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Are there periodically collapsing bubbles in the stock markets? New international evidence

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ABSTRACT

A stock price may face a bubble problem for a number of periods, but in the long run the stock price is determined by its market fundamentals. This paper takes this possibility into account and examines whether there are periodically collapsing bubbles in four international stock markets, i.e., the US, Belgium, Denmark and Finland. We test for the presence of periodically collapsing bubbles by examining the nonstationarity of the log dividend yields based on the dividend discount model. Among the main results, it is found that the hypothesis of the rational bubbles cannot be rejected for these stock markets. In addition, the empirical evidence does not favor the hypothesis of the periodically collapsing bubbles provided that nonlinear adjustment and structural break are allowed. The presence of the rational bubbles, but not the periodically collapsing bubbles, is in line with the rational expectations and efficient market hypothesis.

1. Introduction

Economists have shown considerable interest in the dividend discount model of stock prices which argues that the stock price is the present discounted value of the future expected dividend (e.g., Campbell and Shiller, 1987; Campbell et al., 1997; Cochrane, 2001). However, asset prices that are in excess of what is viewed as the asset's fundamental value have been interpreted as speculative bubbles. A class of speculative bubbles, known as rational bubbles, does not violate the rational expectations' hypothesis and is consistent with the efficient markets hypothesis.

Theoretically, non-fundamental stock price increases and crashes can be integrated into dividend discount model by dropping the transversality condition which imposes a unique solution on the stock prices. Empirical studies, however, have often reported substantial deviations between actual stock prices and theoretical stock prices derived from the linear dividend discount model. For example, many studies find that U.S. stock prices are more volatile than those determined by the dividend discount model. A number of factors have been put forth to account for this substantial deviation, including stochastic speculative bubbles (Blanchard and Watson, 1982; Evans, 1991; West, 1987); noise trader models (Kirman, 1991, 1993; Shleifer, 2000), fads (Shiller, 1981), varying discount rates (Campbell and Shiller, 1988a, 1988b), and the intrinsic bubble (Driffill and Sola, 1998). Readers are referred to Gürkaynak (2008) for an excellent survey.[1]

The extant empirical evidence on the existence of the rational bubble has been extensively presented in the unit root and cointegration framework. For example, Diba and Grossman (1988) showed that linear unit root tests can empirically detect a simple form of rational speculative bubbles. Those studies reporting unit root behavior in the price–dividend relationship, which in turn provides implicit support for the rational bubbles hypothesis (e.g. see Froot and Obstfeld, 1991; Balke and Wohar, 2002; Sarno and Taylor, 2003; Bohl and Siklos, 2004; Kanas, 2005; Jiang and Lee, 2007; McMillan, 2007; Cerquetia and Costantini, 2011), and also those arguing that the price–dividend ratio exhibits fractional integration such that while it is characterized by long memory, the series is ultimately mean reverting (Caporale and Gil-Alana, 2004; Cuñado et al., 2005; Koustas and Serletis, 2005).

The cointegration test examines the relationship between security prices and the vector of fundamental factors over the long term (see Bohl, 2003; Brooks and Katsaris, 2003; McMillan, 2007). If the residuals of the regression of security prices on any set of fundamentals are stationary, I(0), then this can be regarded as evidence against the existence of a bubble. In addition, if security prices and fundamental factors exhibit a long-run relationship as evidenced by any number of cointegrating

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[1] Yoon (2012) recently explores some properties of periodically collapsing bubbles and demonstrates that complicated nonlinear bubbles can be represented as a time-varying parameter linear model of order one. Chen and Duan (2011) propose new models of trader beliefs to explain the creation and burst of price bubbles.

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vectors, they serve as evidence against the existence of bubbles in the security prices. However, Evans (1991) argues that this standard approach will not be able to detect a class of periodically collapsing rational bubbles. For example, the sudden collapse of a bubble may be mistaken by standard cointegration tests for mean reversion, resulting in a bias toward rejection of the null hypothesis of no cointegration.

Different approaches are proposed in the literature in order to test for the periodically collapsing bubbles.[2] For example, Scacciavillani (1994) suggests a test based on fractional differencing. Hall et al. (1999) propose a Markov-switching ADF test. van Norden (1996) employs a switching regression similar, but not equivalent, to the Markov-switching Augmented Dickey–Fuller approach. Taylor and Peel (1998) introduce a cointegrating regression residuals-augmented least squares (RALS) Dickey–Fuller test. Recently, Al-Anaswah and Wilfling (2011) use a state-space model with Markov-switching to detect speculative bubbles in stock-price data and find significant Markov-switching structures in real-world stock-price bubbles. Shi (2013) provides some empirical guidelines for the practical implementation of the Markov-switching Augmented Dickey–Fuller test proposed by Hall et al. (1999) for detecting explosive bubble behavior. Narayan et al. (2013) propose a cross-sectional model of the determinants of asset price bubbles. Using 589 firms listed on the NYSE, they find conclusive evidence that trading volume and share price volatility have statistically significant effects on asset price bubbles.

Another prevalent approach proposed by Phillips et al. (2011) is the sup ADF test. Phillips et al. (2011) empirically test the presence of periodically collapsing bubbles by extending the econometric theory of testing under explosive roots developed by Phillips and Magdalinos (2013). Gutierrez (2011) proposes a bootstrap method which helps in computing the finite sample probability distribution of the asymptotic tests recently proposed in Phillips et al. (2011). By using the bootstrap method, Gutierrez (2011) provides some evidence of bubble characteristics in the price data for the Nasdaq index and Case–Schiller's house prices index. Knight et al. (2014) present a model of bubbles that allows for explosive behavior in at least one regime but still allows for the existence of a steady-state distribution in asset prices, even when a bubble exists. Feng and Wu (2015) employ an equilibrium asset-pricing approach to evaluate China's housing market. Their empirical evidence rejects the existence of a house price bubble at the national level, but it does not rule out a house price bubble in specific local markets.

Some researchers try to detect the bubble by using the Bayesian approach in the literature.[3] See, for example, Li and Xue (2009), Miao et al. (2014), Check (2014), Fulop and Yu (2014) and Shi and Song (forthcoming), to name but a few. The Bayesian approach can extend the bubble testing with using good prior information or giving more flexible extensions on the model. Fulop and Yu (2014) propose a new regime switching model with two regimes, a normal regime and a bubble regime. To estimate the model they use a sequential Bayesian simulation method that allows for real time detection of bubble origination and conclusion. Shi and Song (forthcoming) propose a new infinite hidden Markov model to integrate the detection, datestamping, and estimation of bubble behaviors in a coherent Bayesian framework. As to hypothesis testing problem (bubble case is a special case), it is known that there are some problems in Bayesian hypothesis testing; see Li and Yu (2012), Li et al. (2014), Li et al. (2015) for details.

The aim of this study is to revisit the issue regarding the periodically collapsing bubbles for four international stock prices, namely, the S&P 500, the Belgium stock market (BEL 20), FTSE Denmark and FTSE Finland. To the best of the author's knowledge, some researchers, for instance, Taylor and Peel (1998), Hall et al. (1999), Sollis (2006), McMillan (2007), Phillips et al. (2011) and Yoon (2012) have devoted their efforts to testing for the periodically collapsing bubbles in the stock markets.[4] These studies have so far typically provided an inconclusive answer regarding the periodically collapsing bubbles. However, a stock price may face a bubble problem for a number of periods, but in the long run the stock price is determined by its market fundamentals, i.e., the present discounted value of the future expected dividend. This paper takes this 'possibility' into account and reexamines whether there are periodically collapsing bubbles in international stock markets. In doing so, we adopt the momentum threshold (hereafter MTAR) unit root test, proposed by Enders and Granger (1998) and Enders and Siklos (2001), in this study.[5]

The MTAR model is attractive because it is powerful in testing for periodically collapsing bubbles. As explained in Bohl (2003), the MTAR model can be used to analyze bubble driven run-ups in stock prices followed by a crash in a cointegration framework with asymmetric adjustment. This technique offers a more potent insight in the stock prices' behavior than can possibly be obtained using conventional linear cointegration tests. The Monte Carlo simulation findings of Bohl (2003) show that the MTAR approach provides a sufficiently powerful test to detect periodically collapsing bubble behavior when the actual data generating process is given by the bubble model put forward by Evans.

The MTAR model allows for the possibility of a regime shift between two different trend paths over time. In addition, in order to take the possibility of non-linear trends into consideration, we also use the logistic smooth transition momentum threshold (hereafter LNV-MTAR) unit root test, championed by Cook and Vougas (2009), in this paper. This approach permits a structural break to occur gradually over time instead of instantaneously. Leybourne and Mizen (1999) point out that "when considering aggregate behavior, the time path of structural changes in economic series is likely to be better captured by a model whose deterministic component permits gradual rather than instantaneous adjustment."[6]

As compared to the literature, the contributions of this study are threefold. First, the application of the MTAR technique overcomes the weakness of the traditional linear unit root test in detecting the periodically collapsing bubbles. It allows us to draw conclusions about the long-run validity of the dividend discount model and, hence, addresses the question of whether the stock prices adhere to fundamentals in the long run. Furthermore, in investigating the short-run dynamics the MTAR approach provides a test concerning the importance of bubble-like processes in stock prices. Second, as noted by Phillips et al. (2011), it is important to recognize the possibility of a structural shift in the stock prices and dividends in testing for the null hypothesis of a unit root. We take this possibility into consideration by employing Cook and Vougas's (2009) approach. They combine the ideas of

[2] Homm and Breitung (2012) investigate the ability of several tests to detect rational bubbles.

[3] We owe this point to an anonymous referee.

[4] Payne and Waters (2005, 2007), Jirasakuldech et al. (2006), Waters and Payne (2007) and Xie and Chen (2015) test for the periodically collapsing bubbles in the real estate investment trust markets.

[5] Doffou (2007) investigates empirically the existence of periodically collapsing bubbles in the Asian emerging stock markets using the Enders and Siklos (2001) momentum threshold autoregressive model. The empirical findings for 10 Asian emerging stock markets from 1993 to 2005 refute the bubble hypothesis. Jahan-Parvar and Waters (2010) also use the same approach to test for the existence of periodically collapsing bubbles for seven Middle East and North African (MENA) financial markets. They find that the hypothesis of a bubble formation cannot be rejected for all seven markets. Readers are referred to Nunes and Da Silva (2008) and Vishwakarma (2013) for applying the MTAR model to examine periodically collapsing bubbles for different markets.

[6] In the context of economic time series this has considerable intuitive appeal. Generally speaking, changes in economic aggregates are influenced by the changes in behavior of a very large number of agents. It is highly unlikely that all individual agents will react simultaneously to a given economic stimulus; while some may be able to (and want to) react instantaneously, others will be prone to different degrees of institutional inertia (dependent, for instance, on the efficiency of the markets in which they have to operate) and so will adjust with different time lags (Leybourne and Mizen, 1999, p 804).

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