Investigating the relationship between privatization and information efficiency, regime switch and structural failure in the Iranian economy

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Abstract

Increased government revenues and improved economic efficiency are the main goals of implementing privatization and regime switch in Iran. Information efficiency in the capital market can also be considered as a milestone for increased government revenues and improved economic efficiency. In this study, according to the results of regime switching GARCH models, it is determined that stock returns have had different regimes during the study period (2000-2015). According to the results of the estimation of the three-regime GARCH model, the most important events of the Article 44 of the Constitution in the direction of privatization in Iran's economy and its implementation during the study period have been effective in switching the regimes of the fluctuating process of efficiency. Market risk has also been identified as a factor affecting regime switching in the stock return process, which is due to the behavior of stockholders in low-fluctuation regimes compared to high-fluctuation regimes and liquidity. Also, according to the Kalman filter model, poor performance has been established in Tehran Stock Exchange, which indicates that privatization policy has been effective in improving the efficiency of this marketplace. Using the technique related to the detection of structural failure in the liquidity variable as one of the signs of the stock market depth, the failure of this series was detected by virtue of the implementation of

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privatization, and it was discovered that privatization increased market liquidity as one of the principles of market development.
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Jel classification: *G14,G15,G18*

1.Introduction

One of the most complex sectors in any country is the national economy, which will have a positive effect on other sectors if its expansion and prosperity is properly considered. A country that relies on a capable financial sector can claim that it has a growing and healthy economy. One of the most widespread segments of the financial market is the capital market and one of the most important capital markets is the stock market. In order for such markets to function properly and be able to absorb funds and allocate them appropriately, they should be efficient and a necessary condition for market efficiency is a quick and complete reflection of the new information on the price of securities. In an efficient capital market, financial resources such liquid funds are absorbed more quickly and are led to paths that reach the likelihood of unconventional profits to zero or near. For this reason, the discussion of market efficiency for any financial market, including stock market, is so important that has attracted the attention of many economists and researchers in the field of finance. Despite many studies that have been carried out over the past decades, especially in the past four decades, on the performance of the stock market, such as in Iran, this issue is still interesting for scholars. Perhaps one of the reasons for this is the recognition of some fluctuations in the stock exchange due to some important events, including the implementation of general principles of the Article 44 of the Constitution of the Islamic Republic of Iran. For this purpose, in this study, market efficiency is first examined with a new approach based on some kinds of dynamic state-space models, and then, using Markov Switching Model, it will be examined whether there has been a regime switching in the time series of total stock exchange index during the execution of general principles of the Article 44. Considering the importance of two variables of risk and liquidity in this study, the relationship of these concepts and the concept of regime switching that has been achieved by the implementation of the Article 44 of the Constitution of the Islamic Republic of Iran in the history of the country is investigated. We also investigated the

resulting structural failure (if any) in the time series of the liquidity variable and, according to the definition of the dummy variable for a qualitative phenomenon, named privatization, the emergence of fluctuations in the liquidity variable will be related to this important factor in the period under study. The reason for this is the growing focus on the most important 21st century economic outlook in the world, namely privatization and its role in the development and depth of the stock market. In this study, the liquidity variable is used as the representative of the market depth.

2. Theoretical foundations and research background

In the global history, there have been certain events that have had a certain impact on the economy as a whole. One of the events that has been happening all over the world is privatization, so that some analysts believe that the most important component of the world economy in the 21st century has been privatization (Mirzadeh et al., 2009). A goal of privatization is, first of all, to reduce the cost of public sector institutions and organizations and the financial and economic burden of the state, on the one hand, and to increase the efficiency of institutions and economic units, on the other hand. Secondly, the other goal is to expand capital markets, on the one hand, and to reduce the bureaucracy of the state in economic activities and attract revenues to the benefit of the state's treasury, on the other hand (Dadgar, 2013). In Iran, by notification of the general policies of the Article 44 of the Constitution and the implementation of the general policies of the law in July 2008, the duties and powers of the privatization organization underwentfundamental changes. Therefore, considering the importance of financial markets including the capital market, it is necessary to investigate the effect of this particular event, i.e.notification of the general principles of the Article 44 of the Constitution, on the basis of a specific issue. According to the studies, it was found that information efficiency in the capital market could be pursued as one of the overarching objectives of implementing such a principle in the process of privatization. Since poor performance requires immediate reaction of financial asset prices to existing information including past prices, this would mean that past returns have no predictive power for future returns, hence the market efficiency hypothesis at a weak level can investigate the relationship between

current return and return of the previous period with a linear model (Ryeeb et al., 2013).

In a study conducted by Saeedi and Babaloeian (2012) entitled "Financial and Operational Performance of Companies Included in the Article 44 at Tehran Stock Exchange before and after privatization", evaluation of financial performance of companies included in the Article 44 at Tehran Stock Exchange is done using criteria such as operating profit margins, net profit margin, return on equity, return on assets, operating cash flow ratio, asset turnover, leverage ratio, Q-Tobin ratio, and economic value added. The time domain of this research was from the date of National Iranian Copper Industries Company's IPO as the first company of the Article 44 listed in the stock exchange until the end of 2009. To test the hypotheses in the case of normal data, parametric tests, and in the case of abnormal data,nonparametric tests have been used. The results of this study showed that none of the performance criteria had a significant difference before and after the assignment, and financial performance of companies included inthe Article 44 presented to Tehran Stock Exchange had not improved after the transfer.

Abbasian and Zolfaghari (2013), in a paper entitled "Dynamic Analysis of Weak Level Efficiency in Tehran Stock Exchange by Kalman Filter", used weekly data of the total price index over the period from April 2001 to May 2010 and examined the market efficiency at a weak level. To this end, researchers used the GARCH model with variable coefficients over time to examine the market efficiency, so that the GARCH model with variable coefficients, or TVP-GARCH, was estimated using the Kalman filter approach and in the form of a state-space model. According to the findings of this study, after 2003, signs of a slow movement toward improved performance were felt.

BakyHeskoee and Khajvand (2014) conducted a study entitled "forecasting the fluctuations of future oil markets using GARCH models and Markov Regime-Switching GARCH" and compared a set of different standard GARCH models with a group of MRS-GARCH on the basis of their ability to anticipate fluctuations of future oil markets in one-day to one-month horizons. The empirical analysis showed that according to a wide range of statistical loss functions, the MRS-GARCH-t models perform better than standard GARCH models in predicting fluctuations in shorter time horizons. Based on these tests, the existence of a model better than MRW-GARCH-t is rejected.

Arouri et al.'s (2010) study entitled "time-varying forecast in the crude oil market: A case study of GCC countries" examines the weak information

efficiency hypothesis in the four GCC member countries from 1997 and 2008 as a full course and several sub-courses. Using the parameters of the time-varying state-space model, the researchers have examined dynamic behavior of oil market prices through the effects of the GARCH model. Finally, there is evidence that oil price changes can be predicted in the short run, which leads to a rejection of the null hypothesis and, as a result, rejection of weak market efficiency in this study.

Rejeb and Boughrara (2013) carried out a research entitled "Financial liberalization and stock market efficiency: new evidence from emerging economies" andinvestigated market efficiency of emerging markets in the face of some financial and banking crises in emerging economies of 13 countries using new techniques. The article emphasizes that financial liberalization has not been the only event that has had an impact on market efficiencies, but there have also been other factors that have affected market efficiencies. The model used belongs to the family of state-space models, and its estimation requires the use of an optimal algorithm called the Kalman filter because the use of conventional techniques is impossible.In fact, the Kalman filter depends on the information available over time. The results of the study showed that financial liberalization did not change the degree of market efficiency and could only manage to prevent financial crises in these countries.

3.Research hypotheses

Hypothesis 1: By notification of the general policies of the Article 44 of the Constitution, stock market efficiency has been established at a weak level in Iran.

Hypothesis 2: Some possible regime changes in the return on the total index in the capital market are due to the most important developments in the implementation of the general policies of Article 44.

Hypothesis 3: Market risk, liquidity and notification of the Article 44 of the Constitution of the Islamic Republic of Iran are among the factors influencing the regime change in the stock market returns.

Hypothesis 4: The privatization program in Iran's economy has affected the creation of structural failure in the time series of liquidity variable and has led to an increase in the depth of the Iranian stock market.

4.Research methodology

4.1.Statistical population, sample size and research period

The statistical population used in this research is Tehran Stock Exchange. In order to make the selected sample an appropriate representative of the statistical population, the total index in the stock market is used and the logarithmic efficiency of the index will be used in order to make it stationary. By choosing the sample period from 2000 to the end of 2015 and considering the total index as the main variable of market efficiency during this period, efficiency is examined.

4.2.Research method

The main idea of the method of testing stock market efficiency in this study is based on the main changes in the market on the basis on changes in the structure of the market, which includes increased complexity of the main players of the market and these players' ability to achieve more information over time. These issues lead to market efficiency changes over time. If this is to be done, it is necessary to use time-varying dynamic models to model market returns. Hence, the technique of time-varying models invented by Zalesko-Mitterrand and Hall (1999), developed by Fentin and Guven (2003), is used. In this mode, return coefficients of stock returns are allowed to change over time based on conditions. Efficiency at a weak level can be tested through the following time-varying model:

$$R_{i,t} = B_{i,t}^{(0)} + \beta_{i,t}^{(1)} R_{i,t-1} + U_{i,t} \quad (1)$$

$$U_{i,t} = \beta_{i,t}^{(0)} z_{i,t} \quad (2)$$

$$h_{i,t} = \alpha_i^{(0)} + \alpha_i^{(1)} U_{i,t-1}^2 + \alpha_i^{(2)} h_{i,t-1} \quad (3)$$

$$\beta_{i,t}^{k} = \beta_{i,t-1}^{(k)} + \pi_{i,t}^{(k)} k = 0,1 \quad (4)$$

Where $R_{i,t}$shows the return on the stock market at time t, and $\beta^{(0)}{}_{i,t}$ and $\beta^{(1)}{}_{i,t}$ are long term trends and serial correlation of stock market returns (indicative of predictability) for country i, respectively, and are allowed to change over time

in accordance with the first-order random step process. Also, $h_{i,t}$shows the conditional variance of the residuals resulting from the estimation of the standard GARCH (1.1) model. The remaining variables are also random noises. If the estimated values of $\beta^{(1)}_{i,t}$ are equal to zero or statistically insignificant, then the weak market efficiency hypothesis is significant, meaning that the there is no relationship between the return of the current period and previous period and that the current return variable is only affected by random variables and noise, which is exactly in accordance with the definition provided by Fama in 1970 and 1998. Now, it will be examined whether there has been a regime switching in the time series of stock exchange total index during the implementation of general principles of the Article 44.

4.2.1. Methodology of state-space model and Kalman filter algorithm

The econometric modeling has evolved essentially with co-integration analysis, although convergence approaches are entirely dependent on static series as well as hypotheses that estimate the parameters basically unchanged over time. Given these conditions, researchers doubt about the convergence analysis in some cases. Harvey stated that all dynamic econometric methods should not be based on auto-regression. Hunt et al. (2003) also added methods that allowed the coefficients to be randomly variables over time that could be effective and useful. Meanwhile, the Kalman filter method incorporates all of the above-mentioned features and provides a suitable framework for estimating regression for variables whose effect is changed over time (Morrison & Pike, 1977). Kalman filter is an efficient recursion filter that estimates the state of a dynamic system from a series of measurements with error.

4.2.2. Methodology of Markov Switching Models

Many variables have segments where the behavior of the series varies greatly. That is, any macroeconomic variable or financial data is fraught with many failures in a long period of time. It should be noted that if a process has undergone a change in the past, these changes may also occur in the future, and this should be taken into account in predictions (Hamilton, 1989). In the Markov switching model, the time series process is assumed to be a function of an unobserved random variable s_t. Here, $s_t$is a regime or a state in which the process of time series is placed in time t. S_t is a random variable that takes only

the integer values. Imagine that the probability that s_t is a specific value of j depends only on the past value of the previous period, in that case:

$$p\{s_t = j \mid s_{t-1} = i\ ,\ s_{t-2} = k, ...s_{t-n} = n\} = p\{s_t = j \mid s_{t-1} = i\} = p_{ij} \qquad (5)$$

Such a process represents a Markov chain with n regimes with the probability of transition $p_{ij,}$ the probability of transition from regimen i to regime j.

$$P = \begin{bmatrix} p_{11} & p_{12} & \cdots & p_{1n} \\ p_{21} & p_{22} & \cdots & p_{2n} \\ \vdots & \vdots & \ddots & \vdots \\ p_{n1} & p_{2n} & \cdots & p_{nn} \end{bmatrix} \qquad (6)$$

The element of the j^{th} and i^{th} rows of the p_{ij} probability matrix express the probability that we will have the regimen j after the regimen i. Imagine a regime, which the system is placed in it at time t, is represented by a random variable s_t, and there may also be N regimes (S_t = 1, 2, ..., N),when we are in regime 1, the observed variable y_t is assumed to follow the distribution of $N(\mu_1, \sigma_1)$. If the process is in regime 2, then y_t follows the distribution of $N(\mu_1, \sigma_1)$. Therefore, the conditional density of y_t, provided that s_t = i, is equal to:

$$\left\{ f(y_t \mid S_t = j, \theta = \frac{1}{\sqrt{2\pi\mu_j}} \exp(\frac{-(y-\mu_j)}{2\sigma_j}) \right\} \qquad (7)$$

4.2.2. Introduction of Markov regime switching GARCH model

According to historical reasoning, if a process has been changed in the past, it is likely to be a repeat of changes in the future; this phenomenon has been taken into account in predictions. However, regime switchingshould not be considered as a predictable and definite problem, it is a random and exogenous variable. Consider S_t as a variable that takes only integer values andimagine that the probability that S_t is equal to the pure value of j depends only on its value in the previous period:

$$P\left[S_t = j / S_{t-1} = i \mid S_{t-2} = K, ...\right] = P\left[S_{t^-} = i\right] = P_{ij} \qquad (8)$$

Such a process is defined as a Markov chain with N regimes:

$$p=\begin{bmatrix} p_{11} & p_{21} & \cdots & p_{n1} \\ p_{12} & p_{22} & \cdots & p_{n2} \\ & \vdots & & \\ p_{1n} & p_{2n} & \cdots & p_{nn} \end{bmatrix} \quad (9)$$

This Markov process is guided by the s_t variable. The logic behind this modeling is to have a combination of distributions with different characteristics. These distributions show the current value of the variable. The condition variable is assumed to follow a first-order Markov ring with the following transition matrix:

$$P=\begin{bmatrix} p_{11} & p_{21} \\ p_{12} & p_{22} \end{bmatrix}=\begin{bmatrix} p & 1-q \\ 1-p & q \end{bmatrix} \quad (10)$$

In which p_{ij} denotes the probability of a rotation from the state i at time t-1 to the state j at time t. This means that:

$$\Pr(S_t = j|S_{t-1} = i) = P_{ij} \quad (11)$$

In general, Markov switching GARCH model can be written as follows:

$$r_t \mid \varsigma_{t-1} \begin{cases} f(\theta_t^{(1)})P_{1,t} \\ f(\theta_t^{(2)}(1-P_{1,t}) \end{cases} \quad (12)$$

Where, $f(\theta)$ shows one of the probable conditional distributions that can be assumed to have normal distribution, t-student, or generalized error distribution. The term $\theta_t^{(i)}$ expresses the parameter vector in the ithregime that specifies distribution, $P_{1+t} = \Pr[S_t = 1 \mid \varsigma_{t-1}]$ is the estimated probability, and ζ_{t-1} is information set at time t-1.

4.3.Structural failure

The existence of structural failure in the economic time series is very common due to the existence of shocks such as war, sanctions, certain policies such as subsidy targeting or privatization, climate fluctuations, and so on. If, according to the conditions and requirements governing economic variables, changes in the process of variables occur along with changes in model parameters, or, in

other words, if the stability of parameters of model is failed, these changes are called structural failure. The structural failure test in linear regression models was initially performed by Quant and Chow. In these studies, the structural failure test is performed exogenously at a predetermined point, but since 1990s, other methods have been used to test the structural failure, in which test is endogenously carried out at uncertain or unspecified points. In the present study, the Bay and Peron (2003) method has been used to endogenously estimate the number and location of failure points using a linear regression model for the time series of the liquidity variable, because the failure of this variable will be due to the most important events carried out by privatization, indicating that effectiveevents that have occurred in the depth of the capital market in recent years. First, it is assumed that there is $(m+1)$ policy regimes that will result in m structural changes, that is, linear regression with m failure and $m+1$ parameter bunch, which is displayed as follows:

$$y_t = x_t'\beta + z_t'\delta_t + u_1 t = 1,....,T_1 \quad (13)$$

$$y_t = x_t'\beta + z_t'\delta_{m+1} + u_t t = T_{m+1},...,T \quad (14)$$

Where, T_1, …, T_m are unspecified structural failure points, y_t is the dependent variable at time t, z_t is the vector of independent variables with variable coefficients, x_t is the vector of independent variables with constant coefficients, β is constant coefficients, δ_j is the vector of variable coefficients $(j=1,...,m+1)$, and u_t is error terms. The main purpose of this model is to estimate uncertain coefficients and failure points of the regression when the observation T is available (Marzban and Nejati, 2009). It is worth noting that for calculating the liquidity ratio (Liq), Amihud's non-liquidity criterion (2002) has been used that is of greater relevance in financial studies, which is defined as the ratio of the absolute magnitude of the average daily return of the stock to the traded volume in Rial. This criterion can be interpreted as a daily price change per Rial of volume of transactions.

$$\text{Liquidity} = \text{mean}\left(\frac{\text{return } t}{\text{transactions volume } t}\right) \quad (15)$$

5.Data analysis and hypotheses testing

The data set analyzed in this paper is the Total Price Index (TEPIX) in Tehran Stock Exchange.

Table 1 : Results of Descriptive Statistics for Rate of Return (Rt)

Statistics	Values	Result
No. of observations	3789	
Mean	.000948	
Median	.000521	
Max.	.052581	
Min.	-.056704	
SD	.006373	
Skewness	.30007	
Kurtosis	12.45687	
Jarque-Bera	14175.99***	Non-normal series
ADF (with intercept and without process)	-13.38078***	Stationary
ARCH	138.0379***	conditional heteroscedasticity
LM(9)	81.71128***	conditional heteroscedasticity
Qiu Liang Box (9)	1083.2***	Autocorrelation among residuals
McLeod-lee (9)	368.15***	Autocorrelation among residuals

***** represents significance at 1% error level (Source: authors' calculations)**

According to Alexander (2001), fluctuation is a concept that is only true for stationary processes. Therefore, before designing the fluctuation model, it is necessary to check whether return time series is stationary or not. The augmented Dickey Fuller test (ADF) was used with 9 intervals as the optimal interval (according to the Akaike and Schwartz statistics), which results in stationary return variable in the given time period and the absence of false regression in the modeling processes.

5.1. Introduction and estimation of regime GARCH model

In order to estimate the single-regimeGARCH model with the AR (1) process, the following relation is considered using the return variable as a dependent variable. Equation (16) is used as the mean equation in the modeling of return fluctuations:

$$R_t = \beta_1 + \beta_2 R_{t-1} + U_t \quad (16)$$

$$U_t = h_t z_t \quad (17)$$

$$h_t = \alpha_0 + \alpha_1 U_{t-1}^2 + \alpha_2 h_{t-1} \quad (18)$$

The purpose of ARMA models for modeling returns (fluctuations) is to test whether the simple form of stock market return modeling, without using the GARCH model, yields a more accurate performance in modeling Tehran stock market returns. In the GARCH modeling, the above relations are estimated simultaneously and using the Maximum Likelihood (ML) estimator. The following table presents the results of the GARCH (1.1) model:

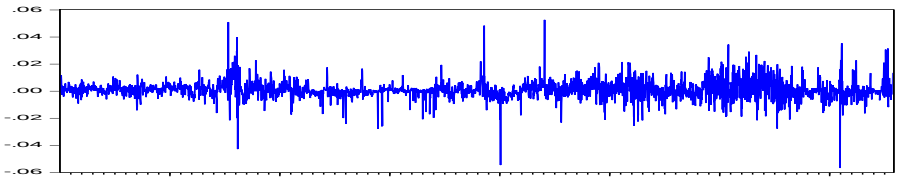
Table2 : results of estimating single-regime GARCH model

Equation	Variable	Coefficient
Mean equation	Intercept	.000122*
	R_{t-1}	.471142***
Variance equation	Intercept	.00000342***
	U^2_{t-1}	.286388***
	h_{t-1}	.644743***
Log of likelihood		14701.29

***, **, and *** represent significance at error levels of 1%, 5%, and 10%, respectively.**

According to estimation results in Table 2, all coefficients are significant and the significance of the R_{t-1} coefficient indicates that there is no weak performance in Tehran Stock Exchange, and the returns of the previous period are transferred to the current period. The diagram of return variable's trendin Tehran Stock Exchange is presented in Figure 2 and the different nature of different fluctuations indicates the likelihood of different regimes in the oscillating trend of the return variable.

Figure2 : Diagram of return variable's oscillating trend in Tehran Stock Exchange (researchers' calculations)



In order to identify and allow different regimes in the time series of return, the estimation of multi-regime models will be done taking into account the highly volatile nature of the return variable. It must be determined whether the estimated coefficients can vary in different regimes over time. The MRS-GARCH model is estimated assuming the presence of AR (1) process in the mean return of Tehran Stock Exchange, which itself indicates the existence of a weak performance in Tehran stock market with the MRS-GARCH model. To illustrate this test, its modeling is once again addressed:

$$r_t^{(i)} = \mu^{(i)} + \phi_1^{(i)} r_{t-1} + \xi_t^{(i)}$$

$$h_t^{(i)} = \alpha_0^{(i)} + \alpha_1^{(i)} \sum_{t-1}^{2} + \beta_1^{(i)} h_{t-1}$$

Indicator i represents the regime. Here, assuming two regimes, one is highly fluctuating and the other is lowly fluctuating. In the three-regime case, an average regime can be imagined between the two regimes. In the weak performance hypothesis, if stock market performance is predictable, the stock market is inefficient, and systematic gains can be achieved predictingthe future of the market. In fact, if the conditional mean equation has a single root, then the efficiency hypothesis can be accepted. Considering that the MRS-GARCH modeling typically uses 2- or 3-regime models and that estimates are then compared based on diagnostic statistics, we have:

Table3 : Likelihood Logarithms for two estimators of the model (authors' calculations)

No. of regimes	Likelihood Logarithms	No. of iterations
2	-14712.32	22
3	-14643.54	10

Considering the superiority of the 3-regime model in explaining the volatility of the stock market in Iran, Markov regime switching GARCH model is presented considering the three regimes estimated in the following table:

Table4: Estimates of the coefficients of the 3-regime GARCH Model (authors' calculations)

Regime	α_0	α_1	β_1
1	.007572	.069898	.367344
2	.000003	.663359	.367344
3	.000624	.121065	.145001

Also, the transfer matrix between regimes is as follows:

Table5: Results of transfer matrix between regimes (authors' calculations)

P_{11}=.325	P_{12}=.001	P_{13}=.018
P_{21}=.493	P_{22}=.99	P23=.846
P_{31}=.182	P32=.009	P_{33}=.136

As shown in Table 5, the likelihood of staying in the second regime is higher and, in the transition between regimes, it is the most likely transition from regime 2 to 3. The possibility of transition from regime 1 to 2 is lower than all transfers. Generally speaking, a low-fluctuating regime means that the regime is less likely to be transferred. As it is seen in Table 5, the probability of transferring from 1 to other regimes is low, and vice versa, the probability of transferring from regime 2 to other regimes is high. Therefore, regimen 1 is low-fluctuating, regime 2 is high-fluctuating, and regime 3 is considered to be in the middle state.

5.2. Stability (fluctuations) of regimes

The sum of coefficients of the ARCH and GARCH indices in the Markov switching GARCH models show the degree of stability of the fluctuations. In the table below, the results of calculating the stability of the fluctuations for 3-regime GARCHmodel are presented to compare the stability of fluctuations in different regimes as well as the stability of the single-regime model fluctuations in order to compare with multi-regime models.

Table6: Results of the stability of fluctuations in regime GARCH models

GARCH model		Stability of fluctuations	Overall stability
Single-regime		.931131	.931131
3-regime	1st regime (low fluctuation)	.437242	.92914
	2nd regime (high fluctuation)	1.030703	
	3rd regime (average)	.266066	

Stability of fluctuations in single-regime GARCH models is higher than multi-regime models. In fact, the application of the regime transfer model reduces the stability of the fluctuations.

5.3. Reviewing the regime change during privatization

The dates associated with the privatization program in Iran's economy are summarized in the following table:

Table7: Important dates in the privatization program in the Iranian economy

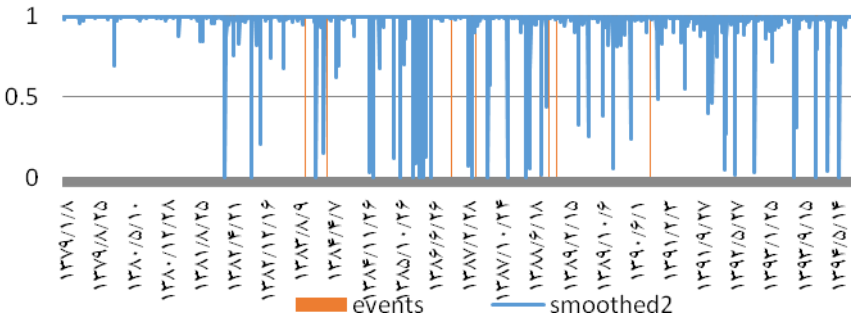
No.	Date	Description
1	October 31, 1979	Approving the Article 44 of the Constitution at the Assembly of Experts on the Constitution
2	June 1989	Reaffirmingthe Article 44 of the Constitution at the Constitutional Review Council
3	January 3, 1998	Explanation of the Article 44 of the Constitution by the Expediency Discernment Council
4	April 4, 1998	Emphasis on the implementation of the Article 44 of the Constitution by the Supreme Leader
5	April 25, 1998	Approving the issue by the ExpediencyCouncil for a proposal to the Macroeconomic, Commerce and Administrative Commission
6	December 11, 2004	Approving the general policies of the Article 44 of the Constitution in five paragraphs by the Expediency Discernment Council
7	Beginning of May, 2005	Notification of general policies to the heads of the three powers by the Supreme Leader
8	January 28, 2008	Approval of the law of the Article 44 by the parliament
9	June 14, 2008	Detection of the approved law as the system's interests by the Expediency Discernment Council
10	July 21, 2008	Notification of the approved law to the Ministry of

		Economic Affairs and Finance by the President
11	October 21, 2009 December 20, 2009 February 21, 2009	Approval of the Statute of the Privatization Organization
12	December 19, 2011	Apply discounts and determine how stocks are transferred to equity holders

According to the data of the sample under study, which was from the beginning of 2000 in relation to Tehran Stock Exchange index, the sixth row of the above table (total of 9 time positions), it will be possible to examine the effect of privatization process in Iran on regime change in the estimated Markov switching GARCH model. In the second regime, as a regime that is more likely to stay in it than other regimes, most of the regime's transmission possibilities are more than 50% even after the record date of the events listed in Table 7, so the process of approval and implementation of privatization in the Iranian economy has led tothe change of the regime in the estimated model.

Figure3 : Trend of the possibility of regime change smoothed for the second regime

(authors' calculations)



In order to monitor the stock market efficiency that changes over time, it is necessary to use mobile models with time to model market returns. For this purpose, the main model introduced in the methodology section will be used. In order to estimate the variable coefficients over the time of the model, Eviews 9 software will be used.

Table8 : Results of estimating the combined model of Kalman Filter GARCH

Equation	Coefficient	Coefficient estimation

Mean equation	$\beta^{(0)}$	.000587***
	$\beta^{(1)}$	.380185
Variance equation	$\alpha^{(0)}$	-.712134***
	$\alpha^{(1)}$	.926462***
	$\alpha^{(2)}$	1.03833
Log of likelihood		20728.8

***** represents significance at 1% error level.**

Since $\beta^{(1)}$ coefficient is insignificant, the capital market of Iran has a weak performance, while the results of the estimation of the single-regime GARCH model indicated the lack of efficiency in the Iranian capital market even at the weak level. Considering that the results of the estimation of the Kalman filter GARCH Model indicate a weak performance due to the implementation of the Article 44 of the Constitution, this fact indicates that in these years, the implementation of this important decision in addition to increasing the volume, size and value of market transactions has led to the movement towards information efficiency in the capital market within the framework of dynamic models.

5.4. Investigating the impact of other factors on regime switching in stock return

Along with the privatization issue that has led to regime switching in Tehran Stock Exchange, it is possible that other factors also play a role in switching the regime in market returns. According to the literature, market liquidity and market risk are two of the most important factors affecting the change in market returns:

$$r_t^{(i)} = \mu^{(i)} + \beta_1^{(i)}\sigma_t + \beta_2^{(i)}Liq_t + \varepsilon_t^{(i)} \qquad (19)$$

In the above equation, $r_t^{(i)}, \sigma_t$, and Liq_t represent the returns, risks and likelihood of market liquidity during the study period, respectively. In order to estimate the above relationship, according to the MRS-GARCH modeling, 2- or 3-regime models are used and finally, based on the diagnostic statistics, the estimates are compared.

Table9: Diagnostic statistics for two estimates of the model (authors' calculations)

No. of	Log. Of	AIC	SBC	HQC	No. of	Descriptions

regimes	likelihood				iterations	
2	13914.31	-7.461	-7.446	-7.456	10	-
3	13926.99	-7.464	-7.438	-7.464	19	Not obtaining unique coefficients

According to the results of estimating 2- and 3-regime model in Table 9, except Schwartz, other statistics show the superiority of the 3-regime model in explaining the fluctuations in the stock market in Iran, but with three regimes, it is impossible to obtain unique coefficients; therefore, with assuming two regimes,model estimation is continued and the results are reflected in Table 10.

Table10 : results of estimating 2-regime model coefficients in terms of liquidity and risk

Regime	μ	β_1	β_2
1	.01455***	.000457***	-.0025***
2	.000069	-.00067***	.000001
Covariance between the two regimes		-5.27173***	

The significance of the risk factor in both regimes reflects the effect of this variable on regime change in stock market returns, but the liquidity variable does not change the regime. Also, the transfer matrix between regimes is as follows:

Table11 : Results of transfer matrix between regimes (authors' calculations)

P_{11}=.74224	P_{12}=.25776
P_{21}=.033221	P_{22}=.966779

As shown in Table 11, transfer will be from regime 1 to 2. The likelihood of a transfer from regime 2 to regime 1 is very low, and vice versa, the probability of transfer from regime 1 to 2 is higher. Therefore, regime 1 is of high fluctuation and regime 2 is of low fluctuation. Also, based on the results of the transfer matrix between regimes, the duration of waiting in a regime can be obtained in accordance with the relationships in the table below:

Table12 : Results of expectancy time in a regimen (authors' calculations)

Constant expected durations (i) $= \frac{1}{1-p_{ii}}$	
Expectancy time of waiting in regime 1	Expectancy time of waiting in regime 2

(high fluctuation)	(low fluctuation)
3.879581	30.10149

In sum, the results of the above modeling indicate that in a volatile regime, where typically more risky or so-called speculative individuals are buying and selling more shares to take advantage of existing waves, risk increases will be associated with higher returns for such people. On the other hand, for these individuals, returns are inversely related to liquidity, because stock is softerwith less liquidity (with respect to its calculation relation), so it is more desirable for speculators to get more profits with less capital. But in a low-fluctuation regime, funders typically invest in a larger volume of transactions, and they buy and sell in large or so-called block sizes. For this category of investors, risk is considered to be a negative factor, and liquidity is of less importance. During the studied period, the stock market fluctuations in Tehran experienced three types of regimes, which were mainly in the fluctuating regime in this period. In addition, market risk and the process of privatization in the Iranian economy have been effective in changing regimes.

5.5. Evaluation of the effect of the privatization program in the Iranian economy on structural failure of liquidity

The results of the Bay and Peron (2003) tests on the liquidity time series are presented in the table below, and the results presented in this table indicate that there are two structural failures in the series.

Table 13 : Results of the investigation of structural failure in the liquidity time series

Null hypothesis	F-statistics	F critical value (Bay and Peron, 2003)	Results
Lack of even 1 failure	1247.320	5.58	Rejected
A minimum of 1 failure	16.8264	10.13	Rejected
A minimum of 2 failures	2.6248	11.14	Not rejected

There are two points of structural failure in the liquidity time series that are presented in the following table in accordance with the results of the Bay-Peron test:

Table 14 : Structural failure points in the liquidity time series

No.	Observations	Date
1	848	10.1.2003
2	2129	5.10.2009

We now want to examine whether the implementation of the Article 44 of the Constitution has been effective in creating structural failure in the liquidity time series. To this end, the impact of privatization according to the distinct dates that are mentioned is considered using the least squares estimation method, with structural failure in the dependent variable. In the table below, the relevant estimation results are presented to examine the effect of privatization on the formation of structural failure in the liquidity time series. Due to the effect of the dummy variable related to the date of privatization, the failure points may be shifted and the number of failures may change. Given that there are failure(s) in the liquidity series, the series is converted into two or three sections, each section having its own intercept, but the dummy variable must be checked throughout the whole series to see whether the failed series is effective. It was also not possible to estimate the model at some time, because the failed liquidity series (sub-samples) included a complete correlation between the regressors.

Table 15: Estimates of the effect of the privatization in Iran's economy on structural liquidity failure

	December 11, 2004	Beginning of May, 2005	January 28, 2008	January 28, 2008	July 21, 2008	October 21, 2009	December 20, 2009	February 21, 2009	December 19, 2011
Intercept	.0005***	Complete co-linearity among regressors in sub-samples	Complete co-linearity among regressors in sub-samples	.0005***	.0005***	.0005***	Complete co-linearity among regressors in sub-samples	.0005***	.0005***
	.00007***			.00007***	.00007***	.00007***		.00007***	.00006***
	.00001***								
Dummy of the date of privatization	.0003			-.00005***	-.00005***	-.00004***		-.00005***	-.00004***

***** represents significance at error level of 1% (authors' calculations)**

According to the results in the table above, most of the dates related to privatization have a negative and significant effect on the liquidity and indicate

the existence of a failure in the liquidity series given only two coefficients for intercept. The negative effect of privatization on liquidity is important given that the liquidity criterion used in this study is based on the equation of the lack of liquidity of Amihud; therefore, privatization has led to a reduction in the lack of liquidity. In fact, privatization has led to an increase in liquidity of the market (as one of the principles of market development), and this can have an interpretation in increasing market efficiency.

6.Conclusion

In this research, econometric methods were used to study the effect of privatization policies on Tehran Stock Exchange returns. According to the results of regime switching GARCH models, it was determined that according to different types of diagnostic statistics, 3-regime model is preferable to others, and Tehran Stock Exchange returns had different regimes in their volatile process during the studied period (2000-2015), among them stability of fluctuations in single-regime GARCH models is higher than multi-regime models. According to the results of the estimation of the three-regime GARCH model, the main events of the Article 44 in the direction of privatization in the Iranian economy and its implementation during the study period were effective in changing the regimes of the fluctuating process ofstock returns, which confirms the 2ndhypothesis of the research. Also, according to the results of the Kalman filter GARCH model, weak performance has been established in Tehran Stock Exchange, which suggests that the privatization policy has been effective in creating or improving the efficiency of Tehran Stock Exchange. Therefore, the hypothesis 1 of the research is also confirmed. In addition, considering the two explanatory variables of risk and market liquidity, it was found that among these two variables, only market risk is effective in regime switch in the stock return process, due to the behavior of stockholders in low-fluctuating regimes compared to high-fluctuating over liquidity. Using the technique related to the detection of structural failure in the liquidity variable, the failure of this series was determined by the implementation of privatization, and it was determined that using the Bay and Peron privatization method led to an increase in the liquidity of the market as one of the principles of the market development. It was also found that privatization affected the emergence of the regime change in the return variable of the stock exchange index during the

third, fourth, and fifth development plans in the form of regime change detection models.

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