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Purchasing Power Parity: A Survey of the Issues

The purchasing power parity (PPP) doctrine, one of the most widely researched areas in international finance, is also probably one of the most controversial in the theory of exchange rate determination. According to the theory of purchasing power parity, the rate of exchange between two currencies is determined by the differences in the price levels of their respective countries. However, while proponents of the theory argue that PPP provides a strong basis for determining exchange rates, others have contended otherwise, with a plethora of empirical research demonstrating persistent deviations from PPP. Consequently, we provide a survey of the issues that contribute to the problems in testing the theory. Notably, factors such as the lack of uniformity in the price indices used to determine the long-run equilibrium exchange rate – also known as the 'index-number problem' – and the issue of productivity bias, which is probably seen as the most serious criticism of PPP theory, are discussed. We also consider the role of market imperfections as well as structural changes in the economy.

Introduction

The origins of PPP theory can be traced back to Spanish scholars of the sixteenth century, although the intellectual origins of the doctrine are credited to Wheatley's and Ricardo's work in the nineteenth century.[1] The PPP theory as we know it today, however, is attributed to Gustav Cassel's writings during the 1920s. Cassel was instrumental in rekindling interest in PPP theory during the modern era, after

its demise in the latter part of the nineteenth century.[2] This interest has intensified over the last two decades with the collapse of the Bretton Woods system and the reintroduction of flexible exchange rates in the early 1970s.[3]

The relationship between exchange rates and prices that is summarized by the PPP doctrine is considered one of the oldest, and possibly the most controversial, in the theory of exchange rate determination. Frenkel (1981) attributes much of the controversy to the fact that the PPP theory does not specify the precise mechanism by which exchange rates are related to prices, nor the precise conditions that must be satisfied in order for the doctrine to be correct. In short, he claims that it merely shows a relationship between two variables without explaining how such a relationship comes about. Other researchers have also suggested that the choice of price indices used in empirical tests, and market imperfections such as transportation and transaction costs, contribute to the problems surrounding the theory. On the other hand, some authors contend that PPP does provide a strong basis for exchange rate determination, with useful policy implications.

As a precursor to our own research in this area, we will first review the issues relating to our research design. The next section looks at the definitions and concepts of PPP itself, after which we deal with the index-number problem and the concept of exchange rate equilibrium, respectively. We then discuss the *productivity bias hypothesis*, which is generally accepted as the most important reason for departures from PPP, and other limitations of PPP. This is followed by a summary.

Absolute and relative parities

PPP required that the price level in two countries be equal when converted to a common currency to ensure that the *real* exchange rate is equal to unity. Consequently, any change in the *nominal* exchange rate would be determined by a change in the price level. Thus, it could be said that the PPP theory of exchange rates looks at the *relationship* between a country's foreign exchange rate and its price level, as well as the relationship between the *changes* in those variables.

PPP may be expressed in either absolute or relative terms. *Absolute PPP* is the ratio of price levels which are measured as the number of units of currency per unit of physical quantity. Since absolute PPP of the foreign currency is the ratio of the domestic price level to the foreign price level, it has as its dimension the number of units of domestic currency per unit of foreign currency. In turn, *relative PPP* is based on price *movements* which are measured by price indices relative to a designated base period. The basic concept here is that the change in the exchange rate should equal the inflation differential. It can either be defined as the ratio of the domestic to the foreign price index, or the product of this ratio and the base-period exchange rate. Relative PPP implies that the real exchange rate is constant, although it need not be unity. This means that movements in the real exchange rate are synonymous with deviations from PPP.

Officer (1982) defines the absolute and relative versions of PPP as follows: absolute PPP is represented by P_{ct}/P_t^*, where P_{ct} and P_t^* are the domestic and foreign price levels, respectively, in period t; relative PPP (first concept) is represented by I_{ct}/I_{ct}^*, where I_{ct} and I_{ct}^* are the domestic and foreign price indices, calculated as $(P_{ct}/P_{c,t-1})$ and $(P_t^*/P_{c,t-1}^*)$, respectively; and relative PPP (second concept) is represented by $I_{ct}/I_{ct}^* \cdot R_0$, where R_0 is the number of units of domestic currency per unit of foreign currency for the base period. This definition of PPP is only equal to the absolute form of PPP, presumed to be the new equilibrium exchange rate, if the changes in the economies that occurred since the base period are purely monetary in nature (Cassel, 1922). In other words, it is only in the case of a uniform inflation where all prices are unaltered in their relation to one another that the relative PPP (second concept) necessarily equals the absolute PPP for that period.

Cassel (1928) observes that the construction of absolute PPP would only allow a precise comparison of price levels in two countries if, and only if, all corresponding prices differ by the same multiplicative factor. In practice, differing relative prices yield only 'an approximate comparison' (p. 8) between the purchasing power of both currencies. Thus, the use of appropriate indices, wherein individual commodities are weighted according to their economic importance, is advocated. The weighting pattern should reflect either the production or consumption of these commodities.

The index-number problem

Frankel (1994, p. 4) states that, 'If purchasing power parity held among currencies, the proper test would be a simple matter of identifying the price index of the appropriate international basket of goods consumed by investors, and measuring asset returns in terms of it.' However, in the course of PPP research there has been much argument over what constitutes an *appropriate* price index for making PPP comparisons. Amongst the possibilities that have been mooted are the wholesale price index (WPI), cost-of-living (COL) price measures, the consumer price index (CPI) and gross domestic product (GDP).

Cassel (1921, p. 110), for instance, suggests that the WPI would be 'a fairly reliable index of the movements of the general level of prices' when 'prices have adjusted themselves to one another so as to make the prices of products correspond to their cost of production'. Consequently, the level of wages in an economy could be a very important factor in determining the value of its currency in the long run (Cassel, 1922). However, Keynes (1930) opposes the use of the WPI to calculate PPP as it is heavily weighted with traded goods. He contends that this would result in a truism since the computed relative price parities would then be almost equal to the actual exchange rate, thus providing spurious verification of the theory. This is consistent with Cassel (1922) who had previously opposed the use of price indices relating solely to traded goods for several reasons: (1) they are 'limited to a small class of commodities, and are therefore subject to variations' (p. 47); (2) ambiguity exists in the definition of traded and non-traded goods (hereafter T and N respectively), given that small changes in the exchange rate may result in one becoming the other; and (3) the applicability of the law of one price to traded goods implies that they tend to move together regardless of the deviation from PPP.

In determining the relationship between PPPs, exchange rates and income levels, Balassa (1964) also acknowledges the index-number problem. He, too, argues against the use of WPIs in determining a cause-and-effect relationship between exchange rates and PPPs, since the heavy weighting given to T would mean that as T moves towards a world price, the prices reflect changes in world markets rather than domestic inflationary pressures. This follows Yeager (1958) who had previously suggested that causation is stronger from

price levels to exchange rates than vice versa, since trade flows are known to have only minor effects on domestic prices. Furthermore, since movements in the general price level are generally determined by changes in the money supply rather than exchange rate movements, use of the WPI would not accurately reflect PPP.

Balassa subsequently finds that his results are dependent on the choice of weights used, in this case the final bill of goods consumed in individual countries. For example, by using one country's consumption pattern as weights, as against another's, the purchasing power of the latter's currency would be underestimated; the latter's currency would be overestimated if its own consumption weights are used. As a solution, Balassa proposes using the geometric average of the two weights, although he concedes that 'this average lacks a specific economic meaning' (p. 587).

If the law of one price holds for every individual good, then it follows that it must hold for any *identical* basket of goods. Froot and Rogoff (1995), however, find that most empirical tests do not attempt to compare identical baskets, but instead use different countries' CPIs and WPIs, which consist of different weights and mixes of goods across countries. Thus, they observe that even if PPP holds, it may not necessarily show up in the results if these indices are used, unless the two countries in question have identical baskets. They suggest the use of *price differentials*, where changes in relative price levels are offset by changes in the exchange rate. Similarly, Betton *et al*. (1995) observe that when consumption bundles are not identical, price indices based on local consumption patterns may behave differently even though the law of one price holds for each commodity. They suggest that measures of inflation differentials and price level ratios are intrinsically subject to error when price indices are based on different baskets of goods, resulting in biased outcomes of PPP tests. This is supported by Kravis *et al*. (1975), who previously recalculated foreign inflation using US weights in the foreign price indices. Their results demonstrate far stronger support for PPP than those using traditionally constructed indices.

Other research based on the use of CPIs includes Frenkel and Mussa (1980), who observe that short-run changes in exchange rates bear little relationship to short-run differentials in national inflation rates, particularly those measured by CPIs. Adler and Dumas (1983)

discover that inflation differentials in the 1970s explain less than 5 per cent of monthly exchange rate movements, which means that 95 per cent of currency movements are *not* caused by current inflation. Meanwhile, Frenkel (1981) and Kravis and Lipsey (1978) find that there has been no close correlation between movements in exchange rates and movements in the ratio of national price levels, especially in the 1970s when it had been close to zero.

In his paper, Miller (1984, p. 354) observes that the use of different price indices for parity calculation purposes 'might conceivably yield different conclusions concerning the validity of PPP … [s]ince the consumer price index, the wholesale price index and the GDP deflator all use different weighting patterns …'. Furthermore, he argues that since the prices of individual commodities have increased at different rates, the various indices often reflect substantially different rates of inflation. He concludes that it is 'therefore possible that one's choice of price index has a considerable bearing on the conclusions'. It is suspected that this problem would have been exacerbated during the 1970s when world economies experienced large changes in relative prices.

Williamson (1983, pp. 19–20) supports the idea of 'a measure that is able to diverge … only as the competitive position of the tradable sector changes', as opposed to consumer prices rising relative to the price of T as a result of rapid productivity growth in the latter. This criterion, he declares, rules out the use of export and consumer prices, and instead lends support to the use of *wholesale prices of manufacturing output*. He eventually settles for a combined index incorporating the geometric means of WPIs and unit labour costs, which is consistent with Cassel's (1922) position on the importance of wage levels discussed earlier.

Sjaastad (1991, pp. 1–2) contends that PPP research is often 'plagued by difficulties in measuring the key underlying variables' in that inaccurate use of broadly defined price levels and the existence of exchange rate controls have complicated the interpretation of any subsequent results. In this particular study, he separates the 'pure' from the 'measurement' error by isolating and quantifying the measurement error component. He considers the Swiss case ideal for this purpose as it has basically had a freely floating exchange rate and a stable commercial policy throughout the post-Bretton Woods period.

Sjaastad's interpretation of PPP allows for changes in relative prices that are not a consequence of the exchange rate. He relates PPP with the behaviour of the exchange rate relative to N prices and foreign-currency prices of T, rather than with domestic and foreign price levels. Using both the bilateral real exchange rate (which is based on two currencies and two respective price levels) and the multilateral real exchange rate (which reflects internal relative prices) in his tests, he finds that the measurement errors are mainly attributed to the use of the bilateral real exchange rate for several reasons. Firstly, the US price level measures a broader set of goods and services than the Swiss index. This means that the price of Swiss T can rise or fall relative to the US price level simply because different weights are given to different commodity groups within the respective indices, which will induce deviations from PPP when relative prices change.[4] Secondly, the degree of influence exerted by the US price level and the dollar exchange rate over the US dollar price of Swiss T also plays an important role in determining measurement errors. This influence is dependent on the degree to which the US dominates the market for Swiss T. Overall, Sjaastad finds strong support for PPP by showing that the high volatility of the US dollar–Swiss franc exchange rate since 1973 has failed to destabilize the Swiss price level; rather, it is due to corresponding variability in the dollar prices of Swiss T. He strongly concludes that 'in the Swiss case, at least, the bulk of the variance in the bilateral real exchange rate is measurement error, pure and simple' (p. 39).

Other supporters of a broader price measure include the asset-market proponents, who theorize that the exchange rate equilibrates by equalizing the PPP of domestic and foreign currencies, *via* arbitrage involving the currencies of these two economies. One suggestion is the use of COL price measures. The advantages of this measure are that (1) costs of production are less subject to exchange rate changes than are prices of T; (2) costs are more likely to be representative of long-run prices (for absolute parity) and reflective of permanent changes in prices (for relative parity) than are product prices, since they exclude the volatile profit component; and (3) the sale of T at world prices which incurs losses (profits) could explain currency overvaluation (undervaluation). Artus (1978) suggests that the cost–parity concept is more appropriate since the structure of factor prices (in the form of wages) within a country changes less over time

than the structure of commodity prices. This makes the relative prices of N, as represented by the former, more stable than those of the latter. He also finds that wage rates in the T sector are less vulnerable to direct foreign influences than are commodity prices in the same sector.

Frenkel (1981), on the other hand, argues that the choice of price indices is immaterial as long as the *structure of relative prices* in the economy remains stable, as when the shocks are of a monetary origin. It only becomes of critical importance when there are *real* shocks which alter relative prices. These shocks result in the presence of secular trends due to shifts in rates of technological change, commercial policies, product mix and commodity-price shocks. Frenkel observes that changes in internal relative prices would be picked up by changes in the ratio of the COL index to the WPI, since the COL index contains relatively more N than the WPI. His tests show that the internal price structure was relatively stable for the US and UK, somewhat changed for Germany, and highly volatile for France during the 1970s. He subsequently attributes the collapse of PPP during that time to this instability in internal relative prices.

Previous to that, Frenkel (1978) had used alternative price indices, namely wholesale, material and food, to test the absolute and relative versions of PPP during the floating rate period of the 1920s. Overall, he finds that both versions of PPP hold for that period, save a couple of exceptions. Upon the incorporation of lags into his model, he finds the estimated long-run elasticities of the exchange rate with respect to the price ratio to be about unity; the short-run elasticities, however, vary across exchange rates and price indices. Furthermore, the speed of adjustment for the material price indices appears to exceed that of the WPIs.

The preceding debate notwithstanding, ultimately, as Cassel (1922) suggests, a *general* price level is required to define absolute PPP, while a *general* price index should be used for relative PPP. This is because only general index figures would encompass, as far as possible, the entire range of commodities available in an economy. In today's terms, this would mean using the gross domestic product (GDP) price level and the GDP deflator to derive the relative and absolute versions of PPP, respectively. Cassel (1932) further justifies the use of a relative PPP approach, as opposed to absolute PPP, since he considers measures of price levels to be practically impossible to obtain for the latter.

Like Cassel, Officer (1974) also advocates the use of the GDP measure, although for a different reason. He argues that GDP is appropriate since it represents each country's pattern of production, which is ideal for weighting purposes in constructing a price measure. Furthermore, since PPP theory is concerned with prices and production within the boundaries of respective countries, GDP is preferred to gross national product (GNP) as it comprises domestic rather than national production. In practice, however, PPP computations using GNP differ minimally from GDP (Officer, 1982).

Determining the equilibrium exchange rate

According to Cassel (1926), absolute PPP is the main determinant of the equilibrium exchange rate (EER); that is, the rate that results in a current account equilibrium. He argues that if the actual exchange rate, defined as the price of foreign currency in terms of domestic currency, exceeds (falls below) the equilibrium rate, then the domestic country would have a trade surplus (deficit). A trade balance is achieved when the actual rate is at equilibrium.

Frankel (1985) proposes six possible reasons as to why disequilibrium in the exchange rate may occur. However, based on available evidence he is able to rule out five of the six possible explanations and posits that 'overshooting' is the most plausible explanation for observed exchange rate behaviour. Although associated with exchange rate volatility, it is consistent with market efficiency in that one cannot expect to make arbitrage profits from this phenomenon. The dynamics of overshooting come from variables that are 'sticky'; that is, variables that do not react instantaneously to changes in the economy even though these changes are reflected in the exchange rate initially. Gradual adjustments of these variables (for example, prices, level of domestic claims on foreign assets and current account balances) eventually result in the reversal of the initial change in the exchange rate.

Dornbusch's (1976) findings on the effects of monetary (or nominal) shocks and sticky prices on exchange rates are supported by the high correlation between real and nominal exchange rate changes, during both fixed and flexible exchange rate regimes. The fact that observed fluctuations in the real exchange rate are greater under flexible rates is due to the higher volatility of nominal exchange rates under

this regime, while price levels remain sluggish under either regime. However, as Stockman (1987, 1988) notes, these are not the only plausible explanations for observed movements in the real and nominal rates. Shocks to technology, tastes, and trade and fiscal policies are also responsible for real exchange rate movements under both fixed and flexible regimes. These shocks are also reflected in the nominal exchange rates instead of relative price levels because of the price stabilization policies pursued by monetary authorities.

Using 130 years of data for the US and UK, Rogers (1995) finds evidence to support both the 'sticky-prices view' of real exchange rate determination, which emphasizes nominal shocks, and the 'equilibrium view', which emphasizes real shocks in the economy. He suggests that real and monetary shocks account for approximately the same percentage of the variance in the real exchange rate in the short term, although the effects of the latter do not persist over the long run. He is also able to separate the sources of the shocks into demand shock (real) and equal amounts of money multiplier shocks and monetary base shocks (monetary).

Officer (1982, p. 15) defines the long-run EER as 'the fixed exchange rate that yields balance of payments equilibrium over a certain time period'. He further suggests that the time period should incorporate both seasonal and cyclical fluctuations in the balance of payments, as well as business cycles at home and abroad. When PPP is used to measure disequilibrium in a floating exchange rate, the implication is that some force is keeping the exchange rate away from its long-run equilibrium, which should equal the PPP. The short-run EER, in turn, is merely that which would exist under a freely floating exchange rate system; that is, one that is completely unmanaged by any institution.

The above concepts are reflected in Officer's three propositions of PPP theory. The first states that PPP is the principal determinant of the long-run exchange rate, such that the long-run EER tends to equal PPP. Secondly, the long-run EER is seen to be the principal determinant of, and tends to be approached by, the short-run EER. Given that the short-run EER approaches the long-run EER, which in turn converges on the PPP, the third proposition follows that the short-run EER must also be determined by PPP. In a nutshell, this means that PPP *should* hold in the long run. Consistent with these propositions, Manzur (1990) finds that PPP performs poorly in the

short run, but that the long-run evidence is consistent with the PPP hypothesis. In this instance, the transition from the short run to the long run appears to take five years.

Krugman (1990a) discusses EER in the context of the equilibrium *real* exchange rate. He sees adjustments to this real rate as being a function of time and nominal exchange rate policy. These equilibrium real exchange rate shifts are attributed to several sources. One possible factor is the existence of real shocks, and international capital flows are another, albeit more contentious, source of shifts in the equilibrium real exchange rate. Capital flows, which are predictably temporary, are said to result in a potential decline in the equilibrium real exchange rate. The argument here is that an economy which is the temporary recipient of capital inflows will see a rise in the demand for its N as well as its T, resulting in a general increase in prices on world markets and a corresponding fall in the real exchange rate to restore equilibrium. Krugman also finds evidence that nominal shocks do, in the short run, cause real exchange rate changes, and that their effects are quite persistent.

Williamson (1983, p. 5) views misalignment in the real exchange rate as 'a persistent departure from its long-run equilibrium level'. He contends that misalignment does not preclude the market from clearing; that is, demand for a particular currency equating its supply. Broadly speaking, there are three concepts of equilibrium: market equilibrium, current equilibrium and fundamental equilibrium. Market equilibrium exists when demand equals supply in the absence of official intervention, at the nominal level. Using this concept, non-intervention implies equilibrium. Like market equilibrium, the current equilibrium rate refers to a nominal rate whose adjustments occur in response to 'news'. Accordingly, this is 'the rate that would obtain if markets had full knowledge of all relevant facts and acted rationally to that knowledge' (Williamson, 1983, p. 16). It is dependent on factors such as interest rates, which in turn are dependent on macroeconomic policy, the state of the business cycle and net asset positions *vis-à-vis* other economies.

Fundamental equilibrium occurs when the exchange rate is that justified by fundamentals. This concept of equilibrium relates to the *real* exchange rate; that is, the inflation-adjusted exchange rate. According to Williamson (1983, p. 14), it is the exchange rate 'which is expected to generate a current account surplus or deficit equal to

the underlying capital flow over the cycle, given that the country is pursuing "internal balance" as best it can and not restricting trade for balance of payments reasons'. This fundamental equilibrium exchange rate (hereafter FEER) is equivalent to that referred to previously by Krugman and Officer as the EER.[5] References to currency over-/undervaluation are usually made within the context of this particular form of equilibrium. These changes to the FEER occur as a result of changes to either the underlying capital flow, or the demand and supply of traded goods. In turn, changes in the latter are usually a result of productivity growth differentials, exploitation of significant new resources or permanent exogenous changes in the terms of trade. The issue of productivity differentials and its significance for PPP will be discussed in detail in the next section.

Consistent with Williamson's definition, Pick and Volrath (1994, p. 555) posit that real exchange rate misalignment occurs when 'actual exchange rates are not allowed to adjust to changes in economic fundamentals'. They perceive factors such as unsustainable monetary, fiscal and various trade and exchange control policies to be the principal causes of misalignment. In quantifying the effects of exchange rate misalignment on developing-country agricultural export performance, they use Edwards' (1989) real exchange rate model to show that such misalignment has a significantly adverse impact on those exports. The results provide support for the argument that exchange rate misalignment could adversely affect the economic growth and export performance of developing countries, thus emphasizing the importance of sustainable macroeconomic policies.

Bartolini (1995, p. 47) suggests that the 'difficulty of assessing the dynamics of equilibrium real exchange rates, combined with statistical problems such as constructing qualitatively homogeneous baskets of goods and services, is central to any analysis of competitiveness'. However, he argues that temporary deviations of exchange rates from their medium- or long-run equilibrium may not necessitate policy intervention, as they are not necessarily a result of market failure. Rather, they may actually be a reflection of optimal market responses to numerous exogeneous shocks.

The productivity bias hypothesis

The *productivity bias hypothesis* (PBH) is probably considered the most serious criticism of the absolute PPP theory today. This hypothesis is

based on the premise that productivity growth in the T sector is faster than that in the N sector. Bartolini (1995, p. 47) observes that

> differential rates of technical change in the traded and non-traded sectors have long been recognised as a cause of sustained movements in equilibrium real exchange rates and, therefore, as a reason for the persistent failure of PPP. This is because, while market competition may keep prices of tradeables broadly aligned internationally, prices of non-tradeables need not move together in different countries.

Thus, assuming that the productivity of T increases while that of N remains constant, the existence of world prices for real interest rates and T means that the productivity increase is matched by a real wage increase that keeps the marginal cost of T constant, while increasing the marginal cost of N and hence their price. It is obvious then that the increase in the relative price of N reflects different productivity growth rates between the two sectors. The result is that if the real exchange rate between two countries is computed using price deflators that include both T and N, then the currency of the country with faster productivity growth in the T than in the N sector will be systematically overvalued relative to its PPP level.[6]

Balassa (1964, pp. 587–8) asserts that, 'international productivity differences in the service sector are considerably smaller than in the production of traded goods, raising thereby the cost of services in high-income countries'. His examination of seven major industrial countries confirms that productivity increases in the services sector are lower than those for the national economy as a whole. He regresses the ratio of PPP to the official exchange rate on per capita GNP for 12 industrial countries, to test the hypothesis that higher levels of service prices in rich countries result in systematic differences between PPPs and EERs. He finds a significant positive correlation between the two variables.

Although the PBH is generally credited to Balassa (1964) and Samuelson (1964), earlier work on the subject includes that of Hagen (1957), Harrod (1939) and Rothschild (1958). Cassel himself (1932) had earlier commented on the fact that services are relatively more expensive in richer countries. Harrod (1939) classifies the goods produced by a country as A, B, and C goods. He defines A goods as staple goods of homogeneous character and capable of entering into

foreign trade. Transportation costs aside, these international goods trade at a common world price. At the other extreme, C goods and services are those that are, by nature, incapable of entering into international trade. There is no international price for C goods. Quasi-international B goods fall in the intermediate position between the two, and although there is a tendency towards a common world price, complete uniformity is rarely achieved.

It is Harrod's contention that when C goods are incorporated into the calculations, the theory of PPP would only hold true in the extreme circumstance where, among other things, the ratio of efficiency in producing C goods to A goods is the same in two countries and the rewards to factors of production – or their ratio in A industries to those in C industries – are the same in both countries. In practice, these conditions would be highly unlikely, given the different levels of technological progress in each country and the expertise of human resources available. According to Harrod, 'the movement of scientific knowledge, business ability and industrial skill is extremely slow and sticky' (p. 73).

Rothschild (1958) is the first author to empirically test the PBH. He states that the purchasing power equivalents (implied exchange rates) would normally yield exchange rates which are less favourable than the equilibrium to the richer country. Furthermore, the greater the productivity differential between the rich and poor countries, the greater the differential between the price of N, and thus the larger the deviation from the EER. Using, alternately, the US and Germany as standard countries for tests of cross-sectional data, his results show that the ratio of absolute PPP to actual exchange rate is positively related to per capita GNP, and that the deviation between PPP and the exchange rate is much higher for T than for N. Both these findings are consistent with the PBH.

However, subsequent studies by Clague and Tanzi (1972) and de Vries (1968), among others, have failed to reproduce statistically significant results similar to Balassa's (1964). Officer (1974, p. 874) questions the validity of the PBH because it ignores 'the difference in the qualities of the services' among countries. Improving on Balassa's apparent methodological weaknesses, Officer (1976b) subsequently provides statistical evidence that the PBH lacks firm empirical foundation. He does, however, concede that 'the most important reason

for a systematic divergence between PPP and the equilibrium rate is the existence of productivity differences between countries' (p. 545).

Clements and Semudram (1983) use three different sets of data to test Balassa's (1964) hypothesis: the price of haircuts, which Samuelson (1964) describes as a classic non-traded good; multi-commodity prices for 15 countries; and relative price movements of N in nine countries. Their results demonstrate a clear positive correlation between the price of a haircut and GDP, which supports the argument that N are relatively more expensive in richer countries. Analysis of Voltaire and Stack's (1980) results, which are based on data from Kravis *et al*. (1978), show that food (which is a traded good) becomes cheaper relative to recreation (a non-traded good) as they move from poorer to richer countries. Using Goldstein and Officer's (1979) time-series data, the authors find the income elasticity of the ratio of N prices to T prices to be significantly positive, thus corroborating the cross-sectional results that N become relatively more expensive with increasing per capita income.

Recently, one method of accounting for departures from PPP has received wide attention. As with Balassa and many others after him, this method produced by the United Nations International Comparisons Project (ICP) is also based on the premise of productivity differentials between countries, as well as 'factor proportion' differentials.[7] According to Kravis (1986), new insights into the world economy have arisen with the use of PPPs to replace exchange rates in converting GDP and its components to a common currency. He claims that this system of international income and purchasing power comparisons improves the measurement of countries' average incomes and the differences between them. He argues that the exchange rate is not a reliable indicator of the purchasing power of a currency. Hence, the non-ICP method of using the exchange rate to convert income denominated in domestic currency to a numeraire currency (usually the US dollar) tends to exaggerate the dispersion of per capita incomes by systematically understating those of poorer countries.

Kravis further states that the ICP method also enables the comparison of *price levels* between countries, and not just the *relative changes* in them. He shows that we are actually able to compare the German price levels in the 1980s with those of the USA, instead of just observing changes in German prices relative to US prices. The third advantage

of the ICP method is that it allows comparison of the relative quantities and prices of goods that make up the GDPs of different countries. For instance, exchange rate deviation from PPP varies for different goods; that is, the relative price structures of countries differ. This means that inter-country quantity relationships which make up GDP may not be consistent with what exchange rate conversions make them out to be. With the ICP method, however, we are able to deduce whether a country's spending share is higher than another's because of its ability to absorb a particular good or merely because its prices are higher.

The ICP method is not without its critics, however. The reason that exchange rates continue to be used, instead of the purportedly superior PPPs, is that the ICP has several methodological problems. One objection is the use of world average prices to value the GDP components (Isenman, 1980). The argument here is that since world average prices are dominated by the larger weights of rich countries, price weights that are not reflective of the low-income countries tend to push up their relative quantity indices. Another area of contention is the ICP treatment of 'comparison-resistant' services, which have no identifiable unit of output which could be easily priced. Maddison's (1983) objection to the use of the ICP stems from the significant differences between his estimates of real GDP per capita for developing countries and those extrapolated from ICP results, which he attributes to the difference in treatment of the services component. Rogoff (1996) argues that ICP data are only gathered at five-year intervals (beginning in 1970) and country coverage is limited, which means that data from non-benchmark years and countries must be obtained by extrapolation. Moreover, there is also a long time lag between collection of the data and its availability. These problems notwithstanding, Kravis supports the use of PPPs over exchange rates since 'methodological improvements can and doubtless will be made, but the indices of real per capita GDP are little changed by the use of alternative methods' (p. 23).

Bahmani-Oskooee (1992) tests for the validity of the PBH as a long-run phenomenon using cointegration techniques. He claims that the problem of using the actual rate as proxy for the EER could be partly resolved in this context, since the actual exchange rate would tend to the equilibrium rate over the longer term. He is also able to avoid the issue of using PPP versus the exchange rate to convert income

from domestic to standard currency by using productivity indices which are unit-free. This measure is calculated as the number of units of each country's currency per man-hour and reported in index form. Of the six countries tested, he concludes that a long-run relationship exists between productivity and the deviation of PPP from the EER, even though he fails to find such a relationship for one other country, while claiming that the data for the remaining two are not 'suitable' for the method used.

De Gregorio *et al*. (1994) use time-series and cross-sectional data to determine the cause of differentials in sectoral inflation, as defined by the behaviour of the relative price of N (in terms of T). They demonstrate that the relative price of N is determined solely by technological conditions; that is, there exists a positive relationship between increased productivity growth in the T sector and the relative price of N, as stated by the PBH.

Further qualifications to PPP

Officer (1976a) categorizes the limitations of PPP theory into four groups: namely, the *index-number problem* relating to price parity, *absolute price parity, relative price parity* and *cost parity*. The *index-number problem*, discussed earlier, pertains to the method of calculating the parity condition. Given that the individual prices used in PPP computations are assumed to represent free-market transactions, the existence of effective rationing and price controls in either country would not be truly reflective of each country's buying power. Furthermore, since the price indices comprise only a sample of commodities, any computed price parity is not truly representative of the true theoretical parity (Pigou, 1922). Another point of contention is centred on the composite index itself; that is, the incorporation of N as well as T, as against the use of T prices only.

Within the context of *absolute price parity*, Officer suggests that the existence of market imperfections such as tariffs and transportation costs could result in deviations in the short-run EER from PPP, to the extent that the former bears practically no relationship to the latter because the price responsiveness of T is greatly reduced. This theory is later supported by Miller (1984) who finds that intra-European PPP relationships perform better than transatlantic ones. He attributes these results to the lower transport costs within Europe, and the tariff

and EMS implications as a result of EEC cooperation. These problems are augmented when controls are extended to the domestic sector in the form of price and wage controls, among others. Other criticisms of absolute PPP look at the roles played by income (Yeager, 1958, 1976), long-term capital flows (Houthakker, 1962; Officer, 1974) and causation between exchange rates and prices (Balassa, 1964; Keynes, 1923).

Michael *et al*. (1994a) offer other explanations for departures from PPP. They examine the roles played by transportation and transaction costs in long- and short-run PPP, respectively, taking into account the non-stationarity characteristic of price series. They exploit this feature by using the cointegration model for their analysis. Their results show that long-run PPP is comfortably satisfied when transportation costs are taken into consideration. Furthermore, they are able to conclude that short-run deviations from PPP, while statistically predictable, cannot be systematically exploited for arbitrage gains since the vast majority of forecasts fall within the transaction cost bands.

In a subsequent paper, Michael *et al*. (1994b, p. 2) argue that

> conventional tests of cointegration between exchange rates and prices may be seriously biased towards rejection of the hypothesis of PPP in the presence of transactions bands [since] the existence of transactions costs will imply a non-linear response to deviations from purchasing power parity which can be represented as a non-linear error correcting process [which] is in contrast with the linear framework in standard cointegration analysis.

Using monthly data for the interwar period and annual data spanning two centuries on non-linear 'threshold models', they find evidence of non-linear adjustment to PPP deviations in the presence of transaction bands – that is, no adjustment within the transactions band but quite fast adjustment outside the band – to which they attribute the mixed results in previous studies of PPP.

One of the main problems of calculating *relative price parity* is the need for a base period where the exchange rate is in long-run equilibrium. However, this is possible only if the exchange rate is freely floating at the time; otherwise there is no guarantee that it is even in short-run equilibrium. Furthermore, even if a free float exists, its value may have been affected by temporary factors, such as short-term

capital flows, that would cause it to move away from the long-run equilibrium.[8] Given the difficulty in locating an equilibrium base period, Bacha and Taylor (1971) and Bunting (1939) argue that the theory is practically unusable.

Another criticism of relative price parity concentrates on the possibility that economic conditions, either structural or non-structural in nature, may have changed since the base period. Non-structural changes include the magnitude of trade restrictions and transportation costs, and conditions governing international capital flows and investment income. Changes in tastes, technology, factor supplies and market form are classified as structural changes, which affect 'the shape or position of the economy's reciprocal demand curve for foreign commodities with respect to their (real) price denominated in domestic commodities' (Officer, 1982, p. 130). Thus, Bunting (1939) posits that the base period should be as close as possible to the current period when computing relative PPP, to minimize the scope for structural changes.

The structural change considered most damaging to PPP is that which involves a differential shift in the T/N price ratio as between countries (Officer, 1982). This is the PBH discussed above. Balassa's (1964) argument of non-uniform productivity advantage – that is, greater for T than for N – enjoyed by the richer country results in a bias in *absolute* PPP. The corresponding bias to *relative* PPP occurs when there is an increase (decrease) over time in the richer country's productivity advantage, as measured by a higher (lower) rate of growth in per capita income, compared to the poorer country.

Harris (1936), who first criticized the *cost parity* concept, contends that the inconsistencies of cost components across countries make comparison difficult. Tamagna (1945), in turn, argues that the comparison of wages across countries at different stages of development would be difficult because of diverse output composition and changes in productivity. The problem of data availability leads Artus (1978, p. 287) to observe that the 'prices of intermediate inputs and capital services are practically always ignored'.

Using the *asset market theory* of exchange rate determination, Frenkel (1981) addresses the question of whether exchange rates and national price levels are comparable, given the intrinsic differences between the two. This theory is based on the notion that the exchange rate, being the relative price of two durable assets (currencies), should

be analysed within the same framework as that of other asset prices. In an efficient and organized market for durable assets, new information about the future is immediately incorporated into current prices, thus precluding arbitrage opportunities. It follows then that during periods dominated by 'news', asset prices would exhibit relatively higher levels of variability. Similarly, we would expect greater volatility in exchange rates during such periods. By contrast, it is well-documented that aggregate price indices, which reflect the prices of less durable goods and services, are less sensitive to news which alters future expectations. Broadly speaking, exchange rates reflect *future* expectations, while prices are an indication of *present* and *past* circumstances which are reflected in existing contracts.

The 'stickiness' exhibited by prices, compared to the quickness of the currency market in responding to new information, implies that exchange rate fluctuations would not be matched by corresponding fluctuations of aggregate price levels, at least in the short term. This behaviour is demonstrated by persistent departures from PPP in the 1970s as a result of real shocks to the world economy in the form of oil embargos, supply shocks, commodity booms and shortages, changes in demand for money supply and differential productivity growth, as well as political uncertainty. It is also consistent with Frenkel's (1978) findings on causality between prices and exchange rates. In that paper, his results indicate that prices do not 'cause' exchange rates, rather, that exchange rates 'cause' prices. He surmises that 'this pattern of "causality" is consistent with the hypothesis that speeds of adjustment in asset markets exceed those in the commodity markets' (p. 183).

It has often been held that the failure of the law of one price is due, in large part, to systematic attempts by firms operating in international markets to stabilise destination market prices, when nominal exchange rates change, in order to protect market share. Ghosh and Wolf (1994) distinguish between deliberate pricing-to-market behaviour and inadvertent import-currency price stabilization stemming from menu costs, in trying to explain observed departures from PPP. Firms are said to 'price to market' when they charge different local prices across export markets to reflect the particular local competitive situation. Any exchange rate movement is absorbed by altering the home currency export price. Menu costs consist of two components: informational costs which capture the inconvenience

to customers as prices are changed, resulting in possible lost sales, and administrative costs which are incurred when determining and implementing new prices.

The authors argue that the speed of adjustment of the real exchange rate to nominal exchange rate movements is determined by the pricing behaviour of such firms. The cover prices of *The Economist* magazine are considered suitable data for this analysis as the journal is a single homogenous product sold in a large number of countries, whose limited life precludes international arbitrage opportunities. Furthermore, the aggregation problems associated with the common use of composite indices – such as the indistinguishability between the two types of pricing behaviour – are avoided here. Based on the significance of lagged exchange rate changes on cross-country relative price changes, Ghosh and Wolf conclude that they are unable to reject the possibility that menu costs, rather than pricing-to-market behaviour, are responsible for the observed departures from parity.

Bearing in mind our earlier discussion on the limitations of PPP imposed by the PBH, Krugman's (1990b) *perfect integration hypothesis* states that the globalization of world markets, *via* improved telecommunication and transportation, has enabled international arbitrage to the extent that cross-border economic transactions can be considered to take place within one global marketplace. As such, national price levels are seen to diverge only through exchange rate changes which result in differential inflation, rather than due to any changes in relative prices. This appears at odds with the PBH assumption that the exchange rate between two countries is determined by the relative prices of T between them. Furthermore, Krugman's finding that exchange rate changes are not passed through, even to the prices of T, implies that there may be factors other than those presumed in these two hypotheses that cause deviations in the PPP. He concludes that 'we still live in a world of highly imperfectly integrated markets, and one in which … there is still quite a lot of price stickiness denominated in domestic currency' (p. 97).

Rogers and Jenkins (1995) categorize theories that explain departures from PPP into those that focus on the properties of price levels and those that concentrate on nominal exchange rate determination in a world of sticky prices. The former is the PBH as discussed earlier, while the latter posits that the nominal exchange rate responds to

shocks in the financial assets market and, because of price stickiness, changes in the nominal exchange rate are *real* changes. Using disaggregated price data from 11 OECD countries, the authors examine the roles played by 'haircuts', that is, the presence of N in the general price index, and 'hysteresis', which is defined as sluggishness in firms' pricing policies with respect to exchange rate changes. Their analysis suggests that both these factors play a part in explaining the empirical failure of PPP. For instance, they find a high correlation between the common-currency price of food across borders and the real exchange rate, implying that sticky prices are a predominant cause of deviations of PPP. They also find that the results of the cointegration and unit root tests provide 'mild support for the Samuelson–Balassa class of models' (p. 353).

In a similar vein, Engel and Rogers (1996) find that physical distance plays an important role in explaining the failure of PPP between two locations. Furthermore, the variability in price ratios for similar goods is also affected by crossing the border between two countries. Using disaggregated CPI data from 23 major cities in the US and Canada over the June 1978 to June 1993 period, they show that 'crossing the border' is equivalent to adding 7182 miles between two cities in the same country.

The authors offer three possible explanations as to why the border may matter. First, the consumer goods could be subject to sticky prices in terms of the currency of the country in which they are sold. The highly variable nominal exchange rate means that cross-border relative prices would fluctuate along with the exchange rate, but the country relative prices would be relatively stable.[9] Secondly, the inter-country variation in prices could reflect variation in the costs of N, such as marketing services, that are required in selling the goods. To the extent that the movement of labour across borders is more restricted than that within a country, one would expect more variation in cross-border prices than within-country prices. Finally, there are the direct costs such as tariffs and trade restrictions. Given the relatively low trade barriers between the US and Canada, especially since the Canadian–US Free Trade Agreement was effected in January 1990, Engel and Rogers posit that trade restrictions cannot account for all the cross-border relative price variability in their results. However, they are unable to conclude whether segmented labour

markets or sticky nominal prices are responsible for the significance of the cross-border variable.

Summary

PPP as a theory of exchange rate determination is probably the most useful and used of all exchange rate theories, despite its many detractors. It is relatively simple and intuitively appealing – its basic ingredients are minimal, that is, prices at home and abroad, and the rate of exchange between two countries; and it has important implications for economic policy decisions. Furthermore, the ability of the theory to allow for adjustments and extensions when taking into account limiting factors further contributes to its versatility. This is evidenced by the surge in the number of publications on PPP research over the past decade alone, as we will discuss in Chapter 2.

Although a plethora of studies already exists on PPP, it is generally accepted that empirical work on the topic could still be improved. Issues such as the choice of an optimal equilibrium exchange rate and an appropriate price index, as well as biases imposed by productivity differentials, are paramount in ensuring the validity of any results obtained. In this book, we will attempt to incorporate these factors into our tests and analyses of PPP.

Notes

1. See, for example, Wheatley (1803, 1807, 1819) and Ricardo (1810/11, 1811a, 1811b, 1811c). The origins of PPP theory are analyzed in detail by Frenkel (1976) and Officer (1982).
2. See, for example, Cassel (1916a, 1916b, 1921, 1922, 1926, 1928, 1932).
3. Studies by Adler and Lehmann (1983), Huizinga (1987) and Meese and Rogoff (1988) are unable to reject the hypothesis that real exchange rates follow a random walk under the floating exchange rate regime. However, recent studies by Abuaf and Jorion (1990), Diebold, Husted and Rush (1991) and Lothian (1990) find evidence of mean-reverting behaviour in real exchange rates, using long-term time series data (see Chapter 2 for a more detailed discussion). Other research into real exchange rate behaviour during the float include Dornbusch (1987), Frankel and Meese (1987), Meese (1990) and Officer (1976a). Surveys of the literature in this area are provided by Dornbusch (1987), Lothian (1997), Officer (1976a), Rogoff (1996) and Taylor (1995).
4. See Saidi and Swoboda (1983) for a more detailed explanation.

5. Note that Cassel's (1926) concept of the EER is slightly different in that it specifically requires equilibrium in the *current* account of the balance of payments.
6. The mechanics of this concept are discussed in further detail in Chapter 3 (pp. 72–3).
7. For example, low-income countries are labour-abundant and since services are labour-intensive they would be relatively cheaper in low-income countries compared to high-income ones.
8. In the course of his research, Cassel provides numerous reasons as to why floating exchange rates may systematically diverge from PPP. Summaries are provided by Angell (1925), Bunting (1939), Holmes (1967), Myhrman (1976), Officer (1982) and Sadie (1948).
9. See previous study by Mussa (1986) on the effect of sticky prices on the variance of the real exchange rate.

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