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LONG-RUN PURCHASING POWER PARITY AND EXCHANGE RATES: EVIDENCE FROM THE MIDDLE EAST

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ABSTRACT

This paper examines the validity of Purchasing Power Parity and investigates the market integration between Jordan and its major trading partners, namely, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates. Unit root tests, Johansen co-integration test and a vector error correction model were employed to test data covering the period 2005Q1-2012Q4. The unit root tests demonstrated that all variables were integrated of order one. The results of co-integration tests showed that a co-integrating relationship existed between exchange rates, domestic and foreign price levels for four Gulf Cooperation Council countries. The two remaining countries, Oman and United Arab Emirates, do not have a co-integration relationship. For the vector error correction model, we found the error correction terms for Jordan with the Gulf Cooperation Council countries carried the expected sign. This suggests that whenever there is a deviation from the equilibrium co-integrating relationship, the exchange rate interacts in a dynamic fashion by adjusting to restore its long-run equilibrium. Finally, the models passed all the diagnostic checking. In conclusion, these results provide evidence that the Purchasing Power Parity model holds in the long run. The results also show the Jordanian economy is integrated with six trading countries.

JEL: C32, F31, F37

KEYWORDS: Purchasing Power Parity; Johansen Co-Integration; Vector Error Correction Model, Jordan and Gulf Cooperation Council

INTRODUCTION

Exchange rates are important to innumerable economic activities. Investors care about the effect of exchange rate fluctuations on their international portfolios. Tourists care about the value of their home currency abroad. Central banks care about the value of their international reserves and open positions in foreign currency as well as about the impact of exchange rate fluctuations on their inflation objectives. In addition, exchanges rates influence markets directly and indirectly. The direct influence occurs as the market for foreign exchange is by far the largest market in the world. The indirect influence occurs because exchange rate shifts can affect various asset prices. Therefore, it is no surprise that forecasting exchange rates has long been prioritized in international finance research agendas. Still, most research literature is characterized by empirical failure.

One of the major theories that explains exchange rate determination is Purchasing Power Parity (PPP). PPP is the simplest tool for global traders, investors, economists, policy makers and academicians to predict exchange rates. Besides exchange rate prediction, PPP is commonly used as a first step in making inter-country comparisons based in real terms of gross domestic product (GDP) and its component expenditures. GDP is commonly used as an economic indicator for size, growth, and health of a nation. PPP also allows countries to be viewed through a common reference point. A special topic to be taken into consideration by

investors and monetary authorities is integration of the international market. This topic is not discussed widely in Middle East and North Africa (MENA) Countries, and there has been limited research on the topic of MENA's market integration. But this topic has been investigated for the market of United States of America and European countries.

PPP states that the exchange rate between two currencies are in equilibrium when their purchasing power is the same in each of the two countries. This refers to the 'law of one price', which means that identical goods should sell for identical prices in different countries' markets. As a result, the exchange rate between countries should equal the ratio of the countries' price levels of a fixed basket of goods and services. For example, when a country's domestic price level increases more rapidly than its major trading partner, the country is experiencing inflation, and its exchange rate must depreciate in order to return to PPP. There are two types of PPP theory, namely, absolute and relative PPP. Absolute PPP theory states that the exchange rate between the currencies of two countries should equal the ratio of the price levels of the two countries and the basket of goods should be the same domestically and abroad if the goods' prices are converted into a common currency. Therefore, absolute PPP theory postulates that the purchasing power of money should be equal between countries.

$$S = \frac{P}{P^*} \tag{1}$$

Where S is the nominal exchange rate measured in units of domestic currency per unit of foreign currency, P is the domestic price level and P^* is the foreign price level.

The relative PPP hypothesis, on the other hand, states that the exchange rate should be proportionate to the ratio of the price level and does not compare domestic and foreign levels of purchasing power. Rather, it focuses on changes in this purchasing power. Relative purchasing power parity theory, therefore, states that the inflation rate differentials between two countries are offset through inverse changes in the nominal exchange rate so that the purchasing power ratio between the two remains constant (Suranovic, 1999).

$$S = k(\frac{P}{P^*}) \tag{2}$$

Where k is a constant parameter. Since information on national price levels normally is available in the form of price indices rather than absolute price levels, absolute PPP may be difficult to test empirically.

The Gulf Cooperation Council (GCC), which comprises Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates plans to convert its cooperation status into a union to enhance economic integration as well as strengthen the economy. Jordan has been invited to join them. Despite differences in environmental conditions, the GCC countries have undertaken parallel economic programs to promote economic growth and development. They have instituted a number of reforms with the objective of enhancing economic efficiency as well as stimulating international competitiveness of international trade. The reforms include exchange rate system privatization and liberalization. Jordan, began the liberalization program and privatization in the early 1990s to increase economic efficiency, avoid future financial crises as well as promote home currency value.

The effects of poor currency value and instability of exchange rates could be greater if the countries were closely-linked in the form of cooperation or a union. However, in this respect, no study has been undertaken focusing on these countries. Therefore, the main purpose of this study is to examine the validity of PPP and to investigate market integration between Jordan and its major trading partners, namely, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates. Although PPP is regarded as one of the central doctrines in the international economy, limited studies have been conducted on Jordan with its trading partners. As a result, for this study, the GCC countries were selected as they were planning to form a union.

This study could assist the GCC countries in evaluating their performance and future plans. The findings of that PPP hold between Jordan and its major trading partners implied that the Jordanian economy is integrated with these countries. Hence, these had important policy implications on cross-border agreements for international trade and investment with these countries. It is crucial for authorities in Jordan and the GCC countries to enhance exchange rates and remove all barriers to have a successful union, particularly in reducing double taxation.

The paper is organized as follows. Section 2 discusses the existing literature, and Section 3 discusses the methodology and data analyzed in this study. Section 4 reports the empirical results, and the last section provides the conclusion and overview of this study.

LITERATURE REVIEW

The PPP theory has been tested for several countries using various statistical methods, sample periods and frequency of data. Despite the extensive research on PPP, to our knowledge, there are only a few analyses for the Middle East countries. In particular, Abumustafa (2006) for Jordan, and Drine and Rault (2008) for different panels of countries including Jordan. Abumustafa (2006) examined PPP between Jordan and Bahrain, and between Jordan and Germany using the unit root method and found no evidence of PPP. Drine and Rault (2008) apply panel co-integration techniques to test the PPP for combinations of countries, such as the OECD, the countries in Africa, Asia, Middle East and North Africa (MENA), Latin America and Central and Eastern European. They reported favorable evidence of PPP in the OECD panel while weak PPP in the MENA panel. For the remaining panels, their study shows that PPP does not seem to characterize the long-run behavior of the real exchange rates.

Many recent studies have examined the hypothesis of PPP in different countries, with the most recent by Al-Gasaymeh and Kasem (2015A) and Al-Gasaymeh and Kasem (2015B). Al-Gasaymeh and Kasem (2015A) test the strong form of PPP and the weak form of PPP between Jordan and its major trading covering 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. While, Al-Gasaymeh and Kasem (2015B) 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. They 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. A Study by Al-Zyoud (2015) who examines long-run movement between the Canadian dollar and US dollar exchange rates for the period 1995:01 to 2008:08 employing the Engle-Granger co-integration test. The analysis suggests that absolute PPP does not hold, indicating no long-run relationship between the observed exchange rate and PPP rate. The result showed no co-integration between actual exchange rate and PPP rate, suggesting there exists no long-run relationship between Canadian dollar and US dollar exchange rates. Kamrul et al (2014) found mixed results on the validity of PPP relationship in South Asian countries employing Pesaran (2004, 2007) to identify the degree of cross-sectional dependence and apply a panel unit root test accommodating this dependence on the real exchange rate series of five South Asian countries. This result was in contrast to the findings of previous studies in similar countries, which did not accommodate cross-sectional dependence (CSD) in their estimation. This finding implies that real shocks do not have a permanent effect on the real exchange rate with other factors remaining the same, and no active policy intervention is warranted for the sustainability of external balance.

Ariful and Rajabrata (2014) confirm mixed test results for the stationarity of South Asian real exchange rates, employing unit root tests 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 PPP 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.

Moreover, Mustafa et al (2014) observed in-country prices from the Turkey over the investigation period of 2005-2012. Following Esaka (2003), the study used a panel estimation framework consisting of 12 disaggregated consumer price indices to identify whether the relative prices of goods between sub-regions of the Turkish economy could be represented by stationary time series properties. The results in general point out that the tests applied for empirical purposes tend to verify the non-unit root characteristics of goods which accept that in the branch of tradable and that non-tradable goods and services, to a much greater extent than tradable, tend not to reject the non-stationary null hypothesis. Oguz (2013) argues these studies are not consistent in Romania by employing Zivot–Andrews unit root test, taking structural breaks into account using annual data from 1991 to 2012. The results show that PPP does not hold in Romania. Adrian et al (2014) employed a dataset of exchange rates for five major currencies (the *lira* of Barcelona, the pound sterling of England, the *pond groot* of Flanders, the florin of Florence and the *livre tournois* of France) to consider whether the law of one price and PPP held in Europe during the late fourteenth and early fifteenth centuries. The results reported in other recent studies indicated that many elements of modern economic theories could be traced back over 700 years in Europe.

Previous empirical studies on Asian countries have found mixed results. Phylaktis and Kassimatis (1994), Salehizadeh and Taylor (1999), Wang (2000) and Azali *et al.* (2001) found evidence to support long-run PPP for Asian economies. However, Lee (1999) found mixed evidence of PPP from thirteen Asian Pacific economies. On the other hand, the results of Cooper (1994), Doganlar (1999), Holmes (2001), Alba and Papell (2007) and Jiranyakul and Batavia (2009) failed to show evidence supporting PPP for Asian Pacific countries. There are numerous studies on PPP conducted in developed countries. Some studies that support exchange rate stationarity for developed countries are Oh (1996) for the G-6 and OECD countries, Papell (1997) for the industrial countries, Lothian (1997, 1998) for the OECD countries, Husted and MacDonald (1998) for the OECD, Coakley and Fuertes (1997) for the G-10 countries and, Koedijk *et al* (1998) for 17 developed countries. On the other hand, some studies have also shown that real exchange rates are non-stationary. These studies were done by Canzoneri *et al*. (1999) for the OECD countries, Alba and Park (2003) for 65 developing countries, and Wu and Chen (1999) for eight Pacific countries and 15 developed countries.

Finally, there are some studies which re-investigate the PPP issue using non-linearity approaches. Obstfeld and Taylor (1997) and O'Connell and Wei (1997) reported additional evidence of non-linear reversion of prices. However, O'Connell (1998), using a balance threshold autoregression (TAR) model for the post-Bretton Woods real exchange rates in a panel framework, found little support for PPP deviations. Wu and Chen (2008) investigated PPP convergence using a threshold vector error-correction model. They found that PPP convergence and the half-life of real exchange rates was less than two and a half years.

METHODOLOGY AND DATA

In this paper, we first examine time series properties. The unit root test of ADF and Kwiatkowski, Phillips, Schmidt, and Shin (1992) (KPSS) tests were used to examine the stationarity of the data. Unit root tests were first implement on level, and then on first difference of the data. If the series were stationary of first order, then we could proceed to test the existence of the long-run relationship among these variables using Johansen co-integration test. If the maximum Eigen statistic and trace statistic was greater than the 5% critical value, then we rejected the null hypothesis. Lastly, we use vector error correction model (VECM)

to investigate the dynamic short-run relationship between the exchange rate and price level as well as its adjustment towards long-run equilibrium. Various diagnostic tests such as normality test (Jarque-Bera), an autocorrelation test (Langranger multiplier), a heteroskcedasticity test (ARCH Test) and a stability test (Ramsey RESET) were performed to ensure robustness of the model. EViews provides a variety of powerful tools for testing a series (or first or second difference of the series) for the presence of a unit root. In addition to the existing Augmented Dickey-Fuller (1979), and Phillips-Perron (1965), tests, EViews now allows researchers to compute the GLS-Dickey-Fuller, Kwiatkowski, Phillips, Schmidt and Shin unit root tests. All of these tests are available as a series. Using EViews software, the following discussion outlines the basic features of ADF unit root tests. Consider a simple AR (1) process:

$$y_t = py_{t-1} + x_t^{'}\delta + \varepsilon_t \quad (3)$$

Where x_t are optional exogenous regressors which may consist of constant, or a constant and trend, p and δ are parameters to be estimated, and the ε_t are assumed to be white noise. If $[p] \geq 1$, y is a nonstationary series and the variance of y increases with time and approaches infinity. If $[p] < 1$, y is a (trend-) stationary series, thus, the hypothesis of (trend-) stationarity can be evaluated by testing whether the absolute value of p is strictly less than one. The unit root tests generally the null hypothesis test $H0 : p = 1$ against the one-sided alternative $H_1 : p < 1$. The test of weak PPP consists in testing the existence of a co-integration relationship between the nominal exchange rate and the price ratio. Let,

$$E=k\ (P/P^*) \quad (4)$$

Where *k* is a constant parameter. Rewrite equation (4) in log form

$$\log e_t = \beta 1 \log p_t - \beta 2 \log p^* \quad (5)$$

Estimation co-integration regression

$$\log e_t = c + \beta 1 \log p_t - \beta 2 \log p^* + \varepsilon_t \quad (6)$$

$$\log e_t - c - \beta 1 \log p_t + \beta 2 \log p_t^* = \varepsilon_t \quad (7)$$

Where e_t, p and p^* are the exchange rate, the domestic price, and the foreign price respectively, *t* denoted for time subscript and c is constant, ε_t is the error term, if ε_t is a stationary process with zero mean then PPP holds in the long run. However, if ε_t is non-stationary implying that deviation from PPP are cumulative and not ultimately self-reversing, then PPP fails in the long run. Let $Xt = (e_t, p_t, p_t^*)$. If all components in Xt are integrated of order 1, $I(1)$, the co-integration vector satisfies the restriction of proportionality, i.e., $\alpha = (1,-1, 1)$. Hence, testing the co-integration among e_t, p and p^* examining the proportional restriction of the co-integration vector are ways of testing the validity of PPP. Then, the test of co-integration between the nominal exchange rate and the national price levels is calculated by estimating the following regression:

$$\log e_t - c - \beta 1 \log p_t + \beta 2 \log p_t^* = \varepsilon_t \quad (8)$$

Where *e* is the nominal exchange rate, *P, P** the domestic price, and the foreign price respectively and c = constant, $\beta 1$, $\beta 2$ = coefficient. εt = error term. For strong PPP to be valid $\beta 1$ should be positive and equal

to one, $\beta 2$ should be negative and equal to one in order for PPP to hold. For relative PPP $\beta 1$ and $\beta 2$ does not need to be equal to 1.

In this paper, the co-integration procedure developed by Johhansen, (1988) and Johansen, (1990) was employed to examine long-term relationships between the different models within economics. Co-integration refers to the possibility that non-stationary variables can be a linear combination that is stationary. From a statistical perspective, a long-term relationship means the balance variables move together in time, so that any short-term deviations from long-term trends will be corrected. These series are said to be co-integrated and, therefore, a common root stochastic trend. Using the Johansen-Juselius (1990) procedure again, in the *n*-variable first order given by VAR.

$$\Delta X_t = A_1 X_{t-1} + \varepsilon_t \tag{9}$$

By subtracting X_{t-1} from each side of the equation, equation (9) can be rewritten as:

$$\begin{aligned} \Delta X_t &= A_1 X_{t-1} + X_{t-1} + \varepsilon_t \\ &= (A_1 - I) X_{t-1} + \varepsilon_t \\ &= \pi X_{t-1} + \varepsilon_t \end{aligned} \tag{10}$$

Where X_{t-1} and ε_t are (*n x 1*) vectors; *A* is an (*n x n*) matrix of parameters; *I* is an (*n x n*) identity matrix; and π is defined as $(A_1 - I)$. The rank of π equals to the number of co-integration vectors, also, the model in equation (11) can be generalized to allow for a higher-order autoregressive process.

$$\Delta X_t = \sum_{i=1}^{m-1} \pi_i \Delta X_{t-i} + \pi i X_{t-m} + \varepsilon_{\varepsilon t} \tag{11}$$

The most important function is still the grade as equal to the number of independent co-integration vectors. As we know that the rank of a matrix is equal to the number of its characteristics which are different from zero, so the number of individual co-integration vectors in this model may be determined by checking the significance of the characteristic roots π. The test for the number of co-integration vectors can be accomplished with the help of two likehood ratios (LR) tests on the track of statistics and maximum eigenvalue statistics as shown below:

Trace Test : $L_{trace(r)} = -T \sum L_n (1 - \lambda_i)$ (12)

Maximum eigenvalue test : $L_{\max(r,r+1)} = -TL_n (1 - \lambda_{r+1})$ (13)

Where λ_I ,the estimated eigenvalues and *T* is the number of valid observations, the null hypothesis of traces of statistical tests that the number of individual co-integration vector is smaller than or equal to *r* against a general alternative which gives the result of not more than *r* co-integrating vectors the last λ max statistical tests the null hypothesis that there is vectors *r* co-integrating against the alternative of *r +1* co-integrating vectors. In general, λ max statistics is more preferable, because it represents the result of exactly *r* co-integrating vectors.

An important practical issue for the implementation of the unit root test is specification of the lag length *p*. If *p* is too small, the remaining serial correlation in the errors will bias the test. If *p* is too large, the power of the test will suffer. The idea is to include enough lagged-dependent variables to rid the residuals of serial

correlation. There are several ways of choosing how many lags need to be added. First, we can use the testing-down strategy, which starts with a reasonably large number of lags and test down until they are all significant. This is one of the lag selection criteria that EViews automatically calculates (Mahadeva and Robinson, 2004). The second test, tests the residuals each time to see whether they contain any serial correlation. We choose a *p* that renders the residuals serial uncorrelated. Another way is to start with a reasonably large number of lags and test down, choose *p* (less than the specified maximum) to minimize one of the following criteria: Akaike information criterion, Schwartz Bayesian information criterion. For ADF, this study will consider whether they contain any serial correlation, choose a *p* that renders the residuals serial uncorrelated. For PP and KPSS the lag length was chosen based on the lowest AIC criteria. To perform the Johansen test, we have to decide the lag length (*k*) in the vector autoregressive (VAR) model, and to examine the appropriateness of including a time trend in the model. We started from a general lag system where the lag has to pass all the diagnostic tests.

This paper will extend the PPP literature by using quarterly data that covers the period from 2005Q1 to 2012Q4 and take the US dollar as a reference currency to construct the real exchange rates for Jordan and six GCC countries. The price series are based on the consumer price index and the nominal exchange rates are end period spot rates relative to the US dollar (domestic price of the US dollar). All data are taken from the International Monetary Fund's International Financial Statistics database.

RESULTS AND DISCUSSIONS

The ADF and KPSS unit root tests were conducted and the results can be seen in Table 1 and Table 2. The result of ADF test clearly show that for all the countries the null hypothesis of unit root cannot be rejected at 1% significant level when all the variables are in the level but can be rejected when they are tested at first difference. This implies all the variables are stationary at first difference. The results of KPSS test shows that the null hypothesis of stationary or no unit root can be rejected at 1% significant level when all variables are tested in their level. However, the null hypothesis of stationary cannot be rejected when all variables are tested in their first differences. Thus, we concluded that all the series are *I* (1) processes.

Table 1: The ADF Unit Root Test

	At Level		First Difference	
Variable	**Constant**	**Trend**	**Constant**	**Trend**
ER J-Bahrain	-2.436(3)	-2.397 (3)	-4.150(2)***	-4.113(2)***
CPI Jordan	-1.510(0)	-2.902(0)	-8.642(0)***	-8.678(0)***
CPI Bahrain	-2.195(4)	-3.361(2)	-3.112(3)***	-12.23(0)***
ER J-Kuwait	-1.337(0)	-1.589(0)	-6.6769(0)***	-6.687(0)***
CPI Kuwait	-0.0037(5)	-2.940(5)	-3.6115(4)***	-6.304(2)***
ER J-Qatar	-2.304(0)	-0.108(0)	-5.634(0)***	-5.952(0)***
CPI Qatar	-2.499(1)	-1.948(1)	-4.339(0)***	-4.908(0)***
ER J- Saudi Arabia	-1.724(0)	-1.673(0)	-7.484(0)***	-7.508(0)***
CPI Saudi Arabia	-1.326(4)	-1.673(0)	-7.484(0)***	-7.508(0)***
ER J- Oman	-1.991(0)	-1.380(0)	-7.250(0)***	-7.33(0)***
CPI Oman	-2.69(5)	-2.457(0)	-7.765(0)***	-8.678(0)***
ER J- UAE	-2.804(0)	-0.925(0)	-7.251(0)***	-7.877(0)***
CPI UAE	-2.738(10)	-2.252(0)	-4.060(0)***	-6.683(0)***

*Notes: Figures are the t-statistics for testing the null hypothesis that the series is nonstationary. *** and ** denotes significance at 1% and 5% levels. Figures in parenthesis are lag length. The ADF unit root tests is conducted to test the null hypothesis of unit root. The results cannot be rejected at 1% significant level when all the variables are in the level but can be rejected when they are tested at first difference; this means all the variables are stationary at first difference.*

All the series are *I* (1) process so the co-integration test can be implemented to examine the long-run relationship among these variables. Table 3 displays the results for the Johansen co-integration test. The results show that there exists a co-integrating relationship between exchange rate, domestic and foreign

price levels for Jordan and Bahrain, Kuwait, Qatar, and Saudi Arabia. And there is no co-integrating relationship among Jordan-Oman and Jordan-United Arab Emirates. The existence of a long-run relationship between the exchange rates of Jordan and its trading partner, CPI Jordan and CPI trading partner support the theory of PPP, indicating that it will hold over the estimated periods.

Table 2: The KPSS Unit Root Test

	At Level		First Difference	
Variable	**Constant**	**Trend**	**Constant**	**Trend**
ER J-Bahrain	0.4679(0)***	0.4571(0)***	0.126(0)	0.064(0)
CPI Jordan	1.0501(6)***	0.3297(3)***	0.2639(6)	0.1113(0)
CPI Bahrain	1.2445(1)***	0.2526(6)***	0.436(4)	0.143(7)
ER J-Kuwait	1.176(0)***	0.7097(0)***	0.1219(3)	0.0622(4)
CPI Kuwait	1.0877(6)***	0.2237(3)***	0.3256(4)	0.1424(9)
ER J-Qatar	1.023(6)***	0.2365(6)***	0.405(9)	0.0902(2)
CPI Qatar	1.048(6)***	0.2536(6)***	0.3267(14)	0.1250(9)
ER J- Saudi Arabia	0.796(0)***	0.736(0)***	0.1055(2)	0.0718(2)
CPI Saudi Arabia	0.796(0)***	0.736(0)***	0.1055(2)	0.0718(2)
ER J- Oman	1.3387(1)***	0.4959(1)***	0.2756(2)	0.0516(1)
CPI Oman	1.0073(6)***	0.2533(6)***	0.4535(11)	0.1315(0)
ER J- UAE	1.003(6)***	0.247(6)***	0.461(8)	0.057(7)
CPI UAE	0.985(6)***	0.278(6)***	0.462(9)	0.096(1)

*Notes: Figures are the LM-statistics for testing the null hypothesis that the series is stationary. *** and ** denote significance at 1% and 5% levels. Figures in parenthesis are lag length. The KPSS unit root tests is conducted to test the null hypothesis of unit root. The results of KPSS test shows that the null hypothesis of stationary or no unit root can be rejected at 1% significant level when all variables are tested in their level.*

Table 3: The Johansen-Juselius Co-integration Tests

Null Hypotheses	**Eigenvalue**	**Trace**	**Critical Value (1%)**	**Max-Eigen**	**Critical Value (5%)**
Jordan-Bahrain					
(r = 0)	0.424347	42.864***	35.65	35.896***	25.52
(r ≤ 1)	0.092794	6.9681	20.04	6.3300	18.63
(r ≤ 2)	0.009769	0.6380	6.65	0.63808	6.65
Jordan-Qatar					
(r = 0)	0.347410	36.813***	36.65	27.742***	25.52
(r ≤ 1)	0.123672	9.0713	20.04	8.58098	18.63
(r ≤ 2)	0.007516	0.4903	6.65	0.49036	6.65
Jordan-Kuwait					
(r = 0)	0.35225	45.990***	35.65	27.792***	25.52
(r ≤ 1)	0.24703	18.197	20.04	18.159	18.63
(r ≤ 2)	0.000603	0.0386	6.65	0.03861	6.65
Jordan- Saudi Arabia					
(r = 0)	0.318665	37.085***	35.65	23.405***	25.52
(r ≤ 1)	0.191232	13.679	20.04	12.946	18.63
(r ≤ 2)	0.011940	0.7327	6.65	0.73273	6.65
Jordan- Oman					
(r = 0)	0.3173	36.352***	35.65	24.050***	25.52
(r ≤ 1)	0.1754	12.30196	20.04	12.150	18.63
(r ≤ 2)	0.0024	0.15166	6.65	0.1516	6.65
Jordan- UAE					
(r = 0)	0.394511	38.836***	35.65	32.611***	25.52
(r ≤ 1)	0.08622	6.2242	20.04	5.86076	18.63
(r ≤ 2)	0.005576	0.3634	6.65	0.36347	6.65

*The co-integration test can be implement to examine the long-run relationship among these variables. Table 3 displays the results for the Johansen co-integration test. The results showed that there exists a co-integrating relationship between exchange rate, domestic and foreign price levels. Notes: r indicates the number of co-integrating vectors. *** and ** denote significance at 1% and 5% levels.*

For the country pairs for which co-integration relationship is detected, we preceded to the VECM, which is a test for short-run relationships among the exchange rate, domestic price level and foreign price level. Table 4 reports on the VECM obtained for Jordan-Bahrain, Jordan-Kuwait, Jordan-Qatar, Jordan-Saudi Arabia and Jordan-United Arab Emirates respectively. The diagnostic tests such as normality test (Jarque-Bera), an autocorrelation test (Langranger multiplier), a heteroskcedasticity test (ARCH Test) and stability test (Ramsey RESET) are also reported.

The estimated coefficients of the co-integrating vector shown in Table 4 indicate that these are correctly signed for Jordan-Bahrain and Jordan-Saudi Arabia. Hence, it seems to represent a PPP relationship for Jordan-Bahrain and Jordan-Saudi Arabia. The results indicate that the error-correction terms (ECTs) for Jordan-Bahrain, Jordan-Kuwait, Jordan-Qatar, Jordan-Saudi Arabia, Jordan-Oman and Jordan-United Arab Emirates carried the expected sign. This suggests that whenever there is a deviation from the equilibrium co-integrating relationship, the exchange rate interacts in a dynamic fashion by adjusting to restore long-run equilibrium. Lastly, the models passed all the diagnostic checking. The diagnostic tests results showed that the residuals were normally distributed, there was no serial correlation, no heteroskedasticity or misspecification problems, and the models were stable.

CONCLUSION

The main purpose of this paper was to examine the validity of PPP and to investigate the market integration between Jordan and its major trading partners, namely, Bahrain, Kuwait, Oman, Qatar, Saudi Arabia and United Arab Emirates based on data covering the period of 2005Q1-2012Q4. The results of co-integration tests showed that a co-integrating relationship existed between the exchange rate, domestic and foreign price levels for Jordan and seven countries, namely, Bahrain, Kuwait, Qatar and Saudi Arabia. Hence, lending support to the validity of PPP. Additionally, there was no co-integrating relationship among Jordan-Oman, Jordan-United Arab Emirates due to recent agreements made with Jordan and some trade barriers such as double taxation and distance. The findings of PPP holding between Jordan and its major trading partners implied that the Jordanian economy was integrated with these countries. This finding has important policy implication on cross-border agreements for international trade and investment with these countries. The efforts to promote trade within these economies and remove barriers with these countries. Given that the goods and services markets appeared quite integrated, future liberalization will likely be pronounced in financial markets. If we envision this process of integration continuing, in particular in the Middle East region, and to the extent that this process requires even more political engagement, we believe the prospects for cooperation along a variety of dimensions are good.

The implications of this paper for policy makers, for Jordan and the GCC country governments is that the degree of conformity to PPP is much less in these countries compared to more developed countries. This should be taken into account when considering the proposed GCC Union, since the absence of PPP relationships between its prospective members raises some doubts about its feasibility or at least long-run sustainability. Moreover, it is well-known that there is a negative relationship between any misalignment of the exchange rate and economic performance such as economic growth, imports, exports and investment and, therefore, the lack of PPP is a reason for concern about growth in these countries and calls for exchange rate management policies. Such policies appear to be crucial in this group of countries also because exchange rate misalignment has a negative effect on export performance.

Overall, our analysis highlights the fact that managing the exchange rate effectively is one of the key challenges in Jordan and the GCC countries and one of the most important issues that should be addressed in that region given the adverse impact on the economy of exchange rate misalignments. In order for the GCC members to have a successful union and achieve objectives faster, it is important to have a similar level of economic performance, in particular in the exchange rate regime.

Table 4: Vector Error-Correction Results

Variables	Expected Sign	Jordan-Bahrain	Jordan-Kuwait	Jordan- Qatar	Jordan- Saudi Arabia	Jordan-Oman	Jordan-UAE
Standardize β Co-integrating Vector							
ER_{t-1}		1.00	1.00	1.00	1.00	1.00	1.00
CPI_{t-1}	-	1.28**	1.56***	6.27***	0.38***	-3.45***	-4.88***
CPI^*_{t-1}	+	27.05***	-1.02***	-19.89***	0.20**	2.17***	5.02***
Standardize α Coefficients							
ECT	-	-0.021***	-0.15***	-0.04**	-0.16***	0.22***	-0.007**
ΔER_{t-1}		0.13	0.09	0.09	0.42	0.38	0.15
ΔER_{t-2}		-0.29	-0.19	-0.14	0.15	-0.14	-0.13
ΔCPI_{t-1}		-0.72	-0.74	-0.53	-0.16	-0.01	-0.31
ΔCPI_{t-2}		0.15	-0.35	0.74	0.29	-0.04	0.46
ΔCPI^*_{t-1}		-0.82	-2.32	0.60	1.49	0.61	-0.95
ΔCPI^*_{t-2}		-0.82	-1.44	-0.55	0.18	1.10	0.08
C		0.009	0.03	-0.0009	-0.03	-0.04	-0.04
D1			-0.03				
D2					-0.04		
D3						-0.03	
D4							-0.05
Diagnostic Tests							
R^2		0.1874	0.8351	0.2055	0.8127	0.8405	0.7308
Adjusted R^2		0.0877	0.8115	0.1062	0.7859	0.8178	0.6923
S.E. of Regression		0.0497	0.0155	0.0208	0.0163	0.0121	0.0227
F-Statistics		1.8785	35.439	2.0693	30.3767	36.8976	18.999
JB		5.0259	0.3177	5.0167	5.0972	1.2284	0.8000
BG – (LM Test)		1.1975	2.5693	0.0955	0.8245	0.0123	0.8502
ARCH Test		0.95688	0.4979	0.3759	0.0921	0.2993	0.0086
Ramsey RESET		0.7939	2.9145	0.4013	2.9579	0.0638	0.6066

*Table: 4 reported the VECM obtained for Jordan-Bahrain, Jordan-Kuwait, Jordan -Qatar, Jordan- Saudi Arabia and Jordan- United Arab Emirates respectively. The diagnostic tests such as normality test (Jarque-Bera), an autocorrelation test (Langranger multiplier), a heteroskcedasticity test (ARCH Test) and stability test (Ramsey RESET). Note: Δ = First difference operator; ***, ** and * denote significant at 1%, 5% and 10% level respectively. D1, D2, D3 and D4 are dummies introduced to correct the normality. D1 = 1 in 2006Q1, 2007Q3, 2009Q1, 2012Q2, 2012Q3 and 2012Q4; D1= -1 in 2005Q2, 2006Q1, 2007Q4, 2009Q3, 2010Q2, 2010Q4, 2012Q2; and zero in all other quarters. D2 = 1 in 2005Q3, 2006Q2, 2007Q1, 2007Q4, 2008Q3, 2010Q2, 2011Q3; D2 = -1 in 2006Q3, 2007Q3, 2008Q4, 2009Q3, 2010Q1, 2010Q3, 2011Q1, 2011Q2, 2012Q1; and zero in all other quarters). D3 = 1 in 2007Q1, 2007Q3, 2008Q1, 2008Q2, 2009Q3 and 2010Q3; D3= -1 in 2005Q2, 2006Q1, 2007Q4, 2008Q3, 2010Q2, 2010Q4, 2012Q2; and zero in all other quarters. D4 = 1 in 2005Q3, 2006Q2, 2007Q1, 2008Q4, 2009Q3, 2010Q2, 2011Q3; D4 = -1 in 2006Q3, 2007Q3, 2009Q4, 2010Q3, 2011Q1, 2011Q3, 2012Q1, 2012Q1; and zero in all other quarters.*

Further future studies the symmetry and proportionality condition on PPP (strong version of PPP), which has also been the object of a considerable research, has to be taken into account. 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

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