TESTING THE LONG-RUN VALIDITY OF PURCHASING POWER PARITY FOR EASTERN AND SOUTHERN EUROPEAN COUNTRIES

A THESIS SUBMITTED TO
THE GRADUATE SCHOOL OF SOCIAL SCIENCES
OF
MIDDLE EAST TECHNICAL UNIVERSITY

BY

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IN PARTIAL FULFILLMENT OF THE REQUIREMENTS
FOR
THE DEGREE OF MASTER OF SCIENCE
IN
ECONOMICS

SEPTEMBER 2013

Approval of the Graduate School of Social Sciences

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I certify that this thesis satisfies all the requirements as a thesis for the degree of Master of Science.

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ABSTRACT

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September 2013, 78 pages

This study examines the long-run validity of the Purchasing Power Parity, namely stationarity of real exchange rates for six Eastern and Southern Europe countries over the period of January 1994- December 2012. Despite extensive research to date, the empirical evidence on the PPP hypothesis remains inconclusive. A number of very recent studies ascribe this to the low power of the standard unit root tests in identifying stationarity of potentially nonlinear real exchange rates. In this sense, this study employs the threshold unit root test developed by Caner and Hansen (2001), which allows for a simultaneous search for non-linearity and non-stationarity. The empirical results reveal strong evidences of non-linearity for all of the real exchange rate series. Moreover, it is observed that PPP holds for all countries with the exceptions being Albania and Macedonia. More specifically, the real exchange rates of Croatia, Moldova, Serbia and Ukraine are characterized by local non-stationarity, that is, PPP holds in one threshold regime, but not in another.

Keywords: Purchasing Power Parity, Real Exchange Rate, Threshold Unit Root Test, Threshold Autoregressive Model (TAR)

ÖZ

SATIN ALMA GÜCÜ PARİTESİ'NİN UZUN DÖNEM İÇİNDEKİ GEÇERLİLİĞİNİN DOĞU VE GÜNEY AVRUPA ÜLKELERİ İÇİN İNCELENMESİ

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Eylül 2013, 78 Sayfa

Bu çalışma, 1994 ve 2012 yılları arasında, Doğu ve Güney Avrupa'da yer alan altı ülke için Satın Alma Gücü Paritesi'nin uzun dönem içindeki geçerliliğini incelemektedir. Doğrusal birim kök testlerinin sonuçları baz alınarak, Caner ve Hansen (2001) tarafından geliştirilmiş olan, hem birim kök hem de eşik etkisini aynı anda test etmeyi mümkün kılan, eşik otoregresif modellerde birim kök testi uygulanmıştır. Ampirik sonuçlar bütün reel döviz kurları için eşik etkisinin bulunduğunu göstermiştir. Bunun yanı sıra, altı ülke içerisinden, Arnavutluk ve Makedonya için uzun dönem Satın Alma Gücü Parite'sinin geçerli olmadığı; Hırvatistan, Moldova, Sırbistan ve Ukrayna için ise reel kurların sadece bir rejimde durağan olduğu sonucuna ulaşılmıştır.

Anahtar Kelimeler: Satın Alma Gücü Paritesi, Reel Döviz Kuru, Eşik Birim Kök Test, Eşik Otoregresif Modeller

To My Husband

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ACKNOWLEDGEMENTS

I would like to express my deepest appreciation to my supervisor Dr. Dilem Yıldırım for her invaluable guidance and motivation throughout this study. I also would like to offer my thanks to the examining committee members Prof. Dr. Nadir Öcal and Assoc. Prof. Dr. Tolga Omay.

I would like to thank my mother, father and brother for their love, encouragement and endless support throughout my life.

Finally, I would like to express my gratitude to my husband for his understanding, endless patience and encouragement when it was most required.

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CHAPTER 1

INTRODUCTION

The Purchasing power parity (PPP) hypothesis, due to Cassel (1918), is one of the most explored issues in international macroeconomics. The PPP hypothesis postulates that the nominal exchange rate between two national currencies should equalize the relative price levels of the two countries, keeping the real exchange rate unchanged. Due to factors like transaction costs, imperfect competition, taxation, subsidies and trade barriers, PPP does not hold in the short-run. However, given that international goods market arbitrage should be traded away over time, PPP is expected to hold in the long run. This implies that the real exchange rate is expected to return to a constant equilibrium value in the long run.

There are voluminous studies available on the empirical validity of the long-run PPP. A major strand of this literature examines its validity by testing for stationarity of real exchange rates, as stationarity implies mean reversion and, hence, PPP. The earlier studies on PPP use standard unit root tests and generally fail to provide any empirical evidence supporting PPP hypothesis. This failure has been attributed to the low power of the conventional unit root tests. There are two alternative approaches in order to address this power problem. One of them is using long horizon data sets and the other is using panel data variants of the formal unit root tests. Although, stronger evidences may be provided, there are some criticisms about these applications. Researchers argue that increasing the length of the time series may cause structural changes in data generating process under different nominal exchange rate regimes. On the other hand, using panel data variants of the formal unit root tests may lead to an over-rejection problem as well as the problem of cross-sectional dependence in panel data. Therefore, whether real exchange rate is stationary or not is still controversial in the linear side of PPP literature.

An alternative explanation is based on non-mean reverting behavior of the real exchange rates due to the existence of transaction costs in international trade. Benninga and Protopapadakis (1988), Williams and Wright (1991), Dumas (1992), Sercu et al. (1995), O'Connell (1997) and Ohanian and Stockman (1997)) develop theoretical models and demonstrate that exchange rate adjustment may follow a non-linear pattern because of the transactions costs in international arbitrage. In these models, transaction costs might create a band, within which deviations from PPP is non-mean reverting since they are smaller than arbitrage costs. Outside of the band, however, they exceed the arbitrage costs and become mean reverting. Accordingly, a growing literature has emerged, which accommodates no-arbitrage and profitable arbitrage dynamics of real exchange rates in an Exponential Smooth Transition (ESTAR) or a Threshold Autoregressive (TAR) model. Considering the low power of conventional unit root tests in addressing stationarity of real exchange rates with such nonlinear dynamics, recently Kapetanios et al. (2003), Sollis (2009), Park and Shintani (2005) and Caner and Hansen (2001), Bec et al. (2004), Kapetanios and Shin (2003) design new unit root tests that account for ESTAR and TAR type nonlinearity, respectively.

Among these nonlinear unit root tests, the test proposed by Caner and Hansen (2001) is the only one that accounts for non-linearity both under the null and alternative hypotheses. They propose a model-based bootstrap procedure to test the null hypothesis of nonstationarity in two-regime threshold models. Obviously, the main advantage of the testing procedure is that it allows for a simultaneous analysis for nonlinearity and nonstationarity. In recent years, the test of Caner and Hansen (2001)) has gained momentum in testing real exchange rate stationarity, with several applications including Liu, Zhu and Su (2010), Benbouziane and Benamar (2006), Chung, Kim and Kang (2009), Giannellis and Kouretas (2012), Başcı and Caner (2005).

This study contributes to the literature of PPP, by examining the long-run validity of PPP for six countries from East and South Europe, namely Albania, Croatia, Macedonia, Moldova, Serbia and Ukraine. Similar to previous studies in the literature, we consider the non-linear nature of the real exchange rates in terms of Threshold Auto Regressive (TAR) model. To the best of our knowledge, this study is the first one that applies the unit root test by Caner and Hansen (2001) in those of six countries. Our empirical results indicate strong evidence for threshold effect, hence nonlinearity for all of our countries. Furthermore, our findings reveal that PPP holds for all of the countries, except Albania and Macedonia. Particularly, Croatia, Moldova, Serbia, Ukraine follows a local non-stationary process, that is, stationary in one regime and non-stationary in the other.

This study is organized as follows: Chapter 1 briefly introduces the study. Chapter 2 reviews the theoretical and empirical literature of PPP. Chapter 3 presents the data used in our study, Chapter 4 describes the TAR model and outlines the methodology proposed by Caner and Hansen (2001), Chapter 5 discusses empirical results and finally Chapter 6 concludes the study.

CHAPTER 2

LITERATURE REVIEW

Purchasing power parity has been a crucial theoretical concept in international economics over the years. The cornerstone of the PPP theory is the law of one price (LOOP), which states that, in the absence of arbitrage, identical goods should be sold at the same price across countries. Aggregating across all tradable goods in the economy implies the basic PPP hypothesis, which postulates that national price levels of the two countries should be equal when expressed in a common currency. Although, some researchers support that this basic proposition holds at any point in time, it is widely accepted in the literature that its empirical validity should be examined over the long-run by testing whether real exchange rate tends to revert an equilibrium level. PPP, therefore, provides an equilibrium relationship for the real exchange rate. In this equilibrium the nominal exchange rate adjusts to equalize changes in relative price levels in such a way that real exchange rate remains constant. This implies that variations in the real exchange rate represent the deviations from PPP. If PPP holds, then real exchange rate must be stationary. Therefore, an evidence of long-run validity of PPP can be provided by testing the presence of unit roots in real exchange rates.

After the Bretton Woods era, a vast number of studies concentrate on the real exchange rate dynamics and fail to provide empirical evidence for stationarity of real exchange rates. Early studies such as Corbae and Quliaris (1988), Meese and Rogoff (1988) and Grilli and Kaminsky (1991) test the validity of PPP by employing conventional unit root tests and fail to reject the null of a unit root. Frankel (1986; 1990) points out that the reason behind non-rejection of the unit root and random walk behavior of real exchange rates may be originated from low power of the conventional unit root tests. This claim is later undertaken by Froot and Rogoff (1995) and Lothian and Taylor (1996). In their works, the authors highlight the idea that short time span of data may not provide sufficient power in order to satisfy mean reversion in real exchange rates. Consequently, Frankel (1986), Edison (1987), Diebold, Husted and Rush (1991), Glen (1992), Lothian and Taylor (1996) and Taylor (2002) reveal significant evidence of mean reversion process for real exchange rates by using long-horizon data sets. However, employing long time span of data has been criticized by Frankel and Rose (1996) due to the fact that increasing the size of the data may cause structural changes in data generating process under different nominal exchange rate regimes. Another approach to raise the power of the formal unit root test is to utilize panel data variants of the linear unit root tests. Abuaf and Jorion (1990), Frankel and Rose (1996), Wu (1996), Oh (1996), Papell (1997) and O'Connell (1998) are able to reject null of unit root hypothesis through panel data methods. However, although using panel data sets has advantages compared to time series or cross-sectional data when it is applied to real exchange rate, it entails some problems. O'Connell (1998) expresses that if the presence of the cross-sectional dependence in real exchange rate is not denied, the null of a unit root is inevitable. Furthermore, the panel data variants of the formal unit root tests have the null hypothesis of a joint non-stationary real exchange rate process, meaning that all of the series have unit root and rejection of the null hypothesis is possible with just one of the series as stationary, leading to the over-rejection problem (Taylor and Sarno 1998; 2002). As far as these criticisms are concerned, whether the problem of non-mean reverting behavior of real exchange rates has been solved is a polemic.

According to a number of studies, accounting for nonlinearities in real exchange rate may create a solution for the PPP puzzle, non-mean reverting behavior of real exchange rates. Indeed, recognition of nonlinearities in real exchange rates dates back to Heckscher (1916), who postulates that deviations from PPP may originate from transaction costs in international arbitrage. A similar insight is later emphasized by Cassel (1922). Recently, Benninga and Protopapadakis (1988), Williams and Wright (1991), Dumas (1992), Sercu et al. (1995), O'Connell (1997) and Ohanian and Stockman (1997) formalize the same idea in a theoretical framework. They improve equilibrium models of real exchange rate determination which take into account transaction costs and reveal that adjustment process of real exchange rates towards PPP is nonlinear. In these models transaction costs create a band within which arbitrage is not profitable as long as price discrepancies are not large enough to cover transaction costs. However, once the price discrepancies exceed transaction costs, arbitrage becomes profitable and deviations from PPP follow a stationary non-linear process. These models imply that real exchange rate is a non-linear mean reverting process and the size of the deviations from PPP, affects the speed of adjustment towards the long-run equilibrium. Most of these models provide evidence of mean reversion for real exchange rate, though it is not clear whether the transition from a non-mean reverting process to a mean-reverting process is smooth or abrupt.

Following these theoretical arguments, a series of studies (Obstfeld and Taylor (1997), Coakley and Fuertes (2001), Taylor (2001), Sarno, Taylor and Chowdhury (2004), O'Connell and Wei (2002), Giannellis and Papadopoulos (2010)) examine the non-linear nature of the deviation from PPP in terms of Threshold Autoregressive (TAR) models (Tong, 1993), which allow for a sharp switch between regimes. In a TAR setting, no adjustment takes place within the transaction cost band, which implies non-mean reverting process of real exchange rate. Outside of the band, however, real exchange rate follows a non-linear stationary process. On the other hand, a number of papers working on real exchange rate characterize the transition between regimes in a smooth and continuous way through Smooth Transition Autoregressive (STAR) models. Michael et al. (1997); Baum, Barkoulas and Çağlayan (2001); Kilian and Taylor (2003) investigate non-linear nature of real exchange rates employing exponential STAR models. However, none of these models consider any mutual effect of non-linearity and non-stationarity; they are just non-linear models and work on behavior of the real exchange rate dynamics by applying formal unit root tests. In order to fill the gap in the literature caused by the lack of non-linear unit root tests, researchers develop a new type of unit root tests which examine the null of non-stationary process against the stationary process in a non-linear frame.

As mentioned before, standard unit root tests may have low power when the true data generating process has a nonlinear structure. Indeed, the non-linearity in theoretical models, which are mentioned in the previous paragraph, can explain the reasons behind the inadequate performance of the standard unit root tests on deviations from PPP. In particular, Pippenger and Goering (1993), Balke and Fomby (1997) reveal that, in the existence of transaction costs, standard unit root tests have low power in favor of non-linear stationary processes. Moreover, Taylor et al. (2001) underlines the poor performance of the conventional unit root tests against non-linear alternatives.

Since then, there has been a growing interest in addressing the problem of non-linearity and non-stationarity jointly and new nonlinear unit root tests have been proposed. These unit root tests have the same null hypothesis, which is existence of unit root, but have different alternative hypothesis with respect to the distinct forms of non-linearity. One of the more recent studies in this area is Bec et al. (2004), which develop a unit root testing procedure to test null of unit root in favor of stationary three-regime Self Exciting TAR process. They apply this unit root test to a panel of European real exchange rate series and reject the null of a unit root for five out of six European series. Kapetanios and Shin (2006) proposes a unit root test which tests the null of unit root against a three-regime Self Exciting TAR model. They examine stationarity in real exchange rates for G7 countries, excluding France and reject the null for three out of five countries[1]. Wu, Chen and Lee (2009) is another paper that follows the approach of Bec et al. (2004) to determine whether real Pound-Dollar rate are non-linear stationary. They perform the Band TAR model under alternative hypothesis and provide strong evidence of mean reversion for real Pound-Dollar rate. Kim and Moh (2010) examine the validity of PPP for 16 Euro and Non-Eurozone countries employing inf-t test developed by Park and Shintani (2005). The null of a unit root is tested against diverse non-linear stationary processes, including Band TAR model. They find a strong empirical evidence of PPP for 14 out of 16 countries under the stationary Band TAR processes. Choi, Kim and Kim (2011) examine the validity of PPP for Southeast Asian countries utilizing inf-t test by Park and shintani (2005). They focus on testing the null of a unit root against three non-linear stationary processes: Double TAR, Exponential STAR and Double Logistic STAR models. They show that 63 percent of the Southeast Asian real exchange rates are non-linear mean reverting where US Dollar is considered as numeraire currency.

Different from the above studies, in the literature, there exist studies that examine the long-run validity of PPP by using different approaches over a wide of range countries. Telatar and Hasanov (2008) examine the real exchange rate dynamics for ten Commonwealth of Independent States countries, including Moldova and Ukraine regarding ST-TAR test proposed by Sollis (2004), which allows both smooth structural change and asymmetric adjustment process toward PPP equilibrium. With respect to the ST-TAR test results, while Moldovan real exchange rate series follow a unit root pattern, the null of non-stationarity is rejected for Ukrainian series. Finally, Bahmani-Oskooee, Kutan and Zhou (2008) analyzes real exchange rate dynamics employing KSS (2003) test for 88 developing countries, including Albania, Croatia, Macedonia, Moldova and Ukraine that are common with this

[1]Kapetanios et al. (2003) consider the interaction between nonlinearity and nonstationarity developing a unit root testing procedure, called KSS test, which tests the null of unit root against globally stationary Exponential STAR process. Liew at al. (2004), Chortereas and Kapetanios (2004), Ceratto and Sarantis (2006), Bahmani-Oskooee, Kutan and Zhou (2007), among others, apply the unit root test proposed by Kapetanios et al. (2003) to the real exchange rate series.

dissertation and find that there is a real exchange rate tendency to converge towards PPP for those of five countries[2].

All of the studies mentioned above have a common feature that they consider the nonlinearity only under the alternative hypothesis of stationarity. In this sense, Caner and Hansen (2001) is the first to provide a test that takes into account existence of non-linearity and non-stationarity simultaneously. They specify a two- regime Threshold Autoregressive (TAR) model with an autoregressive unit root and show that, by Monte Carlo simulations, the threshold unit root test have better performance across standard ADF unit root test if true process is non-linear.

There are many papers investigating PPP through the unit root testing procedure of Caner and Hansen (2001). Liu, Zhu and Su (2010) apply the method proposed by Caner and Hansen (2001) on real exchange rates for a sample of twenty African countries. They provide strong empirical evidence for non-linear mean reversion of real exchange rate towards PPP for six of the countries, Egypt, Ethiopia, Gambia, Malawi, Seychelles and South Africa. Benbouziane and Benamar (2006) analyze bilateral real exchange rate dynamics in the Maghreb countries (Algeria, Tunisia, Morocco). Their empirical results reveal that real Morocco-Tunisia exchange rate follows a non-linear unit root pattern while two others display local non-stationary process. Chung, Kim and Kang (2009) include monthly observations for 27 Industrial countries including Euro Area countries. While 25 out of 27 countries provide an evidence of threshold effect, only 11 of them reject the null of unit root

[2] Arize (2011), also, investigates whether PPP holds for 70 less developed countries (LDC), which contains Croatia and Moldova. They apply KSS test and find non-linear mean reversion for both Moldova and Croatia real exchange rate series. Moreover, considering that deviations from equilibrium level may be asymmetric, two different types of unit root tests are employed. One is proposed by Sollis (2009) by utilizing asymmetric ESTAR model and the other by Pascalau (2007) using asymmetric LSTAR model. Pursuant to these asymmetrical type of unit root test results, while there is no empirical evidence of neither symmetric nor asymmetric stationarity of real exchange rate for the case of Moldova, Croatia is characterized by the non-linear and symmetric mean reverting process.

against two stationary exchange rate regimes. However, this rejection characterized by local non-stationary process where the outer regime has mean-reverting behavior and inner regime follows a unit root. Giannellis and Kouretas (2012) consider Chinese Yuan based bilateral real exchange rates against US Dollar, Euro and Japanese Yen. For the case of Yuan-Euro real exchange rate null of no asymmetry cannot be rejected. For two other bilateral real exchange rate mean reversion is locally provided under presence of non-linearity.

Başcı and Caner (2005), on the other hand, investigate the real exchange rate behavior of 17 OECD countries for the post-float period (1973-1997). The empirical results indicate that 14 out of 17 OECD countries display non-linearity in real exchange rates. Furthermore, the null of non-stationarity is rejected against two-stage stationary threshold model for 11 out of these 14 countries where real exchange rates behave like a stationary process in one threshold regime but a unit root process in the other. Chang, Su and Lee (2012) test the validity of PPP for nine East-Asian countries and show that deviations from real exchange rate are mean-reverting towards PPP in a non-linear manner for six of the countries. Narayan and Narayan (2007) examine the existence of mean-reversion in Italy's real exchange rate relative to the G6 countries (namely, USA, Canada, France, Germany, UK and Japan) and provide strong support for the long-run empirical validity of PPP for five of six real exchange rate series. Finally, Alba and Park (2005) investigate both linearity and stationarity of real exchange rate between Turkish Lira and German Mark. Two main conclusions are drawn from their empirical results. Firstly, they find strong evidence of non-linearity in Lira-Mark real exchange rate. Secondly, the real exchange rates are found to be persistent and follow a unit root pattern in one regime while they display mean-reversion in the other regime. All of these studies agree on the fact that accounting for nonlinearities in real exchange rates increase the probability of obtaining empirical evidence in favor of real exchange rate stationarity.

This study aims to contribute to the empirical literature by examining the long-run validity of Purchasing Power Parity for six countries from East and South Europe, namely: Albania, Croatia, Macedonia, Moldova, Serbia and Ukraine. Methodologically, Threshold Autoregressive (TAR) model and the methodology proposed by Caner and Hansen (2001) is utilized. The main advantage of this approach is that it enables a unit root testing procedure which allows simultaneous examination of non-linearity and non-stationarity. To the best of our knowledge, this study is the only one that utilizes the TAR unit root test suggested by Caner and Hansen (2001) in those of six countries.

CHAPTER 3

DATA

Our empirical study investigates real exchange rate dynamics for six countries from Eastern and Southern Europe, Albania, Croatia, Macedonia, Moldova, Serbia and Ukraine. The data set consists of monthly observations on nominal exchange rate, which are end of the period rates relative to US dollar and Consumer Price Indices, (CPI, 2005=100). All data are retrieved from International Financial Statistic of International Monetary Fund database and covers the sample period from January 1994 to December 2012 for all except Serbia which starts in January 2002 (and ends in December 2012) due to the lack of data.

The real exchange rate, q_t, is calculated as follows:

$$q_t = s_t - p_t + p_t^*$$

where q_t denotes the logarithm of the real exchange rate, s_t the logarithm of nominal exchange rate in terms of US Dollar, p_t logarithm of Consumer Price level of the domestic country and p_t^* logarithm of US Consumer Price Level.

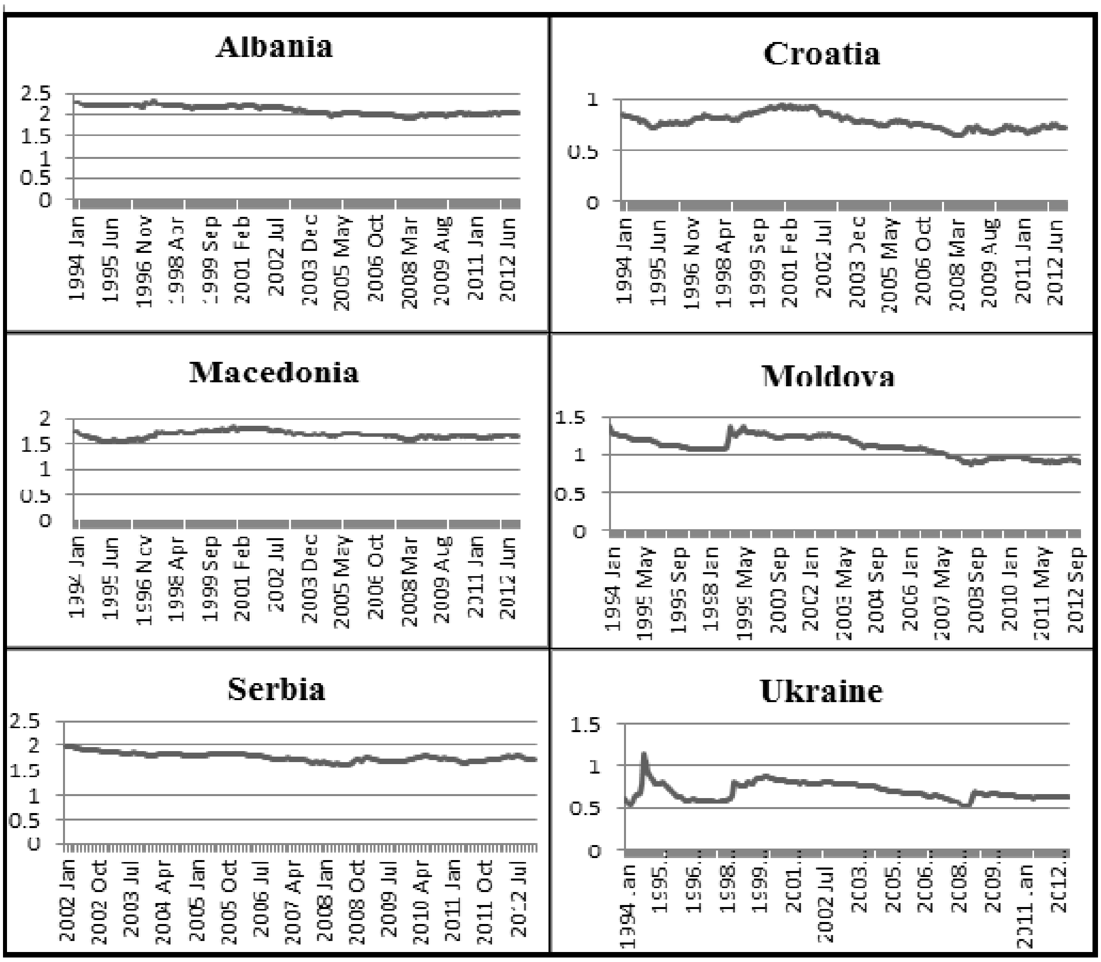

Figure 1: Real Exchange Rates of Eastern and Southern Europe Countries

Figure 1 plots the real exchange rates of Eastern and Southern Europe countries. According to the figure, all of the countries follow similar patterns between the period of 2000 and 2008 while the patterns diversifications occur before 2000 and after 2008. There is a decreasing trend in almost all real exchange rates between the years 2000 and 2008, implying appreciation of the domestic currencies against the US Dollar. The dramatic decline in US real interest rates, which started at 2000, plays role as a push factor for capital inflows to developing countries between 2000 and 2008 and this capital inflow leads to appreciation of the domestic currency against US Dollar.

Among these countries, it is seen that Croatia, Serbia and Macedonia, which are the countries of Southern Europe have a common real exchange rate structure. They have similar economic characteristics, and, hence, they are more sensitive to the common shocks. Croatia and Macedonia experience a transition to the market economy at the beginning of the 1990s while Serbia has a similar process after 2000. Generally, they inherit macroeconomic instability. Indeed, this transition process starts with liberalization of the foreign exchange market. Therefore, in these years, they face a sharp depreciation in real exchange rates. These countries are suffered from the impacts Global Financial crisis in 2007-2008. By comparison with Croatia and Macedonia, Serbia has weathered the immediate consequences of the crisis. Moreover, their economies are negatively affected from the Greek Debt Crisis, which began in 2009 and still is ongoing.

Ukraine and Moldova are the countries of Eastern Europe. After the collapse of Soviet Union in 1991, when they have gained their economic and political independency, both Moldova and Ukraine' real exchange rates display an appreciation following a severe depreciation in early transition period. Between the years 1998 and 2000, both Moldova and Ukraine are affected by the Russian Financial Crisis in 1998, which causes depreciation in both currencies. In these years, Ukraine economy is also affected from the Asian Financial crisis in 1998. Moreover, the Global financial crisis is another fact that negatively impacts both Ukraine and Moldova' real exchange rate, thereby their economy. After the global crisis, both the currencies of Ukraine and Moldova are progressive, appreciated or depreciated, through time. This financial crisis that occurs in 2008-2009 is the reason why they cannot have a stable exchange rate path.

Finally, the years 1994-1997 are the period of transition to a market economy of Albania, which, is a country of Southern Europe. Until 1997, Albanian Economy has significant economic developments in the context of a dramatic transition to the market economy. Indeed, in 1994-1995, an important improvement is made in terms of economic stabilization. Its macroeconomic performance is gradually weakened and at the beginning of the 1997, a full-brown crisis emerges. When the whole picture is evaluated, however, it is seen that there is decreasing trend until 2008, which leads to appreciation of the Albanian currency relative to the US Dollar. Besides that Albanian economy has been directly affected by the Greek crisis in 2009. Furthermore, global financial crisis in 2007-2008 reveals its negative impacts on Albanian Economy.

CHAPTER 4

METHODOLOGY

This chapter describes the TAR-type unit root test of Caner and Hansen (2001) that we apply to test for stationarity of real exchange rates of Albania, Croatia, Macedonia, Moldova, Serbia and Ukraine.

4.1 Two- Regime TAR Model

The model proposed by Caner and Hansen (2001) is a two-regime TAR process defined as:

$$\Delta q_t = \theta_1' x_{t-1} 1_{Z_{t-1} < \lambda} + \theta_2' x_{t-1} 1_{Z_{t-1} \geq \lambda} + e_t \qquad \textbf{(1)}$$

t=1, 2,…,T, where $\mathbf{q}_t$ is the natural logarithm of the real exchange rate, $\mathbf{x_{t-1}} = (q_{t\text{-}1}\mathbf{r_t}'\Delta q_{t\text{-}1}...\Delta q_{t\text{-}k})'$, $1_{\{\}}$ is the indicator function, e_t is an independent and identically distributed error term, $\mathbf{r_t}$ is a vector of deterministic components, including intercept and possibly a linear time trend, $\mathbf{Z}_{t-1}$ is the threshold variable and

λ is the unknown threshold value and assumed to take values in the interval $\lambda \in \mathbf{\Lambda} = \lambda_1, \lambda_2$, where $p(\mathbf{Z}_{t\text{-}1} \leq \lambda_1) = \Pi_1 > 0$ and $p(\mathbf{Z}_{t\text{-}1} \leq \lambda_2) = \Pi_2 < 1$[3].

Following Caner and Hansen (2001), the threshold variable has the form of $\mathbf{Z}_{t\text{-}1} = q_{t\text{-}1}\text{-}q_{t\text{-}m\text{-}1}$, for some delay parameter $m \geq 1$. The specific form of the threshold variable is not critical to the analysis. Generally, the required fact is that $\mathbf{Z}_{t-1}$ is predetermined, strictly stationary, and ergodic with a continuous distribution function. Particularly, this type of the threshold variable is chosen since it ensures the stationarity under alternative assumptions of that q_t is I (1) or I (0).

It is convenient to reveal the components of $\boldsymbol{\theta}_1$ and $\boldsymbol{\theta}_2$ as:

$$\theta_1 = \begin{pmatrix} \rho_1 \\ \beta_1 \\ \alpha_1 \end{pmatrix} \qquad \theta_2 = \begin{pmatrix} \rho_2 \\ \beta_2 \\ \alpha_2 \end{pmatrix},$$

where ρ_1, ρ_2 are scalar, β_1, β_2 have the same dimension as $\mathbf{r_t}$ and $\boldsymbol{\alpha}_1$ and $\boldsymbol{\alpha}_2$ are $kx1$ vectors. ρ_1, ρ_2 are the slope coefficients on $q_{t\text{-}1}$, β_1, β_2 are the slopes on the deterministic components, and α_1, α_2 are the slope coefficients on $\Delta q_{t\text{-}1}, ... \Delta q_{t\text{-}k}$.

[3] There is a symmetric relation between Π_1 and Π_2. In analogy to the discussion in Andrews (1993), it is desirable to pick Π_1 and Π_2 so that the true value λ lies in the interval Π_1, Π_2 (under the alternative hypothesis), otherwise the test may have difficulty in detecting the presence of the threshold effect. Andrews (1993) proposes that setting $\Pi_1 = 0.15$ and $\Pi_2 = 0.85$ provides a reasonable trade-off between these considerations.

For each $\lambda \in \mathbf{\Lambda}$ the TAR model (1) is estimated by Ordinary Least Squares (OLS). For fixed λ, the estimated equation of the model (1) is as follows:

$$\Delta q_t = \theta_1(\lambda)\, x_{t-1} 1_{Z_{t-1}<\lambda} + \theta_2(\lambda)\, x_{t-1} 1_{Z_{t-1}\geq\lambda} + \hat{e}_t(\lambda) \qquad \textbf{(2)}$$

where the OLS estimate of σ^2(variance of the errors) is given by $\sigma^2(\lambda) = T^{-1}\sum_1^T \hat{e}_t(\lambda)^2$. The least square estimate of the threshold parameter (λ) is found by minimizing the $\sigma^2(\lambda)$, i.e. $\lambda = \arg\min_{\lambda\in\mathbf{\Lambda}} \sigma^2(\lambda)$. The other least square parameter estimates are found by $\theta_1 = \theta_1(\lambda)$, $\theta_2 = \theta_2(\lambda)$. Then, the estimated model is written as:

$$\Delta q_t = \theta_1' x_{t-1} 1_{Z_{t-1}<\lambda} + \theta_2' x_{t-1} 1_{Z_{t-1}\geq\lambda} + \hat{e}_t, \qquad \textbf{(3)}$$

where $\sigma^2 = T^{-1}\sum_{t=1}^T \hat{e}_t^2$ is the residual variance obtained from the least square estimation.

The estimates obtained from model (3) can be used to construct inference regarding the parameters of the model (1) employing standard Wald and individual t statistics. However, although the test statistics are standard, their sampling distributions are not standard due to the existence of possible unidentified parameters and non-stationarity of the data.

4.2 Testing for the Threshold Effect

In model (1), the important issue is whether there is any statistical evidence to reject the linear AR model against a threshold model. The threshold effect is tested by the null hypothesis of $H_0:\ \theta_1 = \theta_2$. The following sup Wald test is used in order to test null of linearity in favor of threshold model:

$$\sup_{\lambda \in \boldsymbol{\Lambda}} W_t \ \ \lambda \ = \sup_{\lambda \in \boldsymbol{\Lambda}} T\left(\frac{\sigma_0^2}{\sigma^2(\lambda)} - 1\right), \qquad \textbf{(4)}$$

where σ_0^2 is the OLS estimator of the residual variance of the null linear model and σ^2 is the OLS estimator of the residual variance of the model (3).

The Wald test statistic, W_t, as defined in (4), has a non-standard asymptotic distribution since the threshold parameter λ is not identified under null hypothesis, known as nuisance parameter problem (Davies, 1977). The asymptotic distribution of the Wald test statistic has been examined by Davies (1987), Chan (1991), Andrews and Ploberger (1994) and Hansen (1996) under the assumption of data stationaty data. In this sense, Caner and Hansen (2001) is the first arguing that presence of unit root in the data affects the asymptotic distribution of the threshold test. According to Caner and Hansen (2001), the asymptotic distribution is non-pivotal and depends on the nuisance parameters. The dependence is so complicated that critical values cannot be directly obtained. In order to account for this problem, Caner and Hansen (2001) propose two bootstrap approximations of the asymptotic distribution of the Wald statistics, W_t, one is based on the restriction of a unit root (constrained bootstrap method), and the other depends on the unrestricted estimates (unconstrained bootstrap method)[4]. The latter method is proper only for stationary series. If the true data generating process is non-stationary, however, the asymptotic distribution and critical values obtained by constrained bootstrap procedure[5].

4.3 Testing for the Unit Root Hypothesis

The stationarity of the real exchange rate, q_t, is controlled by the parameters ρ_1 and ρ_2 in the model (1). The null hypothesis of a unit root is then described by $H_0 : \rho_1 = \rho_2 = 0$. Under the null hypothesis, it is seen that the real exchange rate follows a unit root process and is integrated of order one, i.e. $\mathrm{I}(1)$. In the hypothesis testing procedure, the same null hypothesis is used, but the alternative hypothesis is formulated in different ways. Specifically, the necessary and sufficient condition for stationarity is $\rho_1 < 0, \rho_2 < 0$ and $(1+\rho_1)(1+\rho_2) < 1$[6]. Thus, the alternative to the null hypothesis is as follows:

$$H_1 : \rho_1 < 0 \text{ and } \rho_2 < 0 \qquad \textbf{(5)}$$

So, under the alternative hypothesis H_1 both regimes are stationary. However, it is possible that the real exchange rate follows a unit root process in one regime while it

[4] For a detailed description see Caner and Hansen (2001, p.1562-1566)

[5] By Monte Carlo experiments, Caner and Hansen (2001) examine the size and power of the test by implementing both bootstrap procedures. Although both procedures have near identical sizes, they recommend computing procedures and selecting larger, more conservative, p-values if the true order of integration is not known. Moreover, they express in their experiments that power of the test is increasing in the size of the threshold effect.

[6] See Chan and Tong (1985)

behaves like a stationary process in the other regime. This possible local non-stationarity is also considered by Caner and Hansen (2001) and expressed by the following alternative hypothesis:

$$H_2 : \begin{cases} \rho_1 < 0 \textit{ and } \rho_2 = 0 \\ \qquad or \\ \rho_1 = 0 \textit{ and } \rho_2 < 0 \end{cases} \tag{6}$$

Therefore, under H_2, the process is non-stationary but not a pure unit root process. Caner and Hansen (2001) develop a group of test statistics in order to test H_0 in favor of H_1 and H_2. Since H_1 is one sided, the null is tested against the alternative hypothesis by simple one sided Wald test statistic

$$R_{1T} = t_1^2 1_{\rho_1 < 0} + t_2^2 1_{\rho_2 < 0} ,$$

where t_1 and t_2 are t-ratios for ρ_1 and ρ_2, respectively from the estimated model in (3)[7]. Although a significant R_{1T} can justify the rejecting null hypothesis against stationarity, it cannot discriminate between the stationary hypothesis H_1 and partial unit root hypothesis H_2. Therefore, Caner and Hansen (2001) recommend examining individual t statistics (t_1, t_2). If only one of the $-t_1$ or $-t_2$ is statistically significant, then the alternative of H_2 is accepted.

[7] Different from one-sided test statistic (R_{1T}), Caner and Hansen (2001) develop a two sided test statistic which tests null of unit root against unrestricted alternative ($\rho_1 \neq 0$ and $\rho_2 \neq 0$) using by $R_{2T} = t_1^2 + t_2^2$. However, this two sided Wald statistic may have less power than a one sided version of test. Therefore, they suggest employing one sided Wald test.

According to Caner and Hansen (2001), the null hypothesis, H_0, should be rejected for significantly large values of R_T. In order to determine significance, under null hypothesis of a unit root, they, therefore, derive large sample approximations to the distribution of the test statistic, R_T. Since the null hypothesis is compatible with identified $(\theta_1 \neq \theta_2)$ or unidentified $(\theta_1 = \theta_2)$ threshold effect, they reveal that the asymptotic distributions of the test statistics differ depending on whether there is a threshold effect in the data generating process. For each of two cases, therefore, a different bootstrap procedure is derived. Due to the fact that the rejection rates using unidentified threshold model is less sensitive to the nuisance parameters, they suggest calculating p-values using unidentified threshold bootstrap procedure[8].

[8] For a detailed description see Caner and Hansen (2001, p.1569-1575)

CHAPTER 5

EMPIRICAL RESULTS

Taking the results of the linear unit root tests as benchmarks, this chapter discusses the results of the application of the unit root test of Caner and Hansen (2001) to real exchange rates.

5.1 Linear Unit Root Test Results

We start our empirical study by conducting conventional Ng-Perron unit root tests since they are developed versions of the existing standard unit root tests with better power and minimized size distortions[9]. The results of the tests together with the corresponding critical values are reported in Table 1 and Table 2. While no deterministic trend is allowed in Table 1, Table 2 presents the results obtained from inclusion of a deterministic trend in regressions. In both cases, the lag length is determined by Modified AIC (MAIC) as suggested by Ng and Perron (2001) with a maximum autoregressive order of 12. According to test results, all real exchange rates follow a non-stationary process. However, as it is known that standard unit root tests implicitly assume linearity and have low power to detect potential nonlinear stationarity, these results may not be reliable. For this reason, we continue with the unit root test of Caner and Hansen (2001) described in Chapter 4 in order to examine nonlinear stationarity.

[9] See Ng and Perron (2001) for further details.

Table 1: Ng and Perron (2001) Unit Root Test Results

Country	MZα	MZt	MSB	MPT
ALBANIA	0.23717	0.22579	0.95201	54.3756
CROATIA	-1.67788	-0.75139	0.44782	12.1058
MACEDONIA	-2.40517	-0.98582	0.40988	9.56914
MOLDOVA	0.32271	0.22240	0.68917	32.3784
SERBIA	-0.05953	-0.04769	0.80109	37.8617
UKRAINE	-8.73795	-2.09003	0.23919	2.80456

Notes: *The lag order for all unit root tests has been chosen using modified AIC (MAIC) suggested by Ng and Perron (2001). The critical values for the above tests have been taken from Ng and Perron (2001):*

Model with Constant

	MZα	MZt	MSB	MPT
1%	-13.80	-2.58	0.17	1.78
5%	-8.10	-1.98	0.23	3.17
10%	-5.70	-1.62	0.27	4.45

Table 2: Ng and Perron (2001) Unit Root Test Results

Country	MZα	MZt	MSB	MPT
ALBANIA	-7.27143	-1.78440	0.25540	12.7685
CROATIA	-5.91107	-1.71725	0.29051	15.4138
MACEDONIA	-4.49195	-1.49886	0.33363	20.2863
MOLDOVA	-8.70957	-2.08591	0.23950	10.4661
SERBIA	-4.40504	-1.39449	0.31657	19.9493
UKRAINE	-10.7000	-2.29985	0.21494	8.58353

Notes: *The lag order for all unit root tests has been chosen using modified AIC (MAIC) suggested by Ng and Perron (2001). The critical values for the above tests have been taken from Ng and Perron (2001):*

Model with Constant and Linear Trend

	MZα	MZt	MSB	MPT
1%	-23.80	-3.42	0.14	4.03
5%	-17.30	-2.91	0.16	5.48
10%	-14.20	-2.62	0.18	6.67

5.2 Threshold Tests Results

The first issue we need to clarify is whether the real exchange rate series are nonlinear or not. In order to test the null of a linear autoregressive model in favor of a TAR model of the form of (1), the Wald test statistic, W_t, obtained from the regression (2) is calculated. As mentioned before, the testing methodology depends on the delay parameter, *m*, which is unknown a priori. Therefore, Caner and Hansen (2001) suggest making the selection of *m* endogenous. The least square estimate of the delay parameter, *m*, is the value that minimizes the residual variance. This is also the value that maximizes W_t since the Wald test statistic, W_t is a monotonic function of the residual variance. Hence, in order to find the optimal delay parameter for each country, the Wald statistic is calculated for each delay parameter, m=1,..,12, and the one maximizing the Wald statistic is selected. The optimal delay parameters, Wald test statistics, estimated threshold values, bootstrap critical values, bootstrap p-values for threshold variables of the form $Z_{t-1} = q_{t-m} - q_{t-m-1}$ and the number of observations that fall into each regime are reported in Table 3[10].

[10] Detailed test results for each country are given in A.1.1.

Table 3: Threshold Tests

Country	m	W_t	Bootstrap critical values (%)			Boot. p-value	Threshold estimate	Regime 1	Regime 2
			10	5	1				
ALBANIA	2	69.845	33.357	37.489	47.901	0.0001	-0.013	59	156
CROATIA	1	39.499	31.197	34.155	39.529	0.010	0.037	165	50
MACEDONIA	1	35.659	35.466	39.961	49.862	0.096	-0.011	46	169
MOLDOVA	11	187.217	53.257	67.251	104.955	0.0009	0.022	182	33
SERBIA	3	43.999	34.677	38.726	48.364	0.019	-0.0006	68	51
UKRAINE	10	344.06	53.484	71.391	125.100	0.000	0.064	182	33

Notes: m *denotes the optimal delay parameter,* W_t *denotes the Wald statistic for the threshold effects. Threshold estimate is* λ *in our model. Bootstrap p-value stands for the p-value based on the bootstrap distribution and calculated from 10.000 replications.*

According to the results, the Wald statistic is maximized for Albania when m =2, for Croatia when m=1, for Macedonia when m =1, for Moldova when m =11, for Serbia m =3 and for Ukraine when m =10[11]. According to the bootstrap p-values, the null of linearity is rejected in favor of a two-regime TAR model for all of the real exchange rate series. This implies that the adjustment towards PPP exhibit nonlinear patterns and hence, linear unit root tests will not be reliable. Moreover, the dynamics of the real exchange rates appear to differ with regard to the sign of real exchange rate changes over m-month period, with estimated threshold values being close to zero in all cases. A decrease in the real exchange rate implies an increase in the domestic

[11] As reported in Table 6 in A.1.1, the optimal delay parameter for Croatia is 10. Selecting $m = 1$, however, provides near identical values for both the residual sum of squares and the Wald test statistic W_t . Since Caner and Hansen (2001) suggest preferring models with smaller delay parameters, we continue with $m = 1$ for the case of Croatia.

cost of tradable goods, suggesting an appreciation in the domestic currency in real terms. This decline, indeed, leads to deterioration of the international competitiveness of the domestic country. In such a case, domestic country produces tradable goods relative to the foreign country in a less efficient way than before. On the contrary, a rise in the real exchange rate reflects a depreciation of the domestic currency in real terms, which implies an evolution in the degree of domestic country's international competitiveness.

Finally, the last two columns of Table 3 give the number of observations in each regime. It appears that for all countries, except Albania and Macedonia, the second regime includes more observations then the first one. Overall, each regime has sufficient observations to support nonlinearity.

5.3 Threshold Unit Root Tests Results

Once nonlinearity is ensured, we continue with testing for stationarity of real exchange rates through the one sided and two sided Wald test statistics R_{1T}, R_{2T}, and individual t_1, t_2 statistics obtained from the regression (3) [12]. The simple one sided Wald test statistic R_{1T} tests the null of a unit root against the alternative hypothesis of (5) which states that real exchange rate series are stationary in both regimes. Although a significant test statistic can verify the rejection of the unit root hypothesis, it cannot discriminate between the stationary case (5) and the local non-stationarity case (6). Therefore, to find whether non-stationarity is the case, we compute t_1 and t_2 test statistics as described in Chapter 4.3.

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[12] Since the R_{2T} test results are nearly identical to the R_{1T} test, we just report the results of R_{1T} test.

Unit root test statistics together with corresponding bootstrap and asymptotic p-values are reported in Table 4. The optimal delay parameters for each country are observed from Table 3[13]. Although we report both asymptotic and bootstrap p-values under the assumption of unidentified thresholds, we utilize bootstrap p-values since, using Monte Carlo simulations, Caner and Hansen (2001) reveal that bootstrap methods are superior to asymptotic approximations in finite samples. Regarding the results, R_{1T} test statistic provides evidence of global stationarity only for Moldova, Serbia and Ukraine with the bootstrap p-values of 0.011, 0.036, and 0.001, respectively. Global stationarity, however, does not ensure stationarity of both of the regimes. In order to detect whether non-stationarity exists in one of the regimes, we have to examine individual t statistics t_1 and t_2. The bootstrap p-values for the individual *t*-statistics, t_1 and t_2, are 0.702 and 0.009 for Moldova, 0.915 and 0.014 for Serbia, and 0.479 and 0.001 for Ukraine, which implies that the null of a unit root is rejected in favor of $\rho_2 < 0$, but not in favor of $\rho_1 < 0$. These findings indicate under the existence of non-linearity these real exchange rate series exhibit a local non-stationarity, that is, non-stationarity in one regime and stationarity in the other. Indeed switching from non-stationary to stationarity emerges the arbitrage opportunity, meaning that the price differential between the domestic and foreign countries covers the trading costs and arbitrage becomes profitable, which stimulates the international trade between countries. A significant implication that stems from this analysis is that the real exchange rate is not continuously deviating from the PPP equilibrium. International competitiveness of Moldova, Serbia and Ukraine, therefore, does not fluctuate permanently in inconsistency with PPP equilibrium. Moreover, for these countries, PPP can be regarded as model in order to predict equilibrium exchange rate and determine whether a currency over or undervalued. Therefore, they can determine the way of clearing the misalignment which causes distortions in the economy.

[13] Unit root test statistics for all possible delay parameters and for all 6 countries can be found in A.1.2

Turning to countries Albania, Croatia and Macedonia, we fail to provide evidence for stationarity of real exchange rates and, hence, PPP at the 10% significance level. Among these countries, Croatia requires more attention. Although the null of a unit root is not rejected for Croatia with the bootstrap p- value of 0.214, it is observed that the first regime has mean reverting behavior whereas the second regime has a unit root with the p-values of 0.076 and 0.783, respectively. So, the real exchange rate of Croatia follows a local non-stationary process. The failure to support PPP for Albania and Macedonia imply that PPP cannot be used in order to determine the equilibrium exchange rate for these countries. Moreover, since real exchange rate is considered as measurement of international competitiveness, price competitiveness adjustment is not consistent with the PPP equilibrium for these countries. Finally, non-stationary real exchange rate can reveal the degree of exchange rate misalignment. Indeed, if the exchange rate does not adjust to reflect large difference between domestic and foreign inflation rates, it may be persistently misaligned, thereby causing serious macroeconomic disequilibrium that would lead to real exchange rate devaluation to correct external balances.

Table 4: Threshold Unit Root Tests

		R_{1T}		t_1		t_2	
Country	m	Boot.	Asym.	Boot.	Asym.	Boot.	Asym.
ALBANIA	2	0.190	0.304	0.106	0.263	0.448	0.814
CROATIA	1	0.214	0.368	0.076	0.207	0.783	0.960
MACEDONIA	1	0.642	0.840	0.595	0.947	0.403	0.781
MOLDOVA	11	0.011	0.000	0.702	0.972	0.009	0.000
SERBIA	3	0.036	0.043	0.915	0.884	0.014	0.019
UKRAINE	10	0.001	0.000	0.479	0.697	0.001	0.000

Notes: R_{1T} is the one sided wald test statistic, which tests H_0 versus H_1 and t_1, t_2 are the individual t-statistics testing for H_0 against H_2. "Asym." Denotes the asymptotic p-values and "Boot." denotes the bootstrap p-values for the threshold unit root test statistics.

We also analyze the pairwise equality of the individual coefficients in the unconstrained model in order to determine which of the coefficients are variant across regimes. By making a constraint on these invariant coefficients, we re-estimate each model and obtain constrained threshold autoregressive models. Both the results of the equality test of individual coefficients for each m, from 1 to 12, for each of our countries and threshold unit root tests of the constrained model with the corresponding optimal delay parameter are presented in A.1.3., A.2.3., respectively[14].

Pursuant to the results of the constrained threshold model, all of our real exchange rate series reject linearity in favor of TAR process. As compared with the unconstrained model, all have the same delay parameter, except Serbia and Moldova. Moreover, the estimated threshold value in the constrained model is similar to the one in the unconstrained model for each of the countries. The unit root tests (R_{1T}, t_1, t_2), indicate that Albania, Croatia and Macedonia have a non-stationary process in both regimes while Moldova, Serbia, and Ukraine have a stationary process in one regime and a unit root process in the other. Therefore, the results of the constrained model coincide with the unconstrained threshold model for all of the countries, except Croatia. While it follows a local unit root process in the unconstrained threshold model, the null of unit root cannot be rejected in the constrained threshold model.

[14] For each m, from 1 to 12, the results of the threshold tests and unit root tests of the constrained model are separately reported in A.2.1., A.2.2., respectively, for each of our countries.

CHAPTER 6

CONCLUSION

In this study our aim is investigating long-run validity of Purchasing Power Parity by employing the unit root testing procedure developed by Caner and Hansen (2001) for the countries Albania, Croatia, Macedonia, Moldova, Serbia and Ukraine. To the best of our knowledge, this study is the only one that utilizes the TAR unit root test suggested by Caner and Hansen (2001) in those of six countries.

We start our empirical analysis by employing a conventional unit root test, Ng-Perron. The test results indicate that there is no evidence of stationarity for any of the real exchange rate series. Indeed, it is known that, Ng-Perron unit root test assume linearity and has low power in order to detect potential nonlinear stationarity. Therefore, our conventional unit root test results may not be reliable in order to detect stationarity of real exchange rate series. For this reason, we utilize a non-linear unit root testing procedure developed by Caner and Hansen (2001) that allows us to simultaneously investigate non-stationarity and non-linearity under an abrupt transition between regimes. In this procedure, we first check whether there is any threshold effect in real exchange rate series or not. We find evidence of non-linear behaviour in these six real exchange rate series. In this sense, our results indicate that simple linear unit root tests are inappropriate in order to detect mean reversion if the true data generating process is non-linear. Next, we employ threshold unit root tests. The test results indicate that null of unit root is not rejected for Albania and Macedonia. Therefore, under existence of non-linearity, these countries exhibit non-stationary behaviour in both regimes. This implies that PPP is not valid in the long-run for these countries. On the contrary, the rest of the countries, Croatia, Moldova, Serbia and Ukraine are characterized by a local non-stationary process, that is, stationary in one regime and non-stationary in the other. This implies that PPP holds in one regime but not in another for these countries.

Consequently, our empirical study proposes that the empirical evidence in favor of the stationarity increases as the nonlinear nature of the real exchange rates is taken into account. Furthermore, PPP holds for all countries with the exceptions being Albania and Macedonia. Indeed, the reason behind this invalidity may be that true form of the non-linearity is different from the Tar type non-linearity. In this sense, applying an ESTAR model, which allows smooth transition between regimes or a 3-regime Band-Tar model may provide an evidence of stationarity for these real exchange rate series. Finally, there may be possible structural changes caused from the different exchange rate policies in the countries that we consider in this study. Therefore, a future research that takes both structural changes and asymmetries in the data generating process into account will be conducted in order to provide more reliable results.

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APPENDIX

A. Threshold Test Results Unconstrained Model

Table 5: Albania

m	W_t	Bootstrap critical values (%)			Bootstrap
		10	5	1	p-value
1	48.847	33.404	37.369	46.310	0.006
2	69.845	33.357	37.489	47.901	0.000
3	39.858	33.612	37.655	47.326	0.033
4	46.709	33.199	37.434	46.432	0.009
5	54.123	33.104	37.040	46.612	0.003
6	54.168	33.029	36.884	45.949	0.002
7	53.693	33.069	37.112	46.366	0.002
8	53.302	32.759	36.721	45.928	0.002
9	53.584	32.674	36.477	46.312	0.003
10	57.843	32.653	36.620	45.617	0.001
11	49.767	32.602	36.296	45.933	0.005
12	46.757	32.474	35.971	44.488	0.006

Table 6: Croatia

m	W_t	Bootstrap critical values (%)			Bootstrap p-value
		10	5	1	
1	39.499	31.197	34.155	39.529	0.010
2	23.946	30.863	33.795	40.713	0.407
3	31.849	30.848	33.840	40.026	0.078
4	32.187	30.956	33.795	40.191	0.075
5	22.880	30.890	33.869	40.008	0.474
6	30.657	30.563	33.374	39.544	0.096
7	37.048	30.775	33.628	39.347	0.019
8	41.683	30.742	33.589	39.291	0.005
9	36.257	30.668	33.662	39.693	0.025
10	41.701	30.723	33.485	38.833	0.003
11	32.450	30.725	33.571	39.416	0.065
12	33.487	30.671	33.630	39.731	0.051

Table 7: Macedonia

m	W_t	Bootstrap critical values (%)			Bootstrap p-value
		10	5	1	
1	35.659	35.466	39.961	49.862	0.096
2	30.564	35.597	39.992	51.113	0.221
3	24.082	35.625	39.889	49.149	0.535
4	32.136	35.267	39.393	49.754	0.169
5	28.266	35.385	39.488	49.461	0.293
6	28.585	35.212	39.480	49.952	0.280
7	26.181	35.363	39.973	49.406	0.404
8	30.783	35.135	39.266	49.001	0.209
9	31.371	35.240	40.136	50.337	0.186
10	25.137	35.335	39.937	51.431	0.449
11	28.290	35.478	39.581	51.064	0.299
12	25.216	35.517	39.879	50.489	0.454

Table 8: Moldova

m	W_t	Bootstrap critical values (%)			Bootstrap p-value
		10	5	1	
1	102.937	56.106	70.809	105.188	0.010
2	79.165	54.731	68.428	102.774	0.028
3	58.697	53.632	67.189	100.906	0.077
4	64.478	53.351	66.451	101.265	0.056
5	67.192	53.489	67.387	100.532	0.050
6	97.382	54.002	68.326	104.890	0.012
7	98.678	53.073	67.129	106.629	0.013
8	161.046	53.377	66.033	107.338	0.001
9	182.641	53.027	66.798	104.555	0.000
10	160.145	52.951	66.500	105.756	0.001
11	187.217	53.257	67.251	104.955	0.000
12	185.211	53.175	67.372	110.627	0.000

Table 9: Serbia

m	W_t	Bootstrap critical values (%)			**Bootstrap p-value**
		10	5	1	
1	28.341	34.777	38.567	47.556	0.284
2	25.616	34.780	38.606	48.623	0.404
3	43.999	34.677	38.726	48.364	0.019
4	33.467	34.624	38.651	47.537	0.126
5	29.480	34.713	38.957	47.535	0.235
6	33.192	34.509	38.270	47.366	0.127
7	27.288	34.497	38.476	47.163	0.318
8	33.924	34.447	38.399	47.252	0.107
9	28.183	34.457	38.656	46.858	0.276
10	21.352	34.523	38.636	47.700	0.658
11	24.563	34.348	38.580	47.205	0.463
12	20.999	34.350	38.418	47.288	0.678

Table 10: Ukraine

m	W_t	Bootstrap critical values (%)			Bootstrap p-value
		10	5	1	
1	75.499	55.460	73.404	125.688	0.045
2	64.226	55.499	73.337	124.966	0.069
3	47.298	56.076	74.007	127.292	0.144
4	48.353	55.464	72.846	122.459	0.137
5	65.802	55.136	70.656	116.577	0.062
6	52.579	53.972	70.638	114.539	0.107
7	106.129	52.915	70.808	118.951	0.014
8	153.088	53.912	71.519	124.593	0.004
9	163.600	52.737	71.190	124.877	0.003
10	344.062	53.484	71.391	125.100	0.000
11	297.513	53.359	71.393	138.680	0.000
12	197.937	53.894	75.236	143.852	0.003

B. Threshold Unit Root Test Results Unconstrained Model

Table 11: Albania

m	R_{1T}		t_1		t_2	
	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value
1	0.502	0.729	0.223	0.509	0.789	0.960
2	0.190	0.304	0.106	0.263	0.448	0.814
3	0.114	0.172	0.950	0.848	0.042	0.085
4	0.965	0.996	0.772	0.960	0.760	0.959
5	0.965	0.996	0.740	0.956	0.876	0.947
6	0.936	0.994	0.758	0.958	0.689	0.945
7	0.929	0.992	0.700	0.949	0.704	0.949
8	0.609	0.821	0.761	0.958	0.295	0.619
9	0.850	0.973	0.761	0.959	0.536	0.872
10	0.194	0.292	0.681	0.942	0.082	0.171
11	0.696	0.887	0.576	0.897	0.446	0.804
12	0.444	0.635	0.448	0.803	0.304	0.613

Table 12: Croatia

m	R_{1T}		t_1		t_2	
	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value
1	0.214	0.368	0.076	0.207	0.783	0.960
2	0.760	0.937	0.512	0.875	0.584	0.902
3	0.413	0.645	0.867	0.950	0.180	0.426
4	0.425	0.659	0.838	0.957	0.184	0.438
5	0.504	0.736	0.848	0.955	0.228	0.516
6	0.703	0.895	0.373	0.743	0.712	0.948
7	0.639	0.851	0.298	0.652	0.819	0.960
8	0.570	0.792	0.309	0.670	0.597	0.905
9	0.664	0.863	0.332	0.685	0.735	0.953
10	0.262	0.422	0.092	0.244	0.958	0.829
11	0.466	0.686	0.196	0.464	0.955	0.841
12	0.330	0.513	0.119	0.312	0.944	0.417

Table 13: Macedonia

m	R_{1T}		t_1		t_2	
	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value
1	0.642	0.840	0.595	0.947	0.403	0.781
2	0.482	0.678	0.489	0.881	0.342	0.696
3	0.694	0.880	0.412	0.807	0.651	0.961
4	0.684	0.867	0.343	0.725	0.738	0.985
5	0.676	0.851	0.479	0.859	0.553	0.902
6	0.660	0.833	0.450	0.829	0.566	0.909
7	0.605	0.773	0.249	0.537	0.894	0.999
8	0.663	0.821	0.307	0.619	0.817	0.995
9	0.611	0.753	0.249	0.521	0.865	0.998
10	0.688	0.817	0.675	0.961	0.418	0.726
11	0.736	0.857	0.412	0.730	0.752	0.980
12	0.555	0.644	0.455	0.779	0.474	0.776

Table 14: Moldova

m	R_{1T}		t_1		t_2	
	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value
1	0.332	0.368	0.683	0.978	0.155	0.248
2	0.357	0.391	0.631	0.962	0.173	0.292
3	0.085	0.008	0.585	0.932	0.046	0.006
4	0.074	0.002	0.550	0.908	0.044	0.001
5	0.097	0.005	0.644	0.958	0.056	0.003
6	0.024	0.000	0.614	0.939	0.017	0.000
7	0.029	0.000	0.606	0.935	0.021	0.000
8	0.005	0.000	0.478	0.809	0.005	0.000
9	0.002	0.000	0.650	0.951	0.002	0.000
10	0.003	0.000	0.671	0.961	0.002	0.000
11	0.011	0.000	0.702	0.972	0.009	0.000
12	0.013	0.000	0.589	0.910	0.012	0.000

Table 15: Serbia

m	R_{1T}		t_1		t_2	
	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value
1	0.110	0.174	0.080	0.208	0.310	0.666
2	0.116	0.179	0.497	0.872	0.058	0.126
3	0.036	0.043	0.915	0.884	0.014	0.019
4	0.073	0.098	0.980	0.488	0.027	0.046
5	0.169	0.265	0.920	0.876	0.066	0.140
6	0.094	0.121	0.909	0.895	0.033	0.058
7	0.489	0.735	0.219	0.515	0.821	0.958
8	0.625	0.860	0.305	0.665	0.895	0.926
9	0.197	0.307	0.895	0.916	0.080	0.166
10	0.630	0.862	0.556	0.906	0.413	0.759
11	0.090	0.107	0.660	0.944	0.038	0.055
12	0.457	0.674	0.807	0.958	0.220	0.452

Table 16: Ukraine

m	R_{1T}		t_1		t_2	
	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value
1	0.495	0.580	0.487	0.845	0.294	0.636
2	0.080	0.003	0.528	0.864	0.041	0.003
3	0.146	0.034	0.522	0.853	0.073	0.035
4	0.448	0.460	0.489	0.795	0.257	0.560
5	0.243	0.114	0.605	0.916	0.105	0.095
6	0.291	0.162	0.628	0.926	0.121	0.132
7	0.030	0.000	0.653	0.937	0.017	0.000
8	0.009	0.000	0.582	0.864	0.005	0.000
9	0.011	0.000	0.583	0.858	0.007	0.000
10	0.001	0.000	0.479	0.697	0.001	0.000
11	0.005	0.000	0.482	0.705	0.004	0.000
12	0.007	0.000	0.629	0.888	0.005	0.000

C. Equality Test Results of Individual Coefficients Unconstrained Threshold Model

Table 17: Albania

Tests for Equality of Individual Coefficients		
Regressor	Wald Statistics	Bootstrap p-value
Intercept	1.400	0.598
Y(t-1)	2.379	0.384
DY(t-1)	11.348	0.025
DY(t-02)	3.186	0.268
DY(t-03)	5.839	0.133
DY(t-04)	0.290	0.745
DY(t-05)	7.783	0.086
DY(t-06)	2.054	0.403
DY(t-07)	0.005	0.966
DY(t-08)	3.405	0.275
DY(t-09)	5.475	0.150
DY(t-10)	0.505	0.679
DY(t-11)	2.276	0.365
DY(t-12)	10.085	0.046

Table 18: Croatia

Tests for Equality of Individual Coefficients		
Regressor	Wald Statistics	Bootstrap p-value
Intercept	1.319	0.567
Y(t-1)	4.489	0.169
DY(t-1)	2.878	0.250
DY(t-02)	15.372	0.004
DY(t-03)	6.316	0.097
DY(t-04)	10.973	0.024
DY(t-05)	2.940	0.266
DY(t-06)	1.007	0.531
DY(t-07)	3.494	0.226
DY(t-08)	3.454	0.241
DY(t-09)	10.527	0.028
DY(t-10)	0.082	0.858
DY(t-11)	0.028	0.916
DY(t-12)	0.877	0.560

Table 19: Macedonia

Tests for Equality of Individual Coefficients		
Regressor	Wald Statistics	Bootstrap p-value
Intercept	0.081	0.890
Trend	2.736	0.374
Y(t-1)	0.099	0.862
DY(t-1)	9.307	0.049
DY(t-02)	1.493	0.465
DY(t-03)	1.095	0.541
DY(t-04)	0.217	0.787
DY(t-05)	0.010	0.954
DY(t-06)	0.094	0.849
DY(t-07)	1.564	0.456
DY(t-08)	0.147	0.816
DY(t-09)	0.014	0.943
DY(t-10)	0.457	0.694
DY(t-11)	0.278	0.754
DY(t-12)	3.857	0.225

Table 20: Moldova

Tests for Equality of Individual Coefficients		
Regressor	Wald Statistics	Bootstrap p-value
Intercept	90.299	0.003
Trend	124.654	0.001
Y(t-1)	66.429	0.005
DY(t-1)	3.110	0.331
DY(t-02)	14.566	0.067
DY(t-03)	10.160	0.126
DY(t-04)	1.517	0.532
DY(t-05)	1.061	0.582
DY(t-06)	0.287	0.773
DY(t-07)	0.049	0.895
DY(t-08)	1.448	0.515
DY(t-09)	1.429	0.525
DY(t-10)	1.745	0.496
DY(t-11)	6.827	0.184
DY(t-12)	5.122	0.224

Table 21: Serbia

Tests for Equality of Individual Coefficients		
Regressor	Wald Statistics	Bootstrap p-value
Intercept	12.960	0.059
Y(t-1)	11.976	0.045
DY(t-1)	0.156	0.818
DY(t-02)	0.013	0.946
DY(t-03)	0.620	0.658
DY(t-04)	4.822	0.210
DY(t-05)	5.060	0.198
DY(t-06)	0.462	0.704
DY(t-07)	5.264	0.187
DY(t-08)	1.157	0.544
DY(t-09)	0.041	0.911
DY(t-10)	0.509	0.692
DY(t-11)	0.279	0.769
DY(t-12)	5.351	0.179

Table 22: Ukraine

Tests for Equality of Individual Coefficients		
Regressor	Wald Statistics	Bootstrap p-value
Intercept	221.722	0.000
Trend	170.585	0.000
Y(t-1)	175.415	0.000
DY(t-1)	83.308	0.000
DY(t-02)	15.257	0.048
DY(t-03)	15.106	0.055
DY(t-04)	28.127	0.024
DY(t-05)	16.320	0.062
DY(t-06)	15.089	0.071
DY(t-07)	19.244	0.043
DY(t-08)	8.706	0.140
DY(t-09)	58.834	0.003
DY(t-10)	25.763	0.024
DY(t-11)	4.795	0.238
DY(t-12)	11.885	0.082

D. Threshold Test Results Constrained Model

Table 23: Albania

m	W_t	Bootstrap critical values (%)			Bootstrap
		10	5	1	p-value
1	36.688	16.263	18.708	24.103	0.000
2	41.602	16.292	18.709	24.222	0.000
3	23.393	16.194	18.602	25.091	0.014
4	11.452	16.561	18.677	24.580	0.379
5	12.095	16.321	18.709	24.094	0.312
6	13.574	16.283	18.619	23.833	0.209
7	13.794	16.287	18.573	23.963	0.200
8	9.070	16.367	18.729	24.207	0.620
9	10.334	16.251	18.724	24.024	0.479
10	16.699	16.335	18.810	24.677	0.090
11	17.676	16.361	18.944	25.022	0.069
12	19792	16.257	18.871	24.335	0.039

Table 24: Croatia

m	W_t	Bootstrap critical values (%)			Bootstrap p-value
		10	5	1	
1	36.688	16.263	18.708	24.103	0.000
2	41.602	16.292	18.709	24.222	0.000
3	23.393	16.194	18.602	25.091	0.014
4	11.452	16.561	18.677	24.580	0.379
5	12.095	16.321	18.709	24.094	0.312
6	13.574	16.283	18.619	23.833	0.209
7	13.794	16.287	18.573	23.963	0.200
8	9.070	16.367	18.729	24.207	0.620
9	10.334	16.251	18.724	24.024	0.479
10	16.699	16.335	18.810	24.677	0.090
11	17.676	16.361	18.944	25.022	0.069
12	19792	16.257	18.871	24.335	0.039

Table 25: Macedonia

m	W_t	Bootstrap critical values (%)			Bootstrap
		10	5	1	p-value
1	24.433	13.900	16.190	21.174	0.003
2	19.330	14.213	16.252	21.032	0.016
3	7.435	14.351	16.422	22.339	0.661
4	13.151	14.394	16.835	22.075	0.144
5	14.422	14.681	17.064	22.407	0.107
6	8.561	14.754	16.938	22.721	0.533
7	6.181	14.873	17.274	22.827	0.825
8	7.793	14.991	17.495	23.437	0.644
9	20.400	15.394	17.992	24.277	0.026
10	9.419	15.660	18.232	24.579	0.474
11	13.325	15.688	18.402	24.856	0.189
12	16.851	16.016	18.573	25.381	0.080

Table 26: Moldova

m	W_t	Bootstrap critical values (%)			**Bootstrap p-value**
		10	5	1	
1	42.731	17.578	22.464	36.522	0.005
2	37.523	16.888	20.930	35.170	0.007
3	37.004	17.008	21.470	35.469	0.008
4	46.580	17.598	22.260	37.927	0.005
5	52.552	18.101	23.003	41.492	0.005
6	69.095	19.067	24.655	45.038	0.003
7	70.133	19.643	25.263	47.211	0.003
8	101.346	19.875	26.128	48.077	0.000
9	123.680	20.223	26.587	48.256	0.000
10	138.363	20.985	27.555	51.161	0.000
11	157.555	21.706	28.209	51.961	0.000
12	160.176	22.637	30.217	57.395	0.000

Table 27: Serbia

m	W_t	Bootstrap critical values (%)			Bootstrap
		10	5	1	p-value
1	9.653	10.368	12.293	16.630	0.130
2	8.868	10.344	12.155	16.881	0.175
3	18.866	10.731	12.717	16.618	0.004
4	16.917	10.687	12.374	16.376	0.008
5	19.582	10.731	12.714	17.382	0.005
6	9.623	10.759	12.764	17.026	0.151
7	8.359	10.975	12.921	17.119	0.242
8	7.173	10.935	12.992	17.901	0.353
9	16.214	10.989	13.045	17.292	0.015
10	3.245	11.122	13.103	17.821	0.901
11	18.011	11.281	13.064	18.256	0.010
12	5.678	11.336	13.346	17.879	0.567

Table 28: Ukraine

m	W_t	Bootstrap critical values (%)			Bootstrap p-value
		10	5	1	
1	75.340	47.643	63.248	102.704	0.029
2	62.275	48.178	62.713	104.242	0.051
3	47.790	48.368	64.219	107.954	0.102
4	41.859	47.653	64.216	106.225	0.135
5	53.803	47.312	63.234	105.935	0.072
6	51.562	46.445	61.643	103.581	0.076
7	103.565	45.040	60.337	102.984	0.009
8	133.679	45.611	59.341	103.729	0.004
9	148.661	45.239	58.931	108.763	0.002
10	308.895	45.949	60.397	113.041	0.000
11	251.617	45.786	63.487	117.378	0.000
12	135.127	47.121	65.486	126.267	0.008

E. Threshold Unit Root Test Results Constrained Model

Table 29: Albania

m	R_{1T}		t_1		t_2	
	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value
1	0.127	0.153	0.045	0.075	0.793	0.960
2	0.782	0.931	0.552	0.890	0.556	0.879
3	0.767	0.926	0.480	0.841	0.615	0.915
4	0.560	0.748	0.815	0.960	0.266	0.528
5	0.322	0.461	0.783	0.960	0.135	0.273
6	0.178	0.245	0.895	0.939	0.067	0.128
7	0.572	0.764	0.763	0.959	0.275	0.549
8	0.540	0.726	0.797	0.961	0.254	0.505
9	0.596	0.783	0.760	0.959	0.286	0.571
10	0.309	0.430	0.577	0.900	0.164	0.311
11	0.404	0.547	0.607	0.919	0.210	0.396
12	0.672	0.831	0.527	0.864	0.442	0.770

Table 30: Croatia

m	R_{1T}		t_1		t_2	
	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value
1	0.467	0.671	0.201	0.450	0.834	0.959
2	0.724	0.901	0.576	0.909	0.461	0.810
3	0.379	0.560	0.915	0.915	0.160	0.351
4	0.273	0.419	0.935	0.883	0.111	0.242
5	0.396	0.571	0.828	0.959	0.171	0.360
6	0.796	0.941	0.435	0.797	0.856	0.957
7	0.591	0.787	0.271	0.573	0.961	0.835
8	0.465	0.652	0.190	0.432	0.972	0.771
9	0.343	0.505	0.129	0.307	0.989	0.572
10	0.349	0.512	0.130	0.312	0.987	0.631
11	0.563	0.748	0.236	0.528	0.980	0.712
12	0.335	0.479	0.120	0.287	0.999	0.211

Table 31: Macedonia

m	R_{1T}		t_1		t_2	
	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value
1	0.753	0.878	0.777	0.994	0.385	0.702
2	0.599	0.732	0.543	0.901	0.399	0.728
3	0.463	0.571	0.797	0.995	0.201	0.365
4	0.382	0.464	0.820	0.997	0.157	0.272
5	0.391	0.465	0.825	0.997	0.166	0.272
6	0.443	0.514	0.581	0.925	0.265	0.462
7	0.741	0.845	0.515	0.875	0.566	0.881
8	0.822	0.909	0.449	0.793	0.770	0.984
9	0.467	0.490	0.154	0.282	0.978	0.999
10	0.749	0.814	0.755	0.982	0.427	0.668
11	0.578	0.581	0.687	0.953	0.324	0.485
12	0.582	0.556	0.774	0.981	0.289	0.398

Table 32: Moldova

m	R_{1T}		t_1		t_2	
	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value
1	0.035	0.000	0.612	0.954	0.019	0.000
2	0.123	0.022	0.588	0.943	0.073	0.015
3	0.057	0.001	0.602	0.953	0.036	0.001
4	0.042	0.000	0.603	0.946	0.030	0.000
5	0.038	0.000	0.763	0.992	0.025	0.000
6	0.012	0.000	0.756	0.990	0.009	0.000
7	0.015	0.000	0.740	0.988	0.011	0.000
8	0.004	0.000	0.683	0.973	0.003	0.000
9	0.001	0.000	0.793	0.994	0.001	0.000
10	0.000	0.000	0.764	0.989	0.000	0.000
11	0.000	0.000	0.721	0.980	0.000	0.000
12	0.001	0.000	0.625	0.935	0.001	0.000

Table 33: Serbia

m	R_{1T}		t_1		t_2	
	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value
1	0.349	0.458	0.161	0.314	0.627	0.922
2	0.306	0.396	0.635	0.924	0.144	0.262
3	0.018	0.007	0.859	0.952	0.006	0.003
4	0.040	0.022	0.891	0.940	0.015	0.009
5	0.029	0.011	0.863	0.953	0.009	0.004
6	0.082	0.060	0.912	0.920	0.030	0.027
7	0.116	0.102	0.778	0.960	0.048	0.048
8	0.181	0.188	0.737	0.956	0.080	0.097
9	0.096	0.075	0.603	0.917	0.047	0.042
10	0.339	0.412	0.823	0.958	0.163	0.237
11	0.077	0.048	0.653	0.939	0.034	0.024
12	0.333	0.374	0.532	0.870	0.203	0.288

Table 34: Ukraine

m	R_{1T}		t_1		t_2	
	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value	Boot. p-value	Asym. p-value
1	0.352	0.326	0.484	0.847	0.202	0.355
2	0.074	0.002	0.496	0.848	0.041	0.002
3	0.121	0.014	0.511	0.847	0.068	0.015
4	0.245	0.112	0.554	0.878	0.121	0.108
5	0.163	0.032	0.639	0.933	0.076	0.023
6	0.190	0.042	0.635	0.920	0.088	0.032
7	0.024	0.000	0.664	0.939	0.014	0.000
8	0.010	0.000	0.661	0.935	0.007	0.000
9	0.012	0.000	0.648	0.918	0.008	0.000
10	0.000	0.000	0.594	0.854	0.000	0.000
11	0.004	0.000	0.632	0.906	0.004	0.000
12	0.008	0.000	0.640	0.904	0.007	0.000

F. Threshold Unit Root Tests Constrained Model (All Countries)

Table-35: All Countries

Country	m	R_{1T}		t_1		t_2	
		Boot.	Asym.	Boot.	Asym.	Boot.	Asym.
ALBANIA	2	0.782	0.931	0.552	0.890	0.556	0.879
CROATIA	10	0.349	0.512	0.130	0.312	0.987	0.631
MACEDONIA	1	0.753	0.878	0.777	0.994	0.385	0.702
MOLDOVA	12	0.001	0.000	0.625	0.935	0.001	0.000
SERBIA	5	0.029	0.011	0.863	0.953	0.009	0.004
UKRAINE	10	0.001	0.000	0.594	0.854	0.001	0.000

G. TEZ FOTOKOPİSİ İZİN FORMU

ENSTİTÜ

Fen Bilimleri Enstitüsü	
Sosyal Bilimler Enstitüsü	X
Uygulamalı Matematik Enstitüsü	
Enformatik Enstitüsü	
Deniz Bilimleri Enstitüsü	

YAZARIN

Soyadı : CAN
Adı : NESLIHAN
Bölümü: IKTISAT

TEZİN ADI (İngilizce) : TESTING THE LONG-RUN VALIDITY OF PURCHASING POWER PARITY FOR EASTERN AND SOUTHERN EUROPEAN COUNTRIES.

TEZİN TÜRÜ : Yüksek Lisans [X] Doktora [ ]

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