Chapter 7

AN ANALYSIS OF THE EXISTENCE OF STOCK PRICE BUBBLES IN DEVELOPED AND DEVELOPING COUNTRIES: THE CASE OF G20

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INTRODUCTION

The formation of financial asset prices in a free market may cause them to be subject to speculative movements. Especially price movements stemming from speculative movements tend to have adverse impacts on the stability of financial markets. Speculative movements may also lead to the occurrence of asset price bubbles. In many empirical studies, it was stated that speculative movements in the markets caused bubbles in asset prices (Santoni, 1987; Diba & Grosman, 1998; Shiller, 2003; Brunnermeier, 2008; Lind, 2009). The price bubble can be defined as the market price of an asset in excess of the real value of the asset (Brunnermeier, 2008: 578). The existence of a bubble is mentioned when the actual price of an asset dramatically increases for several months or years first, then it plunges almost dramatically (Lind, 2009: 80). Price bubbles begin with large-scale price movements in the short-run (Güleç & Aktaş, 2019). The occurrence of financial asset price bubbles should be considered in terms of both economic and financial circumstances. As financial historians also asserted, most financial crises are often claimed to be caused by financial asset price bubbles (Ahamed, 2009). During the periods through which price bubbles occurred due to speculative movements, investors headed towards non-rational investments.

Because the increased prices within that period led investors to expect more price increases. As a result of such expectations, excessive demand caused asset prices to increase further. This might lead to a more severe financial crisis. Even in the 1929 crisis, which had been explained in all basic economics books, there was an excessive increase in the stock prices and returns. Assets are becoming more and more attractive for investors, especially during the period through which asset prices bubbles occur, and so there is a further increase in asset prices due to increasing demand. At some point, individuals perceive that prices would not in-

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crease any higher so that bubbles cease to exist, demand diminishes and markets become inactive (Case & Shiller, 2003; Shiller, 2003).

The first price bubble in history is thought to have occurred in tulip prices in the Netherlands as of 1637. Throughout that period, also referred to as tulip madness, there was a 1000% increase in tulip bulb prices (Zeren & Esen, 2018). The worldwide notorious bubbles include the Mississippi bubble of 1720, the stock bubble in the 1920s, the credit bubble that occurred in Mexico and other developing countries in the 1970s, the real estate and stock bubble that emerged in Asian countries between the years 1992 and 1997, in the dot-com bubble originating from internet companies in the 1990s, and the mortgage crisis which was caused by the global economic crisis stemming from the bubble in the housing prices in 2008 (Atakişi & et al., 2010).

Different econometric methods are used to determine price bubbles. In this context, one of the first methods in the literature to determine the price bubbles is the variance test utilized in Shiller (1981) and LeRoy and Porter (1981). Another method is the stability test proposed by Diba and Grossman (1984) and Hamilton and Whiteman (1985). In Campbell and Shiller (1987), unit root and cointegration tests were recommended to detect price bubbles (Fabozzi & et al., 2019: 2). Homm and Breitung (2012) stated that Chow and CUSUM tests can be used in detecting price bubbles. Recently, the SADF (Sup-Augmented Dickey-Fuller) and the GSADF (Generalized Sup-Augmented Dickey-Fuller) right-tailed unit root tests developed in Phillips et al. (2011) and Phillips et al. (2015a) are tests also frequently used for detecting price bubbles.

In this study, it is aimed to test whether or not price bubbles are formed in the stock market indexes of both developed and developing countries. The study is expected to make a unique contribution to the literature in terms of determining whether or not price bubbles in stock markets of developed and developing countries differ. The study consists of five sections. In the first section, information about price bubbles and their historical process are provided. The second section consists of the literature that covers price bubble studies conducted on stock market indexes. The third section contains information regarding the data and method used in the study. The fourth section presents the findings obtained from the analysis, and comments and suggestions about the research results are given in the fifth section.

LITERATURE REVIEW

Numerous practical studies have been conducted on the existence of stock price bubbles. Although there were different results in the related studies, in gen-

eral, the results that suggested the existence of stock price bubbles were predominant. In this context, relevant studies are summarized:

Diba and Grossman (1988) was one of the first studies conducted on the existence of stock price bubbles. In the study conducted in the USA, it was stated that there was no evidence for the existence of stock price bubbles. Similarly, Dezhbakhsh and Demirguc Kunt (1990) could not reach any conclusions regarding the existence of stock price bubbles. In Brooks and Katsaris (2003) conducted in the UK, it is stated that there was strong evidence for the existence of stock price bubbles. In Mokthar (2006), it was found that price bubbles existed in selected sector indexes traded in the Malaysian stock market. Altay (2008) stated that price bubbles existed in the stocks traded on Borsa Istanbul. Zhang (2008) found strong evidence for the existence of price bubbles in the Chinese stock market. Zhou and Sornette (2009), which was conducted on the existence of price bubbles in the South African stock market, detected the existence of price bubbles. In Yu and Hassan (2010), it was stated that there was no evidence for the existence of price bubbles in the stock markets of MENA countries. Yanık and Aytürk (2011), a study conducted in Turkey, reached the conclusion that the price bubbles did not exist in the stock market.

In Nartea & Cheema (2014), it was stated that there was no evidence for the existence of price bubbles in Malaysian stock exchanges. In Chang et al. (2016), stock market data of the BRICS countries were used and it was stated that stock price bubbles existed. Chen et al. (2016) found evidence for the existence of price bubbles in the stock exchanges of the US, Belgium, Denmark, and Finland. Costa et al., which was conducted on the Brazilian stock exchange, asserted that price bubbles existed in the stock exchange. In Çağlı and Mandacı (2017), it was concluded that there were generally price bubbles in the stocks which traded on Borsa Istanbul. Akkaya (2018) stated that bubbles existed in Borsa Istanbul return indexes. In Anavatan and Kayacan (2018), it was concluded that there were price bubbles in the BIST 100 index. Zeren and Yılancı (2019), which was conducted on the stock index of 15 selected countries, stated that the findings of price bubbles existed in all the countries concerned.

DATA AND METHODOLOGY

In this study, monthly data of leading stock indexes of nine developed and ten developing countries in G20 are used over the period from January 2004 to October 2019. The countries and stock market indexes used in the analysis are presented in Table 1.

Table 1: Countries included in the Study and their Stock Market Indexes			
Developed Countries		**Developing Countries**	
Countries	**Stock Market Indexes**	**Countries**	**Stock Market Indexes**
USA	NASDAQ100	Argentina	MERVAL
Germany	DAX	Brazil	BOVESPA
Australia	S&P ASX200	China	SHANGHAI
France	CAC40	Indonesia	IDX
South Korea	KOSPI	South Africa	JTOPI
England	FTSE100	India	BSE 30
Italy	FTSE MIB	Mexico	S&P/BMV IPC
Japan	NIKKEI225	Russia	MOEX
Canada	S&P TSX	Saudi Arabia	TADAWUL
		Turkey	BIST 100

The GSADF test developed in Phillips et al. (2015a) is performed in the analysis. In Diba and Grossman (1988), right-tailed unit root tests were proposed to identify potential rational bubbles in the stock market. Gürkaynak (2008) also stated that standard unit root and cointegration tests were "*ex-post*" and the GSADF test was "*ex-ante*" according to estimation procedure and in this context, standard unit root tests might not be sufficient to determine price bubbles. In Phillips et al. (2011), a SADF-based test was proposed to test the evidence covering the beginning and end dates of the speculative price increase. Moreover, Homm and Breitung (2012) conducted an effective simulation study demonstrating that the SADF test can be performed to detect price bubbles. Nevertheless, Phillips et al. (2015a) asserted that the SADF test had limited ability in detecting the presence of multiple bubbles, and the GSADF test was proposed since it had been more successful in detecting multiple bubbles. In this case, in the light of the literature on the method, both SADF and GSADF tests are performed to explicate the subject, since it could provide a wider perspective. The analysis is conducted following the procedure proposed by Caspi (2013) using an EViews add-in called RTADF (Right-Tail Augmented Dickey-Fuller).

The following regression model (1) is used for unit root calculations in the SADF and GSADF test statistics (El Montasser & et al. 2015):

$$y_t = m + \lambda y_{t-1} + \sum_{i=1}^{p} \alpha_i \Delta y_{t-i} + \epsilon_t,\ \epsilon_t \sim iid\ N(0, \sigma^2),\ t = 1, \dots, T \qquad (1)$$

The standard ADF test is calculated by the following Equation (2), which is formed by dividing the coefficient (λ) of the related coefficient y_{t-1} by the standard error (se λ).

$$ADF_{r1,r2} = \frac{\lambda_{r1,r2}}{se(\lambda_{r1,r2})} \quad (2)$$

In order to estimate the GSADF test, the right-tailed ADF tests for multiple sub-samples would be reached with the regression equation defined in Equation 2. Both the endpoint (r2) and the starting point (r1) of the sub-samples change dynamically, and the sub-samples occur as a result of its differentiation from the zero point. Upon considering the fact that the sample ranges between 0 and 1, the starting point of the sub-samples is expected to be between 0 and r_2-r_0; whereas the endpoint is expected to take values ranging from r_0 to 1. Here, r_0 denotes the minimum event window length (Evrim, Mandacı & Çağlı, 2018).

GSADF test calculations can be expressed as follows (Phillips & et al., 2015a):

$$SADF_{r_2}(r_0) = \sup_{r_1 \in [0, r_2 - r_0]} ADF_{r_1}^{r_2}, \quad (3)$$

$$GSADF(r_0) = \sup_{r_2 \in [r_0, 1]} SADF_{r_2}(r0) \quad (4)$$

In the SADF and GSADF unit root tests, the null hypothesis H_0: $\lambda = 1$, claiming the existence of price bubbles, as well as the alternative hypothesis H_1: $\lambda > 1$, claiming the inexistence of price bubbles are tested. In recursive regressions, the model expressed in Equation 2 is recursively estimated using subsets of sample data, which is based on an expanding window of observations up to the current data point (Philips, Shi & Yu, 2015b).

FINDINGS

Firstly, descriptive statistics regarding stock market indexes are calculated in the study. In this context, descriptive statistics regarding the stock market indexes of developing countries are presented in Table 2.

Table 2: Descriptive Statistics for Stock Market Indexes in Developing Countries				
Indexes	**Mean**	**Minimum**	**Maximum**	**Standard Dev.**
BIST 100	62,849.87	17,081.08	119,528.80	25,743.20
BOVESPA	55,756.25	19,544.67	107,219.80	18,565.93
BSE 30	20,187.44	4,759.62	40,129.05	9,278.89
IDX	3,617.19	732.40	6605.63	1805.13
JTOPI	32,410.97	9,200.62	53,269.83	13,125.38
MERVAL	8,762.83	945.45	42,057.77	10,536.94
MOEX	1,540.03	502.81	2,893.98	534.63
SHANGHAI	2,629.61	1,060.74	5,954.77	891.62
S&P/BMV IPC	34,340.82	9,428.77	51,210.48	11,789.89
TADAWUL	8,063.69	19,502.65	4,384.59	2,510.44

Table 2, including the descriptive statistics of the stock market indexes of developing countries, indicates that the highest volatility is realized in the BIST 100 index, whereas the lowest volatility takes place in the MOEX index. In Table 3, descriptive statistics of the stock market indexes of developed countries are presented.

Table 3: **Descriptive Statistics for Stock Market Indexes in Developed Countries**				
Indexes	**Mean**	**Minimum**	**Maximum**	**Standard Dev.**
CAC40	4,412.75	2,702.48	6,104.01	799.51
DAX	8,023.09	3,785.21	13,229.57	2,779.61
FTSE100	6,060.28	3,830.09	7,748.76	931.93
FTSE MIB	24,053.02	12,873.84	43,755.00	7,662.31
KOSPI	1,772.22	2,566.46	735.34	432.83
NASDAQ100	3,272.07	1,116.99	8,083.83	1,934.33
NIKKEI225	14,726.99	24,120.04	7,568.42	4,452.26
S&P ASX200	5,074.79	6,812.60	3,272.00	832.57
S&P TSX	12,974.34	8,123.02	16,658.63	2,195.18

Upon evaluating the results of the descriptive statistics of the stock exchange indexes of developed countries in Table 3, it is seen that the highest volatility takes place in the NIKKEI225 index, whereas the lowest volatility is realized in the KOSPI index. Table 4 presents the results of the GSADF unit root test conducted to detect the existence of the price bubbles in the stock exchange indexes of developed countries.

Table 4: GSADF Test Results for Developing Countries		
Stock Market Indexes	**GSADF**	
	Test Statistics	**Probability**
MERVAL	6.551977*	0.000
BOVESPA	2.201515**	0.050
SHANGHAI	5.687987*	0.000
IDX	2.966115**	0.020
JTOPI	2.373866**	0.040
BSE 30	3.403176*	0.010
S&P/BMV IPC	2.555415**	0.030
MOEX	3.571468*	0.010
TADAWUL	3.757906*	0.010
BIST 100	1.8071	0.150
Critical Values	99% 95% 90% 3.5306 2.2282 2.0418	

*,**, and *** indicate significance at 1%, 5% and 10% levels; respectively.

Upon evaluating the results given in Table 4, it is found that there are price bubbles in the stock exchange indexes of developing countries with the exception of the BIST 100 index.

Table 5: GSADF Test Results for Developed Countries		
Stock Market Indexes	**GSADF**	
	Test Statistics	**Probability**
NASDAQ100	4.4525*	0.000
DAX	2.5831**	0.030
S&P ASX200	1.2801	0.420
CAC40	2.4848**	0.030
KOSPI	2.9434**	0.020
FTSE100	1.2510	0.450
FTSE MIB	2.4288**	0.040
NIKKEI225	2.5334**	0.030
S&P TSX	2.1447	0.070
Critical Values	99% 95% 90% 3.5306 2.2282 2.0418	

*,**, and *** indicate significance at 1%, 5% and 10% levels; respectively.

Upon evaluating the results given in Table 5, it is determined that price bubbles in stock exchange indexes of developed countries except for the S&P ASX200, FTSE100 and S&P TSX indexes exist.

CONCLUSION

In this study, it is aimed to test whether or not there are price bubbles in the stock market indexes of both developed and developing countries in the G20, and whether or not price bubbles, if any, in the stock market indexes of developed and developing countries differ. In this context, the GSADF right-tailed unit root test is conducted using monthly data of the leading stock market indexes of nine developed countries within the G20 (USA, Germany, Australia, France, South Korea, England, Italy, Japan, and Canada) and ten developing countries (Argentina, Brazil, China, Indonesia, South Africa, India, Mexico, Russia, Saudi Arabia, and Turkey) obtained over the period from January 2004 to October 2019, and the existence of price bubbles in the relevant indexes is tested.

As a result of the analysis, it is determined that price bubbles exist in the stock market indexes of all developing countries excluding the BIST 100 index of Turkey. In terms of developed countries, it is observed that price bubbles exist in the stock indexes of all developed countries excluding Australia's S&P ASX200 index, England's FTSE100 index, and Canada's S&P TSX. According to the related results, price bubbles are seen more in developing countries in comparison to developed countries. These results are also consistent with market expectations. This is due to the fact that the capital markets being less effective in developing countries and the need for foreign investors especially because of the insufficiency of capital that causes the related stock markets to be even more vulnerable to speculative movements.

In this context, investors may be advised to invest also in stock markets of developed countries as well as of developing countries. Furthermore, it may be suggested that stock markets such as the BIST 100, FTSE100, S&P ASX200, and S&P TSX in which price bubbles cannot be detected should be included in the investors' portfolios. It may be advisable to develop policies aimed at reducing the impacts of speculative movements by conducting effective supervision for market makers in developing countries. It is thought that the periods during which price bubbles occur would be analyzed in similar future studies to be conducted so that and examination of the developments which result in price bubbles as well as the relations with other market indicators within this period may contribute to the literature.

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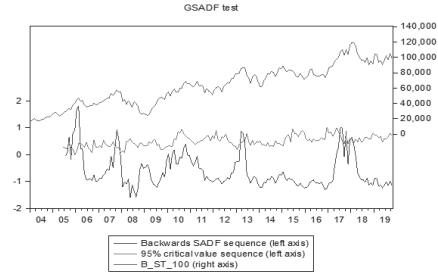
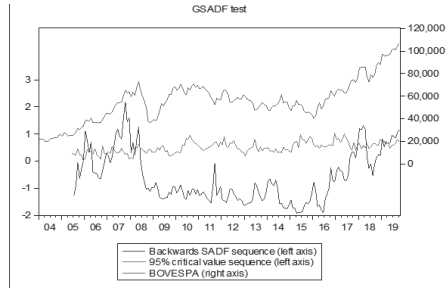
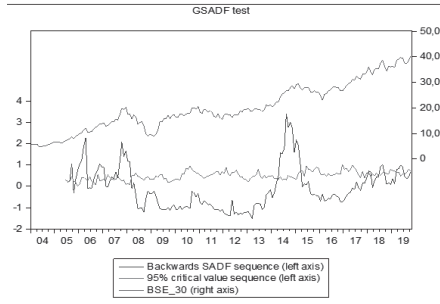
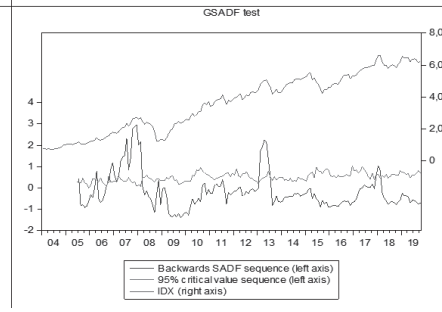
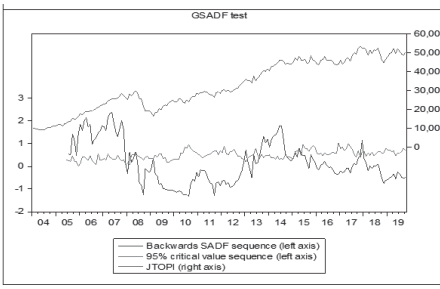
Appendix 1: Graphics of the GSADF Test Results for Developing Countries

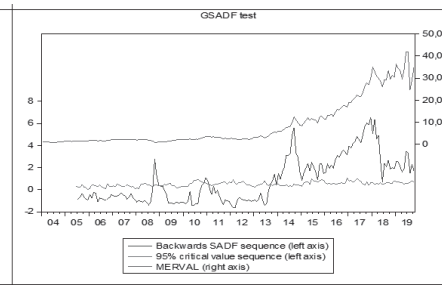


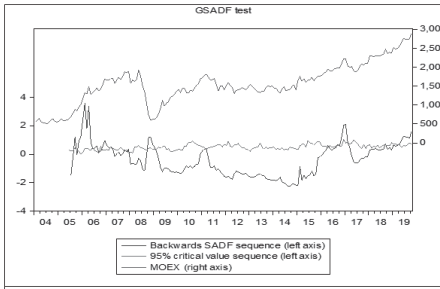


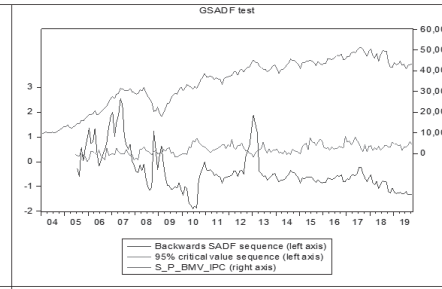


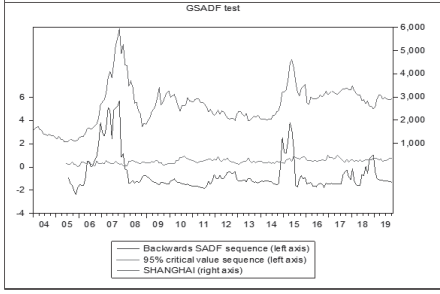


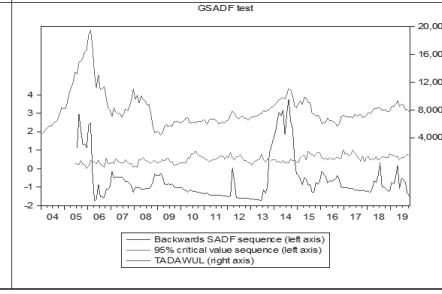












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