Purchasing Power Parity and Country Characteristics: Evidence from Panel Data Tests

Anwar Al-Gasaymeh* and John Kasem**

The purpose of this paper is to move beyond the developed countries dichotomy to investigate the role of country characteristics on purchasing power parity. The distinction is to investigate whether trade, inflation and geographical (distance) contribute towards the validity of purchasing power parity. This requires a sample that includes developing countries because the former contain too little variation to address the question. The stationary attributes of real exchange rates are examined by using four types of panel unit root tests for a group of countries for the period 2004Q1-2014Q4. We conclude that purchasing power parity depends on the country’s characteristics with this perspective, it is appropriate to investigate purchasing power parity among countries with similar characteristics.

JEL Codes: F31, O57

1. Introduction

The theory of Purchasing Power Parity (PPP) expresses units of purchasing power in relation to the exchange rate between two currencies in two countries which are in equilibrium and when their purchasing power is the same in each of the countries. In other words, this means that the exchange rate between different countries should be equal to the ratio of the countries’ price levels of a fixed basket of goods and services. When a particular country’s domestic price level is increasing more rapidly than its major trading partner that tells us that a country is experiencing inflation and that country’s exchange rate must depreciate in order to return to a purchasing power parity equilibrium level (Alba and Papell 2007).

In fact, there are many reasons why we should not expect PPP to hold, even in the long term. One of the most well-known reasons is the "Balassa-Samuelson effect" which was established by Balassa and Samuelson (1964). This effect explains that if high-income countries have a relatively higher productivity advantage in the production of marketable goods, they will produce goods relatively cheaper. If the law of one price applies to the traded goods, so the nominal prices are equal internationally, then the relative price of non-tradable goods will be lower in countries with low income, which means that there are systematic deviations from PPP even in the long term. As evidenced by Neary (1988), the Balassa-Samuelson (1964) effect is only one source of potential long-term deviations from PPP. Another is the so-called "Dutch Disease", where a sudden increase in productivity in an export sector (due to rapid development of natural resources) causes a real exchange

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rate appreciation, leading to a loss of competitiveness for other not booming traded sectors. Other possible explanations include changes in the terms of trade (the external relative price of imports and exports), changes in the government's fiscal policy, and changes in the level of foreign indebtedness of a country. What could cause much stronger evidence of PPP for some regions than in others? Distance appears to be an important factor. One classification studied is by geographic location or specifically, by continent. The concept of PPP is based on arbitrage of prices of goods across countries. PPP may not hold among countries that are geographically far apart because high transportation costs associated with greater distance, which could hinder trade and arbitrage. Distance appears to be an important factor. One classification studied is by geographic location or specifically, by continent.

Inflation experience is one of the countries’ characteristics to be considered. The long-run PPP relationship can be viewed as an equilibrium condition of money neutrality in an international setting. If price movements are dominated by monetary shocks, there is a strong reason to expect parity reversion to prevail. PPP has been known to hold well for high-inflation countries (Frenkel, 1978; McNown and Wallace, 1989). It is thus instructive to see if there is any significant correlation between the cross-country differences in the persistence of PPP deviations and the differentials in inflation rates. If countries have different inflation rates and flexible exchange rates, arbitrage could increase the demand for foreign goods and foreign currency in the high-inflation country. The high inflation country’s exchange rate would then depreciate vis-à-vis the low-inflation country until PPP is restored. Last, a basic idea underlying the PPP theory is that goods market arbitrage can induce parity in prices for a sufficiently broad range of goods. Accordingly, PPP deviations are corrected over time through adjustments in trade flows. Trade barriers that hinder international arbitrage are likely to influence relative prices asymmetrically and make trade more expensive and consequently show less evidence of PPP (Cheung and Lai 2000). PPP is expected to hold between trading partners because of many reasons, such as “free trade movements”, “avoiding double taxation”, and high volume of trade”, “removing barriers and promotion of trade”. Normally special trade agreement between countries existed for trading partners. Removing trade barriers and tax exemption encourage trade. When the trade volume between countries is high, the transportation cost per unit is lower. Thus, the price differences will be smaller. It is expected that PPP will hold when there is high trade.

The puzzle in PPP is that the empirical evidence shows that international price differences for individual goods (in the case of the law of one price) or baskets of goods (in the case of PPP) appear highly persistent or even non-stationary and fluctuations in the real exchange rate are very volatile and very persistent. The objective of this paper is that it examines the somewhat under-researched issue of what determines the validity of PPP? Does trade contribute towards the validity of PPP? How does inflation influence the validity of PPP? Is geographical distance important? This paper tries to link these characteristics, namely, trading partners, high inflation countries and geographical regions with the validity of PPP. Therefore, it is appropriate to investigate PPP among countries with similar characteristics but it is not appropriate for studying PPP among a more diverse group of countries. However, no studies have been done on developing countries taking into account country characteristics. This paper will determine the effect of PPP on developing countries. Previous studies support the validity of PPP using unit root tests while the results of this study do not support the validity of PPP based on trade agreement and evidence of PPP is stronger for countries which have higher inflation. This paper contributes towards reducing the gap in the literature by providing new empirical evidence on the impact of PPP characteristics in developing countries.
2. Literature Review

The early studies on PPP in developed countries use univariate Augmented Dickey Fuller (ADF) tests with post-1973 flexible nominal exchange rate data and often do not find evidence of long run PPP. A common explanation why these studies mostly failed to find evidence of PPP is the lack of power of the unit root tests in testing small samples. To solve this problem, researchers use longer horizon or lag data for developed countries for about more than 200 years and generally show stronger rejections of the unit root hypothesis. Since longer horizon data will mix up the fixed and floating exchange rate periods, many researchers failed to determine whether PPP would hold over a century or more of a stable exchange rate regime. Moreover, previous studies did not take into account the validity of PPP on a group of country characteristics such as trade agreement, inflation and geographic region in developing countries.

The recent studies move beyond the developed/developing country dichotomy to investigate the role of individual country characteristics on PPP by using panel data. This requires a sample that includes both developed and developing countries because the former contain too little variation to address the question. There are a number of reasons why PPP might vary systematically with country characteristics. PPP may hold better for countries more open to trade because trade barriers hinder international arbitrage and among countries that are geographically closer because high transportation costs associated with greater distance could hinder trade and arbitrage. PPP may also hold better between countries with similar inflation rates because, with differences in inflation, countries can prevent their nominal exchange rates from adjusting to parity. The relation between PPP and nominal exchange rate volatility is more nuanced. For developed countries, PPP may hold better among countries with low nominal exchange rate volatility because rigidities may prevent prices from adjusting to parity.

According to the literature PPP works better for countries with high inflation and the best of all periods is at its hyper-inflation period. With the exception of this period, short-term studies have shown the acceptance of the assumption that the real exchange rates follow a random walk with no tendency to return to an equilibrium level. Most of the studies using long-term data have found evidence of the reversion towards PPP but in a very low rate: it takes between three and five years for half of the exemption to be lifted. This generates what Rogoff (1996) called the "PPP puzzle" in the post-Bretton Woods era. Rogoff (1996) states that during nominal floating exchange rates, real exchange rates have been extremely volatile in the short term and thus very slow to achieve equilibrium. |The short-term deviations from PPP can be explained by the high volatility of the nominal exchange rate, which is presumably due to the volatility of the underlying financial factors, combined with nominal price stickiness. However, such short-term stickiness is difficult to reconcile due to the very slow pace of deviation in PPP. Some recent studies suggest a number of explanations for this puzzle, including non-linear dynamics, which show that return to PPP is rapid for large businesses but much less for small businesses due to the heterogeneity between the goods in their rates of convergence.

Drine and Rault (2008) aimed to apply recently developed panel unit root and co-integration techniques proposed by Pedroni (1999, 2004) to examine the robustness of
the PPP concept. The sample contained 80 developed and developing countries divided into five groups of developing countries: Africa, Asia, Latin America, North Africa and Middle East countries and a group of 22 OECD developed countries. They decomposed the period of their study into two sub-periods, 1970-1989 and 1990-1997 and calculated the average level of inflation for each period. The countries for which the average inflation had considerably varied between the two sub-periods were excluded from the sample. Only the countries which have stability on their average inflation level between the two sub-periods were taken into account. They found that strong PPP is verified for OECD countries and weak PPP for MENA countries. However in Latin American and Central and Eastern European countries, PPP does not seem relevant in characterizing the long-run behaviour of the real exchange rate. Further investigations indicate that the nature of the exchange rate regime doesn’t condition the validity of PPP, which is more easily accepted in countries with high rather than low inflation. A recent study by Al-Gasaymeh and Kasem (2015) for strong and weak form of PPP between Jordan and its major trading partners for the period of 2000M1-2012M12. They found evidence for weak PPP but not for strong PPP, hence, the conditions of proportionality and symmetry restrictions may be one of the reasons that PPP not hold when being tested empirically.

Drine and Rault (2008) examine the effect of distance on purchasing power parity by using panel data for a sample of five groups of developing countries, Africa, Latin America, Asia, Middle East and North Africa, and Central and East European countries, and a group of developed countries 22 OECD countries. However they could not provide any evidence of PPP in Latin American and Central and Eastern European countries. PPP does not seem relevant in characterizing the long-run behaviour of the real exchange rate. Alba and Papell (2007) organize real exchange rates in panels according to geographical region because countries from the same region often have similar levels of development, therefore PPP may hold between countries located in the same region. For the period 1976-2002, the countries are from Africa and Latin America which include mostly less developed countries while the countries from Europe include developed countries to examine long-run purchasing power parity (PPP). The results are that they could reject the unit root hypothesis at the 5% or higher levels of significance for panels of countries labelled as nearest and nearer to the United States, but cannot reject the null hypothesis at the 10% level for the panels that are farther and farthest from the United States. This is in accord with the hypothesis that evidence of PPP is negatively correlated with distance. Finally, Cheng et al. (2008) use monthly, end of period nominal exchange rates and CPI data for grouping by geographical regions including 61 countries divided into Africa, America, Europe and Asia, obtained from IMFs. The data reflect the post-Bretton Wood era from 1976-2005. Applying Panel unit root test to examine nominal exchange rates and CPI, the model used to test the unit root hypothesis is the one with intercept and trend because the data used is monthly and the lag lengths are set to 12. Furthermore, the unit root hypothesis is not rejected at the conventional level of significance for nominal exchange rates or CPI. So, the result indicates the variables under investigation are integrated of order 1.

Many recent studies have examined the hypothesis of PPP in different countries, the most recent by Al-Zyoud (2015) examines the long run movement between Canadian dollar and US dollar exchange rates for the period 1995:01 to 2008:08 and employs the Engle-Granger cointegration test. The analysis suggests that absolute purchasing power parity does not hold, indicating no long run relationship between the observed exchange rate and PPP rate. The result shows that there is no cointegration between actual exchange rate and PPP rate, suggesting that there is no long run relationship between Canadian dollar and US dollar exchange rates. Kamrul et al (2014) found mixed results on the
validity of the Purchasing Power Parity relationship in South Asian countries employing Pesaran (2004, 2007) to identify the degree of cross-sectional dependence (CSD) and apply panel unit root test accommodating this dependence on the real exchange rate series of five South Asian countries. This result is in contrast to the previous studies in similar countries, which did not accommodate CSD in their estimation. This finding implies that real shocks do not have any permanent effect on the real exchange rate and other things remaining the same, no active policy intervention is warranted for the sustainability of external balance. Ariful and Rajabrata (2014) confirm the mixed test results for the stationarity of South Asian real exchange rates, employing unit root test by allowing both single and multiple endogenous structural breaks for Bangladesh, India, Pakistan and Sri Lanka for the period of 1957 to 2011. Overall empirical evidence indicates that long-run purchasing power parity does not hold for major South Asian countries. Jayaraman and Chee-Koeng (2014) investigate whether the purchasing parity power theory holds with regard to five countries under fixed exchange rate regimes for 14 Pacific island countries. The findings show that long-run PPP hypothesis holds for all five Pacific island countries. Guglielmo et al (2013) examine the Purchasing Power Parity hypothesis in a number of Sub-Saharan countries by testing the order of integration in the log of their real exchange rates vis-à-vis the US dollar. The test results led to the rejection of PPP in all cases.

Given the above discussion, this study provides a notable contribution by filling the gap for the validity of PPP based on trade agreement, inflation and geographical distance because no previous studies on developing countries exists.

3. The Methodology and Model

This paper will employ the model specification of most of the recent studies, to name a few, Cheung and Lai (2000), Alba and Park (2003), Alba and Papell (2007) in interpreting the PPP doctrine by testing the real exchange rates. This model specifies that the real exchange rates should be mean-reverting. That is, in response to any shock or disturbance, the real exchange rate must eventually return to its PPP-defined level. This is an important interpretation as it is empirically testable. The baseline test of this model involves testing for unit roots in real exchange rates. Rejection of the unit root hypothesis indicates mean reversion in real exchange rates. As argued by most of the studies, for instance, Alba and Papell (2007), the failure to reject unit root tests in real exchange rates could be due to the low power of univariate ADF tests in small size samples. Therefore, this study will use panel methods, which will allow for variation across countries as well as across time to be observed for a group of countries.

3.1 PPP and Real Exchange Rates

A strong version of the PPP theory has as its foundation the law of one price. Abstracting from complicating factors such as transportation costs, taxes, and tariffs, the law of one price states that any good that is traded on world markets will sell for the same price in every country engaged in trade, when prices are expressed in a common currency (Michael and Patricia 2003). To illustrate the law of one price, let $p_i$ and $p_i^*$ be the domestic and foreign currency prices of commodity (a good or service) and $e$ the exchange rate (expressed as the price of foreign exchange). Thus, the law of one price implies that:

$$P_i = e P_i^*$$  (1)
Using the intuition built by the law of one price for a good or service, one can apply the principle across an aggregate of products and prices. Or put another way, one can imagine a common basket of goods that can be traded and prices compared across two countries, this is also known as the consumer price index (Nhat 2005). By using price indices, one can rewrite equation (1) to make a relative comparison of overall price levels between domestic and foreign countries, $p$ and $p^*$:

$$p = e \, p^* \text{ or } e = p/p^*$$  \hspace{1cm} (2)

As a theory of exchange rate determination, PPP, given by equation (3), predicts that the exchange rate will adjust to equalize price levels. Note that this absolute PPP assumes that the real exchange rate, the nominal exchange rate adjusted for differences in national price levels, is constant:

$$\frac{e \, p^*}{p} = 1$$  \hspace{1cm} (3)

Let $q$ be the real exchange rate, then equation (3) can be rewritten as:

$$q = \frac{e \, p^*}{p} = 1$$  \hspace{1cm} (4)

PPP suggest that the real exchange rate series should be stationary. If the real exchange rate is stationary, this suggests that any percentage changes in the price level between two countries would be offset by an equal depreciation/appreciation of the nominal exchange rate. The empirically testable form for real exchange rates involves testing for unit roots in real exchange rates. Rejection of the unit root hypothesis indicates real exchange rates are stationary. If there is a unit root in the real exchange rate this implies that shocks to the real exchange rate are permanent and PPP does not exist between two countries (Kalyoncu and Kalyoncu, 2008). In logarithmic form, the real exchange rate, $q$ can be calculated as:

$$\log(q) = \log(e) + \log(p^*) - \log(p)$$  \hspace{1cm} (5)

That is, the real exchange rate is the nominal exchange rate weighted rate by the relative price levels. Thus, if inflation is higher in the home country, the nominal exchange rate will have to rise just to stabilize the real exchange rate. Notice that a fall in $q$ is a real exchange rate appreciation which reduces international competitiveness, while a rise in $q$ increases competitiveness.

### 3.2 Model Specification

As mentioned earlier the empirically testable form for real exchange rates is testing for the unit roots in real exchange rates. Therefore, this study will employ various panel unit root tests to test the unit roots in real exchange rates. As discussed in the literature review, this study is not the first to investigate the purchasing power parity using panel unit root tests. The work of Azali et al. (2001), Holmes (2002), Alba and Park (2003), Baharumshah et al., (2006), Alba and Papell (2007) and more recently Aslan and Korap (2009) are just few examples of the application of the panel unit root method to the real exchange rates. The panel tests are conducted by running regressions on the following equation:
\[ \Delta q_t = \mu_j + \alpha q_{j,t-1} + \sum_{i=1}^{k} C_{ji} \Delta q_{j,t-1} + \varepsilon_{jt} \]  

(6)

Where \( \Delta q_t \) is the first difference of the real exchange rate and \( k \) is the number of lagged first differences, where \( \mu_j \) represents heterogeneous intercept and the subscript \( j \) is the country index. The lag length \( k \) and the coefficient \( C_{ji} \) are heterogeneous across countries. This unit root test is performed on the level of variables. At first, the model without trend is adopted in the empirical analysis because an inclusion of linear time trend would be theoretically inconsistent with the long run PPP proposition and as suggested by most empirical studies, the time trend in real exchange rate is not consistent with the PPP hypothesis (Zhang and Lowinger, 2006 and Acaravci and Acaravci, 2007). In addition, Alba and Papell (2007), Alba and Park (2003), Holmes (2002), Culver and Papell (1999), Papell (2002) and Al-Rabbieae and Hunt (2004) tested the validity of PPP using panel unit root for the real exchange rate excluding a time trend from the test.

The simple Dickey-Fuller (1984) unit root test described above is valid only if the series is an AR (1) process. If the series is correlated at higher order lags, the assumption of white noise disturbances \( \varepsilon_t \) is violated. The Augmented Dickey-Fuller (ADF) test constructs a parametric correction for higher-order correlation by assuming that the \( y \) series follows an AR (\( P \)) process and adding lagged difference terms of the dependent variable \( y \) to the right-hand side of the test regression:

\[ \Delta y_i = \alpha y_{i,t-1} + \gamma_i + \beta_1 \Delta y_{i,t-1} + \beta_2 \Delta y_{i,t-2} + \ldots + \beta_{p-1} \Delta y_{i,t-p} + \varepsilon_i \]  

(7)

This augmented specification is then used to test \( H_0: \alpha = 0; \ H_1: \alpha < 0 \) using the t-ratio \( t_{\alpha} = \widehat{\alpha}/(se(\alpha)) \), under the null hypothesis, there is a unit root, while under the alternative, there is no unit root. An important result obtained by Fuller is that the asymptotic distribution of the t-ratio is independent of the number of lagged first differences included in the ADF regression. Moreover, while the assumption that \( y \) follows an autoregressive (AR) process may seem restrictive, Said and Dickey (1984) demonstrate that the ADF test is asymptotically valid in the presence of a moving average (MA) component, provided that sufficient lagged difference terms are included in the test regression.

To specify the number of lagged difference terms (which will referred to as the “lag length”) to be added to the test regression (0 yields the standard DF test; integers greater than 0 correspond to ADF tests). The usual (though not particularly useful) advice is to include a number of lags sufficient to remove serial correlation in the residuals. EViews reports the critical values at the 1%, 5% and 10% levels. Statistic \( t_{\alpha} \) value is greater than the critical values so that one does not reject the null hypothesis at conventional test sizes.

This paper used three characteristics, namely, trading partners, distance and high inflation. In the first category, trading partners in two groups were based on trading agreements. The second group was based on the top 55 high inflation countries in the world. For the last characteristic, 13 countries for each group from the same geographic regions of Middle East and Latin America were examined. In each characteristic, different numbers of countries had been employed based on data availability. In addition, the aim
of this study is to investigate each category separately without comparison with each other. Some of the countries had appeared more than once in different categories. Therefore, in total the data of 85 countries was collected and used in this study. We employed quarterly data from 2004Q1-2014:Q4. The use of quarterly data is dictated by data availability across this large sample. The data is obtained from IMF's International Financial Statistics, which uses the nominal exchange rate (domestic per US dollar) and consumer price for all the countries. The US dollar was used as the base currency because most of the countries used in this study are using US dollar in their trades. Accordingly, this nominal exchange rate and CPI were used to construct the real exchange rate ($q$).

4. The Findings

The concept of PPP suggests that the real exchange rate should be constant. However, the empirical studies showed that the fluctuations in the real exchange rate appear highly persistent or even non-stationary. An important and yet somewhat under-researched issue is what determines the validity of PPP, therefore this study examines this issue by organizing countries according to their characteristics in panels of equal size. This chapter evaluates the significance of survivorship bias in PPP analysis by conducting an extensive time-series analysis of the persistence in dollar based real exchange rates using 4 types of panel unit root tests as well for a group of countries classified into three groups. The first group of countries is trading partners based on agreements; the second group is the top 55 inflation countries in the world and the last group shows 13 countries from the same geographic region.

4.1 Trading Partners Based on Trade Agreements

PPP is expected to hold among trading partners for many reasons such as, free trade movements, avoiding double taxation, high volume of trade, removing barriers and promotion of trade. Normally special trade agreement between countries exists for trading partners to remove trade barriers and tax exemption and to encourage trade. When the trade volume between countries is high, the transportation cost per unit is lower and the price differences will be smaller. It is expected that the PPP will hold when there is high trade. In this study we used 4 types of panel unit root tests that had been employed; Levin, Lin and Chu's (2002), Im, Pesaran and Shin (1997) W-stat, ADF-Fisher, ADF-Fisher Chi-square and PP-Fisher Chi-square. The results will be shown in the tables for each group in the three characteristics separately as below

**Table: 1. Panel Unit Root Results of Greater Arab Free Trade Area (GAFTA)**

<table>
<thead>
<tr>
<th>Method</th>
<th>Statistics</th>
<th>Probability</th>
<th>Cross sections</th>
<th>Number of observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Null: Unit root (assumes common unit root process)</td>
<td>-2.363</td>
<td>0.009</td>
<td>12</td>
<td>459</td>
</tr>
<tr>
<td>Levin, Lin &amp; Chu *</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Null: Unit root (assumes individual unit root process)</td>
<td>-0.315</td>
<td>0.376</td>
<td>12</td>
<td>459</td>
</tr>
<tr>
<td>Im, Pesaran and Shin W-stat</td>
<td>23.70</td>
<td>0.478</td>
<td>12</td>
<td>459</td>
</tr>
<tr>
<td>ADF - Fisher Chi-square</td>
<td>17.655</td>
<td>0.819</td>
<td>12</td>
<td>486</td>
</tr>
</tbody>
</table>

The lag length was chosen by Akaike Information Criteria (AIC) auto selection. Lags based on AIC: 6

Note: The null hypothesis for all the tests is unit root
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From the results obtained by using Levin, Lin and Chu’s (LLC) test, we can reject the unit root hypothesis at the 1% level of significance, which means the real exchange rate is stationary at this level. Thus, the result of LLC test does support the evidence of PPP. The results obtained from the Im, Pesaran and Shin (2003) W-stat, ADF-Fisher Chi-square and PP-Fisher Chi-square unit root tests; show that we cannot reject the unit root which means that the real exchange rate is non stationary at this level. Thus, the results of the tests indicate that we cannot support the validity of PPP for this group of countries. The results for trading partners for the first group largely do not support the validity of PPP. This result indicates on the one hand that the price convergence process between developing countries is not yet completed, and on the other, that a certain hindrance exists which prevents a full nominal exchange rate adaptation to price variations.

Table: 2. Panel Unit Root Results of Latin American Integration Association (ALADI)

<table>
<thead>
<tr>
<th>Method</th>
<th>Statistics</th>
<th>Probability</th>
<th>Cross sections</th>
<th>Number of Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Null: Unit root (assumes common unit root process) Levin, Lin &amp; Chu t*</td>
<td>-3.591</td>
<td>0.002</td>
<td>12</td>
<td>484</td>
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<tr>
<td>Null: Unit root (assumes individual unit root process) Im, Pesaran and Shin W-stat</td>
<td>-1.847</td>
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<td>12</td>
<td>484</td>
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<td>ADF - Fisher Chi-square</td>
<td>33.356</td>
<td>0.096</td>
<td>12</td>
<td>484</td>
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<tr>
<td>PP - Fisher Chi-square</td>
<td>19.600</td>
<td>0.719</td>
<td>12</td>
<td>507</td>
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</table>

The lag length was chosen by Akaike Information Criteria (AIC) auto selection. Lags based on AIC: 7
Note: The null hypothesis for all the tests is unit root.

Table 2 above shows the results obtained from Levin, Lin and Chu (LLC). We can reject the unit root hypothesis at 1% level of significance. The test of Im, Pesaran shows that we can reject the unit root hypothesis at 5% level of significance. The result of the ADF test shows that we can reject the unit root hypothesis at 10% level of significance, which means that the real exchange rate is mean reverting or stationary at this level. Different results for PP-Fisher failed to reject the unit root hypothesis. We therefore conclude that the results support the validity of PPP for Latin American countries. It can be seen that, the LLC test can reject the unit root hypothesis at 5% level of significance. But the other three tests (Im, Parasan, ADF Fisher and PP-Fisher) of unit root fail to reject the unit root hypothesis. Thus, the results of the tests indicate that we cannot support the validity of PPP for this group of countries.

The PPP would be more easily accepted for developed countries than for developing ones especially for the post 1973 period when the Bretton Woods System ended. Moreover, some works reveal that some econometric results can be explained by the exchange rate regime instability. Rogoff (1996) noticed that the problem of the exchange rate regime instability related to the use of long time series strongly conditioned the econometric results. Besides, Mussa (1986) indicated that the real exchange rate volatility depended on the exchange rate regime adopted. Balassa and Samuelson (1964) predict that relative PPP would not hold for high growth and low-growth countries. If growth of per capita real GDP reflects growth in productivity of a country, then the higher productivity in the tradable sectors of a high-growth country increases the wages in both the tradable sectors and the non-tradable sectors. As higher wages in the non-tradable sectors are unaccompanied by higher productivity, employers must raise prices of non-traded goods. This increases domestic prices, causing higher inflation in the high-growth country. Taylor and McMahon
(1988) evoked transaction costs as a possible source of nuisance. While Patel (1990) noticed that differences in the construction of price indices between countries could also lead to the empirical rejection of strong PPP.

4.2 Top Inflation Countries

Inflation experience is one of the countries’ characteristics to be considered. The basic idea is that PPP tends to be more easily accepted in countries with high inflation than in countries with low or medium ones. According to the literature, PPP may also hold better between countries with similar inflation rates because, with differences in inflation, countries can prevent their nominal exchange rate from adjusting to parity. Therefore, PPP works in a better way for countries with high inflation, and the best of all periods is during hyper-inflation. The long run PPP relationship can be viewed as an equilibrium condition of money neutrality in an international setting. If price movements are dominated by monetary shocks, there is a strong reason to expect parity reversion to prevail. PPP has been known to hold well for high-inflation countries (Cheung and Lai, 2000; Holmes, 2002; Frenkel, 1978; McNown and Wallace, 1989).

Table: 3. Panel Unit Root Results of Top 55 Inflation Countries

<table>
<thead>
<tr>
<th>Method</th>
<th>Statistics</th>
<th>Probability</th>
<th>Cross sections</th>
<th>Number of Observation</th>
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<td>0.000</td>
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<td>2129</td>
</tr>
<tr>
<td>Levin, Lin &amp; Chu t*</td>
<td>-30.206</td>
<td>0.000</td>
<td>55</td>
<td>2129</td>
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<tr>
<td>Null: Unit root (assumes individual unit root process)</td>
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<td>2129</td>
</tr>
<tr>
<td>Im, Pesaran and Shin W-stat</td>
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<td>0.000</td>
<td>55</td>
<td>2129</td>
</tr>
<tr>
<td>ADF - Fisher Chi-square</td>
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<td>0.000</td>
<td>55</td>
<td>2129</td>
</tr>
<tr>
<td>PP - Fisher Chi-square</td>
<td>622.204</td>
<td>0.000</td>
<td>55</td>
<td>2271</td>
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</tbody>
</table>

Table 3 above shows the results obtained from all tests; Levin, Lin and Chu (LLC), Im, Pesaran and Shin W-stat, ADF-Fisher Chi-square and PP-Fisher Chi-square of unit root tests for a sample of 55 countries of the second group of top inflation countries. It can be seen that we can reject the unit root hypothesis at 1% level of significance for the sample of countries with inflation, which means that the real exchange rate is mean reverting or stationary at this level. Hence, there is evidence of PPP between these groups of countries. We therefore conclude that the results support the validity of PPP in high inflation countries.

These results are compatible with Drine and Rault (2008), who found that strong PPP is more often accepted in countries with high inflation compared to low inflation countries. This is also in accordance with Holmes’s (2002) findings on a sample of African countries which show that strong PPP is more easily accepted in countries with high inflation compared to countries with low inflation. In addition, McNown and Wallace (1989), Liu (1992), Mahdavi and Zhou (1994) and Alba and Park (2003) qualify that PPP is most likely to hold in the case of high inflation countries. Indeed, in high inflation countries nominal shocks account for the most part of the real exchange rate fluctuations, and consequently PPP deviations can only be temporary. Furthermore, an inflationary environment favours spatial and temporal arbitrage which increases the convergence of prices between
countries. Some studies show that PPP is more likely to hold in open countries with low inflation. Indeed, countries with high inflation generally suffer from exchange rate instability and constitute a priori good example of PPP refutation. On the other hand, other works confirm, that given the predominance of nominal shocks in economies with high inflation, PPP deviations tend to respond faster than in economies with low inflation. In addition, Froot and Rogoff (1995) stressed that nothing guarantees that weak PPP holds in low inflation countries because real shocks can modify the prices of relative goods. One more possible explanation for this finding is that, although high inflation may encourage more rapid price adjustment, these price adjustment are still not sufficient to move the economy back towards PPP (Holmes, 2002).

4.3 Geographic Regions (Distance)

One of the advantages of a large-scale, cross country study is that potentially interesting sample information can be revealed by classifying the statistical results systematically into groups according to specific criteria. One classification studied is by geographic location. This paper organizes real exchange rates according to geographical region because countries from the same region often have similar levels of development. Also, some of the studies argued that distance does matter in order for PPP to hold. PPP may not hold among countries that are geographically far apart because high transportation costs associated with greater distance could hinder trade and arbitrage. Transaction costs (distance) and many other factors can lead to a non-unitary relationship. These empirical elements in favour of strong PPP in developed countries can be explained by low transaction costs (distance), the absence of tariff barriers and the relative stability of the adopted trade policies.

Table: 4 Panel Unit Root Results of Geographic Regions in the Middle East Countries

<table>
<thead>
<tr>
<th>Method</th>
<th>Statistics</th>
<th>Probability</th>
<th>Cross sections</th>
<th>Number of Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Null: Unit root (assumes common unit root process)</td>
<td>-2.0180</td>
<td>0.021</td>
<td>13</td>
<td>504</td>
</tr>
<tr>
<td>Levin, Lin &amp; Chu t*</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Null: Unit root (assumes individual unit root process)</td>
<td>-0.063</td>
<td>0.474</td>
<td>13</td>
<td>504</td>
</tr>
<tr>
<td>Im, Pesaran and Shin W-stat</td>
<td>22.453</td>
<td>0.663</td>
<td>13</td>
<td>504</td>
</tr>
<tr>
<td>ADF - Fisher Chi-square</td>
<td>17.274</td>
<td>0.900</td>
<td>13</td>
<td>534</td>
</tr>
<tr>
<td>PP - Fisher Chi-square</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

The lag length was chosen by Akaike Information Criteria (AIC) auto selection. Lags based on AIC: 6
Note: The null hypothesis for all the tests is unit root.

Table 4 shows the results of 4 types of unit root tests that had been employed. From the result of the Levin, Lin and Chu’s (LLC) test, we can reject the unit root hypothesis at 5% level of significance which means that the real exchange rate is mean reverting or stationary at this level. Thus, the result of LLC test does support the evidence of PPP. The results of Im, Pesaran and Shin W-stat, ADF-Fisher Chi-square and PP-Fisher Chi-square unit root tests, show that we cannot reject the unit root which means the real exchange rate is non-stationary at this level. Hence, the results of the tests show that we cannot support the validity of PPP for countries that are in the same geographic regions.
Table 5 below shows the results obtained from all tests; Levin, Lin and Chu (LLC), Im, Pesaran and Shin W-stat, ADF-Fisher Chi-square and PP-Fisher Chi-square of unit root tests for a sample of 13 Latin America countries. It can be seen that we can reject the unit root hypothesis at 1% level of significance for the sample of countries, which means that the real exchange rate is mean reverting or stationary at level. Hence, there is evidence of PPP between these groups of countries. We therefore conclude that the results support the validity of PPP in Latin America based on distance.

Table 5. Panel Unit Root Results of Geographic Regions in the Latin American Countries

<table>
<thead>
<tr>
<th>Method</th>
<th>Statistics</th>
<th>Probability</th>
<th>Cross sections</th>
<th>Number of Observation</th>
</tr>
</thead>
<tbody>
<tr>
<td>Null: Unit root (assumes common unit root process)</td>
<td>Levin, Lin &amp; Chu t*</td>
<td>-2.910</td>
<td>0.001</td>
<td>13</td>
</tr>
<tr>
<td>Null: Unit root (assumes individual unit root process)</td>
<td>Im, Pesaran and Shin W-stat</td>
<td>-2.046</td>
<td>0.020</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>ADF - Fisher Chi-square</td>
<td>40.432</td>
<td>0.035</td>
<td>13</td>
</tr>
<tr>
<td></td>
<td>PP - Fisher Chi-square</td>
<td>67.779</td>
<td>0.000</td>
<td>13</td>
</tr>
</tbody>
</table>

The lag length was chosen by Akaike Information Criteria (AIC) auto selection, Lags based on AIC: 7

Note: The null hypothesis for all the tests is unit root.

These results of the Middle East are compatible with those of Drine and Rault (2008) and Holmes (2002) who fail to find evidence of PPP in developing and LDCs. These empirical elements in favour of strong PPP in developed countries can be explained by low transaction costs (distance), the absence of tariff barriers and the relative stability of the adopted trade policies. On the contrary, for developing countries, strong PPP is not verified. This result indicates on the one hand that the price convergence process between developing countries and their trading partners is not yet finished, and on the other, that certain sources of nuisance exist which prevents a full nominal exchange rate adaptation to price variations. Taylor and McMahon (1988) suggested transaction costs as a possible source of nuisance. On the basis of economic specificities we propose the following factors to justify these empirical results for developing countries (Crucini et al., 2005; Engel and Rogers, 1996, 2001). First, obstacles in international exchanges are likely to influence asymmetrically relative prices by disrupting the spatial arbitrage.

In fact, even though economic liberalization seems to be the general tendency in most developing countries, there still exits tariff and non-tariff barriers in some countries which limit free trade. Second, inflationary anticipations exercise an upward pressure on domestic prices with regard to foreign prices. In fact, most developing countries suffer from a price instability often explained by inadequate monetary and budgetary policies. Third, interventions on the exchange market can influence the value of the currency. Indeed, some countries have to intervene in the exchange market to reduce fluctuations of their exchange rates and to increase their export competitiveness (Sarno and Valente, 2006).

5. Summary and Conclusions

This study examined the stationarity of real exchange rate by using 4 types of unit root tests for a group of countries classified into three groups; the first group is based on trade agreements, the second group is the top 55 inflation countries in the world and the last
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group is the same geographically located countries. The purpose of this study is to move beyond the developed/developing country dichotomy to investigate the role of country characteristics on PPP. This paper employed quarterly data from 2004:Q1-2014:Q4. The data is obtained from IMF’s International Financial Statistics which consists of the nominal exchange rate and consumer price for all the countries.

The results do not support the validity of PPP for the first group based on trade agreement for the regions of the Greater Arab Free Trade Area (GAFTA), but evidence for Latin American countries shows that the result could support the validity of PPP based on trade agreements. The evidence of PPP is stronger for countries which have higher inflation. Geographic regions for Middle East countries failed to find evidence for the validity of PPP, but stronger evidence of stationarity in real exchange rate is found in Latin American countries because it is closer to the United State. In conclusion, this study finds mixed results for the validity of PPP. This study concludes that PPP depends on the country’s characteristics. With this perspective, it is appropriate to investigate PPP among countries with similar characteristics but it is not appropriate for studying PPP among a more diverse group of countries.

The implications of this paper for policy makers is the symmetry and proportionality condition on PPP (strong version of PPP), which has also been the object of considerable research. One implication of unit root tests is that the restrictive conditions of proportionality and symmetry restrictions are satisfied in PPP. That is, nominal exchange rates and aggregate price ratios move together in a one-to-one fashion in the long run. However, transportation costs, and differences in the composition of price indexes may each lead to violations of proportionality and symmetry in PPP, leading to the looser definition of so-called “weak” PPP (Taylor, 1988; Cheung and Lai, 1993); the weak version of the PPP hypothesis states that nominal exchange rates and aggregate price ratios may move together in equilibrium, but the relationship need not necessarily be one-to-one. Testing for weak PPP is typically facilitated by the technique of cointegration. The advantage of the cointegration test for PPP is that it relaxes the restriction of symmetry or proportionality imposed by unit root tests of real exchange rates. McCoskey and Kao (1998), Larsson et al. (2001), and Pedroni (2004) used panel co integration tests to support the weak PPP hypothesis for developed countries.

References

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