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The Existence of Long-Run PPP: A Comparison between Developed and Developing Countries

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Abstract

McNown & Wallace (1989) argued that PPP will tend to holds in less developed countries due to the domination of nominal factors in the economy. In this study we try to investigate the existence of long-run PPP in eight countries consisting four developed and developing countries. Here we show that there is a strong evidence that long-run PPP holds for Germany, United Kingdom, and Chile. Furthermore, the additional tests also show that symmetry and proportionality conditions seem to hold in the three economies. As for other five economies, long-run PPP seems to be absence. Although one step general Error Correction Model and Johansen-Juselius cointegration procedure generates conflicting result, the result of both technique do not show a tendency for PPP to hold in developing countries thus rejecting argument proposed by McNown and Wallace.

Keywords: Purchasing Power Parity; Cointegration Test; Developed Countries; Developing Countries

Abstrak

McNown & Wallace (1989) mengemukakan argumen bahwa PPP akan cenderung berlaku di negara-negara yang belum maju disebabkan adanya dominasi faktor nominal dalam perekonomian. Dalam penelitian ini kami mencoba untuk menyelidiki keberadaan dari long-run PPP di delapan negara yang terdiri dari empat negara maju dan berkembang. Hasil estimasi menunjukkan adanya bukti kuat bahwa long-run PPP berlaku pada Jerman, Inggris, dan Cile. Hasil, tes lanjutan juga menunjukkan bahwa kondisi simetri dan proporsionalitas nampak bertahan di tiga negara tersebut. Sedangkan untuk lima negara lainnya, long-run PPP tidak nampak keberadaannya. Meskipun hasil pada one step Error Correction Model (ECM) dan Johansen-Juselius cointegration procedure menghasilkan hasil yang bertentangan, namun hasil dari kedua metode tersebut konsisten tidak menunjukkan kecenderungan akan eksistensi PPP di negara berkembang.

Kata kunci: *Purchasing Power Parity; Tes Kointegrasi; Negara Berkembang; Negara Maju*

JEL classifications: F31; F4

1. Introduction

With more countries have adopted market-oriented economic policies and floating exchange rate system, especially after the collapse of the Bretton Woods regime, the interest in testing the existence of Purchasing Power Parity (PPP) has increased significantly for around four decades. One of the reason why testing PPP is crucial is because many open macroeconomic models using PPP condition as a long run equilibrium condition. Therefore the justification in applying those models will depend on the existence of the PPP itself.

Unfortunately many empirical research from previous studies have a conflicting result with most of them did not favour the PPP hypothesis. Due to this fact, McNown & Wallace (1989) came with an interesting argument. They argued that findings on empirical result that did not find supportive evidence in favour of PPP is because most of these studies were too focused on industrialized or advanced economies. They argue that in such advanced economies, real factor will tend to dominates nominal factor as causes of exchange rate

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changes. Therefore PPP will more likely tends to hold in a high-inflation or developing countries since nominal factor such as rapid monetary growth and high-inflation rates will dominates real factor.

There are two main purpose of this study. First is to investigate the existence of long run PPP in the eight different countries. The second purpose is to validate the argument proposed by McNown & Wallace (1989) whether there is a difference between developed and developing countries in term of the existence of long run PPP, especially whether there is a tendency for more supportive evidence in developing countries.

The rest of this paper will be organized as follows. Section 2 contains a review of the literature on PPP, followed by concise explanation of an economic theory of PPP in Section 3. Section 4 and 5 will provide a discussion about the data and econometric methodology that being used while Section 6 presents an analysis of the results. Finally Section 7 will provides some concluding remarks.

2. Literature Review

2.1. Economic Theory

Created by Cassel (1918)[1], PPP was promoted as a means for setting relative gold parities for countries exchange rates after World War I. This issue was crucial at that time since utilizing gold standard that had been use prior to the war was totally out of the question. Today while very few economist believe about the existence of PPP in a real word, "most instinctively believe in some variant of purchasing power parity as an anchor for long-run exchange rates' (Rogoff 1996).

Generally speaking, PPP is an economic theory which simply postulate that national price levels should be equal once they are converted into a common currency. The basic idea is if there is a difference in price between countries, one can perform arbitrage in order to gain profit from such activities.

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[1]See Sarno & Taylor (2002).

2.1.1. Variants of PPP

a. Absolute PPP

In the absolute version of PPP perfect arbitrage is assumed will ensure the price between countries to be equal once it is converted into single currency. This relationship can be expressed in the simple mathematical relationship as follows:

$$P_t = S_t P_t^* \qquad (1)$$

where S is nominal exchange rate (the price of 1 unit foreign currency in domestic currency), P is domestic price level and P^* is foreign price level. Therefore in this version, tariffs, transportation cost, and other non-tariff barriers are assumed to be absent.

b. Relative PPP

According to Rogoff (1996) there are at least two major problems with implementing absolute PPP in a reality. First, there is no consensus of constructing standardized basket of goods internationally. Although for some countries like Germany and U.S. the basket of goods are quite similar, but they still differ in some sense like in terms of the basket weight. Secondly, since the indices price data constructed with a concept of a base year (e.g. 2010 = 100), hence it does not give any indication of how much the absolute PPP deviate for a base year. Therefore one must either assume that absolute PPP held on average over some base periods, or only focus his/her attention to _relative_ PPP which can be described from following mathematical relationship:

$$\frac{\sum P_t}{\sum P_{t-i}} = \frac{E_t}{E_{t-i}} \frac{\sum P_t^*}{\sum P_{t-i}^*} \qquad (2)$$

Notice that in this relative version, it only requires the growth of the relative price between domestic and foreign to be equal with the growth of the nominal exchange rate. However while this version is more likely to be hold than the absolute PPP, interpreting the deviation of this relative PPP could be difficult and not so straight forward.

2.2. Empirical Studies

Numerous study has been done in order to investigating the existence of long run PPP. Earlier empirical literature until late 1970s was based on so-called "traditional" test of PPP which focused on testing the restriction of the coefficients. According to Sarno & Taylor (2003) the major problem in this early studies is the fact that those studies did not take into account the stationarity issues that may lead into spurious regression. This leads other researchers to conduct the test on PPP based on cointegration technique which allows to investigate long run relationship between non-stationary variables.

Snell (1996) found an evidence supporting long run PPP for ten advance economies in ten advance economies. Based on unit root test Snell was able to reject the non stationarity in the real exchange rates, encouraging the PPP hypothesis. On the other hand, Cooper (1994) found that the PPP hypothesis doesn't seem to hold for Australia, New Zealand, and Singapore. Based on the two step Engle-Granger cointegration procedure, the long run relationship between price level and nominal exchange rate seems to be rejected.

Using different method, Koedijk, Tims, & Dijk (2004) found supporting evidence to the hypothesis of PPP in advanced economies. Based on panel data studies and seemingly unrelated (SUR) estimator, their result suggest that there is a convergence process toward PPP within Euro area (with the exception of Switzerland) induced by the economic integration in Europe. Also based on panel data studies, similar findings also presented by Kalyoncu & Kalyoncu (2008). Investigating the existence of long run PPP in 25 OECD countries, where most of them are advanced economies, they were able to reject the non-stationarity of the series.

Çağlayan & Saçildı(2010) also succeed in providing evidence for the existence of long run PPP for 29 OECD countries which most of them are developed countries. By using KPSS test they was able to reject the existence of unit roots in all 29 countries. They argued that lack of power in conventional unit root test like ADF and PP test are the origin behind the failure of PPP in many previous studies.

As though following argument proposed by McNown & Wallace, the number of research on the existence of long run PPP has increased drastically in the past two decades. Salehizadeh & Taylor (1999) examined the long run relationship between price level and exchange rates of 27 developing countries. Employing Johansen-Juselius coinitegration procedure, they found strong evidence (14 countries) of the existence of long run PPP. In addition they also argued that when a priori restriction (symmetry and proportionality) are imposed on the cointegrating vector, it may lead into false rejection of the null hypothesis.

On the other hand there are also numerous study which generates result that seems conflicted with McNown & Wallace proposal. The results found by Baharumsah & Ariff (1997) suggest less support for long-run PPP hypothesis. By employing both two-step cointegrating testing while imposing symmetry, the result suggest that PPP holds for only Indonesia and Philippines. However when the symmetry assumption is relaxed, long run PPP is uniformly rejected for all five less developed economies.

Research conducted by Weliwita (1998) also reject the existence of long run PPP in six developing countries in Asia. By employing two step Engle and Granger cointegrating procedure and Johansen-Juselius approach, the cointegrating relationship between price levels and exchange rate are uniformly rejected. In addition, for every case, unit root test suggested that the real exchange rate followed a random walk process.

Study conducted by Holmes (2001) using sample of thirty less developed countries across continents also generated similar result. Using panel data unit root test advocated by Im, Pesaran & Shin, they were able to reject the joint non stationarity. However, the joint non stationarity could not be reject when the sample are divided into sub-group based on the level of inflationary experience (except for small African sub-group countries), suggesting that the previous rejection of the join non stationarity was only driven by a small number of African countries within the panel.

2.3. Potential Issues

As mention before, many empirical studies investigating about PPP generates conflicting conclusions. As a result, many researcher has tried to explain the absence of PPP. For example Krugman & Obtsfeld (2011) has tried to explain the departure from PPP

with four explanations, (i) The existence of barriers to a free trade, (ii) different preferences in consumption between countries, (iii) inclusion of nontraded goods in a price indices (iv) the stickiness of the price in term of the currency in which the goods is consumed.

According to Rogoff (1996) there is a general consensus that the speed of convergence to PPP is around 15 percent per year. With a low speed of mean reverting like this, Frankel (1985, 1990) argued that unit root tests have very low power in rejecting a false null hypothesis with a short span of data after the Bretton Woods Era. Started with this argument, he proposed that when the unit root problem cannot be rejected, it does not necessarily mean that the researcher must the null hypothesis of unit roots problem. Apart from that, this study use the most recent data span around 40 years of observation. With this longer span of data, the probability of the test to correctly reject the null hypothesis should have been increased.

3. Method

3.1. Data

To represent the developed countries in this study, 4 different countries were selected, which are Canada, United Kingdom (UK), Germany and Australia. As for the countries selection criteria, we chose countries from three different continents (America, Europe and Asia) to accommodate different characteristic of developed countries across continents. Notice that for the Europe we use two representatives (UK and Germany) due to the fact that Europe is the continent with the highest number of developed countries. Meanwhile, for the developing countries selection criteria, we chose the top three highest GDP of developing countries with Chile to represent Latin America since all the top three developing countries are from Asia.

Annual data on consumer price index were collected for the United States, Australia, Canada, Germany, UK, India, and Indonesia from 1974–2014 (post Bretton Woods era) while for China the data was collected from 1985–2014 (due to the availability of the data). As for exchange rate data, this study used spot exchange rate (the value of 1 unit local currency in USD) for Australia, Canada, Germany, UK, while in the case of China, Chile, Indonesia and India the spot exchange rate was defined as the value of 1 unit USD in each local currency. Therefore in the former case we treated US as home country while in the latter case we treated US as foreign country, nevertheless the essence is still the same. Annual data were used instead of higher frequency data since it is argued by Frankel (1985) that annual level data are the most suitable for testing the existence of long run PPP. All of the data were obtained from OECD which accessed through Federal Reserve Economic Data official website.

3.2. Econometrics Methodology

3.2.1. Unit Roots Test

According to Engle & Granger (1987) series of variables are cointegrated if every series in a group of k series is integrated to the same order d, and there is exist at least one combination of those series which is integrated to the order b, where $b < d$. In other words there are two conditions that must be satisfied for two or more variable to be cointegrated: (i) they must be integrated of the same order I(d), and (ii) there must be exist at least one linear combination of the series which is I(b) where $b < d$.

In our case if exchange rates and price levels are known to be $\sim$ I(1), then cointegration is said to be exist if there is one or more linear combination between them which is stationary i.e. $\sim$ I(0). Hence one should perform a unit root test for all of the potential cointegrating variables first before moving into estimating the cointegration relationship. In this paper we will employ Augmented Dickey-Fuller test in order to test for unit roots for all of the variables in level.

3.2.2. Long-Run PPP Test

In this paper we employ two cointegration procedures, which are generalized error correction model or one step general error correction model and Johansen-Juselius multivariate cointegration in order to investigate the existence of long run PPP in the group of developed and developing countries. We will also test the assumptions of symmetry and

proportionality implied by PPP theory (i.e. testing that the cointegration vector is (1, -1, 1)).

3.2.3. One Step General Error Correction Model (ECM)

One can easily manipulate equation (1) into:

$$S_t = \frac{P_t}{P_t^*} \tag{3}$$

where S is nominal exchange rate (the price of 1 unit foreign currency in domestic currency), P is domestic price level and P^* is foreign price level as before.

If all those three variables are integrated of the same order, one can test whether there is exist long run relationship between price and exchange rate by transforming all of the variables into logarithmic form and estimating the following equation

$$s_t = \beta_0 + \beta_1 \text{ratio}_t + \varepsilon_t \tag{4}$$

where s, is nominal exchange rate in logarithmic form, $\text{ratio} = p - p^*$ (p and p^* denote the logarithm of domestic price and foreign price respectively), β_0 and β_1 are the coefficients to be estimated and ε is disturbance term. If there is exist long run relationship between price and exchange rates, one would expect that ε in Equation (4) to be stationary. If it is not the case, then the nominal exchange rate and the relative price will tend to diverge permanently. In this paper, CRDW and CR-ADF test will be employ to test for $H_0 : \varepsilon_t$ I(1) against $H_1 : \varepsilon_t \sim$ I(0). Where rejection of H_0 is implying that there is exist cointegration and therefore we can investigate the long-run relationship further and also estimate the speed of adjustment by estimating the following equation:

$$
\begin{aligned}
A(L)\Delta s_t =& \delta + B(L)\Delta p_t + \alpha(s_{t-1} - \beta_0 - \beta_1 p_{t-1}) \\
& + v_t
\end{aligned}
\tag{5}
$$

where: $A(L)$ is lag polynomial $1 - \lambda_1 L - \lambda_1 L^2 - ... - \lambda_p L^p$, $B(L)$ is lag polynomial $1 + \gamma_1 L + \gamma_1 L^2 + ... + \gamma_q L^q$ with α represent the speed of adjustment process and β_1 represent the long run relationship between exchange rates and price levels between countries.

3.2.4. Johansen Juselius Multivariate Cointegration

Notice that estimation equation 4 implicitly restrict the coefficient of p & p* to be β_1 and $-\beta_1$ (i.e. imposing symmetry)[2]. However this a priori restriction argued that it could lead to a false rejection by several researcher like Ardeni & Lubian (1989) and Salehizadeh & Taylor (1999). Hence we will also test cointegration between prices and exchange rates using more general specification allowing the coefficient of p & p* to vary. However with no a priori restriction imposed, now we have trivariate model, thus there could be exist more than one cointegrating relationship. Fortunately Johansen & Juselius (1990) develop a technique based on maximum likelihood method which permits more than one cointegration relationship to be estimated thus allowing us to continue our analysis further. The procedure of Johansen Juselius likelihood ratio test is based on the regression equation as follow:

$$\Delta y_t = \pi + \sum_{i=2}^{k} \Pi_i \Delta y_{t-1+i} + \Gamma y_{t-1} + u_t \tag{6}$$

where all $\Delta y_t, \Delta y_{t-1+i}, \Delta y_{t-1}$ is in a form of $(n \times 1)$ vector of the variables that will be estimated (in our case they represent exchange rates, domestic and foreign price level), π is a vector of constant term, while Π and Γ are $(n \times n)$ matrix of OLS coefficients to be estimated and u is a vector of disturbance term.

3.2.5. Real Exchange Rates Unit Root Test

For final step we will conduct a test to investigate whether symmetry and proportionality conditions implied by PPP theory are exist. One can test the existence of those conditions by defining real exchange rate (rs) variable as follow:

$$rs_t = s_t - p_t + p_t^* + \varepsilon_t \tag{7}$$

where s, is nominal exchange rate in logarithmic form while p and p^* are the logarithm of domestic price and foreign price respectively. If PPP holds in the long run, one can expect that any deviations

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[2]See Frenkel (1980) and Edison (1985) for more comprehensive discussion about symmetry.

from $s_t - (p_t + p_t^*)$ are limited and will tend to revert to its equilibrium. Therefore one can test the existing of the existence of the Absolute PPP by testing the stationarity of the residual term in Equation (7). In this study we are employing ADF test to check the stationarity of the residual term in Equation (7). Notice that rejection of $H_0 : \varepsilon_t \sim I(1)$ implies that the cointegrating vector is (1, -1, 1), which is corresponds to β_1 in the Equation (4) is equal to unity.

4. Result and Analysis

As mention in the previous section, before we proceed to test whether cointegration exist between price levels and exchange rates, all of the variable have to be integrated with the same order. Employing ADF unit root test (with the number of lags, k vary from 3 to 5 between variables) it can be seen as summarized in table 1 that for all of the cases we cannot reject the null hypothesis that all of the series of prices and exchange rates have a unit roots (i.e. non-stationary in levels).

Knowing that all of our variables are not stationary in levels, now we moved to estimate the potential cointegrating equation explained by Equation (4) and test whether the residual are stationary by employing CRDW and CR-ADF test (stationary in the residual indicates existing cointegration relationship). The result of CR-ADF and CRDW test are reported in Table 2.

From Table 2, we cannot reject that the residual are non-stationary at 5% level for all cases both based on CRDW and CR-ADF test (thus implying that PPP doesn't hold) except for the cases of Germany United Kingdom and Chile. For this three cases, CRDW and CR-ADF showed a conflicting result where based on CR-ADF, we can reject the null hypothesis thus indicating there is exist some long run relationship between price levels and exchange rates of this two countries. We investigate this indication further with estimating the one step general error correction model given by Equation (5).

Table 3 shows the summary of the estimation given by Equation (5). For all three cases, lag of s_t (log exchange rate) and p_t (log of price ratio) are statistically significance at 5% level except for the case

of p_t which is significant at 10% level. These result support our previous finding from CR-ADF test that there is exist long run relationship between price level and exchange rates for these three economies.

Having confirmed that long run PPP hold in Germany, United Kingdom and Chile Economies, so far we did not find strong evidence that show there is a tendency for long-run PPP to holds in less developed economies. Now we are moving into test the existence of long-run PPP using Johansen-Juselius cointegration procedure to investigate futher.

Before we move into estimating Equation (6) by using Johansen-Juselius cointegration procedure, we have to determine the optimum lag length k in the equation. We set the k lag structure of the VAR based on the information criterion reported in Table 4. However for cases Australia Canada India and Indonesia, we add 1 additional lags so that we cannot reject null hypothesis that there is no serial correlation in the residual using Breusch-Godfrey serial correlation LM test (up to 4 lags). While in the other hand for United Kingdom case, we followed Akaike Information Criterion rather than suggestion from Hannan-Quinn and Schwarts information criterion due to the fact that with one lag, we still able to reject the null hypothesis of no serial correlation.

Overall based on trace and maximum eigenvalue statistic as reported in Table 5, in all of the cases the null hyphotesis of zero cointegrating vector ($p = 0$) can be rejected except for Australia, United Kingdom, and India which only supported by trace eigenvalue statistic, trace eigenvalue statistic and maximum eigenvalue statistic respectively. Obviously the results from this Johansen-Juselius cointegration test are quite conflicting with our previous finding with univariate cointegration method.

Our result summarized in Table 5 show that Johansen-Juselius procedure tend to accept the long run PPP hypothesis. This results support the evidence found by Huang & Yang (1996) that the Johansen and Juselius Cointegrating testing procedure tends to accept the hypothesis of the long run PPP compare to the univariate cointegration procedure through Monte Carlo simulation. They argued that this is due to the fact that the Johansen-Juselius approach has a bias toward supporting the hypothesis of long-run PPP especially when the assumption of normally and/or independently and identically distributed disturbance term is violated.

Table 1: Unit Root Test for Price Indices and Exchange Rates

	Exchange Rate (Against USD)		Price Level	
	ADF	5% Critical Value	ADF	5% Critical Value
United States			-2.200(5)	-2.972
Australia	-2.145(3)	-2.966	-2.514(3)	-2.966
Canada	-2.189(3)	-2.966	-2.863(4)	-2.969
Germany	-2.004(3)	-2.966	-2.526(3)	-2.966
United Kingdom	-2.858(2)	-2.964	-2.630(3)	-2.966
Chile	-2.424(3)	-2.966	-2.890(5)	-2.972
China	-1.992(3)	-2.966	-1.636(3)	-3.000
Indonesia	-1.518(3)	-2.966	-0.928(3)	-2.966
India	-1.255(3)	-2.966	-0.995(3)	-2.966

*Note: The null hypothesis is the series have unit roots problem. Figure in parenthesis are the number of lags included in the auxiliary regression. All of the variables used annual data from 1974 to 2014, except for the CPI of China (1985–2013) due to availability of the data

Table 2: Potential Cointegrating Regression Test[a]

Australia
s = -0.319 + 1.177ratio_p   CRDW= 0.4419   CR-ADF(2)= -1.936

Canada
s = -0.137 + 1.302ratio_p   CRDW= 0.4157   CR-ADF(2)= -2.426

Germany
s = 0.239 + 0.869ratio_p   CRDW= 0.5634   CR-ADF(4)= -3.895*

United Kingdom
s = 0.515 + 0.739ratio_p   CRDW= 0.997   CR-ADF(2)= -4.010*

China
s = 2.018 + 1.087ratio_p   CRDW= 0.433   CR-ADF(3)= -1.402

India
s = 4.136 + 1.412ratio_p   CRDW= 0.1857   CR-ADF(2)= -0.693

Indonesia
s = 9.506 + 1.449ratio_p   CRDW= 0.3302   CR-ADF(3)= -1.953

Chile
s = 6.319 + 1.031ratio_p   CRDW= 0.4387   CR-ADF(4)= -4.214*

*Note: The null hypothesis is the residual of the potential regression equation suffers from unit roots problem.
CRDW 5% critical value for n = 50 is 0.72.
[a] Figure in parenthesis are the number of lags included in the CR-ADF auxiliary regression.
The critical value for CR-ADF (China's critical values is different than others and denote in parenthesis as follow due to different of sample size) are -3.606 (-3.689), -2.937(-2.972), -2.607(-2.625) at significance level of 1%, 5%, and 10%.
All of the variables used annual data from 1974 to 2014, except for the case China (1985–2013) due to availability of the data.

Table 3: Summary of One Step General ECM Estimation for Germany, UK, and Chile

	Germany	UK	Chile
	Coeff.	Coeff..	coef
Δs_t	1	1	1
s_{t-1} (α)	-0.888***	-1.031***	-0.708***
p_{t-1} $(\alpha\beta_1)$	0.600**	0.805*	0.810***

Note: * : indicates significance at the 10% level
** : indicates significance at the 5% level
*** : indicates significance at the 1% level
Long run relationship between price level and exchange rate (β_1) could be obtained by dividing coefficient attached to p_{t-1} with s_{t-1} (see Equation (5) in previous section). Coefficient on the lag polynomial of the first difference variable are not reported since it doesn't really concern our interest.

Table 4: Summary of Lag Length Selection Information Criteria

	AIC	HQIC	SBIC
Australia	2	2	2
Canada	2	2	2
Germany	2	2	2
United Kingdom	2	1	1
China	2	2	2
India	2	2	2
Indonesia	3	3	2
Chile	4	4	4

Recall that in the case of one step general ECM, we only impose symmetry (between domestic and foreign prices) in the estimation. However, there is one additional properties implied by PPP (see Edison, Gagnon, & Melick 1997) which is proportionality (between price levels and exchange rates). Therefore in this final step, we will also test those two conditions by restricting the cointegration vector to be (1, -1, 1). Notice that testing with such restriction is equivalent with testing the stationarity of the Real Exchange rate (rs)[3]. The results of the unit root test for variable Real Exchange Rates (rs) in Equation (7) are reported in Table 6. Our results support our previous finding using the one step general ECM technique that long run PPP seems to hold for Germany, United Kingdom, and Chile, at 5% level. While for the rest of the country we cannot reject null hypothesis that real exchange rate series of the countries are suffer from unit root problem, hence rejecting the existence of PPP.

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[3]see Verbeek (2010) Chapter 9 for detail explanation about this

5. Conclusion

This study aim to test the existence of PPP in the long run and to investigate whether PPP tends to hold in developing countries rather than in developed countries as argued by McNown & Wallace (1989). Eight countries were chosen with an equal number for developed and developing countries. Employing both one step general ECM and Johansen-Juselius cointegration technique, we found 3 main findings, the first and the third findings are correspond to the first objective of this paper, while the second address the second objective of this paper.

The first result that correspond with our first objective is, we found a conflicting result between one step general ECM and Johansen-Juselius cointegration technique. While one step general ECM only suggest that PPP holds only in Germany, United Kingdom, and Chile, with Johansen-Juselius Cointegration test in all eight cases the null hypothesis of zero cointegrating vector $(\mathrm{p} = 0)$ can be rejected based on both trace and maximum eigenvalue statistic with the exception for Australia, United Kingdom and India which each of these countries only supported by one of the eigenvalue statistical test.

This conflicting result may be caused by a bias in the Johansen-Juselius approach in term of estimating the existence of PPP in the long run especially when the assumption of normally and/or independently and identically distributed disturbance term is not satisfied as argued by Huang & Yang (1996). Another possibility of the cause for this conflicting result is that a priori restriction (symmetry) could lead to a false rejection as argued by Ardeni & Lubian (1989) and Salehizadeh & Taylor (1999).

Second, both technique suggest that there is no significance difference regarding the existence of long run PPP between developed and developing countries. This findings do not support McNown & Wallace (1989) argument which saying that there is more support of PPP in the high-inflation economies due to the fact that nominal factors such as rapid monetary growth could dominate the real factors, while in the industrialized economies with such low inflation real factor is the one that dominates the nominal factors.

Lastly, additional test performed to the residual of real exchange rates support the result generated by

Table 5: Johansen-Juselius Cointegration Test Result

Variables	Trace			Max			No. Lags
	p=0	p⩽1	p⩽2	p=0	p⩽1	p⩽2	k
Australia	29.792*	8.870	1.437	20.922	7.433	1.437	3
Canada	31.724*	5.886	0.0897	25.838*	5.796	0.090	3
Germany	47.7481*	19.334*	3.138	28.414*	16.196*	3.138	2
UK	39.473*	18.793*	3.831*	20.680	14.962*	3.831*	2
China	32.232*	6.481	0.009	25.751*	6.472	0.009	2
India	26.658	5.285	1.278	21.373*	4.007	1.278	3
Indonesia	42.271*	15.374*	0.493	26.897*	14.881*	0.493	3
Chile	44.437*	17.048*	0.081	27.389*	16.967*	0.081	4

Note: * indicate significance at the 5% level
The critical values at 5% level for Trace Eigenvalue test are 29.68, 15.41, 3.76 for
p=0, p = 1, p = 2 respectively.
The critical values at 5% level for Maximum Eigenvalue test are 20.97, 14.07, 3.76
for p=0, p=1, p=2 respectively.

Table 6: Unit Root Test for Real Exchange Rates

	Real Exchange Rate (Against USD)	
	ADF	5% Critical Value
Australia	-2.295 (3)	-2.966
Canada	-2.412 (3)	-2.966
Germany	-3.024* (3)	-2.966
United Kingdom	-5.224* (3)	-2.966
Chile	-3.375* (3)	-2.966
China	-1.671 (3)	-3.000
Indonesia	-2.611 (3)	-2.966
India	-1.834 (3)	-2.966

Note: * Indicate significance at 5% level.
The null hypothesis is the series have unit roots problem.
Figure in parenthesis are the number of lags included in
the auxiliary regression.
All of the variables used annual data from 1974 to 2014,
except for CPI of China (1985–2013) due to availability
of the data.

one step general ECM cointegration test, implying that both properties implied by PPP (symmetry and proportionality) seem to hold in Germany, United Kingdom, and Chile. Therefore we conclude that long run PPP holds in these three economies.

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