Testing purchasing power parity for Japan and the US: A structural-break approach

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In this work we empirically assess the weak and strong forms of purchasing power parity (PPP) hypothesis for the economies of Japan and US. Monthly data for the traded-goods price indices and the JPY/USD exchange rate are employed for the period from January 2000 to October 2012. This period includes large shocks, such as, the US subprime crisis and the 2011 Tsunami in Japan. We take into account possible, structural shifts and breaks by employing the class of Lee and Strazicich (2003, 2004) unit, root tests. Empirical analysis suggests that a break corresponding to the start of the US subprime crisis is not rejected. Furthermore, utilizing the Gregory and Hansen (1996) and, Hatemi (2008) cointegration methodologies, the weak form of PPP is not rejected. We, also test the strong PPP hypothesis by using Dynamic Ordinary Least Squares, (DOLS). The empirical evidence rejects the strong form of PPP for the period, preceding the US subprime crisis in contrast to the period after.

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1. Introduction

During the last two decades, considerable effort has been put into testing the validity of purchasing power parity (PPP) hypothesis. In principle, PPP is considered to be a long-term phenomenon, while various types of rigidities or constraints on the PPP relationship in the short run. The long-run relationship or weak form of PPP can be investigated using unit root and cointegration tests, as well as nonlinear methods. Studies focusing on the weak form of PPP include those of Chang et al. (2012), Wallace and Shelley (2006), Taylor and Taylor (2004) and Lothian and Taylor (2000, 2008) among others. Although there may be a tendency for exchange rates and price ratios to move in equilibrium over long periods of time, this relationship does not necessarily hold in the short-run. The seminal paper of Pedroni (2001) tests the short-run relationship or strong form of PPP using fully modified and dynamic OLS techniques for twenty countries and produces an overwhelming rejection of the strong PPP hypothesis.

Another important issue on which many previous studies focused is the validity of PPP after taking into consideration major economic, financial and currency shocks. For example, Zumaquero and Urea (2002) employed bivariate systems for European countries and located three different breaks corresponding to the oil shock, the beginning of the European Monetary System (EMS) and the general crisis of EMS in 1992. This evidence suggests that strong depreciations or appreciations of the exchange rate lead to international relative price adjustment. Papell (2000) models the appreciation/depreciation of the dollar in the 80s as shifts in the deterministic components of the series.

However, to our knowledge, so far no study has examined empirically the weak and strong PPP hypotheses among US and Japan taking into account both the US subprime crisis and the 2011 Tsunami in Japan. Studies that tested the PPP hypothesis between these two markets have produced mixed and contradictory results. Chang et al. (2010) apply a panel SURKSS to test the PPP hypothesis using monthly data for G7 countries over the period from January 1980 to September 2008. Wallace and Shelley (2006) employ the Fisher and Seater (1993) methodology and finally reject the weak PPP hypothesis for Japan and the US. Their dataset includes one hundred years of annual observations through 1996. Pedroni (2001) empirically investigates the PPP theory in twenty countries using cointegrated panels of post Breton Woods data. Applying the DOLS and the FMOLS methodology he rejects the strong PPP theory for the US and Japan. On the contrary, Chang et al. (2012) testing the long-run PPP via a nonlinear KSS test for G7 countries do not reject the strong PPP.
In the present work we focus on the last turmoil decade taking
into account shocks such as the US subprime crisis, Bank of Japan
currency interventions and Japan’s 2011 Tsunami. The economies
of US and Japan pair exert a significant impact on the rest of
the world. Together they account for over 30% of world domestic
product, while their bilateral economic relationship, via trade and
capital flows, can influence economic conditions in other countries
(see e.g. Dimitriou and Simos, 2013).

We empirically investigate the above issues, for the period
January 2000–October 2012 by employing the Lee and Strauzich
econometric techniques to endogenously identify the structural
breaks in unit roots and cointegration structure. The results
suggest that the weak PPP hypothesis is not rejected for the US and
the Japanese economies. We proceed our analysis by testing
the strong PPP hypothesis through dynamic OLS (DOLS), taking into
account the US subprime crisis which seems to be empirically
dominant.

The rest of the paper is organized as follows. Section 2 presents
an overview of the two markets. Section 3 describes the dataset
and the dynamic relationship between exchange rates and prices,
while Section 4 presents the econometric methodology. In Section 5,
we interpret the empirical results whereas Section 6 concludes.

2. Overview of the two markets

An overview of some key macroeconomic characteristics is
displayed in Table 1. As is shown, the US – Japan bilateral trade
in goods and services has increased over time, is declined
significantly in 2009, however, because of the subprime crisis.
The pace of US – Japan trade picked up in 2010. US imports from
Japan consist mainly of technological parts and machinery.
However, US exports to Japan are much more diverse. A major
portion of these exports are computers and agricultural products,
such as wheat and meat. Moreover, as Table 2 indicates,
the services trade turnover is modest relatively to trade in goods
turnover. The US has realized surpluses in its bilateral trade
in services with Japan. Along with trade in goods and services, Foreign
Direct Investment (FDI) in manufacturing facilities, real estate etc.,
as well as portfolio investments (i.e., investments in government
securities, corporate stocks and bonds and bank deposits) between
residents of the US and Japan also define the strong economic
relationship for these economies (see Table 3). The value of
portfolio and direct investments between the US and Japan
exceeds the value of trade in goods and services. In addition,
investments, particularly FDI, signify a long-term financial
commitment on the part of the investor.

Because of the growth in the US federal budget deficit, Japan has
consistently been among the largest sources of FDI in the US. From
2000 to 2009, the Japanese FDI in the US has more than doubled.

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Source: US Department of Commerce, Bureau of the Census.

These macroeconomic key characteristics support the strong
bidirectional financial, trade and economic relationship and motivate
us to further investigate the PPP issue.

3. Data and the dynamic relationship between exchange rates
and prices

The following data are used in the analysis: traded-goods price
indexes (TPI) and Japanese yen to US dollar (JPY/USD) exchange rate.
We prefer a traded-goods price index to the commonly used
consumer price index (CPI), because the latter might have caused
distortions to our analysis, since it takes into account nontradables,
such as housing and local services. All indexes are obtained from
DataStream. Following the approach of Xu (2003), the traded-
goods price indexes are constructed as follows:

\[ P_t = \left( \frac{EX_t}{IM_t} + \frac{EX_t}{IMP_t} \right) EXP_t + \left( \frac{IM_t}{IM_t - EX_t} \right) IMP_t \]

where \( EX_t \) and \( IM_t \) are the level of exports and imports at time \( t \), and
\( EXP_t \) and \( IMP_t \) are the export and import prices at time \( t \). All data are
monthly and cover the current floating rate period from January
2000 to October 2012, a total of 154 observations. Following
Hakkio’s (1992) methodology, we obtain spot exchange rate deviations as the difference between the actual exchange rate and
an implied relative PPP equilibrium exchange rate. According to
relative PPP, the spot exchange rate between two countries’
currencies should be proportional to the ratio of price levels in the
two countries:

\[ S_t = \frac{P_{J}\_{Japan}^{t}}{P_{US}^{t}} \]

where \( P_{J}\_{Japan}^{t} \) is the price level in Japan at time \( t \), \( P_{US}^{t} \) is the price level
in the US at time \( t \), \( S_t \) is the JPY per USD exchange rate at time \( t \), and
\( \Phi \) is a constant that represents all forces that prevent absolute

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Source: US Department of Commerce, Bureau of the Census.
Note: FDI indices are cumulative.
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