Identifying Phases of Ebullience in EFTA Stock Markets

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Abstract

Previous empirical literature supports that stock bubbles have impacts on efficient allocation of wealth. Researchers targeted various economies in the past using various methods to explore bubble phenomenon. This study uses generalized SADF test which is admitted by empirical literature as the most successful technique to explore stock bubbles in three countries included in European Free Trade Association (EFTA) not studied before. This paper takes a lead and tests for the existence of bubbles in monthly end index prices of respective countries based on latest available time series data from January 2001 to September 2019. Based on empirical results, it is concluded that all three countries stock markets experienced multiple bubbles in study period. The case of Iceland is worse where comparatively more fluctuations in stock prices are seen. To avoid occurrence of further stock price bubbles in these countries policy recommendations are provided as well.

Key words: Simulation; periodically collapsing bubbles; stock market, generalized supremum ADF

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1. Introduction

Asset bubble or market bubble is trade in a security at a price which is not justified by fundamentals. Bubble phenomenon is characterized by high fluctuations in security price. Usually, it extends into three phases. In 1st phase security starts to trade above intrinsic value. Intrinsic value is actual value of security calculated by asset pricing model (Campbell et al., 1997; Cochrane, 2001). 2nd phase involves further fluctuations in market price of security above fundamental value. Such as Shiller (2006) observe that prices of houses do not match with rent and that rent to price ratio of housing sector is gradually decreasing since 1913. In 3rd phase bubble bursts when market price becomes equal to or less than fundamental value. Bubbles often take long time to burst and its duration can extend upto months. In other way security may become overpriced and then its price drops down in a moment. For example, empirical results by Yiu et al. (2013) studying Hong Kong residential property market support the notion. One of bubbles explored by them started from October 2007 and ended in April 2008. Conversely some bubbles had same start date and end date such as June 2000, October 2004 and January 2009 etc.

By looking into world economic history, it can be argued that mispricing in securities has been occurring since long. Tulipmania occurred in Dutch Republic is considered as a first economic bubble when contract prices for tulip bulb started to increase tremendously in 1630. Escalation in price continued for about seven years and then suddenly in 1637 prices dropped down. Similarly, bubbles have been observed in various asset classes**.** The South Sea Bubble occurred in 1720, when stock price of South Sea Company of Britain becomes eightfold only in six months from January to June of year 1720. When it burst in September same year it also goes down other government stocks with them. Most recent study conducted by Vogiazas & Alexiou (2017) provides evidence of property price bubbles in OECD countries. OECD is abbreviated for Organization for Economic Coordination and Development. It is a group of seven countries, Australia, Belgium, Canada, Denmark, Great Britain, Norway and Sweden.

Several studies have focused on financial instability associated with bubbles. IMF (2003) identified 20 cases in 14 countries during 1970-2001 when bubbles bust led to recession. Similarly, Ferguson (2008) and Ahamed (2009) argue that financial crises are often preceded by asset bubble. American subprime mortgage crises (2007, 2009) are no exception. Before crises high inflation was seen in housing sector which were financed by home mortgage loans. Boom in both real estate and credit market was understood by market observers and from time to time they

show their concerns about mispricing in these markets. Such as Shiller (2005) and Pettifor (2006) document that risk is not properly reflected and priced in both housing and credit market. Similarly Bank of International Settlements expressed in their reports repeatedly that prices in financial markets are not based on fundamentals. However limited attention was given to these news and behavior of investors did not change. As a result, bubble continued to become large and eventually busted. It resulted in huge loss not only for real asset investors, mortgage loan providing banks specifically and American economy generally but also its effect was spread in rest of the world.

Recently, the long sequence of increases in stock prices of American stock market followed by a dramatic price drop in October 1987 and Japan's stock market inflation spanning from 1985 to 1989 have sparked new interest in stock price bubbles. Stock price bubble occurs when share prices deviate from its fundamental value. It is the difference between market price and intrinsic value of stock (Reza, 2010). In rational speculative bubble stock holders know that stocks price exceeds their intrinsic values. In other words, it is bullish market sentiment generated through rational speculation about stocks. Despite having information that shares are overvalued, stockholders continue to invest more and more with the belief that prices will go up further and will not decrease. But continuous increase in share price is unexpectedly followed by downfall.

Using recently developed test—the Generalized Supremum Augmented Dickey Fuller (GSADF) by PSY (2015), the case of multiple bubbles in EFTA countries is explored. The study period includes bubbles of both short and long duration. Period of short bubble is two months which occurred in Norway stocks during May to July 2014. Long bubble is identified in Iceland stocks having 38 months duration. It started in May 2003 and ended in June 2006. Next long bubble is explored in Norway stocks for duration of 37 months extended from November 2004 to December 2007. As stock markets of developing countries are characterized by high price fluctuations, exploring stock market behavior of developed countries such as EFTA would be significant contribution in existing empirical literature. This study will work as a base for academicians doing research in the area. Similarly, regulators in these countries will formulate strategies to reduce occurrence of such bubbles in future.

Organization of paper is as follows: Section II provides brief review of stock exchanges operating in EFTA countries. Section III reviews relevant literature. Section IV describes empirical methodology. Section V presents empirical findings and Part VI elaborates conclusions and policy implications.

2. Brief Overview of EFTA Countries Stock Exchanges

EFTA is an organization of four European states i.e Iceland, Liechtenstein, Norway, and Switzerland developed for promoting free trade among member nations. In order to identify stock bubbles in EFTA countries, stock market indices of respective countries are studied for a period of 19 years from January 2001 upto September 2019. Brief review of stock exchanges operating in these countries and its popular indexes are presented here.

Also known as Nasdaq Iceland, Iceland Stock Exchange was established in 1985. Initially it began trading in 1986 in government bonds whereas exchange started trading in equities in 1990. The OMX Iceland All-Share Price Index used in this study is a major stock market index of Iceland Stock Exchange (ICEX). It is based on variety of financial and non-financial firms such as fishing, retail, transportation, banks and insurance. Oslo stock exchange (OSE) is the main market for trading of shares of Norwegian companies. Although OSE started operations in April 1819 (as Christiania Bors), stocks were beginning to trade from 1 March 1881. Not only domestic but international companies of petroleum and shipping sectors etc are also registered on OSE. The Oslo Bors All Share Index (OSEAX) is included in the study to identify multiple bubbles, if any, in Norway stocks. It consists of all shares traded on OSE. It is a share price index adjusted daily for corporate actions such as dividends or coupon payment and stock split etc. SIX Swiss Exchange is Switzerland's stock exchange. Along with shares other securities such as government bonds and derivatives such as stock options are also traded on SIX Swiss Exchange. Switzerland Market Index (SMI) is incorporated in the study to explore multiple bubbles in Switzerland stock market. SMI was introduced for the first time on 30 June 1988. It is made up of 20 largest equities of Swiss Performance Index (SPI) and updated whenever transactions in securities contained in index occur. The securities of SMI collectively represent more than 90 percent of market capitalization and 90 percent trading volume of all Swiss and Liechtenstein equities.

3. Literature Review

World economy has seen many ups and downs in asset prices. Most recent is persistent increase in American stocks prices followed by sudden decrease in 1987. Such fluctuation in stock market is one of several puzzles not explained by efficient market hypotheses (Shiller, 1992, pp. 69-130). On the other hand, some researchers argue that use of efficient market models for testing the presence of stock price bubble is important, as it is helpful in investment decision making (Nartea and Cheema 2014). Vast amount of research is devoted to identify these bubbles (e.g. Jahan-Parvar and Waters, 2010; Mokhtar et al., 2006; Cunado et al, 2005; Nasseh and Strauss, 2004; Bohl, and Henke 2003; Crowder and Wohar, 1998; Timmermann, 1995; and Froot and Obstgeld, 1991). Results on bubble identification are however contradictory. For example, using cointegration tests Sarno & Taylor (1999) find rational bubbles in stock market of Malaysia over a period of 10 years from 1988 to 1997. However, in earlier studies by Chan et al. (1998) applying duration dependence test do not find evidence of stock price bubbles in Malaysia during study period extended from 1977 upto 1994.

The tests of identification can be broadly categorized into five groups as under: First category of tests examines excess volatility in actual stock prices. These tests which are initiated by LeRoy and Porter (1981) assuming linearity in time series compare variance of stock's market price with variance of fundamental value of stock. If variance of former is greater than later then it is an indication that speculative bubble is present in stocks. Using both aggregated and disaggregated data on price and earnings of US firms these authors identified volatility in stock prices. Shiller (1993) conducted research on S& P composite stock price index and Modified Dow Jones Industrial Average by applying same method and found volatility in stock prices. Kleidon (1986) is among others who identified stock prices volatility by comparing actual stock price variance with variance of fundamental value of stock.

Second category of tests use bubble premium to identify bubble. These tests were proposed by Hardouvelis (1988). Bubble premium is defined as the extra return expected by investors in the presence of bubbles. Due to this extra return investors decide to stay in the market despite having information that stocks are overvalued and prices will drop. Studying Japanese, American and UK stock markets data for 10 years starting from December 1977 to December 1987, he finds positive and increasing bubble premium which is a sign of speculative bubbles. Rappoport and White (1991) also detected bubble in 1929 American stock market by this method.

Third set of tests for rational speculative bubbles is specification tests introduced by West (1987). In these techniques initially parameters of discounted present value of dividends are estimated through two different ways. Such as firstly through regressing stock return on dividends; and secondly through the Hansen–Sargent prediction formulas. Then two sets of parameters are compared. If difference exists then bubble is present. West identified bubbles through this way in American stock markets using samples, S& P 500 index (1871-1980) and Dow Jones Index (1928-1978). Dezhbakhsh and Demirguc-Kunt (1990) also tested the existence of stock price bubbles by using methodology of West (1987).

Fourth set of tests examine whether dividend and prices are correlated. Diba and Grossman (1988) detected bubbles in American stock market by applying cointegration test on S& P composite Price Index. These tests basically investigate stationarity property in dividends and stock prices time series. The idea is that if bubbles exist then prices and dividends do not co-move i.e relation between two variables is no longer linear. Sarno and Taylor (1999) using such methodology find evidence consistent with the presence of stock price bubbles in all East Asian economies except Australia where no stock price bubble was identified in period of the study (1988 to 1997). Arshanapalli and Nelson (2008) applying cointegration technique find housing bubble in US in the period 2000-2007.

Fifth group of tests are duration dependence tests. McQueenn and Thorley (1994) detected bubbles in New York Stock Market in period 1927-1991 through this method. As suggested by authors runs of positive abnormal return will be followed by negative returns if bubble is present in asset prices. Mohktar et al. (2006) using the test detected bubbles in Malaysian stock market in pre and post era (1994-1996 and 1999-2003 respectively) of 1997 Asian financial crises. However, Ali et al. (2009) applying same technique in Malaysian context finds no evidence of bubbles over a longer time period (1989-2006). Wang and Wong (2015) detected bubbles in US stock market in period extended from January 1927 to December 2012 by employing duration dependence test on monthly real return. Besides these tests researchers have also used other techniques for bubble identification. Such as using recursive computations Asako and Liu (2013) employ an estimation model to detect bubble. Further, Anderson and Brooks (2014) developed an empirical asset pricing model for bubble detection. If parameter estimates are affected by stock returns, then this is an indication of bubble.

4. Econometric Methodology

Prior to recent techniques, one developed by Dickey & Fuller (1979)—the Augmented Dickey Fuller (ADF) unit root tests were mostly used to test bubble in asset prices. One of the issues raised in ADF test is its inability to detect multiple bubbles in time series (Fatima and Ahmed, 2019). Further researchers explored that bubbles are periodically collapsing and originating. To cope with such circumstances our methodology to explore bubbles is based on the PWY (2011) and PSY (2013). By applying the procedure followed by popular research we become able to explore any bubbles occurred in stock prices clearly showing both date of origination and date of burst of bubble. We regress following model for the purpose:

$$Y_t = \rho 1 + \rho 2 Y_{t-1} + \sum_{k=1}^{n} \theta_k \Delta Y_{t-k} + \varepsilon_t \qquad (1)$$

In above equation Y denotes index price, ρ1 is intercept term, ρ2 is coefficient value of first lag of Y_t, θ_k is coefficient value of ΔY_{t-k}. ε_t is error term having zero mean value and constant variance. To detect bubble, we test null hypothesis of ρ2 = 1 against right tailed alternative hypothesis of ρ2 >1.

To make understanding easy test procedure is described here. In first step sample data is normalized so that it lies in [0,1] interval. Let $ADF_{s1,s2}$ and $\rho 2_{s1,s2}$ are two ADF statistics of estimated coefficient of Y_{t-1} in specified equation (1) of normalized sample [s_1, s_2]. Here s_1 and s_2 are initial and last observations of selected sample respectively. Corresponding window size is $W_S = s_2 - s_1$. When window size $W_S = 1$. It implies that the critical values of RTADF statistic will be different from the usual ADF unit root test. To test already developed null hypothesis, RTADF calculated values are compared with the critical values at 1%, 5% and 10% significance levels. If calculated value is found to be greater than corresponding critical value, then we are justified to reject null hypothesis and presence of explosive bubble in data has been proved.

Based on ADF statistic but advanced one technique for bubble detection is SADF test. The test has fix starting point to select sample of varying window size. As proposed by PSY (2015) the initial window size is selected by $(0.01 + 1.8 \sqrt{T})$. In the window size estimation first observation of the sample is placed as a starting point S_1 i.e. $S_1 = 0$ and the endpoint S_2 is set to minimal window size W_s. In other words, end point of window $S_2 = W_s$. Then regression is run recursively by augmenting the window size $S_2 \in [S_0, 1]$, one observation at a time and ADF statistic ADF_{s2} is

calculated for each estimation. However, estimation carried out in the last step is based on whole sample i.e. $S_2 = 1$ and the corresponding statistic is ADF_1. The SADF statistic is the supremum value of ADF_{s2} sequence for $S_2 \epsilon [S_0, 1]$.

$$SADF_{s0} = \underbrace{sup}_{s2\epsilon[s0,1]} \{ADF_{s2}\}$$

PSY (2015) suggested generalized form of SADF to which they name GSADF. Latest version has greater scope due to formation of different size windows to perform regression analysis. In this process initial window size S_2 can differ inside the given range of [0, $s_2 - s_0$].

$$GSADF_{s0} = \underbrace{sup}_{\substack{s2\epsilon[s0,1] \\ s1\epsilon[0,s2-s0]}} \{ADF_{S1}^{S2}\}$$

4.1 Date stamping of bubbles

One of the important characteristics of both SADF and GSADF techniques is that it identify bubble origination and termination dates in case of explosive bubbles in data. Date stamps of bubbles are estimated in GSADF test as follows:

$$\widehat{\boldsymbol{s_e}} = \underbrace{inf}_{s2\epsilon[s0,1]} \{s_2 : BSADF_{s2} > critic_{s2}^{\delta Ts2}\}$$

$$\widehat{\boldsymbol{s_f}} = \underbrace{inf}_{s2\epsilon[se,1]} \{s_2 : BSADF_{s2} < critic_{s2}^{\delta Ts2}\}$$

The critical value of sup ADF statistic is $critic_{s2}^{\delta Ts2}$ i.e. 100(1- δT)% which is based on [Ts2] observations. The value of backward sup ADF statistic is $BSADF_{s0}$ for $S_2 \epsilon [S_0, 1]$ that can link to GSADF by noting this

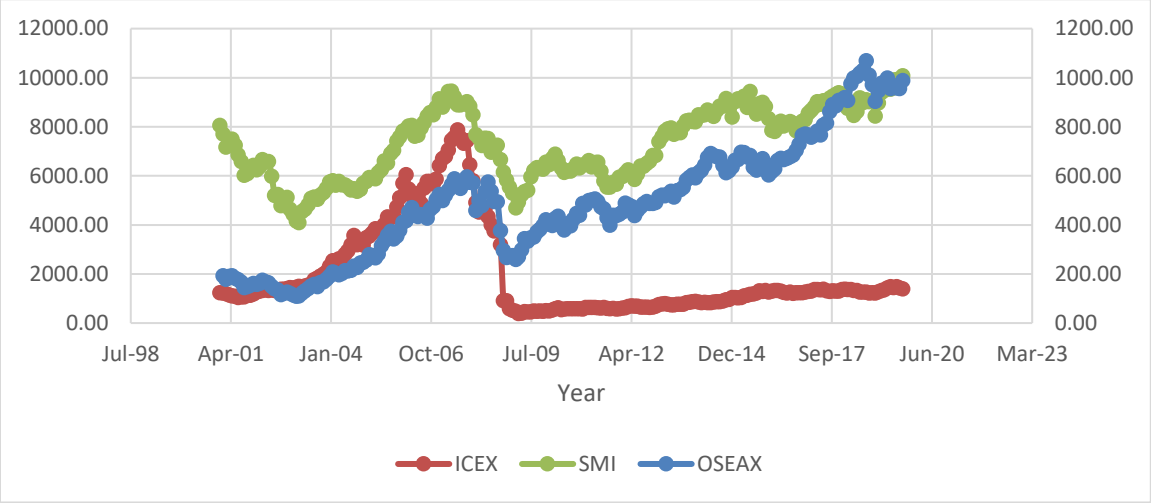
$$GSADF_{s0} = \underbrace{sup}_{s2\epsilon[s0,1]} \{BSADF_{s2}\}$$

4.2 Data and sources

This study uses monthly end stock price indexes from January 2001 to September 2019 of three EFTA countries i.e, Iceland, Norway and Switzerland. These are Iceland Stock Exchange Index (ICEX), Oslo Bors All Share Index (OSEAX) and Swiss Market Index (SMI) respectively.

Reason for using index prices is that it represents aggregate of stocks of large capitalization companies. The choice of using large time period is made to cover maximum data. Where end of month's stock price index was not available, month's latest index price was considered. Note that, in addition to Iceland, Norway and Switzerland, EFTA also includes Lichtenstein as well, but Lichtenstein has no regulated stock exchange and its companies are trading on Switzerland Stock Exchange. Thus, bubbles in Lichtenstein and Switzerland are explored by studying Swiss Market Index. Source used for data collection is investing.com. Figure 1 shows graphical presentation of all three indexes considered in this study.

Figure 1: Graphical View of EFTA Countries Stock Indexes



From Figure 1, it can be seen that all three graphs have same upward and downward trend. Further as depicted all three graphs have remarkable peaks during years 2007-2008. It shows that three stock markets are cointegrated. SMI is trading at higher price during study period comparative to other indexes. Graphs of OSEAX and ICEX show little difference in both prices from 2001 to 2008. However after 2008 difference in prices becomes large which continuously becomes vast till end of the study period. It is due to tremendous decrease in ICEX prices starting after 2008.

Table 1: Descriptive Statistics of EFTA Countries Stock Indexes

Statistic	ICEX	OSEAX	SMI
Mean	1976.335	490.478	7284.942
SD	1833.425	244.629	1466.424
Median	1275.045	481.100	7399.190
IQR	1627.800	366.235	2530.960
Min	386.800	109.020	4085.600
Max	7867.880	1069.140	10078.320
Skewness	1.604	0.387	-0.097
Kurtosis	4.492	2.471	1.830

Table 1 provides description of three index prices, which clearly justifies graphical report of data. SMI has higher mean price than ICEX and OSEAX. Among three time series data OSEAX has lowest average value. In consistency with mean price are maximum and minimum values of indexes. SMI has highest minimum and maximum values than remaining two indexes. Also OSEAX has lowest minimum and maximum values among group of indexes. ICEX has highly dispersed data as shown by comparatively higher standard deviation than other indexes. This may be due to sharp decrease in ICEX prices after 2008 as viewed by earlier graphical presentation.

5. Empirical Findings

Table 2 shows test statistics and critical values for each index. All three test statistics for ICEX and OSEAX indexes are greater than their respective 1% right-tailed critical values. For SMI index only calculated RATDF is greater than 1% critical value. SADF value of the index is insignificant at all conventional significance levels, while its GSASF value is significant at 10% significance level. Thus, our results confirm that data have explosive sub periods and countries experienced speculative bubbles in studied period. To locate bubble periods, we compare GSADF statistics sequence with critical values sequence.

Table 2: **Calculated and critical values of test-statistics**

Index	RTADF	SADF	GSADF
ICEX	4.45 (0.00)	5.91 (0.00)	5.91 (0.00)
OSEAX	1.42 (0.14)	3.32 (0.00)	3.33 (0.00)
SMI	1.98 (0.03)	0.22 (0.46)	2.032 (0.07)
Critical Values			
99%	0.72	2.05	2.69
95%	0.00	1.42	2.11
90%	-0.36	1.12	1.88

Table 3 lists date stamping of bubbles occurred in respective stock market. It includes the details on the bubble start and end period as well as the total duration of bubbles in months.

Table 3: Bubble date stamping

Iceland Stock Market Index— ICEX			
Ser	**Start Period**	**End Period**	**Duration (months)**
1	2003M05	2006M06	38
2	2005M08	2007M10	27
3	2008M10	2009M04	6
4	2015M01	2016M06	18
Oslo Bors All Shares Index— OSEAX			
1	2004M11	2007M12	37
2	2014M05	2014M07	2
3	2017M09	2018M10	14
Switzerland Stock Market Index—SMI			
1	2005M09	2006M04	7
2	2006M07	2007M06	12
3	2008M11	2009M04	5

Past studies (e.g., Ahmed et al., 2010; PSY, 2011; and Chang et al., 2016) consider speculative bubbles originated as a result of various political and economic events. From viewing date stamps on economic bubbles, it is evidenced that all three stock markets face with huge mispricing of stocks during periods of 2007 and 2008. This may be the result of economic meltdown during the periods. Thus, like other economies, EFTA countries too are affected by 2007-2008 world economic crises.

In case of Iceland, tremendous increase was seen in prices of Iceland stocks long before in 2003. This escalation in prices may be the result of privatization of banking sector of Iceland. Privatization made easy access to get loans and people became able to invest a lot of money in stock market. Due to which demand for stocks increased escalating share prices. Equally affecting by world financial crises 2008, government of Iceland revised their monetary policies such as imposing capital controls. Currency restrictions were enforced to diminish negative effects of the crises on economy. But as suggested by Chordia et al. (2008) decreased liquidity increase market inefficiency. Efficient market hypothesis also supports the notion that regulated market with capital control decrease availability of information which leads to inefficient market. Thus, market inefficiency can be observed after global financial crises as evidenced by bubble 2015/2016 afterwards. This bubble can be attributed to financial regulations in Iceland.

Norway stocks experienced explosive bubbles in study duration. First bubble started in November 2004 remained for more than 3 years eventually ended in December 2007. This may be the result of spillover effect of Iceland stock market and global financial crises 2007-2008. After, mispricing is observed in Norway stock market during period from May 2014 to July 2014. This may be due to increased crude oil prices and new oil discoveries in Norway prior to 2014. Which boost the economy and increase demand for stocks consequently increasing their prices. Fall in oil prices in summer 2014 dropped share prices consequently busting bubble. Another bubble was originated in September 2017 and ended in October 2018. The history behind the bubble is that after experiencing two years of economic downturn, the Norwegian economy recovered from the oil shock in 2017. GDP growth rose to 1.9% in 2017. Growth of the mainland economy can be attributed to rising oil prices until September 2018. Further alongwith increase in oil prices, increase in both investment and income is observed during the period

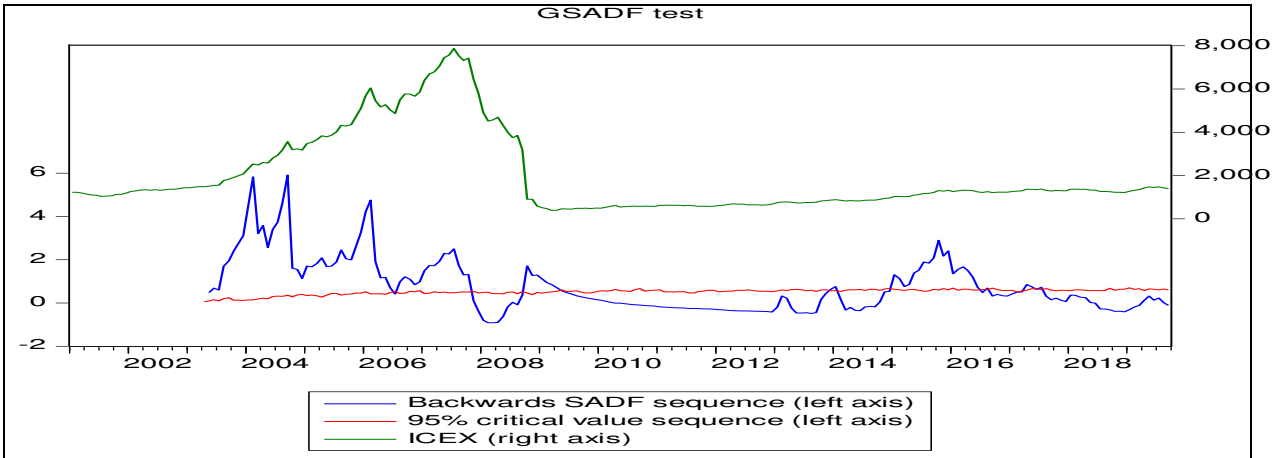
Three bubbles are detected in Switzerland stock market, which cover period from 2005 and 2009. First bubble extended from September 2005 to April 2006 may be due spillover effect from

Iceland and Norway stock markets, which affected Switzerland stock market. Second and third bubbles covered periods of world economic crises of 2007-2008 and therefore may be attributed to the economic turmoil.

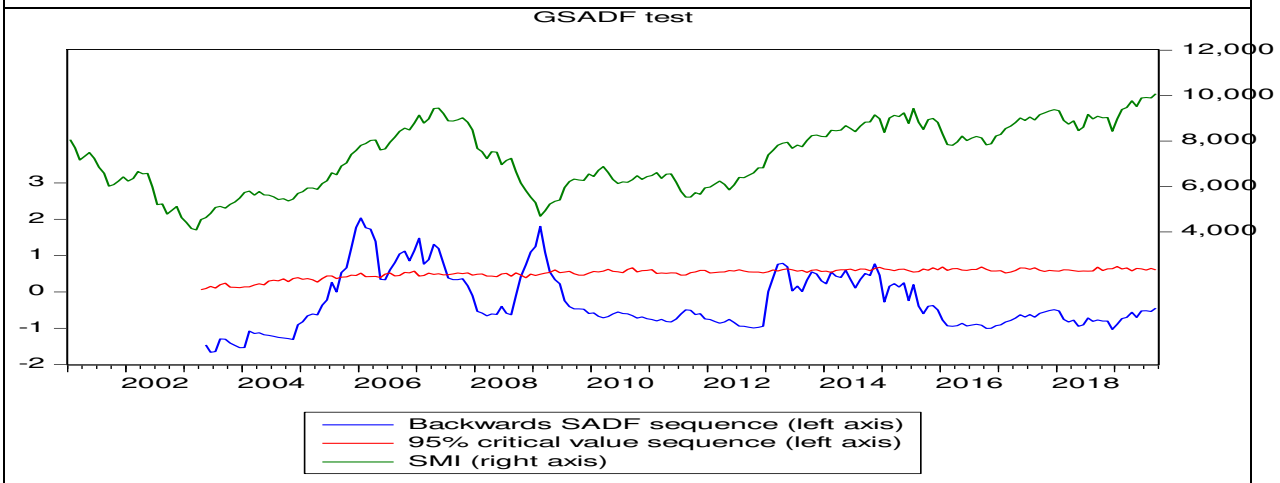
The results presented in this paper are not directly comparable with other studies because no prior study is available on testing and detection of stock bubbles in EFTA countries. However researchers used other contexts for testing bubble in stocks. PSY (2013) using GSADF test find bubble for S& P 500 price dividend ratio during 2008-2009. They attribute price exuberance to subprime mortgage crises. Using same method this study also detected bubbles in all three stock indexes during period extended from 2007 upto 2009. Chen et al. (2015) examined stock bubbles in four stock markets e.g. the US, Belgium, Denmark and Finland for various time periods ending in December 2012. Applying univariate unit root tests on log dividend yields their study provides evidence for bubbles in these stock markets. Whereas in this study also, those identified during 2007-2009 are not the only bubbles. The phenomenon exists in targeted stock markets of the study both prior and after the above-mentioned period.

The results regarding date stamping of identified bubbles for all three stock indices presented in Table 3 are portrayed graphically via figure 2 (a—c).

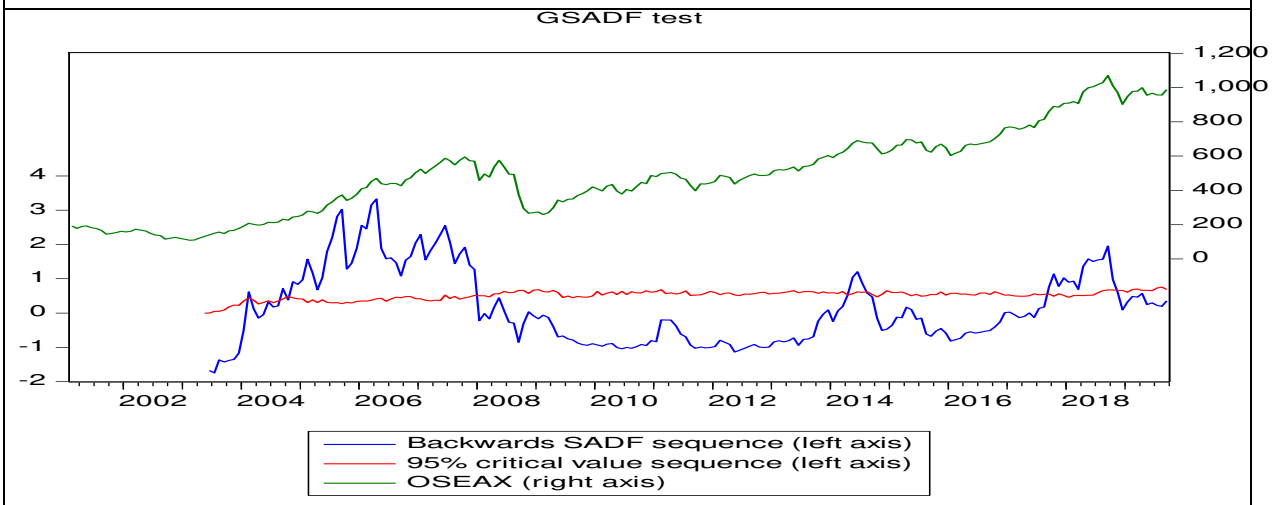
Figure 2: Bubble date-stamping for EFTA countries



(a): Iceland Stock Market Index (ICEX)



(b): Oslo Bors All Shares Index (OSEAX)



(c): Swiss Market Index (SMI)

6. Conclusion and Policy Implications

The major aim of this paper is to identify multiple stock price bubbles in EFTA countries namely Iceland, Liechtenstein, Norway, and Switzerland. We applied GSADF test on our monthly end stock price indexes. This technique was also used by PSY (2011) for multiple bubble identification in S&P500 price dividend ratio. The null hypothesis of no bubbles is rejected for all stock markets and it is concluded that EFTA countries face with multiple price booms and busts in study period from January 2001 to September 2019.

This study has important policy implications for EFTA countries. Previous empirical literature supports that bubble phenomenon results in redistribution of wealth and have negative consequences for both capital market participants and firms. Therefore, EFTA countries need to revise their monetary and fiscal policies to reduce chances of further bubbles in their respective countries. Such as regulatory authority should tighten monitory policy when stock price increase and ease it when prices fall to stabilize share prices. Also one of the causes of mispricing is information asymmetry. Therefore other than macroeconomic reforms, actions are needed at firm level to eradicate bubble occurrence. To enhance financial transparency managers should disseminate important information on firm operations which will be helpful in efficient resource allocation.