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Is purchasing power parity hypothesis valid in Ghana? An empirical assessment

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ABSTRACT
The paper examines the theory of Purchasing Power Parity (PPP) hypothesis to determine whether the hypothesis is valid for Ghana for the period 1960 to 2013, by employing the Augmented Dickey-Fuller (ADF) test and the Kwiatkwski, Phillips, Schmidt and shin (KPSS) test on a single time series data to test the unit root properties of real exchange rate (Official exchange rate). It is found that real exchange rate have unit root or are non-stationary in levels. The findings suggest that the purchasing power parity hypothesis is not valid for the period under discussion.

Keywords: Purchasing Power Parity Hypothesis; Real Exchange Rate, Unit Root
Jel Codes: F31; D51; O24

1 INTRODUCTION

The issue of purchasing power parity (PPP) hypothesis has attracted the attention of researchers such as econometricians; macroeconomist; development economist and financial economist. The PPP hypothesis is considered as generalization of the law of one price, which indicate that all products are similar and that transportation costs, trade barriers, and transportation cost are absent or very low between the countries. The hypothesis explains that for the same basket of products the cost when expressed in the same currency should not be different between the countries (Froot & Rogoff, 1995; Sarno & Taylor, 2002; Sarno, 2003; Kalyoncu, Kula, Aslan, 2010).

The findings of the empirical verification of the PPP hypothesis are found in the works of Cuddington and Liang (2000); Calderón and Duncan (2003); Cerrato and Sarantis (2003); Papell and Prodan (2003); Kalyoncu et al. (2010) and Kurtaran (2015). The findings on the verification of the PPP hypothesis is inconsistent in the literature.

For example, Cuddington and Liang (2000) re-examined the purchasing power parity hypothesis for the dollar-sterling exchange rate using the two centuries of data. The findings of the study supported the PPP hypothesis since the dollar-sterling RER was nonstationary.

Calderón and Duncan (2003) investigated the PPP hypothesis validity as a long run equilibrium condition for Chile, using a battery of unit-root and cointegration tests. The findings of the study supported the PPP hypothesis for Chile. The finding of the study did not change in relation to changes in the domestic price index, to changes in the sample period, and to the econometric technique applied employed in the study.

Cerrato and Sarantis (2003) examined the PPP hypothesis using a panel (monthly) data on black market exchange rates for twenty emerging market economies for the period 19973M1-1993M12. The authors used recent heterogeneous panel unit root and cointegration tests for the study. The study accounted for structural breaks in the examination of the unit root. The findings of the study did not support the hypothesis. However, when the hypothesis was tested in a restricted model using likelihood ratio tests the hypothesis was supported.

Papell and Prodan (2003) investigated the PPP hypothesis (the Cassel and Balassa-Samuelson versions) by using the long-horizon real exchange rate data for 16 industrialized countries. The study accounted for structural breaks in unit root and provided mixed findings for the hypothesis for the period under study. For example, using conventional tests, they found evidence of some variant of PPP hypothesis for 9 of the 16 countries. In restricted tests of the hypothesis, they found evidence for 5 additional countries. In the study, the Cassel version of PPP hypothesis was supported for 10 countries whereas the Balassa-Samuelson version was supported for 4 countries in the study.

Caporale and Gil-Alana (2010) tested for PPP in a group of seventeen Latin American (LA) countries by applying fractional integration techniques to real exchange rate series. The findings of the study based on different assumptions about the underlying disturbances, are in the majority of cases inconsistent with PPP hypothesis when structural breaks are accounted for. The results was different for Argentina where little evidence was found for the PPP hypothesis.

Kalyoncu et al. (2010) examined the PPP hypothesis for Middle East and Northern Africa Countries by using official and black market exchange rates data over 1970-1998. The authors employed the Lagrange Multiplier (LM) unit root test that endogenously determines structural breaks in level and trend. The findings of the study provided evidence of PPP hypothesis for all countries in the study at the 10% level or better for all the data used.

de Carvalho and Júlio (2012). Tested the PPP hypothesis using various tests (standard univariate unit root tests, co-integration, panel unit root tests, and unit root tests for nonlinear frameworks). The findings of the study provided little evidence for the PPP hypothesis.

Kurtaran (2015) examined the PPP hypothesis for 16 OECD countries by using the newly proposed unit root tests which using nonlinearity, structural break and nonlinear panel data structure. The findings of the study provided support for the PPP hypothesis. The findings were influence by nonlinearity modelling and the presence of structural breaks in unit root.

In summary, the review indicates that purchasing power parity hypothesis is supported in some studies whereas in some other studies the hypothesis is not supported. This calls for further studies to enrich the debate using current data set for a larger sample span. This is the focus of the current research. The empirical verification of the purchasing power parity hypothesis has produced mixed results in the literature (Telatar & Kazdaglı, 1998; Bahmani-Oskooee & Mirzai, 2000; Luintel, 2000; Taylor, 2002; Basher & Mohsin, 2004; Narayan & Prasad, 2005; Kalyoncu, 2009) especially studies on developing economies in addition to the fact that much studies have not been done on developing economies like the developed economies. The paper fills in the literature gap. The findings of the research contribute to the theories of purchasing power parity hypothesis by providing answers to the research questions raised in the paper. The empirical results provide information to policy makers on the purchasing power parity hypothesis and its policy implications for government policies.

The paper contributes to the body of knowledge that exists in the literature in the area of international finance and macroeconomic by empirical investigating the nature of unit root properties of real exchange rate for the verification of the purchasing power parity hypothesis. The study specifically examines whether purchasing power parity hypothesis is valid for Ghana. Answer is provided to this question; does the purchasing power parity hypothesis applies to Ghana for the period 1960-2013? The Hypothesis behind the study is; the purchasing power parity hypothesis is not valid for Ghana during the period under discussion.

The data used are secondary data from World Bank database, which might suffer errors in variables that might not be known by the researchers. The findings are limited by the challenges of the ADF test and KPSS test. The rest of the sections of the study are the methodology, empirical results; conclusions and policy implications.

2 METHODOLOGY

2.1 Data

The data for the empirical verification of the hypothesis is based on annual secondary data on real exchange rate for Ghana for the period 1960-2013. The source of the data is the World Bank database. The sample size for the study is 54. The nominal exchange rate values were converted to real exchange rate using the GDP deflator.

Table 1 Data Description, Proxies and Sources

Data Description	Source
Real Exchange Rate (RER)	World Bank World Development Indicator (WDI)

2.2 Data Analysis method

The analysis of the data is based on ADF test and KPSS test.

2.2.1 The ADF model

The stationarity test is performed to determine whether the variable in the model is stationary. If the variable is non-stationary, it is made stationary by differencing. For the purpose of the present study, the unit root test is performed using the Augmented Dickey-Fuller (1981) (ADF) and Kwiatkowski et al. (1992, KPSS). The stationarity test results provide information on the order of integration of the variable (order zero; zero or higher order of two or three). These tests (ADF and KPSS) have their strengths and their weaknesses. The ADF test unlike the KPSS is considered to have low power of tests and might accept a false null hypothesis (Nanthakumar and Subramaniam, 2010). The null assumption (H_o) is that there is a unit root in levels. The alternative hypothesis (H_1) is that the series are stationary in levels. The ADF test may specified as in equation (1).

$$\Delta RER_t = \mu_t + \beta_t \gamma_t + \rho RER_{t-1} + \sum_{i=1}^{q} \partial \Delta RER_{t-1} + \varepsilon_t \text{................}(1)$$

Where γ = trend coefficient, RER= time series variable in the model (Real Exchange Rate), ε_t = error term or stochastic error term. μ= drift term, q = number of lags, Δ= shows the series are in their first difference.

2.2.2 Conceptual Framework

The theoretical framework is that when the real exchange rate variable is not unit root in levels it is an indication that any percentage changes in the price level between two countries would be offset by an equal depreciation/appreciation of the nominal exchange rate. If real exchange rate is not stationary in levels, the presence of shock to real exchange rate remains permanent and not temporary. In this case, the PPP hypothesis is considered not to be valid.

3 EMPIRICAL RESULTS

The empirical results on descriptive statistic; ADF test results and KPSS are presented and discussed in this section of the paper.

3.1 Descriptive Statistics

The results of the summary statistics of the variables are reported in Table 2. The degree of variations in the variables under investigated is measure by the maximum and minimum values. The central tendency of the series variables is measured by the mean and the values do not indicate a good fit. The coefficient of variation is used to measure the volatility of the variable. The coefficient of skewness is used to measure the nature of distribution of the variables. The range of the coefficient of skewness is between positive one (1) and negative one (-1). The series variable is positively skewed. The coefficient of kurtosis was used to measure the peakness of the series variable. The coefficient value of kurtosis of the series variable such as is less than unity (1) which indicates more flat-topped distribution.

Table 1 Summary Statistics, using the observations 1960 - 2013

Variable	Mean	Median	Minimum	Maximum
Real Exchange Rate (RER) ($)	0.0186	0.0167	0.0021	0.0431
Variable	**Std. Dev.**	**C.V**	**skewness**	**Ex. Kurtosis**
Real Exchange Rate (RER) ($)	0.0112	0.6028	0.5483	-0.7293

3.2 Results of Unit Root Tests

Two main unit root tests were used in the present study. They are the Augmented Dickey-Fuller test (ADF) and Kwiatkowski, Phillips, Schmidt and Shin (KPSS).

3.2 Time Series Plots

The Time series plot of the variable is shown in Figure 1 to Figure 4. The plots in levels indicate the variable is not stationary in levels (Figure 1 and 2). However, the variables attained stationarity on first differenced (Figure 3 and Figure 4).

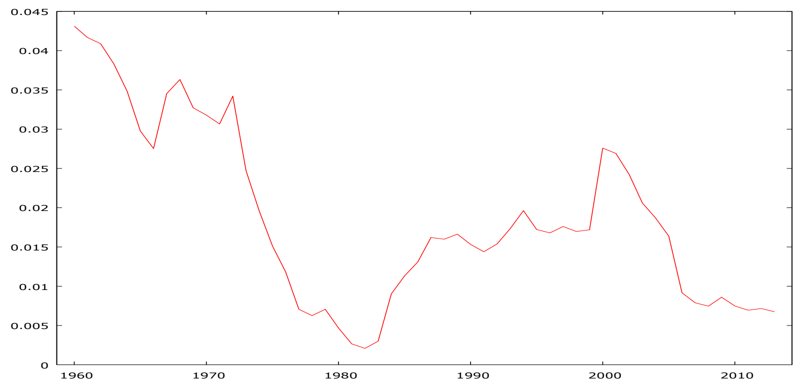

Figure 1. Plot of Real Exchange Rate (levels)

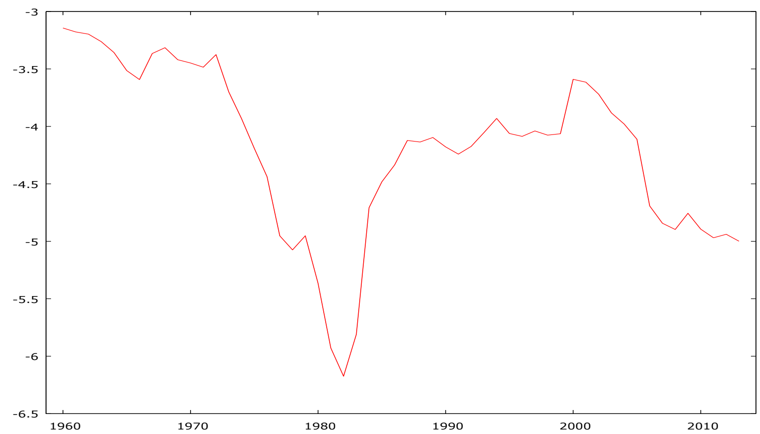

Figure 2. Plot of Real Exchange Rate in log-linear form (levels)

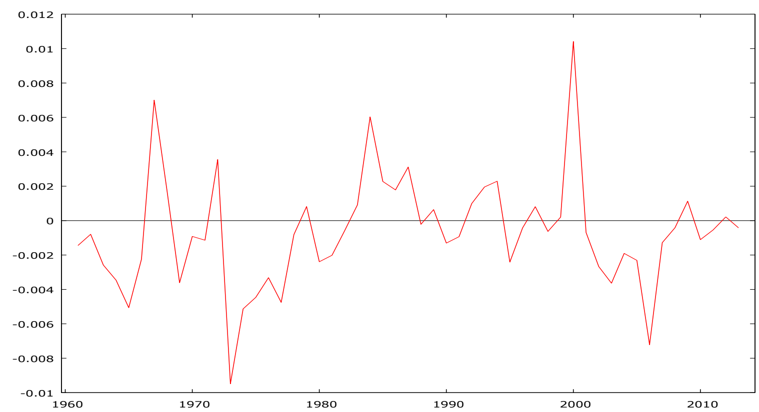

Figure 3. Plot of Real Exchange Rate (1st difference)

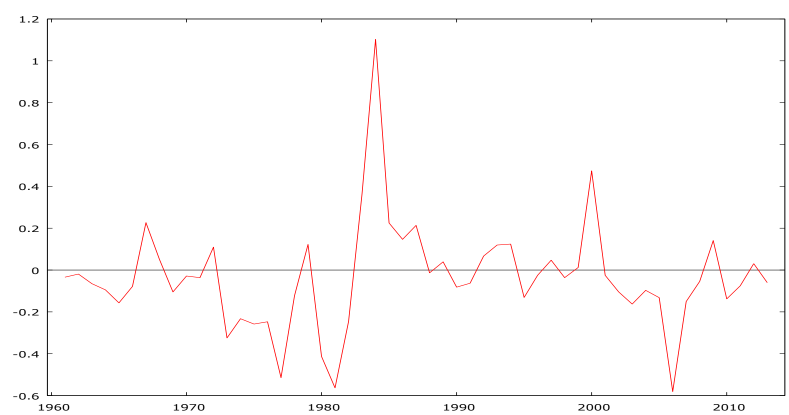

Figure 4. Plot of Real Exchange Rate in log-linear form (1st difference)

3.2.2 The ADF Test

The ADF test was used to examined the unit root with constant and time trend. The results are reported in Table 3. The results of the ADF test for unit root in levels show that the series are non-stationary in intercept. The null hypothesis of unit root was accepted. The series variable attained stationary on first differenced.

Table 3 ADF stationarity test results with a constant

Variables (Levels)	t-Estimated	t-Critical	ADF P-Value	Results	Lag length
RER	-0.0855	-2.1208	0.2365	Unit Root	10
RER-1st diff.	-0.7243	-5.3305	0.0000***	Not Unit Root	10

Source: Author's computation, 2017

Table 4 ADF stationarity test results with a constant

Variables (Levels)	t-Estimated	t-Critical	ADF P-Value	Results	Lag length
lnRER	-0.1004	-2.2199	0.1992	Unit Root	10
lnRER-1st diff.	-0.5799	-4.5179	0.0006	Not Unit Root	10

Source: Author's computation, 2017

Taking the logarithm of the series variables (Real exchange rate attained stationarity) did not attain stationarity in levels with intercept and trend. That is, the null hypothesis of unit root was not rejected in levels. The series variables achieved stationarity on first differenced with intercept and trend. That is, the null hypothesis of unit root was rejected in first difference. The results are reported in Table 5. These results indicate that the series exhibit unit root processes.

Table 5 ADF stationarity test results with a constant and a time trend

Variables (First Difference)	t-Estimated	t-Critical	ADF P-Value	Results	Lag length
lnRER (levels)	-0.1159	-2.3430	0.4099	Unit Root	10
lnRER (1st difference)	-0.5806	-4.4759	0.0039	Not Unit Root	10

Source: Author's computation, 2017

4.2.2 The KPSS Test

The KPSS test is based on the null assumption (H_o) that the series variable under examination are stationary (series are not unit root) against the alternative hypothesis (H_1) that the series variable is not stationary (series are unit root). The KPSS is a reversed test for unit root. It is used in the current study as a confirmatory test to the ADF test. The results are reported in Table 6. The variable was examined in levels and in first difference in logarithm form. The variable is unit root in levels but became stationary in first difference, indicating that they are integrated of order one, I (1) at 1%, 5%, and 10% levels of significance.

Table 6 KPSS stationarity test results with a constant and a time trend

Variable	T-determined	Results	Lag length
lnRER (levels)	0.1668	Unit root	3
lnRER (1st difference)	0.0835	Not unit root	3
Critical values: 10% 0.121, 5% 0.149, 1% 0.213			

Source: Author's computation, 2017

4 CONCLUSION AND POLICY IMPLICATIONS

The objective of the study has been achieved. The test results from both the ADF and the KPSS shows that real exchange rate exhibit unit root processes and are integrated of order one, I(1). The findings of the study suggest that the PPP hypothesis is not supported in Ghana for the period under discussion. The findings are not in support of the findings of previous researchers such as Luintel (2000) for MENA countries; Calderón and Duncan (2003) for Chile; Kalyoncu et al. (2010) for Middle East and Northern Africa Countries and Kurtaran (2015) examined the PPP hypothesis for 16 OECD that provided evidence in support of the hypothesis. The findings are also inconsistent with studies such as Cerrato and Sarantis (2003), Papell, and Prodan (2003) that reported of mixed findings on the PPP hypothesis.

The detection of unit roots in real exchange rate indicate that shocks to the real exchange rate will have permanent effects and not transitory effects. Policies to influence real exchange will have limited effect. Policy maker should incorporate these findings in their policies programmes to ensure stable exchange rate for sustainable economic growth. The findings of the study further indicate that time series analysis using real exchange rate without taking into account the unit root properties may be spurious.

Future studies should use other estimation methods such as the panel unit roots to determine if the findings will be collaborated. Structural breaks in unit root should also be accounted for in further studies to determine if the current findings will be supported.

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