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Analysis of the formation of the price bubble in the financial market: with an emphasis on the price bubble in the insurance industry and the stock market with the Markov-switching approach

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Abstract

This article investigates the formation of price bubbles in the insurance industry index in the Tehran Stock Exchange with the total price index, considering the importance of the price trend and the formation of bubbles in the stock market in order to get a better understanding of the price trend of the insurance industry compared to the total index of Tehran Stock Exchange. The time period studied in this article is from April 2017 to April 2020. The method used here is the Markov switching method. Also, the basis of this study to identify the price bubble is two-regime state-space model of Wu (1995) and Campbell and Shiller (1988), which considers bubble formation in one state and bubble burst in the other. The results show that the trend of price bubble formation in the insurance industry in Tehran Stock Exchange and the total price index of the stock exchange are different and fluctuations in the insurance industry index have been more than fluctuations in the total stock index. Also, based on the results, the number of bubble formation trends related to the insurance industry index is about 26 times and the total index is 19 times. In addition, the bubbles that occur are less compatible with each other, so that studies show that in the period of 2017 to 2018, the total index did not face the formation of bubbles, but the insurance industry index has experienced about 12 bubble formation processes in the same period.

Keywords: Price bubble, Insurance industry, Tehran Stock Exchange

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1. Introduction

Investment is one of the most important economic variables that is considered in both macro and micro dimensions in the theoretical literature of economy. In the macro dimension, capital accumulation is one of the variables determining future economic growth and ensuring economic development and stability. In the micro dimension, individuals and firms always seek to maximize their profits using the available resources and investing them in the right place and at the right time, taking into account the economic principle of profit maximization. In the macro dimension, investment guarantees economic growth in the future of a country's economy.

The capital market is one of the centers for attracting micro-capitals, which on the one hand equips resources towards the macroeconomic dimension, and on the other hand, micro and macro investors in this market are towards maximizing their profits. Fluctuations generally create an unfavorable market environment that reduces the confidence of buyers and can be a reason for the transition of the crisis from the financial sector to the real sector of the economy. Of course, price fluctuations are part of the nature of the market. In general, price fluctuations in financial assets often consist of two main parts: one is the normal part or fundamental price changes that are affected by the initial macroeconomic variables or normal changes in supply and demand. The other is the unusual part or false price changes, which is known as speculative bubbles in economics. For this reason, methods have been developed to modify and supplement the basic patterns so that they can be used to explain excessive price fluctuations.

The insurance industry is of particular importance as one of the components of financial markets that reflects their development. This industry, on the one hand, is active as a factor for the security and stability of economic activities in the country, and on the other hand, as an economic unit, it must be able to be profitable and expand its services to overcome costs as much as possible by providing diverse and quality services. One of the important factors in this regard is proper activity and having a proper index in the capital market. The first step to having a proper index is to know the situation of this industry in this market. Accordingly, this article seeks to examine the trend of the insurance industry index in the Tehran Stock Exchange and the price bubble in this index. Also, it examines the trend of this industry with the total stock index and bubble formed in this industry.

2. Research literature and background

In the economic history, there are well-known examples of economic crises that have occurred as a result of bubble bursts in asset prices. One of the first examples, often referred to as the reference point in the bubble literature, is the tulip mania caused by speculation in the Dutch flower bulb during the period 1634-1637 (Gonzalez et al., 2013). But the first stock market bubbles in the new era of economic history belonged to the French company Mississippi and the British company South Sea in the early eighteenth century. One of the recurring events in the stock market is that investors' attention is drawn to certain companies or industries, which is followed by widespread speculation, accompanied by a sharp drop in prices after a while. For example, the collapse of the US market in 1929, 1989, and 1990 are examples that are clearly remembered by economic circles (Komaromi, 2004). One of the last known crises is related to the financial crisis of a large group of industrial economies in the years 2007-2012 (Gonzalez et al., 2013).

Interpreting the rate of short-term changes in asset prices in the context of efficient and rational markets remains a challenge. Many empirical studies have shown that stock prices exhibit a kind of "extreme volatility", meaning that they fluctuate so much that they cannot be interpreted and explained by changes in fundamental elements, such as dividends or the amount of working capital. Another prominent feature of asset prices is the steady and intermittent jump in prices relative to the estimation of their structural value, called the price bubble, a phenomenon that can be evidenced throughout history in many countries and markets (Salehabadi and Dalirian, 2010). The bubble phenomenon is a term that occurs frequently in stock markets. In the following, the concept of bubble is examined from different perspectives.

2.1. Price bubble from the point of view of mathematical economics

The first aspect is the definition of mathematical economics, which describes the bubbles in asset prices. Mathematical economics defines a bubble as the positive difference between real prices and reasonable prices (core values) of assets. The actual price is given as follows (Serletis & Zisimos, 2005):

$$P_t = \sum_{j=1}^{\infty} \frac{E_t(d_{t+j})}{(1+r)^j} + b_t \qquad (2-1)$$

Here, d_t is dividends, P_t is stock prices at time t, and E_t is the expected amount based on valuable and valid information available at time t. If the r rate is constant throughout the period, the equilibrium price (core value) is obtained and bt shows the random bubble value that causes this condition to be established, which is $b_t = \dfrac{E_t(b_{t+1})}{(1+r)}$. Therefore, there is no negative bubble in this literature at all.

2.2. Rational bubbles

Based on the rational expectations theory, the price of an asset is determined by the sum of the discounted cash flows. According to rational theory, prices are formed according to the information available to market participants and based on conventional economic models tailored to the situation. In this case, it is claimed that market prices cannot be different from their core values, unless there is misleading misinformation in the market. When a person buys unprofitable stocks in order to sell at a higher price and make a profit in the following years, this kind of thinking causes the demand for that stock and consequently the price of that stock to rise. Such a movement in the stock price is called rational price bubbles. This type of bubble is constantly starting to expand and will eventually burst over time, disrupting all planning and forecasting (Madelat, 2002).

2.3. Intrinsic rational bubbles

Blanchard (1979) examined the existence of rational bubbles, showing that even if all investors are rational, there is a possibility of deviating from core values. From this perspective, bubbles are distortions unrelated to the foundations. Based on this argument, Frot Obstfeld (1991) introduced intrinsic bubbles related to foundations and defined bubbles as an algebraic function of revenues. They argued that because the bubble grows with the growth and improvement of fundamentals and related news, intrinsic bubbles are more successful in explaining the divergence between fundamentals and current asset prices. Unlike rational bubbles, intrinsic bubbles can only be explored in a nonlinear process through a nonlinear relationship between prices and revenues (Chen et al., 2009).

2.4. Irrational bubbles

Product price bubbles may arise because irrational speculators, by increasing the value of a product, believe that because the price of that product has already risen, its past increase will continue in the future. In the literature of economics, this prediction is called self-fulfilling prophecy and the bubble that speculators create in this case is called irrational bubble or financial fad. This type of forecast also leads to an increase in demand for that product and as a result, will lead to a further increase in the price of that product in the future. In this case, the market has people with limited intellectual horizons and people do not recognize the difference between market value and intrinsic value and will help to create a bubble in the market. In irrational price bubbles, people do not have rational expectations about the future benefits of goods and their prices. When faced with irrational price bubbles, investment is not based on risk and return information and the market will be guided by a random and psychological reaction (Madelat, 2002).

Ansari et al. (2017) examined the relationship between transparency and quality of financial information disclosure with the possibility of price bubble formation in the period 2010 to 2013 for 158 companies listed on the Tehran Stock Exchange using skewness tests, duration dependence, and logistic regression. In general, the experimental results support the hypothesis that there is a negative and significant relationship between the level of transparency of financial information and the bubble of companies' stock prices. Biabani et al. (2016) used the GSADF and SADF methods and showed that in the 69 months studied, the stock market has been experiencing a bubble phenomenon in 15 months, including July 2013 to January 2014. Ebrahimi Sarv Oulia et al. (2013) used the techniques of kurtosis, skewness, Runs, and risk function and concluded that Tehran Stock Exchange market has witnessed many fluctuations since its reopening in 1989. The results of kurtosis, Runs, and the risk function tests for daily returns prove the existence of bubbles in the Tehran Stock Exchange, but the skewness test rejects the existence of bubbles in the stock market. Vakilifard et al. (2010) stated that there is a significant relationship between the amount of free floating shares of companies and the occurrence of price bubbles and companies that have a free floating share of less than 20% are more exposed to price bubbles compared to other companies.

In their study, Escobari et al. (2017) found that formation of bubble periods in price markets in the 2008 financial crisis preceded bubble cycles in the United States and lasted longer than the US market. Klotz et al. (2016) showed that the price bubble in Spain and Ireland was much larger than in Portugal and Greece from 2003 until the 2008 crisis that led to the bursting of the bubble. The results showed that the monetary and fiscal policies of the central bank led to the effect of the interest rate and the volume of lending on the price bubble in these countries and caused this issue to intensify. Dow Han (2015) asserted that asset replacement does not lead to a price bubble, but deficiencies in management contracts and the resulting conflict of interest lead to the creation of intermediaries that risk the creation of limited tenders, and management is stimulated to be more optimistic towards asset price. Eventually, this leads to a price bubble in contracts and documents the price bubble of assets by restricting debt. Narayan et al. (2013) studied the New York Stock Exchange and found that trading volume and price fluctuations significantly affect the asset price bubble. They praised the effect on electricity, energy, banking and finance, and the smallest companies. Miller and Ratti (2009) showed that in the long run, the stock market has a significant and negative reaction to oil prices and stock returns decrease with increasing oil prices and vice versa. Palshikar et al. (2008) showed that there are collective agreements and collusion that expose the market to price bubbles and their associated consequences. The results of studies adjust the algorithm and charts that identify and predict this market disease. Nunes and Silva (2007) investigated the existence of rational bubbles in 18 stock markets using both conventional and threshold accumulation models. According to the estimates of both models, there are explosive bubbles in the stock markets of Chile, Indonesia, Korea and the Philippines, and collapsing bubbles in the stock markets of China, Brazil, Venezuela, Colombia, Chile, Indonesia, Korea and the Philippines.

3. Research method

The present study is applied and developmental in terms of its objective and it is a library study in terms of data collection method. The spatial scope of this research includes the Iranian insurance industry and the time domain related to this research is from 2017 to 2019. Data are collected on a daily basis from the archives of the Tehran Stock Exchange. The population of this research is the Iranian insurance industry and companies that are active in the Tehran Stock Exchange. According to the stock exchange statistics, out of 32 companies active in the country's insurance industry, 17 companies have been listed on the Tehran Stock Exchange. These 17 companies are: Dana, Asia, Alborz, Etkaei Amin, Etkaei Iranian, Moallem, Tejarat Now, Khavar Mianeh, Ma, Dey, Kowsar, Parsian, Pasargad, Saman, Mellat, Mihan and Novin Insurance Companies. Markov switching method has been used to study the price bubble trend in the total stock index and the insurance industry index.

This study has used Markov switching method to investigate the formation of price bubbles in the framework of the state-space model in the Tehran Stock Exchange. The model used is derived from the study of W_u (1995) and Campbell and Shiller (1988). This model considers two different states. State one is regime 1 and is the burst of the price bubble and the other is regime 2, which is the formation of the price bubble. This study focuses on regime 2 obtained from the estimates to investigate the formation of price bubbles.

3.1. Research model

In this section, the standard model of stock price present value is reviewed based on the logarithmic-linear approximation proposed by Campbell and Shiller (1988). Equation (1) is the rational expectation model for determining stock prices:

$$q = k + \psi E_t(P_t + 1) + (1 - \psi)d_t - p_t \tag{1}$$

Here, q shows the logarithmic rate of the gross return, $E_t(0)$ is the conditional mathematical expectation operator for all data at time t, $p_t = ln(P_t)$ is logarithm of the real stock price at time t, $d_t = ln(D_t)$ is the logarithm and real return on stock at time t, and k and ψ are the linearization parameters that are $0P\psi P$ here.

Equation (1) is a linear differential equation for the real stock price logarithm that can be solved using the following iterative solution. Considering the transitionability condition:

$$\lim_{j\to\infty} \psi^j E_t(P_t + i) = 0^{\square} \tag{2}$$

Here is a unique non-bubble solution:

$$P_t^f = \frac{k - q}{(1 - \psi)} \sum_{i=0}^{\infty} \psi^i E_t(d_{t+i}) \tag{3}$$

The non-bubble solution P_t^f in Equation (2) presents the conventional present value equation, which states that the stock price logarithm is equal to the expected present value logarithm of stock returns. However, it is important to note that from a mathematical point of view, the above transitionability condition does not apply here. In the previous case, the non-bubble solution P_t^f is only a specific solution to the differential equation (1). The general solution is as follows:

$$P_t = P_t^f + B_t \tag{4}$$

Along with the Bt process that applies to the exogenous differential equation, we will have (Cuthbertson & Nitzsche, 2005):

$$E_t(B_{t+i}) = \frac{B_t}{\psi^i} for\ i = 1, 2, \ldots \tag{5}$$

Specifically, the general solution of Equation (4) consists of two components. The first component involves a non-bubble solution of P_t^f and depends solely on the logarithm of stock returns, and is therefore, often referred to as the fundamental market solution. The second component is the mathematical component B_t, which includes unusual or non-original market events and is considered as a rational bubble.

In order not to face the non-stationary problem, the model must be expressed in the form of the first difference. In the seventh order of Equations (2) and (3), there can be:

$$\Delta P_t = \Delta P_t^f + \Delta B_t = (1-\psi)\sum_{i=0}^{\infty}\psi^i[E_t(d_{t+i}) - E_{t-1}(t+i-1)] + \Delta B_t \tag{6}$$

Here it is assumed that the return on equity has a unit root (Wu, 1997). But the stock return process d_t can be approximated using an autoregressive integrated moving average (ARIMA) model. In particular, it is assumed that an ARIMA $(h, 1, 0)$ process is as follows:

$$\Delta d_t = \mu + \sum_{j=1}^{h}\phi_j \Delta d_{t-j} + \delta_t \tag{7}$$

Here,$\delta_i : N(0, \sigma_3^2)$ is the white noise error and h is the autoregressive order and can be estimated using the data.

In the following, the autoregressive process of order (6) can be defined. The vector $(h \times 1)$ is as follows:

$$y_t = (\Delta d_t, \Delta d_{t-1}, \ldots, \Delta d_{t-h+1}), U = (\mu, 0, 0, \ldots, 0), V_t = (\delta_t, 0, \ldots, 0) \tag{7}$$

The matrix(hh) is equal to:

$$\begin{pmatrix} \phi_1 & \phi_2 & \phi_3 & \ldots & \phi_{h-1} & \phi_h \\ 1 & 0 & 0 & \ldots & 0 & 0 \\ 0 & 1 & 0 & \ldots & 0 & 0 \\ \ldots & \ldots & \ldots & \ldots & \ldots & \ldots \\ 0 & 0 & 0 & \ldots & 1 & 0 \end{pmatrix}$$

Equation (7) can be rewritten as follows:

$$y_t = u + Ay_{t-1} + V_t \tag{8}$$

This equation is based on the study of Shiller and Campbell (1987) and equation (6) for the stock price model can be calculated using the following equation:

$$\Delta P_t = \Delta d_t + m\Delta y_t + \Delta B_t \tag{9}$$

Here, m is an $(h \times 1)$ vector defined as follows:

$$m = gA(I-A)^{-1}[I - (1-\psi)(1-\psi A)^{-1}] \tag{10}$$

Where, g is an $(h \times 1)$ vector defined as$g = (1, 0, \ldots, 0)'$, and I is a unit $(h \times h)$ vector. According to Wu (1997), a linear bubble process is considered to be $\{B_t\}$. Hence, Equation (4) implies that:

$$B_t = (1/\psi)B_{t-1} + \eta_t \tag{11}$$

Where, η_t is a process with uniform and independent distribution $N(0, \delta_\pi^2)$. In addition, η_t has no correlation with δ_t in Equation (7).

When estimating equation (9) of stock price, we face this problem that Bt is latent. This can be solved using the Kalman filter, which requires the present value model to be defined in the state-space form.

3.2. Presenting state-space and Kalman filter

In this section, we define the present value model defined in the previous section in the state-space form so that the Kalman filter can be used to estimate the price bubble of an intangible asset based on Wu (1995).

Assume that $B_t$is an $(n \times 1)$ vector of latent variables that is considered as state variables. Also, g_i and Z_i are two $(m \times 1)$ and $(l \times 1)$ vectors of observable variables that are considered as input and output variables, respectively. Therefore, the state-space model can be written as follows:

$$B_t = FB_{t-1} + \xi_t \tag{12}$$
$$Z_t = HB_t + Dg_t + \xi_t \tag{13}$$

Here,ξ_1 and ξ_2 are both $(n \times 1)$ and $(l \times 1)$ perturbation vectors, andF_2, H_2,and D are real constant matrices of consistent dimensions. It is assumed that ξ_1 and ξ_2 perturbation vectors are serially unrelated to each other as we have:

$$E(\xi_t) = 0, E(\zeta_t) = 0$$
$$E(\xi_t \xi_t) = Q, E(\zeta_t \zeta_t) = R$$

Equations (12) and (13) are transition and action equations, respectively. The proposed economic model basically consists of 3 components:

1. The ARIMA $(h, 1, 0)$ process of return on equity Δd_1 in equation (7).
2. The stock price process of Δp_i in equation (9).
3. The process of B_i in equation (11).

The whole economic model can be written in the state-space form as follows:

$$\beta_t = (B_t, B_{(t-1)}); Z_t(\Delta d_t, \Delta P_t); g_t = (1, \Delta d_t, \Delta d_{(t-1)}, \Delta d_{(t-2)}, \ldots, d_{(t-h)}), \xi_t = (\eta_t, 0); \zeta_t = (\delta_t, 0); \tag{14}$$

$$D = \begin{pmatrix} \mu & 0 & \phi_1 & \phi_2 & \ldots & \phi_{h-1} & \phi_h \\ 0 & (1+m_1) & (m_2 - m_1) & (m_3 - m_2) & \ldots & (m_h - m_{h-1}) & -m_h \end{pmatrix}, \begin{pmatrix} 1/\psi & 0 \\ 1 & 0 \end{pmatrix}, H = \begin{pmatrix} 0 & 0 \\ 1 & -1 \end{pmatrix} \tag{15}$$

Here, m_i is the i^{th} component of the$(h \times 1)$ vector belonging to the variable m in Equation (10). Covariance matrices of Ω and R are defined as follows:

$$\Omega = \begin{pmatrix} \delta_\eta^2 & 0 \\ 0 & 0 \end{pmatrix} and R = \begin{pmatrix} \delta_\xi^2 & 0 \\ 0 & 0 \end{pmatrix}$$

Finally, the asset price bubble behaves invisibly in the proposed state-space model, and the equations here can be divided into two transition and action categories. Both equations (11) show the bubble transition process, while the first action equation (Equation 6) shows the equity return process and the second action equation, equation (9), shows the price process.

3.3. Kalman filter technique

In this section, the Kalman filter process used to estimate asset price bubbles is given in general. The main problem here is estimating the latent vector of state B_i . Here,B_{th} is the best estimate of the square mean of B_i in the model at time . In this regard,B_{th} and its covariance matrix can be obtained from the following equations:

$$\begin{aligned}
&\beta_{t|t-1=F\beta_{t-1|t-1}} \\
&K_t = P_{t|t-1}H[HP_{t|t-1}H + R]^{(-1)} \\
&P_{t|t-1} = [I - K_tH]P_{t|t-1} \\
&\beta_{t|t-1} = \beta_{t-1|t-1} + K_t\xi_{t|t-1}
\end{aligned}$$

Here, the covariance matrix of errors in$1 \leqslant t \leqslant T$ consists of the following two equations:

$$P_{t|t-1} = E[(\beta_t - \beta_{t|t-1})(\beta_t - \beta_{t|t-1})] \tag{17}$$
$$P_{t|t} = E[(\beta_t - \beta_{t|t})(\beta_t - \beta_{t|t})] \tag{18}$$

The above equations form the Kalman filter and are calculated as forward regression. More efficient estimates using all information up to time T can be obtained using a more uniform complete sample:

$$\begin{aligned}
&\beta_{t-1|T} = \beta_{t-1|t-1} + J_{(t-1)}(\beta_{t|T} - F\beta_{t|t-1}) \\
&P_{t-1|T} = P_{t-1|t-1} + J_{(t-1)}(P_{t|T} - P_{t|t-1})J_{(t-1)} \\
&J_(t-1) = P_{t-1|t-1}FP^{(-1)}_{t|t-1}t = T-1, T-2, \ldots, 1
\end{aligned}$$

The more uniform equations above are estimated as backward regression.

Kalman Filter considers the model parameters as known parameters. In practice, the parameters of matrices such as F, H, D, R, and are unknown and need to be estimated. By summing the unknown parameters in vector, they can be estimated using the following likelihood exponential function (Hamilton, 1994):

$$L(\alpha|z, g) = const - \frac{1}{2}\sum_{t=1}^{T}(In[det(HP_{t|t-1}H + R)] + \xi_{t|t-1}(HP_{t|t-1}H + R)^{-1}\xi_{t|t-1} \tag{19}$$

In Equation (19),$\xi_{t|t-1}$ and $P_{t|t-1}$ are both implicit functions of the unknown parameters of the vector that are investigated using the Kalman filter. When is obtained using the maximum likelihood, the uniform state estimates the state vector, and its error covariance matrix can be determined using the Kalman filter and the complete sample of the above uniform state.

3.4. State-space model using Markov switching

In this section, two distinct regimes are introduced in the context of the state-space model from the previous section. The idea is that alternative regimes allow us to distinguish between periods of gentle and explosive bubble formation processes (Evans, 1991). This study limits its focus on modeling two regimes. The econometric methodology of this section follows Kim and Nelson's (1999) study, which assumes the general state of regimes as$M \geqslant 2$.

3.5. Model specification

In this section, we start with the dynamic system of transition and action equations (12) and (13). It is assumed that the parameters F, H, D, and R fluctuate between the two regimes, so the state-space model can be expressed as follows:

$$\beta_t = F_[(s_t)]_{(t-1)} + \xi_t \tag{20}$$

$$z_t = H_{(s_t)t} + D_{s_t} g_t + C_t \tag{21}$$

$$\begin{pmatrix} \xi_t \\ \zeta_t \end{pmatrix} \sim N \left(0, \begin{pmatrix} \Omega_{s_t} & 0 \\ 0 & R_{s_t} \end{pmatrix} \right) \tag{22}$$

Where, S_t shows how the parameters in the upper matrix are controlled in a two-state random regime, and in which regime are the parameters at time t, i.e.$S_i = (S_i = 1, 2)$. In this section, we show the probabilistic nature of S_t using the Markov first-order process and fixed transition probabilities of $P_{ij} = p_r[S_i = j|S_{i-1} = i]$, which are summarized in the transition probability matrix:

$$\Pi = \begin{pmatrix} P_{11} & 1 - P_{22} \\ 1 - P_{11} & P_{22} \end{pmatrix} \tag{23}$$

4. Findings

4.1. Price bubble formation in the insurance industry index

The Markov switching model is a suitable model for estimation if the pattern of the examined data is nonlinear. The LR test is used to ensure that the data pattern is nonlinear. The statistical value of this test is calculated using the maximum likelihood values of two competing models, one model with one regime (linear model) and the other model with two regimes (nonlinear model) and has a chi-square distribution. If the statistical value is higher than the critical values at the desired confidence level, it can be concluded that the linear model is not a suitable model at that confidence level and the nonlinear model should be used. Table 1 shows the results of the LR test:

Table 1: LR test for the presence or absence of a nonlinear pattern

Probability	Statistics
0.000	30.09

As the results of the table above show, the studied variables follow a nonlinear pattern. Therefore, linear methods are not suitable for estimating model parameters and non-linear methods should be used to obtain the relationships between variables. Table 2 presents the estimated coefficients of the price index:

Table 2: Results of model estimation

Coefficients	Value	Z statistics	Probability
Price index (regime 1)	5284.03	8.20	0.00
Price index (regime 2)	5397.08	8.38	0.00

As can be seen in Table 2, the coefficients obtained for the price index are significant. The following is a variable trend in Kalman filter mode. First, Figure 1 shows the trend of the insurance industry index, which includes the period from April 2017 to April 2020. Figure 2 shows the Kalman filter mode obtained by estimating the Markov switching method.

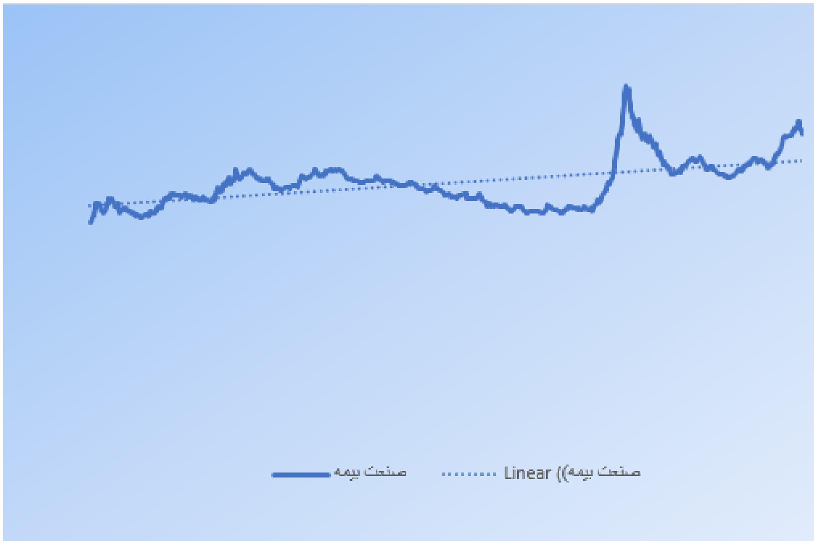

Figure 1: Insurance industry index

As Figure 1 shows, the trend of the insurance industry index fluctuates widely during the period under review. The cross-sectional line shows the linear trend of this index, which shows that the index as a whole has had a positive trend during the study period.

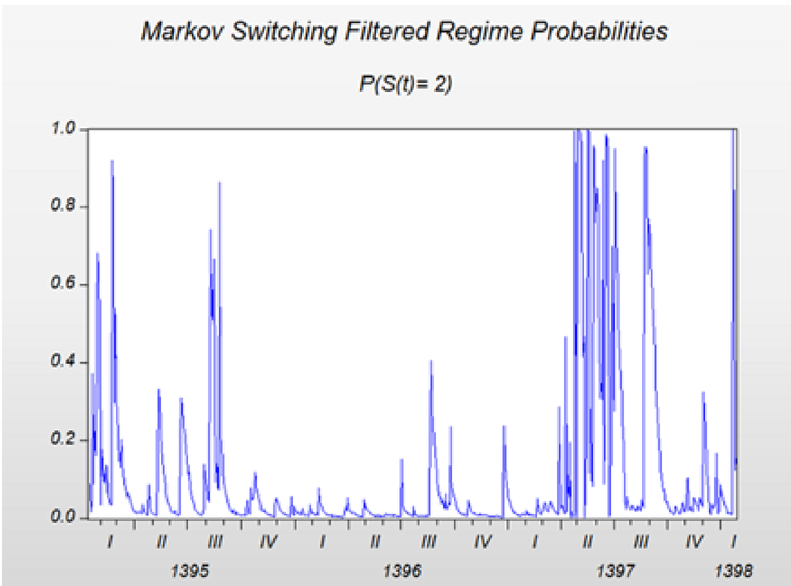

Figure 2: Investigation of bubble formation regime by Kalman filter

Figure 2 shows regime 2, the bubble formation regime. According to Figure 2, the insurance industry in the stock market has witnessed a bubble formation process of a total of 26 times in the period from April 2017 to April 2020, so that the price bubble has been repeated in the entire period under review.

The following are the results of the probability matrix of both regimes. These probabilities can be seen in Table 2.

As can be seen in Table 3, both regimes have different stability rates. Regime 1, which is a price bubble collapse, is less stable, and regime 2 is more stable as a bubble formation regime. In fact,

Table 3: Transition probabilities between the two regimes

Regime type	Regime 1	Regime 2
Regime 1	0.031	0.968
Regime 2	0.772	0.227

the findings show that the insurance industry index tends to be a bubble. The insurance industry price index is more likely to be present and remain in this regime in comparison to the price bubble collapse.

4.2. Bubble formation in the total stock index

The Markov switching model is a suitable model for estimation if the pattern of the examined data is nonlinear. The LR test is used to ensure that the data pattern is nonlinear. The statistical value of this test is calculated using the maximum likelihood values of two competing models, one model with one regime (linear model) and the other model with two regimes (nonlinear model) and has a chi-square distribution. If the statistical value is higher than the critical values at the desired confidence level, it can be concluded that the linear model is not a suitable model at that confidence level and the nonlinear model should be used. Table 4 shows the results of the LR test:

Table 4: LR test for the presence or absence of a nonlinear pattern

Probability	Statistical value
0.000	23.54

As the results of the table above show, the studied variables follow a nonlinear pattern; therefore, linear methods are not suitable for estimating model parameters and non-linear methods should be used to obtain the relationships between variables. Table 5 presents the estimated coefficients of the price index:

Table 5: Results of model estimation

Coefficients	Value	Z-statistics	Probability
Price index (regime 1)	68679	14.86	0.00
Price index (regime 1)	65804	14.24	0.00

As can be seen in Table 5, the coefficients of the price index are significant. The following is a variable trend in Kalman filter mode. Figure 3 shows the trend of the total index of Tehran Stock Exchange, which includes the period from April 2017 to April 2020. Figure 4 shows the Kalman filter mode from the Markov Switching method estimation.

Figure 3: Total stock price index and insurance industry price index

As Figure 3 shows, the trend of the total index of Tehran Stock Exchange has had many fluctuations during the period from May 2018 to April 2019. The cross-sectional line shows the linear trend of this index, which shows that the index as a whole has had a positive trend during the study period. To compare the trend of both indices, the price index of the insurance industry is also presented along with the total price index to allow comparison between the two indices. Of course, the scale of the insurance industry index is less than the total index, which is why a chart with two vertical axes has been used. In general, the fluctuations of the insurance index are more than the total index and its general upward trend has a lower slope than the linear trend of the total index.

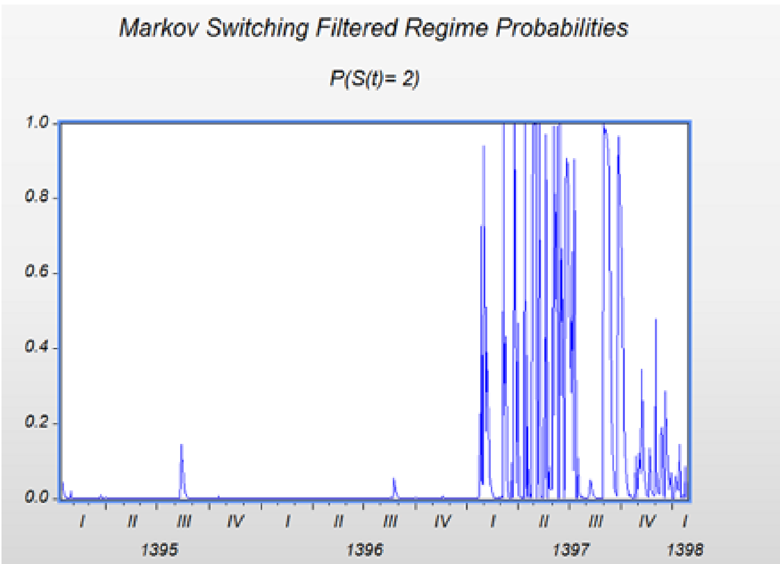

Figure 4: Investigation of bubble formation regime by Kalman filter

Figure 4 shows regime 2, the bubble formation regime. According to Figure 2, the stock market has witnessed a bubble formation process of a total of 19 times in the period from April 2017 to April 2020, so that there has been no price bubble in 2017 and 2018 or may not have been detected. Also, there has been 3 price bubbles in 2019 in Jun, July, and August.

The following are the results of the probability matrix of both regimes. These probabilities can be seen in Table 2.

Table 6: Transition probabilities between the two regimes

Regime type	Regime 1	Regime 2
Regime 1	0.965	0.035
Regime 1	0.453	0.547

As can be seen in Table 6, both regimes have high stability rates. However, regime 1, which is a price bubble collapse, is more stable. In total, both regimes have high stability rates. Here, price bubble formation is less stable and the price index is less likely to be present and remain in this regime in comparison to the price bubble collapse.

5. Conclusion

Using Wu (1995) and Campbell and Fisher (1988) model in the framework of a two-regime state-space model, namely a bubble formation regime and a bubble collapse regime, the Markov switching method was used to investigate the formation and collapse of bubbles in the price index of the insurance industry and compare it with the total price index of the Tehran Stock Exchange.

The results showed that the trend of price bubble formation in the insurance industry in Tehran Stock Exchange and the total price index of the stock exchange are different. The general trend of these two indices showed that these two indices do not have the same trend and the fluctuations in the insurance industry index have been more than the fluctuations in the total stock index. Also, based on the results, the number of bubble formation trends related to the insurance industry index was about 26 times, which was 19 for the total index.

Examining the trends of bubble formation and its collapse also showed that the bubble formation regime in the insurance industry is more stable than its counterpart regime in the total stock price index. This means that the more stable regime of the insurance industry index is the bubble formation mode and the industry index is more inclined to stay in this position, and the opposite is true for the total stock price index. In addition, the bubbles that have occurred were less compatible with each other, so that studies showed that in the period of 2016 to 2017, the total index did not face the formation of bubbles, but the insurance industry index experienced about 12 bubble formation processes in the same period.

Finally, future studies are suggested to compare the price bubble in the insurance industry with other industries, especially industries such as the banking industry and investment funds. Also, the subject should be studied using other statistical methods.

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