Does the purchasing power parity theory hold for the exchange rate between the USA and Malaysia ?

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Does the purchasing power parity theory hold for the exchange rate between the USA and Malaysia ?

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Abstract: One of the most controversial theories in international economics is Purchasing power parity (PPP) and has been debated in the literature for decades and there is still a controversy whether exchange rate between two currencies is determined by the change in relative prices of the two countries. Also in recent studies, the most used price indicator is consumer price index, which was argued that it might not capture the entire price, hence this paper attempts to use producer price index to test for PPP between Malaysia and the US. and applies a time-series technique like Long Run Structural Modeling (LRSM), to explore and aims to examine if purchasing power parity holds between Malaysia and USA by considering the nominal exchange rate between the two countries and their price level (with PPI used as the index) in order to see the long and short-term correlations among these variables. Empirical results tend to show that there exists a cointegration between Exchange rate, Malaysia price level and US price level. This indicates that there exists a long-term stable relationship between these variables. In addition, empirical results of the causal relation show that consistent with established purchasing power parity theory, none of the variables are causing or leading another (all endogenous), which indicates that the three variables are adjusting to bring about equilibrium in the long run, hence it is concluded that purchasing power parity holds between Malaysia and USA.

Keywords: PPP theory test, cointegration, exchange rate, USA, Malaysia

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INTRODUCTION

Since the breakdown of the Bretton wood system in 1970, the relationship between the exchange rate, domestic price level and foreign price level has been at the heart of policy and economic discussion. The notion holds that the stability in exchange rates leads to macroeconomic stability which has a positive impact on economic growth. Although, misaligned exchange rate can have a negative effect on the economic efficiency and leads to misallocation of resources.

Considering the relative importance of exchange rate among countries and inflation level, which has given rise to issues in the past; one of the most controversial theories in international economics is Purchasing power parity (PPP) theory and has been debated in the literature for decades and still exists a controversy whether it holds in the long run or not.

Purchasing power parity was originally developed as a theory of exchange rate determination but today it is primarily used to compare the standard of living across countries.

Simply put PPP theory states that the nominal exchange rate between two currencies should be equal to the ratio of aggregate price levels between the two countries, so that a unit of currency of one country will have the same purchasing power in a foreign country (Taylor, 2012). The implication is that a country with inflation higher than that of her trading partners will tend to have a depreciating currency. Among the studies that support PPP in the long run is Sideries (2004)[1] who's findings support the long-run PPP for the US and

[1] Working paper on "Testing For Long-Run PPP In A System Context: Evidence For The US, Germany And Japan, Dimitrios Sideris (2004).

Germany and also for the US and Japan, which are in contrast to evidence of earlier empirical studies. On the other hand the correlation - type studies which are performed mainly in the 1980s found little or no support for long-run PPP, whereas the unit-root and cointegration based studies (performed from the late 1980s and on)[2] provided mixed results for the validity of PPP.

Testing PPP has been a headache for the policy makers and practitioners in the business world because it helps them link economic growth and real exchange rate valuation in order to draw analytical conclusion, hence they also perceive that PPP should hold in the long run considering that when any county's domestic price level, that is, inflation increases, its exchange rate must depreciate in order to stay in line with the PPP theory. However, in reality there are many factors such as the imperfect competitions, trade restrictions, transport costs, measurement errors and differential productivity shocks which affect the exchange rate and national price level, so PPP might fail to hold (Pedroni, 2001).

In the spirit of recent research, our main goal is to assess the validity of the PPP condition in an emerging market economy like Malaysia using a recently available monthly data that capture some of the years Malaysia currency (MYR) was pegged to USD and the rest captured the post peg period. Malaysia shifted from a fixed exchange rate regime of US$1 = RM 3.80 post Asian Financial crisis 1997 to a managed float on 21 July 2005, after that it operates under a free float policy. Hence this study will focus on three variables, exchange rate of Malaysia to USA, and the price level of each country.

[2] See (Froot and Rogoff (1995), Lothian and Taylor (1996),Cuddington and Liang, (2000), and MacDonald (1999).

The result of this paper shows that there exists a co-integration among Exchange rate, Malaysia price level and US price level. This indicates that there exists a long-term stable relationships among these variables. In addition, empirical results of the causal relation show that consistent with established purchasing power parity theory, none of the variable is causing or leading another (all endogenous and exchange rate happens to be the most endogenous), which indicates that the three variables are adjusting to bring about equilibrium in the long run, hence it is concluded that purchasing power parity holds between Malaysia and USA.

The remaining part of the paper will be divided into seven sections, where section 2 will be pointing out the main objective of this paper, and section 3 will be discussing about the theoretical framework of PPP and the review of empirical studies which is for or against PPP theory will be discuss in section 4. Section 5 will introduce the methodology that will be used in order to answer the main question of the study and will also mention the data and variables used, while section 6 will discuss the empirical results and findings then section 7 will wrap it up with the major conclusions and policy implications

1.0 OBJECTIVE OF THE STUDY

Many studies have been carried on the issue of PPP theory, whether it holds in the long run or not but yet is inconclusive, and the literature suggest that the root cause of the PPP puzzle lie in the different speeds of convergence for nominal exchange rates and prices (Cheung et al., 2004) therefore this study wants to test the validity of the theory using Malaysia as

a case study. Most long span studies have been undertaken for developed countries instead of developing countries, therefore our interest is to study Malaysia considering it being a successful developing country and is forging ahead to become a developed nation in its own mold.

The issue here is that some study argued that PPP holds in the long run, while some proved otherwise. At the same time, other studies argued that PPP does not hold in the short run while others argue it does. However, this paper will examine if the PPP of Malaysia relative to United States, whether it holds in the long run or not, as this study will be using monthly data for the period of twelve years starting 2012. Although there are some studies done to test if the PPP holds in Asian countries but as far as we are concerned, no study has focused mainly on Malaysia and USA. Thus, to test the long run theoretical relationship between the price level of Malaysia and USA and also the exchange rate, time series techniques will be utilized as compared to regression because time series tests the theory, therefore we can get an accurate result.

2.0 THEORETICAL FRAMEWORK

The PPP theory's origin has been traced to the 16th century Salamanca School of Spain. During the nineteenth century, classical economists, including Ricardo, Mill, Goschen and Marshall, endorsed and developed more or less qualified PPP views. The theory, in its modern form, is credited to Cassel, a Swedish economist, who developed and popularized its empirical version in the 1920s (Rogoff, 1996), and his idea was that nominal exchange rate should reflect the purchasing power of one currency to another.

From the perspective of exchange rate determination, PPP is a useful reminder that the monetary policy has no long term impact on real exchange rate. Thus, countries with different inflation rates should expect their bilateral exchange rates to adjust to offset this differential in the long run. The exchange rate however can deviate persistently from its PPP values in response to real shock.

Basically to test PPP of a county, we need to observe the relationship between the price level of the two different countries (domestic and foreign price level) with respect to their exchange rates. Exchange rate is determined in the foreign exchange market and it is the rate at which one currency can be exchange for another. In economies, it is predicted that movements in exchange rates should reflect changes in the relative demand for and supply of the two currencies. Assuming supplies unchanged, if demand for US dollar goes up in relation to MYR, the value of the dollar should rise: more MYR should be exchanged for each dollar than before. In this case the US dollar appreciated, while the MYR depreciated and vice-versa.

Therefore, the idea behind the purchasing power parity theory PPP is that a basket of goods in one country should cost the same amount in a foreign country at the going exchange rate. Relatively the PPP theory is based on the *law of one price* which states that all goods expressed in common currency should have identical or relatively the same price across countries (Hyrina & Serletis, 2010). This means that exchange rate changes for two countries will be proportional to relative inflation of each country. However, if two economies have different rates of labour productivity growth, they will normally have different rates of inflation, and PPP in its classical form might, therefore, not hold. If the

price ratio between the two countries differs from the nominal exchange rate and arbitrage opportunities exist, the resulting trade in goods equates the price ratio with the nominal exchange rate.

3.0 LITERATURE REVIEW

Series of empirical studies has been carried out on the issue of purchasing power parity theory to see if a basket of goods cost the same across nations. Basically in the literature, the trend of the research has been divided and grouped based on the empirical test and methodology utilized, while some are grouped based on the time span and sample size. Froot and Rogoff (1995) group it into three different stage of empirical studies performed. The first was correlation – based studies, second was based on unit root testing studies which test for stationarity of real exchange rates while the third was a cointegration based studies which test for cointegration between relative prices and exchange rates.

On the other hand, Khan and Qayyum (2008) categorized empirical studies into seven main groups and it clearly provides evidence that empirical findings have been mix and conflicting. To start with, studies by Taylor (1988), Giovannetti (1989), Patel (1990), Nachane and Chrissanthaki (1991), Crowder (1992), Sarantis and Stewart (1993), MacDonald (1993), Cooper (1994), Corbae and Ovliaris (1988), Arderi and Lubin (1991), Dornbusch (1988) and Moosa and Bhatti (1996) where they investigated the validity of PPP theory for the post-Bretton Woods floating exchange rates system and did not produce supportive evidence for long-run PPP.

However, Lothain (1990), Ardeni and Lubian (1991) and Moosa (1994) were able to produced supportive evidence using low frequency data. Other studies by Huizinga (1987), Kaminskyu (1987), Abauf and Jorion (1990) and Whitt (1992) reported supportive results

real exchange rate mean reversion. Meanwhile, a number of studies carried out, inter alia, by Frenkel (1978), Krugman (1978), Ardeni and Lubian (1989) and Taylor (1992) examined the validity of the PPP hypothesis also found supportive evidence for almost all exchange rates except for those involving the US-dollar. From the inflation perspective, studies conducted by McNown and Wallace (1989), Liu (1992) and Mahadavi and Zhou (1994) found supportive evidence for countries experiencing hyperinflation, and lastly, studies conducted by Frankel and Rose (1996), Oh (1996), Wu (1996), Pappel (1997), Cheung and Lai (1998, 2000), Taylor and Sarno (1998), Wu and Wu (2001), Engle (2000), Engle and Morley (2001) and Cheung et al., (2004) generally found supportive evidence of PPP reversion. In overall the result of these studies suggest estimates of reversion speed with half-lives ranging from studies done by Helg and Serati (2002) and Coakley and Fuertes (2000) which indicates that the effect of system wide shocks on long run PPP was persistent with the average half-lives. The empirical result shows that the issue is inconclusive.

Looking further, coakley et. al. 2004 findings support that general relative PPP holds. Their empirical studies was based on a large set of data looking into 19 Organizations for Economic Cooperation and Development (OECD) member countries and 26 developing countries and both consumer price index (CPI) and producer price index (PPI) data, where they used the same method to analyses industrial and developing countries. Their finding reveals that inflation differentials are on average reflected one-for-one in long-run nominal exchange rate depreciation.

Also, considering result based on the post Bretoon woods period that used co-integrating analysis which test for the existence of a long run equilibrium relationship among variables might have bias result. Study done by Kim (1990) who used a very large data supported PPP theory. On the other hand, Pedroni (2001) also use co-integrated panels to test the strong version of purchasing power parity for a panel of post Bretton Woods data and compare results using fully modified and dynamic OLS approaches, and strongly reject the hypothesis. Meanwhile, when rejecting the hypothesis that PPP holds in the countries of his sample, it is in favor of the likelihood that it does not for at least some countries. Therefore, his analysis of the individual results furthermore indicates that this failure of strong PPP is not driven by the data from only a few countries, rather, the failure of strong PPP appears to be pervasive in the post Bretton Woods period[3].

It is easy to see the intuition behind the PPP theory and why in practice it may not appear to hold. One way of circumventing the obstacles that makes it impossible for PPP to hold in its absolute version is to resort to the rate of change of both the exchange rates and the national price levels. Despite transport costs and other trade barriers, the change in the exchange rate between two countries' currencies is likely to be influenced by the change in the price level of one country relative to the other country's price level, if indeed PPP is plausible (Beatrice Kalinda Mkenda, 2001). All in all, the review of the literature indicates that there is still an ongoing controversy on the issue of PPP. In some cases, methodology might be bias while the sample period might appear to be bias, therefore the issue remains inconclusive.

[3] See "Purchasing Power Parity Tests In Cointegrated Panels", Peter Pedroni (2001).

4.0 DATA AND METHODOLOGY

Monthly data for 12 years starting from January 2001 collected from the Thomson Reuters Data-stream data service will be utilized for this study. In total, we have 143 observations. There are three variables being used for this study, first is the exchange rate of Malaysia to USD which was pegged from September 1998 – July 2005, and after that it operates under a free float system, thus this study covers some of the pegged period (2001 – July 2005). The second variable is domestic price level of Malaysia, therefore we chose to use Producer price index (PPI) as an indicator of price. Although other indicator like consumer price index can be used but we choose to test with PPI as we have difficulties getting the CPI data. The third variable is foreign price level, which is the price level of USA, in which we choose to use PPI as well.

Precisely, Producer price index (PPI) is used since it was argued in Taylor's (2004) paper that since PPP is based on traded goods, it might be more usefully tested with producer price indices that tend to contain the prices of more manufactured tradable, rather than consumer price indices, which tend to reflect the prices of relatively more non-tradable, such as many services.

We will be using the standard Time series techniques to test our data. Masih and Algahtani and Masih, Al-Sahlawi and De Mello (2010) mentioned about the dilemma of testing non-stationary variables. On the one hand, testing the 'level' form of non-stationary variables through the classical OLS method will invalidate the classical OLS assumption of stationary variables. On the other hand, if the variables were differenced to make it stationary, we will lose long-term theoretical information contained in the trend element.

Fortunately, the development of time series techniques manages to overcome the above shortcoming inherent in traditional regression.

5.0 EMPERICAL RESULTS AND INTEPRETATION

This section will be estimating the data using time series techniques. The data will be tested empirically through eight steps.

6.1 Testing stationarity of variables

The first empirical test is to test for the stationary of our variables. Before we can proceed to other steps, we have to ensure all variables are I(1), meaning each variable has to be non-stationary in their level form and stationary in its difference form. To proceed with the testing, we create a difference form of each variables by taking difference of their log, and then conducted the Augmented Dickey-Fuller (ADF) test on each variable (in both level and differenced form). The result shows that all variables in its level form is non-stationary and stationary in its difference form, therefore we have an I(1) variables, and we can proceed with next step. The table below summarized the result we got for the ADF test. Actually, there is a conflicting value for LUSPPI where AIC is bigger than critical value but SBC is lower than critical value, therefore I consider SBC to AIC which gives a non-stationary variable.

Table 1: ADF Test			
Level form			
Variables	T. ratio	Critical Value	Result
LMYPPI	-2.2980	-3.4430	Non-stationary
LUSPPI	-3.6727(AIC) -3.4130(SBC)	-3.4430	Non-stationary
LXR	-2.7364(AIC) -2.6199(SBC)	-3.4430	Non-stationary
Difference form			
DMYPPI	-5.1361(SBC) -4.4422(AIC)	-2.8827	Stationary
DUSPPI	-6.9437	-2.8827	Stationary
DXR	-9.2334(SBC) -3.8237(AIC)	-2.8827	Stationary

Table 2: Philips Peron Test			
Level form			
Variables	T. ratio	P-Value	Result
LMYPPI	-0.59328	0.554	Non-stationary
LUSPPI	-0.30787	0.759	Non-stationary
LXR	-0.59162	0.555	Non-stationary
Difference form			
DMYPPI	-5.3156	0.000	Stationary
DUSPPI	-6.2621	0.000	Stationary
DXR	-8.9042	0.000	Stationary

6.2 Determination of order of VAR model.

Before we can test for the co-integration of variables, we need to determine the order of Vector Auto regression (VAR) in this step, which is determining the number of lag that need to be use. The table below shows the result of the VAR test, which indicates that AIC recommend order of 2 and SBC recommend order of 0.

Table 3		
	Result	
	AIC	SBC
Optimal order of lag	2	0

According to the VAR result, 2 lag should be used. Although there is a conflict between AIC and SBC, apparently we cannot go for lag lower than 2 in order not to encounter serial correlation problem. To address this we checked for serial correlation of variables. The result is shown below.

Table 4: Serial correlation test		
Variables	Chi-square	Implication 5%
DMYPPI	0.707	No serial correlation
DUSPPI	0.811	No serial correlation
DXR	0.085	No serial correlation

Looking at the table above, it is shown by the test result that there is no serial correlation. We might take a higher lag and the disadvantage of taking a higher order is that we risk over-parameterization. However, in our case, given that we have a relatively long time series (144 observations), this is a lesser concern. Considering the trade-off of lower and higher orders, we decided to choose the higher VAR order of 2, hoping it will be appropriate and will give co-integration among the variables.

6.3 Testing cointegration

In the first two steps, we already confirm that the variables are I(1) and also determined the number of lags to be used from the second step. In this step, we will test for co-integration based on the order of lag determined earlier. Two method will be used to test for co-integration among the variables, the first one is Johansen method which use

maximum likelihood and may identify more than one co-integrating vector. While the second method is Engle-Granger methods which can only identify one co-integrating vector.

When we test for co-integration with two lag, we couldn't get any co-integration. Therefore we keep increasing the number of lags, and we got co-integration with 5 lags (see appendix 3b-3d).

The co-integrating relationship indicates that the three variables are interdependent, meaning there is a common force that brings exchange rate, domestic price level and foreign price level together in the long run. Even If there is no co-integration then there is room for arbitrage between the two countries and it will eventually equates in the long run.

Table 5: Johansen Test

Ho	H1	Statistic	95% Critical Value	90% Critical Value
Maximum Eigen value Statistics				
r = 0	r = 1	28.0663	25.4200	23.1000
r<= 1	r = 2	6.8364	19.2200	17.1800
r<= 2	r = 3	3.8382	12.3900	10.5500
Trace Statistic				
r = 0	r = 1	38.7408	42.3400	39.3400
r<= 1	r = 2	10.6746	25.7700	23.0800
r<= 2	r = 3	3.8382	12.3900	10.5500

Table 6	
Criteria	Numbers of co-integrating vector
Maximal Eigenvalue	1
Trace	0
AIC	1
SBC	0
HQC	1

From the above table (Johansen), looking at the Maximal Eigenvalue, the test statistic for null of r = 0 is greater than the 95% critical value whereas for other null hypotheses, statistic is less than the critical values. For Trace, the null r = 0 cannot be rejected because the test statistics is less than 90 or 95% critical value. For AIC, SBC and HQC, the number of co-integrating vectors is obtained by locating the highest numbers, both the AIC and HQC indicate one co-integrating vector and SBC indicate no co-integrating vector. However, for the purpose of this study we will consider the Maximal Engen value, that is, one co-integrating vector. This result indicates that the variables in some combination result in stationary error term, and also implied that these variables (exchange rates and price level) move along in the long run and are theoretically related. To further confirm/test if our error term is stationary or nor, we run Engle and Granger co-integrating test. The result is shown in the appendix 3E.

6.4 Long run structural modeling

Using long run structural modeling, this step will focus on quantifying the theoretical relationship between domestic price level, foreign price level and exchange rate. One variable will be normalized against others, so our variable of interest is domestic price level

(LMYPPI) which is normalize against foreign price level (LUSPPI) and exchange rate (LXR). The result we get is as follows.

Table 7: Exact identification				
Variables	Coefficient	Standard error	t-ratio	Result
LMYPPI	-	-	-	-
LUSPPI	-5.1270	1.7601	-2.91	Significant
LXR	-0.51676	0.39566	-1.31	Insignificant

The above result indicates that LUSPPI is significant and LXR is not significant. However we normalized the two other variables against the other and the result otherwise (See appendix). Never the less we will focus on LMYPPI as our interest variable. To confirm the above result, we subject the variables to over identifying restriction. The result is shown below.

Table 8: over identification		
Variables	Chi-square/p-value	Result
LMYPPI	-	
LUSPPI	0.000	Significant
LXR	0.185	Insignificant

Table 9: Exact and Over identifying restriction		
	Panel A	Panel B
LMYPPI	1.000 (None)	1.0000 (*None*)
LUSPPI	-5.1270 (1.7601)*	-5.4920 (2.4849)
LXR	-0.51676 (0.39566)	0.0000 (*None*)
TREND	.0093394 (0.0046969)	.011404 (0.0071304)
CHI-SSQUARE	None	1.7607[.185]

However, after applying the over identifying restriction, the result still remain the same. Meanwhile the null hypothesis of LXR cannot be rejected, therefore the restriction is correct (still in significant). Notwithstanding, based on intuition, we believe that LXR is significant, considering the fact that exchange rate and price level move together based on co-integration test established earlier. Also in the theory, it is said that exchange rate depends on relative price levels, hence we go with intuition and theory based.

Therefore, we arrived at the equation below based on the analysis.

$$\underset{}{LMYPPI} - \underset{(1.76)}{5.13}LUSPPI - \underset{(0.39)}{0.52}\,LXR \rightarrow I(0)$$

6.5 Vector error correction model

Based on the analysis done earlier, we established that the variables (MYPPI, USPPI & XR) are cointegrated, although LRSM indicates that XR is insignificant. Meanwhile, the causality wasn't established in the co-integration test, we only know they move together but couldn't indicate which variable leads or cause which. However, we are interested in knowing which variable is exogenous and which is endogenous. Therefore in this step, we will use vector error correction model to analysis and by decomposing the change in each variable to short-term and long-term components, we are able to ascertain which variables are in fact exogenous and which are endogenous. In the result, by examining the error correction term, et-1, for each variable, and checking whether it is significant, we found that all the three variables are endogenous. This indicates that in the adjustment process,

no variable is leading or causing another, they are all followers, be it in the short or long run. This result is considered puzzling as in the LRSM XR was found to be insignificant, meaning it wasn't considered to have an effect on other variables. Although the theory which this study is based on holds that exchange rate and price level have some degree of effect on each other especially in countries that are trade partners. The result is shown in the table below.

Table 10: VECM test result

Variables	ECM (-1) P-Value	Implication
LMYPPI	0.007	Endogenous
LUSPPI	0.000	Endogenous
LXR	0.011	Endogenous

6.6 Variance Decomposition Model

Having established that all the variables are endogenous using VECM, in this step we will be able to identify which one is the most endogenous among the three by using variance decomposition model for analysis. By doing this, the VDC will decomposes the variance of forecast error of each variable into proportions attributable to shocks from each variable in the system, including its own. The least endogenous variable is thus the variable whose variation is explained mostly by its own past variations. Firstly we apply orthogonalized by forecasting 12, 20 & 32 months (short and long term) which give the following result.

Table 11: orthogonalized VDC			
Forecast at horizon monthly	MYPPI %	USPPI %	XR %
Relative variance in ΔMYPPI			
12	69.06	21.48	9.47
20	57.28	32.20	10.52
32	51.35	37.63	11.02
Relative variance in ΔUSPPI			
12	64.16	21.20	14.64
20	52.42	29.37	18.21
32	44.89	33.78	21.33
Relative variance in ΔXR			
12	2.552	19.02	78.43
20	2.231	22.10	75.67
32	1.798	23.41	74.79

From the above table, the rows is read as the percentage of the variance of forecast error of each variable into proportions attributable to shocks from other variables (in columns), including its own while the columns is read as the percentage in which that variable contributes to other variables in explaining observed changes and the highlighted part represent the relative endogeniety. Meanwhile, the ranking of this result (most endogenous) in which the variable can be explained by its own past will be depicted below.

Table 11: ranking	
No.	Index
1	XR
2	MYPPI
3	USPPI

However, there are some limitations in orthogonalized VCD, one of it is assuming that when a particular variable is shocked, all other variables are "switched off", and more importantly, orthogonalized VDCs do not produce a unique solution because the generated numbers are dependent upon the ordering of variables in the VAR, hence the first variable will give the highest percentage and is likely to be the most exogenous. In this case MYPPI comes first in the order of the variables is reported to be the least endogenous while is XR because is the last in ordering of VAR. anyways, the orthogonalized VDC is perceived to be biased, therefore the analysis will be done again using generalized which does not depend on the order of VAR and doesn't switch off other variables when one is shocked. To interpret the generalized result, we have to compute and do the calculation manually because the numbers does not add up to 1 like orthogonalized. The result is depicted below.

Table 12: Generalized VDC

Forecast at horizon	MYPPI %	USPPI %	XR %
Relative variance in ΔMYPPI			
12	68.70	4.210	27.09
20	61.73	7.367	30.91
32	58.08	08.53	33.38
Relative variance in ΔUSPPI			
12	50.48	26.28	23.24
20	44.30	27.10	28.59
32	40.21	25.63	34.17
Relative variance in ΔXR			
12	2.499	13.59	83.91
20	2.188	18.35	79.46
32	1.769	20.29	77.95

Table 13			
No.	Variables relative endogeneity		
	12months	20months	32months
1	XR	XR	XR
2	MYPPI	MYPPI	MYPPI
3	USPPI	USPPI	USPPI

Observing the above table, we notice that the ranking of endogeneity is stable across each horizon and it is consistent with the result from orthogonalized as well as across different time horizon. Hence, XR is the most endogenous or rather the least exogenous variable, which indicates that exchange rates adjust to the level of purchasing power parity. While USPPI is the least endogenous or the most exogenous variable. It can also be observed that the relative difference between the most and least endogenous variable is substantial. In the case of XR and USPPI, the difference is 52.32% in week 32.

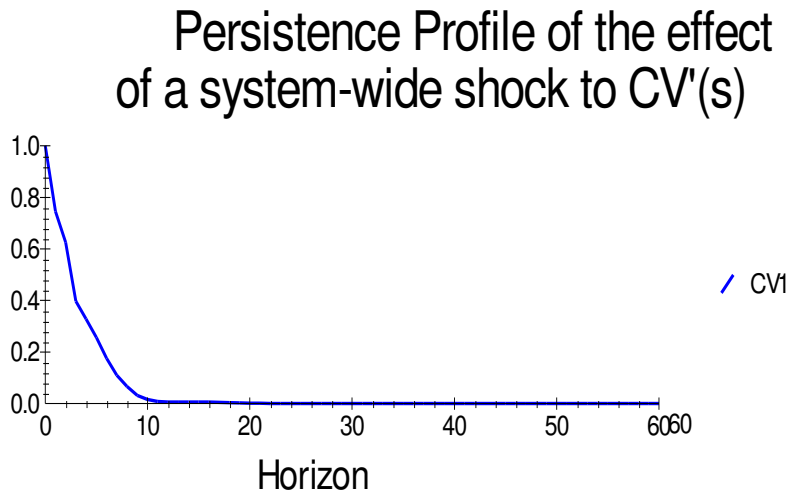
The above result will have the following plausible implications for the policy makers, that when any county's domestic price level increases, its exchange rate must depreciate in order to stay in line with the PPP theory. Perhaps, this might be due to several reasons like transaction cost within trading countries, arbitraging and more, so considering the fact that Malaysia is under a managed floating currency system, therefore there is a minimum level MYR can depreciate and a maximum it can appreciate.

6.7 Impulse Response Functions

The impulse response functions (IRFs) essentially produce the same information as the VDC , except that they can be presented in graphical form. When we applied the Generalized IRFs and found that is consistent with the earlier result.

6.8 Persistence Profile

The persistence profile illustrates the situation when the entire cointegrating equation is shocked, and indicates the time it would take for the relationship to get back to equilibrium. Here the effect of a system-wide shock on the long-run relations is the focus unlike the variable-specific shocks as in the case of IRFs). The chart below shows the persistence profile for the co-integrating equation of this study and the result shows that it takes 12 months for the cointegration relationship to return to equilibrium after a system wide shock.



6.0 CONCLUSION

This paper attempts to test empirically if the relative PPP holds in Malaysia and USA, meaning whether the percentage change in the exchange rates of Malaysia to USA over a given period of time offsets the difference in the inflation rates. Therefore, to do this we utilized the nominal exchange rates of Malaysia to USA, and also each country price level. Specifically, we chose to use producer price index (PPI) as an indicator for price level instead of CPI because PPI is relatively more accurate as it captures more in terms of price level.

This empirical debate on PPP has been on for decades and yet is inconclusive as some empirical findings support the theory, while some did not. And the empirical studies are said to be biased based on the methodology/model used and also the length of time period examined. Meanwhile in this analysis, we investigate empirically whether prices or the exchange rate is the weakly exogenous/endogenous variable in the PPP relationship. As a parity or arbitrage condition, PPP does not imply any direction of causality, but as an exchange rate determination theory it clearly assumes exogenous prices. Contrary to most of the previous PPP empirical studies, we allow the endogeneity/exogeneity status to be evaluated statistically, rather than imposed a priori. Hence, it was revealing that there is no exogenous variable, rather they are all endogenous.

In other words, this result indicates that the Malaysia price level, domestic price level and exchange rate are c-integrated in the long run although it was indicated that exchange rate is not significant in this case. Hence, it implies that changes in exchange rate is being cancelled out by the changes in foreign price level relative to domestic prices therefore it brings about equilibrium. This might be due to the fact that the first few years of our observation MYR was pegged to USD. Notwithstanding, our main result shows that all the

variables are adjusting to bring about equilibrium in the long run, hence it is concluded that purchasing power parity holds in Malaysia. Considering this result, the implication for policy makers can be said that the movement should have no effect on the relative competitive position of domestic or foreign firms as competiveness will depend on the real exchange rate. It can also be said that the behavior/effect of speculators and arbitrageurs will bring about equilibrium in the long run.

Above all, the theoretical foundation and framework of this study revealed something interesting to be looked in depth in the future as most empirical study uses CPI which was argued by Taylor (2004) to be inaccurate as it only reflects the prices of relatively more non-tradable, such as many services while PPI tends to contain the prices of more manufactured tradable goods. The underlying theoretical aspect from various studies done previously may create a fundamental in analyzing the data ahead using PPI say for Asian countries and also including more sample size/time frame.

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