ARAŞTIRMA MAKALESİ / RESEARCH ARTICLE

INVESTIGATION OF SPECULATIVE BUBBLES IN FINANCIAL MARKETS: THE EXAMPLE OF FOREIGN EXCHANGE MARKET

FİNANSAL PİYASALARDAKİ SPEKÜLATİF BALONLARIN ARAŞTIRILMASI: DÖVİZ PİYASASI ÖRNEĞİ

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ABSTRACT

Financial bubbles are described as the deviation of the market values of financial assets from their core values. They are one of the main indicators for the financial crises by negatively affecting the markets due to the constant overvaluation of the assets. Therefore, investigating the presence of financial bubbles and determining the reasons are of great importance for investors, market regulators, and portfolio managers in terms of investment risk and price stability. In the study, the presence of bubbles in the foreign exchange market is investigated by considering the most traded currencies such as the US Dollar, Euro, Japanese Yen, British Pound, and Chinese Yuan. For this purpose, the daily price data for the period between 03.01.2005-20.11.2019 for the US Dollar/Turkish Lira, Euro/Turkish Lira, British Pound/Turkish Lira, and Chinese Yuan/Turkish Lira, and the daily price data belonging to 28.08.2013-20.11.2019 period for Japanese Yen/Turkish Lira are used. Supremum Augmented Dickey-Fuller (SADF) and Generalized Supremum Augmented Dickey-Fuller (GSADF) tests are used to determine the bubbles in aforementioned exchange rates. The results indicate findings regarding the formation of financial bubbles in the foreign exchange market in Turkey.

Keywords: Exchange Rate, Financial Bubble, SADF and GSADF Test.

JEL Classification Codes: G15, G14.

ÖZ

Finansal varlıkların piyasa değerlerinin temel değerlerinden sapması olarak tanımlanan finansal balonlar, varlıkların piyasada sürekli aşırı değerlenmelerinden dolayı piyasaları olumsuz etkileyerek finansal krizlerin öncü göstergeleri olmaktadır. Böylece yatırımcılar, piyasa düzenleyiciler ve portföy yöneticileri açısından finansal balonların varlığının araştırılması ve nedenlerinin tespit edilmesi, yatırım riski ve fiyat istikrarı için büyük önem arz etmektedir. Bu çalışmada Amerikan Doları, Euro, Japon Yeni, İngiliz Sterlini ve Çin Yuanı olmak üzere en çok işlem gören para birimleri dikkate alınarak döviz piyasasındaki balonların varlığı araştırılmıştır. Bu amaç doğrultusunda çalışmada ABD Doları, Euro, İngiliz Sterlini ve Çin Yuanı için 03.01.2005-20.11.2019; Japon Yeni için de 28.08.2013-20.11.2019 dönemi günlük fiyat verileri kullanılmıştır. Söz konusu kurlardaki balonları belirlemek amacıyla Eküs-Genelleştirilmiş Dickey-Fuller (SADF) ve Genelleştirilmiş SADF (GSADF) testlerinden yararlanılmıştır. Çalışma sonucunda Türkiye döviz piyasasında finansal balonların oluşumuna yönelik bulgulara ulaşılmıştır.

Anahtar Kelimeler: Döviz Kuru, Finansal Balon, SADF ve GSADF Testi.

JEL Sınıflandırma Kodları: G15, G14.

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GENİŞLETİLMİŞ ÖZET

Amaç ve Kapsam:

Finansal varlıkların piyasa değerlerinin temel değerlerinden sapması olarak tanımlanan finansal balonlar, varlıkların piyasada sürekli aşırı değerlenmelerinden dolayı piyasaları olumsuz etkileyerek finansal krizlerin öncü göstergeleri olmaktadır. Finansal balonlar 'değer' kavramından dolayı piyasada etkin olmayan bir yapı oluşmasına neden olan asimetrik bilgi sorunu ve volatiliteyle ilişkilidir. Yatırımcıların finansal piyasalarda anormal getiri elde edeceklerine inanmaları ya da piyasadaki ekonomik göstergeler dışında sürü psikolojisiyle hareket etmeleri sonucu oluşan spekülatif kaynaklı ve mevcut bilgiyle açıklanamayan volatil fiyat hareketleri, rasyonel veya rasyonel olmayan finansal balonların oluşmasına neden olmaktadır. Finansal krizlerin de öncü göstergeleri olan bu balonların varlıklarının tespit edilmesi ve nedenlerinin araştırılması; yatırımcılar, portföy yöneticileri ve piyasa düzenleyiciler için yatırım riskinin azaltılması ve fiyat istikrarının korunması açısından büyük önem arz etmektedir. Bu çalışmada Amerikan Doları, Euro, Japon Yeni, İngiliz Sterlini ve Çin Yuanı olmak üzere en çok işlem gören para birimleri dikkate alınarak döviz piyasasındaki balonların varlığı araştırılmıştır.

Yöntem:

Türkiye'de Dolar (USD/TRY), Euro (EURO/TRY), Japon Yeni (JPY/TRY), İngiliz Sterlini (GBP/TRY) ve Çin Yuanı (CNY/TRY) olmak üzere en çok tercih edilen döviz kurları kullanılarak döviz piyasasındaki balonların varlığının araştırıldığı çalışmada; ABD Doları, Euro, İngiliz Sterlini, Çin Yuanı için 03.01.2005-20.11.2019, Japon Yeni için de 28.08.2013-20.11.2019 dönemi günlük fiyat verileri kullanılmıştır. Veriler 'investing.com' veri terminalinden elde edilmiştir. Çalışmada serilerde oluşan balonları belirleyebilmek için tekli balon oluşumunu gösteren Sup-Augmented Dickey-Fuller (SADF) ve çoklu balon oluşumunu gösteren Generalized Sup-Augmented Dickey-Fuller (GSADF) testlerinden faydalanılmıştır. Analizler Eviews 10 Ekonometrik paket programı aracılığıyla yapılmıştır.

Bulgular:

Çalışmada SADF test istatistiği sonuçlarına göre USD/TRY, EUR/TRY, GBP/TRY, JPY/TRY test istatistikleri Monte Carlo simülasyon sonuçlarından elde edilen kritik değerlerle karşılaştırıldığında serinin fiyat balonlarını içermediği şeklinde kurulan sıfır hipotezi reddedilerek fiyat serilerinde balonun varlığı tespit edilmiştir. Ancak CNY/TRY serisinin test istatistik değeri kritik değerlerinden küçük olduğu için serinin fiyat balonlarını içermediği şeklinde kurulan sıfır hipotezi reddedilemeyerek CNY/TRY serisinde balon oluşmadığı görülmüştür. Fiyat serilerinde SADF testine ait grafikler incelendiğinde ise USD/TRY, EUR/TRY, GBP/TRY, JPY/TRY serilerine ait grafiklerin hemen hemen birbirine benzediği yani hemen hemen aynı tarihlerde balon oluştuğu gözlemlenirken, sadece CNY/TRY serisinin diğer serilerden farklı tarihlerde balon oluştuğu görülmektedir. GSADF test istatistiği sonuçlarına göre tüm fiyat serilerinin test istatistiklerinin kritik değerlerinden büyük olmasından dolayı fiyat serilerinde çoklu balon varlığı tespit edilmiştir. Ayrıca fiyat serilerinde GSADF testine ait grafikler incelendiğinde ise SADF testine ait grafiklerle benzer bir durum sergilendiği görülmektedir.

Sonuç ve Tartışma:

Çalışmada çoklu balon oluşumlarının EUR/TRY serisinde daha yaygın, GBP/TRY serisinde ise nispeten daha az olduğu görülmektedir. Bu durumda incelenen dönemler itibarıyla GBP/TRY döviz kurunun diğer döviz kurlarına göre iç ve dış çevreden kaynaklanan olaylardan daha az etkilendiği, USD/TRY ve EUR/TRY döviz kurlarının iç ve dış çevreden kaynaklanan olaylardan daha çok etkilenerek volatil bir yapı sergilediği görülmektedir. Dünyada ve ülkede yaşanan ekonomik ve politik durumlar dönemler itibarıyla değerlendirildiğinde FED'in 2000 yılından 2006 yılına kadar politika faiz oranlarını aşamalı olarak düşürmesiyle oluşan likidite fazlalıklarının yüksek risk içeren konut kredilerine yönlendirilmesi, 2007 yılında ABD'de ikincil ipotek piyasasında başlayan ve 2008 yılında ülkenin en büyük 4. yatırım bankası Lehman Brothers'ın iflasını açıklamasıyla alınan yüksek riskin olumsuz sonuçlanması ve etkisi bütün dünyaya yayılan küresel finansal krizin ortaya çıkması, kriz sonrasında FED'in uygulamaya koyduğu 'Parasal Genişleme-Varlık Alım Programı'nın Aralık 2013'ten itibaren yavaşlatılması, 2014 yılında Suriye, Irak ekseninde yaşanan kaosla birlikte Ukrayna hükümetinin AB ile ortaklık anlaşması yapmaması üzerine halkın protestoları, 2015 yılında yaşanan siyasi belirsizlikler, terörle mücadeleler sonucu Türkiye'nin risk priminin artması, 2016 yılında dünyada petrol ve emtia fiyatlarının düşmesi sonucunda ekonomileri bunlara dayalı ülkelerin ekonomilerinin küçülmesi ve ABD başkanlık seçimi ardından FED'in faiz artırımına gideceği beklentisiyle Dolar Endeksi'nin yukarı yönlü hareketi, yurt içinde 15 Temmuz darbe girişimi ile Suriye ve Irak'la güvenlik sıkıntısı, 2017 yılında dünyada yaşanan ABD başkanının olumsuz yaklaşımları, Brexit olayı, FED'in faiz artırımları, Orta Doğu'da yaşanan olumsuzluklar, Avrupa'daki hükümet sıkıntıları, Kudüs sorunu, ülkede ise Rus uçağı krizi, referandumun bütçede yarattığı sıkıntılar, yüksek enflasyon ve işsizlik sorunu, bütçe açığı, cari açık, dış borç stokundaki artış seyri, 2018 yılında FED'in faiz artışı beklentisinin devam etmesi, küresel volatilite endeksindeki yükseliş, kredi derecelendirme kuruluşlarının düşük notları, OHAL sürecinin devam etmesi, enflasyon oranı, risk primi ve cari işlemler açığındaki yüksek seyir, yerli ve yabancı yatırımcının dolara olan yoğun talebi, 2019 yılında yaşanan ABD-Çin ticaret savaşı, FED'in aşamalı olarak faiz indiriminin yabancı yatırımcı beklentilerini artırması sonucu yaşanan tüm bu ekonomik olaylar döviz kurlarında dalgalanmalara yol açarak balon oluşumunu tetiklemiştir. USD/TRY ve EUR/TRY döviz kurlarının iç ve dış piyasalarda yaşanan ekonomik ve politik olaylara karşı bu kadar hassas olması, Türk döviz piyasalarının oldukça kırılgan bir yapıya sahip olduklarını ortaya koymaktadır. Bu durumdan hareketle Türkiye piyasalarında yatırım yapmak isteyen yatırımcıların mikro ve makro olayları dikkate alarak pozisyon almaları önemli olmaktadır. Yatırımcılar Türkiye'deki döviz piyasalarında işlem yaparak anormal getiri elde edebileceği gibi yatırımcıların karşılaşabilecekleri kayıplara karşı da hazırlıklı olmaları gerekmektedir.

1. INTRODUCTION

The internationalization of financial assets is an ongoing situation with increasing globalization. Increased communication and technological developments have led the financial markets to reach the international level. This situation has caused markets to affect each other. Thus, it can be said that the value of businesses in financial markets can be influenced not only by national but also by international factors. In addition, obtaining all kinds of information instantly with the increasing communication and network in this information age has diversified the efficiency of the markets. According to the Efficient Markets Hypothesis (Fama, 1970), it is possible to say that "the market is efficient" providing that all the information reaching to the market can be reflected correctly on prices (Dowla, 1995: 95). Proper formation of the balance in prices of the market is related to the efficient determination of prices. The prices must cover all the information reaching to the market so that the investors can make the most correct decisions in terms of resource use (Berke, Özcan and Dizdarlar, 2014: 621).

In addition to the efficient market hypothesis of Fama (1970), another important theory for the financial markets is the "Rational Bubble Act" developed by Chan, McQueen, and Thorley (1998). According to this theory, a rational increase in prices will occur when investors are directed to instruments from which higher returns are expected and whose prices will be likely to increase after a possible crisis. When the previous studies are analyzed, Blanchard (1979) states that the increase in prices cannot be explained by the existing information and this increase causes a unique change in prices due to the acceleration of the bubble and then the burst of the bubble. Flood and Garber (1980), on the other hand, call the situation where the price level emerges with self-created expectations without being dependent on market rules as "rational speculative bubbles". Dezhbakhsh and Demirguc-Kunt (1990) define the deviation of asset prices from their core values as bubbles. Garber (2000) describes the rapid increase in the price of a financial asset due to speculations rather than its own value as a 'bubble'. According to Mayer (2011), when financial asset prices show a volatile structure in cyclical times, prices increase more than expected and decrease quickly contrary to expectations, it is called a bubble. In summary, if the value of a financial asset exceeds its core value by ignoring the expected value of the cash flows to be obtained from this asset and it changes of the directions of the economy without considering the conditions that the economy should have, these situations will cause the formation of bubbles (Phillips and Yu, 2011). In addition, the fact that investors in financial markets act in the form of a herd mentality, rather than considering economic indicators, will also cause changes in the prices of financial assets (Blanchard and Watson, 1982: 3). Regardless of the market, the increase in the number of investors for the purpose of profit speculation leads to behaviors described as "madness of rational behavior" or "bubbles" (Anavatan and Kayacan, 2018: 125).

Regardless of the financial asset in which bubbling occurs, it affects the financial markets. Therefore, it is an inevitable fact that bubbles cause financial crises. The sudden decrease in financial asset prices with the explosion of bubbles will decrease the values of assets and expenditures of people, resulting in the weakening of all economic activities (Malkiel, 2010: 14). In addition, the situations that may cause the formation of bubbles can be listed as the decrease in interest rates and the increase in liquidity, the state's securing losses in investments, the manipulative transactions of investors and businesses with monopoly and internal knowledge in the markets and the news that will create shocks in extraordinary situations (Demiröz, 2018). These situations result in abnormalities in ideal markets (Demiröz, 2018). There are many examples of bubbles that caused crises in financial markets in the past years. Some of those are the "Tulip Mania (Tulipmania)", "South Sea Bubble", "Mississippi Bubble", "Swedish Real Estate Bubble", "Internet Bubble (Dotcom)" and "2008 Global Crisis Bubbles" (Akıncı et al., 2014: 719-749).

In today's economy, foreign exchange markets, which have an important place in the financial markets and have a universal character, may cause fluctuations as a result of the acceleration of capital mobility in the markets with the international dimension of trade and investments. The balance of foreign exchange markets is realized by determining the correct and effective exchange rates. As in all financial products, foreign exchange demand and supply determines the exchange rate in foreign exchange markets. The demand for foreign currency is related to the exchange rate. As the exchange rate increases, the demand for a foreign currency decreases. Some events and information occurring in the world economy cause foreign exchange markets to be affected. In such cases, sudden price differences can be observed. This causes an increase in foreign exchange prices and bubbles. The excessive increase in foreign exchange prices and bubble formations have become an important issue by affecting all financial markets (Afşar, Afşar, and Doğan, 2019: 448). Fluctuations in foreign exchange prices may sometimes be caused by speculative behaviors (Altın, 2017: 96). If price increases in foreign exchange markets are caused by

speculative movements, sudden increases or decreases may cause financial instability. However, some studies show that bubbles can also occur in ideal markets, where there are rational individuals and investors, transactions with full information, and there are no problems (Demiröz, 2018). The sudden decrease in the foreign exchange prices, namely the explosion of the bubble, leads to a negative situation in the real economy with the emergence of bankruptcies and credit defaults (Afşar et al., 2019: 449). Determination of the dates when the bubbles occur in foreign exchange prices in the past and the reasons for these bubbles will enable investors and businesses operating in the foreign exchange market to act more cautiously. In other words, the determination of the bubbles in the financial markets is very important for operators, investors, and portfolio managers as the bubbles interact with the financial crises.

Since the bubbles occurring in the foreign exchange markets are one of the factors affecting the markets and have a possibility to cause the financial crisis, the presence of bubbles in the most traded exchange rates in Turkey such as the US Dollar (USD/TRY), Euro (EUR/TRY), Japanese Yen (JPY/TRY), British Pound (GBP/TRY), and Chinese Yuan (CNY/TRY) was investigated within the scope of this study. For this purpose, daily price data between 03.01.2005-20.11.2019 were used for the US Dollar, Euro, British Pound, and Chinese Yuan, while daily price data between 28.08.2013-20.11.2019 were used for the Japanese Yen. Supremum Augmented Dickey-Fuller (SADF) and Generalized Supremum Augmented Dickey-Fuller (GASDF) tests were used to detect the bubbles in the aforementioned exchange rates.

Following the first section in which the concepts of the foreign exchange market and financial bubbles were explained, empirical studies investigating the existence of financial bubbles in the foreign exchange market were presented in the second section. In the third section, information about the methods used in the analysis was given. In the fourth section, the findings of the analysis were given. Finally, in the last section, a general evaluation was made.

2. LITERATURE REVIEW

There are many studies in the literature investigating the presence of bubbles in foreign exchange markets. The summary of some of these studies is given below.

Wu (1995) tried to determine the rational stochastic bubbles in USD/GBP, USD/JPY and USD/DEM exchange rates in the monthly data between January 1974-December 1988. As a result of the analysis using Kalman filter prediction technique, it was found that there were no rational stochastic bubbles in the exchange rates examined after the Bretton Woods period.

In their studies investigating the existence of rational speculative bubbles in GBP/USD, CAD/USD, DKK/USD, JPY/USD and ZAR/USD, Jirasakuldech, Emekter and Went (2006) analyzed the monthly data between January 1989-December 2004. As a result of the study using the Augmented Dickey-Fuller (ADF) and Philips-Perron (PP) unit root test, no bubble formation was found within the periods examined.

The existence of bubbles at GBP/USD was investigated by Bettendorf and Chen (2013). The monthly data between January 1972-December 2012 were examined. ADF, SADF, and GSADF tests were used. The results showed no strong evidence of rational bubbles in GBP/USD.

Deviren, Kocakaplan, Keskin, Balcılar, Özdemir, and Ersoy (2014) tried to detect the crashes in the rates of TRY/USD, TRY/EUR, TRY/JPY, and TRY/CHF in periods of global crisis. In the study, the daily data between 01.01.2005-20.12.2013 were examined. The econometric model developed by Watanabe, Takayasu, and Takayasu (Physica A 382-383 (2007)) was used. According to the results, it was concluded that the crashes in TRY/CHF exchange rates usually ended earlier than other exchange rates, the crash periods in TRY/EUR exchange rates took longer than other exchange rates and the crash periods in TRY/EUR and TRY/USD exchange rates were relatively longer than other exchange rates.

Jiang, Wang, Chang, and Su (2015) investigated bubbles the CNY/USD exchange rate in the monthly data between July 1997-October 2013. As a result of the study using ADF, SADF, and GSADF tests, there was no bubble presence as the exchange rate was under a fixed regime before 2005. However, many bubbles were reached after the exchange rate regime reform in 2005 and the 2008 global financial crisis.

Hu and Oxley (2016) examined the presence of bubbles in the foreign exchange markets of G10, BRICS, Asia, and other developing countries. SADF and GSADF tests were used in the study in which the monthly data between March 1991-December 2014 were used. In the study, no bubble was found in most of the exchange rates in G10 countries including GBP/CHF and GBP/JPY with only a few exceptions. Asian countries had bubbles in currencies during the 1997 Asian financial crisis. While there were no rational bubbles in BRICS countries, Brazil and India, rational bubbles were encountered in South Africa. There was important evidence for explosive behaviors at USD/COP and USD/MXN exchange rates in developing countries.

Korkmaz, Erer, and Erer (2016) investigated the effect of bubbles in gold prices and deposit interest rates along with USD/TRY, EUR/TRY rate on BIST 100 return volatility. In the study in which monthly data between January 2002-May 2016 were used, they used SADF and GSADF tests to determine the presence of bubbles. The results showed the presence of bubbles in the USD/TRY rate and gold prices. However, no bubble was not found the deposit and EUR/TRY rate.

In her study, Maria (2016) investigated the presence of financial bubbles in GBP/USD, CAD/USD, and JPY/USD. In the study, in which the monthly data between 01.01.1990-30.11.2013 were examined and the regime change model was used, strong evidence regarding the presence of financial bubbles was found.

Rasekhi, Zahra, and Milad (2017) investigated the presence of bubbles in the Iranian foreign exchange market, they examined the monthly data between April 2002-March 2016. As a result of the study using SADF and GSADF tests, the presence of multiple bubbles on different dates was reached in the examined period.

In the study carried out by Steenkamp (2017), the monthly and quarterly data between April 1982-March 2016 were used to determine the presence of bubbles in NZD/AUD. As a result of the study using the GSADF test, there was no evidence of the bubbles in the exchange rate.

Korkmaz (2018) investigated the effect of USD/TRY, EUR/TRY rate, and gold prices and bitcoin price and return bubbles on bitcoin returns. In the study, in which daily data between 01.08.2011-23.03.2018 period were examined, SADF and GSADF tests were used. As a result of the study, the presence of bubbles in gold prices and USD/TRY, EUR/TRY rate was reached.

Afşar et al. (2019) investigated the presence of a bubble in the foreign exchange market in Turkey. They used monthly data from January 2005 to November 2018. They considered the USD/TL and EURO/TL exchange rates, which are among the foreign exchange market instruments. According to the results of the GSADF test, many bubbles were found in USD/TRY, EUR/TRY rates.

3. METHOD

Phillips and Yu (2011) and Phillips, Shi, and Yu (2013) have recently introduced a innovative approach for the identification and dating of multiple speculative bubbles in real-time. The purpose of the model is to detect the moment speculative bubbles occur, not after they are formed. The starting point of the model is the observation that the explosive feature of bubbles is very different from random walking behavior. Accordingly, they have developed a new recursive econometric method in which lightly explosive unit roots are used as a clue for bubbles. While performing unit root test procedures for the models with constant and constant/trend, the regions are usually limited not more than unit root when $\delta \leq 1$ in autoregressive processes. In contrast, Phillips and Yu (2011) have modeled mildly explosive behaviors with a δ rooted autoregressive process that transcends unit root but is still within the unit root boundaries. The basic idea of their approach is to calculate recursive right-tailed unit root tests to evaluate evidence of light explosive behavior in the data. The test is right-tailed and therefore differs from normal left- tailed tests for stationarity. Phillips and Yu (2011) argue that their tests have a discrimination power; because the tests are very sensitive to changes that occur when a process changes from a unit root to a slightly explosive root or vice versa. This sensitivity is much higher than left-tailed unit root tests against fixed alternatives. Additionally, as the bubbles often disappear periodically, traditional unit root tests have limited in uncovering the bubbles. To overcome this, Phillips and Yu (2011) have suggested using the supremum of the ADF t-statistics, which is determined recursively. Phillips, Wu, and Yu (2011a) have calculated a number of ADF tests. In the model, $\hat{\delta}_\gamma$ denote the OLS estimator of δ and $\hat{\sigma}_{\delta,\gamma}$ the usual estimator for the standard deviation of , $\hat{\delta}_\gamma$ using the subsample $\{x_1, x_2, x_{[\gamma T]}\}$. The fractional window size of the regression is indicated by r_w. The sample interval of the fixed start window, which is determined as $r_2 - r_1$ and r_0, is set to $[0,1]$ for use and simplicity. The SADF test

is based on the recursive estimation of the ADF model. The window size expands by the amount of r_w from r_0 to 1 so that r_0 is the smallest sample window width section and 1 is the largest window section in the recursion. The starting point r_1 of the sample sequence is fixed at 0, so that the end point of each sample (r_2) equals r_w and varies from r_0 to 1. For a sample running between 0 and r_2, the ADF statistic is represented by $ADF_0^{r_2}$. Advanced recursive ADF test of H_0 against H_a:

$$SADF(r_0) = \sup_{r_2 \epsilon [r_0, 1]} \{ADF_0^{r_2}\} \tag{1}$$

Here $ADF = \frac{\hat{\delta}_t - 1}{\hat{\sigma}_{\delta_t}}$ statistics are calculated for the asymmetric range $[r_0, 1]$. Although r_0 is set to start with a reasonably sized sample fraction in most applications, a limitation of the SADF test is that the starting point is fixed as the first observation of the sample. This means that when two bubbles are present, the second bubble cannot be detected when the first bubble is dominant. Therefore, Phillips et al. (2011a) also apply a rolling version of the SADF test in which the starting window moves over the sample; however, the size of the initial window remains constant, which limits the strength of the test (Chang, Gil-Alana, Aye, Gupta and Ranjbar, 2016: 7-9).

GSADF diagnosis is also based on the idea of sequential right-tailed ADF tests; however, the diagnostic expands the sample set to a more flexible range. The GSADF test replaces the starting and ending point in a suitable window range, rather than fixing the starting point of the sample. In other words, the sub-samples used the recursion in the GSADF test are much more extensive than those in the SADF test (that is, it covers more sub-samples). Additionally, as well as changing the ending point of regression r_2 from r_0 (minimum window width) to 1, the GSADF test allows the starting point of r_1 to vary within a feasible range, ie from 0 to r_2-r_0 (Phillips, Shi, and Yu, 2015: 1048-1049). The sample sequences of the SADF and GSADF tests are shown in Figure 1.
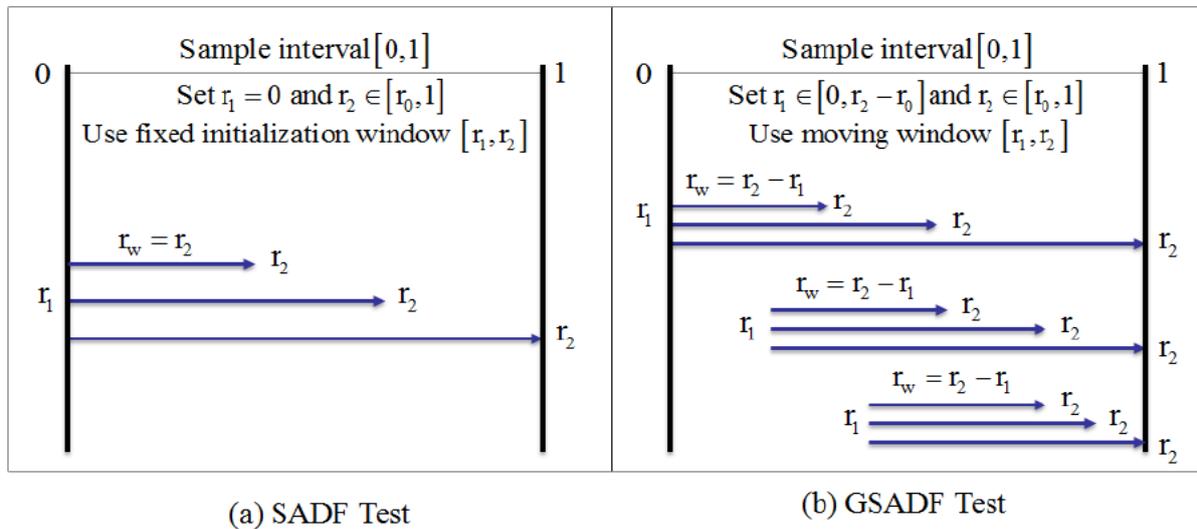

Figure 1. The Sample Sequences and Window Widths of the SADF and the GSADF Test

Source: (Phillips, Wu and Yu, 2011b: 10).

This extra flexibility in forecast windows provides significant power savings compared to SADF. GSADF statistics are defined as the largest ADF statistics in all applicable ranges of r_1 and r_2 (Phillips et al., 2015: 1048-1049). Test statistics GSADF (r_0):

$$GSADF(r_0) = \sup \{ADF_{r_1}^{r_2}\}, r_2 \epsilon [r_0, 1], r_1 \epsilon [0, r_2 - r_0] \tag{2}$$

Since the GSADF test covers more sub-samples of data and has more window flexibility, the SADF test performs better in detecting explosive behavior in multiple sections (Phillips et al., 2011b: 6). GSADF can overcome the weaknesses of the SADF test, as it can detect potential multiple bubbles in the data (Chang et al., 2016: 9-10).

4. DATA AND FINDINGS

In the study, the presence of bubbles in the most preferred foreign exchange rates in Turkey such as the US dollar (USD/TRY), Euro (EUR/TRY), Japanese Yen (JPY/TRY), British Pounds (GBP/TRY) and Chinese Yuan (CNY/TRY) was investigated. For this purpose, daily price data for the period between 03.01.2005-20.11.2019 for the US Dollar, Euro, British Pound, and Chinese Yuan were used, while daily price data for the period between 28.08.2013-20.11.2019 for the Japanese Yen were included. Data were obtained from investing.com. SADF and GSADF tests were used to identify the bubbles formed in the series. The analyses were conducted with the EViews 10 Econometric package software.

Table 1. SADF and GSADF Test Results regarding the Foreign Exchange Series

	Window Size	Test Statistics	Monte Carlo Based Critical Values		
			%99	%95	%90
SADF$_{USD}$	10	7.5093***	3.3163	1.9564	1.6537
GSADF$_{USD}$	10	7.7760**	9.1531	5.1141	4.2837
SADF$_{EUR}$	10	7.6485***	3.3163	1.9564	1.6537
GSADF$_{EUR}$	10	8.4794**	9.1531	5.1141	4.2837
SADF$_{GBP}$	10	6.2061***	3.0263	1.9866	1.6399
GSADF$_{GBP}$	10	8.2883**	9.1531	5.1141	4.3270
SADF$_{JPY}$	10	5.6830***	2.5269	1.8162	1.5306
GSADF$_{JPY}$	10	7.0387***	6.5473	4.2937	3.9248
SADF$_{CNY}$	10	1.5281	3.3163	1.9564	1.6537
GSADF$_{CNY}$	10	7.1563**	9.1531	5.1141	4.2837

Note: Critical values were obtained from the 100 replicated Monte Carlo simulations. *** , and ** denote rejections of the null hypothesis at the 1% and 5% significance levels, respectively.

According to the results of SADF test statistics, which measured the single bubble formation given in Table 1, the null hypothesis claiming that the series did not contain price bubbles was rejected and the presence of bubbles was detected when USD/TRY, EUR/TRY, GBP/TRY, JPY/TRY test statistics were compared to the critical values obtained from Monte Carlo simulation results. However, since the test statistic value of the CNY/TRY series was lower than the critical values, the null hypothesis established as the series did not contain price bubbles couldn't be rejected and no bubbles were observed in the CNY/TRY series. When the GSADF test statistics results showing the formation of multiple bubbles in the series were analyzed, the test statistics were found to be significant in all series and there was empirical evidence demonstrating the formation of multiple bubbles in the examined exchange rates.

The charts of the bubble formation periods according to the SADF test results are shown in Figure 1 and the charts of the periods regarding the bubbles determined according to the results of the GSADF test are shown in Figure 2.
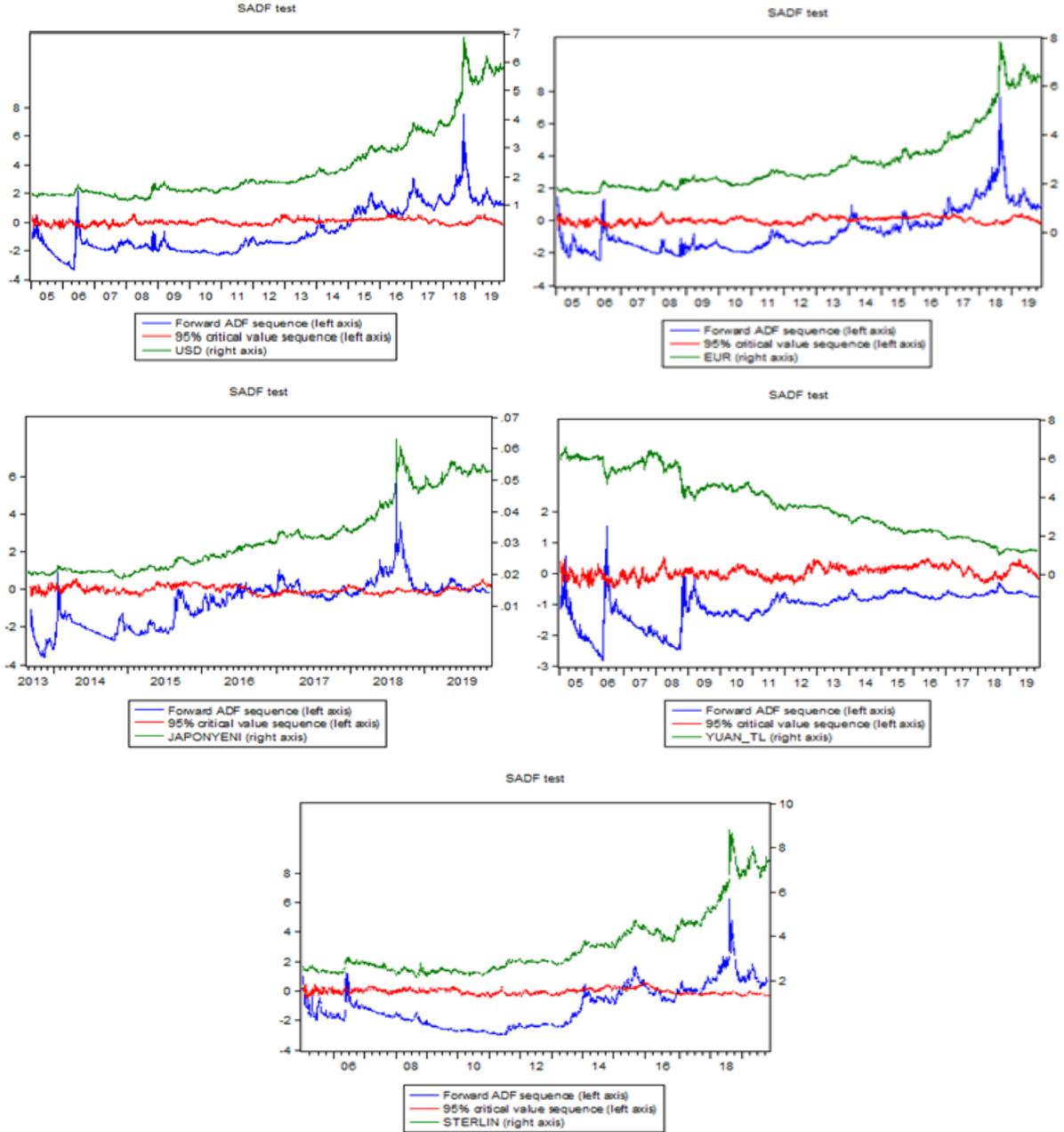
Figure 2. SADF Charts Indicating Bubbles in the Foreign Exchange Series

When the charts of the SADF test showing single bubble formation in the price series were examined, it was observed that the charts of the USD/TRY, EUR/TRY, GBP/TRY, JPY/TRY series were almost identical, that is, the bubble was formed at almost the same dates, while the CNY/TRY series was different from other series.
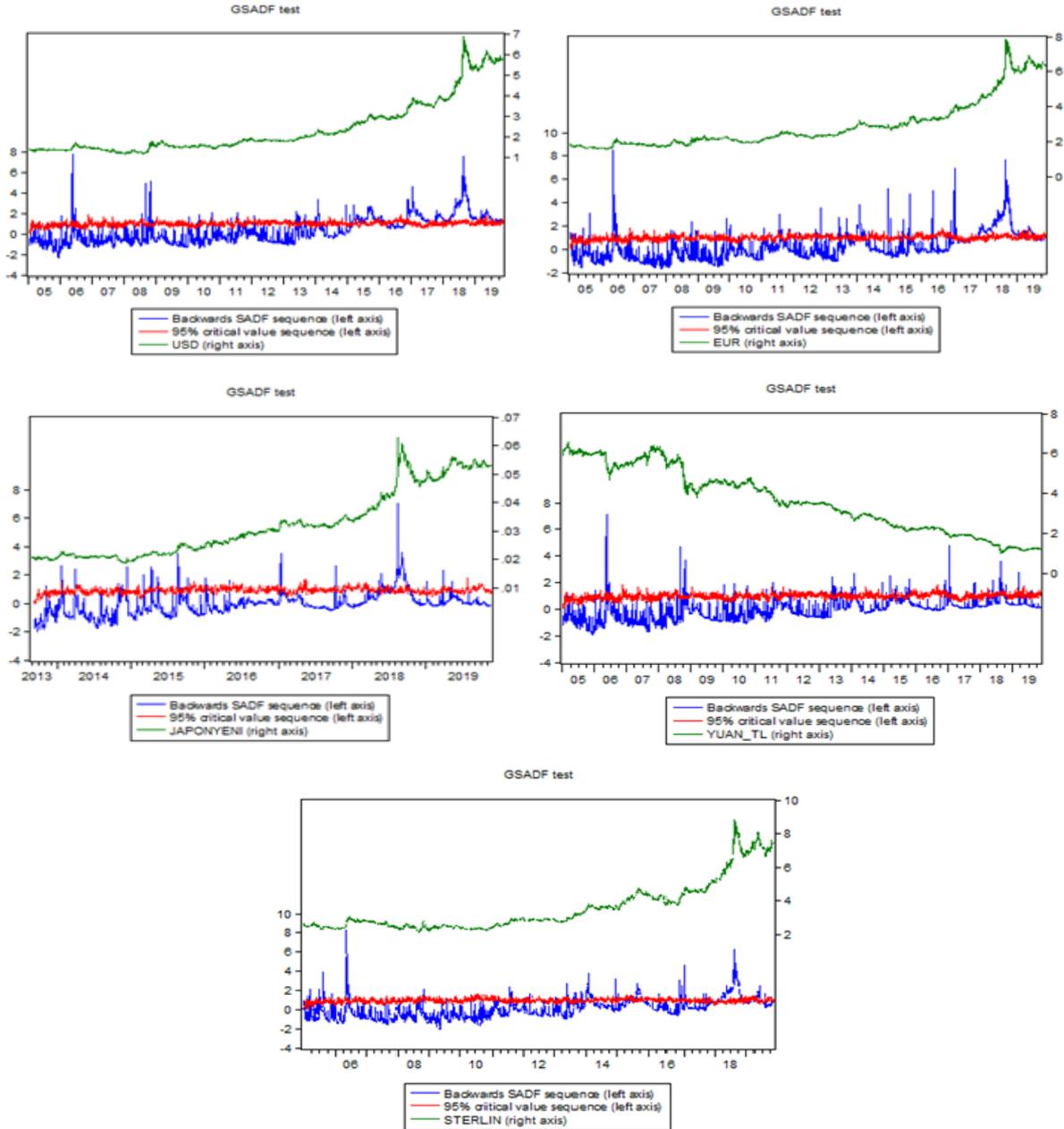
Figure 3. GSADF Charts Indicating Bubbles in the Foreign Exchange Series

When GSADF charts in Figure 3 were examined, it is useful to consider the events occurring in Turkey and the world and affecting the financial markets in general.

As a result of the gradual decrease of the political interest rates of the American Central Bank (FED) from 2000 to 2006, the liquidity surpluses in the financial markets were directed to housing loans by financial institutions despite their high risks (Şentürk, Kayhan and Bayat, 2016: 147). The high risk that started in the secondary mortgage market in the USA in 2007, continued with the bankruptcy of Lehman Brothers, the fourth largest investment bank of the country in 2008, resulted negatively and a global financial crisis affecting all over the world occurred (CBRT Bulletin, 2014). With the slowdown of the "Expanded-Asset Purchase Program" launched by the FED after the global financial crisis as of December 2013, the protests of the people came to the fore in 2014 when the Ukrainian government did not sign a partnership agreement with the EU, along with the chaos in Syria and

Iraq. The political uncertainties in 2015 as well as the fight against terrorism increased Turkey's risk premium and decreased the value TRY.

The fall in oil and commodity prices in early 2016 caused the economies of oil and commodity-based countries to shrink, but this effect ended in the second half. Additionally, with the news that the European Central Bank's asset purchase program would be gradually decreased and terminated in the Euro Area, concerns about the future of the EU increased. After the November elections, the Dollar Index moved upwards in December with the expectation that the FED would increase interest rates (KPMG, 2016). Additionally, there were domestic security concerns with the July 15 coup attempt and the conflicts in Syria and Iraq.

In 2017, the negative attitudes of the USA President, the Brexit incident, the FED's interest rate hikes, the problems in the Middle East, the government troubles in Europe, and the conflict of Jerusalem were posing global problems. Additionally, the Russian jet crisis, the troubles caused by the referendum in the budget, the high inflation, and unemployment problem, the budget deficit, the current account deficit and the increase in the foreign debt stock caused the TRY to continue to depreciate against foreign currencies (Eğilmez, 2017). In 2018, expectation regarding FED's interest rate hike, the increase in global volatility index, low ratings of credit rating agencies, state of emergency, inflation rate, risk premium, high course of current account deficit increased the demand for domestic and foreign investors for the US dollar and affected foreign exchange rates. As a result of the US-China trade war in 2019, CNY depreciated against the USD, FED's gradual cut of interest rate increased foreign investor expectations, and the policies and measures proposed in the New Economy Program for the 2020-2022 period were announced. In addition, Halkbank, Priest Brunson, and S-400 tensions with the US were experienced during the year. Thus, all these economic events caused fluctuations in exchange rates and triggered the formation of bubbles.

5. CONCLUSION AND EVALUATION

Expressing the dramatic increases in the prices of financial assets, the financial bubble is related to the problem of asymmetric information and volatility that caused an ineffective structure in the market due to the concept of 'value'. Speculations and unexplained volatile price movements caused by investors believing that they will obtain abnormal returns in financial markets or acting with herd mentality rather than economic indicators in the market cause the formation of rational or non-rational financial bubbles. Identifying the presence of the bubbles, the leading indicators of financial crises, and investigating their causes are of great importance for investors, portfolio managers, and market regulators in terms of reducing investment risk and maintaining price stability.

In this study, by considering the most traded currencies, such as the US Dollar, Euro, Japanese Yen, British Pound, and Chinese Yuan, the presence of bubbles in the foreign exchange market was investigated for the financial information users in the foreign exchange market. For this purpose, daily price data for the period between 03.01.2005-20.11.2019 for the US Dollar, Euro, British Pound, and Chinese Yuan were used; daily price data between 28.08.2013-20.11.2019 were used for the Japanese Yen. Sup-Augmented Dickey-Fuller and Generalized Sup-Augmented Dickey-Fuller tests were used to determine the bubbles in the aforementioned exchange rates. When the GSADF test charts were analyzed, it was seen that multiple bubble formations were more common in the EUR/TRY series, and multiple bubbles occurring in the GBP/TRY series were relatively less than other series. In this case, it was seen that the exchange rate of GBP/TRY was less affected by the internal and external sources than the other exchange rates and that the USD/TRY and EUR/TRY exchange rates were more influenced by the events arising from the internal and external sources. The fact that the USD/TRY and EUR/TRY exchange rates are so sensitive to the economic and political events in the domestic and foreign markets reveals that the Turkish currency markets have a very fragile structure. Therefore, it is important for investors who will invest in Turkish markets to consider micro and macro events while taking the position. Although investors will be able to obtain abnormal returns by investing in the foreign exchange markets in Turkey, they should also be prepared for possible losses to be faced.

DECLARATION OF THE AUTHORS

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