■ purchasing power parity

The notion of purchasing power parity (PPP) has a long intellectual history and can be traced to the 16th-century writings of scholars from the University of Salamanca in Spain. The modern definition of PPP, usually credited to Gustav Cassel (1918), is quite intuitive: when measured in the same unit, the monies of different countries should have the same purchasing power and command the same basket of goods. Otherwise, international arbitrage should bring about adjustments in prices, exchange rates, or both, which will ultimately restore parity. Another way to interpret the parity condition is that the exchange rate between two currencies should equal the ratio of the countries' price levels.

Despite its simplicity, the parity condition is the subject of many empirical studies, driven mainly by its significant implications for the global economy. For instance, PPP is a major building block of most models in international economics. The relevance of these models and their policy implications thus depends critically on the validity of PPP. Another application of PPP is the comparison of national income levels. Some economists believe that a meaningful comparison of income across countries should be based on, instead of market exchange rates, PPP exchange rates that control for price differentials of same goods across countries.

The use of PPP goes beyond academic interest, however. In the context of the global economy, exchange rate misalignment is a main source of imbalances in trade and capital accounts. These imbalances, if left unchecked, can create intense stresses for both individual economies and the global system. The PPP condition describes the relationship between exchange rates and national price levels and is commonly used as a benchmark for evaluating exchange rate misalignment.

The absolute and the relative PPP conditions are the two commonly discussed versions of PPP. The absolute PPP is given by

$$s = p - p*$$

where s is the exchange rate expressed as the domestic price of the foreign currency, p is the domestic price index, and p^* is the corresponding foreign price index. All the variables are in logs. The relative version is given by

$$s = c + p - p*$$

where c is constant.

Under the absolute PPP, movements in the relative price, $p - p^*$, and in the exchange rate offset each other to maintain the parity. On the other hand, the relative PPP is a less stringent condition and requires only that the proportion of exchange rate variations is the same as the proportion of variations in the relative price.

Law of One Price and PPP The law of one price (LOP) states that prices of identical goods from different locations are the same after adjusting for exchange rates. International arbitrage is the main argument behind the LOP. The difference between LOP and PPP is that the former concept refers to the actual price level of a good while the latter refers to an index of prices for different goods. LOP is a main building block of PPP. For instance, it can be shown that the PPP condition can be derived when only one good satisfies LOP (Niehans 1984). The requirement of only one good, instead of all the goods, satisfying LOP is an interesting result and it implies a high likelihood that PPP holds.

Most studies that evaluate the LOP condition find that, in general, the condition does not hold and deviations from the LOP vary substantially across product types. These studies, however, usually employ price subindexes, such as the price of chemical products. Thus they are examining the relative rather than the absolute LOP. Studies that use actual individual prices are far less common. The documented price convergence in the European car market during the integration process is one of the few pieces of evidence that are in favor of LOP (Goldberg and Verboven 2005). Overall, while one is hard pressed to find favorable evidence among the empirical studies, a casual look at, say, the global precious metal market suggests that the presence of one good satisfying the LOP may not be an extremely stringent condition.

Basics of Evaluating PPP Arguably, the PPP is the most intensely examined parity condition in international economics. Constrained by data limita-

tions, empirical studies usually examine the validity of relative instead of absolute PPP. Specifically, price indexes do not allow an easy comparison of absolute price levels across countries.

The choice of price indexes is an issue in evaluating PPP. The common choice is between consumer price and producer (wholesale) price indexes. Some researchers use the former index as a proxy for the price index of nontradable goods and the latter one as a proxy for tradable goods. In general, the use of producer price index yields stronger evidence in favor of PPP than the use of consumer price index does. Other candidates include price indexes of imports and exports, the GDP deflator, and components of the GDP deflator.

The sample period used in PPP studies ranges from the post-1973 floating period to historical samples that cover 100 years or more. There is a trade-off between short and long samples. An advantage of long historical samples is that they are better suited for studying long-term trends and thus for evaluating the long-run PPP. A drawback, however, is that these samples cover periods of different exchange regime arrangements and significant economic changes that may complicate the analysis. Compared with long historical samples, the post-1973 period may not have enough observations to reveal reversion to the PPP. Nonetheless, results from the post-1973 period are derived from a more homogenous setting and are likely to be more relevant for current policy considerations.

Real Exchange Rate Persistence The persistence of real exchange rates is commonly used to infer the validity of PPP. If PPP holds continuously, the real exchange rate is constant. It is not difficult to verify that the instantaneous PPP does not hold since a constant real exchange rate is typically not observed in reality. This is why most empirical exercises focus on long-run PPP. Under the long-run PPP regime, deviations from parity are possible but short-lived. Over time, the relative price and the exchange rate adjust to restore the parity condition and the corresponding real exchange converges to its equilibrium value. Thus an operational interpretation of long-run PPP is that real exchange rates are mean-reverting, and the test for the validity of PPP can be translated to a test for mean-reverting behavior of real exchange rates.

The mean-reverting behavior of real exchange rates and, hence the PPP condition, is commonly assessed using unit root test procedures. Indeed, the evolution of these empirical studies closely tracks the development of unit root test procedures. In the 1980s, the introduction of the Dickey-Fuller test revolutionized the assessment of economic data persistence in general and real exchange rate persistence in particular. Since then, a flurry of studies have used various versions of unit root tests, including the original augment Dickey-Fuller (ADF) tests, improved versions of ADF tests, Bayesian unit root tests, the fractional integration test, panel data unit root tests, and procedures allowing for alternative adjustment mechanisms to evaluate real exchange rate persistence.

Traditionally, real exchange rate persistence is evaluated in a linear time-series framework. If the real exchange rate follows a nonlinear path, then the use of a linear model can overstate its degree of persistence. A few nonlinear models, including models with structural breaks, fractional integration models, Markov switching models, and threshold autoregressive models, have been applied to real exchange rate data. In general, allowance for nonlinear dynamics enhances the ability to reveal the reversion to the PPP and lowers the empirical estimate of real exchange rate persistence (Michael, Nobay, and Peel 1997).

On balance, the empirical evidence suggests that PPP tends to hold in the long run but not in the short run. Complementing academic empirical findings, foreign exchange dealers, who jointly determine exchange rates in the global market, also indicate that PPP provides a good gauge of exchange rate movements only in the long run (Cheung and Chinn 2001).

Of particular importance is the survivorship bias in PPP analysis (Froot and Rogoff 1995). This bias refers to the common practice of investigating long historical data from developed countries. The practice mainly reflects data availability rather than

research interest. One implication of the bias is that results from developed countries may overstate the empirical support for PPP. A related issue is whether developed and developing countries have similar real exchange rate behavior. Cheung and Lai (2000a) conduct a large-scale analysis and find substantial cross-country heterogeneity in the persistence of deviations from parity, and it is more likely, rather than less likely, to find parity reversion for developing countries than developed countries.

A perplexing and well-known empirical regularity is that real exchange rates display both a high level of persistence and an intense amount of short-term volatility (Rogoff 1996). If one attributes large short-term volatility to some dominating nominal shocks, then the observed persistence is too high to be explained by price stickiness. This phenomenon is labeled a "PPP puzzle." Several attempts have been made to explain the puzzle. One study shows that, when sampling uncertainty is taken into consideration, the estimated persistence parameter gives only a very imprecise measure of the true persistence (Cheung and Lai 2000b). Thus the observed persistence puzzle may not be a well-defined puzzle. Subsequent studies also point out that the estimated level of persistence can be reduced to a "nonpuzzling" level when, say, nonlinearity adjustment mechanisms are considered.

Economic Factors So far the discussion has mainly drawn from studies based on the time-series (à la intertemporal) properties of exchange rate and price data. What economic factors affect the behavior of the real exchange rate, which is a measure of PPP deviations?

The Balassa-Samuelson effect is perhaps the most discussed economic force shaping real exchange rate behavior. The hypothesis is related to the observation that, when measured in the same unit, price levels in high-income countries are higher than those in low-income countries. The price differential is due to the difference in productivities in the tradables and nontradables sectors. The Balassa-Samuelson effect is a supply-side factor. A demand-side factor is government spending. It is perceived that nontradables account for a large fraction of government spending. Thus government spending tends to have a positive impact on a country's real exchange rate.

Other economic factors that affect real exchange rates include net foreign asset position, distribution sector, and market structure. Since the turn of the 21st century, the net foreign asset position has been introduced to a real exchange rate equation via portfolio-balance channels (Lane and Milesi-Ferretti 2002). The role of net foreign asset position is related to the effect of current/trade account balances articulated in the 1980s and 1990s. The effect of net foreign asset position is verified in a number of empirical studies. It is noted, however, that the construction of data on national net foreign assets involves approximations and these data are all in U.S. dollars.

The prices faced by consumers are affected by distribution costs. The productivity and efficiency of the distribution sector will have an impact on the price structure and, thus, on real exchange rate behavior. Intuitively, the distribution activity occurs within a locale and is likely to be a "nontradable" service. In the Balassa-Samuelson effect parlance, improved distribution sector productivity should be associated with a depreciation of the real exchange rate. Nonetheless, the extant empirical evidence points in a different direction—a result that may be driven by tradable components in the distribution sector (MacDonald and Ricci 2005). One caveat is the paucity of data on productivities of distribution sectors.

The implication of market structure for the adjustment of relative prices to exchange rate movements was recognized in the 1980s. A model with, say, a markup pricing strategy that is a function of the degree of monopolistic power offers an easy illustration of the market structure effect on real exchange rate behavior. Indeed, the market structure has implications for both the persistence and volatility of real exchange rates. As always, the availability of proper data is a challenge for the empirical valuation of the market structure effect. Since the turn of the 21st century, some positive evidence of market

structure effects has been reported using sectoral data (Cheung, Chinn, and Fujii 2001).

Inter- and Intracountry Analysis Usually, both LOP and PPP are stated with the implicit assumption that prices in different countries are being compared. There is no reason, however, that the two parity conditions should not apply to prices of the same goods within a country. Indeed, the study of relative price behavior within a country avoids a few problems that plague the cross-country analysis.

For instance, the procedures for compiling price data and constructing indexes can differ across countries. Within a country, however, price data are likely to be collected and recorded in one unified system. Thus data compatibility should not be a significant issue in comparing the prices of same goods across cities and regions within a country.

There are a few other reasons why results based on intracountry data are easier to interpret than those from intercountry data. First, intracountry relative prices are subject to similar fiscal and monetary policies, whereas intercountry relative prices are subject to possibly different policies. Second, the trade barriers within a country are usually less severe than those across countries. Third, the intracountry relative prices are literally linked via an exchange rate that is credibly fixed at the one-to-one level and, thus, are free from uncertain exchange rate variability. Indeed, Engel and Rogers (1996) have shown that there is an enormous increase in relative price variability across national borders. These factors imply that intracountry relative prices of identical goods are more likely to meet the parity condition.

Given these considerations, it is perhaps not too surprising to find that intracountry data, compared with intercountry data, display a faster convergence rate and are more likely to satisfy the parity condition. The result is supported by studies using either individual goods prices or price indexes.

See also Balassa-Samuelson effect; equilibrium exchange rate; exchange rate forecasting; exchange rate volatility; interest parity conditions; nontraded goods; real exchange rate

FURTHER READING

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