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The theory of purchasing power parity in MENA countries: The quantile unit root test

Seyyed Ali Paytakhti Oskooe*, Ehsan Shafei

Department of Economics, Tabriz Branch, Islamic Azad University, Tabriz, Iran.

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Abstract

This paper examines the theory of purchasing power parity about the exchange rate of the dollar with local currencies in MENA countries - the Middle East and North Africa - using a unit root test established on the quantile auto regressive model during the period 1980-2017. This test, like other unit root tests, uses auto regressive model, unlike other methods that emphasize the mean of the dependent variable, this test employees different variables or quantiles for estimating the regression. If the theory of purchasing power parity is in place, the real exchange rate will be stationary. According to the results of quantile unit root test, the real exchange rate for dollar in all countries except the four countries of Morocco, Bahrain, Saudi Arabia and Jordan has a unit root and is not stationary. Therefore, except for the four countries mentioned, the theory of purchasing power parity is not true in other studied countries. This result could be due to the difference in macroeconomic conditions and less flexibility of the foreign exchange system in these countries compared to developed countries.

1. Introduction

The theory of purchasing power parity (PPP) asserts that the nominal exchange rate between countries in the long run is proportional to the ratio of prices between countries, and therefore the real exchange rate which is obtained from the multiplication of the nominal exchange rate in the ratio of the price index between the countries in the long run, has a constant mean and return to a constant equilibrium value in the long run. Therefore, the real exchange rate is a stationary variable. In recent years, the problem that has been known is that there is not much empirical evidence for this theory, and unit root tests are employed to solve this puzzle. The most frequently used unit root tests are the generalized Dickey Fuller test, and Philips Peron test. These tests usually detect the real exchange rate is non stationary and reject the PPP (Bahmani-Oskooee et al. 2016).

In different studies, unit root tests have been used to inspect the justifiability of the theory of purchasing power parity, and different and even conflicting results

* oskooe@yahoo.com
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have been obtained. One of the unit root tests is established on the quantile auto regressive model. Quantile regression has been expanded by Koenker and Bassett (1978), and then Koenker and Xiao (2004) have used this method to estimate auto regressive model and perform a unit root test. Many common root-unit tests take into account the average real exchange rate behavior, but quantile regression emphasizes the behavior of the variables or quantilities of the variable under study. Therefore, in the quantile regression, the form of the function of the distribution of the real exchange rate is more fully taken into account. If the theory of purchasing power parity is established and the real exchange rate is stationary, if this variable is subjected to a shock and diverges it from its long-term equilibrium path, an error correction mechanism will return the real exchange rate to its long-term equilibrium. This phenomenon is called mean reversion.

The importance of the theory of purchasing power parity is that if this theory is established, earning a lot of money from arbitrage on tradable commodities impossible. If this theory is incorrect, the shock to the exchange rate created by, for example, the national currency devaluation policy will cause a permanent deviation from the real exchange rate equilibrium. It also causes the sources of production to be moved from non-tradable sectors to tradable sectors, and ultimately, the exchange relationship changes for the benefit of tradable sectors and losses to non-tradable sectors. This phenomenon represents the Balassa–Samuelson effect. Also, if the theory of equality of purchasing power is not available, a policy of devaluation of the national currency can be used to deal with imbalances (Bahmani-Oskooee et al. 2016).

Table 1 outlines the adopted exchange rate regime in the MENA countries. The Conventional fixed peg is the most adopted regime in this region (eight countries). Algeria and Egypt have the Managed floating with no pre-determined path regime, whereas Syria, Iran and Tunisia implement the Pegged exchange rate within horizontal bands, crawling peg and crawl like regimes respectively. It seems that the adopted exchange rate regimes in the oil exporting countries are different.

Table 1. Exchange rate regime in the MENA countries

Country	Oil exporting	Exchange rate regime
Algeria	*	Managed floating with no pre-determined path
Arabia	*	Conventional fixed peg
Bahrain	*	Conventional fixed peg
Egypt	*	Managed floating with no pre-determined path
Iran	*	Crawling peg
Jordan	-	Conventional fixed peg
Kuwait	*	Conventional fixed peg
Libya	*	Conventional fixed peg
Morocco	-	Conventional fixed peg
Qatar	*	Conventional fixed peg
Syria	*	Pegged exchange rate within horizontal bands

Table 1 (Continued). Exchange rate regime in the MENA countries

Country	Oil exporting	Exchange rate regime
Tunisia	*	Crawl like
Yemen	*	Conventional fixed peg

***Source**: IMF, Annual Report on Exchange Arrangements and Exchange Restrictions*

The conventional unit root tests assume the rate of adjustment to the real exchange rate equilibrium is constant. These tests usually do not reject the unit root hypothesis and do not confirm the theory of purchasing power parity. Employing quantile unit root test can resolve the puzzle of the theory of purchasing power parity especially in developing countries. In the present study, firstly, for MENA countries's currencies against the US dollar, the real exchange rate for the years 2017-1980 was calculated, and then the stationarity of real exchange rate was examined by using conventional unit root tests and by using the unit root test based on the quantile auto regressive model. The under studding countries consist of Algeria, Saudi Arabia, Bahrain, Egypt, Iran, Jordan, Kuwait, Libya, Morocco, Qatar, Syria, Tunisia and Yemen . The study of the Iraqi, Djibouti, and Lebanese countries is not possible due to unavailability of data in some years of the study period.

Investigate the justifiability of the purchasing power parity in the MENA region has been the subject of numerical applied studies. Bahmani-Oskooee (1998) use the KPSS test along with the ADF test to investigate whether the real effective exchange rates in Middle Eastern countries follow a random walk process or they are stationary. In most countries the KPSS test confirmed the stationary of the real effective rates, consequently the validity of PPP. Narayan and Prasad (2005) investigate PPP for 11 Middle Eastern countries employing a numeral of tests: the one break test unit root, the two breaks unit root test, and the panel lagrange multiplier (LM) unit root test with structural breaks. The key result from univariate tests is that there is confirmation for PPP in only seven countries (Lebanon, Saudi Arabia, Egypt, Iran, Syria, Tunisia and Sudan). On the other hand, when the panel LM test is employed with two structural breaks, robust sign is found in support of PPP for the Middle Eastern countries.

Employing nonlinear TAR unit root test Benbouziane and Benamar (2006) examine the purchasing power parity theory in the Maghreb countries (namely, Algeria, Morocco and Tunisia). Their findings suggest that PPP holds in one threshold regime but not in the other. Bahmani-Oskooee and Kandil (2007) by using non-linear STAR unit root test in 14 MENA countries over the 1970-2004 period show that the PPP is confirmed in 8 out of 14 countries. Drine and Rault (2008) apply developed panel cointegration techniques to examine the robustness of the PPP concept for a sample of 80 developed and developing countries. Their finding show invalidity of PPP for MENA countries. Kalyoncu et al.(2010) re-examine the PPP hypothesis in which the endogenously determined break points are incorporated in thirteen major Middle East and Northern Africa (MENA) countries by using official and black market exchange rates data over 1970-1998. Their result show confirmation of PPP for all countries employing official and/or black market real exchange rates at the 10% level or better. Another study by Kalyoncu et al. (2011) show the evidence of PPP for eight of the thirteen MENA countries.

In the light of mixed empirical results, this study applies new unit root test namely quantile unit root test to the real effective exchange rate data from 14 MENA countries. To that end, Section II presents the test. Then the findings are showed in Section III and conclusions are summarized in Section IV.

2. Methodology

The unit root tests use auto regressive model to examine the stationarity of the variables, which in general and generalized form are as follows:

$$Y_t = c + \alpha Y_{t-1} + \sum_{i=1}^{q} \beta_i \, \Delta Y_{t-1} + u_t \qquad (1)$$

In equation (1), if α = 1, the variable Y_{t-1} has a unit root and is non-stationary, and if α <1, then the hypothesis of unit root is rejected and the variable is stationary. To investigate the hypothesis of the existence of unit root employed the t statistic and the common Wald test for the purpose of testing the constraints applied to the regression coefficients (1) and the following hypothesis is tested:

$$H_0 : \ \alpha = 1$$
$$H_1 : \ \alpha < 1 \qquad (2)$$

A significant issue in testing the above hypothesis is that the distribution of t in the unit root test does not have a standard distribution and its critical values are different. For the common ADF unit root test, the critical values are given by McKinon (1996). Koenker and Xiao (2004) have proposed the quantile regression method previously developed by Koenker and Bassett (1978) to conduct unit root test and estimating auto regressive model. Most regression models examine the effect of explanatory variables on the conditional mean of the dependent variable. But in the quantile regression, the linear relationship between the explanatory variables and a particular quintile of the dependent variable is examined. For example, a relationship between the explanatory and Middle (fifth deciles or second quartile) of the dependent variable can be estimated. Quantile regression provides a more complex picture of the conditional distribution of the dependent variable than the conditional average, and this model does not require strong assumptions about the distribution of the dependent variable.

In the ordinary least squares (OLS) method, the sum of squares of errors ($\sum e^2$) is minimized, but in the quantile regression, the sum of the magnitudes of errors ($\sum |e|$)is minimized, and so it is also called the method of minimum absolute magnitude of deviations. Quantile regression shows all the characteristics of the conditional distribution of the dependent variable. For example, if the distribution is either left or right, compared to the average, median is a more appropriate criterion of center-centeredness. Koenker and Xiao (2004) believe that if the assumption of the normalization of the residues is not satisfied, this test is more power than the conventional unit root tests. Equation 3 shows a simple first-order quantile auto regression (QAR (1)):

$$Y_t = \alpha(\tau) . Y_{t-1} + u_t \qquad (3)$$

In auto regressive model (equation 3), the coefficient $\alpha(\tau)$is the same as the auto regressive coefficient α in equation (1), which in fact indicates the persistency effect of the shocks on the Y_t variable. If this coefficient is equal to one, the effect of shocks is persistent and the variable $Y_t$is non-stationary and has a unit root, and if the coefficient α (τ) is less than one, the variable is stationary and the effect of the shocks will be temporary. Equation (3) is estimated by quantile regression method for various quantifiers and, different deciles (τ is equal to 0.1, 0.2 to 0.9) are estimated and unit root test is performed. The critical values of the t statistic in the quantile unit root test are different from the standard t-distribution and even with the distribution of the Dickey Fuller test. These critical values are introduced in Koenker and Xiao (2004). If the hypothesis of the unit root is rejected and the effect of shocks is temporary, then the half -life of the shock is obtained from the following equation:

$$H - L = \frac{ln\ (0.5)}{ln\ (\alpha(\tau))} \tag{4}$$

After obtaining the coefficients of auto regressive α(τ) for various quantals τ and the calculation corresponding $t_{\ n}(\tau)$, for testing the unit root hypothesis, the Kolmogorov-Smirnov statistics of quantile can be defined as follows. This statistic is equal to the absolute value of $t_{\ n}(\tau)$, which in absolute value has the highest value of t for various τ. The critical value of this statistic at 5% is 2,7737.

$$QKS = sup|t_{\ n}(\tau)| \qquad \tau \in (0.1,0.2,0.3, \ldots\ ,0.9)' \tag{5}$$

To obtain the critical values of the calculated $t_{\ n}(\tau)$, statistics, Koenker and Xiao (2004) argue that the asymptotic distribution $t_{\ n}(\tau)$ is a linear combination of the distribution of the Dickey Fuller and the standard distribution, which the linear composition weights are determined by the coefficient of correlation of two series of times. If $u_{\ t}$ is the disturbance of the quantile regression model in Equation (3), then the series $\Psi_t$can be defined as Eq. (6). In the equation (6), the function I(u<0)is an indicator function, which returns the value of 1 for negative values of $u_{\ t}$, and zero for positive or zero values of $u_{\ t}$.

$$\Psi_{\ \tau}(u) = \tau - I(u < 0) \tag{6}$$

$$I(u < 0) = \begin{cases} 1 & u < 0 \\ 0 & u \geq 0 \end{cases} \tag{7}$$

The series $\Psi_t$has only two values and its distribution is Bernoulli distribution with the variance indicated in equation (8). The variables $u_{\ t}$ and $\Psi_t$both have a mean of zero and are correlated with each other.

$$\sigma_{\Psi}^2 = \tau(1 - \tau) \tag{8}$$

The parameter δ^2represents the second power of the correlation coefficient between the series Ψ_t andω $_t$, which the approximation of ω $_t$can be estimated from the following equation (9):

$$\omega_{\ t} = \Delta Y_t \tag{9}$$

In the table of critical values of $t_{\ n}(\tau)$, it is necessary to have the parameter δ^2defined as (10):

$$\delta^2 = \frac{\sigma_{\ \Psi\omega}}{\sigma_{\omega}^2 \ .\ \sigma_{\Psi}^2} \tag{10}$$

The table of critical values of the t-statistic has been presented by Koenker and Xiao (2004) to investigate the presence of the unit root hypothesis in quantile auto regressive model.

The real exchange rate is described as the multiply of the nominal exchange rate of each country in the US consumer price index divided by the domestic consumer price index of each country. Nominal exchange rate is also defined as the domestic currency of the country against the dollar. Data was extracted from the World Bank's world development database during the 1980-2017 period. Firstly, the stationarity of real exchange rate reliability was examined with the common unit root tests, including the ADF test and the PP test, and then unit root test is conducted based on quantile auto regressive model.

3. Empirical Results

The outcomes of these two tests, namely, Augmented Dickey–Fuller (ADF) and the Phillips–Perron (PP) are reported in Table 2. In all countries except Morocco, real exchange rate is non-stationary and purchasing power parity theory in these countries is not confirmed. In the countries of Qatar, Syria, Tunisia, Libya and Yemen because of unavailability of data at the beginning or end of the period, the survey years are shorter than the period of 1980-2017[1].

Table 2. Univariate unit root test

Country	ADF		PP		Period
	Statistics	Critical value 5%	Statistics	Critical value 5%	
Algeria	-1.0562	-2.9412	-1.0661	-2.9412	1980-2017
Arabia	-2.3180	-2.9412	-2.7829	-2.9412	1980-2017
Bahrain	-1.7756	-2.9412	-2.2609	-2.9412	1980-2017
Egypt	-2.4882	-2.9412	-2.0953	-2.9412	1980-2017
Iran	-2.0941	-2.9412	-2.2201	-2.9412	1980-2017
Jordan	-2.4569	-2.9412	-2.2734	-2.9412	1980-2017
Kuwait	-1.6208	-2.9412	-1.7150	-2.9412	1980-2017
Libya	-0.7212	-2.9511	-0.9937	-2.9511	1980-2013
Morocco	-3.9653	-2.9412	-3.3216	-2.9412	1980-2017
Qatar	-1.3377	-2.9458	-0.7464	-2.9434	1980-2016
Syria	-1.5885	-2.9540	-1.7669	-2.9540	1980-2012
Tunisia	0.3620	-2.9511	0.3889	-2.9511	1983-2017
Yemen	-2.5246	-2.9981	-1.3209	-2.9919	1990-2014

Since the panel unit root tests have more power than individual unit root tests in identifying stationarity of economic data, table 3 presents the findings of common panel unit root tests. As it can be seen that according to Levin Lin Chu's statistics, real exchange rate of MENA countries is stationary, whereas the results from three other tests real exchange rate has a unit root process.

[1]- Due to lack of data, Oman is removed from sample.

Table3. Results of panel unit root tests

Test	Test Statistics	P-value	Result
Levin, Lin, Chu	-2.02250	0.0216	Stationary
Im, Pesaran, Shin	-0.82101	0.2058	Non-stationary
ADF-Fisher	33.4686	0.1489	Non-stationary
PP-Fisher	32.1199	0.1892	Non-stationary

Table 4 represents the outcomes of quantile unit root test for various quintiles from the first decade to the ninth decade. The coefficient of auto regressive $\alpha(\tau)$ represents the parameter of the persistency of the shocks on the real exchange rate, and being equal to 1 indicates the non-stationarity of the real exchange rate. The first and upper numbers in each cell from the table (2) indicate auto regressive coefficient in the regression of unit root test. The second and middle number in each cell represents the t statistic for the unit root test. The third numbers in each cell from Table (2) are related to the critical value of t statistic in the quantile unit root test, which is extracted from the table provided by Koenker and Xiao (2004).

According to the results of the quantile unit root test and the comparison of calculated t statistics calculated with their critical values in Bahrain, Jordan, Saudi Arabia and Morocco, the hypothesis of the existence of the unit root is rejected and the real exchange rate is stationary. So, in the case of these four countries, the theory of purchasing power parity is approved. Because of considering asymmetric effect of shocks in quantile unit root test, stationarity of variable in some quantiles suggests that shocks on real exchange rate have asymmetric effects (Koenker and Xiao, 2004). Meanwhile, in the case of Bahrain, Jordan and Saudi Arabia, common unit tests, such as ADF and PP, have showed the non-stationarity of real exchange rate, and rejected the theory of PPP. In Morocco, the common unit tests and the quantile unit root test all emphasize the stationarity of the real exchange rate and the correctness of the PPP theory. For the countries of Algeria, Iran, Egypt, Jordan, Kuwait, Libya, Qatar, Syria, Tunisia and Yemen, the existence of a unit root and non-stationarity of the real exchange rate is confirmed. Therefore, the purchasing power parity theory is not established in these countries.

Table4. Quantile unit root test

Country	Quantiles								
	0.1	0.2	0.3	0.4	0.5	0.6	0.7	0.8	0.9
Algeria	0.9159	0.9385	0.9705	0.9849	0.9711	0.9839	1.0151	0.9469	0.8996
	-----	-1.6534	-0.8205	-0.3951	-0.7321	-0.4087	0.3907	-0.8264	-----
	[-2.51]	[-2.58]	[-2.64]	[-2.64]	[-2.72]	[-2.72]	[-2.72]	[-2.75]	[-2.75]
Arabia	0.8812	0.8928	0.8999	0.9169	0.9410	0.9516	0.9509	0.9580	0.9564
	----	-3.4041	-2.8105	-2.4894	-1.9294	-1.6335	-1.800	-1.6804	----
	[-2.58]	[-2.64]	[-2.72]	[-2.72]	[-2.72]	[-2.64]	[-2.64]	[-2.58]	[-2.51]
Bahrain	0.9759	0.9748	0.9385	0.9262	0.9376	0.9266	0.9273	0.9536	0.9842
	----	-0.7901	-2.2642	-2.9877	-2.2278	-2.8542	-2.9055	-1.6667	---
	[-2.64]	[-2.72]	[-2.75]	[-2.72]	[-2.72]	[-2.64]	[-2.72]	[-2.64]	[-2.58]
Egypt	0.9241	0.9402	0.9318	0.8676	0.8922	0.8979	0.8243	0.7675	0.7478
	---	-1.0255	-1.1013	-1.7275	-1.3705	-1.3475	-1.7337	-1.5994	---
	[-2.4]	[-2.51]	[-2.58]	[-2.58]	[-2.64]	[-2.64]	[-2.75]	[-2.81]	[-2.81]
Iran	0.8045	0.8904	0.8932	0.9462	0.9491	0.9507	0.9937	1.000	0.8468
	----	-1.8526	-2.0919	-1.4303	-1.3033	-1.2855	-0.1266	0.0062	---
	[-2.4]	[-2.4]	[-2.4]	[-2.51]	[-2.51]	[-2.58]	[-2.58]	[-2.64]	[-2.72]
Jordan	0.9856	0.9351	0.9442	0.9541	0.9352	0.9040	0.8989	0.8458	0.8457
	---	-1.4288	-1.1593	-0.9269	-1.3153	-1.8329	-2.0465	-2.8843	----
	[-2.51]	[-2.58]	[-2.58]	[-2.58]	[-2.64]	[-2.64]	[-2.64]	[-2.58]	[-2.64]
Kuwait	0.7136	0.8658	0.9224	0.9611	0.9613	0.9078	0.9023	0.8636	0.8564
	----	-1.4951	-1.0806	-0.5435	-0.5286	-1.2466	-1.3835	-1.5737	---
	[-2.64]	[-2.72]	[-2.72]	[-2.72]	[-2.72]	[-2.72]	[-2.72]	[-2.64]	[-2.58]
Libya	0.9064	0.9290	1.0089	0.9997	0.9983	1.0029	0.9998	1.0012	1.0226
	---	-1.4693	0.3544	-0.0094	-0.0574	0.1110	-0.0070	0.0477	---
	[-2.4]	[-2.4]	[-2.51]	[-2.51]	[-2.51]	[-2.51]	[-2.58]	[-2.64]	[-2.75]
Morocco	0.6276	0.4649	0.5391	0.5580	0.6171	0.7081	0.6791	0.6986	0.8638
	---	-3.9733	-2.9723	-2.7733	-2.3288	-1.6615	-2.1068	-2.3233	---
	[-2.58]	[-2.58]	[-2.64]	[-2.72]	[-2.72]	[-2.72]	[-2.64]	[-2.72]	[-2.64]
Qatar	0.5012	0.8603	0.8539	0.9985	0.9932	1.0755	1.1134	1.1354	1.1366
	----	----	-0.6796	-0.0097	-0.0426	0.5235	0.6402	---	---
	[-2.51]	[-2.75]	[-2.72]	[-2.72]	[-2.72]	[-2.64]	[-2.58]	[-2.58]	[-2.51]
Syria	0.8655	0.8217	0.9090	0.9102	0.9310	0.9196	0.9178	0.9255	0.9643
	---	-1.3609	-1.9567	-1.8881	-1.4118	-1.7312	-1.8599	-1.4829	---
	[-2.28]	[-2.4]	[-2.4]	[-2.4]	[-2.4]	[-2.51]	[-2.51]	[-2.58]	[-2.81]
Tunisia	1.1631	1.0787	0.9196	0.9737	1.0102	1.1513	1.1234	1.0295	1.0452
	---	0.3506	-0.4179	-0.1365	0.0591	1.1716	1.0389	0.2674	---
	[-2.58]	[-2.72]	[-2.75]	[-2.75]	[-2.75]	[-2.75]	[-2.75]	[-2.72]	[-2.58]
Yemen	1.0842	1.041	1.0466	1.0597	1.0033	0.9926	1.0668	0.7377	0.5907
	----	0.5631	0.6411	0.8250	0.03457	-0.0723	0.8238	-1.4632	----
	[-2.40]	[-2.51]	[-2.58]	[-2.58]	[-2.64]	[-2.72]	[-2.75]	[-2.72]	[-2.75]

Table 5 shows the quantile statistics of Kolmogorov-Smirnov for each country, which is equal to the maximum value of the t-statistic in terms of absolute magnitude for different deciles in Table (2). By comparing Kolmogorov-

Smirnov's quantile statistics with its critical values in four countries namely Bahrain, Morocco, Jordan and Saudi Arabia, real exchange rate is stationary, whereas in other countries is non- stationary. Also, for countries where the real exchange rate is stationary, the average half-life of the shocks on the real exchange rate is also reported in terms of the year in Table 5. In the case of stationary variables, the impact of the shock is temporary and over time, the impact of the shock is lost and the variable returns to its long-term equilibrium average. The half-life calculated in Table 5 indicates the amount of time needed to return to the average in case of a shock to the real exchange rate. According to Table 5, the half-life needed to eliminate the effects of shocks on real exchange rates in Bahrain is 9 years, Jordan 4 years, Saudi Arabia 6 years and Morocco one year. In other countries, due to non-stationarity of the real exchange rate, in the event of a shock to the real exchange rate, it causes a permanent deviation of its long-term equilibrium path and causes a different exchange rate equilibrium.

Table5. Quantile statistics of Kolmogorov-Smirnov and half-life of shocks

Country	K-S Statistics	Half-Life of shocks(years)
Algeria	1.6534	-----
Arabia	3.4041	6.3423
Bahrain	2.9877	9.1057
Egypt	1.7337	-----
Iran	2.0919	-----
Jordan	2.8843	4.1389
Kuwait	1.5737	-----
Libya	1.4693	-----
Morocco	3.9733	1.0717
Qatar	0.6796	-----
Syria	1.9567	-----
Tunisia	1.1716	-----
Yemen	1.4632	-----

4. Conclusion

In the current paper, we employ Quantile unit root test proposed by Koenker and Xiao (2004) to examine the PPP theory in 14 MENA countries using their real exchange rates over the period 1980–2017. According to the results of the common unit root tests, including ADF and PP tests, only in Morocco, the real exchange rate is stationary. But with the quantile unit root test, four countries namely Bahrain, Jordan, Saudi Arabia and Morocco have a stationary real exchange rate. Thus, the theory of purchasing power parity is confirmed in these four countries. These findings are also supported by the Kolmogorov-Smirnov's quantile statistics.

In countries where the exchange rate is stationary, the devaluation policy cannot be used to balance the balance of payments, because in the event of a deviation of the real exchange rate from the long-run equilibrium, the error correction mechanism returns it to previous equilibrium path. In these countries, in the long run, the PPP purchasing power equality theory can be employed to determine the equilibrium exchange rate, which is influenced by the ratio of domestic and foreign prices in these countries. Also, contrary to the findings in the developed countries, the purchasing power theory is not established in majority of the MENA countries as developing countries. This phenomenon can be due to the limited flexibility in the foreign exchange system of the under studied countries.

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