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FIXED VS. FLOATING: UNDER WHICH EXCHANGE RATE REGIMES PPP HOLDS-AN EMPIRICAL STUDY ON TURKISH ECONOMY

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ABSTRACT
Exchange rates are among the important indicators that affect the economic activities. It is well known that sharp changes occurring in the exchange rates affect severely the course of economic activities. In Turkey throughout 1990s, exchange rate policy is especially used as a tool to balance the Turkish economy. After severe costs of fixed exchange rate system, Turkey has adopted floating system in 2001. This study provides new empirical evidence regarding the impact of alternative exchange rate regimes on Turkish economy. The methodology that is used is EG cointegration and Johansen VAR techniques. The evidence points out PPP held under the floating exchange rate regime.

Keywords: Exchange Rate Regime, Purchasing Power Parity, Unit Root, Cointegration.

SABİT- DALGALI KUR REJİMİ: HANGİ KUR REJİMİNDE SATINALMA GÜCÜ PARİTESİ (PPP) GEÇERLİ? TÜRKİYE EKONOMİSİ ÜZERİNE AMPİRİK BİR ÇALIŞMA

ÖZET
Ekonomik faaliyetleri etkileyen en önemli faktörlerden birisi döviz kuru seviyesidir. Çalkantılı dönemlerde gözlemlenen hızlı kur değişimleri ekonomik faaliyet ve sonuçları etkilemektedir. Türkiye'de 1990'lı yıllarda döviz kuru politikaları ile ekonomik sonuçlar dengelenmeye çalışılmıştır. Sabit kur rejiminin yarattığı sarsıcı etkileri sonucu dalgalı kur rejimine geçilmiştir. Bu çalışmada farklı kur rejimlerin Türkiye ekonomisi üzerindeki etkileri ko-entegrasyon ve VAR yöntemleri ile irdelenmiştir. Sonuç olarak satın alma gücü paritesinin (PPP) dalgalı kur rejiminde geçerli olduğu görülmüştür.

Anahtar Kelimeler: Döviz Kuru Rejimi, Satın alma Gücü Paritesi, Koentegrasyon

INTRODUCTION

Exchange rates are among the important indicators that affect the economic activities. Fluctuations in exchange rates are one of the primary reasons affecting the course of economic activities. Therefore, following a stable variation trend in exchange rates affect the economic stability positively. From this perspective, changes in exchange rates should be considered the gateway for the economic stability and the strength of interference should be examined.

Among the emerging market countries, Turkey entered the 1990s with widely varying fundamentals, which ended up with severe financial turbulence in financial markets. Suffice it to say that currency and financial crises hit badly Turkish economy in 2001.
Developments in the Turkish economy over time obviously show that changes in the exchange rate policy have played significant impact on shaping up the economic status of the country. The causes of the crises have been widely debated, but it is difficult to attribute them solely to corrupted monetary system and fiscal policies. Turkey has been keeping exchange rates within target zones, often combined with so-called "rate of crawl".

The exchange rate fluctuations have been always a critical issue for the academic empirical studies. In Turkey throughout 1990s, exchange rate was used more than else as a policy tool to balance the economy. After the severely cost of fixed exchange rate system, Turkey adopted floating system in 2001.

This study tests the effectiveness of Purchasing Power Parity (PPP) under two main exchange rate systems: the floating and fixed exchange rate systems. Purchasing power parity theory states that a given representative basket of goods and services should cost the same wherever it is bought when converted into a common currency. Since Turkey has vividly experienced the consequences of two different nominal exchange rate regimes in this study, it has been concentrated on Turkish lira. This study makes both fixed and floating regime comparisons of real exchange rate stability and cointegration of nominal rates with price indices for the Turkish lira with the US dollar.

This study tries to determine empirically the impact of the floating and fixed exchange rate systems on purchasing power. The following questions are attempted to answer in accordance with the empirical evidence:

- Is there a comparative impact of floating and fixed exchange rate regimes?
- Is exchange rate a crucial economic policy tool that would be used to balance purchasing power in Turkey? What is the relationship between PPP and the exchange rate system?

The Purchasing Power Parity

Gustav Cassel (1918) was first to pronounce the purchasing power parity (PPP) which is currently known both an economic theory and technical method used to be able to determine and estimate the relative value of currencies. Among the many tools in economics to evaluate national economies and wealth of a country, PPP is likely more practical and descriptive which measuring what goods actually cost through determining the real value of money relative to the foreign exchange rate.

Purchasing power parity, called also the law of one price, states that the equilibrium exchange rate between two countries is equal to the ratio of their relative price levels (Brooks,2008). The "law of one price" means market forces would settle the same price for goods and services in every country under certain situations that all things being equal when the market is efficient, and issues such as transportation costs, quota, tariffs and differing regulations do not exist.

There are two forms of PPP theory: absolute form of PPP and relative form of PPP. The former suggests as mentioned above, prices of similar products of two different countries should be equal when measured in a common currency. This relation is shown below:

$$Spot_{exchange\ rate} = \frac{P_i^{domestic}}{P_i^{foreign}}$$

(Eq.1)

P_i is the price of product "*i*" for domestic and foreign countries. Hence, domestic price of a product can be written as;

$$P_i^{domestic} = Spot_{exchange\ rate} * P_i^{foreign}$$

(Eq.2)

Instead of one product's price, price index of a basket of goods can also be used.
The latter, relative PPP, accounts for the possibility of market imperfections such as transportation costs, quota and tariffs. According to this version of PPP changes in prices would cause changes in the currencies' values. Hereby exchange rate is defined by Hallwood and Macdonald (1986) as the relative price of the currencies of two countries (Özkan, 2013). This version of PPP states that over time a country with a higher inflation than another will experience a proportionate depreciation of its currency and it has been investigated in many studies such as Officer (1980), Fritsche and Wallece (1997), Chen and Wu (2000), Xu (2003), Enders and Dibooglu (2001), and the relation can be formulated as follows (Özkan,2013) :

$$\frac{Spot_{exchange\ rate\ at\ time\ T}}{Spot_{exchange\ rate\ at\ time\ T-1}} = \frac{P_i^{domestic}{}_{at\ time\ T} \Big/ P_i^{domestic}{}_{at\ time\ T-1}}{P_i^{foreign}{}_{at\ time\ T} \Big/ P_i^{foreign}{}_{at\ time\ T-1}} \qquad \text{(Eq.3)}$$

It refers the percentage changes in exchange rate and price levels.
($\%\Delta exchangerate = \%\Delta P_{domestic} - \%\Delta P_{foreign}$ where $\%\Delta$ is percentage changes in exchange rate and price levels)
Since differences in weighting may cause deviations in computing absolute PPP, indexes are generally used to get around the comparability problems.

Literature Review

The significance of exchange rates has been an important research agenda for many economies since the end of Bretton Woods agreement in 1973 (Bossone, 2008). There is an immense literature on the purchasing power parity which is really difficult to list all of these. These studies evaluate the subject with a wide scope of view from deviation reasons of the parity, various methods of testing the parity on the economies to possible solutions and recommendations. In the course of time, these broad literatures have examined the parity in two aspects. On one hand, a number of researchers analyzed the long-run cointegration of relative prices along with exchange rates; on the other hand, some others analyzed this relationship by testing whether the real exchange rate has a tendency to revert to a stationary (Sarno and Valente 2006) form. Rogoff (1996) points out variations in the real exchange rate appear as the deviations from the parity as long as there is a stable equilibrium level and long run PPP holds.

Numerous researches tried to bring out the nature of relationship between exchange rate fluctuations and inflation, represented by especially price indices, for the last few decades[1]. However, the findings are mixed.

Sarno and Valente (2006), propose an empirical study for deviations from long-run PPP under different exchange rate regimes. The sample spans from the late 19th or early 20th century to the late 20th century study comprises annual observations for the nominal exchange rate and the price levels relative to the US for each of the G5 countries (U.S., U.K., France, Germany, Japan). As a result, they provide evidence that long-run PPP holds, the relative importance of nominal exchange rates and prices in restoring PPP varies over time and across different exchange rate regimes, and reversion to PPP occurs nonlinearly, at a speed that is consistent with the nominal rigidities suggested by conventional open economy models.

[1] Large literature on this relationship can be reviewed:
J.A. Frenkel and M.L. Mussa. (1985). *Asset Markets, Exchange Rates and the Balance of Payments* in R. W. Jones and P. B. Kenen eds., Handbook of International Economics, v.II, New York: Elsevier Science Publishers.
P. Hallwood, R. MacDonald. (1986). *International Money, Theory, Evidence and Institutions*. Basic Blackwell, Oxford.
R. MacDonald. (1988). *Floating Exchange Rates: Theories and Evidence*. Unwin Hyman, Boston.
C. A. E. Goodhart. (1989). *Money, Information and Uncertainty*. 2nd ed., MIT Press, Cambridge. Chapter 8.
J. D. Sachs and F. Larrain. (1993). *Macroeconomics in the Global Economy*. Englewood Cliffs NJ: Prentice Hall. Chapter 10, 11.

The validity of PPP hypothesis has been considered covering Turkish economy by numerous researchers. For instance, Chakrabarti (2006) rejects even the weak form of purchasing power parity hypothesis by using overall prices index from quarterly observations on developed countries over the period 1977 to 1994. On the contrary, Cerrato and Sarantis (2007) find empirical support for the long-run PPP for 20 OECD countries. As far as the validity of parity is concerned, the discussions are concentrated on the long run and short run deviations as well. Johansen and Juselius (1992) and Cheung et al. (2004) put evidence on the approach that the purchasing power parity is efficacious in the long run, meanwhile according to Crowder (1996) and Cushman (2008) the long run parity is not valid. Telatar and Kazdağlı (1998) examined the hypothesis of long-run PPP using co integration techniques for Turkey. Extending the study of Telatar and Kazdağli, Sarno (2000) has re-examined the long-run PPP hypothesis using data for Turkey and its major trading partners. The conventional unit root tests imply rejection of long-run PPP over the sample while using recently developed nonlinear modeling techniques provide strong support for the validity of long-run PPP with theoretical models, which predict nonlinear adjustment in real exchange rates.

In another examination concerning Turkish economy, Erlat (2003) searched the persistence in real exchange rates through the use of unit root tests and autoregressive fractionally integrated moving average models. The findings of the study support validity of the absolute version of the PPP. Meanwhile, Yazgan (2003) re-examined the long-run PPP hypothesis for Turkey and strong evidence on long-run PPP is provided by using standard multivariate co integration techniques. In addition, Kalyoncu (2009) analyzed the validity of PPP between Turkey and trading partners, which include USA, Germany, Japan, France, Netherlands and UK by using different unit root test and different base countries to determine if the validity of PPP is influenced by the type of test and/or the base country. The results of the study showed that PPP testing is sensitive to the choice of the base country and the type of test can influence the findings. Sulku (2010) investigates the PPP hypothesis for 16 less developed countries including Turkey during fixed and flexible exchange rate regimes over the period 1957:01-1999:12. In the study, the whole period lies in 1969:01-1999:12 for the Turkish economy. 1969-1979 period is considered as fixed regime, 1980-1999 period is considered as flexible. The bilateral exchange rates of less developed countries and the United States, and their respective price levels are considered. Unit-root tests, Engle–Granger (1987) cointegration technique and Johansen multivariate VAR methodology (1988) are employed. The main conclusion of the study is that the deviations from PPP in less developed countries cannot be attributed to the exchange rate regime system.

While the validity of PPP is important for developing countries, empirical evidence for developing countries mixed (Telatar and Kazdaglı, 1998; Bahmani-Oskooee and Mirzai, 2000; Tastan, 2005; Kalyoncu, 2009). These mixed results can be due to the use of ADF type models that they do not allow researchers to model the impact of

structural changes in the economy. These structural changes, which could be a result of shocks, do impact macroeconomic variables. In this respect, Kum (2012) examines the impact of structural breaks on the validity of PPP for Turkey comprising annual data from 1953 to 2009. In order to test the unit root hypothesis taking into account the possibility of structural breaks in the data, the Zivot and Andrews and Lagrange Multiplier unit root tests developed by Lee and Strazicich (2004) is employed. Empirical findings of the study show that while unit root test without structural break illustrate mixed results, PPP holds for Turkey with the presence of structural breaks which are 1997 (Asian crisis), 1994 and 2000 (financial crises in Turkey).

On the other hand, macroeconomic stability is a key precondition for membership in the euro zone. The failure of PPP to hold can indicate exchange rate misalignment resulting in overvaluation of Turkish lira. Overvaluation will widen Turkey's current account deficit, and thus have an adverse impact on the country's macroeconomic stability. Therefore, whether PPP holds for Turkey has practical implications for Turkey's prospects for joining the European Union. In this respect, Alba and Park (2005) test the validity of the parity between Euro and Turkish lira. They apply the non-linearity and non-stationarity tests of monthly real exchange rates from January 1973 to October 2004. They provide strong support for non-linearity in real exchange rates and find that exchange rates behave like a stationary process in one threshold regime, but a unit root process in the other regime. Therefore, their evidence provides mixed empirical support for PPP in Turkey. Similarly, Kasman S., Kasman A. and Ayhan D. (2010) investigate the validity of PPP for the eleven new member and candidate countries including Turkey of the European Union. They use the minimum Lagrange multiplier unit root tests that allow for a maximum of two endogenously determined structural breaks to test the stationary of real bilateral exchange rates against the numeraire currencies. European economic structure, monetary stability and nominal exchange rate stability are required for monetary integration. These Maastricht convergence criteria imply real exchange rate stability and the achievement of PPP. Therefore, empirical evidence on PPP provides directions for economic integration in the euro area. The test results reveal that the real exchange rate series are stationary for Turkey, which is consistent with the PPP hypothesis. Empirical evidence suggests that deviations from the parity can be caused by sudden changes in the exchange rates, high inflationary pressures, or monetary shocks; do not persist over time and allow PPP to hold in the long run.

Empirical Tests of Purchasing Power Parity

Data collection

In this econometric analysis, it is analyzed the PPP hypothesis using monthly data set for the variables of *Real Effective Exchange Rates* (REER*), Nominal Exchange Rates* (NER) and *Consumer Price Indices* (CPI) for two currencies: Turkish lira and US dollar. In this study, the overall period is divided into two-sub-periods (1990:01 -

1999:12) and (2003:01 - 2012:12) and the variables are used equally scaled before and after 2001, that is the year Turkey switched its exchange rate regime from fixed to floating. The data has been obtained from the International Monetary Fund's International Financial Statistics (IFS) and Turkish Central Bank database.

The reason why no common index exists for both countries the consumer price index (CPI) will be used as proxy for the foreign and local price predictions.

Methodology

It has been focused on the Turkish lira in order to underline the differences over two different exchange rate regimes. It has been made both fixed and floating regime comparisons within the real exchange rate stability context and cointegration technique of nominal rates with price indices for the Turkish lira with the US dollar. The cointergation method, which is one of the most successful models in analyzing the long run relationship between the underlying variables, is deployed in the study.

As Officer (1976) reports in his study the absolute PPP can never reach exchange rate equilibrium for the reason that there is no common price index. On the other hand Enders (1989) underlines the superiority of the relative PPP for the explanation the exchange rate changes for different countries with relative prices. For this reason, the relative PPP is used in the study.

Unit Root Tests

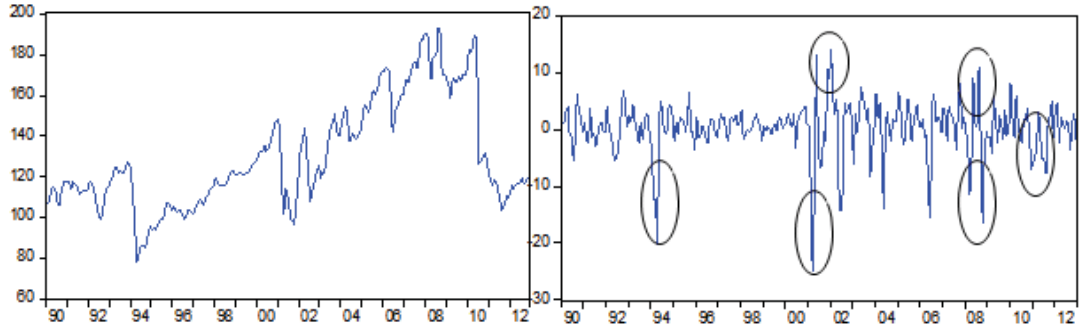
All differing forms of purchasing power parity assume that the real exchange rate reverts to a constant mean (Kim ve Young,2012). The results that emerge from a number of the exchange rates literature is that evidence of long run PPP can be proved by a unit root test in real exchange rate. If real exchange rates are stationary then it can be concluded that the parity holds. In the studies of Froot and Rogoff (1995) and Rogoff (1996)("*the parity puzzle"*) they affirm that if the unit root null hypothesis is rejected then there is long-run mean reversion and long-run PPP holds. If the real exchange rate follows a random walk, then the parity will not hold in the long run.

Stationary characteristics in any time series analysis is a special feature which is used to eliminate the effect of shocks The stationary properties of the real effective exchange rate are investigated by Augmented Dickey–Fuller (1979) (ADF) and Phillips Perron (1988) (PP) unit root tests. The tests are applied first for the entire period (1990-2012) then for the two sub-periods of 1990-1999 and 2003-2012. To alleviate the impacts of the crisis, one year before and after 2001 is omitted since 2001 is the year of policy change in the exchange rate regime.

Real effective and logarithmic real effective exchange rates graphs are depicted below. Turkish economy has witnessed big financial crises during this period of analysis; 1994 Asia crisis, 2001 Turkey's local crisis, 2008 global mortgage crisis

and the European debt crisis, which began in late 2009. Frankel and Rose (1996), Reinhart and Smith (2001), Stiglitz (2002), and Krugman and Obstfeld (2003) addressed that market impediments like financial crises would cause persistent deviations from PPP. If PPP is holding the real effective exchange rate should remain unchanged so the graph of the rate should follow a stable way. According to relative PPP theory, changes in the nominal exchange rates would cause changes at the same magnitude in price levels so this situation would end up with no movement in real exchange rates.

GRAPH 1: Real Effective and Logarithmic Real Effective Exchange Rates (1990-2012)



Besides graphical analysis, two different unit root tests, basically ADF and PP are conducted on the real effective exchange rate series for the selected sample size. Whenever the computed test statistic is less than the critical value, the null hypothesis (H0) of being unit root would be rejected.

TABLE 1: Unit Root Tests for Real Effective Exchange Rate (1990-2012)

	Level			1st difference		
	Intercept	Trend & Intercept	None	Intercept	Trend & Intercept	None
Augmented Dickey-Fuller test statistic	-1.950 (0.309)	-3.917 (**0.013**)	0.136 (0.725)	-11.525 (0.000)	-11.504 (0.000)	-11.531 (0.000)
Phillips-Perron Adj.test statistic	-1.672 [0.444]	-3.451 [**0.047**]	0.491 [0.820]	-11.069 [0.000]	-11.028 [0.000]	-10.947 [0.000]
Test critical values:						
1% level	-3.454	-3.992	-2.573	-3.454	-3.992	-2.573
5% level	-2.872	-3.426	-1.942	-2.872	-3.426	-1.942
10% level	-2.572	-3.136	-1.616	-2.572	-3.136	-1.616

*Results of critical values for ADF and PP are approximately same.

The results of ADF and PP unit root tests as shown in Table 1 show that the data are non-stationary for the overall period at the *level*. When *trend* and *intercept*

peculiarities are added to the series, properties of stationary follow a trend-stationary process.

De-trending, logarithmic transformation or taking the differences is the common tools that can be applied to transform a non-stationary series. The question we ask whether PPP hypothesis holds under fixed and/or flexible periods separately and further for the entire period of the sample size.

GRAPH 2: Real Effective and Logarithmic Real Effective Exchange Rates (1990 -1999)

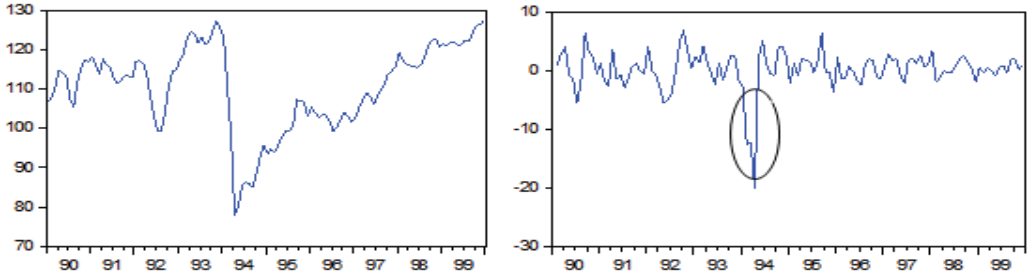


TABLE2: Unit Root Tests for Real Effective Exchange Rate (1990-1999)

	Level			1st difference		
	Intercept	Trend & Intercept	None	Intercept	Trend & Intercept	None
Augmented Dickey-Fuller test statistic	-2.717 (0.074)	-2.764 (0.213)	0.057 (0.698)	-6.497 (0.000)	-6.488 (0.000)	-6.515 (0.000)
Phillips-Perron Adj.test statistic	-1.385 [0.587]	-1.454 [0.839]	0.275 [0.764]	-5.930 [0.000]	-5.875 [0.000]	-5.959 [0.000]
Test critical values:						
1% level	-3.487	-4.037	-2.585	-3.486	-4.037	-2.584
5% level	-2.886	-3.448	-1.944	-2.887	-3.449	-1.943
10% level	-2.580	-3.149	-1.615	-2.579	-3.150	-1.614

*Results of critical values for ADF and PP are approximately same.

On the graphs above, due to effects of 1994 crisis, unit root test results at the level stage do not expose a stationary process when neither intercept nor trend is added. Only it could be stationary when the differences are taken.

The second sub-period which floating regime adopted displays a more stable process than fixed regime, graphical and statistical test results shown below.

GRAPH 3: Real Effective and Logarithmic Real Effective Exchange Rates (2003 -2012)

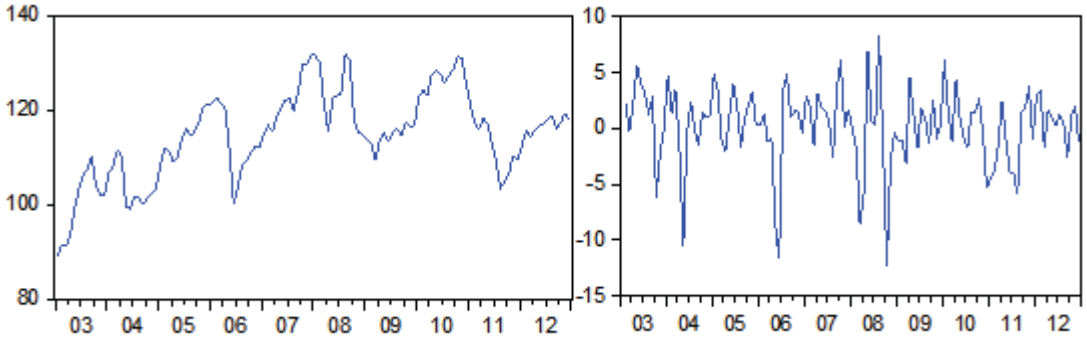


TABLE 3: Unit Root Tests for Real Effective Exchange Rate (2003-2012)

	Level			1st difference		
	Intercept	Trend & Intercept	None	Intercept	Trend & Intercept	None
Augmented Dickey-Fuller test statistic	-2.688 (**0.079**)	-3.369 (**0.061**)	0.404 (0.798)	-6.465 (0.000)	-6.497 (0.000)	-6.460 (0.000)
Phillips-Perron Adj.test statistic	-3.116 [**0.028**]	-3.087 [0.114]	0.507 [0.823]	-7.944 [0.000]	-7.950 [0.000]	-7.965 [0.000]
Test critical values:						
1% level	-3.488	-4.039	-2.585	-3.488	-4.040	-2.585
5% level	-2.887	-3.449	-1.944	-2.887	-3.449	-1.944
10% level	-2.580	-3.150	-1.615	-2.580	-3.150	-1.615

*Results of critical values for ADF and PP are approximately same.

On the other hand, the prominent finding of the unit root test for the real effective exchange rate in the period of 2003-2012 during which floating exchange rate regime is carried out probabilities of ADF and PP test statistics prove a stationary process at *level*. The two sub-periods have equal time frame – both are 10 years- and although the second period, floating regime was exposed to 2008 mortgage crisis and European debt crisis, the nominal exchange rates are more volatile. It is inherent in floating exchange rate regimes that the unit root tests prove stronger stationarity evidences than in the fixed regime for the real effective exchange rate.

Cointegration

Engle and Granger (1987) in mid-80's make all regression analyses involving I(1) variables meaningful. If two variables are non-stationary then the combination of their errors are stochastic and probably have another non-stationary process. However two stochastic trends would be very similar to each other and when combined together it should be possible to find a combination of them which eliminates the non-stationarity. In this special case two variables are cointegrated (Asteriou,2007).

The theory of PPP implies that the ratio of relative prices in two countries and the exchange rate between them should be cointegrated. An interesting question to ask is whether a potentially cointegrating regression should be estimated using the levels of the variables or the logarithms of the levels of the variables. Hendry and Juselius (2000) affirm that if a set of series is cointegrated in levels, they will also be cointegrated in log levels. In this part of our study logarithmic transformations of the variables (nominal exchange and consumer price indices) are used.

When it was analyzed the log variables nominal exchange rate, CPI of Turkey and US denoted respectively by *LNER*, *LTRCPI* and *LUSCPI* it was found that the series at level I(0) are non-stationary for all periods of our analysis and they are stationary at the same level, at their first difference I(1). These as it is known are the requirements to search cointegration relationship between the variables. The stationary test results of log variables are shown below at Table 4. If the data at hand thought to be non-stationary and possibly cointegrated, the modeling strategies of Engle-Granger (1987), Engle-Yoo and Johansen (1988) can be used.

TABLE 4: Unit Root Tests for Log Variables

		Intercept & Trend at Level			Intercept & Trend at 1st Difference		
Periods/Variables		LNER	LTRCPI	LUSCPI	LNER	LTRCPI	LUSCPI
1990-1999	ADF	-3.154 (0.099)	-2.838 (0.186)	-3.111 (0.109)	-7.263 (0.000)	-7.723 (0.000)	-7.870 (0.000)
	PP	-2.730 [0.226]	-2.396 [0.379]	-3.198 [0.089]	-6.952 [0.000]	-7.283 [0.000]	-8.476 [0.000]
2003-2012	ADF	-2.937 (0.154)	-4.148 *(0.0071)*	-3.159 (0.099)	-8.494 (0.000)	-8.205 (0.000)	-6.860 (0.000)
	PP	-2.795 [0.201]	-3.0575 [0.121]	-2.376 [0.389]	-7.481 [0.000]	-12.872 [0.000]	-5.221 [0.0002]
1990-2012	ADF	-0.445 (0.985)	0.258 (0.998)	-3.750 *(0.021)*	-10.445 (0.000)	-9.986 (0.000)	-10.690 (0.000)
	PP	-0.343 [0.989]	0.360 [0.998]	-3.180 [0.091]	-10.566 [0.000]	-10.061 [0.000]	-8.839 [0.000]

As shown in Table 4, all log variables are non-stationary in level I(0) and are stationary in level I(1) for all periods with a significance level of 5%. Thus, cointegrating relation among the variables could be tested.

Our empirical analysis searches the cointegration relationship between variables by deploying both Engle-Granger and Johansen techniques.

Testing for cointegration in the regression, a residuals-based approach (Engle-Granger method) is utilized first. According to Brooks, the model for the equilibrium correction term could be generalized to include *k* variables (*y* and *k-1*X_S) (Brooks,2008)

$$y_t = \beta_1 + \beta_{2X_{2t}} + \beta_{3X_{3t}} + \ldots\ldots\ldots \beta_{kX_{kt}} + u_t$$

(Eq.4)

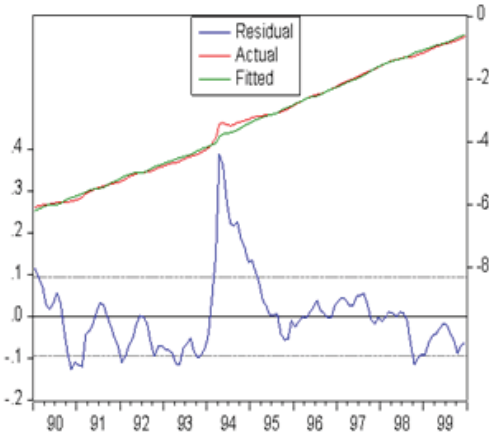
the residuals of the regression should be I(0) if the variables y_t , x_{2t} ,…. x_{kt} are cointegrated, if they are not cointegrated the residuals should be non-stationary. Therefore, the stationarity test must be applied first. Here Augmented Dickey-Fuller and Philips Perron tests are conducted for the test of stationary.

On the EViews regression estimation output, the log version of the variables shown in the equation (3) is formed as:

log of nominal exchange rate c log of Turkish CPI log of US CPI which is shortly defined as *lner c ltrcpi luscpi* in the model. (Regression 1)

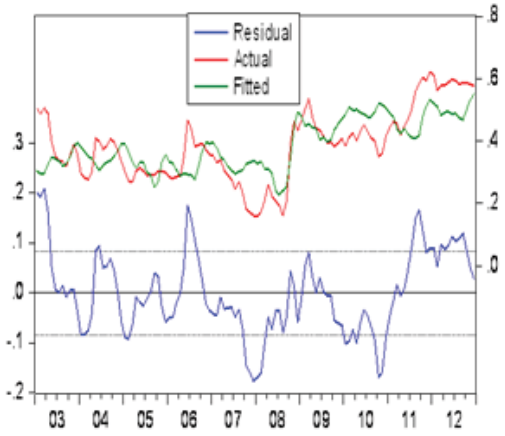
Plots of the residuals and unit root test at level, I(0), are presented in Tables 5, 6 and 7 below for the periods of 1990-1999 (the period of fixed exchange rate regime), 2003-2012 (the period of floating exchange rate regime) and 1990-2012 (the entire sample) respectively.

TABLE 5: Plot and Unit Root Tests of Residuals at Level I(0) (1990-1999)



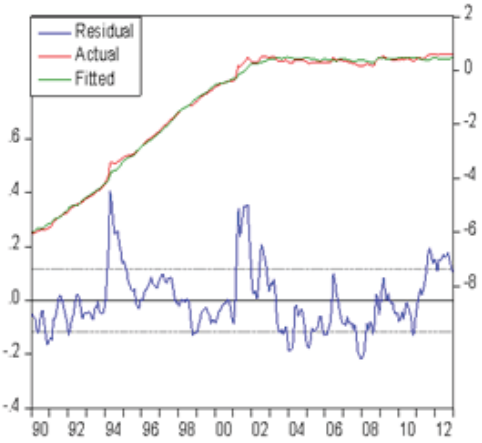
	Intercept	Trend & Intercept	None
Augmented Dickey-Fuller test statistic	-3.469 (0.010)	-3.455 (0.049)	-3.484 (0.000)
Phillips-PerronAdj.test statistic	-2.652 [***0.085***]	-2.644 [***0.261***]	-2.662 [0.008]
Test critical values:			
1% level	-3.486	-4.037	-2.585
5% level	-2.886	-3.448	-1.944
10% level	-2.580	-3.149	-1.615

TABLE 6: Plot and Unit Root Tests of Residuals at Level I(0) (2003-2012)



	Intercept	Trend & Intercept	None
Augmented Dickey-Fuller test statistic	-4.209 (0.001)	-4.235 (0.005)	-4.219 (0.000)
Phillips-PerronAdj.test statistic	-3.512 [0.009]	-3.473 [0.047]	-3.509 [0.0006]
Test critical values:			
1% level	-3.486	-4.037	-2.585
5% level	-2.886	-3.448	-1.944
10% level	-2.580	-3.149	-1.615

TABLE 7: Plot and Unit Root Tests of Residuals at Level I(0) (1990-2012)



	Intercept	Trend & Intercept	None
Augmented Dickey-Fuller test statistic	-4.464 (0.000)	-4.456 (0.002)	-4.473 (0.000)
Phillips-PerronAdj.test statistic	-3.388 [0.012]	-3.383 [0.055]	-3.395 [0.0007]
Test critical values:			
1% level	-3.454	-3.991	-2.573
5% level	-2.871	-3.426	-1.941
10% level	-2.572	-3.136	-1.615

Test statistics support the PPP hypothesis for the period of floating exchange rate regime. This result is obtained by analyzing the unit root tests of the regression residuals. Test results support this evidence also for the entire period. However, this study rejects the cointegrating relation between variables under fixed exchange rate regime at 5% significance level.

Johansen Technique Based on VARs

If there are more than two variables in the analysis, Engle-Granger approach is not appropriate to use. Instead, Johansen Vector Autoregressive (VAR) framework is potentially more qualified. Therefore, Johansen cointegration approach is implemented (Sulku, 2010) to a linear combination of nominal exchange rate and price indices, so that long-run relationship between relative prices and nominal exchange rates is examined.

Another important aspect in the formulation of the model is whether an intercept and/or a trend should enter either the short-run or the long-run model, or both

models. The general case for the vector error correction model including all various options is given below:

$$\Delta y_t = \Pi y_{t-k} + \Gamma_1 \Delta y_{t-1} + ... + \Gamma_{k-1} \Delta y_{t-(k-1)} + \alpha \begin{pmatrix} \beta \\ \mu 1 \\ \delta 1 \end{pmatrix} (t_{t-1} 1t) + \mu 2 + \delta 2t + u_t$$

(Eq.5)

In this model we can have a constant (μ1) and/or a trend (δ1) in the long-run cointegrating model, and a constant (μ2) and/or a trend (δ2) in the short run model.
According to Johansen (1988) there are two methods and corresponding two test statistics for determining the number of cointegrating relations, and both involve estimation of the matrix Π which is a *k x k* matrix with rank *r*. The procedures are based on propositions about eigenvalues (Asteriou, 2007):

$$\lambda_{trace}(r) = -T \sum_{i=r+1}^{g} In(1 - \hat{\lambda}_i)$$

(Eq.6)
And

$$\lambda_{\max}(r, r+1) = -T\, In(1 - \hat{\lambda}_{r+1})$$

(Eq.7)

A significant eigenvalue would indicate a significant cointegrating vector in the model (Goudarzi and Ramanarayanan, 2011).
After determination of the lag length with the help of Schwarz information criteria (SC) the Johansen cointegration test is applied. The test results for the all periods are summarized in Table 8.

TABLE 8: Test Statistics of Johansen Approach

Periods	Test Specifications	Hypothesized no. of CE(s)	Eigenvalue	Trace Statistic [Max-Eigen Statistic]	0.05 Critical Value	Prob.
1990-1999	Data Trend: Quadratic with Intercept & Trend Information Criteria: SC Lag Lenght:1	None	0.137766	31.85445 [17.49101]	35.01090 [24.25202]	0.1048 [0.3027]
		At most 1	0.087189	14.36345 [10.76467]	18.39771 [17.14769]	0.1676 [0.3306]
		At most 2	0.030038	3.598782 [3.598782]	3.841466 [3.841466]	0.0578 [0.0578]
2003-2012	Data Trend:Linear with Intercept & Trend	None	0.203580	51.94819 [26.63252]	42.91525 [25.82321]	0.0049 [0.0390]
		At most 1	0.139976	25.31567	25.87211	0.0585

	Information Criteria: SC			[17.64301]	[19.38704]	[0.0880]
	Lag Lenght:2	At most 2		7.672661	12.51798	0.2796
			0.063474	[7.672661]	[12.51798]	[0.2796]
1999-2012	Data Trend:Quadratic with Intercept & Trend	None	0.115732	46.52333	35.01090	0.0020
				[33.57774]	24.25202	0.0022
	Information Criteria: SC	At most 1	0.046312	12.94559	18.39771	0.2445
				[12.94527]	[17.14769]	[0.1846]
	Lag Lenght:2	At most 2	1.16E-06	0.000317	3.841466	0.9879
				[0.000317]	[3.841466]	[0.9879]

CE(s): cointegrated equation(s)

Table 8 reports the trace and maximum eigenvalue test results in a system of unrestricted VAR constructed under fixed regime, floating regime and whole period. According to the statistics found, it can be stated at least one cointegrating vector for the period of floating exchange rate regime and for the entire period of analysis. However, both the trace test and max-eigenvalue test indicate that there are no cointegrating vectors at 5% significance level for the fixed exchange rate regime.

CONCLUSION

This study investigates the relative PPP hypothesis for the Turkish economy for the last 23 years. During this period Turkish economy has experienced two major shifts in foreign exchange rate regime and two domestic financial crises. The methodology that is applied to investigate PPP hypothesis is based on unit root tests, EG and Johansen VAR approach. In the end, we achieve strong evidence in favor of PPP for the entire sample period. It has been seen greater variability in exchange rates under floating regime than under fixed due to shocks and changes associated with the financial crises. When the analysis is conducted across sub-periods of fixed and floating exchange rate, the results obtained from statistical tests barely favor the PPP hypothesis under fixed exchange rate regime. The findings support PPP as a long run relationship over the floating period. Also, the main contribution of this study is to provide a comparison of two different exchange rate regimes for the validity of PPP for a long period of time span.

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