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Speculative Rational Bubbles: Asset Prices in GCC Equity Markets

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Abstract

Conventional theory of speculative bubbles describes stock bubbles as stock prices that exceed their fundamental value because current owners believe that the stocks can be resold at an even higher price in the future. A speculative bubble driven by rumors and not supported by fundamentals will result in mis-allocation of resources into non-optimal uses. Therefore, identifying and dating speculative explosive bubbles has been a major concern in the economic literature. This study examines the presence of the phenomenon of stock market bubbles in the GCC countries including Saudi Arabia, Qatar, United Arab Emirates, Oman and Bahrain over 2000 to 2013. Considering rational bubble change stock price from random walk to an explosive regime and traditional unit roots has less power in detecting periodically collapsing bubbles as point out by Evans (1991), this study employ newly developed testing approach of Phillips and Yu (2011b) and Phillips et al. (2012) right tailed unit root test to not only investigates the presence of rational periodically collapsing bubbles, but also stamps the times of bubbles emergence and collapse. Our empirical results indicate the existence of rational bubbles in GCC stock market, which is contradicted to that of Yu and Hassan (2009) and Jung-Suk Yu and Hassan (2011). The estimation of the starting date of the bubbles indicates that explosive regime emerges in the early 2000s.

Keywords: Rational Speculative bubbles, Periodically collapsing bubbles, unit root tests, GCC stock market, gharar

1. Introduction

Over the last decades, believing that equity market encourages capital accumulation and allocation for economic growth, many developing countries have pursued public policies to foster financial market development through building regulatory frameworks and institutional development. It is believed that a well functioning and growing stock market can channel money from savers (share holders) to borrowers (firms) for productive investment and thus spurring the economic growth. In efficient stock markets, prices of stock provide an accurate signal for optimal resource allocation based on investment utility and risk factor (fundamentals). In deed, it is well known that those countries with well-functioning sophisticated capital market generally enjoy better economic growth and high living standard.

With increasing capital mobility across national boarders due to economic liberalization and a shift to market-based policies, a number of countries benefited with an exponential growth in the market capitalization and turnovers. However, one of distinctive feature of in the past has been the prolonged buildups and sharp collapses in asset markets both in developed and developing world. The dramatic asset prices increase followed by rampant price drops has led to turmoil in financial markets in particular and the wider economy in general.

A sharp rise in asset prise then implodes are defined as bubble yet the asset price movement that cannot be explained by fundamentals (Garber, 1990, Kindleberger, 1978). On other hand, Curthbertson (1996) defined the rational speculative bubbles as an attempt to identify the behavior of investors who act irrationally, such as when herding occurs while Diba and Grossman (1988a) attribute the rational speculative bubbles to a self-fulfilling belief based on intrinsically irrelevant information that is not related to market fundamentals . For instance, if the economic agent anticipate an increase in asset price whereas these expectations are not based on changes in the fundamentals, the demand for asset will increase moving the price away from its intrinsic value. In other words, the investors realized share prices exceed their fundamental value but they believe there is high probability that the bubble will continue to expand and lead to a high return, which compensates them for the probability of crash. A rational bubble is consistent with the efficient market hypothesis and the no arbitrage condition. It can be derived from a basic asset pricing model assuming competitive markets and rational expectations with no informational asymmetries. Agents know that the asset is overvalued, but they are prepared to pay more for the asset than its intrinsic value if they expect to sell it at an even higher price. The bubble increases at the required rate of return and bursts when agents expectations return to normal. Generally, bubbles occurs when assets price exceeds the fundamental value of the asset.

A speculative price increase mainly driven by something else rather than fundamentals will result in misallocation of resources into non-optimal uses. The varied experiences that emerging and developed economies have had with financial crises in recent history have highlighted the importance of good macroeconomic, financial, and regulatory policies. Therefore, identifying and dating speculative explosive bubbles has been a major concern in the economic literature.

Numerical empirical studies have attempted to investigate the persistence of rational bubbles in the stock market, yet there is still no common framework on how to detect or predict the formation of a bubble, consequently, leading to a mixed results at large.

As a speculative bubble is defined as a different between fundamentals determined and observed prices, in empirical studies , stationarity and cointegration test are recommended by Hamilton and Whiteman (1985) and Diba and Grossman (1988a) as an indirect way to obtain the evidence for rational bubbles. The main idea behind this test is that if a rational bubble exists and if the dividends are stationary at the first difference, the first difference of stock prices should be stationary (i.e., stock prices are more explosive than dividends). Conversely, the lack of co-integration between prices and fundamental values is indicative of a rational bubble. This test has been employed in several prior studies including Campbell and Shiller (1987), Diba and Grossman (1988a,b),Herrera and Perry (2003), Jirasakuldech, et al. (2008) and Mieza and Afzal (2012).

Although the unit root and co-integration tests have been widely used in empirical research, there is a serious limitation with the methodology pointed out by Evans (1991) who demonstrated that the unit root and cointegration tests are not capable of detecting explosive bubbles when there are periodically collapsing bubbles in the sample Blanchard and Watson (1997). Collapse breaks nonlinearity in the dynamic structure and substantially decreases the power of the test.

New tests have been proposed to overcome the difficulty in detecting periodically collapsing baubles.[1] Homm and Breitung (2012)investigate several tests designed for detecting rational bubbles. They find that the sequential right tail unit root test by Phillips and Yu (2011b) has the highest power for detecting periodically collapsing bubbles among the alternative approaches. Phillips et al. (2012) further extended the Phillips and Yu (2011b) to overcome the discriminatory power of the test Phillips and Yu (2011b).

Gulf Cooperation Council Countries (GCC) stock markets have a short history relative to the world financial markets. Prior to 2000, most of the GCC markets were operating informally. However, Stock markets across these countries have witnessed an extraordinary expansion from 2000 to 2005 and to 2012. The size of the overall GCC market in terms of market capitalization have rose from $120 billion in 2000 to over a trillion in 2005, individually, GCC stock markets grew at explosive rates ranging from 164% for Oman to 2004% for UAE. Similarly, trading has tremendously increased in all GCC markets from 2000 through 2005. The number of trades and volume traded for the combined GCC market rose by more than 7000% and 1000%, respectively. Indeed, the Saudi market was ranked 16th in the world in terms of market capitalization and 14th in terms of number of trades by the end of 2005.

However, GCC countries stock markets have gone through two substantial market fall: The first in 2006, the total GCC market was dropped by 35%, but rose up again by 54% in 2007. In particular, Saudi Arabia

[1]Another test is the duration dependence method developed by McQueen and Thorley (1994) is based on the statistical theory of duration dependence. It suggests that if security prices contain bubbles, then runs of positive abnormal returns will exhibit negative duration dependence (decreasing hazard rates), which is a unique characteristic of rational speculative bubbles. That is, the conditional probability of a run ending, given its duration, is a decreasing function of the duration of the run. Since then this test has been employed in several previous studies including Chan et al. (1998), Harman and Zuehlke (2001), Lavin and Zorn (2001), Mokhtar (2006) and Jirasakuldech et al. (2008).

and Dubai lost by 65% and 50%, respectively. The second occurs along the 2008 global financial crisis,which hit all of the local stock markets and led to valuations that in many cases were a third or less of what they had been in the mid-2000s. The 2006 stock market crisis in particular generated huge losses for hundreds of thousands of unsophisticated local retail investors who had been drawn into the stock market frenzy of the first half of the decade. There was a popular backlash against large investors who had been "gaming the market". If this is the case, from Islamic economics' point view, such activity considered as *gharar* because pricing on speculation is disconnected from underlying profit-related fundamentals (Ahmed and Rosser, 1995). This is deviated from the very hope mobilize capital to boost economic development to mere profit-generating through speculation. Considering more than 95 percent population of these countries are practicing Muslims, a evidence of rational bubble in the stock markets may contradict to basic principle of Islamic finance.

Despite the speculation about the existence of bubbles in GCC markets and a few approaches available to test the existence of bubbles, only Yu and Hassan (2009) investigate the occurrence of asset bubbles in these markets and do not find strong evidence of rational speculative bubbles. Yu and Hassan (2009) examine the possibility of rational speculative bubbles in OIC stock markets by employing alternative bubble tests, such as fractional bubble tests and duration dependence tests. They confirm that log dividend yields of OIC stock markets are fractionally integrated and none of the nonparametric Nelson-Aalen smoothed hazard functions is monotonically decreasing. Therefore, they do not find strong evidence of rational speculative bubbles in OIC stock markets without regard to currency denominations. As usual in the empirical studies of this kind, the findings of this paper need to be interpreted with a measure of caution. It is worthy to point out that empirical rational speculative bubbles tests usually require correctly specified market fundamentals, which values are not available in our study, therefore, as Ahmed and Rosser (1995), Ahmed and Uppal (1999), we assume, the changes in dividends are relected in the market prices. However, the GCC stock market during the period had no available dividend history and no other empirically suitable proxy for market fundamentals. In

More recently, Jung-Suk Yu and Hassan (2011) examine the existence of rational speculative bubbles in the Middle East and North African (MENA) stock markets. Despite recent extreme fluctuations of MENA stock markets, fractional integration tests built on autoregressive fractionally integrated moving average models do not support the possibility of bubbles in the MENA stock markets. Similarly, duration dependence tests based on nonparametric Nelson-Aalen hazard functions not only reject the existence of bubbles but also support equality of hazard functions between domestic and the US-based investors without regard to the rapid financial liberalization and integration in the MENA stock markets.

To this end, we seek to extend research on emerging market bubbles to investigates the evidences and timing of rational speculative bubbles in GCC stock markets including Saudi Arabia, Qatar, United Arab Emirates, Oman and Bahrain over 2000 to 2013. The testing algorithm, recently developed by Phillips et al. (2012) is based on forward and backward recursively calculated Augmented Dickey-Fuller (ADF) test statistics and is more powerful than previously developed tests because it can detect the existence of multiple explosive periods and find their origination and termination dates.

The purpose of this paper is twofold. First, this paper is to test the existence of speculative bubbles in GCC stock market. Second, is to identify the date when the bubbles starts if the is speculative bubbles. Our empirical results indicate the existence of rational bubbles in GCC stock market in the early 2000s which is coincidence with structural changes and marker-deregulation in GCC stock market. Our results are contrary to Yu and Hassan (2009) who document that there is no bubble in the OIC country stock market. The rest of this paper is organized as follows. Section II will present the rational bubble model. Section IV reviews some relevant literature. Section IV highlights the data and empirical evidence and final section V concludes.

2. Rational Speculative Bubbles

Rational speculative bubbles have a long history in economics. Keynes (1936) described equity markets as an environment where speculators anticipate "what average opinion expects another average opinion to be", rather than focusing on things fundamental to the market. Starting from the seminal study by Shiller (1981), the issue of rational speculative bubbles on the US stock market has generated a large amount of literature; refer to Blanchard and Watson (1982), Tirole (1982, 1985) , Diba and Grossman (1987), West (1987) among others. Two surveys that cover both theoretical and empirical aspects of rational speculative bubbles include Camerer (1989) and Flood and Hodrick (1990). Speculative bubbles in stock markets are systematic departures from the fundamental price of an asset. Then a simple and basic efficient market condition is that an assets expected return is equal to its required return.

$$E_t[R_{t+1}] = R \tag{1}$$

where $E_t$denotes the mathematical expectation on the basis of the information set at time t. R is the constant risk free rate. $R_t + 1$ is the rate of return at time $t + 1$ and giving by

$$R_{t+1} = \frac{P_{t+1} - P_t + D_{t+1}}{P_t} \tag{2}$$

Where P_t is the price at time t. D_{t+1}) is the dividend paid for the owner of the stock between t and t+1. Therefore, in terms of prices, the equation (1) shows that the current price equals the expected future price plus the dividend, and then both discounted the rate of return required by the investors

$$P_t = (1 + R)^{-1}(E_t[P_{t+1} + D_{t+1}]) \tag{3}$$

If imposing the transversality condition $\lim_{n\to\infty} E_t[(1+R)^{-k} P_{t+k}] = 0$, solving euqation (3) by forward iteration yields the fundamental price:

$$p_t^f = \sum_{i=1}^{\infty} (\frac{1}{1+R})^i E_t(D_{t+i}) \tag{4}$$

Equation (4) states that the fundamental price is equal to the present value of all expected dividend payments. Testing bubbles in this case is to compared the integration order of the price series with that of the underlying dividend series, which is used to proxy fundamentals. Specifically Diba and Grossman (1988a) argue that if a bubble is not present then equation (4) would imply that prices and dividends have the same order of integration.

Alternatively Equation (4) can be expressed as

$$p_t^f - \frac{D_t}{R} = \frac{1}{R} \sum_{i=1}^{\infty} \left(\frac{1}{1+R}\right)^i E_t(\Delta D_{t+i+1}) \tag{5}$$

which, in turn implies that even if P_t and D_t are difference stationary the two series P_t and D_t should be cointegrated, thereby rules out the presence of bubbles.

However, Shiller (1978), Blanchard and Watson (1982) and West (1987) show, when the transversality condition does not hold, equation (4) is not the unique solution to equation (3), but only one solution from a potentially infinite class given by

$$p_t = p_t^f + B_t \tag{6}$$

where B_t, the bubbles term, is a sub-martingale that satisfies (Diba and Grossman, 1988a)

$$E_t[B_{t+1}] = (1 + R)B_t \tag{7}$$

Therefore, it can seen that if, on average, a rational speculative bubble factor B_t grows at the required rate of return, the market price can deviate from the fundamental value by the factor (McQueen and Thorley, 1994). Equation (6) says that if a bubble is present in the asset price, any rational investor must expect the bubble to grow.If this is the case and B_t is strictly positive, this builds the stage for speculative investor behavior. A rational investor is willing to buy an “overpriced” stock If the investor believes that price increases is sufficient to compensate for the extra payment he has to make as well as the risk of the bubble bursting. In that sense, the stock price bubble is a self-fulfilling expectations. The pricing of the asset is still rational (Gurkaynak, pril). Eventually,the bubbles implodes, stock price fall with sharp correction and de-leveraging occurs due to vicious enhanced stop-loss strategies. Bubbles of the kind are often termed as rational bubble because they do not violate the rational bubble hypothesis and hence, also are consistent with efficient market hypothesis.

When the bubble is present, B_t should be added to the right hand side of equation (5) , equation (7) states that B_t is an non-stationary, explosive process, which in turn implies that there is no cointegration between P_t and D_t due to $P_t^f - R^{-1}D_t$ will have an explosive expectation. Thus testing for unit root and cointegration between real stock prices and dividends is a way to test for the presence of bubbles (Diba and Grossman, 1988a).

The rational bubble condition given by equation (7) may take a variety of process. For instance, a bubble does not necessarily grow forever. This is a phenomenon that is not observed in the real world. Thus Blanchard and Watson (1982) depicts the progress of bubbles growing and bursting model that still satisfies the sub-martingale properties of equation (7) where

$$B_{t+1} = \begin{cases} \frac{(1+R)}{\pi} B_t - \mu_{t+1} & \text{with probability } \pi \\ \mu_{t+1} & \text{with probability } (1-\pi) \end{cases} \quad (8)$$

where $\{\mu_t\}_{t=1}^{\infty}$ is a sequence of iid random variable with zero mean. In each period, the bubble described in Equation (8) will continue, with probability π, or collapse with probability $1 - \pi$. As long as the bubble does not collapse, the realized return exceeds the risk-free rate R as a compensation for the risk that the bubble bursts. The expected rate of growth however is equal to R. Thus the Blanchard and Watson (1982) bursting bubble avoids the unappealing '*forever growth*' property of the previous growing bubble in equation (4). However Diba and Grossman (1988a) formally showed that once a bubble bursts it cannot restart. Therefore for a bubble to exist it must have been present on the first day of trading.

In his critique of Diba and Grossman (1988a) testing approach, Evans (1991) proposed the an alternative bursting model of periodically collapsing bubbles:

$$\begin{cases} B_{t+1} = (1+R)B_t u_{t+1} & \text{if } B_t \leq \alpha \\ B_{t+1} = [\delta + \pi^{-1}(1+R)\theta_(t+1)(B_t - (1+R)^(- 1)\delta)]u_{t+1} & \text{if } B_t \geq \alpha \end{cases} \quad (9)$$

where δ and α are the positive parameters which satisfy $0 < \delta < (1+R)\alpha$, and $\{u_t\}_{t=1}^{\infty}$ is an iid process with $u_t \geq 0$ and $E_t[u_{t+1}] = 1$ for all t. $\{\theta_t\}_{t=1}^{\infty}$ is an iid Bernoulli process, where the probability that $_t = 1$ is π and the probability that $\theta_t = 0$ is $1 - \pi$, with $0 < \pi \leq 1$. If the initial value $B_0 = \delta$, the bubble will increase until it exceeds some value of α. Thereafter, it is subject to the possibility of collapse with probability $1 - \pi$, in which case it will return to δu_{t+1}, otherwise it returns to δ in expectation. In other words, The bubbles process doesn't fall under Diba and Grossman (1988a) argument that is if the bubbles process collapses it cannot restart, since it never collapses to zero. The amplitude of bubbles and the length of time before collapse strictly depends on how important are the values of the parameter δ, α and π.

Standard unit root and cointegration tests may be able to detect one-off exploding speculative bubbles, but may not be able to detect periodically collapsing bubbles as proposed by Evans (1991). Evans (1991) showed that the traditional unit root tests are not well equipped to handle changes from I((0) to I(1) and back to I(0) which makes it not powerful enough in detecting explosive bubbles. Evanss periodically collapsing bubble led to the emergence of new tests that try to overcome the short comings of these unit root tests. For instance Taylor and Peel (1998) develop a residual augmented least squares Dickey Fuller test (RALS DF) that corrects for skewnesss and excess kurtosis. Hall and Sola (1999) propose an augmented Dickey Fuller test within a regime switching model to model these nonlinearities in the bubble process. Along the same line Bohl (2003) suggests using a momentum threshold autoregressive model (MTAR). Most recently, a nuanced and persuasive approach to identification and dating multiple bubbles in real time was developed by Phillips, Wu and Yu (2011, PWY), Phillips and Yu (2011b), Phillips and Yu (2011a) and Phillips et al. (2012) that combining technical rigor with ease of implementation. In following section, we demonstrate how periodically collapsing bubbles can be detected using the recursive right-tailed unit root tests by Phillips and Yu (2011b)and Phillips et al. (2012).

3. Econometric Approach

The essence of Phillips and Yu (2011b)and Phillips et al. (2012)is to spot speculative bubbles as they occur, not just after they have collapsed. The basic idea is that the observation of the explosive property of bubbles is very different from random walk behavior. Phillips and Yu (2011b)and Phillips et al. (2012)interpret mildly explosive unit roots as a hint for bubbles in their new recursive econometric approach. Consider the typical difference of stationary *vs* trend stationary process testing procedure for a unit root, where the focus is that the autoregressive process is no more than a unit root process. Phillips and Yu (2011b)and Phillips et al. (2012) testing approach, however, model mildly explosive behavior by an autoregressive process with a root that more unity but is still in the neighborhood of unity. The basic of this approach is to calculate recursively right-sided unit root tests to assess evidence for mildly explosive behavior in the data. The test is a right-sided test and therefore differers from the usual left-sided tests for stationarity. More specifically, the following autoregressive (AR) model estimated by recursive least squares:

$$y_t = \mu + \rho y_{t-1} + \varepsilon_t \qquad \varepsilon_t \sim iid(0, \sigma^2) \tag{10}$$

The null hypothesis is still $H_0 : \rho = 1$, but unlike the left-sided tests which have relevance for a stationary alternative, Phillips and Yu (2011b) set $H_1 : \rho > 1$, indicating a mildly explosivity, where the autoregressive parameter is a function of sample size such that $\rho_n = 1 + c/k_n, c$ is a constant,with $c > 0, k_n \to \infty$: and $k_n/n \to 0$.

It is worth to note that bubbles usually collapse periodically, Evans (1991) shows that the standard unit test and co-integration technique have limited power in detecting explosive bubbles.[2] To overcome this shortcoming, Phillips and Yu (2011b) proposed to use the supremum recursively determined Dickey-Fuller (DF) t-statistics to identify the time period where the explosive property of the bubble component become dominant in the asset price process. The test is applied sequentially on different subsamples. The subsample contains observations from the initial sample and then extended forward until all observations of the complete sample are included.

Specifically, Phillips et al. (2012) consider the null hypothesis that y_t follows a random walk with an asymptotically negligible drift:

$$y_t = dT^{-\mu} + y_{t-1} + \varepsilon_t \tag{11}$$

where d is a constant, T is the sample size, $\mu > 1/2$, and $\varepsilon_t \sim iid(0, \sigma^2)$. There are bubbles in the alternative case. Assume there are two bubble periods with the first one in the $A_1 = [\tau_{1e}, \tau_{1f}]$ and the second in $A_2 = [\tau_{2e}, \tau_{2f}]$, where $\tau_{1e}, \tau_{1f}, \tau_{2e}, \tau_{2f}$ are the origination and termination dates of each episode, respectively. This data generating process can be represented as:

$$\begin{aligned} y_t = y_{t-1}\mathbf{I}\{t \in N_0\} + \sigma_T y_{t-1}\mathbf{I}\{t \in A_1 \cup A_2\} + \left(\sum_{\kappa=\tau_{1f}+1}^{t} \varepsilon_\kappa + y^*_{\tau_{1f}} \right) \mathbf{I} t \in N_1 \\ + \left(\sum_{\kappa=\tau_{2f}+1}^{t} \varepsilon_\kappa + y^*_{\tau_{2f}} \right) \mathbf{I}\{t \in N_2\} + \varepsilon_t \mathbf{I}\{t \in N_0 \cup A_1 \cup A_2\} \\ t = 1, \ldots, T, \sigma_T = 1 + c/T^\alpha, c > 0, \alpha \in (0,1) \end{aligned} \tag{12}$$

where $\mathbf{I}$ is the indicator such that $\mathbf{I}\{.\} = 1$ when the conditions in the bracket hold and 0 otherwise, $\varepsilon_\kappa \sim iid(0, \sigma^2)$, and $N_0 = (1, \tau_{1e})$,$N_1 = (\tau_{1f}, \tau_{2e})$ and $N_2 = (\tau_{2f}, \tau)$ are three non-explosive sub-periods. At the bubble collapse dates τ_{1f} and τ_{2f} , the price reinitializes and jumps to a new level $y^*_{\tau_{1f}}$ and $y^*_{\tau_{2f}}$,respectively. For given values of c and α, the parameter σ_T, which equals $1 + c/T^\alpha$, is greater than unity in finite samples and approaches to one when the sample size T approaches infinity. This is what so called *mildly-integrated roots* as specified in Phillips and Magdalinos. (2007). While no general asymptotic inference can be established for purely explosive autoregressive process as the central limit theory does not apply (White, 1958, Anderson, 1959). The asymptotic behavior of midly explosive process is more regular and a least squares regression theory can be established to construct confidence intervals (Phillips and Magdalinos., 2007).

Equation (12) implies that to measure the start and end dates of multiple explosive bubbles accurately, the testing procedure must first distinguish the explosive behavior of the time series at τ_{1e} from its non-explosive behavior at τ_{1e-1}. Similarly, at τ_{1f} the testing procedure must be capable of identifying the transition from an explosive path to a random walk . The Phillips et al. (2012) procedure is designed to for such task.

Consider the following Augmented Dickey-Fuller (ADF) regression equation

[2] Busetti and Taylor (2004),Kim et al. (2002) and Leybourne et al. (2006)have shown that traditional unit root tests have low power in the case of gradually changing persistence and/or the existence of persistence breaks.

$$\Delta y_t = \mu_{r_1,r_2} + \rho_{r_1,r_2} y_{t-1} + \sum_{i}^{k} \phi^i_{r_1,r_2} \Delta y_{t-i} + \varepsilon_t \tag{13}$$

where $r_1$andr_2 denotes fractions of the total sample size that specify the start and end of the (sub)sample period. The number of observation in the regression is $n_w = [nr_w]$, where[.] denotes the integer part of its argument and the ADF-statistic (t-statistic) based on this regression is denoted by $ADF^{r_2}_{r_1}$. Then the standard ADF statistics corresponds to $r_1 = 0$ and $r_2 = 1$ and is denoted by ADF^1_0

Given a fraction r_0 of the total sample as a initial window size, The Phillips and Yu (2011b) test a sequence of ADF-tests based on a forward-expanding sample one observation stepwise and using the supremum of these as the basis of a test. The forward recursive sup ADF (SADF) test is defined as

$$SADF(r_0) = \sup_{r_2 \in [r_0,1]} \{ADF^{r_2}_0\} \tag{14}$$

A limitation of the $SADF$ test is the starting point is fixed as the first observation. The discriminatory power of the SADF could be diminished especially in the case of multiple bubbles with periodically collapsing behavior. Phillips et al. (2012) instead consider what is in effect a *backward* $supADF$ test, where the endpoint of the sample is fixed at a fraction r_2 of the total sample and the window size is allowed to expand from an initial fraction r_0 of the total sample to r_2. The backward $supADF$ statistic is then defined as

$$BSADF_{r_2}(r_0) = \sup_{r_1 \in [0, r_2 - r_0]} \{ADF^{r_2}_{r_1}\} \tag{15}$$

Finally, Phillips et al. (2012) construct a test based on the *generalized* supADF (GASADF) static which is contracted through repeated implementation of the BSADF test procedure for each $r_2 \in [r_0, 1]$. That is instead of fixing the starting point of the sample, the $GSADF$ test allows to change both the starting and ending point of the sample over a feasible range of windows. It was demonstrated that the $GSADF$ test outperforms the $SDAF$ test in detecting periodically collapsing bubbles. The GSADF test statistics is defined as the supremum of the BSADF test statistics

$$GSADF(r_0) = \sup_{\substack{r_2 \in [r_0,1] \\ r_1 \in [0, r_2 - r_0]}} \{ADF^{r_2}_{r_1}\} \tag{16}$$

The date stamping (date of bubbles emerges and collaps) is achieved through the BSADF statistic, a period belong to explosive region if

$$BSADF_{r_2}(r_0) > scv^{\alpha}(r_0). \tag{17}$$

where $scv^{\alpha}(r_0)$ is the $100 - (1 - \alpha)\%$ right side critical value of the $BSADF$ staticis. In other words, the beginning of the bubbles os estimated as the first date when the DF_t-statistic is greater than its corresponding critical value of the right-sided unit root test . The end of the speculative bubble is determined as the first period when the DF-t-statistic is below the aforementioned critical value. Because the distributions of both the $SADF(r0)$ and $GSADF(r0)$ are non-standard critical values have to be obtained through Monte Carlo simulations. One important advantage of the (2012) testing procedure is that it allows testing the bubble origination and termination dates on a real-time basis, which may be of considerable value to policymakers who want to monitor price variability and some precautionary steps make taken ahead of the bubbles.

4. Data and Empirical Evidence

4.1. Data

The data consists of weekly closing indices representing the GCC stock market. These include the Tadawul All Share Index (TASI) of Saudi Arabia, MSM 30 index of Oman, DSM 20 index of Qatar, Bahrain All Share Index of Bahrain, Dubai Financial Market General Index and Abu Dhabi Securities Exchange General Index are used in the analysis. The data source is Datastream We apply the tests to the logarithm of the inflation adjusted time series.

4.2. Empirical Finding

This section presents empirical testing results for rational speculative bubbles on the GCC stock market. We first apply the GSADF test to the equity market series. As a first step in determining the existence of explosive periods and locating their exact origination and termination dates, the lag order in the estimation equation (13) must be specified. Phillips and Yu (2011b) argue that the asymptotic distributions of the test statistics remain the same when a low lag order is used, so Phillips and Yu (2011b) used a lag order of zero when conducting the forward recursive analysis with initialization of the first observation. Phillips et al. (2012) further demonstrate that adding lag orders can potentially bias the estimation results and recommend obtaining the ADF test statistics with a lag order of zero. We thus employ the testing strategy recommended by Phillips et al. (2012) and set the lag order to zero in equation (13). The initial start-up sample for the generalized forward recursive analysis contains 36 observations as Phillips et al. (2012). Table 1 shows that the GSADF statistics for all countries are exceed their respective 1% right-tail critical values, giving strong evidences that those equity market under study had explosive sub-periods, Therefore we conclude that there are bubbles in these equity markets.[3]

Table 1: The GSADF tests of the GCC Equity Market Indexes

		Finite Sample Critical Values		
Country	Test statistics	90%	95%	99%
Saudi Arabia	4.267	1.282	1.604	2.184
Oman	3.733	1.291	1.605	2.170
Qatar	3.696	1.291	1.605	2.203
Bahrain	4.129	1.293	1.605	2.203
Dubai	5.314	1.229	1.507	2.107

Notes: Critical values are obtained from Monte Carlo simulation with 5,000 replication.

Having the evidence of bubbles in these equity market, we proceed to locate the bubbles period(s). When defining the end dates of the explosive periods, the price explosiveness needs to last at least some periods to be considered economically meaningful. Phillips et al. (2012) suggest the minimum length of the explosive period to be $log(T)$, giving a minimum length of 2 weeks for the data considered in this study. In locating the bubble period(s), we compare the backward SADF statistics sequences with the 95% SADF critical value sequence, which were obtained from Monto Carlo simulations with 5,000 replications.

Figure 1 - 6 displays results for the date-stamping strategy for different countries. The identified exuberance and collapse periods are highlighted with shade. For instance, in the case of Saudi Arabia, the bubbles starts October 2004 and ends March 2006. This strategy also identifies two episodes of crisis or explosiveness whose durations are shorter than three months, during July 2003 to October 2003 and April 2004 till May 2004. As noticed that Phillips et al. (2012) procedure not only locates the explosive expansion periods but also identifies collapse episodes.

5. Conclusion

This study examines the presence of the phenomenon of stock market bubbles in the GCC countries including Saudi Arabia, Qatar, United Arab Emirates, Oman and Bahrain over 2000 to 2013. Considering rational bubble change stock price from random walk to an explosive regime and traditional unit roots has less power in detecting periodically collapsing bubbles as point out by Evans (1991), this study employ newly developed testing approach of Phillips and Yu (2011b) and Phillips et al. (2012) right tailed unit root test to not only investigates the presence of rational periodically collapsing bubbles, but also stamps the times of bubbles emergence and collapse. Our empirical results indicate the existence of rational bubbles in GCC stock market,

[3] To have a robust results, we have used different lag order and different window size. The findings are qualitatively and quantitatively are robust to those choices.

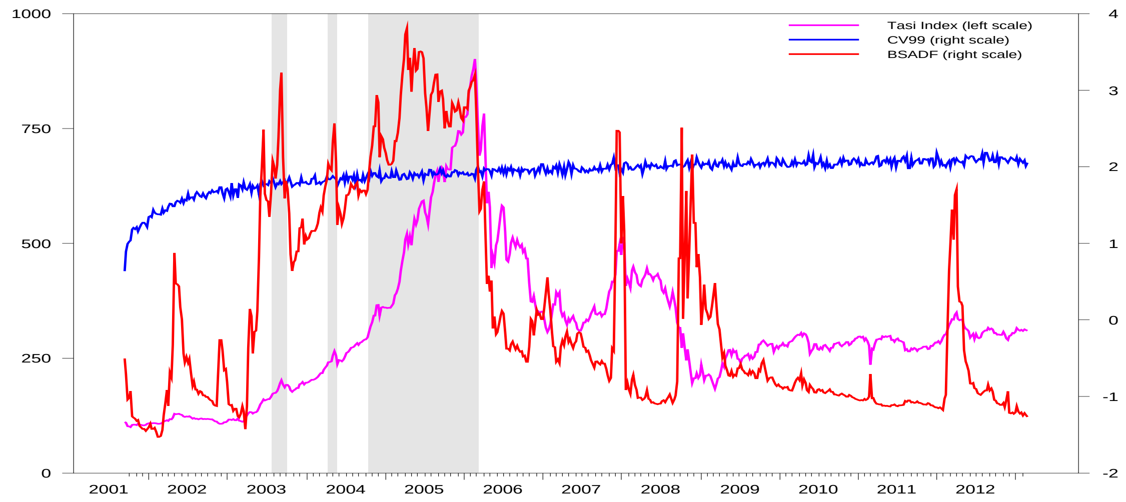

Figure 1: Date-Stamping bubble periods in the Saudi Arabia Tadawul All Share Index

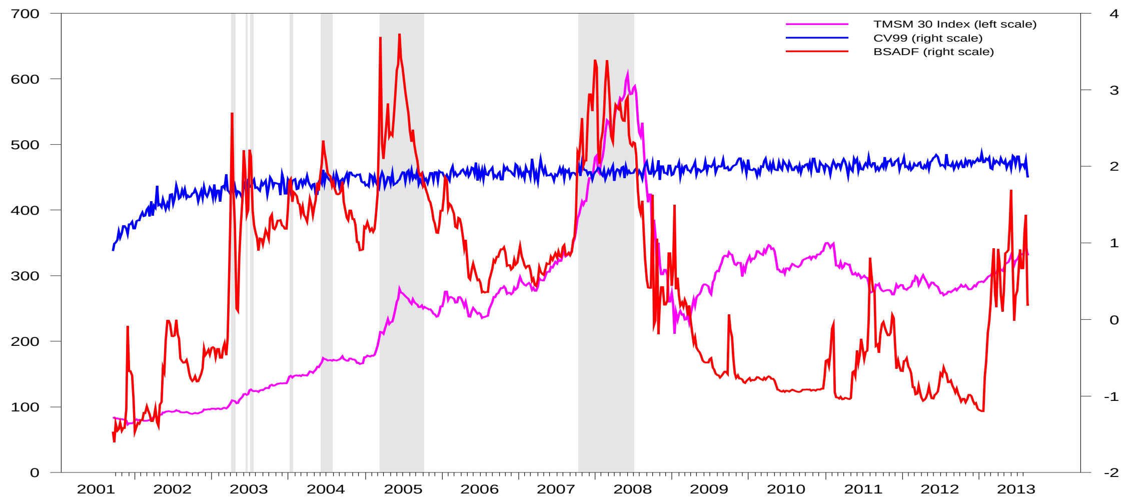

Figure 2: Date-Stamping bubble periods in the MSM 30 Index of Oman

which is contradicted to that of Yu and Hassan (2009) and Jung-Suk Yu and Hassan (2011). The estimation of the starting date of the bubbles indicates that explosive regime emerges in the early 2000s.

The results of this paper provide various implications to the investors and most importantly to the policy makers. From the investors point of view, it will make them conscious of the size of a bubble, then assist them in identifying early signals prior to crash, which may enable them to perform rationally by selling the assets and adjusting the share price toward its fair value, as well as making the market to be efficient. The existence of rational speculative bubble may lead to a serious mis-allocation of resources and harsh economic fluctuations. The Economy in this region may also be subject to instabilities and oscillations. This results may also raise questions to Islamic economics and prohibition of *gharar*. Policy-makers need to be aware, therefore, of the potential harm caused by irrational investor behavior and may require intervention to prevent stock market immoderation.

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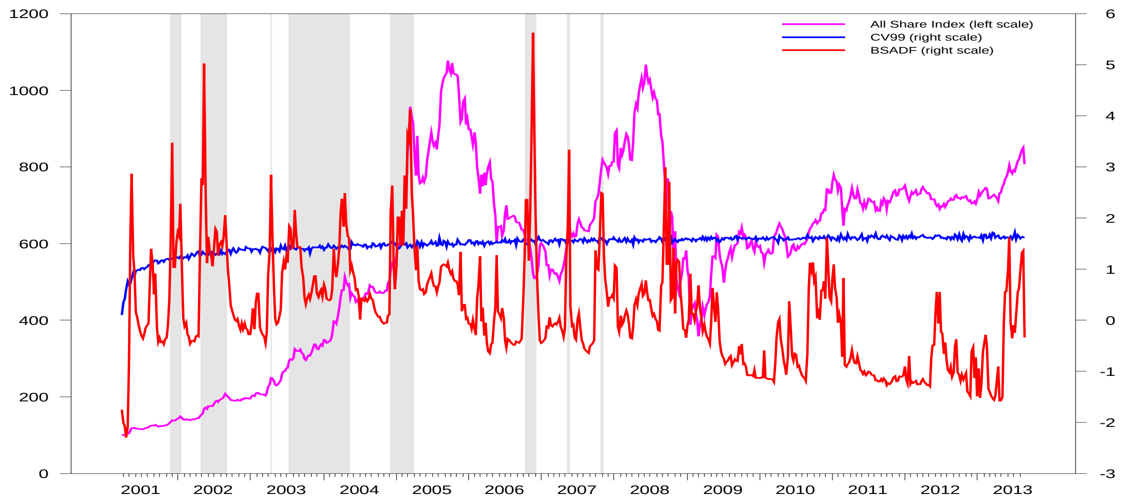

Figure 3: Date-Stamping bubble periods in the DSM 20 Index of Qatar

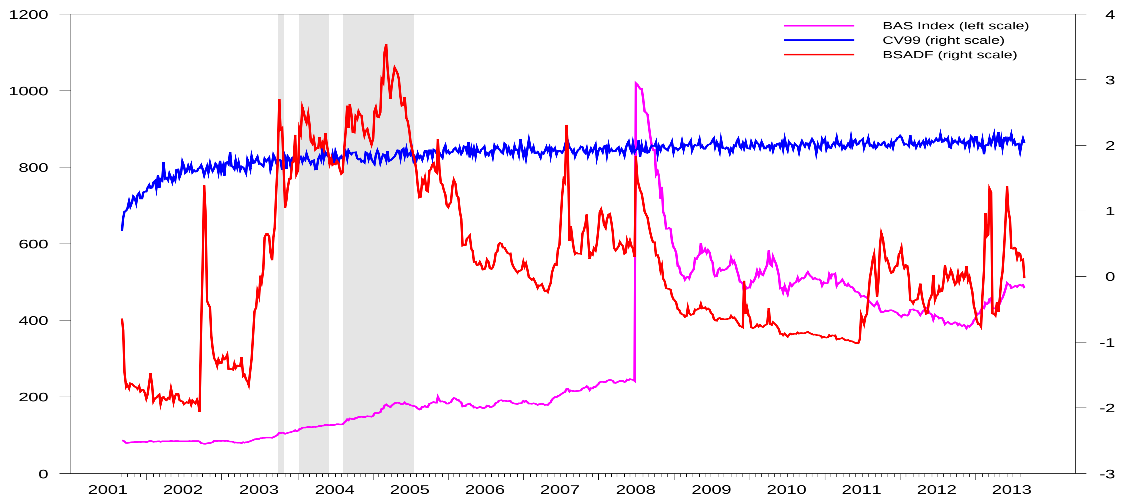

Figure 4: Date-Stamping bubble periods in the All share index of Bahrain

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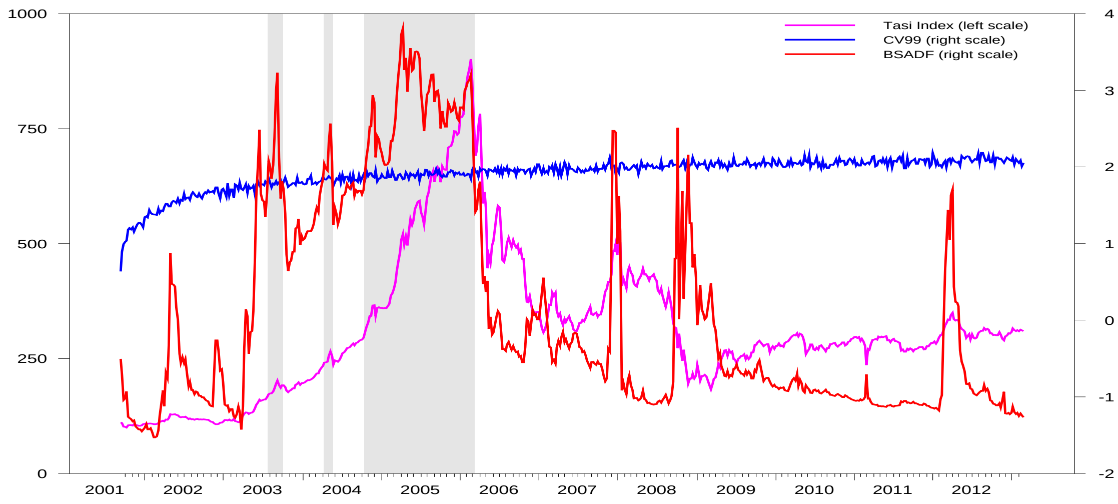

Figure 5: Date-Stamping bubble periods in the Dubai Financial Market General Index

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