Factors that influence the exchange rate: Purchasing Power Parity - does it hold?

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Kate Holohan analyses the shortcomings of the economic theory surrounding purchasing power parity. As she discovers through careful consideration of the Irish case, there can be considerable differences in price rates between countries, even when adjusted for inflation and expressed in a common currency. This has implications for the Irish government's policies aimed at deterring cross-border shopping, as it shows that the cuts in VAT rates which have been made in the most recent budget have been insufficiently aggressive to put an end to the practice.

Introduction

There are numerous factors which influence the exchange rate such as relative inflation rates, relative interest rates, relative economic growth rates and political and economic risk (Shapiro & Sarin, 2009). The factor this article will focus on is Purchasing Power Parity (PPP) because it is the foundation of most models of exchange rate determination (Abuaf & Jorion, 1990). Absolute PPP states that price levels should be equal worldwide when expressed in a common currency. This is an application of the law of one price, which states that if prices were not equal worldwide arbitrage opportunities would exist. If absolute PPP holds then the more general form of PPP, relative PPP (where the spot exchange rate starts in equilibrium, and any change in the relative inflation between the two countries will be offset, over the long run, by an equal but opposite change in the exchange rate), will also hold (Feenstra & Taylor, 2008).

Although PPP existed in literature for many years, the father of the phrase 'Purchasing Power Parity' and one of the strongest proponents of the intuition was Gustav Cassel (1918). Cassel's proposition was that long-run changes in the price level have much greater consequences for the nominal exchange rate than any change in the real conditions of international trade (Galliot, 1971).

The focus of this essay is relative PPP and its goal is to determine whether or not it holds in practice. First this article will pose the problem of PPP's failure to hold in the short run before looking at the tests and empirical evidence which are associated with the issue.

The short run

Frenkel (1981) provides the basis for criticism of PPP in the short run. In reality, there is a fundamental difference between nominal exchange rates and the price level in the short run. The exchange rate is expected to reflect future expectations immediately resulting in high volatility. The price level, on the other hand, is much less sensitive. The author argues that in periods dominated by 'news' that will impact professional expectations about future events, deviations of the real exchange rate from the mean will be common. Another factor to be considered is that the effects of real shocks require a change in the relative price level. Price changes do not occur in the short run and thus, deviations from PPP persist and accumulate (Adler & Lehmann, 1983). There are a number of reasons why price levels do not change in the short run including transaction costs, non-traded goods (i.e. services), imperfect competition and legal obstacles (i.e. brand names, copyrights and legal protection). However, the most widely cited cause for this phenomenon is price 'stickiness' (Feenstra & Taylor, 2008). If PPP does not hold in the short run and the real exchange rate deviates from unity, significant arbitrage opportunities will exist (Feenstra & Taylor, 2008).

Application
To observe PPP in action it is interesting to look at the deviations from PPP that exist between the Republic of Ireland and Northern Ireland. There is evidence of cross-border savings on a representative basket of alcohol and food products (which is not the consumer price index), as these are the most commonly purchased items amongst cross border shoppers according to the Central Statistics Office (CSO)[1]. This analysis assumes that the law of one price holds for all goods. The tables below (*Figure 1.* and *Figure 2.)* compare these items as priced by Tesco[2] in sterling as well as an example of the calculation of PPP (*Figure 3*):

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[1] http://www.finfacts.ie/irishfinancenews/article_1018614.shtml
[2] Price data from *www.tesco.com* for Northern Ireland and *www.tesco.ie* for the Republic of Ireland

Product	Rep. Price converted to £	North Price £
Smirnoff red label 1 litre	£27.02	£14.99
Gordon's Gin 1 litre	£26.08	£14.99
Baileys 1 litre	£23.52	£14.00
Malibu 1 litre	£25.08	£13.98
Finlandia vodka 1 litre	£29.59	£20.44
Carlsberg 10x440ml cans	£9.00	£7.00

Figure 1: Alcohol prices: North versus South

Product	Rep. Price converted to £	North Price £
Goodfellas ham and pineapple pizza	£3.15	£2.38
Tesco finest Banoffe tart	£3.42	£2.99
Tesco Sheppard's pie	£2.25	£1.70
Tesco chicken pie	£2.60	£1.90
Tesco lamb with gravy	£4.24	£4.00

Figure. 2 Grocery prices: North versus South
*Conversion rate as of 5/12/09:€1 = £ 0.901169

Price of vodka in the republic	Price of vodka in the north	Implied exchange rate by PPP	Actual exchange rate 6/12/09 £1 = €	Over valuation of the euro against the pound
Eur 29.99	£14.99	0.5	1.10353	60.4%

Figure. 3: Calculation of PPP for 1 litre of red label Smirnoff Vodka

The impact of the failure for PPP to hold on the Irish economy is huge. PPP implies that the purchasing power of one unit of currency in foreign currency terms is equal to the purchasing power of the foreign currency. This is clearly not the case for the euro versus the pound. An arbitrage opportunity is available as long as the savings made on a basket of goods exceeds transportation costs. The CSO estimates that €435 million was lost from the Republic of Ireland due to shopping trips to Northern Ireland in the year up to July 2009 and that 16 per cent of all households in the Republic made at least one shopping trip across the border[3]. Retailers in the Republic of Ireland argue that they can not compete with the 15 per cent VAT rate in the UK versus a 21 per cent rate in the Republic of Ireland, highlighting

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[3] http://www.finfacts.ie/irishfinancenews/article_1018614.shtml

transaction costs in the short run (Fottrell, 2009). David Forde of the Irish Business Association (IBA) argues that "just like other alcohol categories, most of the selling price… consists of excise duty and VAT. Taxation makes up over 43% of a price of a 50cl can (of beer) in the Republic"[4]. Alcohol is a big attraction and it was clear that the Minister for Finance, Mr Brian Lenihan, was taking this into account when he attempted to close the gap with the publication of the Budget 2009 and a reduction in excise duty of 12 cent per pint of beer, 14 cent per half glass of spirits and 60 cent per bottle of wine[5].

Early empirical papers on long-run PPP and tests on the random walk hypothesis

> "With the benefit of nearly 20 years of evidence it is obvious that short run PPP does not hold, the relevance of long run PPP is still a very open question"
>
> (Papell, 1997: 313)

Galliot (1971) a strong proponent of Cassel's (1918) theory, believed that the real exchange rate moves towards unity as average PPP deviations are zero in the long run. During the early 1970s support for PPP grew stronger as Frenkel (1976) attempted to revive the monetary view of exchange rate determination by supporting the ability of PPP to hold in the short run. By the late 1970s floating exchange rates were in full force and the real exchange rate became more volatile. The PPP literature 'collapsed' when Frenkel (1981) proposed that PPP worked better in the 1920s than the 1970s.

After the apparent 'collapse' of PPP, the model became ensnared by the naïve random walk hypothesis (Rapach & Wohar, 2002). During the early 1980s, papers began to emerge which doubted the stationarity of the real exchange rate and proposed that real exchange rate followed a random walk process. The random walk model rejects the two fundamental results found in literature on long-run PPP: first, that the real exchange rate swings above and below unity and second, that deviations from PPP average to zero over long periods of time (Adler & Lehmann, 1983). If the real exchange rate follows the random walk model then it is "a stochastic process in which successive increments are unpredictable" (Adler & Lehmann 1983: 1,472).

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[4] http://www.finfacts.ie/irishfinancenews/article_1018614.shtml
[5] http://www.belfasttelegraph.co.uk/news/politics/irish-budget-moves-unlikely-to-halt-shopper-exodus-14591811.html#ixzzG2njezNIF

Econometricians[6] examined deviations from PPP by testing if the real exchange rate has a unit root. If a unit root exists then the real exchange rate is non-stationary and must follow a random walk process. PPP needs the real exchange rate to remain stationary so that changes in exchange rates solely reflect changes in inflation (Feenstra & Taylor, 2008).

A similar school of thought fails to find cointegration between nominal exchange rates and relative price levels[7]. The cointegration framework was first established by Engle and Granger (1987) as a 1980s modern development of econometrics. If cointegration does not hold there is no relationship between the price level and the nominal exchange rate and both factors will follow a random walk. The papers test the null hypothesis of no cointegration amongst the exchange rate and relative prices. Both Patel (1990) and Taylor (1988) are unable to find support for cointegration and show there is little evidence to support any models of exchange rate determination that relies on PPP. Developments in the 1980s reduced confidence in the fundamental theory behind PPP (Taylor & Sarno, 1998). Even with the use of more advanced techniques, the null hypothesis of no cointegration could not be rejected.

Criticisms of random walk testing procedures

Many subsequent studies have strongly criticised the random walk literature. Abuaf and Jorion (1990), Lothian and Taylor (1996), Kim (1990) and Mishkin (1984) all contend that the failure of previous tests to reject the random walk model reflect the poor power of the methodology employed. Unit root testing has more recently been developed to employ augmented Dickey-Fuller techniques, which provide a more powerful and advanced means of testing (Taylor & Sarno, 2002). Testing the real exchange rate in the recent floating period may not render enough data to find evidence of a long-run equilibrium. Substantial short-run deviations from PPP can take three to five years to be reduced by half (Abauf & Jorion, 1990). The work carried out by Adler and Lehmann (1983), Roll (1979), and Rogalski and Vinso (1977) tested floating exchange rate data which spanned between four and ten years at the time of testing. Taylor and Sarno (2002) show that if the real exchange rate is slowly reverting to the mean, the probability of not being able to reject the null hypothesis of a unit root, given short span of data, is in excess of 92 per cent.

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[6] Roll (1979), Adler and Lehmann (1983) and Rogalski and Vinso (1977)
[7] Enders (1988), Patel (1990), Taylor (1988), Corbae and Ouliaris (1987) have all tested this theory.

Testing long spans of data
Tests of long spans of data show that because of the slow reversion of the real exchange rate, the data tested in the early 1980s will not show the reversion tendencies of the real exchange rate. Lothian and Taylor (1996) tested data spanning two centuries (1791-1990) and they concluded that the real exchange rate reverts to the mean slowly, with the forecasting superiority of PPP improving over time. Papers testing long spans of data use Dickey-Fuller statistics combined with Monte-Carlo simulations; these testing procedures would not have been available to the proponents of the random walk model (Taylor & Sarno, 2002). Abuaf and Jorion (1990) maintain that the conclusions of their tests are stronger then those of the random walk model due to the use of Dickey-Fuller statistics in a multivariate setting and of Monte-Carlo experiments over a 74 year period. The short time spans tested combined with the low power of the unit root tests goes some way towards explaining the failure of PPP in the early 1980s (Abuaf & Jorion, 1990).

Panel testing
Applying long spans of data heavily weights the pre-floatation data during the Bretton-Woods era (Lothian & Taylor, 1996). Frankel and Rose (1996) argue that the use of cross-sectional data through panel testing provides a more powerful result than long spans of data, as 100 years of data will encounter many changes in exchange rate regime.

Panel tests could therefore prove useful if we are solely interested in post-floatation data. Levin, Lin and Chu (2002) show how panel testing can improve the power of a unit root test by increasing the number of observations when long spans of data are not available. Oh (1996), Papell (1997) and Frankel and Rose (1996) all use panel testing procedures to test data from the floating rate period of 1973 to 1990. Favourable results for PPP are achieved. Although Papell (1997) provides overall support for PPP, the author finds stronger evidence against the unit root null hypothesis when larger rather than smaller panels, monthly rather than quarterly data are used and when the deutschmark is used as a base currency rather then the American dollar. This paper may point to some potential for variance in the results obtained.

The results obtained using panel testing must be interpreted carefully since the null hypothesis is testing for the joint non-stationarity of all of the real exchange rates (Taylor & Sarno, 1998). If just one of the real exchange rates is stationary, the random walk hypothesis will be rejected for all series (Taylor & Sarno, 1998). Taylor and Sarno (1998) illustrate this point through the use of Monte-Carlo simulations and conclude that panel test results can be ambiguous as rejection of the

null hypothesis will not show which series are stationary. Taylor and Sarno (1998) alleviate this problem by improving the test, so that the null hypothesis will only be rejected if all series are stationary. These researchers ultimately find evidence of mean reversion of the real exchange rate during the floating rate period. The use of more powerful tests cannot be underestimated when testing the random walk model.

The non-linear model
More recently another school of thought has developed, which reports that the real exchange rate adjusts to long-run equilibrium in a nonlinear pattern (Killian & Taylor, 2003). Killian and Taylor (2003) use the ESTAR model to link the nominal exchange rate nonlinearly to movements in relative price. This allows the real exchange rate to adjust nonlinearly and goes some way towards explaining the slow reversion of the real exchange rate to equilibrium. As Killian and Taylor (2003) found only very small shocks will result in slow speed adjustment, while large shocks will see the real rate adjust much faster. Indeed, close to equilibrium the real exchange rate is accurately approximated by a naïve random walk. The problem with the ESTAR model, as Killian and Taylor (2003) argue, is that nonlinear mean reversion cannot be detected unless there are large departures from equilibrium. These authors obtain similar evidence to the papers using long spans of data and conclude that the forecasting ability of PPP will increase at longer time horizons when there is a greater likelihood of large deviations from equilibrium.

Conclusion

It is clear from the applied example that PPP does not hold in the short run. In the long run, as people continue to shop across the border, these results may change as the arbitrage opportunities alleviate due to shoppers exploiting the over-valuation of the euro against the pound; restoring prices to parity. The Budget 2009 goes someway towards aiding the price gap but not nearly far enough.

This article has given an overview of some of the empirical evidence and testing techniques associated with the issue of PPP. It is clear from the above analysis that there is much disagreement as to the reliability of the random walk model. It is irrefutable that panel studies and long spans of data employ more powerful testing procedures then those used in the 1980s and therefore, obtain more reliable results. It seems the results proclaiming the rejection of the random walk model are the 'Holy Grail' that finance was searching for. "Professional confidence in PPP having been low for a number of years, may itself be mean reverting" (Taylor and Sarno, 1998:308). PPP cannot deny the glory of being a building block

of many models of exchange rate determination but PPP should be viewed as a long-run equilibrium model and not a model of exchange rate determination within itself. Despite these positive results, it would be wise to recall the words of the infamous monetarist John Maynard Keynes (1923):

> *"The long run is a misleading guide to current affairs. In the long run we are all dead. Economists set themselves too easy, too useless a task if in tempestuous seasons they can only tell us that when the storm is past the ocean is flat again."*

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