the national levels of prices during a given period of time may be classified in different ways. A distinction might be made, for example, betweewn real and monetary factors or between long run and short run influences. Another classification that suggests itself is one that would divide the influences according to which of the two factors that enter into the formula for the price level (7) they affect - i.e., those that operate on the relative domestic price level (the PPP) and those that work through the exchange rate. From a general equilibrium standpoint this may be viewed as a misleading dichotomy since PPP and exchange rates jointly determine relative price levels and are determined by them in an interdependent set of relationships.[13] The simple monetarist approach to the balance of payments, for example, holds that price levels are the same everywhere (with exceptions for nontradables, in some versions). A policy designed to alter the domestic-

currency price level will merely produce compensating changes in the exchange-rate from the standpoint of the individual country. However, it has already been established that in the real world price levels are not the same in different countries, and it is preferable to leave open the possibility that some influences may operate on exchange rates with an incomplete or delayed adjustment in domestic-currency price levels, and others on domestic-currency price levels with an incomplete or delayed adjustment in exchange rates.[14]

The twofold classification used in the exploratory empirical work which follows does not rest squarely on this distinction, but embodies some aspects of it. Influences on the price level (PL) are viewed as consisting of long run factors that determine the underlying price level and of short run factors that cause deviations from the basic level. The long run factors are regarded as real variables, and the short run factors are mainly monetary variables.

Long run structural factors. The long run factors are structural variables that characterize the comparative economic framework of the country. One key structural variable, real per capita GDP, has already been shown to be positively correlated with the price level. Other structural characteristics that merit examination for possible links to price levels are the industrial composition of GDP and factor endowments, including the skill composition of the labor force and the distribution of the labor force across industries. The size of the country and the influence this has in leading it to more or less participation in international trade are also relevant. These variables are for the most part long run in character in the sense that they change only gradually over time.

As pointed out in the earlier discussion of the productivity differential model, some of these factors affect the price level primarily through a differential impact on the prices of tradable and nontradable goods.[15] It has long been a matter of casual empirical observation that service prices and the prices of nontradables generally are relatively cheap in low income countries. This is confirmed in the ICP studies. For the 34 countries included in the 1975 ICP benchmark study, classified by increasing income levels, the price indexes for tradable and nontradable goods are as follows:

Income Class[a]	Price Indexes (U.S. = 100)		
	GDP	Tradables[b]	Nontradables[c]
1	40.6	60.0	24.9
2	51.7	70.7	37.2
3	64.7	86.6	46.5
4	73.5	97.9	53.4
5	107.5	118.5	96.7
6	100.0	100.0	100.0

[a]See Table 1 for income ranges and numbers of countries.
[b]Final product commodities excluding construction.
[c]Final product services and construction.

Source: Kravis, Heston, and Summers (1982), p. 196.

Of course, if tradable goods prices are linked more or less closely to world price levels, but nontradables are cheap in low income countries, the low income countries will be characterized by low price levels for GDP as a whole, again a finding of the ICP studies evident in the above text table.

The productivity differential model ascribes low nontraded goods prices to relatively high productivity in the poor countries' service industries, industries that account for most nontraded goods (Kravis, Heston, and Summers (1978a)). That is, although the productivity of poor countries is

low relative to that of rich countries in both service and commodity producing industries, the productivity differentials are smaller in the service industries. Empirical evidence supporting this pattern of productivity differences was first offered by Kuznets through the use of sectoral productivity ratios - i.e., sectoral shares in output divided by sectoral shares in employment.[16] Confirmation is found in Chenery and Syrquin's "stylized" presentation of relationships for 101 countries covering the period 1950-70 (Chenery and Syrquin, 1975, pp. 20-21; Chenery 1979, p. 20).[17]

Productivity in this model is usually interpreted in the Ricardian sense, that is, as a partial productivity measure--i.e., output per unit of labor input. This explanation of differences in service/commodity price ratios between rich and poor countries could be reconciled with an explanation based on a standard factor proportions trade model. Using the latter model we would explain the differences in service/commodity price ratios in the same way that we explain differences in price ratios among tradable goods: namely, the abundance and prices of the factors of production in rich and poor countries.

The factor proportions explanation would run as follows. Service industries are relatively labor intensive, on the average, in all countries.[18] Because capital is abundant in rich countries, labor is highly productive and expensive. As a result, rich countries produce and export to poor (labor-abundant) countries capital-intensive tradables, and poor countries produce and export to rich countries labor-intensive tradables. Nontradables, however, must be produced by each country for its own use. Since services (nontradables) are labor intensive, and since labor is expensive in rich countries, the price of services tends to be

high in rich countries relative to the price of commodities, just as the price of labor-intensive goods is high relative to that of capital-intensive goods. We thus have an alternative explanation of the price structure that does not require the assumption that productivity, with respect to all factors, or in the production function sense, is more similar between rich and poor countries in services than in goods, and is even compatible with identical production functions in all countries.

Total factor productivity provides the test upon which the survival of the differential productivity theory relative to this simpler explanation depends. Some far-from-perfect data suggest that low income countries do have a lesser disadvantage in services than in commodities with respect to total factor productivity as well as for labor productivity:

Productivity Ratios, Lower Income Relative to Higher Income Countries

	Commodities			Services		
Groups[a]	Capital	Labor	Average[b]	Capital	Labor	Average[b]
I/VI	1.39	.28	.32(.55)	2.13	.48	.54(.89)
II/VI	.99	.42	.46(.56)	1.05	.49	.54(.63)
II/IV	.93	.53	.57(.63)	1.04	.57	.61(.69)

[a]See Table 1 for definitions of groups of countries.

[b]Capital and labor productivity combined with weights of .15 and .85, and for figures in parentheses with weights of .25 and .75.

Source: Derived from Stern and Lewis data in Kravis, Heston, and Summers (1983).

The reasons for these differences seem to be complex and cannot be pursued here in any depth.[19] Kuznets (1957, p. 14f) mentions several factors affecting the supply and demand of the services and commodities and of the types of labor that produce them, including, for example, the higher incomes that some of the professions providing services may be able to

extract in low income countries that have relatively little national investment in human capital. Another area of explanation may be found in the differences in the diffusion of technology; that is, the technological gap separating productive practices in poor and rich countries may be smaller in service production than in commodity production, especially in countries where backwardness in overpopulated rural areas may be a severe problem.

A possible further explanation of the high relative prices of services relative to commodities in developed countries is that the elasticity of substitution between capital and labor is lower in service industries.[20] If that is the case, while in tradables industries, rich countries can adapt to high labor prices by substituting capital for labor and thus achieve higher labor productivity in tradables than poor countries even if they are all on the same production function, the same possibility is not available in nontradables industries. There the substitution possibilities are absent, or lower, and labor productivity differences are therefore also absent, or lower.

Although we have described productivity differentials between tradables and nontradables as a function of the level of per capita income, there could be other determinants of such differentials. One country's tradables sector may include a protected, backward agriculture, while another's may be entirely composed of highly efficient and competitive manufacturing. One country's service sector may be filled with small, inefficient retailing units protected by laws restricting mass retailers while another's may permit vigourous competition which eliminates inefficient units. Rational efficient growth should eliminate these intersectoral differences. But in the meanwhile large dispersions in sectoral productivity

ratios should, other things being equal, lead to high prices in the low productivity sectors which would be more shielded from international competition than high productivity sectors. Consequently, PL should vary directly with the dispersion of sectoral productivity ratios of each country. Unfortunately, it is difficult to develop accurate sectoral productivity measures for large numbers of countries, particularly for industries subdivided into more than 8 or 10 branches.

Among the structural factors not related to the productivity differential model is the strength of the country's economic links with the rest of the world, which we refer to as "openness." For a country with a high degree of openness a large proportion of tradables will actually be traded and, other things equal, exports and imports will be large relative to GDP.

The degree of openness may affect the price level through its influence on prices of the factors of production. The higher the degree of openness, the higher the price of the abundant factor, abstracting from differences in elasticity of factor supply. If services tend to be labor intensive relative to commodities or tradables everywhere, the more open a labor-abundant country, the higher its price of services and the higher its price level, because openness would increase the price of labor. The more open a capital-abundant country, the higher the price of capital and the lower the relative price of services and the overall price level. If low incomes and labor abundance are associated with low elasticities of labor supply, the effect of a high degree of openness in producing a high price level would be enhanced. This would not be the case, however, in surplus labor economies with very high labor supply elasticities and comparative advantage in labor-intensive industries. In comparisons with the U.S., however, if the U.S. is the most labor-scarce (capital-abundant) of all countries, the

effect of openness should be positive on all countries' price levels. However, the effect should be stronger on the price levels of low income countries, with the possible exception of the surplus labor economies.

The productivity differential model as described above points to variables such as real per capita GDP (r) that attempt to capture the direct impact of the operation of the model, or to measures of relative productivity in commodity and service production. An alternative suggestion, first made by Clague and Tanzi (1972) and recently implemented in a more plausible way by Isenman (1980) is to try to use the relative quantity or prices of skilled labor to reflect differential productivity. Isenman assumes that services are intensive in skilled personnel, and a relatively large proportion of educated or highly skilled personnel or low incomes for educated and skilled personnel would therefore have a negative influence on a country's price level.

A number of other structural factors have been suggested. The role of trade restrictions in tending to lower the price level of a country whose exports are depressed by partner country restrictions to a greater degree than it curbs its imports has already been mentioned in connection with Cassel's work. Usher (1968, pp. 108-113) has offered a somewhat broader treatment of this influence, and Clague (1980) has modelled the relationship. Clague and Tanzi (1972) argue that a country rich in natural resources is apt to have a higher price level, other things (including r) being equal, because abundant resources relative to human skills should make commodity prices (which tend to be resource intensive relative to services) relatively cheap and service prices relatively dear. Tradable natural resource products will sell at or near world price levels, and high service prices will lead to a high average price level for GDP. Usher

(1968, pp. 78f) pointed out that transport costs might affect price levels if their impact on home prices of exports and import goods was not offsetting - as might be the case for a price-taking country distant from world markets.[21] Finally, Balassa suggested that a high share of tourist expenditures (intensive in skilled labor) in exports would push the price level up; so too would a high ratio of indirect to direct taxes, assuming that the indirect taxes are also levied on the imports.[22]

Short run factors. By contrast to the relatively small literature dealing with long run determinants of national price levels, relatively short run influences have been the subject of close and extensive scrutiny in the literature on exchange rate determination. The unexpected volatility of the nominal exchange rates of the main currencies since the end of the Bretton Woods has led to a still on-going search for improved explanations of exchange rate determinants.[23] Some of this has been addressed to the real exchange rate, which, as seen above, is the reciprocal of a time-to-time index of relative price levels. It is clear that the volatility of nominal exchange rates has been large relative to the movements of national price levels (Flood, 1981; Aizenman, 1982). The implication is that there are short run factors that have a substantial impact on exchange rates without necessarily involving offsetting adjustments in domestic-currency price levels. If this is the case, short run variations in price levels (PL) may well be dominated by exchange rate influences.

The explanation of exchange rates which has the longest history, the monetary approach, views the exchange rate as the relative price of two monies, the price of each dependent on its supply and demand. Since the law of one price is held to prevail, the exchange rate must equal the

purchasing power parity. Hence,

$$(8) \quad e_{j/b} = PPP_{j/b}$$

Given the assumption that prices are determined by nominal money supply and real money demand and that real money demand is determined by real income and nominal interest rates (Dornbusch, 1980), changes in the exchange rate are a function of these variables, as follows:

$$(9) \quad e_{j/b} = F(\overset{+}{m}_{j/b}, \overset{+}{i}_{j/b}, \overset{-}{r}_{j/b})$$

The terms in (9) are in logs; and $e_{j/b}$ is the price in j's currency of a unit of b currency, m the nominal money supply, i the nominal interest rate and r the real income. The signs over the variables indicate that increases in j's money supply or in interest rates relative to those of b will raise the exchange rate (a depreciation) and a raise in j's real income will have the opposite effect. The rise in interest rates and in real income work through their impact on money balances, the former decreasing the demand for money balances and thus raising prices and causing a depreciation and the latter increasing the demand for money balances with the opposite consequences.

The extensions of the monetary model to cope with the volatility of exchange rates has led to formulations based on a view of the exchange rate as the price of an asset, and to efforts to take account of the current balance as the means through which shifts in asset holdings occur. This avenue also led to the inclusion of expectations measured by interest rate differentials or by the relationship of the forward to the spot rate, and to attempts to take into account the effects of unanticipated events as well.

Efforts to explain the volatility of exchange rates more specifically

include the Dornbusch (1976) hypothesis that exchange rate changes overshoot those required in the long run, as explained below.

Another line of explanation for the volatility of exchange rates rests on the idea that current exchange rates reflect not only current supply and demand conditions but also expectations about future market determinants (Frenkel, 1976; Mussa 1976). The current price of foreign exchange is closely linked to its future price because like other financial assets foreign exchange can be held at small storage cost and traded at small transactions cost. Because of this link, changes in supply and/or demand conditions, particularly unexpected changes based on new information, have magnified impacts on exchange rates.

Various models of exchange rate determination differ too in their treatment of relative prices - across sectors and across countries. The Dornbusch (1976) overshooting model does not assume any long-run inflation differential between the country considered and the rest of the world. A monetary expansion leads to an immediate depreciation of the exchange rate to, or even beyond the equilibrium rate. The events that bring about that depreciation take place in financial markets, while goods prices, which will eventually rise to offset the ultimate depreciation, lag behind. In this event there will be an initial fall in the exchange-rate-converted price level of domestic goods and then a rise as their prices come finally to rise in proportion to the money growth. In this model, the extent of overshooting in the depreciation depends on the degree to which the money growth reduces interest rates; a large reduction implies a large overshooting since a low interest rate must be associated with expectation of an appreciating currency. Thus we would expect to find low price levels, relative to those suggested by long-run influences, associated with

recent monetary expansion and low nominal interest rates.

Long-run differences in inflation rates, matched by differences in nominal interest rates, are incorporated in a model offered by Frankel (1979). The short-run effects of money growth are similar to those in Dornbusch, with money growth causing the same initial overshooting of depreciation. The deviation of the exchange rate from purchasing power parity is proportional to the differential in real interest rates and is not associated necessarily with high or low nominal rates. Such a model suggests both monetary variables and real interest rates as explanatory variables for our analysis.

One of the few models that allows for permanent changes in relative prices, and therefore in price levels, is what Dornbusch (1980) refers to as an "extended Mundell-Fleming model." In this version, changes in demand can bring about long-term changes in relative prices while monetary disturbances cause only short-term price level changes. The variables of interest to us in this model include both monetary and fiscal policy variables, particularly in the form of unanticipated changes in policy, and changes in real wealth, as well as any other factors which cause shifts in demand.

While these models do not explicitly introduce the dichotomy between traded and nontraded goods, that distinction has become common in balance of payments models, as, for example, in Berglas and Razin (1973) and Bruno (1976). A recent article by Craig (1981) treats traded goods prices as determined instantaneously by world prices, so that an increase in money supply, which produces an excess demand for all goods, leads to "an increase in imports and decrease in exports" but to a temporary increase in prices of nontraded goods and therefore to a temporary increase in the price level.

Because the various theories present partial models that try to simplify complex reality by focusing on a few key variables, they sometimes produce opposite predictions about the effects of certain of these variables. The Keynesian theory, for example, predicts that higher real income will produce current account deficits and exchange rate depreciation; the monetary approach, as noted above, sees the increase in income as raising the demand for money balances and thus leading to a current account surplus and exchange rate appreciation. If all the relevant variables were taken into account these differences might disappear. For example, higher real income might indeed absorb more money balances if the increase was due to real factors such as domestic expansion, but the Keynesian prediction that higher real income would bring deficits and depreciation would be correct if the monetary authorities more than met the extra demand for money (Bilson, 1979). Another illustration is the effect of an increase in the interest rate on the exchange rate; if the interest rate rises because of a tight money policy, the exchange rate will appreciate, but if the cause is inflation the exchange rate will depreciate.

Given these complexities and the uncertainties of the present state of knowledge about exchange rate determination, the literature on the subject will be used more as a guide to the search for variables affecting price levels and to the interpretation of the behavior of these variables than as a source for the rigorous specification of relationships.

Clearly an important influence on the price level in general or on the price level for nontraded goods in particular that these models point to is the growth in money supply, although with somewhat varying implications for price levels. The nominal or real rate of interest is also involved in the

process, as an indicator of expectations regarding exchange rates and rates of inflation.

There are in any case difficulties in the direct translation of variables designed to trace only the movements of one country's exchange rate over time to the explanation of the country to country structure of price levels. One difficulty in transforming the intertemporal version of the variables to an interspatial context is that it may not be justifiable to carry over to an interspatial context the implicit assumption that a variety of other influences can safely be ignored since they tend to be relatively constant over time within a given country. For example, the velocity of circulation, implicitly assumed to be constant in most time-to-time analysis, may vary widely across countries.

Secondly, and not completely unrelated to this first complication, the explanation is being sought for a wide variety of countries with different exchange rate practices and with different degrees of market power. The currencies of some countries such as the U.S. dollar, the U.K. pound, and the Japanese yen, were in a managed float in the reference period 1975: Others, such as the French franc and the Germany mark, were in a joint float against the dollar and other outside currencies. Most of the developing countries were pegging their rates to the U.S. dollar, or to one of the other major currencies, or to some composite of other currencies. It is more difficult to describe simply the relative degrees of market power of different countries. Obviously, a small country like Sri Lanka is more likely to be a price taker than a large one like the U.S.; but a small country whose exports are highly concentrated, like those of Sri Lanka, may be a large factor in the world market for some of its exports (tea, for example, in the case of Sri Lanka).

The view we will take in the empirical work is to assume that the structural determinants of price levels are constant over the whole period or change only along a trend. We associate them with equilibrium differences in price levels and we do not expect such differences to show any tendency to disappear. On the other hand, the short-term determinants of price levels reflect mainly timing differences such as differences in the speed with which traded goods prices and nontraded goods prices respond to changes in domestic monetary variables or exchange rates or differences in the speed with which domestic prices in general and exchange rates respond to changes in these variables or in expectations about them.

V. The Empirical Explanation of Price Levels

In this section we make a beginning exploration of a large uncharted field. We confine our work here to a data set defined by the ICP coverage of benchmark countries - 16 with a 1970 reference date and 34 for 1975. The ICP data used here are price level estimates for GDP as a whole and for traded and nontraded goods, and corresponding estimates of real per capita quantities of GDP and of traded and nontraded goods. No attempt is made to tackle the more extensive data set available by extrapolating the benchmark estimates to other years and to other countries. By these means the data set could include over 100 countries over a 20 or 30 year period.

Structural variables. We begin our empirical analysis of price levels by testing the implications of the productivity differential model and the factor proportions model, using as the independent variable explaining the price level (PL), real GDP per capita. We then add to this a measure of the openness of the economy, the nontradable share of GDP, and the share of the labor force working in the nontradable sector. The coefficient for real GDP per capita (r) may reflect the lower relative nontradables (services plus construction) productivity associated with higher real income.[24] That is, countries with higher real income enjoy a larger margin in productivity over lower income countries in tradables than in nontradables. Or it may reflect the higher price of labor and therefore of labor-intensive nontradable goods associated with higher real income. In either case, the coefficient should clearly be positive.

The openness variable, as mentioned earlier, should reflect the effect of strong ties with the rest of the world. Such ties, which cause tradables prices to resemble those of other countries, should generally, we

argued earlier, cause them to be lower, relative to nontradable prices, than they would be in the absence of such ties. In other words, openness should raise the relative price of nontradables and thus the overall price level.

The role of the share of nontradables in output or employment is a little different, though related. If nontradables tend to be high-priced in rich countries and low-priced in poor countries, a large share of nontradables should tend to raise the price level of a rich country but lower that of a poor one. In that case the share of nontradables should be introduced in the form of an interaction between income per capita and the nontradable share of output. The share of nontradables may be calculated either in own-prices or in international dollars. One would expect a stronger positive correlation between PL and the own-price version of the nontradables share.

Equation (10) gives a relationship between price level (PL) and real GDP per capita (r), both relative to the United States, across 34 countries in 1975 (t-ratios in parentheses):[25]

$$(10) \quad PL = \underset{(7.6)}{.3081} + \underset{(11.6)}{.0094}\, r \qquad \bar{r}^2 = .801 \quad S.\underline{E.E.}_{\overline{PL}} = .1297 \quad \frac{S.E.E.}{\overline{PL}} = .7015$$

Neither the addition of a squared term in r nor the fitting of a logarithmic equation with or without a squared term, adds to the explanatory power of the relationship.[26]

Assuming that the real income level of a country is a structural characteristic we then test whether the relation between income and price level has changed over the five year period for which we have some data, 1970,1973, and 1975. Equations (11), (12), and (13) are fitted to data for

the identical group of 16 countries in the three years.

(11) $PL(75) = .2785 + .0094\ r$ (5.1) (9.9)
$\bar{r}^2 = .866$
$S.\underline{E.E.}/\overline{PL} = .1141/.7404$

(12) $PL(73) = .3307 + .0088\ r$ (6.7) (9.24)
$\bar{r}^2 = .856$
$S.\underline{E.E.}/\overline{PL} = .1087/.7248$

(13) $PL(70) = .3337 + .0064\ r$ (12.2) (12.1)
$\bar{r}^2 = .907$
$S.\underline{E.E.}/\overline{PL} = .0621/.6071$

Equation (11) does not differ significantly from equation (10); that is, restriction of the data to only 16 of the 34 countries does not change the relationship. The tests clearly indicated that the equation for 1970 was significantly different from those for both 1973 and 1975, but that the observations in those two years could belong to the same relationship. We thus conclude that there was a shift in the relation of price level to income after 1970. However, the closeness and strength of the relationship is evident in all of the equations: real income per capita explains most of the differences in price levels.

Although the coefficients in the equations for 16 and 34 countries in 1975 do not differ substantially, the $\bar{r}^2$ is much reduced by the addition of the 18 countries. One difference in the two data sets is that while 8 of the original 16 were OECD countries with developed economies and statistical systems, the additional 18 consisted of only 5 developed OECD countries and of 2 centrally-planned economies, and 11 developing countries. It may be that the centrally-planned and developing countries do not fit the model as well as the developed countries, or that the data for prices and nominal

income are sufficiently poorer to introduce large data errors, or that the prices set in the centrally-planned economies depart further from the structure of costs than in the other countries.

If there were structural factors other than income determining price levels, as opposed to short-term influences, we might expect that the residuals from the various equations would be correlated. That is, a country with a high positive residual in 1970 would also show a high positive residual in other years. Between 1970 and the other two years we found little correlation ($\bar{r}^2$ = .08 between 1970 and 1975 and .18 between 1970 and 1973). However, there was a statistically significant positive relationship between the residuals in 1973 and 1975 ($\bar{r}^2$ = .70). The lack of correlation between 1970 and the later years suggests that there might be no other structural variables, or at least none that was important. Instead there may have been non-structural factors that affected countries' price levels between 1970 and 1973 that persisted through 1975.

Despite these results that discouraged the search for further structural variables we did experiment with several. One was openness, a structural variable that had proved useful in previous efforts to estimate real GDP from nominal GDP.[27] The openness measure is the one used in Kravis, Heston, and Summers (1978a), a ratio of trade (exports plus imports) to GDP. This measure reflects not only the trade policy of a country but also its size and the density of its population, both factors important in determining the trade output ratio. Other measures of openness designed to eliminate the effects of country size and density, described as "residual openness" in Kravis and Lipsey (1982a, p. 216), did not appear to be as closely related to price levels and were not used in the equations shown here.

When openness (scaled with the U.S.=100) is included with r as an independent variable, the result for the 34 1975 observations is as follows:

$$(14) \quad PL = \underset{(5.0)}{.2374} + \underset{(11.7)}{.0090\ r} + \underset{(2.5)}{.00024\ OP} \qquad \begin{array}{r} R^2 = .829 \\ S.E.E. = .1204 \\ \overline{PL} = .7015 \end{array}$$

As we hypothesized earlier, openness is positively related to the price level.

Two other structural variables that seemed theoretically promising were the share of nontradable goods in GDP (nSH) and the share of nontradable goods industries in total employment (LSH). Since the overall price level is presumably determined by the price level for nontradable goods, a larger nontradable goods sector should mean a higher than average price level for rich countries -- that is, high for the per capita real income -- and a lower than average price level for poor countries. We can test the role of the nontradable goods share by adding to our equations a term for the share of nontradable goods in nominal GDP (nSH) or an interaction term for the share of nontradable goods and per capita real income (nSH . r) as in Equations (15) and (16).[28]

$$(15) \quad PL = \underset{(0.5)}{-.0611} + \underset{(6.4)}{.0068r} + \underset{(1.5)}{.00014\ OP} + \underset{(2.8)}{.0100\ (nSH)} \qquad \begin{array}{r} \bar{R}^2 = .859 \\ S.E.E. = .1092 \end{array}$$

$$(16) \quad PL = \underset{(5.0)}{.2909} + \underset{(0.3)}{.0015r} + \underset{(2.2)}{.00021\ OP} + \underset{(1.5)}{.00014\ (nSH.r)} \qquad \begin{array}{r} \bar{R}^2 = .836 \\ S.E.E. = .1180 \end{array}$$

The share of nontradable goods adds to the explanation of PL in part by diminishing the influence of income and OP. The effect on the openness coefficient, in particular, is not surprising since a higher proportion of nontradables in production is likely to mean a lower level of openness, as

we measure it. When the nontradables share is introduced in the form of an interaction term, the product of the nontradable goods share and per capita real GDP, as in equation 16, the R^2 is reduced.

An alternative measure of the importance of the nontradable sector is the proportion of the labor force engaged in the production of nontradable goods. Labor force information, however, is not available for final product sectors such as were used in the ICP, but only, in international compilations for a large number of countries, for 9 industrial sectors, such as manufacturing, retail and wholesale trade, etc. One way to see how much difference it makes when the industrial classification is substituted for the final product classification is to compare the ICP shares of nontradable goods with nontradable goods shares as measured by the industrial classification. In terms of own current prices, the correlation is quite high - the $\bar{r}^2$ for a correlation involving 26 of the 34 ICP countries for which an industrial breakdown of GDP is found in World Tables, 1980 is 0.67.[29] Furthermore, the substitution of the World Tables share variable (nSHW) for the ICP variable produces a highly similar equation. Equations (17) and (18) contain the same 26 countries but the first includes nSHW and the second, corresponding to (15) but for only the 26 countries, the ICP version (nSH):

$$(17) \quad PL = \underset{}{-.2356} + \underset{(1.7)}{.0062}\, r + \underset{(6.4)}{.00024}\, OP + \underset{(3.0)}{.0103}\, nSHW \qquad (3.5)$$

$$\bar{R}^2 = .912$$
$$S.\underline{E.E.} = .0933$$
$$\underline{PL} = .7315$$

$$(18) \quad PL = \underset{}{-.0923} + \underset{(0.8)}{.0066}r + \underset{(6.7)}{.00017}\, OP + \underset{(1.9)}{.0107}\, nSH \qquad (3.1)$$

$$\bar{R}^2 = .904$$
$$S.\underline{E.E.} = .0974$$
$$\underline{PL} = .7315$$

Equation (17), based on the shares in terms of industrial origin, gives a slightly closer fit, but the difference is clearly marginal. Furthermore, very similar results to those of equation (18) for these 26 countries can be gotten from an equation including only real income per capita and the nontradable share of output, as in equation (19):

$$(19) \quad PL = \underset{(1.1)}{-.1294} + \underset{(6.1)}{.0063r} + \underset{(3.9)}{.0134\ nSH}$$

$$R^2 = .893 \quad S.E.E. = .1031$$

The similarity of (18) and (19) indicates that OP adds little, but something, to the explanation of price levels in this form. Perhaps it might be more appropriate to define OP in the form of the ratio of trade to tradables production.

Given our structural explanations of the price level, the influence of real income per capita should be larger on nontradable than on tradable goods price levels. At the extreme, if there were pure tradable goods, and if trade equalized prices, we would expect no relation at all between their prices and income levels, and we would have to think of the observed differences mentioned earlier as reflecting the nontradable element in all tradable goods. We test this supposition with 34-country data for 1975 by relating the two price levels first to real incomes per capita:

$$(20) \quad PLNT = \underset{(3.3)}{.1239} + \underset{(13.9)}{.0102\ r} \qquad \bar{r}^2 = .853,\ S.E.E./\overline{PL} = .1186/.5542$$

$$(21) \quad PLT = \underset{(10.0)}{.5408} + \underset{(7.4)}{.0080\ r} \qquad \bar{r}^2 = .618,\ S.E.E./\overline{PL} = .1737/.876$$

Our expectations are met in several respects. We explain the price levels for nontradable goods more successfully, in terms of both the degree of correlation ($\bar{r}^2$) and the standard error of estimate, and the coefficient of r (real per capita income) is higher for nontradable goods, presumably because in the tradable goods equation it reflects the influence of r only on the nontradable component of these goods' prices.

Our earlier analysis of the openness variable, which was that a more open economy would tend to have tradable goods prices closer to world prices than a more closed one, implies that there should be little relation between openness and the residuals from Equation (21) but a stronger one with the residuals of Equation (20). We test this proposition in Equations (22) and (23) by adding an openness variable to Equations (20) and (21). We find that openness has the expected positive coefficient in each equation,

$$\begin{array}{lrcccc} (22) & PLNT & = & .0502 + .0098r + .00025\ OP & \bar{R}^2 & = .881 \\ & & & (1.2) \quad (14.5) \quad (2.9) & S.E.E. & = .1068 \end{array}$$

$$\begin{array}{lrcccc} (23) & PLT & = & .4732 + .0076\ r + .0023\ OP & \bar{R}^2 & = .640 \\ & & & (7.7) \quad (7.1) \quad (1.7) & S.E.E. & = .1688 \end{array}$$

but the coefficients for openness are very similar in the two equations. It does not, moreover, add more to the explanation of price level differences for nontradable goods than for tradable goods.

The residuals from the two pairs of equations (i.e., 20 and 21 and 22 and 23) were positively correlated ($\bar{r}^2$s were .40 and .34 respectively). High prices for tradable goods, relative to per capita income levels, were associated with high prices for nontradable goods, as we would expect if the tradable goods price levels reflected the nontraded component of these goods. There were some outliers in this relationship, however. Sri Lanka and India had the lowest price

levels for nontradable goods relative to tradable goods prices, given their levels of r and OP. Not quite as low but still below average were the relative nontradable goods prices of Luxembourg and the three centrally-planned economies. At the other extreme, Syria, Thailand, Japan, and Kenya had low prices for tradable goods and high prices for nontradable goods. That relationship suggests that in these countries the productivity level in nontradable goods is lower, relative to that in tradable goods, than we would expect of countries at their levels of real income per capita.

In some countries both tradable and nontradable goods prices are high or low in comparison to what we would expect from the levels of real income per capita. That is, the residuals in the two equations are large and both positive or both negative. In such cases we can say that exchange rates are high or low relative to price levels. Jamaica, Zambia, Denmark, and Ireland seemed to belong in the category of relatively high price levels for both types of goods. Hungary, Uruguay, and the United States were all on the low side.

We also experimented with variables designed to measure the quality of the labor force, such as enrollment ratios at various levels of schooling and numbers of teachers, but these contributed little or nothing to the explanation of the variation in PL. We are left so far with real income per capita, openness and the share of nontradable goods as the explanatory variables, all positively correlated with the price level.

Nonstructural influences. We assume that Equations (17) for aggregate price levels and (22) and (23) for nontraded and traded goods price levels represent the structural elements of price level determination.[30] Since the residuals from th 1970 and 1975 equations were not significantly correlated, we conclude tentatively that the differences between the equations

represent the effects of economic policy or other changeable characteristics of the economies, and we therefore attempt here to explain the residuals by such factors.

The recent volatility of exchange rates has been so extreme that it must have produced changes in the deviations of price levels from their long run equilibrium levels since domestic currency prices for aggregate output do not fluctuate that widely. The change in the exchange rate regime between 1970 and 1975 brought exchange rate movements which were a mixture of, initially, officially determined changes, presumably to remove deviations from long-run equilibrium, and later, largely market-determined changes, some of which may have created new deviations. Equation (24), which relates the difference in residuals (from Equation (17) between 1970 and 1975 to exchange rate changes, shows that countries with comparatively large increases in exchange rates (i.e., large currency depreciations) between 1970 and 1975 tended to have their price levels fall relative to their position on the per capita income scale:

$$(24) \qquad \underset{}{RPL(75\text{-}70)} = \underset{(2.0)}{.1275} - \underset{(2.0)}{.1202}\ XR75/70 \qquad \begin{array}{l} \bar{r}^2 = .169 \\ S.E.E. = .0684 \\ n = 15 \end{array}$$

where RPL(75-70) = differences in residuals from the structural price level equations in 1975 and 1970, and XR75/70 = 1975/1970 ratio of exchange rates.[31]

Starting from a period of fixed exchange rates, as we do with 1970 as the first year, we can think of a chain of events as initiated by the change in exchange rates. Then we expect that the immediate impact of a currency depreciation from the standpoint of partner countries is to lower the prices of the depreciating country since prices do not move as rapidly

as exchange rates. As the depreciation begins to have its effects on the depreciating country, through tendencies toward equalization in traded-goods prices, its own-currency prices and hence PL (i.e., PPP/XR) will rise. For these 16 countries over the period 1970-75, the rise (fall) in domestic prices was not sufficient to negate completely the currency depreciation (appreciation) and therefore PL did decline (rise). Or to put the implied causality differently, the rise (fall) in domestic prices brought about a more than fully offsetting depreciation (appreciation) in the exchange rate and hence a rise (fall) in XR is associated with a fall (rise) in PL.

A different view, probably more appropriate for the second part of our period, is to treat the exchange rate changes as intermediate steps in a process beginning with differences in rates of growth of the stock of money which affect both own-currency prices and exchange rates. In that case, the change in deviations from long-run relationships would depend on the speed with which own-currency prices and exchange rates respond to money growth, as discussed above. If exchange rate changes more than offset the concurrent price changes, countries with the most rapidly increasing money stock over the preceding few years will have relatively declining deviations from long-run price levels. Little support for this proposition is given by Equation (25):

$$(25) \qquad \underset{}{RPL(75/70)} = \underset{}{.0730} - \underset{(1.0)}{.0281}\ \underset{(.1.0)}{MQ75/70} \qquad \bar{r}^2 = 0.002,\ n = 15$$

This correlation is not significant, but the tendency for a negative coefficient to show up for the variable representing the stock of money in equations in which the change in the residual price level is the dependent

variable is quite persistent in alternative formulations of the money variable.[32] Changes in the money supply over this period were positively, but not very strongly, associated with changes in the exchange rate ($\bar{r}^2$ = .13 for the 1975/70 ratios). The weakness of the association may reflect the initial change from fixed rates that were far removed from their equilibrium levels. We are ignoring here the important distinction made in the theoretical literature cited earlier between money supply growth that is a continuation of the past rate and is already incorporated in the initial residual price level and unexpected changes in the rate of money growth.

Thus far we have discussed changes in the residuals of the structural equations for a common set of 16 countries between 1970 and 1975. The effects of changes between 1970 and 1975 in exchange rates and, less clearly in money supply, have been shown to be associated with the differences in the two sets of residuals. If the changes in exchange rates between 1970 and 1975 had not yet, by 1975, been fully absorbed into own-currency price levels, of if the rates of money supply growth from 1970 to 1975 had not been reflected in exchange rates and in own-currency prices to the same degree, we should find that exchange rate changes or money growth should help to explain the residuals from the structural equation for the 34 countries in the 1975 ICP comparison.

The residuals of the 1975 equation (RPL75) are related to exchange rate changes from 1970 to 1975 as follows:[33]

$$(26) \qquad \underset{}{RPL75} = \underset{(1.7)}{.0359} - \underset{(2.6)}{.0290}\ XR75/70 \qquad \bar{r}^2 = .167,\ S.E.E. = .0899,\ n = 31$$

This equation again suggests a negative relationship between price levels and exchange rate changes; the full effects of an appreciating currency, at least during these years, were not absorbed in contemporary price changes and exchange rate changes did not simply offset concurrent price changes.

Equation (26) also does not support the idea that the 1970 to 1975 exchange rate movements performed the function of eliminating deviations from long-run relationships that had been sustained by fixed exchange rates. As a further test of this hypothesis we correlated the 1975/70 exchange rate changes with the 1970 deviations from the structural relationship (RPL70). There was no relationship between the 1970 deviations and the subsequent changes in exchange rates. Either the 1970 deviations did not represent disequilibria or the subsequent changes in exchange rates did not move exchange rates towards equilibrium levels.

When the residuals of the 1975 price level equation are correlated with the change in the stock of money over the period 1970-75, the coefficients of the money growth variable are negative for the GDP price level and for the prices of traded and nontraded goods:

(27) $$\underset{}{RPL75} = \underset{(2.3)}{.0596} - \underset{(2.9)}{.0218}\ MQ75/70 \qquad \bar{r}^2 = .20,\ S.E.E. = .0881,\ n = 31$$

(28) $$\underset{}{RPLT75} = \underset{(1.1)}{.0491} - \underset{(1.7)}{.0216}\ MQ75/70 \qquad \bar{r}^2 = 0.06,\ S.E.E. = .147$$

(29) $$\underset{}{RPLNT75}\ \underset{(2.7)}{.068} - \underset{(2.8)}{.0193}\ MQ75/70 \qquad \bar{r}^2 = .18,\ S.E.E. = .0828$$

It is interesting to see in these equations that differences in money supply growth accounted for more of the deviations of price levels from their structural positions in the case of nontraded goods than in the case of traded goods. Presumably international competition was a larger influence relative to money supply in affecting traded goods prices.

Other monetary variables and the combination of those with the exchange rate changes did not add to our ability to explain the 1975 residuals from the structural equation. We therefore settle tentatively on the money supply growth alone as the only nonstructural variable to include in equations combining structural and nonstructural elements. The combinations are represented by equations (30) through (32).

$$\begin{array}{lll} (30) & PL75 = \underset{(0.2)}{.2439} + \underset{(7.1)}{.0067}r + \underset{(2.2)}{.00018}\,OP + \underset{(3.2)}{.0102}nSH - \underset{(2.7)}{.0214}\,MQ75/70 & \bar{R}^2 = .908 \\ & & S.E.E. = .0926 \\ & & n = 31 \end{array}$$

$$\begin{array}{lll} (31) & PLT75 = \underset{(6.6)}{.4913} + \underset{(7.8)}{.0075}r + \underset{(2.5)}{.00031}\,OP - \underset{(1.6)}{.0207}\,MQ75/70 & \bar{R}^2 = .727 \\ & & S.E.E. = .151 \end{array}$$

$$\begin{array}{lll} (32) & PLNT75 = \underset{(2.6)}{.1112} + \underset{(18.1)}{.0099}r + \underset{(3.6)}{.00025}\,OP - \underset{(2.6)}{.0192}\,MQ75/70 & \bar{R}^2 = .929 \\ & & S.E.E. = .0858 \end{array}$$

As before, it is the price levels for traded goods that we have the least success in explaining; the $\bar{R}^2$ for that equation is the lowest and the standard error of estimate the highest among the three equations. For both traded and nontraded goods price levels and for the total price level, real income per capita is the major source of variation among countries but openness, as measured by the ratio of trade to output, is always significant. Both high income per capita and a high degree of openness are

associated with high price levels. In addition, the share of nontraded goods in output is significant in the equation for the total price level, with a high share associated with a high price level. These are the long-run or structural influences that we have identified. The strongest short-term or nonstructural variable we have found is the rate of growth of money, with a high rate of past growth associated with a low price level. In other words, whatever the inflationary effect in domestic currency of a rapid rate of money growth, it was more than offset during this period by changes in exchange rates.

Much remains to be explained about the factors that determine differences in national price levels. In this first reconnaissance, we have done little to explore what may prove to be substantial differences in the operation of explanatory factors for different circumstances, particularly for the difference between periods of fixed rates and periods in which major currencies floated, between (since 1973) countries that have had pegged rates and those that have managed floats, and between countries that are price takers and those that are large enough to influence prices. We have ignored the interest rate link between money growth and exchange rate changes, the distinction between expected and unexpected money growth, also linked to interest rates, the relation of money growth to the demand for money, and the role of capital flows, partly in response to interest rates and partly autonomous, in determining exchange rates and price levels. These are subjects for future study.

What seems very likely from our studies so far is that efforts to explain changes in exchange rates over a moderately long period--say 5 or 10 years--are likely to be improperly specified if the structural factors are ignored, even for industrial countries if there are substantial

differences among them in growth rates. It also appears likely that the search for better short cut estimates of real GDP per capita needs to take into account short run influences. Such influences dominate the literature on exchange rate determination but they have been largely ignored in the much more limited literature on short cut methods.

Footnotes

1. A closely related use of such a theory, when expressed in equations explaining relative price levels, is to pave the way for better "short cut" estimates of real per capita GDP. ("Real" per capita GDP's are converted to a common currency by purchasing power parities, rather than by exchange rates). Benchmark studies such as those relied upon in this paper will not soon, if ever, be feasible for all the countries of the world. If a comprehensive system of real product comparisons is to be developed, therefore, short cut methods will have to be applied to non-benchmark countries. Short cut estimates are formed by extrapolating to other countries the relationships between real and exchange-rate-converted GDP found in benchmark studies of purchasing power and real GDP such as those included in the UN International Comparison Project (Kravis, Heston, and Summers, 1982).

2. Beckerman writes that "The role of exports in growth has been of central importance in economic history, particularly in explaining differential national growth rates in the second half of the nineteenth century..." Export-led growth requires "competitive" exports and competitiveness is "basically a question of price and technological superiority." Exports have also figured in the literature on the economic growth of developing countries although explicit references to the role of prices are infrequent. See I.B. Kravis, "Trade as a Handmaiden of Growth: Similarities Between the Nineteenth and Twentieth Centuries," Economic Journal, December 1970.

3. The Harrod volume treats the subject in a chapter entitled "Comparative Price Levels."

4. Indeed, Jones and Purvis show how under different assumptions with respect to the reactions of different countries to external shocks (e.g., two importers of a given middle product facing a rise in its world price), the resulting price changes for the final product may vary from one country to another. Among the factors producing the varying price responses are country-to-country differences in technological flexibility (i.e., the ease of substituting labor for the middle product), in the share of labor and the middle product in the cost of the final product, and the price elasticity of demand for the final product. It is hard to see, however, how the factors pointed to by Jones and Purvis can contribute to an explanation of the systematic relationship between the price levels of various countries and their real per capita incomes observed in Table 1. (Of course, that was not their aim.)

5. Gilbert and Kravis (1954); Gilbert and associates (1958); and a series of three reports of the U.N. International Comparison Project, the latest of which is Kravis, Heston, and Summers (1982a).

6. Though the OECD and U.N. studies included some analysis of price and quantity relationships.

7. The first attempt at these "short-cut" methods appears to have been made by Delahaut and Kirschen (1961).

Footnotes (continued)

8. Kravis, Heston, and Summers (1978a). For reviews of different short cut methods, see Heston (1973), and Ahmad (1980).

9. The advantage of price comparisons over quantity comparisons is not only that prices are easier to obtain -- one can go into a store and ask -- but also that we are willing to assume that the price ratios between countries for items we cannot or do not sample are like those we do sample. Quantity ratios, on the other hand, vary much more widely among products, even within a given sampling stratum.

10. These are, of course, alternative ways each of these questions might be answered. For example, the issue of which prices to include might be resolved by selecting the set of prices entering into the purchases of consumers. However, such a criterion would leave out capital goods and government services, both important components of total output. If restricted to prices paid by households, the prices would exclude publically financed services, the scope of which varies from one country to another according to the extent to which such services as health and education are financed out of private or public purses. Another possibility is to use the set of prices collected by the statistical authorities for the country's wholesale price indexes, but this choice has little to commend it. There is no clear conceptual framework for wholesale price indexes. Furthermore, this set of prices is apt to be biased toward adherence to the law of one price relative to other goods because it includes a high proportion of tradable goods. This bias may be reinforced by the tendency of the indexes to overrepresent primary products and to underrepresent highly differentiated manufactured goods.

11. In models based on small country assumptions, in which all tradables prices are determined outside the country, the only possible effects on relative prices of a small country's devaluation stem from changes in the price of tradables relative to that of nontradables in the small country. That change itself is sometimes described as the "real rate of exchange" in balance of payments models. See, for example, Berglas and Razin (1973) and Bruno (1976). The relation between that definition and the one used here, which involves no assumptions about the fixity of price relationships, depends on the movement of tradables prices and of nontradables prices in the rest of the world and on the share of nontradables in the country being observed.

12. However, the results might be affected if use were made of "effective exchange rates," each representing a trade-weighted average of a given country's changes in its exchange rates vis-a-vis its trading partners. The concept of an effective exchange rate is relatively simple to employ when the purpose is to explain exchange rate changes over time for one country. Where, as in the present work, the focus is on a large number of countries at once, the introduction of effective exchange rates would bring substantial complications in forming the explanatory variables. Also the disadvantage of using simple exchange

Footnotes (continued)

rates may be offset by the fact that the inclusion of many countries does cause some account to be taken of each country's exchange rate relative to the currencies of a number of other countries, though in not so precise or systematic a way.

13. Frenkel (1978), though recognizing that price levels and exchange rates are best viewed as mutually endogeneous variables, finds that single equation methods tend to support the line of causation running from exchange rates to price levels rather than in the opposite direction favored by PPP theorists.

14. Mussa (1982) suggests that monetary models are useful in explaining nominal exchange rates and that models taking balance of payments equilibrium as the final determinant of exchange rates are most relevant to real exchange rates.

15. The productivity differential model bears a strong relationship to "Scandinavian" models of price and wage-setting behavior which distinguish between "exposed" and "sheltered" sectors of the economy (Aukrust, 1970). Prices in the exposed sector are set in international markets, these prices determine wage levels in all sectors, and prices in sheltered sectors are set by markups over cost. The exposed sectors are essentially tradables and the sheltered sectors essentially nontradables.

16. Kuznets (1957). See p. 41 for the data and p. 33 for Kuznets' discussion of the meaning of sectoral productivity measures. See also the revision reaching the same conclusions on the basis of later data: Kuznets (1971, pp. 208-248). The latter part of this section (p. 236f) considers the possible explanations for the observed intersectoral differences.

17. Chenery and Syrquin (1975), writing about developing countries, do not show data for high income countries. Kuznets' data comparing nonagricultural commodities with services cover the whole income range and support the view that service productivity relative to commodity productivity is lower in the very high income countries than in very low income countries.

18. For example, capital/labor ratios for very low and very high income countries are as follows:

	Commodities	Services
Low income	4.39	2.48
High income	21.91	10.96

(Kravis, Heston, and Summers, 1983).

Footnotes (continued)

19. For a further probing of the reasons for the relatively high service productivity in poor countries, see Kravis, Heston, and Summers (1983).

20. A well-known example of this story is the explanation by Baumol and Bowen for the rise in prices in the performing arts (Baumol and Bowen, 1966).

21. The country's exports would be cheap at home and the effect on its import prices might not be compensating as, for example, if its exports were wage goods or if they embodied substantial imported inputs. Usher (1968, p. 78f).

22. Cited by Clague (1980).

23. For recent reviews of this literature, see Bilson (1979); Dornbusch (1980); and Isard (1978).

24. In view of the interdependence between PL and r, errors of measurement in one produce equal and opposite errors in the other. In our equations incorporating PL as a dependent variable and r as an independent variable, the coefficient of r is biased towards -1.

25. The PL variable was scaled with U.S. = 1.0; r with U.S. = 100.

26. If a logarithmic form is desired because it explains percentage differences in price levels, a squared term does improve the explanation. The equation in logs relating price level to income per capita is

$$\ln PL = \underset{(7.92)}{3.99} - \underset{(1.47)}{.481} \ln r + \underset{(2.80)}{.141} \ln r^2 \qquad R^2 = .781$$

When the fitted values from this regression are exponentiated and correlated with the original observations (in arithmetic form) the R^2 is .800.

27. Kravis, Heston, and Summers (1978a).

28. The use of the share of nontradable goods valuing GDP and all its components in international dollars also improved the results of equation 14, though by not as much as the own-prices form of the variable used in equations 15 and 16.

29. Agriculture, mining and manufacturing industries were regarded as producing tradable products. Construction; electricity, gas and water; trade and finance; transportation and communication; public administration; and other branches were considered as producing nontradable goods.

Footnotes (concluded)

30. An equation like (17) but without openness (equation 17') has almost as strong a claim for representation of the aggregate price level, particularly since in the 16 country data for 1970 it produces a higher $\overline{R}^2$ than the analogue of (17). The $\overline{R}^2$s for the 1970 and 1975 equations based on the 16 Phase II countries are as follows:

	Independent variables	
	r, nSH	r, OP, nSH
1970	.927	.921
1975	.867	.884

The coefficient of openness had a t-value below 0.1 in 1970 and the coefficient of the nontraded goods share variable in the equation with openness has a t-value of .9 in 1975. However, the choice between these two equations makes little practical difference since their residuals are very highly correlated ($\overline{R}^2$ = .98 for the correlation of

31. Exchange rates, expressed as U.S. dollars per local currency unit, are annual average market rates taken from IMF International Financial Statistics, 1981 Yearbook (row rf when available).

32. For changes in exchange rates and in the stock of money, the ratio of 1975 to 1970 seemed a natural starting point since we begin by comparing the residuals from the 1970 and 1975 equations. This limitation, if it is a legitimate one, does not apply to subsequent materials where we try to explain the residuals of 1975 equations. Experiments with changes in exchange rates and money stocks based on a number of alternative periods generally yielded similar results. One, 1974-75 as a ration of 1972-73 values, tended to produce marginally higher $\overline{R}^2$s, but we retained the simpler formulation.

33. Actually 31 countries are included since some of the necessary data were unavailable for 3 countries.

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