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Forecasting Tehran Stock Exchange Prices: Smooth Transition Autoregressive (STAR) Approach

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ABSTRACT

Background: Nowadays because of the increasing growth of financial markets, changes in these markets can have a huge influence on the whole global economy. Forecasting the behavior of these markets, for example stock markets as the main financial market, has always a significant and important role in economic topics. In this regard, controlling the exchange rate and its fluctuations, and in fact proper and optimized selection of exchange systems will have a significant impact in attracting capitals of investors toward exchange market of a country. Moreover, global price of gold is one of the most important economic variables representing most of the international and financial developments. **Objective:** Therefore, the main goal of this study is providing a suitable pattern to forecast stock price index using two exogenous variables, exchange rate and price of gold. In this regard, in order to analyze the data, among time series data of gold price, exchange rate and index of Tehran Stock exchange price during the first period of March 2001 up to September 2012, different patterns of ARIMA, logistic smooth transition autoregressive (LSTAR) has been used. **Results:** The result of this study suggests alternativeness of exchange, gold, and stock markets. In addition, performance accuracy of LSTAR non-linear model has been higher than ARIMA linear model in the field of forecasting the price of Tehran stock exchange market. **Conclusion**: The vulnerability amount of efficiency of stock index comparing to exchange rate is somehow more than the effects caused by gold price changes on this index (with regard to Elasticity values of mentioned variables in long term equation), so as a policy proposal, comparing to gold price changes, it's possible to take the attention of most investors in Tehran stock market mostly to exchange rate fluctuations. Therefore, investors and financial analysts can present more actual analysis from changes and fluctuations of stock price by following the news and information of mentioned markets. On the other hand, findings of this study indicated that using nonlinear models has more ability to describe the behavior of stock index and its changes. Therefore, it can be suggested that policy proposals in this field must be established according to the researches that their results come from nonlinear models, otherwise, Bias in the specification of mentioned variable will lead to take wrong policies.

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INTRODUCTION

Achieving sustainable economic growth requires the mobilization and allocation of resources at national economy level, and this is not possible easily without the help of financial markets. Stock market is one of the components of the financial markets and is subjected to it as a part of economy collection. If this market does not have a logical relation with other parts, problems and shortcomings will come in its performance. Recession and booming of stock markets will affect not only national economy, but it also affects the global economy as well (Eizaguirre and Co, 2009). On the other hand, the role of foreign exchange in economic systems is undeniable, and the reason is obvious. Today most countries of the world in most economic parts are dependent on transactions with other countries, and these transactions are being done with different exchanges. Controlling exchange rate and its fluctuations, and in fact proper and optimized selection of exchange systems will have a significant impact in attracting capitals of investors in exchange market of country. Because deviation of the real exchange rate affects the estimation of investment costs, it leads production factors to the production of non-

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tradable product, and consequently leads to the transfer of resources to noncommercial sector, and allocating them to the non-tradable activities (Shirinbakhsh and Roozbehi, 2011).

Moreover, global price of gold, which represents most of the international monetary and financial developments, is one of the most important economical indexes and studying the behavior of Gold price has always guided the policymakers in monetary and exchange policy orientations of each country's economy (Hsu and Tasi, 2012). On the other hand, gold markets are major rivals of capital market, and this makes the importance of the role of this good doubled, since the existence of various financial markets, and quick and easy transactions there, puts new investment opportunities in front of investors, and leads to transferring cash among various financial markets.

Theoretically, according to Portfolio thesis, property owners of stock market rival try to choose the combination of their financial assets in a way that their output rate becomes equal and mentioned combination (Portfolio) balanced. According to this, increase in the efficiency of an asset, which can be caused by rising prices, such as gold or land, will lead to increasing the attraction of investment in these markets, and therefore will cause investment growth in mentioned markets. Thus, by increasing demand for these assets, their prices will increase directly, and consequently, the price for competitor's assets will decrease (Kaliyamoorthy, 2012; Tan, 2011; Mashayekh and Co, 2012).

In this respect, dealing with exchange rate and global price of gold as two fundamental factors which play the role of alternative stock market, is essential in forecasting stock price. Therefore, in this study we will deal with reviewing the effect of each exchange rate and global price of gold on stock price indexes.

Wang and Co, 2012, evaluated the relation among stock price index of America, Germany, Japan, Taiwan, and China with explanatory variables of exchange rate, price of gold and crude oil in both short term and long term. The result of this study indicates that there is a long term relation among mentioned explanatory variables and price indexes of Germany, Japan, Taiwan, and China, while any long-term relation is not provable between those indexes and America stock market. Using logistic economic smooth transition autoregressive model, Clayton, 2011, has forecasted the financial market stock of FTSE, DAX, NIKKEI, and S&P as monthly data utilization. The result of this research indicated the operational superiority of out-of-sample forecast of non-linear model ESTAR over linear model ARIMA. Acatrinei and Caraiani, 2011, dealt with modeling and forecasting stock price of Romania with the help of non-linear dynamic patterns of STAR & TAR, and also linear model AR. Findings of this study indicated that STAR, AR, TAR models have respectively minimum errors in modeling and forecasting.

Yahyazadehfar and Babaie, 2012, studied the effects of macroeconomic variables such as gold price on the price of Iran stock. The results of this study indicated the indirect relationship between the price of gold and stock. Ghezalbash, 2012, evaluated the effect of changes in gold price on stock index. The results of this research indicated that, firstly, entrance of gold price in neural network model as an exogenous stock index has improved the forecast of stock index; and secondly, it has declared the negative relation between these two variables. Esfahanipour and Aghamiri, 2010, discussed forecasting price index of Tehran stock market price using phase neural network models. The results of this study indicated that making forecast is almost 97.8% near to reality.

Studies such as: Mohd-Hussin and Co (2012), Aydemir (2009), Nishat and Khalid (2008), Capie and Co (2005), Kim, 2003, Soenen and Hennigar (1988), Ajayi and Mougoue (1996), Piraeey and Shahsavar (2009), Samadi and Co (2007), Sajadi and Co (2010), and Karimzadeh (2006), are evidences for existence of negative relation between currency price and stock price index in the countries around the world. As it is expected according to economic theories, gold market, just like currency market, is one of the rivals of stock market and it is confirmed by the findings of this research. Since in both long and short term scales, reverse relation between gold price and stock index is achieved. It is worth mentioning that gold market has less impact on the market comparing with other rival markets of stock market. The research results of Yahyazadehfar and Babaie (2012), Samadi and Co (2012), Sadri and Tayebisani (2012), Ghezelbash (2012), Le and Chang (2011), indicates reverse relation between gold price and stock index.

The hypotheses of the study:

The hypotheses to be tested in the study are as follows:

H_1: the results of STAR test, confirm using that model in the stock price of Tehran stock exchange market.

H_2: accuracy of LSTAR nonlinear model is higher than ARIMA linear model in forecasting the price of Tehran stock exchange market.

H_3: accuracy of ESTAR nonlinear model is higher than LSTAR nonlinear model in forecasting the price of Tehran stock exchange market.

Research Method:

3.1. Smooth Transition Models (STAR):

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Generally, one of the problems for modeling economic variables is heterogeneity and the other is non-stationary of them. Different models have been presented to solve each of these problems. Some examples of the models which are used to remove heterogeneity are: switching-Markov model, Hedrick-Proskat filter and also ARIMA, ARFIMA, and ECM models. In the meantime smooth transition models such as STAR, LSTAR, ESTAR, and also wavelet decomposition technique, not only solves heterogeneity, but also it solves the problems of stationary. These regression models can be considered as developed form of regression switching models of Bacon and Watts, 1971, which has a non-linear structure.

Essentially, these models in addition to having a non-linear structure in different regimes (situations), they also consider dynamic behavior of economic variables in their modeling. By considering dynamic behavior of endogenous variable in modeling, we mean that the model applies special characteristics such as being different in average, variance, and autocorrelation between data in different situations in modeling. Therefore, since the main goal of this research is using smooth transition models of LSTAR & ESTAR in forecasting stock price, we will briefly describe generalities and features of these 2 models (Fomby and Terrell, 2004).

3.1.1. LSTAR Model:

As stated previously, smooth transition models are modeling the endogenous variable data in different regimes. It means that, when the relation between 2 variables is changing over the time, or when these 2 variables are non-stationary, the relation between them will be changed over the time. So, assuming this relationship constant, leads to specification error. While smooth transition models consider this feature and deals with the specification of relation between variables of the research. One of these models is LSTAR model or logistic transition model and its general form is as follow:

$$LSTAR:$$

$$Y_t = \alpha_0 + \alpha_1 x_t + \alpha_2 z_t + \ldots + \alpha_k w_k + \sum_{i=1}^{p} \alpha_i Y_{t-i} + [\beta_0 + \sum_{i=1}^{p} \beta_i Y_{t-i}] G(\beta, e, Y_{t-d}) + u_t$$

$$G(\beta, e, Y_{t-d}) = \left[\frac{1}{1 + \exp\{-\beta(Y_{t-d} - e)\}} \right]^{\frac{1}{2}}$$

In a/m equation, Y is a non-stationary variable, which has become static with I times subtracting. (x, z, … and w) are exogenous variables, the phrase $\sum_{i=1}^{p} \beta_i Y_{t-i}$ shows lags of endogenous variable, self-explanatory factor, in which P shows AR lags. e is a fix amount which leads to the balance of STAR model Shittu and Yaya, 2012.

3.1.2. ESTAR Model:

Basically, the difference of smooth transition models is in their $G(\beta, e, Y_{t-d})$ component. For example, in LSTAR model, this component has a logistic structure while in ESTAR model it has an exponential structure (Jansen and Wang, 2012).

$$ESTAR:$$

$$Y_t = \alpha_0 + \alpha_1 x_t + \alpha_2 z_t + \ldots + \alpha_k w_k + \sum_{i=1}^{p} \alpha_i Y_{t-i} + [\beta_0 + \sum_{i=1}^{p} \beta_i Y_{t-i}] G(\beta, e, Y_{t-p}) + u_t$$

$$G(\beta, e, Y_{t-d}) = 1 - \exp\{-\beta(Y_{t-p} - e)^2\}$$

4. Experimental result of Research:

4.1. Specifying Model:

The data, which are using in this research, are timely series of total Tehran stock exchange index, price of gold rate, and price of Tehran stock exchange index during first period of March 2001 up to September 2012. Since the main goal of this research is forecasting Tehran stock exchange index using explanatory variables of exchange rate and gold price in order to improve its performance; and also to ease the execution of this research, first we describe the abbreviations used in this research which are as follows:

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Table 1: Abbreviations for variables used in the research.

abbreviation	Description	Abbreviation	Description
LTED	Logarithm of the total stock exchange	DLTED	Difference logarithm of the total stock exchange
LEX	Logarithm of exchange rate	DLTED	Difference logarithm of exchange rate
LGO	Logarithm of the gold price	DLGO	Difference logarithm of the gold price

4.2. The stationary test of Variables:

In order to study the stationary of variables in this research we used Augmented Dickey-Fuller Unit Root and Phillips-Perron tests. According to the results of these two tests, variables of this study are non-stationary; therefore we will deal with studying the stationary of the differences for variables of the study.

According to Augmented Dickey-Fuller Unit Root and Phillips-Perron tests, computational values are larger than critical values at 5% error level, so, the difference of the model variables is stagnant at the level of 95% confidence. Therefore, from now on, to prevent any false regression, we will deal with modeling and forecasting the difference of total exchange index logarithm (efficiency) with the help of differential explanatory variables.

4.3. Ljung-Box Test:

Considering the point that, all models of the study including ARIMA, LSTAR, and ESTAR have auto regression process, it is necessary to do Ling Box test which follows the discovery of the correlation among the components of one time series before modeling endogenous variable.

Using this test the existence of autocorrelation in the series of logarithm difference for total exchange index has been studied. The p-values for 1 to 5 delays leads to reject the null hypothesis based on the absence of autocorrelation on the series been studied, so, the series have the auto regression process. According to the results of this test, using ARIMA, LSTAR, and ESTAR models in modeling and forecasting logarithm difference variables of stock exchange index is permitted because according to a/m test, the relation or in other words, significant autocorrelation between intervals of the variable is approved.

4.4. Estimating ARIMA Model:

Essentially, determining the optimal lag length of AR & MA is the most important phase in modeling process of autoregressive moving average models (ARMA). Anyway, in order to find appropriate levels of interruptions, first we should make the variable stagnate, then we consider some limitations such as p,q<5 on it (Keshavar and Samadi,2009). Also, according to Box Jenkins methodology (we can recognize AR & MA levels with the help of significant dents of correlation recorder chart) we can do the modeling of equation of logarithm difference series for total stock index. According to Akaike (AIC) and Schwarz (SBC) criteria, ARIMA model (1, 1, 1) is the best estimation among other ARIMA models, but since co efficiency of this model is not significant, we choose ARIMA model (2, 1, 1) as the best model. Best model specification form is as follows:

Table 2: ARIMA specification model

Prob	t statistics	Standard error	coefficient	Variable name
0/000	7/235	0/00037	0/0026	C
0/001	3/234	0/216	0/698	AR(1)
0/093	1/681	0/047	0/079	AR(2)
0/000	-3/868	0/213	-0/824	MA(1)

R^2	0/016	Loglikelihood	3383/227
F-Statistic	6/947(0/000)	DW	1/9988
Akaike	-5/376655	Schwarz	-5/360309
ARCH-test	9/554(0/002)	McLeod-Lee-test (5)	72/751(0/000)
LM-test	0/031(0/969)	Ljung-Box-test (5)	3/280(0/194)

Source: Researcher findings

As it can be seen in a/m table, the coefficients of all variables in this study such as explanatory variable first and second order, average moving variable first order, are significant (in 5% level, except explanatory variable second order which is significant in 10% level) and compatible with statistical and economic theories. It is worth mentioning that, the results of each estimated model are attributable when diagnostic test of that model confirms the absence of any disturbance in the model. For this purpose, first we examine the statistics of the coefficient of determination, which its amount is very small and confirms the low explanatory power of a/m model, and we can look at the cause of this incident in two factors: first, not using explanatory variables, which has effect on stock index, naturally leads to reduction of R^2 (Suitability of Durbin-Watson statistics, also rejecting the existence of autocorrelation among disturbance components of Ling-Box test and LM - existing frequent autocorrelation among residuals, and the average moving process in residuals of this model - is another reason of this claim), and another one is that nonlinear behavior of the stock index is expected, so using linear

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models will be together with low determination coefficient amount. Therefore, considering these points, we can expect increasing statistics of log likelihood, F-statistics.

Also, tests for the existence of heteroscedasticity in disturbance components and also the existence of nonlinear relation among disturbance components have been done through ARCH & McLeod-Lee tests respectively. The results of these tests indicate that the effects of heteroscedasticity exist in residuals of a/m model, and according to McLeod-Lee test, this model's residuals have a kind of nonlinear relation. These two tests are somehow signaling for nonlinear relation in the process of stock efficiency series. So in the next part, in order to solve this problem, we will do nonlinear tests, so that by discovering the kind of nonlinear relation among residuals, we choose an optimized model for solving the problem, and also increasing the accuracy of model for more accurate forecast of total stock efficiency index.

4.5. Tests for diagnosis of nonlinear processes:

Before dealing with the general study of the model that best fits our available data, it is necessary to test whether the data pattern is nonlinear or not.

4.5.1. Ramsey reset test:

We can use regression equation specification error test to study establishment of null hypothesis of linear patterns against general hypothesis of being nonlinear. If the residuals from a linear model are exogenous, they will not be in correlation with regressions used in estimating equation or the fitted estimated values. The null hypothesis for this test is based on "No significant nonlinear relationship", and according to this hypothesis, we did the related test and the result of it is shown in following table:

Table 3: The results for Ramsey reset test.

Prob	d.f	value	Criterion Statistics
0/027	(1249,4)	2/749	F
0/026	4	11/021	Likelihood Ratio

Source: Researcher findings

The result of the table indicates that data processing in series being studied is not a linear process. So, we can use different nonlinear models to specify the process of logarithm difference for series of stock total index.

4.5.2. LSTAR or ESTAR patterns:

Since LM & RESET tests are not capable of accurate identification of smooth transition process of LSTAR & ESTAR, it's necessary to use another tool to identify smooth models. Accordingly, Terasvirta, 1994, designed a framework that we can mostly use to identify nonlinear behavior. Moreover, we can use this method also to determine which one of LSTAR or ESTAR models are fitted better on the data. So, in this study we will also benefit this frame to study presence or absence of smooth transition processes, and also the smooth transition process type available in stock efficiency series. This test is based on Taylor series expansion of STAR general model.

The results of this test, in a/m approach are as follows:

First Stage:

It is worth mentioning that according to Terasvirta method, 1994, it has been chosen as the best endogenous variable interruptions.

Second stage:

In this stage, we deal with estimation of helping equation, which changed to easier form based on Taylor expansion, in the least of nonlinear squares method model (NLS).

Table 4: The results of identification pattern of smooth transition test

Variable	Index name	Coefficient	Std.Error	T-Statistic	Prob
C	C(1)	0.00285	0.00041	6.9548	0.0000
DLTED(-1)	C(2)	-0.10534	0.03690	-2.8547	0.0044
DLGO(-1)	C(3)	0.00104	0.01405	0.07402	0.9410
DLEX(-1)	C(4)	0.21834	0.10778	2.02609	0.0430
(DLEX+DLGO)*(DLTED(-1)^{8}2)	C(5)	-567.007	33.1279	-17.1156	0.0000
(DLEX+DLGO)*(DLTED(-1)^{8}3)	C(6)	-573.402	657.751	-0.87176	0.3835
(DLEX+DLGO)*(DLTED(-1)^{8}4)	C(7)	170844.0	15349.6	11.13014	0.0000
(DLEX+DLGO)*(DLTED(-1)^{8}5)	C(8)	-25915.5	163564.9	-0.158442	0.8741
(DLEX+DLGO)*(DLTED(-1)^{8}6)	C(9)	-8825174.	1689467.	-2.111255	0.0000
F-Statistic=62.08804(0.0000)					

*It is from the name of variables so that variable indexes used will be clear in the next tests.

Source: Researcher findings

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Findings of a/m table indicates that, the estimated structure of LSTAR & ESTARmodels (based on Taylor expansion) confirmed that with regard to the point that the total model was significant which was done as F test (in which the d.f of its numerator and denominator is 8 & 1252 respectively), we can be sure that the type of specification used to describe its behavior is optimized, and find out that smooth transition structure will be fitted to data used in this research. Also, according to this specified pattern, we can also study and analyze with the help of the test presented by Terasvirta which is in the form of third stage.

Third Stage:

In this section, two tests will be conducted. First, we will study significance of threshold behavior in endogenous variable, stock efficiency index, in the form of test c(5)=c(6)=c(7)=c(8)=c(9) and then we will recognize the kind of process LSTAR or ESTAR so that it can present the best specification to describe the behavior of this variable.

We will do the hypothesis testing c(5)=c(6)=c(7)=c(8)=c(9) in order to recognizethe threshold behavior in stock efficiency index series with the help of Wald test. The results of this test have been indicated in the below table:

Table 5: The result of significant test for existence of threshold Behavior in stock efficiency index

P-Value	d.f	Statistics	criterion test statistics
0/000	(4,1249)	55/9659	F-Statistic
0/000	4	223/8784	Chi-Square

Source: Researcher findings

As it can be seen in the results of a/m table, in the hypothesis test of nonlinear coefficient equality of estimated model, the amount of computational statistics F & x^2 in this test is more than critical amount , and we can find out this also by studying the amounts of P-Values. So, it can be concluded that threshold behavior of this variable is acceptable.

After discovering significances of existing threshold behavior about stock efficiency index series, based on explanatory variables of the research, we should determine which of LSTAR or ESTAR patterns are more suitable. To diagnose each of mentioned patterns we can use T test. According to this, if c(5) coefficient variable is significant, we can also be sure of existing ESTAR in a/m series. Also, if c(7) variable is significant, we can conclude the existence of LSTAR pattern in a/m series (Enders,2005).

Therefore, with regard to significances of c(5) & c(7) variables which have been shown in Table (5), it is obvious that although ESTAR model is significant in explaining the stock efficiency index series behavior, because of the significance of c(7) variable ratio, we can claim that ESTAR model which is a subsidiary of LSTAR model, cannot cover all nonlinear aspects of regime change behavior of a/m series. So, the most suitable pattern for describing nonlinear behavior of Tehran stock efficiency index series is LSTAR pattern. Therefore, in the following, we will study and test threshold, or in other words, the LSTAR pattern structure type.

4.5.3. The test to diagnose the kind of LSTAR process:

LSTAR models in time series studies were introduced by Chan & Tong at 1998 in which they considered density of the normal distribution as transition function. STAR single variable models have been used several times in modeling asymmetric behavior of financial and economic variables such as unemployment rate, inflation, financial market indexes, exchange rate, and price of gold. According to this, in this research for estimating stock efficiency index behavior, we will use one of LSTAR patterns, LSTAR1 & LSTAR2. In fact LSTAR2 pattern can be a replacement for ESTAR pattern, because both of them have equal characteristics to describe stock efficiency index behavior.

According to this, the following test, which is dealing with the simultaneous investigation of being linear against process of smooth transition, involves determination of LSTAR model type and will be presented as proposal model in the following table.

Table 6: The results of the test to diagnose the kind of LSTAR pattern

Transition Variable	F	F2	F3	F4	Suggested Model
dlted(t-1)	$6.957*10^{8}$-4	$6.617*10^{8}$-3	$6.250*10^{8}$-1	$1.132*10^{8}$-3	LSTR1

Source: Researcher findings

As it can be seen in a/m table, we have chosen smooth transition variable as the only first lag of endogenous variable. Because, with regard to the results of introduced linear model in previous sections (based on Box-Jenkins methodology), only the first lag of endogenous variable has the capability to describe the behavior of

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the variable significantly. Moreover, studied series is static, and without any trend. Accordingly, using trend variable instead of transition variable will be useless.

F quantities, used in a/m table, which are derived from hypotheses test of third stage of Terasvirta decision making method (which was described in details in previous section), are not F statistical quantities. They are the p-values for existence of this statistics which will be presented by J-Multi software output. According to this , as the result of a/m table indicates, while the hypothesis of the model being linear is strongly rejected and the opposite hypothesis, the existence of the effects for smooth transition, is accepted, LSTAR1 model has been chosen as the best model to describe the behavior of stock efficiency series. Therefore, in the followings, we will introduce its specification form.

4.6. Estimating LSTAR model:

After different nonlinear processes and confirming the existence of nonlinear structure based on smooth transition patterns (STAR) and also confirming the existence of a threshold in stock efficiency index series (as the main variable of the study), in this section, first we compare different models of LSTAR1 with different input variables (explanatory). To express this better, we will test experimentally that if it is better to put explanatory variables in linear part or nonlinear part of the model, and then we will present the specification form of the best model among different models of LSTAR1 (based on information criterion of Akaike & Schwartz).

Table 7: Studying LSTAR1 differentpatterns with different inputs

P-Value of Gamma	SBC	AIC	R^2	Input		Pos
				Nonlinear	Linear	
0.000	-8.1946	-8.2150	0.01	Const	Const	1
				DLTED(-1)	DLTED(-1)	
0.007	-9.0459	-9.744	059	Const		2
				DLTED(-1)	Const	
				DLEX	DLTED(-1)	
				DLGO		
0.008	-9.0303	-9.0712	0.58	Const	Const	
				DLTED(-1)	DLTED(-1)	3
				DLEX		
				DLGO	Seasonal effect	
0.830	-9.0338	-9.0623	0.58	Const	Const	
					DLTED(-1)	4
				DLTED(-1)	DLEX	
					DLGO	
0.084	-9.0184	-9.592	0.58	Const	Const	
					DLTED(-1)	5
					DLEX	
				DLTED(-1)	DLGO	
					Seasonal effects	

Source: Researcher findings

With study of different LSTAR1 patterns which has been done according to different input variables and presented in a/m table, we can find out that:

First, using explanatory variables of exchange rate and gold price have perfectly acceptable effectiveness in describing the behavior of stock index, and this is clearly recognizable by comparing amounts of data criterion and the coefficients of the models, because it has added about 60% to coefficients of all models. This situations, is confirmed also theoretically and experimentally.

Second, although existence of seasonal effects might be able to improve modeling prices, but in this study, in any of a/m models, coefficient of the variables were not significant, therefore using them doesn't seem logical.

Third, with comparing presented models in Table (7) we can find out that using explanatory variables of exchange rate, gold price and the first lag of endogenous variable in linear structure, did not have suitable performance based on data criterion, coefficient, and significance of threshold variable in nonlinear part of a/m model, and in contrast using the explanatory variables in the nonlinear sector of a/m model makes the results of modeling more reliable. So, according to the results of a/m table, second model has been elected as the chosen model, and in the followings we will deal with the results of estimation of this selected model.

As it is determined by the results of a/m table, this model has two linear & nonlinear parts. In nonlinear part of this model, in addition to first lag of endogenous variable, exchange rate variable and gold price have been used to improve modeling process, and the coefficients of these variables are significant and in accordance with economic theories. That is because in this part of LSTAR pattern, the signs of the coefficients of explanatory variables of exchange rate and gold price are negative, and this indicates that these two markets are in fact rival

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markets of stock market, and with increasing total stock index, the demand to purchase these replacing investment goods will increase.

Table 8: The results of estimation selected LSTAR1 pattern

Variable	Coefficient	SD	t-Statistic	P-Value
Linear Part				
Const	-0.02915	0.0068	-3.8363	0.000
DLTED(-1)	0.2749	0.0337	8.1586	0.000
Nonlinear Part				
Const	0.1859	0.1581	1.1756	0.240
DLTED(-1)	0.27492	0.0540	5.0911	0.000
DLEX(-1)	-7.92458	0.8560	-9.2577	0.000
DLGO(-1)	-0.93326	0.1642	-5.6837	0.000
Gamma	0.09364	0.0353	3.6810	0.0045
C1	0.27390	0.0371	7.3827	0.000
R^2	0.59	adjaustedR2:	0.59	
AIC	-9.0744	SBC	-9.0459	

Source: Researcher findings

On the other hand, in linear part of this model, a const and first lag of endogenous variable are used to be sure there is not any specification error in the model, in which the sign for coefficient variable of first lag of endogenous variable is negative. Negative sign of the coefficient, indicates that the changes of the period before endogenous variable have diverse effect with present period. It means that, if the stock market has positive changes in one period, it will have negative changes in the next period, and the diagram for total stock index changes (stock efficiency) shows this, because as this picture indicates mostly along with any positive change, a negative change can also be observed.

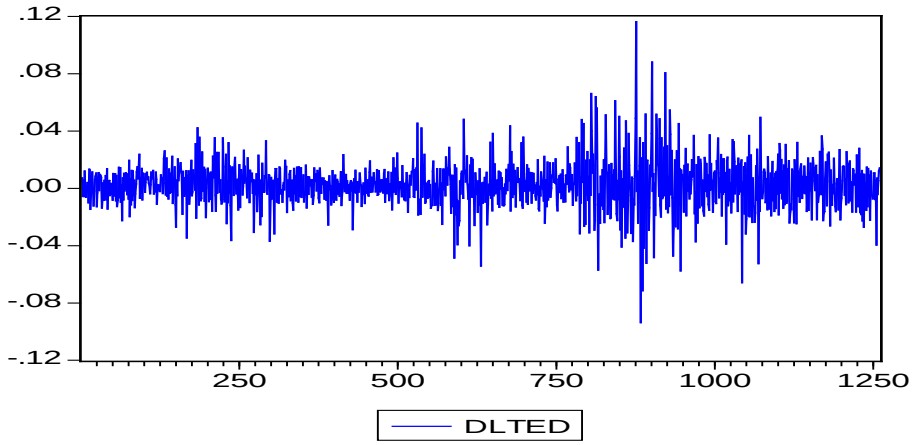

Diagram. 1: Stock return index
Source: Research findings

4.6.1. Diagnostic tests of LSTAR:

A) Autocorrelation test:

This test examines the existence of autocorrelation among the estimated disturbance components of the model. In order to do this test, we use Ljung-Box test statistics. In this test, the hypothesis indicates Lack of autocorrelation among the disturbance components of series. Based on these concepts, the results of Ljung-Box test on disturbance components of LSTAR model are presented in the below table.

Table 9: The result of Ljung- Box estimation in LSTAR1 disturbance components

Lags	F-Value	DF1	DF2	P-Value
1	4/0159	1	1249	0/0453
2	2/0561	2	1247	0/1284

Source: researcher findings

As it is obvious from the result of a/m table, there is not any evidence of existing autocorrelation among the disturbance components of LSTAR model, and on the other hand, with regard to the point that the coefficient of determination of this model is about 60% (this amount is very significant for time series models), we can be sure that specification error in this model is negligible.

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B) Heteroscedasticity test:

Another classic tests which is done after estimating regression models to be sure of reaching to an efficient model, is heteroscedasticity test. The importance of establishment of classic hypothesis, non-existence of heteroscedasticity, is because it makes unbiased coefficients achievements possible. So, studying this test regarding the residuals of the model, makes the researcher aware of the presence or absence of bias in estimating model coefficients, and makes the necessity to use an estimation method except ordinary least square method. Therefore, the result of the heteroscedasticity test of LSTAR1 model, is shown in the below table.

Table 10: The results for estimation of heteroscedasticity in the disturbance components of LSTAR model

Criterion Statistics	Amount	P- Value
$Ch^8 2$	13/9867	0/1736
F	1/4145	0/1680

Source: Researcher Findings

According to the results of this test which have been shown in a/m table, we can find out that residuals of LSTAR1 model don' t have the heteroscedasticity effect.

4.7. Comparison of linear and nonlinear forecasted models:

With regard to the main goal of this study, using exchange rate and gold price variables which actually are to major investment platforms, is necessary and in this section, after determining the best specification, while estimating measure of calculated forecast errors, we compare it with forecasting errors criteria resulted from ARIMA linear model. So in this part, we deal with estimation of the calculation of forecasting accuracy criteria of models used in this study (ARIMA & LSTAR models) for the last 60 observations of the sample data.

It is worth mentioning that according to the presence of the impacts of heteroscedasticity in residuals of ARIMA (2,1,1) models, to estimate this model again for calculation of forecasting series amount studied in this research, we used Robust Regression method, so that factor amounts reached by a/m model don't have a bias , and we can achieve reliable results.

Table 11: the result of estimating forecasting accuracy of research models

RMSE	MAE	Model
0/016536	0/012034	ARIMA(2,1,1)
0/01049	0/00656	LSTAR1

Source: Researcher Findings

Regarding the gained criteria, forecasting accuracy of smooth transition model of LSTAR has the least error in forecasting, therefore we can name it as the best model to forecast Tehran total stock exchange index efficiency.

5. Conclusion and Recommendations:

This study has followed the examining and analyzing the effects of financial market rivals in forecasting stock market (including exchange and gold market), and the findings of this research confirm the vulnerability of stock price index and its efficiency by financial market rivals, in a way that the most effective variable between these two markets, is exchange market with a factor of -7.92. Negativity of this variable is due to the role of this market as the rival of stock market. Exchange rate fluctuations can affect the market from two aspects. On one side, increasing exchange rate leads to reduction of import and growth of export in major importing countries, production growth, and consequently stock index growth. On the other hand, increasing this variable as the rival of stock market has taken the attention of investors and persuades them to transfer their funds from stock market to exchange market in order to increase their investment income.

Generally, to achieve the main goals of this study, first some hypotheses were established and now we will review whether they have been accepted or rejected. The hypotheses this study is reviewing are as follows:

The first hypothesis of this research which was "the results of STAR test, confirm using that model in the stock price of Tehran stock exchange market" is approved.

The second hypothesis of this study which was "accuracy of LSTAR nonlinear model, is higher than ARIMA linear model in forecasting the price of Tehran stock exchange market" also is approved according to findings of research.

At last, "accuracy of ESTAR nonlinear model is higher than LSTAR nonlinear model in forecasting the price of Tehran stock exchange market" is rejected, because as it is cleared by the result of the tests of forth section, accuracy of LSTAR model in describing the behavior of stock index was higher comparing to ESTAR model.

The vulnerability amount of efficiency of stock index comparing to exchange rate is somehow more than the effects caused by gold price changes on this index (with regard to Elasticity values of mentioned variables in

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long term equation), so as a policy proposal, comparing to gold price changes, it's possible to take the attention of most investors in Tehran stock market mostly to exchange rate fluctuations. Therefore, investors and financial analysts can present more actual analysis from changes and fluctuations of stock price by following the news and information of mentioned markets. On the other hand, findings of this study indicated that using nonlinear models has more ability to describe the behavior of stock index and its changes. Therefore, it can be suggested that policy proposals in this field must be established according to the researches that their results come from nonlinear models, otherwise, Bias in the specification of mentioned variable will lead to take wrong policies.

REFERENCES

Acatrinei, M.C., P. Caraiani, 2011. Modeling and Forecasting the Dynamics in Romanian Stock Market Indices Using Threshold Models. Romanian Journal of Economic Forecasting, 2: 42-54.

Ajayi, R., M. Mougoue, 1996. On the dynamic relation between stock prices and exchange rates. Journal of Financial Research, 19(2): 193-207.

Aydemir, O., 2009. The Relationship between Stock Prices and Exchange Rates Evidence from Turkey . International Research Journal of Finance and Economics .

Capie, F., T.C. Mills, G. Wood, 2005. Gold as a Hedge Against the Dollar .International Financial Markets Institutions and Money, 15: 343-352.

Central Bank Iran, http://www.CBI.ir. (March 2001 up to September 2012).

Clayton, M., 2011. Econometric Forecastingof Financial Assets Using Nonlinear Smooth Transition Autoregressive Models . A Thesis Submitted for the Degree of PhD University of St Andrews.

Eizaguirre, J.C., J.G. Biscarri, F.P.G. Hidalgo, 2009 .Financial liberalization stock market volatility and outliers in emerging economies. Applied Financial Economics Engel Robert F.

Enders Walter, 2005. Econometrics of Time Series with Practical Approach, Translated by Mehdi Sadeghi and Saeed Shavalpur, 2: 2-385.

Esfahanipour, A., W. Aghamiri, 2010. Adapted Neuron Fuzzy Inference System on indirect approach TSK fuzzy rule base for stock market analysis. Expert Systems with Applications., 37: 4742-4748.

Fomby, T.B., D. Terrell, 2004. Econometric Analysis of Financial and Economic Time Series . Advances in Econometrics, 20, Part B.

Gold Coins and Gold Bullion since, 1973 . http://www.usagold.com . (March 2001 up to September 2012).

Granger, C.W.J., 1987. Cointegration and error correction: representation, estimation, testing. Econometrica pp: 55.

Ghezelbash, A., 2012. Predicting Changes in Stock Index and Gold Prices to Neural Network Approach , the Journal of Mathematics and Computer Science, 4(2): 227-236.

Gujarati, D., 2008. "Fundamentals of Econometrics", Translated by Hamid Abrisham, Tehran University Publication, 1 and 2.

Hsu, T.K., C.C. Tsai, 2012. Return and Volatility Spillovers in Crude Oil Market and Gold Markets . Business and Information, 3: 637-654.

Hwey, Y.Y., Ch.N. Chien, 2009. Testing for cointegration with threshold effect between stock prices and exchangerates in Japan and Taiwan. Japan and the World Economy, 21(3): 292-300.

Jansen, D.W., Z. Wang, 2012. Evaluating the 'Fed Model' of Stock Price Valuation: An out-of-sample forecasting perspective . Advances in Econometrics., 20: 179-204.

Kaliyamoorthy, S., S. Parithi, 2012. Relationship of Gold Market and Stock Market: An Analysis .International Journal of Business and Management Tomorrow, 2(6): 1-6.

Karimzade, M., 2006. "Investigation of Long Term Relation of Stock Price Index with Cash Macro Variables Using Co-integration Method in Iran Economy", Iran Economic Researches Journal, 8th Year, 26: 41-54.

Keshavarz, G.h., B. Samadi, 2009. Estimation and forecasting of efficiency turbulence in Tehran stock market and comparison of precision of in danger values estimation methods : a function of "FIGARCH" family methods. The journal of economic research, 86: 193-235.

Kim, J.R., 2003. The stock return-inflation puzzle and the asymmetric causality in stock return inflation and real activity .Economics Letters, 80: 155-160.

Le, T.H., Y. Chang, 2011. Dynamic relationships between the price of oil gold and financial variables in Japan: a bounds testing approach .Munich Personal Repack Archive (MPRA Paper). 33030: 1-25.

Mashayekh, Sh, H.H. Moradkhani, M. Jafari, 2012. Impact of Macroeconomic Variables on Stock Market: The Case of Iran .International Conference on Business and Economic Research (2nd ICBER 2011).

Mishra, P.K., J.R. Das, S.K. Mishra, 2010. Gold Price Volatility and Stock Market Returns in India .American Journal of Scientific Research, 9: 47-55.

MohdHussin, M.Y., F. Muhammad, M.F. Abu, S.A. Awang, 2012. Macroeconomic Variables and Malaysian Islamic Stock Market: A Time Series Analysis .Journal of Business Studies Quarterly, 3(4): 1-13.

Journal of Applied Science and Agriculture, 9(1) January 2014, Pages: 149-159

Nishat, M., M. Khalid, 2008. Philippine Trading volume and serial correlation in stock returns in an emerging market: a case study of Pakistan. Philippine Review of Economics University of the Philippines School of Economics and Philippine Economic Society, 45(2): 101-117.

Pirayee, Khosro and M.R. Shahsavar, 2009. "The Effect of Macro Economic Variables on Iran Stock Market", Iran Economy Journal, pp: 21-38.

Sadri, H., E. Tayebi Sani, 2012. The Impact of Crude Oil, gold price & Their Volatilities on Stock Markets: Evidence from Selected Member of OPEC. Journal of Basic and Applied Scientific Research, 2(10): 10472-10479.

Sajady, S.H., H. Farazmand, H.A. Sufy, 2010. "Correlation Investigation of Macro Economic Variables and Cash Efficiency of Stock Index in Tehran Stock Market", Economic Science Research, 10th Year, 39: 123-150.

Samadi, S., Z. Shirany Fakhr, M. Davarzade, 2007. "Investigation of Vulnerability Rate of Tehran's Stock Price Index from Global Price of Oil and Gold (Modeling and Forecasting)", Economic Investigation Journal, 4th Period, 2: 25-51.

Shirin Bakhsh, Sh., A. Ruzbehy, 2011. "Investigation of Asymmetrical Effects of Impulses of Oil Price Indexes and Real Foreign Currency Cost on Total Stock Index Price", Master Degree Thesis, Azad University of Khuzestan's Sciences and Investigation Unit, Economic Science Field, Economic Development and Programming Major.

Shittu, O.I., O.S. Yaya, 2012. On Fractionally Integrated Logistic Smooth Transitions in Time Series .CBN Journal of Applied Statistics., 2(1): 1-13.

Soenen, L.A., E.S. Hennigar, 1988. An analysis of exchange rate and stock prices The U.S. experience between 1980 and 1986.Akron Business and Economic Review, 19: 7-16.

Summer, S.W., J. Robert, S. Lus, 2010. Spillover effects among gold stocks and bonds .Journalist of CENTRUM Cathedra., 3(2): 106-120.

Tan, R., 2011. Relationship between Stock Returns and Macroeconomic Variables: A Study of Beverage and Food Companies Listed on the Shenzhen Stock Exchange China .An on-line scholarly publication issue, Hypothesis University of Thailand., 4(2): 123-134.

Tehran Stock Exchange. http://www.Irbours.ir . (March 2001 up to September 2012).

Terasvirta, T., 1994. Specification , estimation and evaluation of smooth transition autoregressive models. Journal of the American Statistical Association., 89: 208-218.

Wang, M.L., C.P. Wang, T.Y. Huang, 2012. Relationships among Oil Price Gold Price Exchange Rate and International Stock Markets . International Research Journal of Finance and Economics., 47: 80-89.

Yahyazadehfar, M., A. Babaie, 2012. Macroeconomic Variables and Stock Prices: New Evidence from Iran .Middle East Journal of Scientific Research, 11(4): 408-415.