A COINTEGRATION ANALYSIS FOR THE VALIDITY OF PURCHASING POWER PARITY: EVIDENCE FROM MIDDLE EAST COUNTRIES

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ABSTRACT

This paper examines the validity of Purchasing Power Parity between Jordan and its major trading partners namely, Turkey, Qatar, Iraq, United Arab Emirates and Saudi Arabia. Unit root tests, Johansen cointegration test were employed to test the data covering the period of 2000Q1-2020Q4. The unit root tests demonstrated that all variables are integrated of order one. The results of cointegration tests showed that there exists a cointegrating relationship between exchange rate, domestic and foreign price levels for the selected countries does have a cointegration relationship. This suggests that whenever there is a deviation from the equilibrium cointegrating relationship, exchange rate interacts in a dynamic fashion in adjusting to restore long-run equilibrium. As a conclusion, these results provide evidence on Purchasing Power Parity model hold in the long run and the Jordanian economy is integrated with these countries.

Keywords*: Purchasing Power Parity; Johansen Cointegration.*

1. INTRODUCTION

Purchasing power parity theory (PPP) has been discussed widely in the literature and has a long history but really came to the prior during discussions concerning appropriate exchange rates in which countries should rejoin the Gold Standard after the First World War. The theory still commands considerable respect in certain quarters and some financial institutions, such as the Swiss Bank Corporation [1], regard it as a useful guide to long-term currency movements. In recent times, there has been an explosion of empirical research on the validity of PPP in the real world. [2] argue whether PPP hold with the geographic region or based on trade volume. [3] point out, these studies may be categorized according to whether: price and exchange rate levels based on absolute PPP or changes in prices and exchange rates according to relative PPP. The second issue purely traded goods' prices or non-traded as well as traded goods' prices are considered. The agreement aims to deepening the trade integration and promoting mutual investments between the member of countries, to increase investment opportunities between these countries and to facilitate trade movement between the countries and double taxation avoidance [4][5].

A special topic to be taken into consideration by investors and monetary authorities is the integration of the international market. This topic is not discussed very widely ranging between the Middle East and North Africa (MENA) Countries, and not much research has been done on the topic of market integration of MENA. But this topic has been investigated for the market of United States of America (U.S.A.) [6][7]. Moreover, the issue of the symmetry and proportionality condition on PPP (strong version of PPP), which has also been the object of considerable research. One implication of unit root tests is that the restrictive conditions of

proportionality and symmetry restrictions are satisfied in PPP [8][9][10][11][12]. 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 [10][13], the weak version of the PPP hypothesis states that nominal exchange rates and aggregate price ratios may move together in equilibrium, but the relationship need not necessarily be one-to-one [14][15]. Testing for weak PPP is typically facilitated by the technique of cointegration [16]. The advantage of the cointegration test for PPP is that it relaxes the restriction of symmetry or proportionality imposed by unit root tests of real exchange rates. Therefore, this study will use the Johansen cointegration test as it serves the purpose [17][18].

The puzzle of PPP based on the empirical evidence shows that international price differences for individual goods (in the case of the law of one price)[19] or baskets of goods appear highly persistent or even non-stationery and fluctuations in the real exchange rate are very volatile and very persistent [20] [21]. The objective of this paper is that it examines the somewhat under-researched issue of what determines the validity of PPP? Does trade and geographic contribute towards the validity of PPP?[22] This paper tries to link these characteristics, namely, trading partners, and geographical regions with the validity of PPP [23]. Therefore, it is appropriate to investigate PPP among countries with similar characteristics, but it is not appropriate for studying PPP among a more diverse group of countries [24][25]. This paper contributes towards reducing the gap in the literature by providing new empirical evidence on the impact of PPP characteristics in developing countries [13][26][27].

The rest of the paper is organized as follows. Section two discusses the PPP theory and section three a brief of literature review. Section four is a review on the methodology and data employed in this study[28][29]. Section five reports the empirical results of this study, and the last section provides the conclusion and overview of this study[30].

2. THEORY OF PURCHASING POWER PARITY

PPP stated that, the exchange rate between two currencies is in equilibrium when their purchasing power is the same in each of the two countries that is 'the law of one price', that identical goods should sell for identical prices in different countries' markets[31]. That means the exchange rate between countries should be equal to the ratio of the countries' price levels of a fixed basket of goods and services [32]. When the country's domestic price level is getting increased more rapidly than its major trading partner that tell us a country experiencing inflation [33], that country's exchange rate must depreciate to return to purchasing power parity [34]. There are two types of purchasing power parity theory, absolute and relative purchasing power parity. Absolute purchasing power parity 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[35], in other words [36], absolute purchasing power parity theory postulates that the purchasing power of money should be equal between countries [2][37][38].

$$S = P/P^* \quad (1)$$

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 [39]. 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[40][41], but rather focuses on changes in this purchasing power [42][43]. Relative purchasing power parity theory [44][45], 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 [46][47].

$$S=k\ (P/P^*) \quad (2)$$

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 [48].

3. LITERATURE REVIEW

The PPP theory has been tested for several countries using various statistical methods, sample periods and frequency of data[49]. Despite the extensive research on PPP, to our knowledge, there are only a few analyses for the Middle East countries [50]. In particular, [51][52] for Jordan, and [37] for different panels of countries including Jordan [32]. [14] test two forms of purchasing power parity (PPP), specifically the strong form of PPP and the weak form of PPP between Jordan and its major trading partners [33] namely, Japan, United Kingdom, Turkey, and United State, based on data covering the period of 2000M1-2012M12 [53]. The found evidence for weak PPP but not for strong PPP [54], hence, the conditions of proportionality and symmetry restrictions may be one of the reasons that PPP does not hold when being tested empirically. [52] examined PPP between Jordan and Japan, and between Jordan and Germany using unit root method and found no evidence of PPP. [37] apply panel cointegration techniques to test the PPP for different panels of countries, such as the OECD, the countries in Africa, Asia, Middle East, and North Africa (MENA), Latin America and Central and Eastern European [55][56]. They reported favorable evidence of PPP in the OECD panel while weak PPP in 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 [57][58].

Previous empirical studies on Asian countries have found mixed results. [51],[59], [60],[26] and [5] found evidence to support long-run PPP for Asian economies. However, [61] found mixed evidence of PPP from thirteen Asian Pacific economies. On the other hand, the results of [62], [63], [64], [27], [1] and [65] failed to show evidence in supporting PPP for Asian Pacific countries. There are numerous studies on PPP conducted on developed countries. Some recent studies that supported exchange rate stationarity for developed countries are Oh (1996) for the G-6 and OECD countries, [66] for the industrial countries, [67] for the OECD countries, [68] for the OECD, Coakley and [69] for the G-10 countries and [70] for 17 developed countries. On the other hand, some studies have also shown that the real exchange rate of non-stationary. These are done by [71] for the OECD countries, [38] for 65 developing countries, and [72] for eight Pacific countries and 15 developed countries.

Recently, there are some studies conducted beyond the developed/developing country dichotomy to investigate the role of individual country characteristics on PPP. [14]; [12] test two forms of purchasing power parity, specifically the strong form of PPP and the weak form of PPP between Jordan and its major trading partners [73]. The results show that the real exchange rate in each country is nonstationary. This implied that the long-run PPP fails to hold for all countries [74][75]. The results of cointegration tests showed that there exists a cointegrating relationship for all the countries between exchange rate, domestic and foreign price levels. They conclude that the evidence of weak PPP is found between Jordan and its major trading partners. The unit-root tests of real exchange rates-imposed proportionality and symmetry restrictions that nominal exchange rates and aggregate prices move together in a one-to-one fashion[76][77]. The weak form of the PPP states that the nominal exchange rate

and aggregate price ratios may move together in equilibrium, but the relationship need not necessarily be one-to-one [78][79]. This paper 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 does not hold when being tested empirically[80][81].

Based on the above literature, it is noticed that few studies have been conducted for the developing countries in particular Jordan, Turkey, Qatar, Iraq, United Arab Emirates and Saudi Arabia [82]. Although, these countries are expanding their businesses and a high volume of trade among them[83]. Therefore, it is important to discuss this issue with these countries [84].

4. METHODOLOGY AND DATA

In this study, we first examine the time series properties. The unit root test of ADF test issued to examine the stationarity of the data. The unit root tests were first implemented on level, and then on first difference of the data[85][86]. If the series are of first order, then we may proceed to test the existence of the long-run relationship among these variables using Johansen cointegration test [87]. If the Maximum Eigen statistic and trace statistic greater than 5% critical value, then we rejected the null hypothesis. 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 [88]. In addition to the existing Augmented Dickey-Fuller, (1979) and Phillips-Perron, (1988) tests, EViews now allows you to compute the GLS-detrended Dickey-Fuller (Elliot, Rothenberg, and Stock, 1996) [89], Kwiatkowski, Phillips, Schmidt, and Shin (1992), Elliott, Rothenberg, and Stock Point Optimal (1996), and Ng and Perron, (2001)[90] unit root tests [91]. All these tests are available as a view of a series. in this study, some selected courtiers chosen due to the high trade among them i.e. between Jordan and its major trading partners namely, Turkey, Qatar, Iraq, United Arab Emirates and Saudi Arabia [92]. Unit root tests, Johansen cointegration test were employed to test the data covering the period of 2000Q1-2020Q4 by using EViews software the following discussion outlines the basic features of ADF unit root tests. Consider a simple AR (1) process:

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

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 [93].

The unit root tests that EViews provides generally test the null hypothesis $H0: p = 1$ against the one-sided alternative $H_1: p < 1$. The test of weak PPP consists in testing the existence of a cointegration relationship between the nominal exchange rate and the price ratio. Let,

$$E=k\ (P/P^*) \quad (2)$$

Where k is a constant parameter
Rewrite equation 2 in log form

$$\log e_t = \beta 1 \log p_t - \beta 2 \log p^* \quad (3)$$

Estimation cointegration regression

$$\log e_t = c + \beta 1 \log p_t - \beta 2 \log p^* + \varepsilon_t \quad (4)$$

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

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 [94]. 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 [95].

Let $Xt = (e_t, p_t, p_t^*)$. If all components in Xt are integrated of order 1, ($I(1)$, if the cointegration vector satisfies the restriction of proportionality, i.e., α=(1,-1,1). Hence, testing the cointegration among e_t, p and p^* examining the proportional restriction of the cointegration vector are ways of testing the validity of PPP [96][50].

Then, the test of cointegration between the nominal exchange rate and the national price levels by estimating the following regression:

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

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 for PPP to hold. For relative PPP $\beta 1$ and $\beta 2$ does not need to be equal to 1[97] [98].

4.1. Cointegration Test

In this study, cointegration procedure developed by Johhansen, (1988) and Johansen-Juselius, (1990) is employed to examine long-term relationship between the different models within economics, as proposed in the coming parts [99]. Cointegration refers to the possibility that non-stationary variables can be a linear combination that is stationary [100]. From a statistical perspective, a long-term relationship means that the balance variables move together in time [101], so that any short-term deviations from long-term trend will be corrected. These series are said to be cointegrated and therefore a common root stochastic trend. Johansen-Juselius, procedure again, in the *n*-variable first order given by VAR Engel, and [102][103]

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$$\Delta X_t = A_1 X_{t-1} + \varepsilon_t \quad (7)$$

By subtracting X_{t-1} from each side of the equation, equation (7) can be rewritten as:

$$\begin{aligned} \Delta X_t &= A_1 X_{t-1} + X_{t-1} + \varepsilon_t \quad (4) \\ &= (A_1 - I) X_{t-1} + \varepsilon_t \\ &= \pi X_{t-1} + \varepsilon_t \end{aligned}$$

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 cointegration vectors, also, the model in equation (8) can be generalized to allow for a higher-order autoregressive process [104]. Which is

$$\Delta X_t = \sum_{i=1}^{m-1} \pi_i \Delta X_{t-i} + \pi i X_{t-m} + \varepsilon_{\pi t} \quad (9)$$

And the most important function is still the grade as equal to the number of independent cointegration vectors [105]. 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 cointegration vectors in this model may be determined by checking whether the significance of the characteristic roots π [106]. The test for the number of cointegration vectors can be accomplished with the help of two like hood ratios (LR) test on the track of statistics and maximum eigenvalue statistics [107] as shown below:

Trace Test : $L_{trace(r)} = -T\sum L_n(1-\lambda_i)$ (10)

Maximum Eigenvalue test : $L_{\max(r,r+1)} = -TL_n(1-\lambda_{r+1})$ (11)

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 cointegration vector is smaller than or equal to *r* against a general alternative which gives the result of not more than *r* cointegrating vectors the last λ max statistical tests the null hypothesis that there is vectors *r* cointegrating against the alternative of *r +1* cointegrating vectors. In general, λ max statistics is preferable, because it represents the result of exactly *r* cointegrating vectors. Critical values for both tests are in a table [108][109].

5. RESULTS AND DISCUSSION

The ADF unit root tests are conducted, and the results can be seen in Table 1. The result of ADF test clearly shown 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 [110]; this means all the variables are stationary at first difference. However, the null hypothesis of stationary cannot be rejected when all variables are tested in their first differences [111][112]. Thus, we concluded that all the series are *I* (1) process.

Table 1: The Augmented Dicky Fuller Unit Root Test

	At Level		First Difference	
Variable	**Constant**	**Trend**	**Constant**	**Trend**
CPI Jordan	-1.510(0)	-2.902(0)	-8.642(0) ***	-8.678(0) ***
ER J-Qatar	-2.201(3)	-2.365 (3)	-5.130(2) ***	-5.443(2) ***
ER J-Iraq	-3.436(3)	-2.322 (3)	-6.120(2) ***	-6.154 (2) ***
ER J-Turkey	-2.436(3)	-2.397 (3)	-4.150(2) ***	-4.113(2) ***
CPI Qatar	-2.345(4)	-3.361(2)	-3.112(3) ***	-10.27(0) ***
CPI Iraq	-0.015(4)	-3.434(2)	-3.334(3) ***	-11.43(0) ***
CPI Turkey	-2.195(4)	-3.361(2)	-3.112(3) ***	-12.23(0) ***
ER J-UAE	-1.337(0)	-1.589(0)	-6.6769(0) ***	-6.687(0) ***
CPI UAE	-0.0037(5)	-2.940(5)	-3.6115(4) ***	-6.304(2) ***
ER J-Saudi Arabia	-2.304(0)	-0.108(0)	-5.634(0) ***	-5.952(0) ***
CPI Saudi Arabia	-2.499(1)	-1.948(1)	-4.339(0) ***	-4.908(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.

Table 2 above shows all the series are *I* (1) process; the cointegration test can be implemented to examine the long-run relationship among these variables [113]. Table 2 displays the results for the Johansen cointegration test.

Table 2: The Johansen-Juselius cointegration tests

Null Hypotheses	Eigenvalue	Trace	Critical Value (1%)	Max-Eigen	Critical Value (5%)
Jordan-Turkey					
(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)	0.345423	32.645***	24.65	32.696***	17.52
(r ≤ 1)	0.076763	6.7856	20.55	6.3434	22.63
(r ≤ 2)	0.008887	0.4543	6.65	0.68787	6.65
Jordan-Iraq					
(r = 0)	0.317323	44.213***	34.25	32.712***	26.22
(r ≤ 1)	0.123672	9.0713	20.04	8.58098	24.13
(r ≤ 2)	0.002416	0.3334	6.65	0.34234	6.65
Jordan-United Arab Emirates					
(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-Saudi Arabia					
(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

Notes: r indicates the number of cointegrating vectors. *** and ** denote significance at 1% and 5% levels.

The results showed that there exists a cointegrating relationship between exchange rate, domestic and foreign price levels for Jordan and five countries namely, Turkey, Qatar, Iraq, United Arab Emirates and Saudi Arabia [114]. The existence of a long run relationship between the exchange rates of Jordan and its trading partner, CPI Jordan and CPI trading partner supports the theory of PPP, indicating that it will hold over the estimated periods[115].

6. CONCLUSION

The main purpose of this study is to examine the validity of Purchasing Power Parity and to investigate the market integration between Jordan and its major trading partners namely, Turkey, Qatar, Iraq, United Arab Emirates and Saudi Arabia based on data covering the period of 2000Q1-2020Q4 [116][45]. The results of cointegration tests showed that there exists a cointegrating relationship between exchange rate, domestic and foreign price levels. Hence, lending support to the validity of PPP. The findings of PPP hold between Jordan and its major trading partners implied that the Jordanian economy is integrated with these countries [117][118]. Hence, these had important policy implication on cross-border agreement for international trade and investment with these countries. It is promising the efforts to promote trade with these economies and further removal of barriers with these countries[119][120]. Given the goods and services markets appeared quite integrated, future liberalization will be likely pronounced in financial markets. If we envision this process of integration continuing, 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 [121][122][123][124][125][126][127][128].

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