Does Purchasing Power Parity Hold?

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This handout shows a good example of how to structure an empirical literature survey, in this case empirical evidence for purchasing power parity. There are vast amount of papers written on this topic, they are grouped according to the estimation methods they use.

1 Introduction

Purchasing Power Parity (PPP) is a simple proposition that essentially says that once differences in exchange rates are taken into account, the general price levels of a range of different countries must be equal. This is due to the observation that goods market arbitrage forces the price of a product in different countries to converge, and that this holds for the majority of consumer goods.

The empirical literature trying to test whether or not PPP actually holds in reality has evolved over time together with the econometric literature. As more sophisticated estimation techniques were developed, the testing methods of PPP has changed and developed over time. This brief survey summarises three stages of PPP empirics evolution. The first section discusses the early method of testing PPP, mainly using the OLS, disregarding the presence of a unit root in most economic time series. One it became well established that most economic time series contain a unit root and its implication of OLS estimation and inferences (see Granger and Newbold (1973) for example), the testing methods of PPP have changed accordingly. This is discussed in section 3. Econometrics literature took a major step once again with the discovery of cointegration as an empirical feature of an economy in a long-run steady state (See Granger (1983) and Engle and Granger (1987) for example). Section 4 discusses the empirical evidence on PPP using this new methodology.

2 Simple PPP as a Null

PPP was seldom thought of as holding at all points in time, but early formal empirical analysis were limited by the inability to distinguish between short and long run. Hence the regressions were of the form

\[ s_t = \alpha + \beta (p_t - p_t^*) + \epsilon_t \]  

where \( s_t \) is the nominal exchange rate, \( p_t \) log of domestic price level and \( p_t^* \) log of foreign price level. If PPP holds, the coefficient \( \beta \) must equal one. This method was most successful when applied to high inflation economies. For example Frankel (1986) found estimates of \( \beta \) close to one and based on these estimates concluded that PPP held. However, outside of hyperinflations, most tests using this method rejected PPP. Various adaptations on OLS estimation were tried, attempting to take account of the endogeneity of prices (instrumental variables etc) but over time and as the econometrics literature developed all of these stage one econometrics contained a fundamental flaw; the failure to take account of the possible nonstationarity of relative prices and exchange rates. Stage two addresses this problem.
3 Real Exchange Rates as a Random Walk

If the real exchange rate is a random walk then PPP does not hold, hence the null is for a unit root in the real exchange rate where the alternative hypothesis is PPP holds in the long run. The unit root tests impose $\beta$ at one and then test that the log of the real exchange rate, defined by

$$q_t = s_t + p_t - p_t^*$$

is stationary. A range of tests for unit roots are then discussed. The basic result in the empirical literature is that if one applies unit root tests to bilateral industrialised country monthly data, it is difficult to reject the null of a unit root for floating currencies e.g. see Meese and Rogoff (1988) or Mark (1990). For currency pairs that are fixed the evidence is more mixed.

The main problem with this type of test is its low power and therefore its inability to distinguish between slow mean reversion and a random walk real exchange rate, especially if one relies on post Bretton Woods data. Froot and Rogoff conjecture that the required sample length which would make the null rejectable at the 5% confidence interval is 864 months i.e. 74 years.

In response to this small sample criticism there have been two strands of literature. The first is to use a number of currency pairs simultaneously (i.e. cross section data) to extend the length of the data set. Despite this most studies e.g. Hakkio (1984) and Abuaf and Jorion(1990) still cannot reject a unit root. The second response extends the time horizon (not the frequency) over which PPP is tested, in some cases to over a hundred years. The presence of a unit root in real exchange rates can now be rejected , see Frankel (1986), Edison (1987) and Abuaf and Jorion (1990). All these studies use approximately 100 years of data and estimate a half life of between 3.3 years to 7.3 years for deviations from PPP. The criticisms of these results relate a perceived need to combine data from the low variance pre-Bretton Woods period with the highly volatile post-Bretton Woods to produce these results. Lothian and Taylor (1994) test an even longer period which include pre-Bretton Woods data (i.e. floating period of up to 100 years) and reject the random wall hypothesis. Hence long run PPP does not depend on the inclusion of the fixed exchange rate period.

4 Cointegration Analysis

Cointegration is designed for long run analysis, hence testing PPP in this framework follows very obviously. Endogeneity and left out variables are less of an issue in this framework, also the possibility of testing the restrictions implied by PPP or for a range of types of PPP exist (relative versus absolute, or where a constant could be include etc.). The cointegration tests have fallen into two categories; two stage Engle-Granger and Johansen one-step full information maximum likelihood estimator. A large number of studies have applied cointegration methods to testing PPP. These studies reveal several systematic features of the data:

1. rejections of the no cointegration null occur less frequently for currency pairs that are floating than currency pairs that are fixed
2. tests based on CPI price levels tend to reject less frequently than those base on WPI. One explanation for this finding is that consumer price indices have a higher nontradable component than wholesale prices.
3. for post Bretton Woods floating exchange rates, rejections of the no-cointegrating null occurs more frequently for trivariate systems (where $p$ and $p^*$ enter separately) than for bivariate systems (where they enter as $p - p^*$ ) or where the coefficients are constrained to be one. Weakening the
proportionality restrictions therefore makes the residuals appear more stationary. Hence at first glance cointegration appears to reject the unit root in real exchange rates. This is much more the case when Johansen rather than the two stage Engle-Granger approach is adopted. However the estimates of the coefficients on the price terms vary widely across studies and are often implausible. Cheung and Lai (1993a) for example find coefficients that range from 1.03 to 25.4 for CPI and .3 to 11.4 for WPI, with most of the coefficients coming above one. Rationalising these type of results is very difficult. A point worth noting is that cointegration test seem to yield much more reliable results when estimated over longer periods.

Generally it is not clear what we have learned from cointegration and doubts still linger regarding the small sample properties of these tests.

References


