

Revisiting Purchasing Power Parity in Pakistan

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Abstract

The study aims to revalidate the purchasing power parity hypothesis in Pakistan using yearly exchange rate data from 1980-2012. The Augmented Dickey-Fuller and Zivot-Andrews unit root tests were used to validate the long run purchasing power parity hypothesis. The results suggest that the Augmented Dickey-Fuller test failed to validate the PPP hypothesis in Pakistan. However, the Zivot-Andrews unit root test with structural break provides evidence to support the PPP hypothesis. The finding is not consistent with several prior studies which did not find evidence to support the PPP hypothesis. Future studies may analyze the PPP hypothesis in other developing countries using advanced time series approaches.

Keywords: *Purchasing power parity, exchange rate, unit root test, structural break, Pakistan.*

Introduction

The exchange rate of a country provides a link between domestic and foreign markets. A variation in the exchange rate has an impact on the growth rate of the economy and its trade activities. Thus, a stable exchange rate provides certainty to financial markets and helps investors take strategic business decisions. On the contrary, fluctuations in the exchange rate can have adverse effects on the various economic indicators such as net exports, growth and inflation.

The Purchasing Power Parity (PPP) theory postulates that exchange rates between currencies are in equilibrium when their purchasing power is the same in each of the two countries. This implies that the exchange rate between two countries should equal the ratio of the two countries' price level of a fixed basket of goods and services (Cerrato & Sarantis,

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2007). The PPP theory was first presented by Cassel (1922). In essence, the foundation of the theory dates back to the 16th century when Spanish money lenders were forced by the Catholic Church to allow interest payment on loans in foreign currency. The scholars from Salamanca school in Spain presented the PPP hypothesis after taking into consideration price fluctuations, gold inflow from the US and the domestic currency circulation (Officer, 1982).

On the basis of expectations theory, Cassel (1922) argued that the PPP hypothesis had no effect on international trade of a country. It was argued that exchange rate deviations are associated with higher speculative domestic inflation as compared to foreign inflation. Ricardo (1821) defined the exchange rate as the estimated value of the domestic currency in terms of a specified foreign currency. The author argues in favor of using the price index which includes tradable goods. Heckscher (1916) defines PPP in terms of the purchasing power of tradable goods. The study argues that transaction costs lead to deviations from the PPP.

Keynes (1930) also supported Cassel's point of view suggesting that PPP is based on the equilibrium exchange rate determined using the general price level of all goods and services available for purchase. There has been an extended debate on the nature of PPP. Einzing (1935) opposed Cassel's view of the PPP and argued that during the First World War inflationary growth in the exchange rate prompted the overall price to decline as it was affecting domestic operations. The Bretton Woods system introduced in 1944 relied on the fixed exchange rate system by using the US dollar as the reserve currency (Lothian, 2003). After 1973, many countries abandoned the Bretton Woods system in favor of a flexible exchange rate system (Eichengreen, 1992). The fixed exchange rates was a major reason behind the collapse of the Bretton Woods system.

Fundamentally, the PPP theory relies on the law of one price. The validity of long term PPP remains inconclusive. Prior studies testing the PPP have reported mixed findings. The mixed findings are due to the use of different statistical methodologies, duration of data and assumptions (Telatar & Kazdagli, 1998; Bahmani-Oskooee, & Mirzai, 2000; Tastan, 2005; Kalyoncu, 2009). Over the years, several studies have investigated the long run PPP hypothesis using conventional time series techniques but did not find supporting evidence (Taylor, 1988; Corbae & Ouliaris, 1988; Giovannetti, 1989; Patel, 1990; Ardeni & Lubian, 1991; Nachane & Chrissanthaki, 1991; Chishti, Hasan & Afridi, 1993; Crowder, 1992; MacDonald, 1993; Cooper, 1994; Moosa & Bhatti, 1996; Khan & Ahmad, 2005). On the other hand, some studies have found evidence supporting the PPP hypothesis (Khan & Qayyum, 2007; Bhatti & Hussain, 1996; Liew et al., 2004).

The low power of statistical tests is the main reason why a huge number of studies have failed to establish the long run PPP hypothesis. Frankel (1990) suggests that the speed of convergence has an important role in testing the PPP hypothesis. The study argues that a long dataset is required for testing the PPP hypothesis if the speed of convergence is slow. However, a number of researchers have argued against the use of a long data set as it makes it difficult to provide conclusive evidence in favor of PPP. As a result, several researchers have used panel data in order to validate the PPP theory. Levin & Lin (1993) suggests that the use of panel data improves the power of unit root tests for testing PPP. However, studies using panel data to validate the PPP theory has also provided mixed results (MacDonald, 1996; Papell, 1997; Heimonen, 1999). Perron (1989) argues that structural breaks weaken the power of standard unit root tests. Therefore, time series analysis techniques that allow for structural breaks in the data can provide results that are more robust. In the context of the foreign exchange market, structural breaks may be caused by different exchange rate regimes (Dropsy, 1996; Kum, 2012; Mladenovic et al., 2013). Structural breaks can be permanent or temporary and may bring short or long variations in the exchange rate. For the PPP to be valid in the long run, a stable exchange rate is required. Therefore, the objective of the study is to validate the purchasing power parity theory in Pakistan in presence of a possible structural break during the period 1980-2012. The study has used the real exchange rate data that is deflated by Consumer Price Index (CPI).

Literature Review

Prior research has examined the validity of the purchasing power parity theory in several countries over the years. During the 1980's, the PPP theory was validated in both developed and developing countries. The early research on validating PPP had used correlations analysis while later studies have adopted time series models (Froot & Rogoff, 1995; Granger & Newbold, 1974; Frankel, 1981).

Krugman (1978) examined the market exchange rates of dollar-deutschmark, dollar-pound and dollar-franc. The study suggests that deviation in market exchange rates is caused by an unstable monetary policy. The study tested for the presence of endogeneity in the model and used an instrumental variable approach to circumvent the problem. The author did not find evidence to support the PPP hypothesis.

Frenkel (1981) concluded that the PPP hypothesis was not supported due to sticky prices and real exchange rate misalignments. The author observed that hyperinflation may be the reason behind the deviation from the PPP hypothesis. Froot & Rogoff (1995) suggest that OLS and GLS approaches may only be used in the first phase of analyzing the PPP. However, these methods may lead to incorrect results when there is exchange rate instability. Engle &

Granger (1987) introduced the unit root test to determine the order of integration between variables. Several studies have used the unit root test to validate the PPP hypothesis and found support for the theory (Sarno, 2000; Taylor, 1988; Rogoff, 1996; Kalyoncu, 2009). On the contrary, some studies did not find evidence to support the PPP theory (Telatar & Kazdagli, 1998; Acaravci & Ozturk, 2010; Aslan, Kula & Kalyoncu, 2011). Nusair (2003) used quarterly data from 1973 to 1999 to validate the PPP hypothesis in six Asian countries. The study implemented the ADF, KPSS and PP unit root tests. The results of the study provides evidence of real exchange rate convergence in Indonesia. In addition, the author found support for the PPP hypothesis in Indonesia, Korea, Thailand and Malaysia.

Validating the PPP in Turkey in the absence of structural breaks has produced mixed results (Kum, 2012). Kum (2012) used the DF-GLS unit root test to examine the PPP hypothesis during the period 1953 to 2009 after taking into account the Asian financial crisis. The results indicate that exchange rates are mean reverting and there is no evidence to support the PPP. Acaravci & Ozturk (2010) used data from eight transition economies over the period 1992 to 2009 for validating the PPP. The study used four unit root tests to verify the stationarity of the exchange rate. The results suggest that the ADF and KPSS tests do not support the PPP hypothesis. However, the PPP hypothesis was validated in Bulgaria and Romania after considering structural breaks.

The mixed results reveal that PPP hypothesis has limited support in transition economies. The divergence in real exchange rates may be a possible reason behind the weak support for the PPP hypothesis. Obstfeld & Rogoff (2000) used the unit root test to examine the convergence of local price level in Japan using the monthly data from 1970-2009. The study found out that the relative local CPI is stationary. Kocenda (2001) suggest that PPP hypothesis was not validated due to persistent fluctuations in the real exchange rate. Dumas (1992) investigated PPP rigidities by including trade costs which includes transaction and transportation costs. Several studies have integrated the cost of trade with PPP (Obstfeld & Rogoff, 2000; Dumas, 1992). The study reveals that the deviations in purchasing power parity were constant over time in the presence of fluctuations in trade costs .

Cerrato & Sarantis (2007) compared the sticky price model and Engle & Murley's base model in determining the speed of convergence between nominal exchange rate and price index. The study suggests that the both models have a slow speed of convergence between the nominal exchange rate and price index leading to invalidation of the PPP hypothesis. Kocenda (2001) analyzed the behavior of exchange rates in Central and Eastern European countries. The study used the real exchange rate based on the US dollar and the Deutsche mark. Monthly data was taken for the period 1991-1997. The results of the study suggest that structural shocks were present in volatile economies while stable economies did not

suffer from structural shocks. The study concluded that structural changes were the result of measures taken by monetary authorities. Therefore, monetary authorities are responsible for stability in the exchange rate of an economy.

Cecchetti et al., (2002) used a panel econometric technique to determine the degree of price convergence and exchange rate mean reversion in selected American cities. The study found a very slow pace of convergence in selected cities due to heavy transportation expenses, price index based on non-tradable commodities and a sluggish adjustment of prices to shocks. Granger & Newbold, 1974 tested the validity of the PPP hypothesis during currency crisis in several South and Latin American countries including Mexico, Venezuela, Argentina, Brazil and Colombia. The study also analyzed several Asian countries including Malaysia, Hong Kong, Singapore, Thailand and South Korea. The Asian countries had a flexible exchange rate while South and Latin American countries had a pegged exchange rate. The study found evidence of PPP in Asian countries but not in Latin and South American countries using the ADF, PP, LL and IPS unit root tests. The results suggest that PPP holds in Asian countries before financial crisis of 1997 while PPP does not hold for South and Latin American countries.

Papell (1997) analyze the long run PPP hypothesis in sixteen industrialized countries in the presence of structural breaks. The study used data for the period 1892-1998. Both conventional models and time series models with structural breaks were applied. The study concludes that PPP was validated in seven countries using conventional approaches. On the other hand, time series models with structural breaks validated the PPP in fourteen countries. Mladenovic et al., (2013) validate the PPP in several European countries using the Lee-Strazicich unit root test with structural breaks during the sample period 2000-2011. The study found evidence for the PPP hypothesis and persistence of exchange rate except Turkey, Poland and Romania. On the contrary, Nachane & Chrissanthaki (1991) used data for 197 countries for the period 2001-2011 to examine the PPP hypothesis. The results indicate that 46 countries achieved price convergence. However, the study found that the speed of convergence was slow and PPP hypothesis was not supported using CPI as the price index to deflate the exchange rate.

Corbae & Ouliaris (1988) used conventional time series methods to test the PPP hypothesis during financial crises of four currencies against the US dollar. The results revealed that PPP holds both in the short and long run for the Euro. In addition, the short run PPP was observed for the British pound and the Japanese Yen. Cerrato & Sarantis (2007) assessed the weak and strong form of PPP in the US and Japan using monthly data for the period 2000 to 2012. The study used the 2001 tsunami in Japan and the 2008 global financial crisis in the US as structural breaks. The empirical results suggest that the weak form of purchasing power

parity holds even during the crisis period. Hegwood & Nath (2013) used data from 17 major cities of the US to validate the PPP using monthly data of CPI for the period 1918-2001. The results of the study provide evidence of price convergence for all cities after incorporating year 1985 as a breakpoint year. Al-Ahmad & Ismaiel (2016) examined the validity of PPP in four politically instable Arab countries by using the Zivot-Andrews structural break test and the Lumsdaine-Papell structural break test on monthly data for the period 1995-2014. The study suggests that it is important to specify the correct number of structural breaks in the data to validate the PPP.

Methodology

Theoretical Explanation of PPP

Purchasing power parity hypothesis is based on the theory of one price which suggests that the exchange rates between currencies are in equilibrium when their purchasing power is the same in each of the two countries.

$$P_{it} = NER_t P^*_{it} \dots\dots\dots (1)$$

Where P_{it} represents the price of good i expressed in domestic currency, P^*_{it} refers to the price of that good in terms of foreign currency units and NER_t represents the nominal exchange rate at time t. While taking into account the fluctuations caused by exogenous factors, the above equation can be expressed in logarithmic form as follows:

$$\text{Log}(NER_t) = \text{log}(P^*_{it}) - \text{log}(P_{it}) + \mu_t \dots\dots\dots (2)$$

Where μ_t is used to show the fluctuations
If the said deviations are associated with real exchange rate, the above equation takes the following form:

$$\text{Log} (RER) = \text{Log} (NER) + \text{log} (P^*) - \text{Log} (P) \dots\dots\dots (3)$$

Data

To test the validity of the purchasing power parity in Pakistan, the data of real exchange rate has been used. The data has been collected from the World Bank data repository for the period 1980 to 2012.

Statistical Analysis

The hypothesis of purchasing power parity can be validated if the exchange rate is

stationary over time. The Augmented Dickey Fuller test was used to test the null hypothesis of the presence of unit root in the series with trend and without trend. In addition, the Zivot-Andrews unit root test with structural breaks was also performed. Past studies have reported that the conventional unit root test has low power and fail to reject the null hypothesis of unit root in presence of structural breaks (Crowder, 1992). The Zivot-Andrews unit root test was used to test the validity of PPP hypothesis taking into account one structural break. The test assumes that the structural break can occur in the intercept, trend or both trend and intercept.

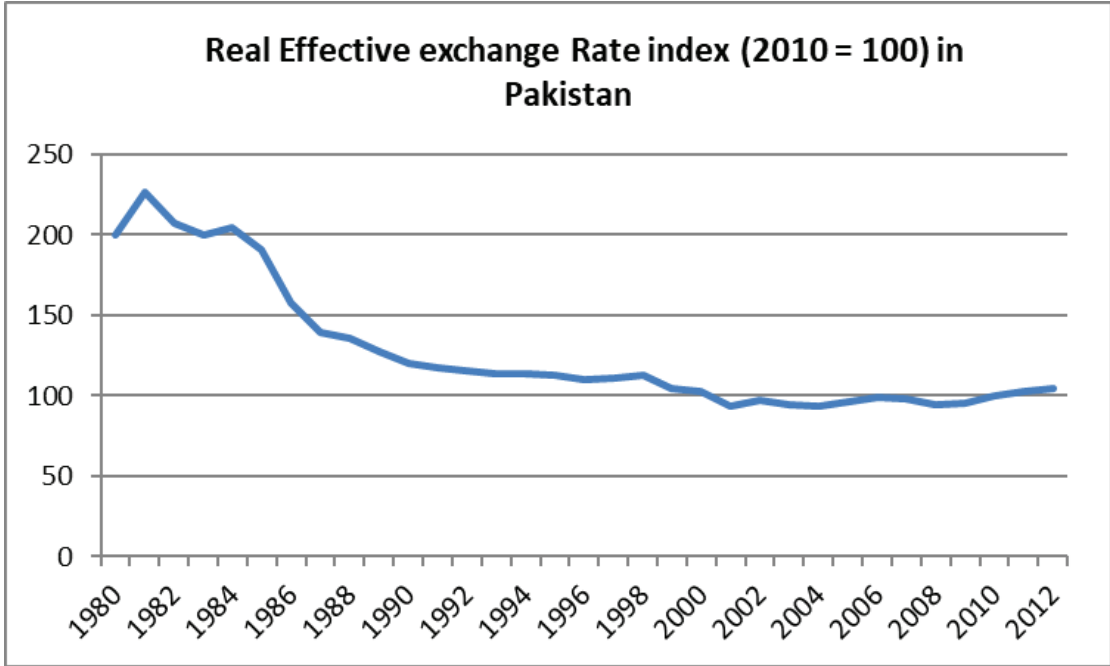
Results and Discussion

Descriptive Statistics

The value for real exchange rate (ReeR) in Pakistan was 127.03 in 2012. The graph below shows that the real exchange rate had a maximum value of 229.15 in 1981 and a minimum value of 93.78 in 2004. Table 1 presents the average real effective exchange rate during the period 1980-2012.

Table 1 : Average Real Effective Exchange Rate

Years	ReeR
1980-84	207.6447
1985-89	150.1182
1990-94	116.1947
1995-99	110.2094
2000-2004	96.11848
2005-2008	97.12077
2009-12	100.5939



Unit root test results

The result of ADF unit root test results are presented in Table 2. The results indicate that the data is not stationary at level form when tested for trend and intercept. Hence, we fail to reject the null hypothesis of unit root test for exchange rate data in Pakistan for the period 1980-2012. Therefore, we conclude that the PPP hypothesis was not supported in Pakistan.

Table 3 presents the results of Zivot-Andrews unit root test while taking into account at least one structural break. The results indicate that we can reject the null hypothesis of unit root in the presence of one structural break at trend, intercept, and both at trend and intercept. Thus, we can conclude that that the PPP hypothesis is valid in Pakistan.

Table 2: ADF Unit Root Test Results

H0: The Series has a Unit Root H1: The Series is Stationery			
Constant		Constant and Trend	
t-Statistic	-2.59	t-Statistic	- 1.22
Critical values		Critical values	
1%	-3.670170	1%	-4 296729
5%	-2.963972	5%	-3.5683 79
10	-2.621007	10	-3218382

Table 3: Zivot-Andrews Unit Root Test Result

H0: The Series has Unit Root With Structural Break H1: The Series is Stationery With Structural Break					
Break in intercept	Break point	Break in trend	Break point	Break in both	Break point
-5.77	1996	-6.69	2002	-6 .62	2002
Critical values		Critical values		Critical values	
1%	-5.33	1%	-4.80	1%	-5.57
5%	-4.93	5%	-442	5%	-5.08
10%	-4.98	10%	-4.11	10%	-4 .82

Conclusion

This study investigates the PPP hypothesis in the context of Pakistan by using the Augmented Dickey Fuller and Zivot-Andrews tests. The results of the Zivot-Andrews unit root test provides support to the PPP hypothesis after considering for a structural break. On the other hand, the Augmented Dickey-Fuller test was insignificant. The finding is not entirely consistent with several prior studies which did not find evidence to support the PPP hypothesis. The main limitation of the study is that data for only one country, i.e. Pakistan, has been used. Future studies may analyze the PPP hypothesis in other developing countries using advanced time series approaches.

References

- Acaravci, A., & Ozturk, I. (2010). On the relationship between energy consumption and economic growth in Europe. *Energy*, 35(12), 5412-5420.
- Al-Ahmad, Z., & Ismaiel, L. (2016). Testing the PPP Using Unit Root Tests with Structural Breaks: Evidence from Politically Unstable Arab Countries. *International Journal of Business, Economics and Management*, 3(12), 173-187.
- Ardeni, P. G., & Lubian, D. (1991). Is there trend reversion in purchasing power parity? *European Economic Review*, 35(5), 1035-1055.
- Aslan, A., Kula, F., & Kalyoncu, H. (2010). Additional evidence of long-run purchasing power parity with black and official exchange rates. *Applied Economics Letters*, 17(14), 1379-1382.
- Bahmani-Oskooee, M., & Mirzai, A. (2000). Real and nominal effective exchange rates for developing countries. *Applied Economics*, 32(4), 411-428.
- Bhatti, R. H., & Husain, F. (1996). A Correct Test of Purchasing Power Parity: The Case of Pak-Rupee Exchange Rates. *The Pakistan Development Review*, 671-682.
- Cecchetti, Stephen G., Mark, Nelson C., Sonora, Robert J., 2002. Price index convergence among United States cities. *International Economic Review*, 43 (4), 1081–1099.
- Cassel, G. (1922). *Money and Foreign Exchange after 1914*. London: Constable and Company Limited.
- Cerrato, M., & Sarantis, N. (2007). Does Purchasing Power Parity Hold in Emerging markets? Evidence from a Panel of Black Market Exchange Rates. *International Journal of Finance & Economics*, 12(4), 427-444.
- Chishti, S., Hasan, M. A., & Afridi, U. (1993). What Determines the Behaviour of Real Exchange Rate in Pakistan?[with Comments]. *The Pakistan Development Review*, 32(4), 1015-1029.
- Cooper, J. C. (1994). Purchasing power parity: A Cointegration Analysis of the Australian, New Zealand and Singaporean Currencies. *Applied Economics Letters*, 1(10), 167-171.
- Corbae, D., & Ouliaris, S. (1988). Cointegration and Tests of Purchasing Power Parity. *The Review of Economics and Statistics*, 508-511.
- Crowder, W. J. (1992). Purchasing Power Parity over The Modern Float an Application in Higher Order Cointegration. *Economics Letters*, 40(3), 313-318.
- Doganlar, M. (2006). Long-run Validity of Purchasing Power Parity and Cointegration Analysis for Central Asian countries. *Applied Economics Letters*, 13(7), 457-461.
- Dropsy, V. (1996). Real Exchange Rates and Structural Breaks. *Applied Economics*, 28(2), 209-219.
- Dumas, B. (1992) Dynamic equilibrium and the real exchange rate in a spatially separated world. *Review of Financial Studies*, 5, 153–80.
- Eichengreen, B. (1992). *Is Europe an optimum currency area?. In The European Community after 1992*. London: Palgrave Macmillan.

- Einzig, P. (1935). *World finance, 1914-1935*. New York: Macmillan.
- Engle, R. F., & Granger, C. W. (1987). Co-integration and error correction: representation, estimation, and testing. *Econometrica: Journal of the Econometric Society*, 55(2), 251-276.
- Frankel, J. (1981). The collapse of purchasing power parity during the 1970s. *European Economic Review*, 16, 145–65
- Frankel, J. A. (1990). Zen and The Art Of Modern Macroeconomics: The Search For Perfect Nothingness. *Monetary Policy for a Volatile Global Economy*, 117-123.
- Froot, K. A., & Rogoff, K. (1995). Perspectives on PPP and Long-Run Real Exchange Rates. *Handbook of International Economics*, 3, 1647-1688.
- Giovannetti, G., (1989). Testing Purchasing Power Parity as a Long-Run Equilibrium Condition. *Giornale Degli Economisti*, 46, 491-508.
- Granger, C. W., & Newbold, P. (1974). Spurious regressions in econometrics. *Journal of Econometrics*, 2(2), 111-120.
- Heckscher, E. F. (1916). Växelkursens Grundval Vid Pappersmyntfot. *Ekonomisk Tidskrift*, 309-312.
- Hegwood, N. D., & Nath, H. K. (2013). Structural breaks and relative price convergence among US cities. *Journal of Macroeconomics*, 36, 150-160.
- Heimonen, K. (1999). Stationarity of the European Real Exchange Rates-Evidence from panel data. *Applied Economics*, 31(6), 673-677.
- Kalyoncu, H. (2009). New evidence of the validity of purchasing power parity from Turkey. *Applied Economics Letters*, 16(1), 63-67.
- Keynes, J. M. (1930). *A Treatise on Money: In 2 Volumes*. Macmillan & Company.
- Khan, F. N., & Ahmad, E. (2005). Test of Purchasing Power Parity based on Cointegration Technique: The Asian Evidence. *Pakistan Economic and Social Review*, 167-183.
- Khan, M. A., & Qayyum, A. (2007). Exchange rate determination in Pakistan: Evidence based on purchasing power parity theory. *Pakistan Economic and Social Review*, 181-202.
- Kočenda, E. (2001). Macroeconomic convergence in transition countries. *Journal of Comparative Economics*, 29(1), 1-23.
- Krugman, P. R. (1978). Purchasing power parity and exchange rates: Another look at the evidence. *Journal of International Economics*, 8(3), 397-407.
- Kum, H. (2012). The impact of structural break (s) on the validity of purchasing power parity in Turkey: Evidence from Zivot-Andrews and lagrange multiplier unit root tests. *International Journal of Economics and Financial Issues*, 2(3), 241.
- Levin, A., Lin, C.F., 1993. Unit root test in panel data: new results. Working Paper, University of California at San Diego

- Liew, V. K. S., Baharumshah, A. Z., & Chong, T. T. L. (2004). Are Asian real exchange rates stationary?. *Economics Letters*, 83(3), 313-316.
- Lothian, J. R. (2004). *Exchange Rates*. *Oxford Encyclopedia of Economic History*, Joel Mokyer, ed., forthcoming. Fordham University, National Bureau of Economic Research (NBER) Available at SSRN: <https://ssrn.com/abstract=613693>
- MacDonald, R. (1993). Long-run purchasing power parity: is it for real?. *The Review of Economics and Statistics*, 75(4), 690-695.
- Mladenovic, Z., Josifidis, K., & Srdic, S. (2013). The purchasing power parity in emerging europe: Empirical results based on two-break analysis. *Panoeconomicus*, 2, 179-202.
- Moosa, I. A., & Bhatti, R. H. (1996). Does purchasing power parity hold between Japan and other Asian countries. *Journal of International Economic Studies*, 10, 85-94.
- Nachane, D. M., & Chrissanthaki, A. (1991). Purchasing power parity in the short and long run: a reappraisal of the post-1973 evidence. *Applied Economics*, 23(7), 1257-1268.
- Nusair, S. A. (2003). Testing the validity of purchasing power parity for Asian countries during the current float. *Journal of Economic Development*, 28(2), 129-147.
- Obstfeld, M., & Rogoff, K. (2000). New directions for stochastic open economy models. *Journal of International Economics*, 50(1), 117-153.
- Officer, L. H. (1982). *Purchasing Power Parity and Exchange Rates: Theory, Evidence And Relevance*. Greenwich: JAI Press.
- Papell, D. H. (1997). Searching for stationarity: Purchasing power parity under the current float. *Journal of international Economics*, 43(3), 313-332.
- Patel, J. (1990). Purchasing power parity as a long-run relation. *Journal of Applied Econometrics*, 5(4), 367-379.
- Perron, P. (1989). The great crash, the oil price shock, and the unit root hypothesis. *Econometrica: Journal of the Econometric Society*, 57(6), 1361-1401.
- Ricardo, D. (1821). *The Principles Of Taxation And Political Economy*. London: JM Dent & Sons.
- Rogoff, K. (1996). The purchasing power parity puzzle. *Journal of Economic Literature*, 34(2), 647-668.
- Sarno, L., & Taylor, M. P. (1998). Real exchange rates under the recent float: unequivocal evidence of mean reversion. *Economics Letters*, 60(2), 131-137.
- Telatar, E., & Kazdagli, H. (1998). Re-examine the long-run purchasing power parity hypothesis for a high inflation country: the case of Turkey 1980-93. *Applied Economics Letters*, 5(1), 51-53.
- Tastan, H. (2005). Do real exchange rates contain a unit root? Evidence from Turkish data. *Applied Economics*, 37(17), 2037-2053.
- Taylor, M. P. (1988). An empirical examination of long-run purchasing power parity using cointegration techniques. *Applied Economics*, 20(10), 1369-1381.