Purchasing Power Parity :
Evidence From the GCC Countries

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Abstract

Purchasing power parity (PPP) is one of the most extensively tested hypothesis in open macroeconomics. It states that the equilibrium exchange rate between two countries equal in the long run the ratios of their price levels. This hypothesis has been subjected to extensive tests however, the evidence has been less than conclusive.

The majority of studies tested the validity of the hypothesis, have been on developed countries and only a limited number on developing countries.

The paper explores the presence of PPP in five GCC countries, namely Kuwait, Saudi Arabia, Bahrain, Qatar and Oman. The PPP hypothesis was examined using two alternative econometric techniques – testing for a countegrating vector between the nominal exchange rate and price levels and testing of unit roots in the real exchange rate. The results shows that PPP holds but in a weak form in case of Saudi Arabia, Bahrain and Oman. No evidence is found in favor of the hypothesis in case of Kuwait and Qatar.

تكافؤ القوة الشرائية :
دراسة تطبيقية على دول مجلس التعاون الخليجي

الملخص

تعتبر فرضية تكافؤ القوة الشرائية من أكثر المواضيع التي نالت الكثير من الدراسات الاقتصادية على مستوى الاقتصاد الكلي المفتوح . و تقول فرضية تكافؤ القوة الشرائية التوازن في سعر الصرف بين دولتين في الأمد الطويل يساوي النسبة بين المستويات العامة للأسعار فيما بين تلك الدولتين .

و على الرغم من أن هذه الفرضية كانت موضع بحث الكثير من الدراسات ، إلا أن النتائج التطبيقية كانت أقل من حاسمة حول صحة هذه الفرضية . و تجدر الإشارة إلى أن معظم الدراسات حول فعالية هذه الفرضية كانت مطبقة على اقتصاديات الدول المتقدمة ، بينما لم تحظ الدول النامية إلا بعدد محدود من هذه الدراسات .

هذا البحث يختبر صحة فرضية تكافؤ القوة الشرائية في خمس من دول مجلس التعاون الخليجي و هذه الدول هي : الكويت ، السعودية ، البحرين ، قطر ، و عمان .

لقد تم في هذا البحث استخدام أسلوبين من أساليب الاقتصاد القياسي لاختبار فرضية تكافؤ القوة الشرائية حيث كان الأول لمتجه التكامل المشترك بين سعر الصرف الاسمي و مستويات الأسعار ، و الثاني كان اختبار أحادية الجذر في سعر الصرف الحقيقي .

النتائج التطبيقية أظهرت بأن هناك وجود ضعيف لصحة فرضية تكافؤ القوة الشرائية في حالة السعودية و البحرين و عمان ، بينما لا يوجد أي أدلة على صحة هذه الفرضية بالنسبة لدولة الكويت و دولة قطر .

I. Introduction

Purchasing power parity (PPP) is one of the most extensively tested hypothesis in open macroeconomics. It states that the equilibrium exchange rate between two countries equal in the long run the ratios of their price levels. This hypothesis has been subjected to extensive tests however, the evidence has been less than conclusive. Frenkel (1981a), Rush and Husted (1985), Kim (1990), and Davutyan and Pippenger (1985), among others, report findings in favor of PPP hypothesis. Kim found the strongest support for PPP. He looked at exchange rates and prices using annual data for the period 1900-87, He also looked at both the wholesale price index (WPI) and the consumer price index (CPI). Kim found the PPP holds better with the WPI than with the CPI because a greater Proportion of traded goods included in the WPI than the CPI which is expected to consist mostly of non traded goods.

On the other hand, studies like krugman (1978), Dornbusch (1980) and Frenkel (1981b) found evidence against long run PPP Frenkel in an article entitled "The Collapse of purchasing power parity During the 1970s" concluded that the PPP worked better during the 1920s than during the 1970s when the fixed exchange rates were abandoned. Davutyan and Pippenger (1985) argued the

he 1970s was characterized by real supply shocks and international co-ordination of monetary policies. Thus, the PPP did not fail; rather there was an increase in the volatility of these factors that give rise to the deviations from the PPP, Many other studies like Ender (1988), Hoque (1995), AL-Mutairi and Hoque (2000), Kargbo (2003), and Hassanain (2004), among others report mixed support for the hypothesis.

It should be noted that the majority of studies tested the validity of the hypothesis, have been on developed countries and only a limited number on developing countries. In this paper, we would like to extend the analysis to the case of Gulf Co-operation Council (GCC) countries with some unique features that they are capital-rich, oil-exporting developing countries. They follow a fixed exchange rate policy and heavily depend on imported goods and expatriate labor force. The study tests the validity of the PPP hypothesis with the US for five GCC countries namely, Kuwait, Saudi Arabia, Bahrain, Qatar and Oman. The study employs Johansen multivariate countegration technique and error correction modeling to examine the long run relationship between bilateral nominal exchange rate with US and relevant price levels of countries involved. The existence of a long run relationship among the variables in question is evidence for presence of PPP, the study will also develop a vector error correction model if the variable are found to be cointegrated to estimate the adjustment

coefficients that measure the speed of short run response of each variable in systems to disequilibrium occurring in the system.

The paper is organized as follows. Section II provides a simple discursion of purchasing power parity. In section III. The methodology used to test the PPP hypothesis is outlined. Section IV present the choice of data and the results. Section V discusses alternative methodology for testing the PPP hypothesis, and section VI concludes.

II. Purchasing Power Parity

PPP is a theory of exchange rate and price determination. The relation between exchange rate and relative prices could be expressed as the following.

$$E_t = \frac{P_{dt}}{P_{ft}} \tag{1}$$

Where P_{dt} and P_{ft} are the domestic price level and foreign price level respectively, and E denotes the bilateral exchange rate, measured as the domestic currency price of foreign currency. In its absolute version, PPP relies on the law of one price, which states that in the absence of government intervention and significant transportation cost and tariffs, an internationally traded

basket of similar goods shall sell for the same effective price when converted into the same currency. Equation (1) can be rewritten as

$$P_{dt} = E_t P_{ft} \qquad (2)$$

According to (2), when exchange rate is fixed, appreciation in prices in one country can be transmitted to its trading partners or the exchange rates will adjust to equalize prices when it is not fixed implying that floating exchange rate helps insulating the domestic country from outside shocks.

In practice, the absolute PPP does not hold for many reasons, including the existence of trade barriers and transportation costs, the existence of non-traded goods and services that preclude arbitrage, the difference in tastes of different countries and the difference in the composition and weights used in the construction of price indices of different countries. Instead a weaker version of PPP, known as relative PPP may hold. The relative PPP implies that the nominal exchange rate between two countries will adjust to account for differences in their price levels. Thus, the relative PPP provides useful explanation for exchange rats movements between two countries when exchange rate is influenced mostly by monetary rather than real shocks.

Taking the log form, equation (1) can be stated as

$$e_t = B_0 + B_1 P_{dt} + B_2 P_{ft} + \mu_t \qquad (3)$$

Where e_t, P_{dt} and P_{ft} are the logs of the exchange rate, domestic price level, and foreign price level respectively (as defined earlier) and μ_t is an error term capturing the deviations from PPP. For absolute PPP to hold in the long run, μ_t should be stationary and there should proportionality between exchange rate and price level requiring that $B_0 = 1$, $B_1 = 1$, $B_2 = -1$, Thus changes in the domestic or foreign price level are offset by change in the nominal exchange rate except for any stochastic shocks However, for an number of reasons mentioned earlier, the relation between exchange rate and price levels is more likely to be in form the relative PPP which requires only a stationary μ_t but the proportionality condition ($B_0 = 1$, $B_1 = 1$, $B_2 = -1$) does no necessarily hold.

In term of cointegration literaliure, even when the long ru proportionality between exchange rate and price levels is n exactly one to one, it is interesting to know whether exchange ra and price level move together or whether the variables in equatic (3) form a cointegrated system, Thus, a finding that the nomin exchange rate, domestic price level and foreign price level a

cointegrated is interpreted as evidence for long run PPP. Th present study uses the Johansen multivariate cointegratio technique to test the long run PPP relation between each of th GCC countries included in study and the US. A brief descriptio of this technique is presented in next section.

III. Cointegration and Vector Error–Correctio Model

The dynamic interaction between exchange rate and pric levels as specified in equation (3) can be analyzed by formulatin an unrestricted VAR system with all variables as endogenou: This multivariate technique is more efficient than single equatio modelling when the variables under consideration form more tha one cointegrated relationship. Since this condition may be preser in our data, the Johansen (1988) multivariate cointegratio technique is used to test the existence of a long run equilibriur relationship among the variables specified in equation (3), A brie description of this technique is presented below.

Consider the vector autoregressive (VAR) model of order K.

$$X_t = \Pi_1 X_{t-1} + \Pi_2 X_{t-2} + \ldots + \Pi_k X_{t-k} + \mu_t \quad (4)$$

$$(t=1,\ldots, T)$$

Where X_t is a column vector of 3 endogenous variables included in model (3), i.e., $X = (e_t, p_{dt}, p_{ft})$, k is the number of lags, and μ_t is a vector of normally distributed error term. Since most economic time series are non – stationary and since the VAR system required the data to be stationary, the system in (4) should be estimated in the first-difference form. However, since first differencing removes much of the valuable information about the equilibrium relationship among the variables, we follow Johansen (1988), and Johansen and Juseluis (1990) and rewrite system (4) in its first-difference form as

$$\Delta X_t = \Pi_0 + \Gamma_1 \Delta X_{t-1} + \Gamma_2 \Delta X_{t-1} + \dots + \Gamma_{k-1} \Delta X_{t-k-1} + \Pi X_{t-k} + \mu_t \quad (5)$$

$$(t = 1, \dots, T)$$

Where ΔX_t is the vector of growth rates of the variables included in the model, Π_0 is a vector of intercepts, the Γs are estimable parameters, and Π_0 is the long run parameter matrix. The above system is known as VEC (vector error correction) model which is basically the first-difference version of a VAR model plus an error correction term ΠX_{t-k}. The matrix Π contains information on the long-run relationship between the variables in X_t. If the rank of the Π matrix r is $0 < r < 3$, then there are two matrices, α and β, each with dimension 3xr such as $\alpha\beta$,

where r is the number of cointegrating vectors, and $\beta'X_i$ is stationary.

The matrix β contains r elements of the cointegrating vectors and matrix α contains the coefficients that show the speed of adjustment to the long run equilibrium. The important issue is how to determine the number of cointegrating vectors r. There are two likelihood ratio test statistics to test for the number of r. the first likelihood ratio statistics for the null of exactly r cointegrating vector against the alternative of r + 1 vector is the maximum eigenvalue statistic. The second statistic for the hypothesis of at most r cointegrating vector against the alternative is the trace statistics. For more details see Johansen (1991).

IV. Data and empirical analysis

All the data used in this study are quarterly and annually, and are obtained from the International Financial statistics (IFS). The PPP is tested between US dollar on one hand and the currencies of five GCC countries namely, Kuwait, Saudi Arabia, Bahrain, Qatar, and Oman. UAE is excluded from the study because of no data either quarterly or annual are found on price level (CPI or WPI). Price level series in case of Qatar and Oman are found on annual base , thus alternative method for testing the

long run PPP is used. The exchange rate is defined as the unit of domestic currency per US dollar. The preferred price level are the WPI because the WPI series is likely to include a greater proportion of traded goods compared to CPI, hence PPP is expected to hold better with WPI than with the CPI, However, because of the limitation in data availability, the CPI used rather then WPI in case of all countries except Kuwait. The series of price levels are measured in indices with 2000 as the base year. All series are converted to their natural logarithms. The sample period for testing PPP is constrained by the availability of data for each country as follows: Kuwait (1980:1-2005:2), Saudi Arabia (1985:1-2005:2), Bahrain(1980:1-2001:4), Qatar (1972-2004) and Oman (1988-2004).

Before testing for cointegration , all variables must be tested for the presence of unit roots. The Augmented Dickey-Fuller (ADF) test and Phillips -Person (PP) test were performed on the times series. The null hypothesis is that the series under consideration is integrated of order one (non-stationary) against the alternative hypothesis that it is integrated of order zero(stationary)[2]. Table 1 presents the results of ADF and PP tests results. From Table1, we can observe that the t-statistics of first

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[2] Statistically speaking, a time series is said to be stationary if its mean, variance and covariance are all invariant with respect to time. Such a series is denoted by 1 (0), that is, integrated of order zero.

difference of all time series for each country are significant at either 1% and 5%. Some of the t-statistics of the level series are also significant at 1% or 5%. We can therefore conclude that the series are either integrated of order zero or one and so they are useful for cointegration test.

Table 1. Test Results for Unit Roots

	ADF		PP	
	level	First difference	level	First difference
Kuwait				
Exchange rate	-2.64	-10.31	-2.64	-10.30
WPI	-1.36	-7.81	-3.01	-48.83
Sandi Arabia				
Exchange rate	-6.02	-2.77	-25.27	-6.18
CPI	-3.06	-6.95	-2.91	-6.93
Bahrain				
Exchange rate	-5.19	-9.27	-19.46	-9.27
CPI	-2.79	-3.36	-4.89	-8.82
Foreign price Level (US{WPI})	-0.54	-6.13	-0.89	-8.11

Note: Testing the presence of a unit root with the ADF and PP involves estimating the following equations by OLS

$$\Delta Y_t = \alpha + BY_{t-1} + \sum_{i=1}^{m} n\Delta Y_1 + Pt + e_t \quad \textbf{(ADF)}$$

$$\Delta Y_t = \alpha + BY_{t-1} + \phi\left(t - \frac{T}{t}\right) + \sum_{i=1}^{m} n\Delta Y_1 + e_t \quad \textbf{(PP)}$$

Where Y_t is the relevant time series, Δ is the first difference operator and e_t stationary random error. The optimum lag length (m) in the ADF is determined by AIC and in the PP is decided according to Newly-west using Bartlett kernel. The time trend t is allowed only when found to be significant. The critical value for ADF and PP at 5% level is 2.89 (Mackinnon 1990). Equations were estimated using E-views 5.1 program.

The test for the presence of a cointegrating vector is performed using the Johansen method as discussed earlier. In applying this method a constant and lags were included. The optimum lag length for the variables (i.e. k in equation 4) for each country under consideration is determined using the "Akaike Information criterion"(AIC). The existence of cointegrating vectors is tested based on trace and maximum eigenvalue tests and the results are shown in Table 2.

Based on both trace and maximum eigenvalue tests, the hypothesis that "no countegrating vector exists" is rejected in favor at least "two cointegrating vector exist" at 5 percent significance level in case of Saudi Arabia, and in favor of at least "one cointegrating vector exists" at 5 percent significance level in case of Bahrain.

On the other hand, the hypothesis of no cointegrating vector is not rejected in case of Kuwait. Thus, the results indicate that the PPP holds in case of Saudi Arabia and Bahrain and it does not hold in case of Kuwait despite of the fact that Kuwait is the only country among the three countries which we use WPI as price index where the PPP often holds better since WPI include exported goods and thus is weighted more toward traded good than is the CPI. The possible reason for the failure to support the

PPP hypothesis in case of Kuwait is that until 2005, the central bank of Kuwait has been determining the dinar's foreign exchange rate based on a weighted basket of currencies whose composition is supposed to reflect Kuwait's foreign trade while other GCC countries including Saudi Arabia and Bahrain peg their domestic currencies against one major currency which is the US dollar (the base currency in this study). The present finding with respect of Kuwait is in contrary with that obtained by Al-Mutairi and Al-Hoque (2000) who find evidence in favor of PPP hypothesis over the period 1972:1-1993:4. This, however, could be attributed to differences in the methodology and sample period.

One more reason for different finding is that contrary to present study, Al-Mutairi and Al-Hoque (2000) worked with CPI as price index rather than WPI. Kuwaiti government like other government in the Gulf highly generously subsidies many non – tradable goods and services (enter in the computation of CPI) such as water, electricity, health, education, construction materials, basic foodstuffs (bread, rice, sugar, fish, meat....etc) to keep the overall price level low. This suggests that the inflation rate in Kuwait are watched very closely and a parity with international level especially with its major trading partners are maintained. This explain the support for the PPP found by Al-Mutairi and Al-Hoque (2000). The highly subsidized non-tradable goods and

services enter in CPI could offer another explanation for the evidence supporting PPP in case of Saudi Arabia and Bahrain found by the present study. Moreover, our finding with regard to Saudi Arabia, Bahrain and Kuwait is in line with those obtained by Hassanain (2004).

Table 2: Johansen – Juselius Cointegration Test Results

	Maximum eigenvalue statistics			Trace statistics			Eigen values		
	Kuwait	Saudi Arabia	Bahrain	Kuwait	Saudi Arabia	Bahrain	Kuwait	Saudi Arabia	
$r = 0$	15.36 (22.29)	57.49 (22.29)	55.27 (22.29)	32.30 (35.19)	77.77 (35.19)	65.77 (35.19)	0.145	0.512	
$r \leq 1$	13.18 (15.89)	17.14 (15.89)	7.27 (15.89)	16.94 (20.26)	20.21 (20.26)	10.49 (20.26)	0.125	0.197	
$r \leq 2$	3.75 (9.16)	3.12 (9.16)	3.21 (9.16)	3.75 (9.16)	3.12 (9.16)	3.21 (9.16)	0.037	0.039	

Note: The values in parentheses show the 5% critical value.

Because the nominal exchange rates and price levels are cointegrated in case of Saudi Arabia and Bahrain, we can proceed

Table 3. Estimates of Cointegrating Vectors

Country	Nominal Exchange Rate (e)	Domestic Price level (Pd)	Foreign Price Level (Pf)	Constant	Trend	Error Correction Coefficient (EC)
Saudi Arabia	1	0	-4.55 (-1.96)	1.615	-0.002 (-4.11)	-
	0	1	-51.11 (7.05)	63.23	-0.003 (-2.46)	-
Bahrain	1	0.255 (10.62)	-0.043 (-2.14)	-	-	-0.166 (-3.23)

Note: Numbers in parentheses are the t-statistics

V. Real exchange rate

The literature on PPP also includes alternative method for examining whether long run PPP holds. This method is based on testing whether the deviations from PPP i.e, real exchange rate follows a random walk. If e_t, P_{dt}, and P_{ft} are the logs of the nominal exchange rate, domestic price level, and foreign price level respectively, then the log of the real exchange rate is defined as.

$$R_t^e = e_t - P_{dt} + P_{ft}$$

If the real exchange rate (the short run deviations from PPP) is characterized by random walk behavior, then there will be no

with estimating the value of cointegrating vector (β's) and error correction coefficients (EC) for each of both countries. The cointegrating vectors are normalized to unity by the nominal exchange rate in case of Bahrain and by both nominal exchange rate and domestic price level in case of Saudi Arabia because there are two countegrating vectors. The β coefficients shown in Table 3 describe the long run relationship between nominal exchange rate and price levels. These coefficients are significant and have the correct signs. The values of β are greater than 1 in case of Saudi Arabia and less than 1 in case of Bahrain. These findings, therefore, support the weak form of PPP and no evidence of strong form of PPP.

The error correction coefficients that show the adjustment toward the equilibrium is - 0.167 in case of Bahrain where one cointegrating relationship exists indicating that about 17% of the deviations from PPP is corrected in each time period (quarter). In case of Saudi Arabia, no error correction coefficients were estimated because there are two equilibrium relationship linking the variables, hence the error- correction representation is not easily defined.

tendency for nominal exchange rate and price levels to settle down together (converge) even in the long run. This implies that the deviations from PPP follows a random walk and hence PPP can not hold, even as a long run phenomenon. In term of the time series property of the data, this indicates that the real exchange rate is non-stationary, i. e. integrated of order one.

To find out whether or not PPP holds, we test the bilateral real exchange rates between US dollar as "base currency" and the currencies of five GCC countries namely Kuwait, Saudi Arabia, Bahrain, Qatar, Oman. It is important to note that in case of Qatar and Oman, the analysis is conducted using annual data which are the only available data. Table 4 gives the ADF and PP statistics testing the non-stationarity of the real exchange rates. The null hypothesis of a random walk for the real exchange rate series could not be rejected for all countries at 1% and 5% significance level except for Oman at 5%. In case of Saudi Arabia and Bahrain the null is weakly rejected at 10%. The above results indicate that long run PPP holds well in case of Oman and weakly holds in case of Saudi Arabia and Bahrain, where as it does not hold in case of Kuwait and Qatar. These results are consistent with our earlier results on cointegration implied a presence of PPP in case of Saudi Arabia and Bahrain, and a failure of PPP in case of Kuwait.

Table 4. Unit- root tests for real exchange rates

Country and Period	ADF	PP
Kuwait Quarterly (1980:4-2005:2)	-0.424	-0.385
Saudi Arabia Quarterly (1985:3-2005:2)	2.586*	-2.622*
Bahrain Quarterly(1980:3-2001:4)	2.636*	-2.715*
Qatar Annual (1980-2004)	2.601	-2.614
Oman Annual (1994-2004)	-2.089**	-2.846**

Note; **,* indicate the 5% and 10% statistical significance levels respectively

VI. Conclusion

The aim of this paper was to examine the PPP hypothesis in five GCC countries, namely Kuwait, Saudi Arabia, Bahrain, Qatar and Oman. The PPP hypothesis was examined by testing for a cointegrating vector between nominal exchange rate, domestic price level, and foreign price level in case of three countries, Kuwait, Saudi Arabia and Bahrain where quarterly data are available. The PPP hypothesis was also examined by testing for unit roots in the real exchange rate in all five countries under consideration including Qatar and Bahrain where only annual data are available.

Based on the cointegrating testing, the results indicate that PPP holds in case of Saudi Arabia and Bahrain and fails to hold in case of Kuwait despite of the fact the WPI was used as a measure for a price level. The null hypothesis of a unit root in the real exchange rate could be rejected strongly in case of Oman, and weakly in case of Saudi Arabia and Bahrain suggesting that PPP holds in case of these countries. The results are generally consistent with the results obtained by Hassanain (2004) with regard to these countries.

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