Rational Speculative Bubbles in Istanbul Stock Exchange

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ABSTRACT

The stock market in Turkey has been experiencing a bullish market condition especially since 2002. Turkish equity market also had several boom and bust cycles in recent years, which raises the question of whether equity prices in Turkey reflect their fundamental values. An asset price movement, unexplained by the fundamentals is called a price bubble. In this paper, the existence of a bubble in the Turkish stock market is tested for the period 2002 – 2010. A relatively new technique, duration dependence test is used to detect any rational speculative bubble in Turkish stock market. Results of non-parametric duration dependence test indicate evidence of no negative duration dependence in runs of positive excess returns, consistent with the absence of rational expectations bubbles during the sample period.

Keywords: *Rational Speculative Bubble, Duration Dependence, Turkish Stock Market*

Jel Classification: G14, G10, G12

İstanbul Menkul Kıymetler Borsası'nda Rasyonel Spekülatif Balonlar

ÖZET

Türk hisse senedi piyasası özellikle 2002 yılından bu yana bir boğa piyasasının koşullarını yaşamaktadır. Ayrıca son yıllarda Türk hisse senedi piyasası, hisse senedi fiyatlarının temel değerleri yansıtıp yansıtmadığına ilişkin bir şüpheyi uyandıran çeşitli ani aşırı yükseliş ve çöküş döngülerine tanıklık etmiştir. Herhangi bir varlıktaki temel değerlerle açıklanamayan bir fiyat hareketine, spekülatif balon adı verilir. Bu makalede, Türk hisse senedi piyasasında, herhangi bir spekülatif balon olup olmadığı 2002 – 2010 dönemi için test edilmektedir. Göreceli olarak yeni kabul edilebilecek bir yöntem olan süre bağımlılığı testi, Türk hisse senedi piyasasında bir rasyonel spekülatif balonun var olup olmadığını tespit etmek amacıyla kullanılmaktadır. Bu makalede parametrik olmayan süre bağımlılığı testi sonuçları, pozitif aşırı getiri koşularında negatif süre bağımlılığı olmadığını göstermektedir. Analiz sonuçları, örneklem döneminde Türk hisse senedi piyasasında bir rasyonel spekülatif balonun var olmadığı çıkarımıyla tutarlıdır.

Anahtar Kelimeler: *: Rasyonel Spekülatif Balon, Süre Bağımlılığı, Türk Hisse Senedi Piyasası*

Jel Sınıflandırması: *G14, G10, G12*

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1. Introduction

The term speculative bubble is used to define continuous market overvaluation of assets followed by a market crash. Theoretical literature provides alternative explanations for the existence of speculative bubbles on asset markets. The bubbles can be classified into three groups: (i) rational bubbles; (ii) irrational bubbles, fads, and noise traders and (iii) inefficiencies that are due to imperfect and heterogeneous information (Boucher, 2003: 2). The existence of irrational bubbles can be attributed to the existence of irrational investors in markets. A speculative bubble can be caused by the inefficiencies that are due to heterogeneous or imperfect information. The reason for the existence of such a bubble is the informational asymmetry among markets participants. In this study, rational stock bubbles are examined. The point which converts a speculative stock market bubble into a rational speculative bubble is the investors' realization of prices which exceed fundamental values. As stated by Chan et al. (1998) one of the basic characteristics of rational speculative stock market bubbles is that stock prices may deviate from their fundamental value, even though existence of irrational investors is assumed. If there is a rational speculative bubble in stock markets, prices deviate from fundamental value, but, investors believe that, with high probability, the prices will continue to increase and they yield a high return which compensates the risk of the probability of a market crash. This investor belief shows the rationality of staying in the market despite the overvaluation.

Calverley (2004: 11-12) defines the classic profile of a bubble as several stages. In the beginning stage, there is a so-called displacement, some outside event that changes the investment environment and seems to open up a new investment opportunity. The displacement can be the end of a war, a new technology or perhaps a large fall in interest rates. If this displacement effect is strong enough, it generates an economic boom as investment goes into the new area. New investment floods into the new area, pushing up prices and opening up still more profit opportunities. At some stage the bubble reaches a phase variously called euphoria or mania, where speculation mounts on top of genuine investment and expectations for potential returns reach wild heights. Strong market performance is extrapolated endlessly forward and any consideration of fundamental valuation criteria is swept aside. Eventually the market rise slows as some people take profits and fewer people are willing to come in. And a new event precipitates a decline in prices. This event can be a new external shock such as war, or it may be a rise in interest rates or slowdown in the economy. Sometimes the trigger does not necessarily have to be a large event. The next stage is called revulsion; prices fall, financial distress rises, bankruptcies mount, and banks pull back on lending. The economy is affected by the fail in new investment and the rise in uncertainty so that perfectly good projects now fail, adding to the distress.

There may also be a panic phase, when prices fall extremely rapidly as people try to sell before everyone else and there are hardly any buyers which means that liquidity may dry up.”

In most cases, a typical bubble ends up with a crash, following the crash; the economy is hit by a combination of reduced wealth, financial caution, and uncertainty. This situation leads to an economic slowdown or a recession or at worst a major depression. Bubbles can cause major problems when they occur in an asset that is widely held. Bubble does not affect directly a large number of people when bubble bursts. As the bubble inflates it also interacts with the economy, creating a self-reinforcing boom and bust. The most dangerous bubbles are therefore usually the ones in stock markets and property (Calverley, 2004: 6).

Bubbles are not the unique for the modern economy; they are dated back to hundreds of years ago in the history, for example, the Tulip Mania (Holland, 1630s), and the South Sea Bubble (London, 1720). In the twentieth century the most famous bubbles are the Wall Street Crash (the US, 1929), the Japanese bubble (1980s), the Asian Tigers bubble (mid-1990s), and the technology mania (late 1990s). Recently we have been experiencing housing price bubble since 2007.

There are several methods to test for the presence of speculative bubbles in asset prices. Brooks and Katsaris (2003) group these methods into three main categories: tests for bubble premiums, tests for excess volatility and tests for the cointegration of dividends and prices. They also state that tests of stationary and cointegration are the best analytical tool available to identify the presence of a long-term relationship between actual prices and fundamental variables. The presence of a long-term relationship between dividends and prices can be an indication of bubble absence, but the tests greatly depend on the method employed to construct fundamental values (Brooks and Katsaris, 2003: 331). McQueen and Thorley (1994) classify bubble tests into two basic categories. One category of bubble tests compares actual prices to fundamentals, which are believed to determine price. To find evidence of bubbles, stock prices can be compared with dividends with variance bounds tests or regressions. These tests assume linearity relating all the observations in a series to the value of prior observations using one set of parameters. However, rational speculative bubbles suggest nonlinear patterns in returns. A second category of bubble tests examines returns for empirical attributes of bubbles such as autocorrelation, skewness, and kurtosis, which result from the two characteristics of bubbles: extended runs of positive abnormal returns and crashes. However, these attributes are not unique to bubbles and are often associated with fundamentals (McQueen and Thorley, 1994: 380).

Gurkaynak (2008) classifies the econometric tests of rational bubbles as variance bounds tests, West’s two-step tests and integration/cointegration based tests. Cointegration method is criticized based the joint test of null hypothesis of no bubble and no model misspecification. Gurkaynak (2008: 182) points out that the econometric bubble detection tests impose very little structure on the bubble process. These tests do not produce a time series of the bubble component, so it is difficult to evaluate whether the implied properties of the bubble are reasonable or not.

A method, called duration dependence test, was firstly employed to detect rational speculative price bubbles by McQueen and Thorley (1994). They suggest that if security prices contain bubbles, then runs of positive abnormal returns will exhibit negative duration dependence (decreasing hazard rates). Hazard rate is the conditional probability of a positive abnormal return run's ending, given its duration, is a decreasing function of the duration of the run. Duration dependence test does not require normally distributed time series data and the identification of fundamental factors.

Since the foundation of the Istanbul Stock Exchange (ISE) in 1987, ISE has experienced a rise along with the growth of Turkish economy. From 2002 to 2009, while Turkish economy (GDP) has increased 130% in current prices, indicator index, ISE 100 index has increased 285% in nominal returns, as represented in Figure 1 and 2.

Figure 1: ISE 100 Price Index 1998/12 – 2010/09

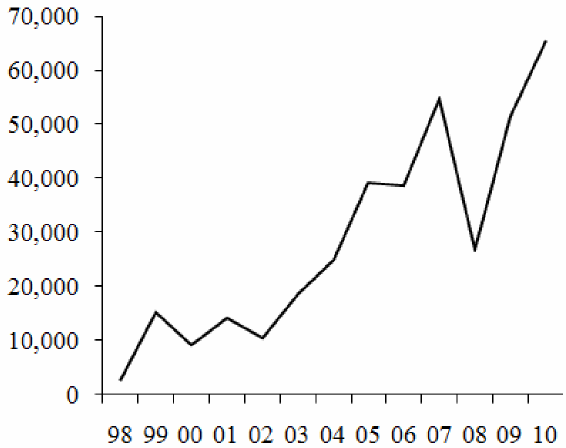
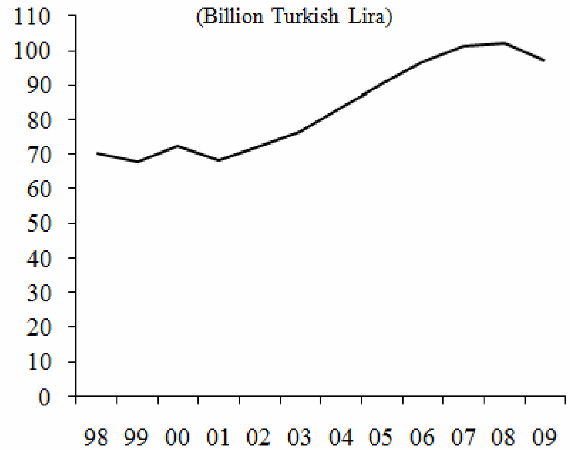


Figure 2: Turkey's GDP 1998 – 2009



Explosive growth of Turkish stock markets between 2002 and 2010 has led investors to suspect the existence of a bubble in the markets. Although there is a discussion about the existence of bubbles in Istanbul Stock Exchange, there exists limited systematic study trying to explain whether the price behavior in Istanbul Stock Exchange is consistent with the characteristics of stock market bubble.

This paper examines the Istanbul Stock Exchange returns for the special empirical properties of a rational speculative bubble using duration dependence test. In section 2, the basic rational speculative bubble model is explained. In section 3, the data used in this study is described and empirical duration dependence test is explained. In section 4, duration dependence tests are conducted and the results of the tests are reported. In section 5, the conclusions are presented.

2. Rational Speculative Bubble Model

McQueen and Thorley (1994) and Chan et al. (1998) explain the basic rational speculative bubble model as following. In a simple efficient market condition, expected return of any asset equals its required return (McQueen and Thorley, 1994: 380; Chan et al. 1998: 128),

$$E_t\,[R_{t+1}] = r_{t+1} \qquad (1)$$

where E denotes the mathematical expectation given the information set at time t, $R_{t+1} \equiv (p_{t+1} - p_t + d_{t+1}) / p_t$, p_t is the price at time t, d_{t+1} is the dividend at time t + 1, and r_{t+1} is the required rate of return. According to Chan et al. (1998) the competitive equilibrium condition in equation (1) states that the current price equals the expected future price plus the dividend, both discounted at the return required by investors (McQueen and Thorley, 1994: 381; Chan et al. 1998: 128),

$$p_t = \frac{E_t\,[p_{t+1} + d_{t+1}]}{(1 + r_{t+1})} \qquad (2)$$

Solving equation (2) in a repetitive manner yields one solution to the equilibrium condition. This solution is the fundamental value of the asset (McQueen and Thorley, 1994: 381; Chan et al. 1998: 128),

$$p_t^* \equiv \sum_{i=1}^{\infty} \frac{E_t\,[d_{t+i}]}{\prod_{j=1}^{i} (1 + r_{t+j})} \qquad (3)$$

However, in the literature, any price of the form

$$p_t = p_t^* + b_t, \text{ where } E_t\,[b_{t+1}] = (1 + r_{t+1})\, b_t \qquad (4)$$

is a solution to the equilibrium condition as well. In this respect, the market price can deviate from the fundamental value by a rational speculative bubble factor, b_t, if, on average, the factor grows at the required rate of return. Blanchard and Watson (1982) propose one type of rational bubble which allows the bubble to grow and burst (McQueen and Thorley, 1994: 381; Chan et al. 1998: 128):

$$b_{t+1} = \frac{(1+r_{t-1})\,b_t}{\pi} - \frac{1-\pi}{\pi}\alpha_0 \text{, with probability } \pi \qquad (5)$$

$= \alpha 0$, with probability $(1 - \pi)$.

In this process, the bubble factor grows by the exact amount needed to compensate investors or the probability, $(1 - \pi)$, that the bubble will crash and revert to the small initial value,$\alpha 0>0$. In order for the Blanchard and Watson (1982) model to be consistent with the two traditional characteristics of bubbles, a long run-up in price followed by a crash, the probability of the bubble continuing, π, also must be greater than 50 percent (McQueen and Thorley, 1994: 382; Chan et al. 1998: 128-129).

This rational speculative bubble model allows for unexpected price changes, $\varepsilon_{t+1} \equiv (R_{t+1} - r_{t+1})\, p_t$, from two unobservable sources. These are unexpected changes in the fundamental value, as stated in equation (6) and unexpected changes in the bubble, as stated in equation (7) (McQueen and Thorley, 1994: 382; Chan et al. 1998: 129),

$$\mu_{t+1} = p^*_{t+1} + d_{t+1} - (1 + r_{t+1})\, p^*_t \qquad (6)$$

$$\eta_{t+1} = b_{t+1} - (1 + r_{t+1})\, b_t \qquad (7)$$

The observable unexpected price change, $\varepsilon_{t+1} = \mu_{t+1} + \eta_{t+1}$ equals the sum of the fundamental and bubble changes (McQueen and Thorley, 1994: 382; Chan et al. 1998: 129)

$$\varepsilon_{t+1} = \mu_{t+1} + \frac{(1-\pi)}{\pi}\left((1 + r_{t+1})\, b_t - \alpha_0\right) \text{, with probability } \pi \qquad (8)$$

$= \mu_{t+1} - (1 + r_{t+1})\, b_t + \alpha_0$, with probability $(1 - \pi)$.

In order to explain the bubble generating process, in their study, Chan et al. (1998) assert that in the efficient markets condition, the expected value of bubble factor is zero. However, the probability of a bubble factor or abnormal return can be greater than 50 percent even if the fundamental innovations are symmetric around zero. The basic reason of such a situation is the inherent skewness of the bubble innovations. If the bubble continues, its innovation is positive. Positive innovation will be small relative to an infrequent but large negative innovation if the bubble bursts. The growth rate of the bubble factor increases each period, this growth rate enables the bubble survive to compensate investors for the potential crash of a progressively larger bubble. While it survives, the explosive bubble factor becomes a more dominant component in total price innovations compared to fundamental factor, causing higher and higher observed returns leading up to the crash (Chan et al. 1998: 129).

Chan et al. (1998) state that the skewed and explosive nature of bubbles combined with the serially independent fundamental value innovations cause bubbles to leave some 'footprints' in observed returns. These footprints include positive autocorrelation (a preponderance of positive returns while the bubble grows), negative skewness (unusually large negative returns when the bubbles crashes) and leptokurtosis (fat tails due to the mixing of distributions as the bubble grows). However, these basic statistical attributes of bubble-based return moments are inconclusive, because fundamental price movements can also be associated with these attributes (Chan et al. 1998: 129).

After Chan et al. (1998) emphasize that using basic descriptive statistical attributes for detecting a rational speculative is not acceptable, they suggest a new non-parametric test, called as duration dependence test, developed by McQueen and Thorley (1994) stating that a long run of positive excess returns suggests the presence of a bubble, and a bubble decreases the probability of a negative abnormal return. Taken together, these characteristics leave a unique footprint in observable returns: if there is a price bubble, then runs of observed positive abnormal returns will exhibit duration dependence with an inverse relation between the probability of a run ending and the length of the run. A similar inequality does not hold for runs of negative abnormal returns, because bubbles can never be negative. In other words, bubbles generate negative duration dependence in runs of positive abnormal returns (Chan et al. 1998: 130).

As stated by Gurkaynak (2008) many existing econometric bubble tests have one thing in common: they are not very good at detecting bubbles. The duration dependence test can overcome most of the criticisms laid against traditional bubble tests; its advantages are that it is unique to bubbles, it addresses nonlinearity and it does not require correct identification of the observable fundamental variables. However, one disadvantage of using duration dependence test is its sensitivity to the data set (weekly or monthly returns). Harman and Zuehlke (2004) found inconsistencies in their results by using weekly and monthly data which shows the sensitivity of duration dependence test results to the data set.

3. Literature Review

Stock market bubbles have a long history and there are several conditional econometric bubble tests. However, use of duration dependence test to detect a stock market bubble is a relatively new technique. McQueen and Thorley (1994) in their pioneering study prove the presence of speculative bubbles in the New York Stock Exchange (NYSE) with duration dependence test by using data from 1927 to 1991. They find that there is statistically significant negative duration dependence in runs of monthly positive abnormal returns for both equally weighted and value-weighted portfolios of NYSE-traded securities.

Chan et al. (1998) investigate the existence of speculative bubbles in several Asian stock markets and the Standard & Poor's 500 Index by using weekly and monthly abnormal returns. They find no statistically significant duration dependence in returns to the S&P 500 and Asian stock markets except one case implying that there are no rational speculative bubbles among the S&P 500 and most of Asian stock markets for the period 1975 – 1994.

Lavin and Zorn (2001) examine the fundamental-value hypothesis in agricultural land markets with duration dependence tests over the period 1910 – 1995 by using yearly data. The results of duration dependence tests in this study indicate that rational-expectations bubbles do not exist in land values.

Harman and Zuehlke (2004) test the presence of rational speculative bubbles in NYSE and American Stock Exchange (AMEX) over the period 1927 – 1997. They also examine the sensitivity of duration dependence tests for speculative bubbles to several hazard models, to value-weighted or equally weighted portfolios and to the construction of monthly versus weekly runs of abnormal returns. They find that the conclusions are sensitive to the choice of sample period, the method of controlling for discrete observation of continuous duration, the use of equally weighted versus value-weighted portfolios, and the use of weekly versus monthly returns. The results of this study call into question the efficacy of using hazard models to test for speculative bubbles.

Jirasakuldech et al. (2008) examine whether Thai equity market is characterized by rational speculative bubbles over the period June 1975 and June 2006. They conduct both the cointegration test and duration dependence test. The cointegration test provides of no lung-run relationship among prices, dividends and earnings indicating the presence of a rational bubble. Furthermore, the results of non-parametric duration dependence test show evidence of negative duration dependence in runs of positive returns, consistent with the presence of rational expectations bubbles.

Zhang (2008) analyzes the rational speculative bubbles in Chinese stock market for the period 1991 – 2001 by applying duration dependence tests. The results show that the probability of ending a run of positive excess returns decreases with the length of the run, the results on the duration tests are consistent with rational bubbles.

Tasci and Okuyan (2009) test the existence of speculative bubbles in Istanbul Stock Exchange over the period 1987 – 2008 by using duration dependence tests. They use daily nominal returns not real or abnormal returns contrary to general duration dependence test methodology. They find no statistically significant evidence supporting the presence of speculative bubbles in different ISE indices by using duration dependence tests.

Lehkonen (2010) examines the presence of stock market bubbles in Chinese stock markets with the duration dependence test by using both weekly and monthly data over the period 1992 – 2008. The results of duration dependence tests are mixed that for weekly data, the test shows bubbles in Chinese stock markets, but monthly data do not support the existence of bubble in Chinese stock markets. The results show that the duration dependence test is sensitive to the use of weekly versus monthly results. Thus, the reliability of the duration dependence tests for bubble detection is questionable.

Yu and Hassan (2010) investigate the existence of rational speculative bubbles in the Middle East and North African (MENA) stock markets including Istanbul Stock Exchange. They test whether rational speculative bubbles exist or not in Bahrain, Egypt, Jordan, Morocco, Israel, Oman, Saudi Arabia and Turkey by using both local and the US dollar denomination. They do not find any statistically significant evidence of bubbles from duration dependence tests for all of the eight MENA stock markets including ISE.

4. Research Methodology and Data Description

There are several traditional methods to detect rational speculative bubbles such as variance bounds tests, West's two-step tests and integration/cointegration based tests mainly relying on the expectations of future streams of dividends. However, these methods have crucial shortcomings mentioned earlier. In this study, to overcome shortcomings of the traditional bubble tests, a new approach, duration dependence methodology developed by McQueen and Thorley (1994) is employed to test the presence of rational speculative bubbles in Istanbul Stock Exchange. This test has been conducted in several prior studies investigating rational speculative bubbles such as Chan et al. (1998), Lavin and Zorn (2001), Harman and Zuehlke (2004), Jirasakuldech et al. (2008), Tasci and Okuyan (2009), Lehkonen (2010) and Yu and Hassan (2010). The benefit of the duration dependence test is that this methodology does not require normally distributed time series data and the identification of fundamental factors.

Duration dependence tests developed by McQueen and Thorley (1994) require that returns are transformed into series of run lengths on positive and negative observed abnormal returns. Formally, the data consist of a set, S_T, of T observations on the random run length, I. A run is defined as a sequence of abnormal returns of the same sign. Thus, I is a positive valued discrete random variable generated by some discrete density function, $f_i \equiv \text{Prob}\ (I = i)$, and corresponding cumulative density function, $F_i \equiv \text{Prob}\ (I < i)$. Define N_i as the count of completed runs of length i in the sample. The density function version of the log likelihood is (Chan et al. 1998, p. 134)

$$L\ (\theta \mid S_T) = \sum_{i=1}^{\infty} N_i \ln f_i \qquad (9)$$

where θ is a vector of parameters. The hazard function $h_i \equiv \text{Prob}\ (I = i \mid I \geq i)$, represents the probability that a run ends at i, given that it lasts at least until i. A hazard function specification describes data in terms of conditional probabilities in contrast to the density function specification which focuses on unconditional probabilities. The choice between a hazard and density specification depends on the economic question of interest.

Duration dependence test for rational speculative stock market bubble questions whether the probability that a return run continues depends on the length of the run; consequently, the hazard specification is appropriate. The hazard function is related to the density function by (Chan et al. 1998, p. 135)

$$h_i = \frac{f_i}{(1 - F_i)} \text{ and } f_i = h_i \prod_{j=1}^{i-1} (1 - h_j) \qquad (10)$$

Using the relationships in equation (10), the hazard function version of the log likelihood is

$$L(\theta \mid S_T) = \sum_{i=1}^{\infty} N_i \ln h_i + M_i \ln(1 - h_i) \qquad (11)$$

where M_i is the count of runs with a length greater than i. To perform tests of duration dependence, a functional form must be chosen for the hazard function. The log–logistic functional form is used, (Chan et al. 1998, p. 135)

$$h_i = \frac{1}{1 + e^{-(\alpha + \beta \ln i)}} \qquad (12)$$

The log–logistic function transforms the unbounded range of $\alpha + \beta \ln(i)$ into the (0, 1) space of h_i, the conditional probability of ending a run. The null hypothesis of no bubbles implies that the probability of a run ending is independent of the prior returns or that positive and negative abnormal returns are random. In terms of the model, the null hypothesis of no duration dependence is that $\beta = 0$ (constant hazard rate or geometric density function). The bubble alternative suggests that the probability of a positive run ending should decrease with the run length or that the value of the slope parameter, β, is negative (decreasing hazard rates). Tests are performed by substituting equation (12) into equation (11) and maximizing the log likelihood function with respect to α and β. The likelihood ratio test (LRT) of $\beta = 0$ is asymptotically distributed X^2 with one degree of freedom (Chan et al. 1998, p. 135).

In this study, the duration dependence tests are conducted using weekly returns data for Wednesday closing prices. In the situation that the Wednesday is a holiday or a non-trading day, Tuesday's close is used. If Tuesday's data are also unavailable, then Monday's close price is used. In the case that the Monday close price is also unavailable, the returns for the week are combined with those for the following week. ISE 100 price index expressed in local currency is chosen as an indicative index for Turkish equity markets. The data are obtained from ISE web site. The prices are transformed into continuously compounded weekly returns, $r_t = \ln(p_t / p_{t-1})$, where p_t is the index closing price for period t, and p_{t-1} is the price for the preceding period. All tests are conducted on nominal returns.

Following Chan, McQueen, and Thorley (1998) runs of weekly abnormal returns are determined by the residuals from a fourth-order autoregressive model of weekly returns. Chan, McQueen, and Thorley (1998) assert that AR(4) model is preferable to imposing a common mean, because it enables one to control for short-term sources of autocorrelation, such as non-synchronous trading.

To apply the duration dependence test, the returns need to be transformed into series of run lengths on positive and negative observed abnormal returns. Here, according to McQueen and Thorley (1994), a run is defined as a sequence of abnormal returns of the same sign. The following example is given to explain how to transform the returns: a return series of three positive abnormal returns followed by four negative abnormal returns, two positive and, finally, three negative abnormal returns is transformed into two data sets: a set for the runs of positive abnormal returns with values of 3 and 2; a set for the runs of negative abnormal returns with values of 4 and 3.

5. Empirical Results

Descriptive statistics of weekly returns are presented in Table 1. Table 1 provides the mean, standard deviation, minimum, maximum, skewness, kurtosis and autocorrelations for the weekly returns of ISE 100 Index. Jarque-Bera normal distribution test statistics are also presented in Table 1.

Table 1: Descriptive Statistics for Weekly Returns of ISE 100 Price Index

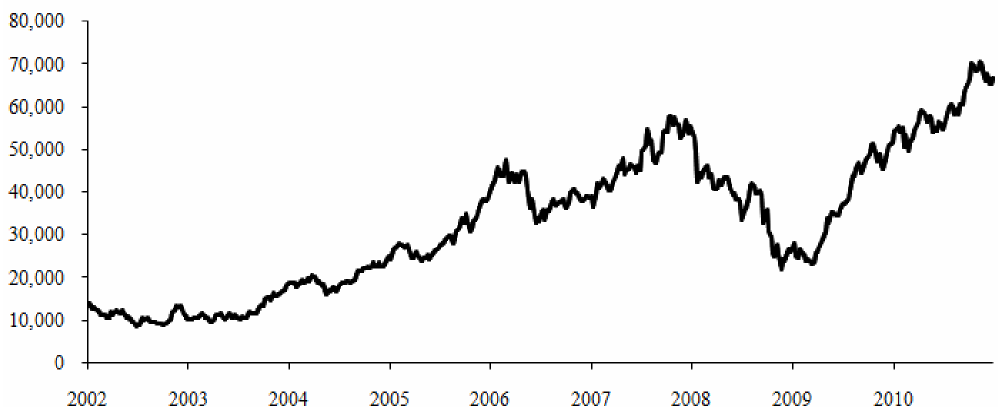
Number of Observations	Mean	Maximum	Minimum	Std.Dev.	Skewness	Kurtosis	Jarque-Bera
463	0.0035	0.1663	-0.1829	0.0458	-0.3342	4.4262	47.8558 (0.000)

Lag	Autocorrelations
1	-0.027
2	0.037
3	0.100
4	-0.012
5	0.003
6	-0.042
7	-0.128
8	0.057
9	-0.010
10	-0.006
11	0.074
12	-0.060
$S(p)$	0.046
Q(12)	20.126 (0.065)

p values are presented in parenthesis.

In Figure 3, data are illustrated for the overall sample period, January 2002 – December 2010. For the overall sample period, Turkish equity market is characterized by an average weekly nominal return of 0.3521% with a standard deviation of -0.1829. For weekly returns in Table 1, ISE 100 Index has negative skewness. Also, weekly returns of ISE 100 Index have a high positive kurtosis value. The Jarque-Bera test statistic shown in Table 1 rejects the null hypothesis of normality at the 1% significance level for the sample period. The Box-Ljung statistic for 12 lags, denoted by Q(12) indicates that significant linear dependencies exist at 10% significance level. However, all autocorrelation coefficients are not positive, they are mixed.

Figure 3: ISE100 Price Index (Local Currency) 2002 – 2010

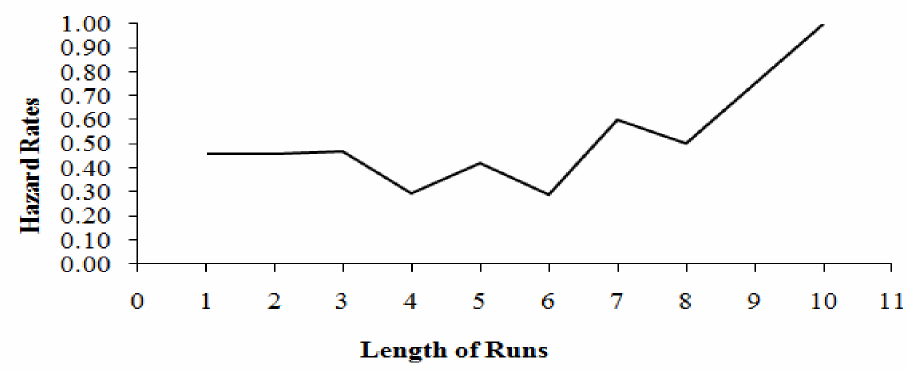


The rational speculative bubble model implies negative skewness, excess kurtosis and non-normality of returns. The rational speculative bubble model also implies autocorrelation in returns because returns tend to be positive as the bubble grows. In our data set, evidence of excess kurtosis, skewness, non-normality and autocorrelation points to the potential for rational speculative bubbles in Turkish equity markets. However, such descriptive statistics may be driven by factors unrelated to bubbles. Because of this reason, we also conduct duration dependence test to detect any rational speculative bubble in ISE. To perform the duration dependence test, firstly, we need to obtain the positive and negative abnormal returns. Following Chan, McQueen, and Thorley (1998) runs of weekly abnormal returns are determined by the residuals from a fourth-order autoregressive model, AR(4) model of weekly returns. As a result of this model, ε_t, residuals as weekly positive and negative abnormal returns are calculated. The run counts for positive and negative abnormal returns are calculated.

The hazard rate, $h_i = N_i / (M_i + N_i)$, represents the conditional probability that a run ends at i, given that it lasts until i, where N_i is the count of runs of length i and M_i is the count of runs with a length greater than i. Hazard rates for both positive and negative abnormal returns are calculated using Excel.

The duration dependence test results for the sample period are reported in Table 2. For the sample period, there are 463 weekly nominal returns and 459 weekly abnormal returns. There are 218 total runs comprising 109 runs of positive returns and 109 runs of negative returns. The longest positive return run lasts 10 weeks and the longest negative return run lasts 8 weeks. One characteristic of a rational stock market bubble is that the hazard rate should be a declining function of the length of positive runs; otherwise a bubble cannot be sustained. For the sample period, there is no such a pattern of decreasing hazard rate in positive runs. The hazard rates for positive returns are 0.4587, 0.4576, 0.4688, 0.2941, 0.4167 and 0.2857 for the run lengths 1 to 6. This mixed pattern is indicative of the absence of any rational speculative bubbles in Turkish equity markets. This pattern is also shown in Figure 4.

Figure 4: Hazard Function of Positive Returns



As stated earlier in this study, one feature of a rational speculative bubble is that the hazard rate is a declining function of the length of positive runs; otherwise, a bubble cannot continue. To perform tests of duration dependence, a functional form must be chosen for the hazard function. The log–logistic functional form is used with respect to α and β. The hazard function is estimated as a Logit regression in which the independent variable is the log of current length of run and the dependent variable is 1 if the run ends in the next period and 0 if it does not. Under the null hypothesis of no bubble (β = 0), the likelihood ratio test (LRT) is asymptotically distributed X^2 with one degree of freedom.

Table 2 reports the maximum likelihood estimates of the log-logistic function parameters α and β coefficients for weekly returns. The null hypothesis of no-bubble implies a constant hazard rate (β = 0). The alternative bubble hypothesis implies a negative sloping hazard function (β < 0) for runs of positive returns. In our study, consistent with the rational bubble model prediction, the runs of positive abnormal returns have a negative β coefficient;

but the coefficient is not statistically significant. From Table 2 we note that ISE 100 Index does not have a significant negative β coefficient for the sample period. The likelihood ratio test (LRT) of the null hypothesis of no duration dependence or constant hazard rate (H_0: β = 0) cannot be rejected even at the 10% significance level with the LRT = 0.1701. Since rational expectations bubbles do not occur in runs of negative returns, we do not find evidence of rational speculative bubbles in the negative returns.

Table 2: Duration Dependence Tests for ISE 100 Price Index 2002 – 2010

Run Length	Positive Abnormal Returns: Actual Run Counts total=109	Positive Abnormal Returns: Hazard Rate	Negative Abnormal Returns: Actual Run Counts total=109	Negative Abnormal Returns: Hazard Rate
1	50	0.4587	50	0.4587
2	27	0.4576	32	0.5424
3	15	0.4688	15	0.5556
4	5	0.2941	8	0.6667
5	5	0.4167	3	0.7500
6	2	0.2857	0	0.0000
7	3	0.6000	0	0.0000
8	1	0.5000	1	1.0000
9	0	0.0000		
10	1	1.0000		
Log-logistic Test			**Log-logistic Test**	
α		-0.1500	α	-0.2473
β		-0.0311	β	0.1553
LRT statistic		0.1701	LRT statistic	1.7380
H_0: $\beta = 0$ (p-value)		0.6801	H_0: $\beta = 0$ (p-value)	0.1874

A run of length i is a sequence of i abnormal returns of the same sign. +1 indicates a partial run not included in the run count. The sample hazard rate, $h_i = N_i / (M_i+N_i)$, represents the conditional probability that a run ends at i, given that it lasts until i, where N_i is the count of runs of length i and M_i is the count of runs with a length greater than i. The log-logistic function $h_i = 1 / (1 + e^{-(\alpha + \beta \ln i)})$. The LRT (likelihood ratio test) of the null hypothesis, H_0: β = 0, of no duration dependence (constant hazard rate) is asymptotically distributed X^2 with one degree of freedom. p value is the marginal significance level, which is the probability of obtaining that value of the LRT or higher under the null hypothesis.

The findings of this paper on the absence of rational expectations bubble in ISE 100 index confirm that stock prices are line with their fundamental values in the period 2002 – 2010. The results of this paper are consistent with the findings of Tasci and Okuyan (2009) and Yu and Hassan (2010).

6. Conclusion

In this paper, the existence of a stock price bubble in the Turkish stock market is tested over the period 2002 – 2010. Descriptive statistics give the evidence of excess kurtosis, skewness, non-normality and autocorrelation implying that there should be a potential for rational speculative bubbles in Turkish equity markets for sample period. However, such descriptive statistics may be driven by factors unrelated to bubbles. A relatively new technique, duration dependence test is used to detect any rational speculative bubble in Turkish stock market. Test results of non-parametric duration dependence test indicate evidence of no negative duration dependence in runs of positive excess returns, consistent with the absence of rational expectations bubbles during the sample period.

The findings of this paper on the absence of rational expectations bubble in ISE 100 index confirm that stock prices are line with their fundamental values in the sample period 2002 – 2010. The results of this paper are consistent with the findings of Tasci and Okuyan (2009) and Yu and Hassan (2010).

Rational speculative bubble tests provide domestic and international investors as well as policy makers with invaluable knowledge to better understand the stock market behaviors. These tests may help investors in their portfolio decisions and hedging strategies.

In this paper, the existence of a stock price bubble in the Turkish stock market is tested over the period 2002 – 2010 by using weekly nominal returns based on local currency. However, Harman and Zuehlke (2004) and Lehkonen (2010) point out the sensitivity of duration dependence test to the use of different data set (weekly or monthly data; nominal or real return data; local or foreign currency data). In future research to robust the results of this study, the existence of a stock price bubble in the Turkish stock market can be tested with monthly real returns based on both local currency and US dollar.

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