IS THERE A RATIONAL BUBBLE IN BIST 100 AND SECTOR INDICES? [1]

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Abstract

Global financial crises, which can stem from the bubbles in asset prices and which have been observed especially in the United States and Europe, have demonstrated once again how important the determination of bubbles is. The bubbles in question in financial markets are referred as excessive increase in asset prices. When considering the close relationship of rational bubbles with financial crises, the analysis and detection of them become even more important for investors, portfolio managers and market regulators. For this purpose, the aim of this study is to examine the existence of rational bubbles in Borsa Istanbul 100 Index (BIST 100) and some sector indices for the period of 1990-2015. For this, right-tailed unit root test, Sup Augmented Dickey-Fuller test and Generalized Sup Augmented Dickey-Fuller test have been used. As a result of the analyses, it has been observed that no rational bubbles existed in BIST 100 and the mentioned sector indices. Our findings may provide policy makers and both domestic and international investors in order to make appropriate decision and thus, to take a position in the markets.

Keywords: bubbles, BIST 100, sector indices, SADF, GSADF

JEL Classification: G10, G17

1. Introduction

Rational bubbles in financial markets are referred as excessive increase in asset prices. In other words, rational bubbles can be

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expressed as a deviation between its fundamental value and market value of an asset (Blanchard and Watson, 1982). This kind of deviations from fundamental value of an asset can be monitored the existence of bubble in financial markets. In other respects, bubbles have always been contradictive issue in accordance with the efficient markets. Moreover, if market participants have same information, that is, if there is symmetric information, they will not want to buy the assets with high price which is differ from their fundamental value. Therefore, if there is asymmetric information, there can be bubbles in the markets. Only unexpected news can change asset prices in efficient markets. Nevertheless, striking and rapid price changes in asset prices have been dominant over time. That' why, this issue has examined the market efficiency and has impelled the studies regarding rational bubbles. The main idea of the rational bubble is that asset prices do not reflect the new information effectively and the difference between fundamental prices and market prices may provide investors to make profit. Additionally, because investors are willing to sell the stocks they buy at a higher price tomorrow, they are willing to buy assets today. The case of continues buying stocks can cause rational speculative bubbles in financial markets (Cajueiro and Tabak, 2006).

Some bubbles in asset prices might be closely connected with financial crises in general. It has been said that bubbles have great impact on crises and this kind of bubbles might trigger off crises. Especially financial markets have suffered from bubbles which are observed periodically. Recent examples such as Mississippi Bubble in 1720, Japanese asset price bubbles in 1980s, Great Depression in 1929, the U.S. dot.com bubble in the late 1990s, Mortgage Crisis in 2007, and dot-com bubbles in 2000 are significant and considerable events (Oran, 2011, Friedman and Abraham, 2009). For this reason, it can be said that bubbles come into prominence in global financial markets. In other words, it is expected that determination of the bubbles can be a warning system against the crises appeared in financial markets.

2. Literature review

There are great numbers of research investigating bubbles in stock markets. While some of studies found multiple bubbles in stock markets, others stated absence of the bubble. Chan et al. (1998) investigated bubbles in the U.S. and six Asian stock markets by using

conditional skewness and duration dependence tests of McQueen and Thorley (1994) and explosiveness tests. The conclusions showed that speculative bubbles were existed in especially Malaysia, Hong Kong, and Thailand, whereas bubbles in the U.S. stock market weren't found. Harman and Zuehlke (2004) investigated the existence of bubbles in American Stock Exchange and NYSE by using duration dependence tests.

Likewise, Jirasakuldech et al. (2008) tested speculative bubbles in Thai stock market with duration dependence and cointegration tests and found the presence of speculative bubbles. Zhang (2008) also found the existence of bubbles in Chinese stock market by using duration dependence tests.

In other respects, Jiang et. al. (2010) investigated bubble in Shenzhen stock exchange component exchange and Shanghai stock exchange composite index for the periods of 2005-2007 and 2008-2009. Log-periodic power law model was considered to detect bubbles. The results showed that there were explosive financial bubbles for the periods. Asako and Liu (2013) developed a statistical model including time varying parameters and transition probabilities and estimated by recursive computations to detect bubbles grow and burst in time. They applied this model for the stock markets of China, Japan, and the U.S. and found that the U.S.' stock market had bubbles, whereas Japan and China hadn't. Additionally, their results showed that probability of bubble increased when stock prices decreased or increased too much.

On the other hand, Chang et al. (2014) applied generalized sup Augmented Dickey-Fuller test to analyse the presence of multiple bubbles in the BRICS countries such as South Africa, China, India, Russia, and Brazil by covering monthly data regarding stock price-dividend ratio. They concluded that multiple bubbles existed in the aforementioned stock markets. Phillips et al. (2014) also investigated whether or not there were multiple bubbles in the stock market of S&P 500 by implementing GSADF and SADF tests for the period of 1971-2010. Their findings indicated the existence of bubble in the stock market of S&P 500. Likewise, Chen et. al (2015) applied GSADF test to detect multiple bubbles in sub sector namely health care of some developed markets such as German, the UK, and the U.S. They found that bubbles existed in those all stock markets. Nneji (2015) examined the effects of market liquidity and funding liquidity shocks on stock market bubbles. They stated that both of these shocks raised bubbles

in stock markets. Additionally, the effect of market liquidity had more influence on bubble than the other one.

As far as the research conducted in Turkey are concerned, it has been seen that there have not any bubbles in Istanbul Stock Exchange. Tasci and Okuyan (2009) examined the presence of bubbles by using duration dependence tests for the period of 1987-2008. Öğüt et al. (2009) researched stock manipulation via Artificial Neural Networks and Support Vector Machine. Similarly, Yu and Hasan (2010) also analysed the existence of bubbles in Istanbul Stock Exchange, Middle East and North African stock markets by using duration dependence tests. Parvar and Waters (2010) tested bubbles in Borsa Istanbul through traditional cointegration test and cointegration test including kurtosis and skewness. Yanık and Aytürk (2011) tested the presence of a bubble in Turkish stock market by using duration dependence test for the years between 2002 and 2010. Bozoklu and Zeren (2013) investigated the presence of rational bubbles in Borsa Istanbul by applying hidden and traditional cointegration tests. The findings of the all these studies stated that there weren't any rational expectation bubbles.

As for methodology used in the literature, cointegration and unit root test have implemented to analyse the rational bubbles in general. According to Turkish studies, cointegration, duration dependence and conditional skewness tests have used (such as Öğüt et al., 2009, Tasci and Okuyan, 2009, Parvar and Waters, 2010, Yanık and Aytürk, 2011, Bozoklu and Zeren, 2013). This paper makes contribution to the existing literature especially by using right-tailed unit root test, SADF test and GSADF test developed by Phillips et al. (2011) for BIST 100 and some sector indices in Turkish stock exchange namely Borsa Istanbul.

This study examines the detection of rational bubbles in Borsa Istanbul 100 Index and some sector indices using right-tailed unit root test, SADF test and GSADF test. Section 3 explains methodology used. In section 4, the data used in this research is identified. Section 5 provides empirical findings of the research. Lastly, section 6 presents conclusions.

3. Methodology

We deal with recursive right-tailed unit root tests. The time series which is $\boldsymbol{y_t}, \boldsymbol{t} = \mathbf{1}, \ldots, \boldsymbol{T}$ is considered. Null hypothesis test states

whether or not $\boldsymbol{y_t}$ follows AR (1) having unit root through all sample. Alternative hypothesis says that $\boldsymbol{y_t}$ moves as at least AR (1) process for some sub-sample. Philips et al. (2011) proposed PWY test to detect rational bubbles by using recursive Dickey Fuller tests. This test statistic is as follows:

$$PWY = \sup DF_T \tag{1}$$

Here, DF_T is standard Dickey Fuller test, in other words, it is $\widehat{\emptyset}$ t ratio in Ordinary Least Squared Error (OLS) regression estimation.

$$\Delta y_t = \hat{\alpha} + \widehat{\emptyset}_{PWY}\, y_{t-1} + \hat{\varepsilon}_t \tag{2}$$

Sub-sample period is $t = 1, \ldots, [\tau T]$.
Here, $\bar{y}_\tau = ([\tau T] - 1)^{-1} \sum_{t=2}^{[\tau T]} y_{t-1}$
and $\hat{\sigma}^2_{PWY} = ([\tau T] - 3)^{-1} \sum_{t=2}^{[\tau T]} \hat{\varepsilon}_t^2$ (Harvey et al. 2015).

In left-tailed unit root tests, the findings are generally sensitive towards model specification. Formulation of an appropriate hypothesis is difficult especially in the case of the existence of non-stationary series. Because, parameters take different roles under both null hypothesis indicating existence of unit root and under alternative hypothesis in which stationary is provided (Philips et al. 2014).

On the other side, right-tailed unit root tests are quite convenient to determine slightly exploding series or exploding series. For example, Diba and Grossman (1988) implemented right-tailed unit root tests for precisely sampled data to detect financial bubbles. Phillips et al. (2011) suggested applying right-tailed unit root tests to recursive sub-samples. The formulation of regression model specification and null /alternative hypotheses are of importance in both left-tailed and right-tailed unit root tests (Phillips et al. 2014).

One of the right-tailed unit root tests is "Sup Augmented Dickey Fuller Test" denoted by SADF. This test has proposed by Phillips et al. (2011). SADF test is based on recursive estimation of ADF model and it is acquired as sub value of ADF statistic serial in question. Right-tailed unit root tests show asymptotic distribution characteristics based on the regression model and the null hypothesis and it is as follows:

$$x_t = \mu_x + \delta\, x_{t-1} + \sum_{j=1}^{J} \emptyset_j \Delta x_{t-j} + \varepsilon_{x,t}, \qquad \varepsilon_{x,t} \sim NID(0, \sigma_x^2) \tag{3}$$

Here, *NID* is independent and has normal distribution, lag parameter is demonstrated as *J*. Right-tailed alternative hypothesis is $H_0 = \delta > 1$ and null hypothesis is $H_0 = \delta = 1$ in unit root tests. The aforementioned above model is repeatedly estimated increasing one observation at each trial in recursive regressions.

$$ADF_r \rightarrow \frac{\int_0^r \widetilde{W}\, dW}{(\int_0^r \widetilde{W}^2)^{\frac{1}{2}}} \tag{4}$$

$$sup_{r\in[r_0,1]}\, ADF_r \rightarrow sup_{r\in[r_0,1]} \frac{\int_0^r \widetilde{W}\, dW}{(\int_0^r \widetilde{W}^2)^{\frac{1}{2}}} \tag{5}$$

Standard Brownian motion is indicated by W, and $\widetilde{W}(r) = W(r) - \frac{1}{r}\int_0^1 W$ is reduced Browian motion (Phillips et al. 2011: 206-207).

Just like in SADF test, GSADF test depends on a rolling approach but with several different forward expanding sequences begins from the starting point. Sub-samples of GSADF are more extensive value when compared to SADF. Additionally, GSADF test enables starting point *"r_1"* to modify within a possible sequence by considering changing the ending point "r_2" which runs from "r_0" to "1". The largest ADF statistic over all possible sequences of r_1 and r_2 is stated as GSADF. The formulization of GSADF test is as follows (Phillips et al. 2013: 10).

$$GSADF(r_0) = \sup_{\substack{r_2\in[r_0,1] \\ r_1\in[0,r_2-r_1]}} \left\{ADF_{r_1}^{r_2}\right\} \tag{6}$$

4. Data

The research was implemented for Borsa Istanbul stock index (BIST 100) and sector indices including services, financial, industrials, and technology indices in order to analyse the presence of rational bubbles. The monthly data span from 1990 to 2015 except for services

index and technology index which start with the years 1997 and 2000, respectively. The data were taken from Borsa Istanbul official web site.

5. Empirical findings

In this study, right-tailed unit root test, SDAF Test and Generalized SDAF Test were conducted to determine rational bubbles in Turkish financial market.

Table 1 depicts descriptive statistics regarding BIST 100, services, financial, industrials, and technology indices. According to Table 1, all series had excess kurtosis value. Besides, they displayed positive skewness except technology index. As Jargue-Bera statistics were examined, all series had not normal distribution, however they exhibited fat tailed characteristic.

Table 1

Descriptive Statistics

	BIST 100	Financial	Industrials	Services	Technology
Mean	0.02548	0.02784	0.02676	0.01641	0.00559
Median	0.02434	0.01970	0.02394	0.02169	0.01157
Maximum	0.58658	0.61984	0.53305	0.51008	0.35952
Minimum	-0.49485	-0.49077	-0.52417	-0.46965	-0.42628
Std. Dev.	0.13343	0.15095	0.12319	0.11354	0.12351
Skewness	0.26056	0.36219	0.16826	0.05393	-0.34452
Kurtosis	5.20236	4.68217	5.84230	6.67055	4.01657
Jarque-Bera	64.4516	40.6726	99.3273	122.485	11.0602
Probability	0.00000	0.00000	0.00000	0.00000	0.00396
Observations	302	291	291	218	176

The SADF and GSADF tests of the BIST 100, Financial, Industrial, Services and Technology indices are provided in Table 2.

According to this table, the SADF test statistics were -7.308402, -6.720856, -7.635591, -4.963127 and -7.170339, respectively. Besides, GSADF test statistics were -5.168279, -5.799413, -5.391155, 2.472663 and -3.694068, respectively. Both of these tests didn't exceed their respective %1, %5 and %10 right-tail critical values. That's why; the null hypothesis assuming no bubble was not rejected. It cannot be found any evidence regarding to the presence of bubble in BIST 100 and all sub-sector index. The results have parallels with the studies such as Öğüt et al. (2009), Tasci and Okuyan (2009), Yu

and Hasan (2010), Yanık and Aytürk (2011), Bozoklu and Zeren (2013).

Table 2

SADF and GSADF tests of the indices

	SADF	GSADF
BIST 100 Index	**-7.308402**	**-5.168279**
90% critical value	1.016040	1.760996
95% critical value	1.282928	2.053025
99% critical value	1.830091	2.523389
Financial Index	**-6.720856**	**-5.799413**
90% critical value	1.864033	2.612326
95% critical value	1.344502	1.923172
99% critical value	1.106382	1.618296
Industrial Index	**-7.635591**	**-5.391155**
90% critical value	1.864033	2.612326
95% critical value	1.344502	1.923172
99% critical value	1.106382	1.618296
Services Index	**-4.963127**	**2.472663**
90% critical value	1.856858	2.391317
95% critical value	1.296439	1.858786
99% critical value	0.993431	1.647252
Technology Index	**-7.170339**	**-3.694068**
90% critical value	1.903659	2.434469
95% critical value	1.327736	1.888086
99% critical value	0.910942	1.659578

Note: Both tests' critical values are provided from "Monte Carlo simulation" with 1000 replications (sample size 301). The smallest window has 35 observations.

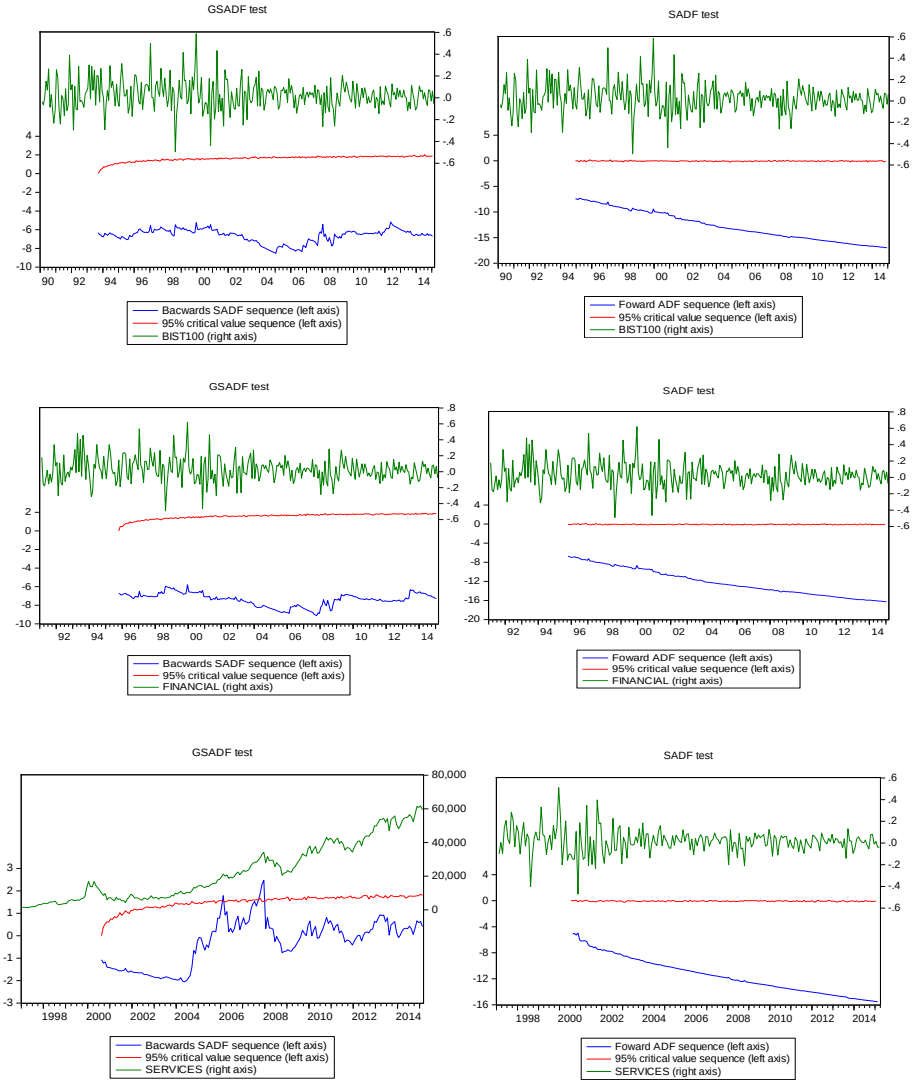
Figure 1 presents findings for the data-stamping bubble periods in the BIST 100, Financial, Industrial, Services, Technology indices for the period of 1990 – 2015.

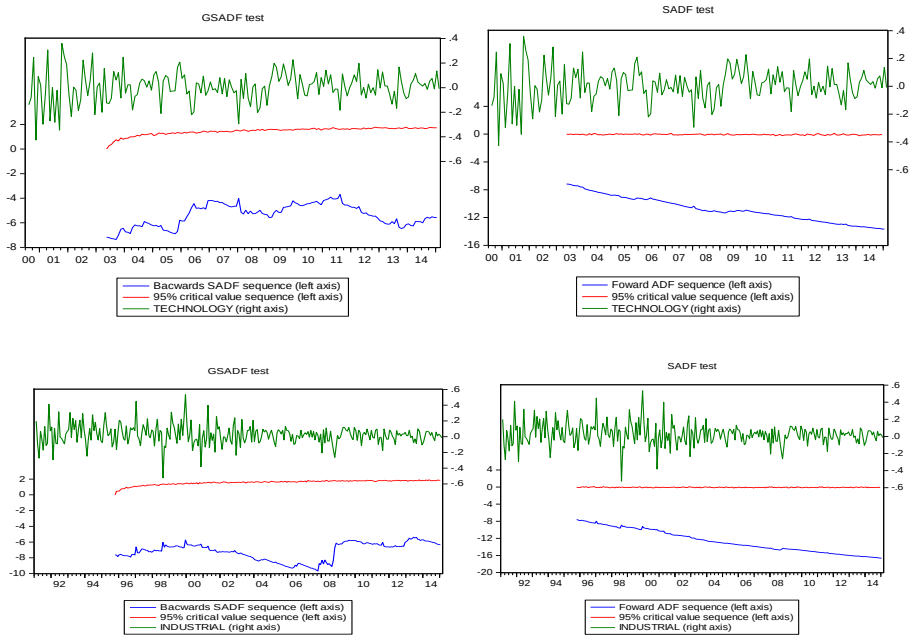
In order to detect bubble periods, we have taken Monte Carlo simulations with to the backward SADF statistic of 95 % critical value sequence and compared it with 1000 replications for each observation. According to Figure 1, it was seen that there was not the presence of bubbles in BIST 100 index and all sub-indices for the so-called period. The findings of this study were similar with the results of Öğüt et al. (2009), Tasci and Okuyan (2009), Yu and Hasan (2010), Yanık and

Aytürk (2011), Bozoklu and Zeren (2013) studies. Consequently, it is claimed that the possible failure appearing in Turkish stock market can stem from the another reasons except bubbles.

Figure 1

Data-stamping bubble periods in the indices: GSADF and SADF test





6. Conclusion

This paper presents whether or not there is a rational bubble in Borsa Istanbul 100 Index namely BIST 100 and some sector indices. In order to understand movements of markets and crises that appear from time to time, it is extremely important issue to identify the bubbles. Furthermore, the presence of rational bubbles in financial markets is an indicator that there are inconveniences in the financial system. That's why, determination of the bubbles can be a warning system against the crises appeared in financial markets. This study differs from the other studies dealing with bubbles in Turkish stock markets in terms of the methodology. For this, we used "right-tailed unit root test" and recent bubble tests which are "Sup Augmented Dickey-Fuller Test" and "Generalized Sup Augmented Dickey-Fuller Test" developed by Phillips et al. (2011) by covering the monthly data between 1990 and 2015. As a result of analyses, it can be stated that there were no rational bubbles in BIST 100, services, financial, industrials, and technology indices in Turkish stock markets. Our findings are consistent with the other studies which are related to determination of

bubbles in Turkish stock markets in the literature. Moreover, the results of this study regarding the absence of rational bubble in BIST 100, services, financial, industrials, and technology indices can state that prices of these indices are consistent with their fundamental values in the period between 1990 and 2015.

When considering the close relationship of rational bubbles with financial crises, the analysis and detection of them become even more important for investors, portfolio managers and market regulators. That's why, our findings may provide policy makers and both domestic and international investors in order to give the right decision and accordingly, to take a position in the markets. In further studies, it can be investigated the bubbles by using price dividend ratios and it can be examined the effects of monetary policy on the bubbles if there are bubbles in the financial markets.

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