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PURCHASING POWER PARITY

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ABSTRACT

The paper is a survey of PPP theory and evidence prepared for the New Palgrave dictionary of economics. Following a statement of the absolute and relative versions of the theory, there is a brief sketch of the history of thought with emphasis on Cassel and the monetary approach. A theoretical part distinguishes structural and transitory deviations from PPP. The main basis for structural deviations is the Ricardo-Harrod-Balassa-Samuelson model of productivity differentials that affect the real prices of home goods and hence real price levels. Transitory deviations emerge from differential speeds of goods and assets markets. In particular sticky wages combined with imperfect competition or spatial discrimination in pricing give rise to sometimes persistent movements in real exchange rates. After an overview of empirical evidence the paper concludes with a review of implications of PPP disparities. Applications to international real income comparisons, interest rate linkages and exchange rate policy receive attention.

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PURCHASING POWER PARITY*

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Purchasing Power Parity (PPP) is a theory of exchange rate determination. It asserts (in the most common form) that the exchange rate change between two currencies over any period of time is determined by the change in the two countries' relative price levels. Because the theory singles out price level changes as the overriding determinant of exchange rate movements it has also been called the "inflation theory of exchange rates".

The PPP theory of exchange rates has somewhat the same status in the history of economic thought and in economic policy as the Quantity Theory of Money (QT): by different authors and at different points in time it has been considered an identity, a truism, an empirical regularity or a grossly misleading simplification. The theory remains controversial, as does the QT, because strict versions are demonstrably wrong while soft versions deprive it of any useful content. In between there is room for theory and empirical evidence to specify the circumstances under which and the extent to which PPP provides a useful though not exact description of exchange rate behavior.

The analogy with the QT holds particularly in the effects of monetary disturbances. The analogy with the QT holds particularly in the effects of

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monetary disturbances. The QT fails to hold exactly when disturbances are primarily monetary, for instance in the course of hyperinflations, because changes in the expected rate of inflation generate systematic movements in velocity that break the one to one link between money and prices. In the same way, monetary disturbances cause exchange rate movements that at least temporarily deviate from PPP, implying changes in the exchange rate adjusted relative price levels or "real" exchange rates. It is true that when the economy, following a major monetary disturbance, has settled down again the cumulative changes in money, prices and the exchange rate will tend to be the same or at least close. In that sense PPP holds. The same is decidedly not true, however, in the course of the disturbance.

And in the long run, just as changes in real income or financial innovation bring about trend changes in velocity that destroy the one to one relationship between the money supply and prices, there are also trend deviations from PPP: productivity growth differentials between countries, for example, lead to trend changes in real exchange rates.

1. Statement of the Theory

Let p_i and p_i^* represent the price of the i th commodity at home and abroad, stated in home and foreign currency respectively, and e the exchange rate. The exchange rate is quoted in the American manner as the number of units of domestic currency per unit of foreign money. Further let P and P^* be the price level at home and abroad quoted in the respective currencies.

The strong or absolute version of PPP relies on the "law of one price" in an integrated, competitive market. Abstracting from all and any frictions the price of a given good will be the same in all locations when quoted in the same currency, say dollars: $p_i = ep_i^*$. Consider now a domestic price index $P =$

$f(p_1, \dots, p_i, \dots, p_n)$ and a foreign price index $P^* = g(p^*_1, \dots, p^*_i, \dots, p^*_n)$. If the prices of each good, in dollars, are equalized across countries, and if the same goods enter each country's market basket with the same weights (i.e. the homogenous-of-degree-one $g(\cdot)$ and $f(\cdot)$ functions are the same) then absolute PPP prevails. The law of one price in this special case extends not only to individual goods but also to aggregate price levels. Spatial arbitrage then takes the form of the strong or absolute version of PPP:

$$(1) \quad e = P/P^* = \frac{\$ \text{ price of a standard market basket of foods}}{\pounds \text{ price of the same standard basket}}$$

where the right hand side is the common multiple of the price of each good in one currency and in the other. Specifically if $p_i/p^*_i = k$ for all i we then have $e = P/P^* = k$. Note now the implication of absolute PPP. Whatever the monetary or real disturbances in the economy because of instantaneous, costless arbitrage the prices of a common market basket of goods in the two countries, measured in a common currency will be the same or $P/eP^* = 1$ at all times.

There can be no objection to (1) as a theoretical statement. Objections arise, however, when it is interpreted as an empirical proposition. In fact the (spot) prices of a given commodity will not necessarily be equal in different locations at a given time. Transport costs and other obstacles to trade, in particular tariffs and quotas, do exist and hence the location of delivery does matter. Therefore we would not expect the price even of an ounce of gold of a specified fineness always to be the same in New York and in Calcutta. The fact that prices of the perfectly homogeneous commodity are not equalized across space at every point in time does not suggest market failure; it may simply reflect the inability to shift commodities costlessly and

instantaneously from one location to the other. Information costs and impediments to trade stand in the way of strictest spatial equalization of price. But these impediments to trade do not preclude that common currency prices of any given good in different locations should be closely related and, indeed, arbitrated. They just will not be literally equalized. Impediments to trade and imperfection of competition, of course, also make it possible that spatial price differentiation can occur thus further limiting strong PPP.

The weak or relative version of PPP therefore restates the theory in terms of changes in relative price levels and the exchange rate: $e = \theta P/P^*$, where θ is a constant reflecting the given obstacles to trade. Given these obstacles an increase in the home price level relative to that abroad implies an equi-proportionate depreciation of the home currency:

$$(2) \quad \hat{e} = \hat{P} - \hat{P}^*$$

where a $\hat{}$ denotes a percentage change.

Equation (2) is the statement of PPP as it was applied by Gustav Cassel to an analysis of exchange rate changes during World War I.

"The general inflation which has taken place during the war has lowered this purchasing power in all countries, though in a different degree, and the rates of exchange should accordingly be expected to deviate from their old parities in proportion to the inflation of each country. At every moment the real parity is represented by this quotient between the purchasing power of the money in the one country and the other. I propose to call this parity "purchasing power parity". As long as anything like free movement of merchandise and a somewhat comprehensive trade between the two countries takes place, the actual rate of exchange cannot deviate very much from this purchasing power parity." (Cassel, 1918, p.413).

Absolute PPP in (1) was stated in terms of the relative prices in different currencies and locations of a given and common basket of identical

goods. Going from there to relative PPP as in (2) may merely be a way of circumventing the qualifications arising from transport costs or obstacles to trade. But often more is involved because the shift, in practice, leads to a use of PPP in terms of particular price indices such as CPIs, WPIs, or GDP deflators. Once that is done we go beyond the law of one price because the shares of various goods in the different national indices may not be the same and the goods that enter the respective indices may not be strictly identical as is clearly the case for non-traded goods.

Once shares in the indexes are no longer equal and commodities are not strictly identical the appeal to the law of one price can no longer serve as support for PPP. Now PPP can only hold, even in the weak form, if the conditions of the homogeneity postulate of monetary theory are justified. The homogeneity postulate asserts that a purely monetary disturbance, leaving unchanged all equilibrium relative prices, will lead to an equiproportionate change in money and all prices, including the price of foreign exchange. In this very special experiment PPP holds even if the law of one price does not apply. The constancy of real variables under the assumption of a purely monetary disturbance (i.e. an unanticipated, non-recurrent increase in money) assures that once the economy has adjusted the exchange depreciation matches the inflation of any individual price or the price of any market basket so that (2) applies. To appreciate the difference of this experiment with absolute PPP note that under these conditions (2) could even be stated in terms of indices on nontraded goods prices.

PPP theory as a theory of equilibrium must be supplemented by an adjustment mechanism. In the case of identical commodities the theory is simply that of spatial arbitrage. But when the goods are not strictly identical more is required. A high degree of substitution in world trade is

generally assumed to be the mechanism through which exchange rate-adjusted prices are kept in line internationally. A further point concerns causation. In much of the literature, especially in the writing of Cassel, exchange rates adjust to prices. But there is an important alternative tradition that singles out exchange rate depreciation as an independent source of inflation.

Criticism of PPP focusses on systematic ways in which relative price changes destroy the strict validity of PPP. Keynes (1923, p.80), although strongly supporting the idea of PPP as a broad guide, recognized these possible departures from purely monetary disturbances:

"If on the other hand these assumptions are not fulfilled and changes are taking place in the 'equation of exchange', as economists call it, between the services and products of one country and those of another, either on account of movements of capital, or reparation payments, or changes in the relative efficiency of labor, or changes in the urgency of the world's demand for that country's special products, or the like, then the equilibrium point between purchasing power parity and the rate of exchange may be modified permanently."

This limitation of PPP led Samuelson (1964, p. 153) to argue:

"Unless very sophisticated, indeed, PPP is a misleading, pretentious doctrine, promising what is rare in economics, detailed numerical prediction."

2. History

Versions of the PPP theory have been traced to the Salamanca school in 16th century Spain and to the writings of Gerrard de Malynes appearing in 1601 in England. The Swedish, French and English bullionists in the second part of the 18th and in the early 19th century present further statements of PPP. Particularly noteworthy is the Bullion Report in England (1810, p. ccxxii).

"Whether this 13 1/2 per cent, which stands against this country by the present exchange on Lisbon, is a real difference of exchange, occasioned by the course of trade and by the remittances to Portugal on account of government, or a nominal and apparent exchange

occasioned by something in the state of our currency, or is partly real and partly nominal, may perhaps be determined by what your committee have yet to state."

During the 19th century classical economists, including in particular Ricardo, Mill, Goschen and Marshall, endorsed and developed more or less qualified PPP views. This history is reviewed and discussed in Viner (1937), Schumpeter (1954), Holmes (1967) and Officer (1984).

Even though PPP theory was well established by the time of World War I, the forceful use and development of the theory by the Swedish economist Gustav Cassel, has made him the outstanding protagonist of the theory. He turned the theory into a paradigm with all the necessary trappings: an alleged challenge to gold standard orthodoxy, a catchy name, a formula, and the claim of empirical support for the new view.

Cassel's first contributions on the subject were published in 1916 in the Economic Journal. He argues the inflation theory of exchange rates and proceeds to a demonstration using price level and exchange rate data for the belligerent countries, the U.S., and Sweden. J.M. Keynes as the editor appends a footnote drawing attention to the contribution and noting his surprise that, war disturbances notwithstanding, PPP should hold. A further challenge was the implication of PPP that the pre-war par with gold might not be reestablished or more guardedly, might require a powerful deflation in a country like Britain.

Cassel never abandoned an uncompromising PPP view of exchange rates even though he already in 1918 started recognizing the possibility that exchange rates might transitorily diverge from PPP. A decade later in Cassel (1928a, p. 16) a clear statement of his final position is made:

"The fact that the rate of exchange corresponding to Purchasing Power Parity possesses such a remarkable stability is a sufficient reason for regarding Purchasing Power Parity as the fundamental factor determining the rate of exchange and for classifying all other

factors that may influence the rate and perhaps make it deviate from the Purchasing Power Parity as factors of secondary importance, most suitably grouped under the head of 'disturbances'."

He identified three groups of disturbances: actual and expected inflation or deflation, new hindrances to international trade, and shifts in international movements of capital. Even though these disturbances are recognized, their quantitative effect on deviations from PPP is invariably seen as "confined within rather narrow limits". (Cassel, 1928a, p.28-29). In insisting on the proposition that deviations from PPP are limited and transitory, Cassel neglected paying close attention to the determinants of purchasing power disparities. Even though he recognized that inflation first leads to undervaluation, and stabilization leads later to an overvaluation (Cassel 1928b, p.26) never took these ideas further. His emphasis was on PPP. But he points out with some merit (Cassel, 1928b) that without some quantifiable concept of PPP, a sensible discussion of over or undervaluation can hardly begin.

Keynes (1923, 1971 Chapter 3) takes up PPP, crediting Ricardo with the invention and Cassel with the name. Keynes recognized PPP as an important empirical possibility. Giving it all the right qualifications he still endorses it for all practical purposes:

"This theory does not provide a simple or ready-made measure of the 'true' value of the exchanges. When it is restricted to foreign-trade goods, it is little better than a truism. When it is not so restricted, the conception of purchasing power parity becomes much more interesting, but is no longer an accurate forecaster of the course of the foreign exchanges. Thus defined 'purchasing power parity' deserves attention, even though it is not always an accurate forecaster of the foreign exchanges. The practical importance of our qualifications must not be exaggerated." (Keynes, 1923, p.77-78).

Cassel received support for PPP from the monetary disturbances of the 1913-1928 period. Extensive PPP studies were conducted for the U.S. government (see Young (1925)) and for the League of Nations. PPP emerged in the discussion of the resumption of the pre-war gold par in Britain in 1925, and Jacques Rueff used wage-based PPP to calculate an appropriate par for France's stabilization under Poincaré in 1926-28. But while it became a regular tool of applied macroeconomics, there was also plenty of controversy. Viner (1933) challenged the doctrinal view that classical economists had a concept of PPP, arguing that without the notion of a price level PPP could not be conceived. In fact Viner had little patience with PPP. The opposition is easily recognized today: Viner and other critics always reacted to the overstated claim that PPP must hold as a matter of fact or of theory, pointing out that only a purely monetary disturbance provided the theoretical or practical experiment in which PPP would apply. For them PPP as a theory was simply misstated and as a practical proposition overstated.

A new wave of interest in PPP emerged at the end of World War II when once again exchange rates had to be set following the war-time suspension of trade and convertibility. (See Metzler et al, 1947). Renewed interest in PPP followed in the late 1950s and early 1960s. Yeager (1958) and Haberler (1961) emphasized the practical usefulness of PPP and highlighted the role of high price elasticities in international trade as the factor supporting PPP. High elasticities in world trade would assure that real disturbances have only small effects on relative prices thus establishing more nearly the conditions under which exchange rate movements reflect dominantly differences in monetary experiences. Hendrik Houthakker (1962) drew attention to dollar overvaluation, using absolute PPP calculations based on consumer price comparisons. Samuelson

in (1964) formalized much of the PPP discussion: while endorsing the Houthaker thesis of dollar overvaluation he doubted that a proper test was given by the fact that one could buy cheaper abroad than in the U.S. a given market basket of goods.

In the late 1930s Harrod had drawn attention to the fact that divergent international productivity levels could, via their effect on wages and home goods prices, lead to permanent deviations from Cassel's absolute version of PPP. This idea was already developed by Ricardo and has become central to work on international real income comparisons. Balassa (1964) and Samuelson (1964) elaborated similar ideas to argue that there are systematic trend deviations from PPP. This "productivity bias" to PPP is discussed in more detail below.

PPP had yet another intellectual upturn with the move to flexible exchange rates in the early 1970s. The then fashionable "monetary approach to the balance of payments" developed by Robert Mundell (1968, 1971), Harry Johnson and their students readily adapted to become a PPP-based monetary approach to the exchange rate. (See Frenkel and Johnson (1975, 1978) and Mussa (1979)). The exchange rate under strict PPP conditions was interpreted as a monetary phenomenon. The absolute version of PPP in (1) above combined with the QT for each country ($MV = PY$ and $M^*V^* = P^*Y^*$) yielded the key equation determining exchange rates by relative money supplies, velocities and real incomes:

$$(3) \quad e = (M/M^*)(V/V^*)(Y^*/Y)$$

Empirical research on the 1920s and on the very early data of the 1970s initially seemed to lend support to PPP and the monetary approach.

But large movements in real exchange rates of the 1970s led to the currently dominant PPP skepticism. The new direction following the Mundell-

Fleming model of the 1960s emphasized fluctuations in real exchange rates or the terms of trade (import relative to export prices) arising from the discrepancies between flexible, forward looking asset markets and asset prices, and shortrun sticky prices and wages. Work on exchange rate dynamics (Dornbusch (1976)) developed these ideas about transitory deviations from PPP in a rational expectations context.

Concern with PPP continued to be very active in the late 1970s and the early 1980s. The real exchange rates of the main currencies underwent large, persistent fluctuations with important effects on trade flows and resource allocation. At the same time currency experiments in Latin America involved dramatic real appreciations with ruinous consequences for several countries. Sometimes in history there was bafflement as to how, all things considered, PPP could work so closely. This time, however, the surprise was on the other side: how can real exchange rates get that far out of line? We now review in more detail the theory of and evidence on deviations from PPP.

3. Purchasing Power Disparities

Qualifications to PPP take one of several forms: departures from PPP can be "structural" in the sense that they arise systematically in response to new and lasting changes in equilibrium relative prices. Alternatively, they occur in a "transitory" fashion as a result of disturbances to which the economy adjusts with differential speeds in goods and assets markets. These qualifications imply that even the weak or relative form of PPP cannot be expected to hold closely.

These disparities arise primarily for the following reasons: First, the terms of trade may change as a consequence of changes in trade patterns. Second, economic growth systematically affects the relative price of home and

traded goods. Third, monetary and exchange rate changes bring about transitory deviations in real price ratios and in PPP as a consequence of imperfectly flexible wages and prices.

Structural Departures: The literature is replete with qualifications to PPP singling out particular real disturbances that change equilibrium relative prices. Thus it has been recognized since Ricardo that real prices of home goods are high "in countries where manufactures flourish". It also has been argued that the "price level is high in borrowing countries". The Ricardo-Harrod-Balassa theory provides a framework for these ideas.

Consider a Ricardian model where the law of one price applies to traded goods and where there is also a home good. With perfect competition and constant returns prices are given by unit labor costs. We define as R the relative consumer price levels of two countries measured in a common currency:

$$(4) \quad R = P/eP^*$$

With identical homothetic tastes and the law of one price the international component of price indices is the same in both countries and hence cancels out in (4). The relative price level is then determined by the relative prices of home goods in the two countries, measured in a common currency. Let h and h^* be the levels of productivity in traded goods (at the competitive margin) relative to home goods in each country. It is readily shown (See Dornbusch, Fischer and Samuelson (1977)) that the relative price level then reduces to:

$$(4a) \quad R = R(h/h^*), \quad R' > 0$$

A uniform rise in traded goods productivity at home would bring about a rise in the relative price level of the home country or a real appreciation. The mechanism is the following: with the law of one price applying to traded goods, increased productivity in the traded goods sector increases wages in that industry and hence raises economy-wide wages. But without accompanying productivity gains in the home goods sector, costs and prices there must rise and hence the growing country's relative price level increases as shown by (4a).

In (4a) above the national productivity relatives h and h^* are measured in the traded goods sector at the competitive margin. Shifts in technology, tastes, commercial policies or labor force growth will all change the equilibrium competitive margin and hence will change the real exchange rate. Thus real factors, as the literature since Ricardo has recognized, will introduce systematic departures from PPP. For example a shift in world demand toward the home country's goods would raise the relative wage and reduce the range of goods produced by the home country. The rise in the relative wage, given productivity, raises the relative price level of the home country. Likewise an increase in spending relative to income (i.e. borrowing or a current account deficit) will lead to a rise in the relative price level of the spending country.

A variant of the Ricardian productivity differential model as an explanation for the relatively low price of non-tradeables in poor countries has been advanced by Lipsey and Kravis (1983) and Bhagwati (1984). They rely on differences in factor endowments and factor rewards rather than differences in production functions. In the poor labor abundant country, the labor-using

non-traded services can be produced at a relatively low cost compared to the rich, capital abundant country. Whichever is the model, this effect, as we will discuss below, has found ample support in empirical research on international real income and price comparisons.

Transitory Deviations: There is no difficulty in accepting that prices of close substitutes or even identical goods could diverge across space at any point in time. This would be the case because, in the shortest time period, transportation and information costs make arbitrage difficult or even impossible. These difficulties would explain that PPP holds up to a constant and white noise error (see Aizenman (1984)). But in fact we have to explain relatively persistent and often large deviations from PPP. These can arise from divergent speeds of adjustment of the exchange rate compared with wages and prices. Particularly when flexible exchange rates behave like asset prices while wages are determined by longterm contracts, there is room for relative prices to show relatively persistent deviations from PPP.

Okun (1981) made the distinction between "auction goods" and "customer goods". The former are in the nature of homogeneous commodities traded in spot markets on organized exchanges, the latter are differentiated and marketed in established customer relations. The former typically have flexible and highly arbitrated prices, the latter are priced on the basis of normal unit costs and tend to be sticky. This characterization is implicit in the Mundell-Fleming model of international capital mobility under flexible exchange rates, which has been the standard frame of reference for the discussion of open economy macroeconomics since the 1960s. This model assumes that prices in each country are fixed and hence exchange rate changes move the terms of trade one for one, thus bringing about permanent changes in real exchange rates. But even when

prices are only sticky in the short run there will still be relatively persistent deviations from PPP, although in the long run money is fully neutral.

Theoretical approaches to support the relative stickiness of prices can rely on the presence of long term labor contracts combined with oligopolistic pricing in goods markets. A model of imperfect competition is essential because the less-than-perfect degree of substitution is a key ingredient in PPP deviations. Less than perfect substitution means that we are not dealing with the law of one price and arbitrage but with firms' decisions to set relative prices. A suggestive framework is the Dixit-Stiglitz (1977) model of product diversification with imperfect competition. Given constant returns and labor as the only factor each firm will set prices as a fixed and common mark-up over wages. In the world market for the products of a particular industry the relative price of domestic and foreign variants of the product is determined by relative unit labor costs measured in a common currency:

$$(5) \quad p/ep^* = w/ew^*$$

where w and w^* denote unit labor costs at home and abroad in the respective currencies. Given sluggish wages, for contract reasons or otherwise, exchange rate movements will be one for one reflected in changes in the real exchange rate.

The assumption that firms base their pricing entirely on home cost, as it appears in this model, leaves no room for the alternative of spatial price differentiation. There is yet no definitive or even large body literature that develops industrial organization aspects of pricing under flexible and volatile exchange rates.

Empirical Evidence: There is little doubt that the prices of primary commodities traded on major organized exchanges in different locations are fully arbitrated when literally all adjustments for contracts (maturity, delivery terms and location etc.) are made. But all available evidence suggests that PPP in the strong or weak version does not apply in the same fashion to manufactured goods. The lack of a close conformity with PPP is as much true for individual commodity prices as it is for aggregate price indices. Moreover, this absence of a very tight PPP relation appears particularly true during major monetary dislocations.

Studies of high inflation episodes always appear to offer support for PPP in that they show close cumulative movements of internal prices and the exchange rate. But even here the evidence is deceptive as becomes clear when one looks at relative prices which do show large variations. Indeed, particularly during high inflation, the differing frequencies of adjustments of wages, prices and the exchange rate introduce considerable variability in relative prices which only disappears in the most intense stages of hyperinflation where all pricing comes to be based on the exchange rate.

Kravis and Lipsey (1978) and Isard (1977) have shown tests of the law of one price at the level of narrowly defined manufactured goods. The studies established for the same good (or highly substitutable goods) quite definitely persistent price discrepancies between domestic and export prices, between domestic and import prices, and between export prices to different markets. The evidence on the slack in the law of one price at the level of individual commodities is sufficiently strong for Isard (1977, p.941) to conclude:

"The denial of the law of one price in this context--at the most disaggregated product level for which price data can be readily matched--provides a strong presumption that it is impossible to assemble available data into aggregate price indexes which can be

expected to obey the law of one price (except, perhaps, when product coverage is restricted to primary commodities)."

Empirical studies on time series PPP relationships for aggregate price indices in the past twenty years also show evidence of persistent deviations. Once relative prices are not strictly constant PPP will perform differently depending on the particular price index chosen for comparison. Commonly the choice is among CPIs, WPIs, and GDP deflators. WPIs are often ruled out on the argument that conceptually they are poorly defined being neither producer nor consumer price indices. The preference is most often given to GDP deflators that have a clear methodological definition. Figure 1 shows relative GDP deflators expressed in a common currency in the 1972-83 period for Germany and for Japan, each relative to the U.S. The Figure clearly brings out that relative GDP deflators expressed in a common currency are far from constant, thus refuting the weak version of PPP.

As a measure of the departure from PPP Table 1 shows the correlation of annual rates of change of various price indices for the period 1971-83. In each case the bilateral comparison is conducted on exchange rate adjusted price indices so that inflation rates are measured in a common currency. The Table reports correlation coefficients for the CPI, GDP deflator, the GDP deflator for manufacturing, and export prices of non-electrical machinery. The latter example is shown as a particular case of a relatively disaggregated traded good. The weak form of the PPP hypothesis would predict that the correlation coefficients are approximately unity. In fact, as is apparent, the values are far off unity and in many cases even negative.

Table 1: Correlation of Inflation Rates Expressed in U.S. Dollars
(Annual data, 1971-1983)

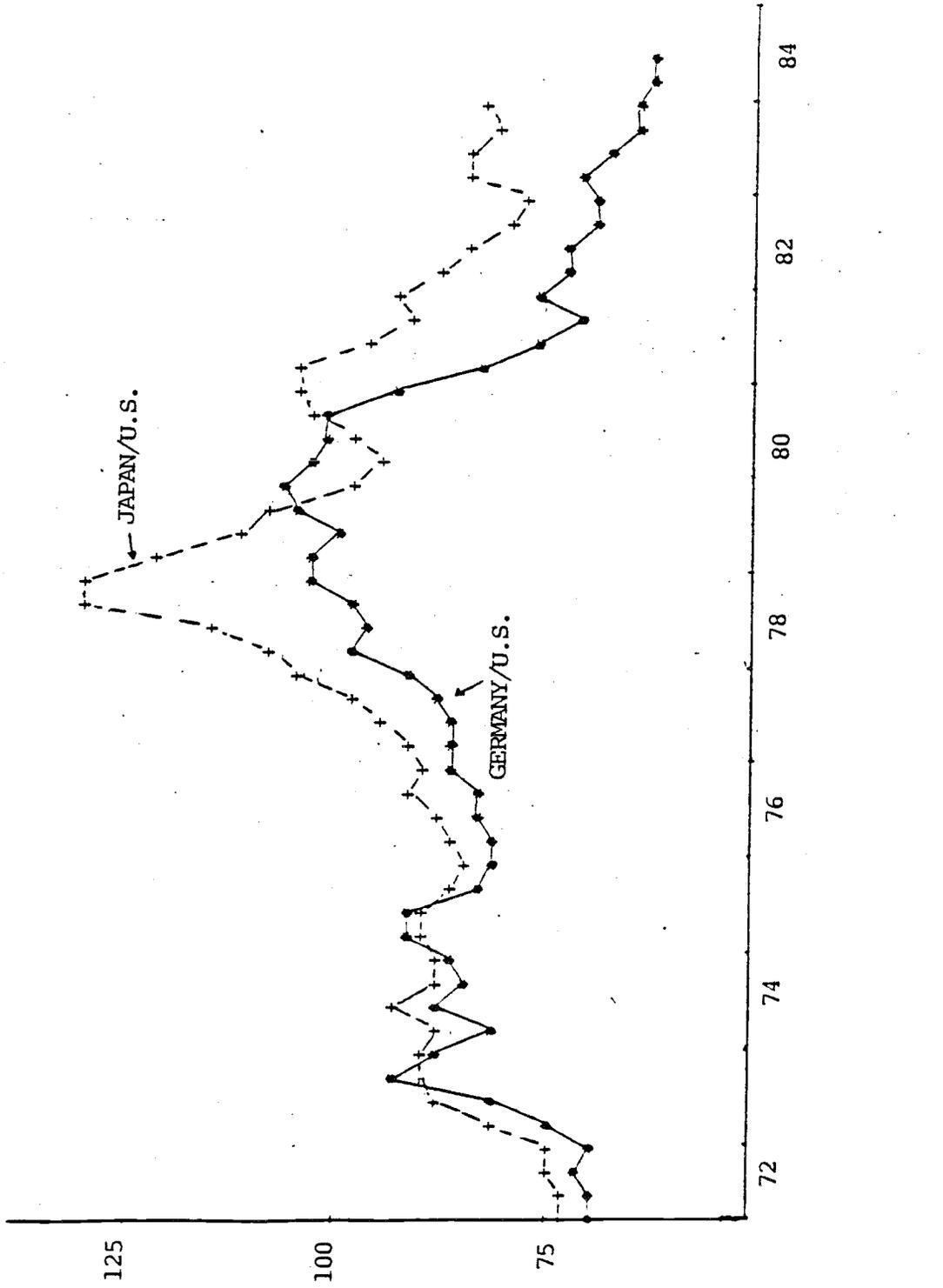
	US-Germany	US-Japan	Germany-Japan
GDP Deflators	-0.16	-0.22	0.64
Consumer Prices	0.28	0.36	0.60
Export Prices of Machinery	-0.24	-0.10	0.58
Deflator for Manufactures	-0.10	-0.13	0.61

Table 2 presents correlations of the quarterly rates of inflation of GDP deflators (in U.S. dollars) of a wider group of countries for the flexible rate period 1971-1983. The Table shows once more correlations far off Cassel's hypothetical value of one. Interestingly even for the more integrated European countries the correlation is low, though much larger than correlations involving the United States.

Table 2: Correlations of Inflation Rates Expressed in U.S. Dollars
(GDP Deflators, quarterly data 1971-1983)

	U.S.	Japan	U.K.	France	Germany
Japan	0.07	1			
U.K.	0.32	0.32	1		
France	0.25	0.50	0.55	1	
Germany	0.04	0.49	0.50	0.79	1
Italy	0.24	0.40	0.63	0.76	0.68

Figure 1
Relative GDP Deflators in a Common Currency
(Index 1980= 100)



The very strong deviations from PPP can likewise be found in looking at relative prices. Table 3 shows the variability of relative GDP deflators, measured in a common currency and using the U.S. as the numeraire country. The data for these relative price variability measures are quarterly and correspond to the fixed and flexible rate periods. The Table shows a large increase in variability in the shift to flexible exchange rates.

Table 3: Coefficient of Variation of Relative GDP Deflators
(Quarterly data, deflators measured in common currency)

	Germany-US	Japan-US	UK-US
1960-72	9.0%	9.3%	5.5%
1973:3-83	14.0%	13.4%	17.7%

The evidence on deviations from PPP leaves little doubt that they have been large and persistent. To pin down the major sources of these movements, however, is significantly more difficult. Among the chief explanations are capital flows induced by internationally divergent monetary-fiscal mixes interacting with sluggish wages and prices. Thus it would appear that a country that shifts in the direction of tight money and easy fiscal policy, for example, will experience real appreciation.

Besides these dominant macro shocks there is, of course, a host of other factors. Jacob Frenkel (1981a and 1981b, pp.694-695) has noted in this context:

"The experience during the 1970s illustrates the extent to which real shocks (oil embargo, supply shocks, commodity booms and shortages, shifts in the demand for money, differential productivity growth) result in systematic deviations from PPP...It should be noted, however, that to some extent the overall poor performance of the purchasing power parities doctrine is specific to the 1970s. During the floating rate period of the 1920s, the doctrine seems to have been much more reliable."

While PPP failed altogether in the 1970s it is now apparent that even the evidence from the 1920s is far from supportive as Krugman (1978) and Bernholz (1982) have shown.

The lack of solid empirical evidence in support of PPP extends to the assumption that divergent price developments "cause" exchange depreciation. From the study of experiences of high inflation it is clear that in some instances capital flight and exchange depreciation precipitated increases in inflation. In fact Nurkse (1944) makes much of the point that expectations acting via capital flight on the exchange rate, not actual money and prices, often initiate inflationary episode.

We conclude with a reference to evidence on structural PPP deviations. The evidence here establishes quite firmly that over time real exchange rates, rather than showing constancy or a tendency to fluctuate around a constant level, in fact exhibit a distinct trend. Productivity levels or real incomes influence systematically the relative prices of traded and nontraded goods within a country and hence international relative price levels across countries and across time.

In the context of an international income comparison project Kravis and associates have constructed indices of relative national price levels using an absolute price comparison approach. Drawing on a detailed sample of prices they construct matched sets of the price of individual commodity groups in a particular country relative to a reference country. For commodity i the price relative is p_i / p_i^* where the p 's are measured in the respective countries' currencies with an asterisk denoting the reference country. Using an arithmetic average with weights a_i given by final expenditure shares a PPP index is defined:

$$(6) \quad \text{PPP} \equiv \sum a_i (p_i / P_i^*)$$

The expenditure shares a_i used in the weighting may be those of either one of the countries or some other appropriate weighting scheme. With the help of this PPP index the (Kravis) real price level of a country (relative to the reference country) is defined as the ratio of the PPP index in (6) divided by the actual exchange rate:

$$(7) \quad \text{Kravis Real Price Level} \equiv \text{PPP}/e$$

This real price level definition represents a measure of the deviation from the law of one price at the aggregate level.

Kravis and Lipsey (1983, p.21) report the results of a cross section study of 34 countries where the 1975 real price level as defined in (7) of the sample of countries (relative to the U.S.) is explained by the country's real income compared to the U.S. The evidence shows that the higher is a country's relative income, the higher is its relative price level. Work by Hsieh (1982) using a time series approach further supports the extensive evidence on divergent productivity trends as a source of structural PPP deviations. It must be noted, though, that the evidence on structural deviations continues to be challenged by Officer (1984).

4. Implications of Purchasing Power Disparities:

The fact that exchange rate movements often or even predominantly do not conform to tight PPP patterns poses important issues for macroeconomic measurement, linkages, and policy. We review here several implications:

Real Income Comparisons: With strict PPP based on the law of one price, the purchasing power of a given income in one country and currency can be compared with the purchasing power of the income of any other country by simply measuring incomes in a common currency. If one income is twenty times larger than the other, measured in the same currency at actual exchange rates, then its command over goods and services is twenty times larger. But the fact that PPP does not hold leads to systematic biases in the comparisons. Specifically, as the work of Kravis and associates (1978, 1982, 1983) has shown the real income of poor countries is severely underestimated when actual exchange rates are used to make the comparison. The low relative price of non-tradeables in poor countries (due to the productivity differential discussed earlier) yields for poor countries true purchasing power of income significantly above what exchange rate converted income suggests.

Table 4 reports on the magnitude of biases in a sample of 34 countries separated into six income groups with the U.S. as the numeraire country. Note that the biases are particularly large for countries whose incomes are only a small fraction of the U.S. level so that productivity differential effects play a maximal role. The poorer a country the lower the real price level. An interesting point is that these real price level differences apply both to commodities and to services. One reason they also apply to goods is that these always have a local retail component which on account of labor costs (though perhaps not transport) will tend to be low in poor countries.

Table 4: Kravis-Heston-Summers International Real Income Comparisons
(Index US = 100)

Group	(1) Real Income (mean per capita)	(2) Dollar Income	(3) Real Price of: Commodities	(4) Services	(5) GDP
1	9.0	3.7	57.2	20.7	40.6
2	23.1	12.1	65.1	34.1	51.7
3	37.3	24.2	83.1	41.2	64.7
4	52.4	38.7	94.0	46.3	73.5
5	76.0	82.3	119.0	94.6	107.5
U.S.	100.0	100.0	100.0	100.0	100.0

Source: Kravis, Heston and Summers (1982).

The ratio of dollar income to real income for each group (column 2 divided by column 1) represents the extent to which exchange rate conversions understate real income. For low income countries actual real income is two to three times what exchange rate-converted incomes suggest. These structural deviations from PPP, of course, would be invariant under a purely monetary disturbance so that the weak form of PPP would still apply.

Interest Rate Linkages and PPP: Under perfect international mobility of capital and risk neutral speculation there is a linkage between nominal interest rates and the anticipated rate of depreciation which is given by the open economy Fisher equation:

$$(8) \quad i = i^* + x$$

where i and i^* are the nominal interest rates at home and abroad and x is the anticipated rate of depreciation of the home currency. Adding and subtracting

anticipated inflation rates on both sides yields an equation in terms of inflation-adjusted or real interest rates:

$$(8a) \quad r^* = r + \dot{R}/R$$

Real interest parity, according to (8a) prevails when the real interest differential equals the expected rate of real appreciation, \dot{R}/R . From the real interest parity condition it is apparent that under exact PPP the real exchange rate is constant. In the absence of restrictions on capital flows, real interest rates must therefore be strictly equalized across countries.

The real interest parity equation has two interesting implications. A first one is the linkages between the level of real exchange rates and monetary policy. Suppose that in a medium-term macroeconomic context, following a disturbance, the actual real exchange rate adjusts only gradually to the trend level R' according to the process: $\dot{R}/R = (1/a)(R'-R)$. Here $1/a$ is the speed of adjustment which depends among other things on the extent to which wages and prices are sticky. Combining this process with (8a) yields an equation for the equilibrium real exchange rate:

$$(9) \quad R = R' + a(r-r^*)$$

The result shown here is that when real interest rates at home exceed those abroad the real exchange rate will be appreciated relative to its trend value. A tightening of monetary policy, by raising real interest rates would thus bring about a (transitory) real appreciation. Equation (9) emerges from the dynamic Mundell-Fleming models and is often thought to explain real

exchange rate movements and their tendency to only return gradually to their long run value.

A second way to look at (8a) draws on the fact that the traded-nontraded goods distinction has implications for real exchange rates. Suppose the law of one price holds for traded goods and that shares in the two countries' price indices are the same. Then as argued before, the real exchange rate is equal to the relative price of nontraded goods (in a common currency) in the two countries. Structural disturbances such as differential productivity growth or changes in aggregate demand will now have a systematic impact on relative nontraded goods prices and hence on real interest rate differentials. Specifically the country with the higher growth rate of productivity has a rising relative price of home goods and thus has a lower real rate of interest. As another example in a country where aggregate demand is transitorily high has a home goods prices are is high but falling. Accordingly the real interest rate is high relative to that abroad. Deviations from PPP, trend or shortrun, thus introduce an equilibrium international interest rates differential.

PPP deviations affect interest differentials another way. In (8) above we assumed risk neutrality. But once risk averse speculators are admitted, the possibility that exchange rate movements could deviate from a strict PPP pattern introduces portfolio risk associated with the currency composition of the portfolio. PPP deviations are thus a basic motive for international portfolio diversification. A risk premium will appear and among the determinants of this premium is the variability of the real exchange rate. The risk premium will be an increasing function of real exchange rate uncertainty. (See the survey in Branson and Henderson (1984)).

Finance theory-oriented literature has posed the important question whether deviations from PPP imply economic inefficiency (see Roll (1979)).

Inefficiency means that a rational speculator, using available information, could make excess profits by borrowing in one country and buying spot and holding a commodity basket representing the foreign country's CPI. If the rate of real depreciation predictably exceeds the real rate of interest in a country, there exists the possibility that markets are inefficient. For example an investment in foreign goods would yield a real rate of return in terms of domestic goods equal to \dot{R}/R . An investment in home financial assets yield an expected real return r . Let the random differential between these two investments be $K \equiv r + \dot{R}/R$. Finance theory predicts that in an information-rational market $K_t = E(K_t | I_{t-1}) + u_t$ where u_t is a white noise error uncorrelated with any information I_{t-1} available at time $t-1$. Hence a regression of K_t on variables known at time $t-1$ will not yield a statistically significant coefficient, nor serial correlation in the errors. The evidence does not lend unambiguous support to this efficiency hypothesis, possible explanations being risk premia and the obvious difficulty of storing the CPI. (See Cumby and Obstfeld (1984)).

Exchange Rate Policy: In Cassell's view even small deviations from PPP would bring about large changes in trade flows and hence a rapid discipline to move prices back into line internationally. But the reversion toward PPP has often not been quick and deviations from PPP have taken more nearly the pattern of persistent swings in a country's external competitiveness. The changes in competitiveness in turn have implied large swings in external balances, in output and in employment in the traded goods sector. Changes in exchange rates that deviate from PPP at the same time influence the path of a country's inflation: real depreciation increases inflation and real appreciation dampens

inflation. These effects of purchasing power disparities make the exchange rate an important issue in macroeconomic policy.

Countries with high inflation cannot afford a fixed exchange rate since the loss in external competitiveness would soon lead to excessive and growing external deficits and large unemployment. If freely fluctuating rates are deemed too unstable the policy answer is often a crawling peg. In a crawling peg regime the rate of depreciation follows a PPP path such that over time the real exchange rate remains constant. (See Williamson (1965, 1982)). Such a policy is an important advance over a system of occasional devaluations (too little, too late), but it is not without risks for two reasons. First, freezing the real exchange rate may be a bad policy when disturbances in fact call for a path of, say, real depreciation. Second, there is a trade-off between stability of the real exchange rate and price stability. A policy of fully accommodating any and all price or cost disturbances by an offsetting depreciation may in fact remove price stability altogether (see Dornbusch (1982)).

PPP issues enter exchange rate policy also when a country seeks to gain macroeconomic advantages by a deliberate policy of driving the exchange rate away from PPP. A real depreciation serves to gain competitiveness and shift employment toward the depreciating country. In the 1930s this was called a "beggar-thy-neighbor" policy and in post World War II Europe it became "export-led growth." A policy of appreciation by contrast serves to reduce inflationary pressure as the rate of increase of traded goods prices is pushed below the prevailing rate of inflation. These macroeconomic effects of purchasing power disparities are not difficult to bring about: easy money, in the short and medium term, serves to depreciate the exchange rate and thus create employment. This policy is more effective and more lasting the more

sticky wages and the smaller the connection between wages, prices and the exchange rate. By contrast, in an economy that is strongly indexed and in particular with exchange rate influences on indexation, an attempt at creating employment via easy money would be frustrated as exchange depreciation precipitates off-setting wage and price inflation.

Deviations from PPP have also been used as a disinflation policy. (See Fischer (1984)). Deliberate fixing of the exchange rate or preannounced rates of depreciation below the prevailing rates of inflation, have been adopted in various countries to break inflation. The experience has been almost uniformly disappointing and worse. The resulting overvaluation very often has led to excessive external deficits, borrowing and capital flight and ultimately only moderate success at disinflation. The cases of Chile and Argentina in the late 1970s were particularly extreme. Exchange rate policies led to extreme overvaluation. But these economies had been opened to unrestricted trade or free capital flows. The public therefore could speculate against the overvalued currency by massive imports or capital flight while the governments financed the resulting deficits by external borrowing. In the end the scheme collapsed leaving the private sector with foreign goods or foreign assets and the governments with huge foreign debts.

PPP disparities are relevant for the exchange rate choice between flexible and fixed or managed rates. In a world where exchange rate movements conform strictly to PPP and monetary policy governs prices there is no issue. Flexible rates then allow a country to choose its preferred rate of inflation. But once disparities are possible both as a result of structural trends and perhaps as a consequence of short term capital movements, the fixed versus flexible rate choice becomes more difficult. Flexible rates are preferable because there is no risk that the government pegs a rate that no

longer corresponds to equilibrium. But flexible rates suffer the handicap that disequilibrating capital flows can drive the real exchange rate away from the level warranted by the fundamentals of the goods market. In particular if exchange rates respond more to asset markets than price levels, persistent real appreciation or depreciation become a possibility. Figure 1 above is suggestive of such disequilibrium movements. When these do occur there is invariably a call for PPP-based foreign exchange market intervention to bring rates back to "fundamentals". Explicit target zones have been proposed as a means of maintaining the advantages of flexible rates within limits to maintain approximate PPP. (See Williamson(1983)).

Flexible rates are also a concern because disequilibrating capital flows can provoke large changes in the rate of inflation. A loss of confidence, whether warranted or not, induces a capital outflow and a real exchange depreciation. If domestic financial policies are linked via the budget or indexation to the exchange rate the real depreciation can initiate a sharp increase in inflation. Much of the discussion of the merits of flexible rates has concentrated on the question of whether speculative capital flows "cause" the inflation or whether they merely respond to an inflationary situation, bringing about exchange depreciation in line with prevailing inflation. The Graham-Nurkse-Robinson view asserts, contrary to Milton Friedman, that destabilizing capital flows are the central element in the outbreak of major inflation experiences. Exchange stabilization, similarly, is seen as an essential step in stopping a run-away inflation and initiating a stabilization program.

PPP is also relevant in the context of devaluation of a fixed rate. In the monetary approach to the balance of payments a firm tenet is the proposition that a devaluation cannot exert a lasting effect on relative

prices or the balance of trade. Exchange depreciation raises the prices of all traded goods in the same proportion and any effect then must be limited to a temporary depression of home goods prices due to reduced absorption. As money responds to the external surplus, real absorption rises and the initial real equilibrium is restored. This approach has the disturbing implication that devaluation does not appear to be an effective means of coping with trade or employment problems. In practice a devaluation will work well when it is designed to speed up the the adjustment from an initial disequilibrium in a situation where wages and prices are less than fully flexible downward. But a devaluation is likely to be ineffective if it is accompanied by a monetary expansion and wage increases, thus eliminating any real effects.

5. Concluding Remark.

PPP remains an essential element of open economy macroeconomics for two reasons. First it is a benchmark by which to judge the level of an exchange rate. Cassel argued that without PPP there would be no meaningful way of discussing over or undervaluation. That recognition has found a very concrete expression in the real exchange rate series now routinely calculated and reported by governments, international organizations and financial institutions. These series show exchange rate adjusted price relatives for a country relative to its trading partners. The series are constructed on the basis of GDP deflators, unit labor costs, manufacturing prices and wholesale prices for all major industrialized countries and increasingly for developing countries, too. They are used to judge changes in a country's external competitiveness thus implicitly assuming, as Cassel did, that movements in equilibrium relative prices are negligible. Changes in real exchange rates

then (and only then) unambiguously translate into changes in competitiveness from which to expect changes in trade flows and net exports.

There is no question that these data provide a useful benchmark for policy discussion. But the objections remain the same that have been brought over the past seventy years. For example from 1978 to 1984 the U.S. dollar appreciated on a trade weighted basis in real terms by 25 percent using GDP deflators in manufacturing as the basis of comparison. How much of this real appreciation represents a movement away from fundamentals? The base year, 1978, may have represented an excessive undervaluation. Furthermore macro and micro structural changes may have increased the equilibrium relative price of U.S. goods. With the present state of knowledge it is difficult to judge whether the overvaluation is ten or twenty percent and hence to decide whether there is a major market failure calling for intervention.

The second use of PPP is to serve as a prediction model for exchange rates. Under perfectly flexible wages and prices a monetary expansion would lead to equi-proportionate increases in wages, prices and the exchange rate, leaving all real variables unchanged. This combination of the QT and PPP is an important insight in guiding policy. Expansionary monetary policy can only be effective if wages and prices are less than fully flexible and will be more effective the more flexible the exchange rate. The essential channel is the real depreciation of the exchange rate that serves to create employment, at least for a while. Similarly, exchange depreciation can only be effective if money wages and prices are unresponsive. Policy can be effective only if PPP fails to hold. Macroeconomic theory goes increasingly in the direction of information, contracting, and pricing models to explore what is the basis of PPP failure and to determine the resulting extent and persistence of policy effects.

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