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Portfolio Balance Approach to Exchange Rate Determination: Testing a Model by Applying Bilateral Data of Turkey and United States[1]

Döviz Kurlarının Belirlenmesinde Portföy Yaklaşımı: Türkiye ve ABD'nin Karşılıklı Verilerini Kullanarak Bir Modelin Test Edilmesi

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ABSTRACT

Turkish economy started to be liberated in the beginning of 1980's and gradually to be a part of global economic and financial system. But as a result of economic articulation of Turkey to the global world, global economic and financial headwinds have affected trade and economy especially via exchange rates. Since Turkey is of ever-growing foreign trade volume with global economic world determination of fluctuations in exchange rates has increased in importance. Due to global integration of financial markets, inflow and outflow of foreign bonds could cause economic agents to change currency composition of foreign assets to reduce the risks arisen from exchange rates. This situation can negatively affect exchange rates by fluctuating them. Aim of this study is to empirically investigate the portfolio balance effect on exchange rates. In this context, different version of Cushman's model (2007) using monthly bilateral data of Turkey and U.S. covering the period 2006-2016 will be employed and portfolio balance approach to the exchange rates determination will be tested by performing cointegration test allowing for multiple structural breaks.

Keywords: Exchange Rate Determination Approaches, Portfolio Balance, Risk Premium, Maki Cointegration Test

ÖZET

Türkiye ekonomisi 1980'li yılların başında serbestleşmeye ve küresel ekonominin ve finansal sistemin bir parçası olmaya başladı. Türkiye'nin dünya ekonomisine eklemlenmesinin bir sonucu olarak, küresel iktisadi ve finansal dalgalanmalar, özellikle döviz kurları aracılığıyla, Türkiye'nin dış ticaretini ve ekonomisini etkilemektedir. Türkiye küresel ekonomi ile birlikte sürekli büyüyen bir dış ticaret hacmine sahip olduğu için döviz kurlarındaki dalgalanmaların belirlenmesinin önemi artmaktadır. Finansal piyasalardaki küresel entegrasyondan dolayı yabancı fonların yurt içine giriş ve çıkışları iktisadi birimlerin, döviz kurları tarafından oluşturulan risklerin azaltılması amacıyla, yabancı varlıklarının döviz kompozisyonlarını değiştirmesine neden olabilmektedir. Bu durum döviz kurlarını olumsuz yönde etkileyebilmektedir. Bu çalışmanın amacı döviz kurları üzerindeki portföy dengesi etkisini incelemektir. Bu bağlamda, Cushman (2007) tarafından kullanılan modelin farklı bir versiyonundan faydalanılarak, Türkiye ve ABD'ye ait 2006-2016 dönemini kapsayan karşılıklı aylık veriler kullanılmıştır. Döviz kurlarını belirlemede portföy dengesi yaklaşımı çoklu yapısal kırılmaya izin veren eşbütünleşme testi ile sınanmıştır.

Anahtar Kelimeler: Döviz Kuru Belirleme Yaklaşımları, Portföy Dengesi, Risk Primi, Maki Eşbütünleşme Testi.

1. INTRODUCTION

Economic structure of today's world, global competitiveness and the key role of international trade for economies cause forecasting and determination of exchange rates to be one of the main economic issues not only for decision makers but also for academics. As uncertainties created by fluctuations in exchange rates give rise to difficulties to estimate the return of their investments for economic actors economic performances of countries suffering from this uncertainty are negatively affected, which leads to economic shrinkage.

[1] **This study is extracted from the Phd Thesis of Mehmet Çağrı Gözen, titled "Başlıca Döviz Kuru Belirleme Yaklaşımları ve Seçilmiş Yaklaşımların Etkinliğinin Türkiye Örneğinde Test Edilmesi".**

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Many theories have been established to determine the exchange rates by economists following the liberalization. Since development of international trade and financial markets all over the world have changed the structure of world economy and have raised the importance of financial assets market asset approaches such as monetary approach to determine the exchange rates have been more succesfull than the traditional models like balance of payment approach. This approach suggests that expected rate of returns together with effects of relevant macroeconomic factors have a large and lasting impact on the present value of assets. Essential assumptions of monetary model are purchasing power parity condition (PPP), uncovered interest rate parity (URP) and money market where money demand has a negative relation with stock returns is of an equilibrium condition. Stock price increases are most probably results of a raise in domestic output which leads to decrease in interest rates because of a fall in money demand. This situation causes domestic currency to depreciate due to URP condition and price level increases occur as a result of money demand decreases via PPP. According to income effect, raise in financial transactions and cash flows of future income cause an increase in stock prices in opposition to interest rate effect. Domestic money demand will go up as a result of wealth increase and consequently exchange rate will appreciate. Eventually, relative power of income and interest rate effect is the main determinant of the sign of the relation between stock prices and exchange rates (Yılancı, V. And Bozoklu, Ş.; 2015, s.156-157).

Branson (1977, 1981, 1983) developed the portfolio balance model, as an extension of monetary model, to exchange rate determination claiming that financial markets determine the exchange rates by creating demand for an asset in compliance with predetermined stock supplies (Min, H.G and McDonald, J.;1993). This approach assumes that money, local and foreign bonds are part of investors' portfolio and that changes in any one of these three assets oblige the investor to reestablish the balance in his portfolio in such a manner that he desires. The adjustment process in portfolio influences the exchange rates via demand changes for assets. Foreign assets (including money) and domestic assets are substitutes for each other. But there is a main difference between portfolio balance approach and monetary approach. While portfolio balance approach states that domestic assets and foreign assets are not perfectly substitute for each other monetary approach assumes that domestic securities (which represents assets other than money) perfectly subtitute for foreign assets. A large set of diverse assets in the absence of perfect substitutability mentions an equilibrium condition that must be explicitly modeled for at least one of the securities markets. To put another way, uncovered interest rate parity condition does not hold because of imperfect substitution of domestic and foreign assets. That is, summation of expected rate of exchange rate changes and foreign interest rates could not be equalized by domestic assets' interest rates (Isard, P; 1995, p.107).

The objective of this study is to test the validity of portfolio balance approach of Turkey by using bilateral Turkish and US data. Related literature has not arrived at a consensus about this model. We are of opinion that the validity of portfolio balance approach being one of the least applied approaches among all exchange rate determination approaches for Turkey should be tested more by using empical methods. Trying to account for instantaneous changes in exchange rates due to rapid changes in demand and supply of financial assets, portfolio balance approach has much more potential than many other approaches in revealing the reasons of short-term exchange rate changes. Moreover, findings obtained from this approach will be more reliable since it considers the risk factor contrary to monetary approach. Thus, the validity of the model in Turkey has been tested in this study by using cointegration methods allowing multiple structural breaks. Empirical findings obtained from test results would provide important evidences on exchange rate determinants and policy implications could be drawn from the empirical test results in this paper.

2. LITERATURE REVIEW

Compared to monetary approach, relatively less empirical research on Turkey has been conducted on portfolio balance approach due to some limitations. One of the limitations is the low quality of non-monetary assets data and other limitation is lack of high frequency data of non-monetary assets. When examined the related literature for both Turkey and other countries it is seen that validity of this approach has been tested by using different variables having data with various frequencies.

Fatum (2015) empirically examines the transmission channels of central bank interventions for USA and Japan by using daily data covering the period 1999-2004. In this study, conducted under the assumption of zero interest rate and limited use of

traditional monetary policy tools, Fatum concludes that intervention works via portfolio balance channel. Using quarterly data of USA and Pakistan from 2001 to 2010, Khan and Abbas (2015) test the validity of portfolio balance approach for Pakistan. In addition to Phillips-Perron and ADF tests, they employ ARDL test and their findings shows the validity of this approach. In their study, analyzing the Malaysian Ringit between the years of 1991 and 2012 by utilizing monthly data, Tze-Haw, Teck and Chee-Wooi (2013) compares two different artificial neural network models with random walk model and VAR model by employing portfolio balance approach. According to their findings, artificial neural network models produce more exact results than those of econometric methods. Breedon and Vitale (2008) analyzed the effects of information in portfolio balance and order flow approach on exchange rate determination by employing GMM method. Using daily data covering 08.2000-01.2001, they conclude that exchange rate intervention could be explained by portfolio balance approach to a large extent. Furthermore, they point out order flows have impact on exchange rates via portfolio balance. By using quarterly Mexican Peso and U.S. Dollar data, Nwafor (2008) tests the portfolio balance approach for the period 1985-2005. He adopts unit root and cointegration tests to examine the validity of perfect substitution between domestic and foreign assets and his findings shows weak evidences between Peso-Dollar exchange rate and portfolio balance approach in the long-term. Cushman (2007), using quarterl data for the period 1970-1999, employed portfolio balance approach on the Canadian-US exchange rate. According to cointegration test results, two cointegrating vectors are detected. The approach is also tested for out of sample forecasting. Findings couldn't clearly verify the validity of portfolio balance approach despite the fact that the model applied satisfy the theoretical expectations of random walk model. Hall et. al. (2008) adopt the a cointegrated vector error correction (VEC) approach and time varying coefficient (TVC) approach to understand the determinant of money demand in the context of portfolio balance framework. Applying quarterly data for the period 1980-2006, they claim a stable relationship among the determinants of money demand in Euro Zone. Kim (1986) test the validity of portfolio balance model for Korea by applying quarterly data for the period 1980-1984. Empirical findings suggest significant results for their model and their simulation results give evidences being in line with the expectations of portfolio balance approach. Study of Min and McDonald (1993) aims to determine Korean Won and U.S. Dollar exchange rates via portfolio balance approach. Using monthly data for the period between 1981-1989, they claim that portfolio balance model provides better forecast than the random walk model.

In addition to literature mentioned above, Berke (2012), Öcal (1990), Ay (2000), Karacaoğlu (2010), Umer et. al. (2015), Erer et. al. (2016), Pekkaya and Bayramoğlu (2008), Aydemir and Demirhan (2009) and Doğru and Recepoğlu (2013) have reached different results in their studies on Turkey. For the period from 01.04.2002 to 31.07.2012, Berke (2012) analyzes the relationship between TL/USD ve IMKB 100 index by employing single equation cointegration tests (FMOLS, DOLS and CCR). Using daily data, she comes to a conclusion that portfolio balance approach is valid. By applying the monthly data for the period 1985:01-1989:03, Öcal (1990) analyzed the factors affecting the TL against U.S. Dollar for Turkey. A model, suitable for non-convertible currencies and including interest rate parity, is preferred in this study. Regression results suggest that banks canalyses their sources foreign assets when interest rates are increased till the level where credit demands start decreasing. Since exchange rate demand increases exchange rates are also increase. Based upon the Hooper-Morton model, Ay (2000) employs least square method and Granger Causality method and utilizes five models. According to results of first and second models, money supply, national income, expected inflation rate difference and real exchange rate coefficients are statistically significant. In the third model, expected inflation rate difference and real exchange rate coefficients are significant. While coefficients of expected inflation rate difference, money supply and real exchange rate are found statistically meaningful in the fourth model, results obtained from the last model suggest that coefficients of money supply, lagged value of national income, expected inflation rate difference and real exchange rate are statistically significant. Study of Karacaoğlu (2010), employing Branson model, perfoms the regression analysis to analyze the ratio of internal debt stock to monetary base. In this study using quarterly data for the period 2002-2010, although coefficients are statistically meaningful signs are in the opposite direction. Evidences state that the portfolio balance approach is not valid for Turkey. Umer et. al. (2015) perform the ARDL model for emerging markets and analyze the relation between asset prices and exchange rates by applying monthly

data covering the period 1998-2014. Their findings show stronger movement of variables in the same direction during the period of crisis. Causality is from exchange rates to asset prices during the period of crisis while being in the opposite direction in the other periods. According to test results, portfolio balance approach is invalid for Turkey, among the countries analyzed in this study. Using monthly data for the period 2002-2015, Erer et. al. (2016) employ Geweke and Porter-Hudak fractional cointegration test to test the long-run relation between BIST 100 and TL/U.S. Dollar exchange rate. Results of this study, detecting a causality from exchange rates to asset prices, claim the cointegration relation among variables. Thus, portfolio balance approach is not valid for Turkey. Pekkaya and Bayramoğlu (2008) utilize IMKB 100 and S&P 500 indexes by applying daily data covering the period 02.01.1990-13.04.2007. Empirical findings point out a causality relation from indexes to exchange rate and there is no any cointegration relation among non-stationary variables. Applying daily data for the period 23.02.2001-11.01.2008, Aydemir and Demirhan (2009) conduct an empirical research to analyze the relationship between exchange rate and asset price changes by employing ADF, PP, KPSS, Toda-Yamamoto, VAR and MWald methods. Their findings show bidirectional causality between exchange rates and asset prices. Besides, they also find evidences supporting the validity of portfolio balance aproach for Turkey. Doğru and Recepoğlu (2013) analyze both of linear and non-linear cointegration relations between Euro/TL and U.S. Dollar/TL exchange rates. They perform the bound test developed by Pesaran, Shin and Smith (2001) being linear and employ non-linear test developed by Breitung (2001). They detect a cointegration relation among the variables in the long-run. According to results of this study indicating the direction of relationship from exchange rates to assets, the relation among variables, becoming negative in the short-run, is found as pozitive in the long-run.

3. MODEL AND DATA

Model in this study is determined by considering the works of Frankel (1983) and Branson and Henderson (1985). Assumptions added by Cushman (2007) to this model constructed by four assets, which are financial assets and curriencies of two countries, are taken into consideration. One of the assumptions is that residents of each country don't hold the currency of other country. Second assumption suggests money demand of a country is not the function of other country's return on assets. Besides, money demand is independent from nominal wealth and has unit elasticity with respect to nominal wealth. Domestic and foreign asset demands are assumed to be unit elastic with regard to non-monetary nominal wealth. In relation with returns, asset demand is only dependent on interest rate differences. Asset demand and wealth constraints constructed according to these assumptions are as follows:

$$L_{tr} = \alpha_{tr}(i)Y, \quad \mathrm{D}_{us} = \alpha_{us}(i^*)Y^* \tag{1a, 1b}$$

$$T_{tr} = \beta_{tr}(i - i^* - E\Delta s)(\mathrm{W}_{tr} - \mathrm{L}_{tr}), \quad \mathrm{T}_{us} = \beta_{us}(i - i^* - E\Delta s)(\mathrm{W}_{us} - D_{us}) \tag{2a, 2b}$$

$$SU_{tr} = [1 - \beta_{tr}(i - i^* - E\Delta s)](\mathrm{W}_{tr} - \mathrm{L}_{tr}), \quad \mathrm{SU}_{us} = [1 - \beta_{us}(i - i^* - E\Delta s)](\mathrm{W}_{us} - D_{us}) \tag{3a, 3b}$$

$$\mathrm{W}_{tr} = SU_{tr} + T_{tr} + \mathrm{L}_{tr}, \quad \mathrm{W}_{us} = SU_{us} + T_{us} + D_{us} \tag{4a, 4b}$$

S in equations above shows TL/US Dollar exchange rates (s is logarithmic value of exchange rates). T_{tr} and T_{us} represent, respectively, Turkish assets held by Turkish citizens and Turkish assets held by US citizens. U_{us} and U_{tr} indicate, respectively, US assets held by US citizens and US assets held by Turkish citizens. L_{tr} is the assets of Turkish citizens denominated in TL and D_{us} is the assets of US citizens denominated in US Dollar. W_{tr} and W_{us} denote the wealth of Turkish and US citizens respectively. Y is the nominal income of Turkey and Y^* is the nominal income of USA. Furthermore, i represents the interest rate in Turkey while i^* represents the interest rate in USA. E is expectation operator and β_{tr} ve β_{us} having value between 0 and 1 in equations (2a,b) and (3a,b) are increasing functions of interest rates differantiations. $\beta_{tr} > \beta_{us}$ is assumed under the domestic asset preference assumption. That endogenous variables in model could be consecutively determined allows the simplifications below:

$$S = (T_{tr} / U_{tr})[1 - \beta_{tr}(i - i^* - E\Delta s)] / [\beta_{tr}(i - i^* - E\Delta s)] \tag{5a}$$

$$S = (T_{us} / U_{us})[1 - \beta_{us}(i - i^* - E\Delta s)] / [\beta_{us}(i - i^* - E\Delta s)] \quad (5b)$$

Equations (5a) and (5b) show the asset demand for both of the countries. Equations (6a) and (6b), linearized form of (5a) and (5b), are used in the study of Frankel (1983)

$$s = \gamma_{tr} - \delta_{tr}(i - i^* - E\Delta s) + t_{tr} - \mathrm{u}_{tr} \quad (6a)$$

$$s = \gamma_{us} - \delta_{us}(i - i^* - E\Delta s) + t_{us} - \mathrm{u}_{us} \quad (6b)$$

Apart from interest rates, variables represented with lower case in equations (6a) and (6b) are logarithmic values. After all, given that variable s is I(1), expected change of s (EΔs) becomes I(0). Thus, this variable could be ignored in cointegration analysis. Hence, econometric model implied in this study contains seven variables and two equations one of which represents domestic investors while other represents foreign investors. In the modified model, where the assumption that asset demand of a country is not affected by international liabilities of that country is invalid, part of non-monetary wealth (β) held as domestic asset in the model is accepted not only as function of interest rate difference, but also as function of non-monetary wealth of net foreign liabilities. As a result of this, asset demand in equations (2a,b) and (3a,b) is not unit elastic with respect to wealth under the assumption that elasticities are still positive. So, equations (5a) and (5b) are as follows:

$$S = S([i - i^* - E\Delta s]^{(-)}, \mathrm{T}_{tr}^{(+)}, \mathrm{U}_{tr}^{(-)}, \mathrm{T}_{us}^{(\pm)}) \quad (7a)$$

$$S = S([i - i^* - E\Delta s]^{(-)}, \mathrm{U}_{tr}^{(\pm)}, \mathrm{T}_{us}^{(+)}, \mathrm{U}_{us}^{(-)}) \quad (7b)$$

If the asset demand has elasticity bigger than one in both of the countries T_{us} variable in equation (7a) has positive sign and U_{tr} variable in equation (7b) has negative sign. When it is smaller than one sign of a variable becomes reversed. If we consider equation (7a) in the elastic situation, as a result of an increase in T_{us} variable, net wealth of Turkey decreases and this causes TL to depreciate due to a relative decrease in the demand of Turkish citizens for Turkish assets and variable S increases. For equation (7b), an increase in variable U_{tr} results in a decrease in US net wealth. Moreover, US Dollar will depreciate since the relative demand of US citizens to US assets decreases and S variable will also decrease. Contrary to the model in (5a), (5b), (6a) and (6b), only one variable in each asset demand function is ignored in the modified model.

In the econometric study, Frankel (1983) is used as a base by describing the asset of a country held by its own citizens (T_{tr} ve U_{us}). In this study, bilateral data for each country is employed by considering one country's asset might be held by other country's citizen (T_{us} ve U_{tr}). As Bisignano and Hoover (1982) specify it is found appropriate to use bilateral asset data to analyze the bilateral exchange rates. Data between current account and rest of the world is not employed in contrast to Frankel (1983).

Monthly data covering the 2006:M01-2016:M11 period is applied. *exc* variable describing the TL/ABD Dollar exchange rate is dependent variable in this study having seven variables. Independent variables are quarterly US treasury bond interest rate, quarterly deposit interest rate of Turkey, value of US asset holdings of US citizens denominated in US Dollar, value of Turkish asset holdings of US citizens denominated in US Dollar, value of Turkish asset holdings of Turkish citizens denominated in US Dollar and value of US asset holdings of Turkish citizens denominated in US Dollar

Data used in this study obtained from Central Bank of Turkish Republic EVDS system, Federal Bank of St. Louis database, IMF International Financial Statistics database and US Department of Treasury database. US and Turkish Consumer Price Indexes (CPI) are used to deflate nominal data to real values. In order to test the validity of Portfolio Balance Approach (PBA) more properly, differences of related variables are taken in accordance with the theoretical framework of this approach. Variable *i_fark*, which is obtained by subtracting US interest rates from Turkish interest rates, gives interest rate differences between two countries. Variable *tr_yab_varlik* is obtained as result of subtraction of Turkish assets held by Turkish citizens from US assets held by Turkish citizens. This variable represents the demand of Turkish citizens to US assets. Variable *yab_tr_varlik*, obtained by taking the difference between Turkish assets held by US citizens and US assets held by US citizens, shows the US demand for Turkish assets.

Johansen cointegration test and Maki (2012) cointegration test allowing multiple breaks are employed to test the validity of PBA for Turkey. Furthermore, effects of independent variables on dependent variable are analyzed by decomposing the residuals obtained from independent variables. Eviews 9.0 and Gauss 8.0 softwares are utilized to derive the results from data.

4. METHODOLOGY: MAKI TEST

Regression models below allow cointegration analysis with multiple breaks.

$$y_t = \mu + \sum_{i=1}^{k} \mu D_{i,t} + \beta' x_t + u_t \quad (1)$$

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \beta' x_t + \sum_{i=1}^{k} \beta_i' x_t D_{i,t} + u_t \quad (2)$$

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \gamma t + \beta' x_t + \sum_{i=1}^{k} \beta_i' x_t D_{i,t} + u_t \quad (3)$$

$$y_t = \mu + \sum_{i=1}^{k} \mu_i D_{i,t} + \gamma t + \sum_{i=1}^{k} \gamma_i t D_{i,t} + \beta' x_t + \sum_{i=1}^{k} \beta_i' x_t D_{i,t} + u_t \quad (4)$$

y_t and $x_t=(x_{1t}, \ldots, x_{mt})'$ in the equations indicate observable I(1) variables and u_t shows error term (t=1,2, …, T). y_t is an scalar and $x_t=(x_{1t}, \ldots, x_{mt})'$ is a (m×1) vector. z_t vector (n×1) is assumed to be generated by $z_t=(y_t,x_t')'=z_{t-1}+\varepsilon_t$. ε_t with zero mean has an independent and homogenous distribution with $E|\varepsilon_t|^s<\infty$ where positive definite variance-covariance matrix is Σ and s>4. μ, μ_i, γ, γ_i, β'=($\beta_1, \ldots, \beta_m$), and $\beta_i'=(\beta_{i1}, \ldots, \beta_{im})$ are true parameters. While $D_{i,t}$ becomes 1 in the case of $t>T_{B,i}$ (i=1, …, k), it becomes 0 if not so. K indicates maximum number of breaks and $T_{B,i}$ shows the time period of breaks. While equation 1 allows changes in level, model 2 is a regime switching model allowing structurak break of β in addition to μ. Model 3 is the form of model 2 with trend. Equation 4 allows the structural breaks in level, trend and regressor.

While, in cases where k=1, it corresponds to cointegration model introduced by Gregory and Hansen (1996a,b), it becomes the model introduced by Hatemi-J (2008) when k becomes two. On the other hand, Maki cointegration test developed based on tests with structural breaks introduced by Bai and Perron (1998) and unit root test with structural break introduced by Kapetanios (2005) assumes that unknown number of breaks either equals to probable maximum number of breaks or is smaller than that. The null hypothesis of this test accepts no cointegration and alternative hypothesis asserts cointegration with l number of breaks where (i≤k). This test has advantage when number of breaks is unknown or is incorrectly determined. There are six stages to apply this test:

Stage 1. Maximum number of breaks (s) is determined. For instance, equation 5 is used to estimate model1

$$y_t = \mu + \mu_1 D_{1,t} + \beta' x_t + u_t \quad (5)$$

Afterwards, the alternative hypothesis ρ<0 is tested against the null hypothesis ρ=0 with the help of regression below.

$$\Delta \hat{u}_t = \rho \hat{u}_{t-1} + \sum_{j=1}^{p} \alpha_j \Delta \hat{u}_{t-j} + \varepsilon_t \quad (6)$$

In this regression, ε_t is independently and homogenously distributed (0, σ^2) and $\hat{u}_t$ is the least square residual value in Model 5. Single break are searched and t statistics is calculated for all probable break periods of ρ=0. All probable partitions and t statistics are respectively shown as T_1^a ve τ_1. In the case where k=1, minimum t statistics in τ_1 is used as test statistics.

Stage 2. First break point is choosen by minimizing the sum of squares of the residuals in model 5 as follows:

$$SSR_1 = \sum_{t=1}^{T} (y_t - \hat{\mu} - \hat{\mu}_1 D_{1,t} - \hat{\beta}' x_t)^2 \quad (7)$$

$\hat{\mu}$, $\hat{\mu}_1$ ve $\hat{\beta}$ are the OLS estimators and first breaking point is shown as $\hat{b}\, p_1 = \arg\min_{T_1^a} SSR_1$.

Stage 3. Estimated break point bp_1 is applied to the sample and then second break point is searched from all possible partitions in the sub-samples. t statisticsis calculated in an attempt to test ρ=0 for all possible periods of second break using regression in equation 8.

$$y_t = \mu + \mu_1 D_{1,t} + \mu_2 D_{2,t} + \beta' x_t + u_t \quad (8)$$

and

$$\Delta \hat{u}_t = \rho \hat{u}_{t-1} + \sum_{j=1}^{p} \alpha_j \Delta \hat{u}_{t-j} + \varepsilon_t \quad (9)$$

All possible subsets of ρ and t statistics are respectively indicated as $\tau_\rho^k = \tau_1 \bigcup \tau_2 \bigcup ... \bigcup \tau_k$ and τ_2. Additionally, $\tau_\rho^2 = \tau_1 \bigcup \tau_2$.

Stage 4. Second break point bp_2 for all possible subsets (T_2^a) in equation 8 is decided on the minimum point of SSR_2.

$$SSR_2 = \sum_{t=1}^{T} (y_t - \hat{\mu} - \hat{\mu}_1 D_{1,t} - \hat{\mu}_2 D_{2,t} - \hat{\beta}' x_t)^2 \quad (10)$$

Second break point is shown as $\hat{b}\, p_2 = \arg\min_{T_2^a} SSR_2$.

Stage 5. Estimated break points bp_1 and bp_2 are applied to the sample. Following this process, Stage 3 and Stage 4 are repeated until k number of break points is detected. Subset and t statistics generating are indicated as T_i^a ve τ_ρ^i (i=1,…,k).

Stage 6. $\tau_{\min}^k$ is accepted as t statistics (minimum t statistics in set $\tau_\rho^k = \tau_1 \bigcup \tau_2 \bigcup ... \bigcup \tau_k$).

Trim parameter (from η to η=0.05) is applied to eliminate the circumstances where the break doesn't occur or consecutively occurs. For instance, if m becomes two the first break point is estimated in T sample between 5% and %95. When the first break point bp_1=int(0.5T) (int(·)=(·) integer partition) interval of the second break point for T sample becomes between 5% - 45% and 55% - 95%. As noted by Bai ve Perron (1998, 2003) and Kapetanios (2005), this method considers undetermined number of breaks provided that upper bound is given. Furthermore, coefficients of model are consistently estimated when the process mentioned above is followed. In addition to this, test statistics ensures the consistency and is inclined to negatively infinite under alternative hypothesis.

5. TEST RESULTS

Table 1 indicates the results of asymmetric effects of positive and negative shocks obtained from independent variables by decomposing their residuals. Decomposed shocks of independent variables on exchange rate could present some evidences about whether or not the direction of relationship between dependent and each of independent variables is in line with the theoretical expectations.

Positive interest rate shock (pozitif_faiz) is expected to decrease the exchange rates. Positive interest rate shock increases the exchange rates by affecting it in the same direction contrary to expectations, whereas anticipation for the sign is negative, i.e., negative relation between exchange rates and positive interest rate schock. One of the reasons might be the negative perception of market players about the message related to effects of macroeconomic performance for the next period to the changes in 3-month interest rates. In addition to this, negative evaluations carried out by credit ratings agencies might ensue this result due to negative political and economic conditions of Turkey and its neighboring countries. Because evaluations and downgrade decisions of credit ratings agencies cause Turkey to seem risky for investment from the viewpoint of investors. So, these evaluations increasing the risk factor of Turkey may be the evidence showing that there is no perfect substitution between foreign and domestic assets and risk premium plays an important role.

Since negative interest rate shock (negative_faiz) attracts less attention to Turkey for the portfolio investments it is expected to cause that exchange rates increases, thereby depreciating Turkish Lira against US Dollar. Findings show that exchange rates move in the same direction with expectations and results are statistically significant.

Table 1: Effects of Decomposed Shocks on Exchange Rates

Shocks	Test Statistics (χ^2)	Degrees of Freedom	Probability	Expected Sign	Sign
pozitif_faiz	56.47411	3	0.0000	Negative	Pozitive
negatif_faiz	116.7156	2	0.0000	Negative	Negative
tr_yab_varlik_artisi	0.705153	3	0.8720	Pozitive	Negative
tr_yab_varlik_azalisi	1.500774	3	0.6821	Pozitive	Pozitive
yab_tr_varlik_artisi	114.6528	3	0.0000	Negative	Negative
yab_tr_varlik_azalisi	81.0465	3	0.0000	Negative	Pozitive

As positive demand shock of Turkish citizens to the US assets (tr_yab_varlik_artisi) increases the demand for US Dollar exchange rates also raise. Theoretical expectations mention the existence of relationship between positive demand shock of Turkish citizens to the US assets and exchange rates move in the same direction. But test findings exhibit opposite results about relation between related variable and dependent variable contrary to theoretical anticipation. On the other hand, these results are not statistically significant. That the amount of US Dollar demand as a result of increase in US asset demand is low in propotion to total volume of US Dollar in circulation might be an important reason for a statistically insignificant result.

Negative demand shock of Turkish citizens to the US assets (tr_yab_varlik_azalisi) decreases the demand for US Dollar, thus, exchange rates will decrease. As it is seen from the Table 1, TL appreciates and exchange rates decreases by moving in the same direction as a result of negative shocks to the US assets. On the other hand, even though obtained signs are matching up with the expectations, test results are statistically insignificant. It could be the major reason that negative US Dollar shock with respect to the volume in circulation is very low.

Since positive demand shock of US citizens to the Turkish assets (yab_tr_varlik_artisi) leads to an increase in the TL demand and an increase in US Dollar supply a decrease in exchange rate will arise. Statistically significant test results matching up to expectations could be presented for evidence there is a negative relationship between exchange rate and positive demand shock to the Turkish assets

Negative demand shock of US citizens to the Turkish assets (yab_tr_varlik_azalisi) results in an increase in exchange rate due to depreciation of TL against US Dollar as demand for TL and supply of US Dollar will decrease. Hence, negative shock posed by related variable should have a negative relation. In spite of the fact that empirical findings are statistically significant, relation between variables is in the same direction contrary to expectations. Decrease in demand of US citizens to the Turkish assets doesn't lead to a depreciation of TL against US Dollar and exchange rate reacts this by decreasing. Main reason for this result might arise from that TL demand increase resulting from diminishing demand of Turkish citizens to US assets is higher than the decrease in US citizens' demand for TL.

5.1. ADF Unit Root Test Results

ADF test results indicates that all variables, excluding *i_fark* variable which is interest rates difference, become stationary in their first differences for 1%, 5% and 10% significance level. *i_fark* variable becomes stationary in its first difference for the 1% and 5% significance level but it is stationary at level for 10%.

5.2. Johansen Cointegration Test Results

Johansen cointegration test results show that there is one cointegrated vector according to 5% significance level. This result suggests a long term relation among the variables. This finding from Johansen cointegration test points out that monetarist approach might be valid in the long run rather than portfolio balance approach. Because that variables act together in the long run may be interpreted in the manner that domestic and foreign assets are perfect substitute with each other and changes in returns of assets don't require any additional demand for risk premium from the investors to revise their portfolio preferences.

Table:2 ADF Unit Root Test Results

	exc	**i_fark**	**tr_yab_varlik**	**yab_tr_varlik**
t Statistics	-1.0115	-3.4105	-2.4086	-1.3550
%1	-4.0307	-4.0307	-4.0307	-4.0301
%5	-3.4450	-3.4450	-3.4450	-3.4447
%10	-3.1473	-3.1473	-3.1473	-3.1472
Probability	0.9380	0.0544	0.3734	0.8693
Stationarity Level	I(1)	I(1)	I(1)	I(1)

Table:3 Johansen Trace Statistics

Cointegrated Vectors	**Eigen Value**	**Trace Statistics**	**0.05 Critical Value**	**Probability**
r=0	**0.243444**	**53.49209**	**47.85613**	**0.0135**

Table 4: Johansen Maksimum Özdeğer İstatistiği

Cointegrated Vectors	Eigen Value	Maximum Eigen Value Statistics	0.05 Critical Value	Probability
r=0	**0.243444**	**35.70924**	**27.58434**	**0.0036**

Table 5: Vector Error Correction Model Results

	D(EXC)	D(I_FARK)	D(TR_YAB_VARLIK)	D(YAB_TR_VARLIK)
Coefficients	-0.001772	-1.605499	-2.272169	-136.5607
Standard Deviation	0.02762	0.37267	3.44576	46.9463
t Statistics	-0.06416	-4.30815	-0.65941	-2.90887

5.3. Maki Cointegration Test Results

This test developed by Maki (2012) could be applied with the help of Gauss programming language. Break dummy variables coded for slope and trend in our model don't exist in the original code. Interaction doesn't occur as dummy variable in original model. So, lack of this is removed by writing the additional codes in Gauss programming. Differentiation among the long-run tendency of variables in cointegration vector is attiributed to error term and applying the unit root test with breaks to error terms is the building block for such methods (error terms reveal deviations). Break periods are taken into the consideration subject to minimum t statistics as in the study of Maki (2012) and findings are obtained by adding the mutual interaction variables.

Regime switching model allowing structural break (i.e., Model 2) is preferred to obtain Maki (2012) cointegration test results in Table 6 consisting of 2006-2016 period. Existence of three structural breaks including 2009:M03, 2013:M06 and 2014:M06 are detected. Critical values required to test existence of cointegration relation among the series under the structural break is derived from critical value table obtained from Monte Carlo Simulation in the study of Maki (2012). Accordingly, null hypothesis "there is no cointegration relation among the series under structural break" is rejected in the event that results obtained from Maki cointegration test, as absolute value, is higher than the critical value, and alternative hypothesis "there is a cointegration relation among the series under structural break" is thereby is accepted. For Model 2 with three regressors and three breaks, null hypothesis cannot be rejected according to levels 1%, 5% and 10%. As a result, any cointegration relation considering the break couldn't be detected contrary to the results of Johansen cointegration test results. That is, series are not moving together in the long run under the existence of structural break. These findings support the idea that portfolio balance approach is valid for Turkey. The assumption of perfect substitution between foreign and domestic assets suggested by monetarist approach is invalid, from which it is concluded that foreign assets are evaluated and included by investors in the case of risk premium's existence.

Until the break period, interest rates difference and foreign asset demand of Turkish citizens affect the exchange rate in the same direction but demand of US citizens to the Turkish assets affects the exchange rates in the negative direction. From 2009:M03 (39. Breaking Point) to 2013:M06 (90. Breaking Point), interest rates difference continues to affect exchange rates in the same direction but foreign asset demand of Turkish citizens and US demand for Turkish assets have a negative impact on exchange rates. As of second break, the relation between demand of US citizens for Turkish assets and exchange rates returns from negative to positive. While affect of interest rates difference on exchange rates remains in the same direction, foreign asset demand of Turkish citizens continues to affect exchange rates negatively as in the first break period. After the third break period (2014:M06), the direction of the relation between foreign asset demand of Turkish citizens and exchange rates becomes positive by varying the direction of the relation. Interest rate difference and U.S. demand for Turkish assets continue to affect the exchange rates in the same direction by following the tendency in the previous break period.

Table 6: Maki (2012) Cointegration Test Results

Maximum Number of Break	**Test Statistics**	**Break Points**	**Break Time**	**Trim Value**
3	-6.7005591	39, 90, 102	2009:M03 2013:M06 2014:M06	0.05
Parameters (Estimators) of Cointegration Test with Break				
Variables	**Level**	**1. Break**	**2. Break**	**3. Break**
Constant	2.6138186	-0.014216126	0.0045483503	-0.00022991878
i_fark	0.97997865	0.0057274914	6.0656713e-005	0.036576864
tr_yab_varlik	0.36166726	-9.0139097e-005	-0.026258405	0.0010353619
yab_tr_varlik	-0.11248003	-0.0053454256	0.0057708856	8.7233161e-005

6. CONCLUSION

This study has constructed a portfolio balance model based on Frankel (1983), Branson and Henderson (1985) and Cushman (2007) for Turkish-U.S. exchange rate and includes montly data between 2006 and 2016. Johansen cointegration test results indicate at least one cointegrating vector between the variables. This result presents evidence to support the validity of monetary approach rather than the portfolio balance approach for Turkey. To consider the unknown number of structural breaks arising from facts in economy, Maki (2012) cointegration test is employed and break dummy variables not presented in the original model are included in the test. Test results show three structural breaks on March 2009, July 2013 and July 2014 and the findings obtained from Maki cointegration test results don't show evidence for existence of cointegration relationship among all variables. Contrary to results of Johansen cointegration test, empirical evidences from Maki cointegration test point out that perfect substitution assumption between domestic and foreign assets are not valid and risk premium should be included in the rate of returns of domestic assets in order that foreign investors could demand for domestic assets.

Asymmetric effects of positive and negative shocks obtained from independent variables by decomposing their residuals are also analyzed. In this study, in which four variables are statistically significant, three of them move in the expected direction. The variable representing the demand of Turkish citizens to US assets is statistically insignificant even though it has the expected sign. Evaluation of asymmetric effects of shocks introduces the situation that significant perception of risk is developing for Turkey due to political and economical developments especially from the point of foreign investors. Thus, it is thought that the developing risk perception leads to demand for risk premium in addition to return on domestic assets.

REFERENCES

Alper, A. M. (2010), "Sürdürülebilir Reel Döviz Kuru: Türkiye Örneği", *Yayınlanmamış Doktora Tezi*, Ankara: Ankara Üniversitesi Sosyal Bilimler Enstitüsü.

Atış, A. G. (2008), "Türkiye'de Denge Döviz Kurunun Belirlenmesinde Portföy Yaklaşımı", *Yayınlanmamış Doktora Tezi*, İzmir: Dokuz Eylül Üniversitesi Sosyal Bilimler Enstitüsü.

Ay A. (1996) , "Döviz Kurunun Belirlenmesinde Portföy Denge Modeli Yaklasımı: Türkiye Örneği (1989-1996), *Yayınlanmamış Doktora Tezi*, Konya: Selçuk Üniversitesi Sosyal Bilimler Enstitüsü.

Aydemir, O. ve Demirhan, E. (2009), "The Relationship between Stock Prices and Exchange Rates Evidence from Turkey", *International Research Journal of Finance and Economics*, 23, s.207-215.

Bai, J. ve Perron, P. (1998), "Estimating and Testing Linear Models with Multiple Structural Changes", *Econometrica*, 66, s. 47–78.

Bai, J. ve Perron, P. (2003), "Computation and Analysis of Multiple Structural Change Models" *Journal of Applied Econometrics*, 18, s. 1–22.

Berke, B. (2012), "Döviz Kuru ve IMKB100 Endeksi İlişkisi: Yeni Bir Test", *Maliye Dergisi*, Sayı 163, s. 243-257.

Bisignano J. ve Hoover K. (1983), "Some Suggested Improvments to A Simple Portfolio Balance Model of Exchange Rate Determination with Special Reference to the US Dollar-Canadian Dollar Rate", *Weltwirtschaftliches Archiv*, 119, s.19-37.

Black, S.W. (2013), "The Portfolio Theory of Exchange Rates-Then and Now", *Review of International Economics*, 23(2), s. 379-386.

Branson, W. H., Haltunen, H., ve Masson, P. (1977), "Exchange Rates in the Short Run", *European Economic Review*, 10, s. 395–402.

Branson, W. H. (1977), "Asset Markets and Relative Prices in Exchange Rate Determination, *Sozialwissenschafiliche Annalen,* 1(1), s. 69-89.

Branson, W. H. (1981), "Macroeconomic Determinants of Real Exchange Rates,' *NBER Working Paper,* No. 801, Cambridge, MA: NBER.

Branson, W. H. (1983), "A Model of Exchange Rate Determination with Policy Reaction: Evidence from Monthly Data,' *NBER Working Paper,* No. 1135, Cambridge, MA: NBER.

Branson,W.H. (1983), "Macroeconomic Determinants of Real Exchange Risk", *R.J. Herring (ed.), Managing Foreign Exchange Risk, Cambridge: Cambridge University Press*.

Branson, W. H., ve Henderson, D. W. (1985), "The Specification and Influence of Assets Markets", *R. W. Jones, & P. B. Kenen (Eds.), Handbook of international economics*, Sayı 2, Amsterdam: Elsevier.

Breedon, F. ve Vitale, P. (2010) "An Empirical Study of Portfolio-balance and Information Effects of Order Flow on Exchange Rates," *Journal of International Money and Finance,* 29, s. 504–524.

Copeland, L. (2005), "Exchange Rates and International Finance", *Pearson Education Limited.*

Cushman, O. D. (2003), *A Portfolio Balance Approach to the Canadian- U.S. Exchange Rate*, (http://homepage.usask.ca/~doc658/PBpaper.pdf), (Erişim Tarihi: 09.10.2013), s.1-35

Cushman, D.O. (2007), "A Portfolio Balance Approach to the Canadian-US Exchange Rate", *Review of Financial Economics*, 19, s. 305-320.

Doğru, B. ve Recepoğlu, M. (2013), "Türkiye'de Hisse Senedi Fiyatları ve Döviz Kuru Arasında Doğrusal ve Doğrusal Olmayan Eş Bütünleşme İlişkisi", *Dumlupınar Üniversitesi Sosyal Bilimler Dergisi (Özel Sayı)*, s. 17-34.

Erer, D., Erer, E. ve Güleç, T.C. (2015), "Fractional Cointegration Analysis of Stock Market and Exchange Rates: The Case of Turkey", Financial Studies, 20(3).

Fama, E.F. (1970),"Efficient Capital Markets: A Review of Theory and Empirical Work", *Journal of Finance,* 25, s. 383-417.

Fama, E.F. (1991),"Efficient Capital Markets: II", *Journal of Finance,* 46, s. 1575-1617.

Fatum, R. (2015), "Foreign Exchange Intervention When Interest Rates are Zero: Does the Portfolio Balance Channel Matter After All?", *Journal of International Money and Finance,* 57, s. 185-199.

Frankel, J. (1983), "Monetary and portfolio balance models of exchange rate determination", *J. Bhandari, & B. Putnam (Eds.), Economic interdependence and flexible exchange rates*, Cambridge, MA: MIT Press, s. 84–114.

Frankel, J. (1984), "Tests of monetary and portfolio-balance models of exchange rate determination", *J. Bilson, & R. Marston (Eds.), Exchange rate theory and practice Chicago: University of Chicago Press.*

Gregory, A.W. ve Hansen B.E. (1996a), "Residual Based Tests for Cointegration in Models with Regime Shifts", *Journal of Econometrics*, 70, s. 99-126.

Gregory, A.W., Hansen, B.E., (1996b), "Tests for Cointegration in Models with Regime and Trend Shifts" *Oxford Bulletin of Economics and Statistics*, 58, s. 555–560.

Gregory, A.W., Nason, J.M. ve Watt, D.G., (1996) "Testing for Structural Breaks in Cointegration Relationships", *Journal of Econometrics*, 71, s. 321–341.

Hall, S.G., Hondroyiannis, G., Swamy, P.A.V.B. ve Tavlas, G.S. (2008), "A Portfolio Balance Approach to Euro-Area Money Demand in a Time-Varying Environment", *University of Leichester Working Paper No. 08/9*, s.1-37.

Hatemi-J, A. (2008), "Tests for Cointegration with Two Unknown Regime Shifts with an Application to Financial Market Integration", *Empirical Economics*, 35, s. 497–505.

Hatemi-J, A. (2012), "Asymmetric Causality Tests with an Application", *Empirical Economics*, 43(1), s. 447–456.

Hatemi-J, A., Al Shayeb, A. ve Roca, E. (2017), "The Effect Of Oil Prices On Stock Prices: Fresh Evidence From Asymmetric Causality Tests", *Applied Economics,* 49(16), s. 1584-1592.

Karacaoğlu, A. (2010), "Portföy Dengesi Yaklaşımı ve Türkiye Örneği", *Yayınlanmamış Yüksek Lisans Tezi*, Ankara: Gazi Üniversitesi Sosyal Bilimler Enstitüsü.

Kapetanios, G. (2005), "Unit-Root Testing against the Alternative Hypothesis of up to m Structural Breaks" *Journal of Time Series Analysis*, 26, s. 123–133.

Khan, A. Ve Abbas, Z. (2015), "Portfolio Balance Approach: An Empirical Testing", *Journal of Economics and International Finance*, 7(6), s. 137-143.

Kilian, L. ve Vigfusson, R.J. (2011), "Are the Responses of U.S. Economy Asymmetric in Energy Price Increases and Decreases?", *Quantitative Economics*, 2, s. 419-453.

Kim, K. (1986), "An Exchange Rate Determination by Portfolio Approach in Korea: Empirical Results", *Journal of Economic Integration,* 1(2), s. 194-208.

Lewis, K.K. (1986), "Testing the Portfolio Balance Model: A Multi-Lateral Approach", *Journal of International Economics*, 24, s. 109-127.

MacDonald, R. (2007), "Exchange Rate Economics: Theories and Evidence", *Taylor & Francis Group: Taylor & Francis E-Library.*

Maki, D. (2012), "Tests for Cointegration Allowing for an Unknown Number of Breaks", *Economic Modelling*, 29, s. 2011-2015.

Mark, N.C. (1995), "Exchange Rates and Fundamentals: Evidence on Long-Horizon Predictability", *The American Economic Review,*85(1), s. 201-218.

Markowitz, H. (1952), "Portfolio Selection", *The Journal of Finance*, 7, No.1, s. 77-91.

Min, H.G. ve McDonald, J. (1993), "The Portfolio Balance Model of Exchange Rates: Short-Run Behavior and Forecasting (The Korean Won/U.S. Dollar Case)", *International Economic Journal,* 4, s. 75-87.

Nwafor; F. (2008), "Portfolio Balance Model of Exchange Rate Behavior: A Peso-Dollar Example", *The Icfai University Journal of Financial Economics,* 6, s.41-47.

Öcal, M. S. (1990), "Döviz Kurunun Belirlenmesinde Portfölyo Yaklaşımı ve Türkiye Üzerine Bir Deneme (1985-1989)", *Yayınlanmamış Yüksek Lisans Tezi*, Ankara: Gazi Üniversitesi Sosyal Bilimler Enstitüsü.

Öruç, E. (2016), "Döviz Kurlarının Belirlenmesinde Parasalcı Yaklaşım: Türkiye Örneği", *Kocaeli Üniversitesi Sosyal Bilimle r Dergisi*, 32, s. 101-122.

Pekkaya, M. ve Bayramoğlu, M. F., "Hisse Senedi Fiyatları ve Döviz Kuru Arasındaki Nedensellik İlişkisi: YTL/USD, IMKB100 ve S&P500 Üzerine Bir Uygulama", *Muhasebe ve Finansman Dergisi*, Sayı 38, s. 163-176.

Tze-Haw, C., Teck, L.C. ve Chee-Wooi, H. (2013), "Forecasting Malaysian Ringgit: Before and After the Global Crisis", *AAMJAF*, 9(2), s. 157-175.

Umer, U.M, Güven, S. ve Kamışlı, S. (2015), "The Dynamic Linkages between Exchange Rates and Stock Prices: Evidence from Emerging Markets", *Journal of Finance and Investment Analysis,* 4(3), s. 17-32.

Yılancı, V. Ve Bozoklu, Ş. (2015), "Analysis of Symmetric and Asymmetric Nonlinear Causal Relationship Between Stock Prices and Exchange Rates for Selected Emerging Market Economies", *Doğuş Üniversitesi Dergisi*, 16(2), s. 155-164.