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TESTING THE VALIDITY OF EXCHANGE RATE DETERMINATION APPROACHES FOR TURKEY

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Abstract

This paper investigates the two of the exchange rate determination approaches for Turkey. Efficient Market Hypothesis (EMH) in weak form is tested by using overnight, weekly, monthly, quarterly and yearly forward exchange rates and spot exchange rates for Turkish Lira/US Dollar and Turkish Lira/Euro. Weekly data is used to test EMH for 2002:11-2015:06 period. Other approach empirically tested in this paper is Purchasing Power Parity (PPP) Hypothesis for Turkey. Whether or not this approach is valid is determined with monthly data covering the 2002:11-2015:03 period. In this study, LP and LM unit root tests with two structural breaks is applied as method in addition to KPSS and Augmented Dickey-Fuller unit root tests. Our findings don't support the evidence that PPP hypothesis is valid but support that market efficiency in weak form is valid.

Keywords: Exchange Rate Determination, Purchasing Power Parity, Efficient Market Hypothesis, ADF Unit Root Test, LM Unit Root Test

JEL Classification: F31, C22, C12

DÖVİZ KURUNU BELİRLEYEN YAKLAŞIMLARIN TÜRKİYE İÇİN GEÇERLİLİĞİNİN TEST EDİLMESİ

Özet

Bu çalışmada döviz kuru belirleme yaklaşımlarından iki tanesinin geçerliliği Türkiye için sınanmıştır. Zayıf formda etkin piyasa hipotezi gecelik, haftalık, aylık, üç aylık ve yıllık vadeli (forward) ve anlık TL/ABD Doları ve TL/AVRO kurları kullanılarak test edilmiştir. Zayıf formda etkin piyasa hipotezinin geçerliliğinin sınanmasında 2002:11-2015:06 dönemi için haftalık veriler kullanılmıştır. Bu çalışmada

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ampirik olarak test edilen diğer çalışma satın alma gücü paritesi hipotezidir. Bu yaklaşımın geçerli olup olmadığı sınanırken 2002:11-2015:03 dönemini kapsayan aylık verilerden yararlanılmıştır. Çalışmada KPSS ve ADF birim kök testinin yanı sıra iki kırılmalı LM ve LP birim kök testi de uygulanmıştır. Elde edilen bulgular satın alma gücü paritesi hipotezinin Türkiye için geçerli olmadığını gösterirken, zayıf formda etkin piyasa hipotezinin geçerli olduğunu ortaya koymuştur.

Anahtar Kelimeler: Döviz Kurunun Belirlenmesi, Satın Alma Gücü Paritesi, Etkin Piyasa Hipotezi, ADF Birim Kök Testi, LM Birim Kök Testi

JEL Sınıflaması: F31, C22, C12

1. Introduction

Until the period of 1970's, change in exchange rates were tried to be explained by changes in foreign trade and since financial markets were not developed, demand for foreign currency was determined by foreign trade demand. As a result of this, flow variables such as export and import became fundamental variables for analysis of exchange rates. As flow approach created a framework to determine exchange rate theories were developed to reach the balance in the long run and to stabilize the exchange rates according to this approach. After the collapse of Bretton Wood system, the system couldn't determine the exchange rates and new situation suggested that international capital flows had important effect on the determination of exchange rates. New theories have been developed by considering the new situation, because of the importance of economic agents' portfolios, stock variables have become crucial. Governments ended the restrictions on financial markets and began to act to establish free movement of capital. Finally, portfolio preferences played an important role on the determination of exchange rates. One of the aims of this study is to find an empirical answer to the question of whether foreign exchange market is efficient or not in Turkey. On the other hand, empirical validity of purchasing power parity hypothesis can show the degree of economic integration among countries. By testing the fulfilment of this hypothesis for Turkey, we can have an idea Turkey's economic integration level with other countries.

In the period after 1980, Turkey, as an emerging market, has started to remove restrictions on financial markets and especially after the economic crisis in 2001, Turkey has allowed for total liberty of capital movements and started to use flexible exchange rate system. Because of these changes, global fluctuations or changes in some variables cause exchange rates to be volatile. As Turkey has had ever-growing foreign trade with the rest of the world since 1980's fluctuations in exchange rates are damaging the Turkish economy by creating uncertainty. For determination of exchange rates, there are various theories and approaches developed by economists and some of these approaches have been developed after liberalization of economies all over the world together with globalization since other approaches remained incapable of predicting the exchange rates well. Some of exchange rate determination theories are balance of payments model, purchasing

power parity approach, currency substitution approach, portfolio balance approach, efficient market hypothesis, interest rate parity approach, monetary approach, speculative bubbles theory and microstructure approach. Our study tests the validity of purchasing power parity (PPP) approach and efficient market hypothesis (EMH) for Turkey. In this context, this paper utilizes LM unit root test to analyze theories mentioned above for the period of 2002-2015.

When literature is reviewed it is seen that researchers has been generally examining just one approaches of exchange rate determination for Turkey. Difference of this study from the others is to test and compare two theories by using appropriate econometric methods. One of our contributions of this study to empirical literature is we use long span of weekly data to test PPP hypothesis and monthly data to test EMH approach. Second, we allow for structural breaks to test the validity of PPP hypothesis and EMH. The next section of the paper explains the theoretical framework of EMH and PPP hypothesis. In section 3, we provide selected literature review. Section 4 outlines the data and methodology followed by section 5 where the empirical results are discussed. Section 6 is the concluding remarks.

2. Theoretical Background

As it is mentioned above, there are a lot of exchange rate theories developed and analyzed by researchers. Testing the validity of PPP approach gives the measure of economic integration of Turkey. Test results of EMH display whether or not exchange rate market is efficiently working.

2.1. Purchasing Power Parity

Purchasing power parity (PPP) is one of the cornerstone approaches in the international economics. Since 1970s, the analysis of PPP approach has been one of the topics which are controversial. According to PPP hypothesis, difference between foreign and domestic rates of inflation determines the nominal exchange rates. This approach is based on the assumption that law of one price prevails in an integrated competitive market. PPP points out that prices, in the existence of law of one price, will be the equal to each other when quoted in different countries. That is, when it is expressed in terms of same currency prices should be same in two different countries. Because relative prices of two countries alter the nominal exchange rates between two countries will also alter. In this way, exchange rate will stay. Thus, PPP hypothesis is also stated using the real exchange rate concept. Empirical validity of PPP approach is of key implications, not only since it is the base line for macroeconomic models but also since it has common use as a benchmark to detect the deviations of exchange rates from its real value and as a measure of economic integration among countries (Cuestas, 2009). In summary, this approach states that real exchange rates should be 1. It is shown with equations as follows:

$$q_t = s_t p_t / p_t^* = 1 \qquad (1)$$

Where q_t shows real exchange rate, s_t is nominal exchange rate, p_t and p_t^* are respectively domestic and foreign price levels. It is generally accepted that PPP is a long run theory of exchange rate determination. In the short run, it is possible to become some deviations from PPP but some forces in the market are capable of bringing the exchange rate its long run PPP value. This stylized fact points out that real exchange rate must be stationary to validate PPP hypothesis empirically. One of several methodologies which can be used to test the validity of PPP approach in the literature is unit root tests. But when it is tested by means of unit root one of the issues, that is structural breaks should be taken into account because unit root tests without structural breaks can end up with misleading results (Erlat, 2003). Big shocks or structural breaks in the short term period can result in deviations from the long term equilibrium point of real exchange rate (Edison, 1987). To test PPP hypothesis, minimum LM unit root test with two structural breaks which was developed by Lee and Strazicich (2003,2004) is used.

2.2. Efficient Market Hypothesis

According to efficient market hypothesis (EMH) firstly explained by Fama (1965), prices always fully reflect all the available and relevant information in an efficient market and Jensen (1978) mentions that none of the market participants can earn excess profit by exploiting the set of information. Fama et. al. (1969) defines efficient market term as a market adjustment to new information sharply. This definition indicates that market rationally processes the new information when new information is not neglected or there is no any systematical mistake. In this context, exchange rates change only with the arrival of new information and since there is no any possibility to predict future information it is impossible to forecast future exchange rate changes with the help of information set available. Therefore, by using the available information, making any profit is not possible. Grossman and Stiglitz (1980) claim that it is impossible to have the complete informational efficiency for a market. As obtaining information is costly prices cannot fully reflect the all information in the prices. If prices fully reflected all the information investors spending their resources to obtain and to analyze the new information couldn't generate an income to cover their expenses. Fama (1991) states that prior condition in EMH is zero cost of information and transactions. One of the other required conditions for EMH is not to have monopoly on information and data and to have transaction costs competitively determined. Because EMH might fail in the existence of imperfect market.

Fama (1970) subdivides EMH into three different form depending on information set. Weak form of efficiency as one of three forms in this hypothesis means that available information in past prices is not reflected by the current prices. That is, current exchange rates don't reflect all the available information in the past exchange rates. For this reason, a speculator cannot use the past information to forecast the exchange rates in the future. So, they cannot follow any strategy to gain any profit. The other form of this approach is semi strong-form which not only reflects the information in the past exchange rates but it also reflects publicly available information in the current exchange rates. Last of three forms, strong form efficient market, reflect the inside

information in current exchange rates in addition to semi-strong form. Weak and semi-strong form versions of EMH are encompassed by the strong form of efficient market hypothesis. Efficient exchange rate market has important policy implications. In an inefficient market, movement of exchange rates can be best predicted with the help of a model developed. And this situation can provide some opportunities to gain profits from exchange rates transactions. Moreover, government authorities can reduce volatility in exchange rates, evaluate the possible results of different economic policies and try to find a way to influence foreign exchange market in an inefficient foreign exchange rates market. Efficiency implies that exchange rates respond quickly and accurately to new relevant information.

An efficient exchange rates market is characterized by a unit root process (random walk) indicating that historical data of exchange rates cannot have any effect on prediction of future exchange rates. When exchange rates follow a random walk process all of shocks on exchange rates will be permanent and exchange rate won't be inclined to return its own trend path over time. The random walk property emphasizes that future returns from the exchange rate cannot be predicted based on observations in the past and that exchange rate volatility can grow without bounds in the long run. Conversely, in a trend stationary process (mean reverting), shocks to exchange rates is transitory and exchange rates return back to the trend path over time after the shock. The article tests the weak form efficiency of foreign exchange rate market by applying relatively new econometric techniques.

3. Literature Review

There is a large amount of literature about theories tested in this study. Related literature use different econometric methods such as linear, nonlinear and panel data econometrics. For testing the validity of PPP hypothesis and weak form market efficiency, unit root tests are generally preferred by researchers and some of these works conducted are given below.

3.1. Literature Review for Purchasing Power Parity

Studies testing the validity of PPP hypothesis use different econometrics methods in the related literature. One of the methods is panel unit root tests with or without structural break. Yıldırım et. al. (2013) examined the PPP hypothesis for Turkey, EU-27, EU-15, OECD countries and G-8 by using yearly data. Findings from CADF panel unit root test shows that PPP hypothesis is not valid for Turkey. Validity of quasi PPP hypothesis is tested by Guloglu et. al. (2011) for 18 Turkish reel exchange rate series using a panel unit root test with structural breaks in level and trend. Their findings support the validity of quasi PPP for almost all the real exchange rate series. Tatoglu (2009) analyzed also the validity of PPP hypothesis using panel unit root tests with and without structural breaks in 25 OECD countries. Findings of this study shows that PPP is valid for 10 countries in the absence of structural break but results of panel unit root test with structural break supports the validity of PPP for all countries. Gozgor (2011) and Lau (2009) apply the

panel unit root tests without structural break. Gozgor (2011) employed panel unit root tests to examine the validity of PPP hypothesis in Turkey together with eight of its trading partners. Using observations between 2003:01 and 2010:12, they find that empirical results obtained from panel unit root tests support the validity of PPP hypothesis for Turkey. Lau (2009) tests PPP hypothesis on four OECD countries between year 1950-1995 by applying new panel unit root test, in addition to ADF test, developed in that paper to overcome the pitfalls of classical unit root test. New test developed by Lau (2009) give strong support for long run PPP for three of OECD countries.

In the literature, some of the studies utilize linear and nonlinear unit root tests to detect the validity of PPP hypothesis. Ceylan and Ulucan (2014), Cuestas (2009) and Cuestas and Regis (2008) apply nonlinear techniques to test the hypothesis. On the other hand, Tirasoglu (2014), Yildirim and Yildirim (2012), Kum (2012) and Kalyoncu (2009) use linear methods. Validity of PPP hypothesis for OECD countries having the increasing economic integration is tested in the paper of Ceylan and Ulucan (2014) using annual data for the 1970-2013 period. As econometric methods, they used KSS and AESTAR test procedures based on nonlinear techniques and test results point out that AESTAR test gives much better results than KSS test and PPP hypothesis holds for 20 countries. Cuestas (2009) empirically investigated PPP hypothesis for Central and Eastern European countries with the help of two different unit root tests, that is, ESTAR models and nonlinear deterministic trends. Evidence obtained from this work supports validity of PPP hypothesis for the most of the countries since nonlinear deterministic trends and smooth transitions has been taken into account. Cuestas and Regis (2008) applied nonlinear unit root test to provide evidence on PPP hypothesis by using monthly data between the time period 1972-2010 for the OECD countries and they found that it is more convenient to apply nonlinear unit root test for the half of the countries. PPP hypothesis holds for the many of the countries in this study.

Tirasoglu (2014) analyzed the PPP hypothesis for 18 OECD countries by using quarterly data for 1993-2011 period with the help of linear methods. ADF, ZA (1992) and Lee and Strazicich (2003, 2004) unit root test with structural breaks were applied and according to test results, PPP holds for Canada and Mexico. Kum (2012) examined the validity of PPP hypothesis with annual data for the 1953-2009 period for Turkey by using ADF, DF-GLS, ZA and LM unit root tests. His findings show that with the presence of structural breaks, PPP hypothesis holds for Turkey. By using linear techniques, PPP hypothesis was investigated by Yildirim and Yildirim (2012). Reel effective exchange rate was tested using unit root test with break(s) for the period 1990:1-2009:12 including economic crises with which Turkey struggled. Results of unit root test with one structural break reveal that validity of PPP hypothesis is dependent on price index preferred. But PPP hypothesis holds according to results of unit root test with no structural break. Kalyoncu (2009) tests the PPP hypothesis between Turkey and its trading partners (USA, Germany, Japan, France, Netherlands and UK) over the period 1980:Q1-2005:Q4. This paper applies ADF and PP tests to determine the stationarity of real exchange rates. In addition to these tests, KPSS test which is stronger than the others also is applied. Empirical results using ADF and PP tests point

out that all countries except UK have unit root. Using KPSS test results, real exchange rate in Turkey is stationary and support long run PPP. In addition to the literature, Akdi et. al. (2009) test PPP by applying periodogram method for the existence of unit root in the reel exchange rate series of G7 countries. Their findings shows that compared to ADF test, this method rejects the existence of unit root of large number of G7 countries. For ten emerging markets, Doganlar et. al. (2009) empirically analyze the PPP hypothesis with the help of cointegration techniques. Monthly observations used for this paper consists of 1995-2005 time period. Their findings are not very supportive for the validity of PPP hypothesis and show that PPP hypothesis holds for only two countries among countries analyzed.

3.2. Literature Review for Efficient Market Hypothesis

There are many studies conducted by Bashir et. al. (2014), Berke et. al. (2014), Mabakeng and Shefeni (2014), Cicek (2014), Al-Khazali et. al. (2012), Cheung et. al. (2011), Ibrahim et. al. (2011) and Wickremasinge (2004) that test market efficiency in weak and semi strong form by using different unit root tests and cointegration techniques.

Bashir et. al. (2014) test empirical relationship between efficiency of forward and spot exchange rate market for Pakistan, using monthly data on spot and forward rates over the period 2006:07-2013:12. According to their findings, forward exchange rates don't reflect all of the available information. Thus, they conclude that EMH doesn't hold for exchange rate market of Pakistan and economic agents in the market can benefit from speculation because of market inefficiency.

Berke et. al. (2014) examine exchange rate market efficiency in weak form and semi-strong form over the period 2006:4-2013:12 for Turkish Lira/US dollar and Turkish Lira/Euro by using unit root and cointegration methods with structural breaks. Results they obtained from empirical methods show that foreign exchange market is efficient at weak form and inefficient at semi-strong form. On the basis of forward rate unbiasedness hypothesis, Turkish foreign exchange market is tested by Cicek (2014). This study applies unit root test and Johansen Cointegration test for Turkish Lira/US dollar and Turkish Lira/Euro for the period 05.02.2005-26.07.2013. Unit root test supports market efficiency in its weak form. Besides, since they find a cointegration between forward exchange rates and spot exchange rates and nonexistence of systematic expectation errors support forward rate unbiasedness hypothesis and thus provide evidence against market efficiency in semi-strong form.

In their study, Mabakeng and Shefeni (2014) analyze weak form efficiency in foreign exchange market of Namibia using three bilateral exchange rates by applying ADF, PP and KPSS unit root tests. Monthly data used for empirical application covers period 1993-2011. According to their results, weak form of market efficiency exists in Namibia, that is, past exchange rate values cannot be used to predict current values. Al-Khazali et. al. (2012) investigates the weak form of market efficiency for currencies of seven Asian emerging markets together with Australian Dollar against Japanese Yen, Euro and US Dollar. They analyze during the period of 1993:01-2008:12

with Asian financial crisis in 1997 as a structural break point. Their paper tests martingale difference hypothesis and random walk hypothesis to determine the market efficiency. Evidences they have obtained from their study supports the martingale and random walk for Korean Won and Australian Dollar since Asian crisis. But other exchange markets have made little progress toward weak form market efficiency after the Asian crisis.

In their paper, Cheung et. al. (2011) examines the efficient market hypothesis in Euro FX market. For 82 countries, they test autocorrelation in daily FX returns over the period 1999-2010. Escanciano & Lobato (2009)'s automatic Box-Pierce Qp test, Nankervis & Savin (2010)'s generalized Andrews-Ploberger test and Deo (2000)'s robust Durlauf test are applied and findings indicate no serial correlation problem for the most of the Euro exchange rates, suggesting that foreign currency markets are weak form efficient. Ibrahim et. al. (2011) empirically investigates weak form market efficiency for 30 OECD countries by using weekly data over the period 2000-2007. Econometric methods they use are ADF, PP and KPSS unit root tests. Results for weak form market efficiency exhibits random walk for exchange rates and this result is consistent with weak form market efficiency. Study of Wickremasinge (2004) tests weak form and semi-strong form of foreign market efficiency in Sri Lanka for six bilateral exchange rates. Data used in this paper consist of nominal spot exchange rates between the 1986:01-2000:11 period. Weak form efficiency is tested using ADF and PP unit root tests and semi-strong form of efficiency is investigated with variance decomposition, Granger causality and cointegration techniques. Test results of unit root shows random walk for six exchange rates, that is, results support weak form of market efficiency. On the other hand, test results doesn't support semi strong form.

4. Data and Methodology

This study analyzes validity of PPP hypothesis in Turkey using monthly spot exchange rates of Turkish Lira/US dolar and Turkish Lira/Euro over the period 2002:11-2015:03. Consumer Price Index (CPI) of European Union (27), USA and Turkey are used to obtain real exchange rate series. Base year for CPI is 2005. Spot exchange rate data are acquired from Central Bank of Turkey electronic database (EVDS) and CPI for Turkey is obtained from Turkish Statistical Institute. European Union CPI statistics are extracted from Federal Bank of ST. Louis database and US CPI statistics are obtained from US Bureau of Labor Statistics.

In this study, weekly forward and spot exchange rates data for Turkish Lira/US Dollar over the period 29.10.2002-26.05.2015 and for Turkish Lira/Euro over the period 31.10.2002-29.05.2015 are used to test EMH (657 observations). While weekly spot exchange rate data are obtained from Central Bank of Turkey electronic database (EVDS) weekly forward exchange rates are acquired from datastream database. This paper uses ADF Minimum LM unit root test to examine weak form efficiency.

Although most of the time series are affected by structural breaks traditional unit root tests take no account of structural breaks and this situation becomes one of the reasons not to have

evidence about stationarity. Due to problems of traditional tests, unit root tests with structural breaks have been developed and applied. Perron (1989) states that if unit root tests are applied by ignoring structural breaks in the existence of structural breaks possibility of accepting unit root hypothesis increases. Even though Zivot and Andrews (1992) (ZA test) endogenous structural break unit root test and Lumsdaine and Papell (1997) unit root test with two structural break test are taking structural breaks into consideration these tests don't assert that structural breaks are under null hypothesis in the existence of unit root but their critical values are derived in keeping with existence of this situation. LM unit root test developed by Lee and Strazicich (2003,2004) to fill this deficiency are used in this study. By the reason of determination of break moment endogenously, this test together with breaks doesn't cause to wrong rejections in the existence of unit root. Besides, wrong rejections are out in case of rightness of alternative hypothesis (Lee and Strazicich, 2004:2). According to study of Lee and Chang (2008), to the extent that null hypothesis is rejected in LM unit root test, this situation indicates rejection of unit root without having structural breaks. Structural breaks in LM unit root test modeled based on study of Perron (1989) are explained data generating process (DGP) below.

$$y_t = \delta' Z_t + X_t t \ , \ X_t = \beta X_{t-1} + \varepsilon_t \qquad (2)$$

While y_t in the equation above shows forward or spot exchange rate Z_t represents exogenous variables and ε_t represents error terms. Lee and Strazicich, contrary to ZA unit root test, use Model A and Model C. Model A allows two breaks in level and it is in the form of $Z_t=[1,t,D_{1,t,}$ $D_{2,t}]$. Dummy variable allowing break in level of time series is represented by $D_{j,t}$. T_{bj}, in case of showing the date of two breaks, is $t \geq T_{bj}+1$ for $D_{j,t}=1$ and zero in other cases. Model C allows two structural breaks in level and in trend and it is in the form of $Z_t=[1,t,D_{1,t,}$ $D_{2,t}$, $DT_{1,t}$, $DT_{2,t}]$. $D_{j,t}$ and $DT_{j,t}$ are dummy variables showing structural breaks in level and trend of series respectively. Here is $t \geq T_{bj}+1$ for $D_{j,t}=1$ and zero in other cases. Additionally, $t \geq T_{bj}+1$ for $DT_{j,t}=t- T_{bj}$, zero in other cases. DGP in LM unit root test contains breaks under either null hypothesis ($\beta=1$) or alternative hypothesis ($\beta<1$). Null and alternative hypothesis in Model A and Model C depending on value of β are shown in the following equations.

Null Hypothesis (Model A) : $y_t=c_0 + d_1B_{1t} + d_2B_{2t} + y_{t-1} + v_{1t}$ *(3)*

Alternative Hypothesis (Model A): $y_t=c_1 + \gamma t + d_1 D_{1t} + d_2D_{2t} + v_{2t}$ *(4)*

Null Hypothesis (Model C): $y_t=c_0 + d_1B_{1t} + d_2B_{2t} + y_{t-1} + v_{1t}$ *(5)*

Alternative Hypothesis (Model C): $y_t=c_1 + \gamma t + d_1 D_{1t} + d_2D_{2t} + d_3DT_{3t} + d_4DT_{4t} + v_{2t}$ *(6)*

While B_{jt} in equations above indicates dummy variable under null hypothesis v_{jt} shows stationary error term. Moreover, $t = T_{bj} + 1$ for $B_{jt} = 1$ and zero in other cases. Unit root statistics in LM test can be obtained from regression in Equation 7

$$\Delta y_t = \delta' \Delta Z_t + \varphi \tilde{S}_{t-1} + \sum_{p=1}^{k} \beta_p \Delta \tilde{S}_{t-p} + \varepsilon_t \qquad (7)$$

Δy_t and ΔZ_t variables respresent the value of first differences of y_t and Z_t. $\tilde{S}_{t-1}$ is expressed as detrended value of y_t. $\Delta\tilde{S}_{t-p}$ is incorporated in regression on the purpose of correcting autocorrelation. ε_t in equation 7 represents stochastic error term. Stationarity of y_t is tested with the hypothesis expressed $H_0 = \varphi = 0$. Finally, t test developed for $\varphi = 0$ in the regression of Model C is used to calculate LM test statistics.

5. Results

LM and LP unit root test together with ADF and KPSS unit root test not taking breaks into consideration so as to compare is applied for spot and forward Turkish Lira/US dollar exchange rates and results for market efficiency are indicated in Table 1. In the table, spot exchange rate and daily,weekly,3 months and 1 year forward exchange rates are stationary in their first differences (I(1)). According to this result, this exchange rates follow random walk process and pass values of these observations cannot be used to predict current values of those exchange rates. Similarly, findings obtained from KPSS unit root test show the same results as ADF unit root test results. These exchange rates are consistent with weak form of EMH. Evidences supported by ADF test and KPSS unit root test point out that economic actors in this market cannot benefit from statistical methods to gain any profit.

Table 1: Weekly Turkish Lira/US Dollar

Variable	ADF Unit Root Test Results		KPSS Unit Root Test Results		Result
	Test Value	Critc. Value	Test Value	Critc. Value	
Overnight Forward	-1.716266	-3.416683	0.596412	0.146	I(1)
Weekly Forward	-1.719087	-3.416683	0.596133	0.146	I(1)
Monthly Forward	-1.42373	-3.416683	0.59831	0.146	I(1)
3 Months Forward	-1.528511	-3.416683	0.598793	0.146	I(1)
1 Year Forward	-2.600486	-3.416683	0.566838	0.146	I(1)
Spot	-1.513054	-3.416693	0.599249	0.146	I(1)

In Table 2 and Table 3, results LP of LM unit root tests with structural breaks can be seen for Model A and Model C. Maximum lag is nineteen. t statistics value of last lagged term taken the first difference is compared with asymptotic normal value 1.645 at level of %10. After optimal lags in every alternative combination in which structural breaks occur are determined breaks are determined at the point where endogenous LM t statistics with two structural breaks takes minimum value (Berke et. al., 2014). T as sample size, possible combinations of points of two breaks are investigated in [0.1T,0.9T] time interval. Although many researchers believe that Model C is superior to Model A results of Model A are included in this study.

Table 2: LM Unit Root Test Model A and LP Unit Root Test

Variables	Lee-Strazicich					Lumsdaine-Papell				
	Minimum Test Statistics	Breaks		Coefficients	Lags	Minimum Test Statistics	Breaks		Coefficients	Lags
		Break-1	Break-2				Break-1	Break-2		
Overnight Forward	-3.0099	6/27/2006	18.06.2013	-0.0250	13	-3.9922	6/27/2006	11/26/2013	-0.0397	13
Weekly Forward	-2.9913	6/27/2006	6/18/2013	-0.0247	13	-3.9801	6/27/2006	11/26/2013	-0.0393	13
Monthly Forward	-2.4967	6/27/2006	8/20/2013	-0.0184	13	-3.5365	6/27/2006	10/22/2013	-0.0312	11
3 Months Forward	-2.4536	6/27/2006	8/20/2013	-0.0176	13	-3.8437	6/27/2006	10/22/2013	-0.0331	13
1 Year Forward	-1.9689	6/29/2004	6/27/2006	-0.0112	13	-4.2386	5/18/2004	10/22/2013	-0.0375	13
Spot	-2.4481	10/28/2008	8/20/2013	-0.0130	12	-3.7907	6/27/2006	11/26/2013	-0.0311	19

Table 3: LM Unit Root Test Model C and LP Unit Root Test

Variables	Lee-Strazicich					Lumsdaine-Papell				
	Minimum Test Statistics	Breaks		Coefficients	Lags	Minimum Test Statistics	Breaks		Coefficients	Lags
		Break-1	Break-2				Break-1	Break-2		
Overnight Forward	-5.0381	12/16/2008	9/10/2003	-0.0822	19	-5.2136	9/2/2008	11/13/2012	-0.0824	13
Weekly Forward	-5.0445	12/16/2008	9/10/2013	-0.0823	19	-5.2085	9/2/2008	11/13/2012	-0.082	13
Monthly Forward	-5.0055	10/28/2008	8/20/2013	-0.0719	13	-4.666	9/2/2008	10/9/2012	-0.066	11
3 Months Forward	-4.9893	10/28/2008	8/20/2013	-0.0708	13	-5.1687	9/2/2008	10/9/2012	-0.0726	13
1 Year Forward	-4.5218	8/17/2004	10/4/2011	-0.0548	13	-4.7811	8/5/2008	10/9/2012	-0.0521	13
Spot	-5.0221	12/16/2008	10/8/2013	-0.0636	19	-5.1556	9/30/2008	12/25/2012	-0.0708	19

Table 4: Critical Values for LM Unit Root Test with Two Structural Breaks

λ_2	0.4			0.6			0.8		
λ_1	%1	%5	%10	%1	%5	%10	%1	%5	%10
0.2	-6.16	-5.59	-5.27	-6.41	-5.74	-5.32	-6.33	-5.71	-5.33
0.4	-	-	-	-6.45	-5.67	-5.31	-6.42	-5.65	-5.32
0.6	-	-	-	-	-	-	-6.32	-5.73	-5.32

When minimum test statistics obtained from Model C is compared with critical values derived from work of Lee and Strazicich (2003) findings show that Turkish Lira/US Dolar forward and spot exchange rates follow a random walk process. Evidences acquired from LM unit root test

are similar to findings obtained from LP test searched for two breaks. Results reached from these tests are related variables don't have mean reversion dynamics and shocks are permanent. These results justify the opinion that Turkish Lira /US Dolar exchange rate is efficient in weak form.

KPSS and Augmented Dickey-Fuller unit root tests are applied for Turkish Lira/Euro spot and forward exchange rates and results related these exchange rates are given in Table 5 below. Spot and daily, weekly, monthly, 3 months and 1 year forward exchange rates are stationary in their first differences (I(1)). Also, findings from KPSS test results show that all of the exchange rates data are stationary in their first differences. These results seem like results above. Turkish Lira/ Euro exchange rates follow random walk process and future values of exchange rates cannot be predicted with help of past values of exchange rates. These exchange rates are efficient in the weak form.

Table 5: Weekly Turkish Lira/Euro

Variable	ADF Unit Root Test Results		KPSS Unit Root Test Results		Result
	Test Value	Critc. Value	Test Value	Critc. Value	
Overnight Forward	-2.76334	-3.41668	0.377332	0.146	I(1)
Weekly Forward	-2.74489	-3.41668	0.380819	0.146	I(1)
Monthly Forward	-2.71686	-3.41668	0.389331	0.146	I(1)
3 Months Forward	-2.65599	-3.41668	0.408804	0.146	I(1)
1 Year Forward	-2.7592	-3.41668	0.446075	0.146	I(1)
Spot	-2.98823	-3.41669	0.380636	0.146	I(1)

Table 6: LM Unit Root Test Model A and LP Test

Variables	Lee-Strazicich					Lumsdaine-Papell				
	Minimum Test Statistics	Breaks		Coefficients	Lags	Minimum Test Statistics	Breaks		Coefficients	Lags
		Break-1	Break-2				Break-1	Break-2		
Overnight Forward	-3.5134	6/22/2006	11/29/2007	-0.0344	13	-4.8063	12/9/2004	5/16/2013	-0.0635	16
Weekly Forward	-3.4926	6/22/2006	11/29/2007	-0.034	13	-4.8221	12/9/2004	5/16/2013	-0.0636	16
Monthly Forward	-3.4509	6/22/2006	11/29/2007	-0.0328	13	-4.8584	12/9/2004	5/16/2013	-0.0636	16
3 Months Forward	-3.369	3/12/2009	3/6/2014	-0.0294	9	-4.9352	12/9/2004	5/16/2013	-0.0637	16
1 Year Forward	-2.9992	6/3/2004	3/12/2009	-0.0216	13	-5.2981	12/9/2004	5/16/2013	-0.0608	16
Spot	-3.4797	7/21/2011	5/30/2013	-0.0298	13	-4.9306	12/16/2004	5/16/2013	-0.0527	16

Table 7: LM Unit Root Test Model C and LP Test

Variables	Lee-Strazicich					Lumsdaine-Papell				
	Minimum Test Statistics	Breaks		Coefficients	Lags	Minimum Test Statistics	Breaks		Coefficients	Lags
		Break-1	Break-2				Break-1	Break-2		
Overnight Forward	-4.575	4/28/2005	8/15/2013	-0.0686	16	-4.5651	4/14/2005	11/14/2013	-0.0631	13
Weekly Forward	-4.5744	4/28/2005	8/15/2013	-0.0686	16	-4.5394	2/22/2007	10/10/2013	-0.0618	13
Monthly Forward	-4.5679	4/28/2005	8/15/2013	-0.0682	16	-4.5884	10/28/2004	9/5/2013	-0.0615	13
3 Months Forward	-4.529	4/28/2005	8/15/2013	-0.0674	16	-4.6644	11/11/2004	9/5/2013	-0.0625	13
1 Year Forward	-4.7203	4/20/2006	5/16/2013	-0.0671	16	-5.0747	7/20/2006	9/19/2013	-0.0644	13
Spot	-4.6892	9/11/2008	8/15/2013	-0.0562	15	-4.6876	4/14/2005	8/22/2013	-0.0559	13

Table 8: Critical Values for LM Unit Root Test with Two Structural Breaks

λ_2	0.4			0.6			0.8		
λ_1	%1	%5	%10	%1	%5	%10	%1	%5	%10
0.2	-6.16	-5.59	-5.27	-6.41	-5.74	-5.32	-6.33	-5.71	-5.33
0.4	-	-	-	-6.45	-5.67	-5.31	-6.42	-5.65	-5.32
0.6	-	-	-	-	-	-	-6.32	-5.73	-5.32

Comparison of minimum test statistics of Model C with critical values derived from Lee and Strazicich (2003) study points out that Turkish Lira/Euro forward and spot exchange rate have consistent results like ADF unit root test results and they follow random walk process. According to result of LM unit root test with two structural breaks, Turkish Lira/Euro exchange rates are efficient in weak form. Also, LP test results with two breaks show that related variables don't have mean reversion dynamics and shocks are permanent.

Empirical findings for PPP hypothesis obtained from Augmented Dickey-Fuller unit root test suggest that real Turkish Lira/Euro exchange rate series are not stationary for %1 and %5 levels and invalidity of PPP hypothesis is determined for these significance levels with the help of these results. Optimum lag value for these series is detected as 1. Test results for real Turkish Lira/US Dollar give the evidences that this series has unit root for 1%, %5 and %10 significance levels. Optimum lag of these series is 2 and series becomes stationary in their first differences. KPSS unit root test also shows same results like ADF test.

Table 9: Monthly Turkish Lira/US Dollar and Turkish Lira/Euro

Variable	ADF Unit Root Test Results				KPSS Unit Root Test Results				Result
	Test Value	Critc. Value			Test Value	Critc. Value			
		1%	5%	10%		1%	5%	10%	
Real Turkish Lira /US Dolar	-2.933	-4.022	-3.441	-3.145	0.341	0.216	0.146	0.119	I(1)
Real Turkish Lira /Euro	-3.434	-4.021	-3.441	-3.145	0.225	0.216	0.146	0.119	I(1)

Table 10 and Table 11 show empirical application results for testing the validity of PPP hypothesis using LP and LM unit root test with two structural breaks for Model A and Model C. Maximum lag value is sixteen in the application of these tests. t statistics value of last term taken the first difference is compared with 1.645 asymptotic normal value at %10 level. Possible combinations of points of two breaks are investigated in [0.1T,0.9T] time interval (T is sample size).

Table 10: LM Unit Root Test Model A

Variables	Lee-Strazicich					Lumsdaine-Papell				
	Minimum Test Statistics	Breaks		Coefficients	Lags	Minimum Test Statistics	Breaks		Coefficients	Lags
		Break-1	Break-2				Break-1	Break-2		
Real Turkish Lira /US Dolar	-1.296	2010:11	2013:12	-0.0354	3	-5.0695	2004:09	2007:03	-0.1918	3
Real Turkish Lira /Euro	-3.5936	2011:07	2014:03	-0.1877	11	-4.6375	2005:05	2006:06	-0.4764	3

Table 11: LM Unit Root Test Model C

Variables	Lee-Strazicich					Lumsdaine-Papell				
	Minimum Test Statistics	Breaks		Coefficients	Lags	Minimum Test Statistics	Breaks		Coefficients	Lags
		Break-1	Break-2				Break-1	Break-2		
Real Turkish Lira /US Dolar	-4.5508	2008:11	2011:11	-0.4324	3	-5.8584	2008:09	2011:04	-0.2895	3
Real Turkish Lira /Euro	-6.4387	2008:08	2010:06	-0.5296	11	-5.9074	2006:12	2010:07	-0.9387	16

Table 12: Critical Values for LM Unit Root Test with Two Structural Breaks

λ_2	0.4			0.6			0.8		
λ_1	%1	%5	%10	%1	%5	%10	%1	%5	%10
0.2	-6.16	-5.59	-5.27	-6.41	-5.74	-5.32	-6.33	-5.71	-5.33
0.4	-	-	-	-6.45	-5.67	-5.31	-6.42	-5.65	-5.32
0.6	-	-	-	-	-	-	-6.32	-5.73	-5.32

LP and LM unit root test results in Table 11 support the evidences that PPP hypothesis is not valid for both of series. Deviations from real exchange rates cannot reach their equilibrium values.

6. Conclusions

Real spot and forward exchange rates data of Turkey is investigated over the period 31.10.2002-29.05.2015 to test for evidence weak form market efficiency. In addition to LM unit root test endogenously determining the breaks in trend and level, we utilize the KPSS and ADF unit root tests. Our results from these unit root tests conclude that spot exchange rates and daily, weekly, 3 months and 1 year forward exchange rates are stationary in their first differences for real Turkish Lira/Euro and real Turkish Lira/US Dollar. Thus, weak form market efficiency holds for Turkey and economic actors cannot gain any profit by predicting values of the exchange rates. Besides, results of LP and LM unit root tests with two structural breaks show also same results as ADF and KPSS unit root test results. Evidences obtained from Model A and Model C results for both of the series indicate that series follow a random walk process and verify the opinion that future values of Turkish Lira/Euro and Turkish Lira/US Dollar exchange rates cannot be predicted by using the past values of these series. These findings are in line with the findings of Berke et. al. (2014), Çiçek (2014), Cheung et. al. (2011) and Ibrahim et. al. (2011). If the policy makers use the information provided by exchange rates market the market could be expressed as efficient. That is, since the exchange rates market efficient in the weak form in Turkey government cannot have an effect on the exchange rates market which is an important policy variable. Government cannot take any action to reduce the exchange rate volatility. Also, outcomes of policies for exchange rates might not be evaluated and government is not able to make informed decisions on exchange rates market. For companies, efficiency in the market means timing for transactions or currency selection does have less importance and hedging policies are less effective to avoid from risks. For future research, validity of semi strong form of market efficiency in Turkey can be tested by using different methods allowing multi-structural breaks. In addition, whether or not EMH is valid can be tested with higher frequency of data such as daily data.

Many researches about Turkish economy using standard unit root tests mention that PPP hypothesis is generally not valid. Besides LP and LM unit root tests, standard unit root tests are used in this study. This paper analyzes the effect of structural breaks on validity of PPP hypothesis in Turkey for the period 2002:11-2015:03. Our findings from the ADF unit root test show that Turkish Lira/Euro exchange rate series is not stationary for 1% and %5 levels. Thus, PPP hypothesis is not valid for 1% and %5 levels but is valid for %10 level as it is stationary. Real Turkish Lira/US Dollar series have unit root for 1%, %5 and %10 significance levels. Both of series become stationary in their first differences. Empirical results obtained from LP and LM unit root test with two structural breaks shows that PPP hypothesis is invalid for both of the series in Model A and Model C. We conclude that PPP hypothesis doesn't hold for ADF, KPSS, LP and LM unit root tests with two structural breaks. Findings of this study are consistent with the literature of Tıraşoğlu (2014), Yıldırım et. al. (2013) and Doğanlar et. al. (2009) but inconsistent

with the literature of Guloglu (2011), Tatoglu (2009), Gozgor (2011), Ceylan and Ulucan (2014), Kum (2012), Kalyoncu (2009) and Yıldırım and Yıldırım (2012). Policy makers in the countries where PPP hypothesis is invalid should first take stability of exchange rates into the consideration before they create and apply their economic policies. The important implication coming from the findings is the fact that a temporary shocks on the real exchange rates in Turkey would result in permanent effects. Monetary transmission mechanism could affect the real exchange rates permanently. Long run value of real exchange rates would be permanently affected by contractionary or expansionary monetary policies. As a possible further research, non-linear adjustment of real exchange rates can be modelled using non-linear methods since deviations from PPP might follow a non-linear process for Turkey due to market frictions.

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