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RESEARCH PAPER

Investigating the Effects of Selected Macroeconomic Variables on Istanbul Stock Market Return through Applying Markov Regime Switching Model

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Abstract
In this paper, we investigate the effects of selected macroeconomic variables on the Istanbul Stock Market Return. We explore the relationship among the Istanbul Stock Market Return, Crude oil price, Inflation rate, and Exchange rate via employing monthly data from 2000-04-01 until 2017-12-01 in Turkey. Based on the Markov Regime Switching Model, we find that the Turkish Stock Market Return is divided into two regimes. The results indicate that Stock Return lags have a positive effect on the Stock Market itself, and only the second lag in regime 1 is significant. Besides, the test results show that the positive effects of crude oil price and negative effects of inflation rate in regime 0 (Low-return regime) are meaningful, while the exchange rate is meaningful just in regime 1 (High-return regime), which leads to reductions in Stock Market Return. Furthermore, the probability matrix indicates that the probability of stability in regime 0 is more than that of regime 1.
Keywords: Istanbul Stock Market Return, Macroeconomic Variables, Markov Regime Switching Model, Turkey.
JEL Classification: C34, C58, E31, E44, G14.

Introduction

Globalization has important roles in saving investors' capital and decreasing risks of Stock Market's characteristics in the recent century (Robinson, 2009). In the history of economics development, Stock Market Return has been considered as a key factor in specifying and reflecting the economic situation of a country. Stock Market Return has two purposes and approaches, which gather liquidity and small savings, and tries to guide them to the production part. Many reasons suggest that this study is essential and significant. First, predicting the Stock Market Return is an important aspect of each investor's preferences. The effectiveness of selected variables in Stock Market Return is major problem put forward in the present study which. Second, great challenges of investors in predicting the Stock Market Return has caused researchers to estimate the decreasing risks and increasing returns which are the priority of a wide range of investors. Hence, it is necessary to select the important and effective variables in Stock Market Return (Heidari et al., 2018). In studying the Stock Market Return, two methods including technical analysis and fundamental analysis are used which help governments in making policies, economic conditions, industrial processes, and political events in fundamental analysis (Abbasi and Jahrami, 2012).

Turkey is an importer country for Crude oil, hence gives the effectiveness of the Crude oil

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price on macroeconomic variables. The Stock Market Return has been a continuing concern within recent years, and most of the researchers have investigated many related aspects in this area. There are two theories related to the relationship between selected macroeconomic variables and Istanbul Stock Market Return. The first explains a relationship among macroeconomic variables, and the other one confirms no relationship among macroeconomic variables and Stock Market. There are different applied studies that support negative, positive, bi-directional, or no-relationship among macroeconomic variables and Stock Market. There is a hypothesis which considers a negative relationship between oil prices and Stock exchanges (Najaf, 2016; Taşkin et al., 2016) as well as between oil prices and Real Stock Returns (Şahin, 2014; Mediaa Swies, 2016). Negative relationship between oil prices and Stock Return is more significant in importer countries such as Turkey in bull situations (Mediaa Swies, 2016). The positive relationship hypothesis between Stock prices and oil prices was explored by Halaç (2013). The literature points to a positive correlation between inflation rate and Stock prices (Sonmez Saryal, 2007; Karagöz et al., 2009). Inflation rate positively affects Stock Returns (Karagöz et al., 2009; Yaya et al., 2010; Torrecillas et al., 2013), and negative relationship between inflation rate and Stock Returns is indicated in short terms (Torrecillas et al., 2013). The casualty goes from inflation rate to business cycles, and Stock Market is propounded as one of business cycles in each country (Ozun and Turk, 2009). A negative correlation hypothesis between exchange rates and Stock Returns was represented (Dinçergök, 2016; Yudakul et al., 2005; Şahin, 2014). The relationships among Exchange rates, Stock prices, and Stock indices are found to be negative (Özbey et al., 2016; Demirhan et al., 2009). It is better to have a point to a negative relationship among exchange rates and Bank Stock Returns which they consist parts of Stock Markets (Kasman et al., 2011). On the other hand, a positive correlation exists among exchange rates and Stock Returns (Yaya and Shittu, 2010), and several researchers explored the positive connection among exchange rates and Stock prices (Karagöz et al., 2009; Anlas, 2012; Güleç et al., 2015). In addition, changes in U.S Dollar and Canadian Dollar have positive effects on changes in ISE-100, while other variables such as interest rates and Saudi Arabia Rial have negative effects on changes in ISE-100 (Anlas, 2012). There is bi-directional causal relationship among exchange rate and all Stock Market indices, while a negative causal relationship exists between exchange rate and all Stock Market indices. However, there is a positive causal relationship between technology indices and exchange rates (Demirhan and Aydemir, 2009). The results of the related studies might be different due to the assumptions, methodologies, data, etc. Some researchers have estimated the relationship among selected variables, but much uncertainty still exists with regard to the relationship among the effects of selected variables on Stock Market Return altogether.

In the present study, we selected the sensitive duration in Turkey due to several reasons. First, Turkey has experienced various downturns which led to permanent structural changes or breaks due to macroeconomic and financial variables. The prominent structural breaks in Istanbul Stock Market were mainly seen in March, 2003, when the invasion of Iraq happened, and the Turkish parliament refused to send troops to Iraq. Turkish Stock Market decreased by 11.29% during 17-25, 2003 due to the invasion of Iraq (Taşkin et al., 2016). Second, the exchange rates were determined to be floating in this period (2001-2008). Third, via the implementation of the inflation targeting policy, Turkey has been able to curb the inflation and eliminate the last six zeros of the national currency in January, 2005.

This study attempts to explore the relationship among some macroeconomic selected variables and Istanbul Stock Marker Return through applying Markov Regime Switching Model. In fact, we aim to estimate the relationship among selected variables which have not been paid attention to in previous studies. The main assumption is that Turkey is a net importer country of oil so Crude oil price, and exchange rate directly and inflation rate indirectly have strong effects on Stock Market Return.

The novelty of this paper is that we consider the effects of Crude oil price, inflation and exchange rates on Istanbul Stock Marker Return via applying Markov Switching Model. Our results showed that the Markov Switching Model can support the results more precisely, and the probability of low regime's stability is stronger than that of high regime. Investors and policy makers have to be more sensitive in this respect.

Data and Methodology

Different methods have been previously proposed to classify the time series relations among macroeconomic variables and Stock Market Return. In this study, the data sample spans the period 2000-04-01 to 2017-12-01 on a monthly frequency in Turkey. We selected macroeconomic variables based on their hypothesized effects on stock return. We assumed that H_0 hypothesis shows a relationship between selected macroeconomic variables and Stock Market Return. Besides, we assumed that there is no relationships among selected macroeconomic crude oil prices [represented by OIL icon], exchange rate [presented by REER icon], and inflation rate [represented by INF icon]) variables and Stock Market Return (H_1 hypothesis). The data were obtained from Electronic Data Delivery System (EDDS) of the Central bank of Turkey's on-line database and Bursa Istanbul and Energy Information Administration (IEA). We used different time series to analyze the behavior of economic and financial variables. Linear models including Auto regressive (AR), Moving Average (MA), and mixed ARMA model are more common. Mostly, linear models are suitable to be used; however, they are unable to explain the nonlinear dynamic patterns of variables. Hamilton Markov Switching (1989; 1994) is one of the well-known nonlinear time series models, which has multiple structures that can examine the time series behavior in different regimes and show precise behavior of variables fluctuations. The conversion and transmission mechanisms between different structures and regimes are controlled via an unpopular situation, which is the first order of Markov Switching model. Based on the Markov Switching process, in different situations or regimes, which are different from the unrecognizable variables of S_t, the changes in the regime occur in case of all or some parameters. In this model, there are different combinations of different distributions with different characteristics. This model is expected to be used to identify the value of variables according to the unusual situation determined by observations (Abbasinejad and Ebrahimi, 2014). In general, a simple time series model of AR in format of Markov Switching model is:

$$y_t = \alpha^t + \beta_1^t y_t + \beta_2^t y_{t-1} + ... \qquad s_t = 1,2,...,i \tag{1}$$

and a simple time series of Markov switching model in two regimes are:

$$y_t = c_0 + \alpha_1 y_{t-1} + \varepsilon_t \qquad s_t = 0 \tag{2}$$

and,

$$y_t = c_0 + c_1 + \alpha_1 y_{t-1} + \varepsilon_t \qquad s_t = 1 \tag{3}$$

where y_t is stock return in this research, and S_t is the status variables which is uncovered (Souri, 2013). Distribution of probabilities of y_t in Markov Switching model is represented by:

$$p(y_t|y_1, y_2,..., y_{t-1}) = p(y_t|y_{t-1}) \quad (4)$$

It shows that distribution of probabilities for y_t in each time like t depends on $t-1$ time. It is assumed that in terms of the first order chain of Markov Switching model with the probability of transmitted to the following of i status to j status:

$$\Pr(s_t = j|s_{t-1} = i) = p_{ij} \quad (5)$$

The probability of transferring status from i status in t-1 shows the j status at t time. In other words, it is:

(6)

$\Pr(s_t = 1|s_t = 0) = p_{01}$ The probability of transferring from zero regime to regime number one

$\Pr(s_t = 0|s_{t-1} = 1) = p_{10}$ The probability of transferring from regime one to zero regime

$\Pr(s_t = 0|s_{t-1} = 0) = p_{00}$ The likelihood of staying in zero regime

$\Pr(s_t = 1|s_{t-1} = 1) = p_{11}$ The likelihood of staying in regime number one

In this research, we assume that there are two regimes. Hence, we can form transfers of Matrix in the form represented below:

$$P = \begin{bmatrix} p_{00} & p_{10} \\ p_{01} & p_{11} \end{bmatrix} = \begin{bmatrix} p_{00} & (1-p_{11)} \\ (1-p_{00}) & p_{11} \end{bmatrix} \quad (7)$$

In the present study, we specified Stock Market Return as a dependent variables and attempted to estimate the effects of Crude oil price, inflation rate, and exchange rate on Stock Market Return.

Model Estimation

Based on the econometric model described in the previous section, , the main model provided in Equation 1, namely Markov Regime Switching model for Stock return, will be estimated.

The Unit Root Test

In fact, most of macroeconomic variables have a non-stationary nature, and regression analysis would not be suitable to discover the relationship among them. Hence, to ensure the stationary nature of the variables, a unit root test procedure seems more appropriate. Prior to estimating the Markov Regime Switching Model, we have to identify the sustainable tests for the variables. We use the Phillips - Peron and Zivot Anderese to determine the presence of a unit root in the series. Results of Phillips - Peron and Zivot Anderes are depicted in Table 1.

Table 1. Results of PP and ZA Unit Root Tests

variables	Philips Peron				Zivote Anderes			
	Constant		Constant and Linear		Has a unit root with a structural break in the intercept		Has a unit root with a structural break in the intercept and trend	
Return	T-statistic	Prob 0.000=-16.893 Prob 5%=-2.874	T-statistic	Prob 0.000= -16.862 Prob 5%=-3.430	T-statistic	Prob 0.306= -11.808 Prob 5%=-4.93	T-statistic	Prob 0.0312= -12.26 Prob 5%=-5.08
OIL	T-statistic	Prob 0.202= -2.197 Prob 5%= -3.430	T-statistic	Prob 0.488= -2.197 Prob 5%= -3.43	T-statistic	Prob 1.89E-05= -5.567 Prob5%= -4.93	T-statistic	Prob 0.0001= -5.275 Prob 5%=-5.08
REER	T-statistic	Prob 0.000= -7.009 Prob 5%= -2.87	T-statistic	Prob0.000= -7.661 Prob 5%= -3.430	T-statistic	Prob 0.001 -6.166 Prob 5%= -4.93	T-statistic	Prob 0.016= -6.282 Prob5%= -5.08
INF	T-statistic	Prob0.137= -2.419 Prob 5%= -2.874	T-statistic	Prob0.485= -2.202 Prob5%= -3.430	T-statistic	Prob0.014=-4.05 Prob5%= -4.93	T-statistic	Prob0.005=-4.957 Prob5%= -5.08

Source: Research finding.
Note: statistical significance at 5%.

The preliminary step in our empirical analysis is concerned with examining the time series properties of the series. The results of Philips Peron and Zivote Anderes tests in Table 1 indicate that Stock return and inflation rate variables are integrated in level $I(0)$ constant and constant and linear exogenous. Crude oil price is not integrated in level $I(0)$ by PP since PP does not consider structural breaks, and therefore we tested it through ZA test. The result shows that crude oil price is integrated in $I(0)$ level. The exchange rate (REER) variable played a different role in tests which shows that it cannot be integrated by PP and ZA. Thus, we differed in the variable REER, and the results indicate that REER is integrated in level $I(1)\cdot$

Table 2. The Results Differed Variables

Philips Peron					Zivote Anderes			
Constant			Constant and Linear		Has a unit root with a structural break in the intercept		Has a unit root with a structural break in the intercept and trend	
dREER	T-statistic	Prob 0.000= -9.768 Prob5%= -2.87	T-statistic	Prob 0.000= -9.786 Prob5%= -3.430	T-statistic	Prob0.034= -9.261 Prob5%= -4.93	T-statistic	Prob0.001= -9.338 Prob5%= -5.08

Source: Research finding.

We use Markov Regime Switching Model for estimating the effects of Crude oil prices, exchange rate, and inflation rate on Stock Market Return. We assume that variables are not linear and use Markov Regime Switching Model that is investigated via Likelihood Ratio (LR) test. This test is defined as k-2 according to the number of parameters$\left[\chi^2(q)\right]$. In fact, null hypothesis is rejected which shows the lack of regime transfers in the model. If the null hypothesis is rejected, a nonlinear relationship would exist between the variables. This occurs if the degree of freedom of this distribution is equal to the number of disturbances plus the number of linear constrains. According to the results, the amount of LR statistics is 56.98 and the meaning level of relation to DAVIES is less than 0.05 percent; therefore, the existence of nonlinear relationships between variables is confirmed.

Conclusion

The results of the estimation of model parameters indicate that the time interval in stock

return can be divided into 2 regimes, whereby the width of the origin in the zero regime is -2.29 and in the regime 6.04. In the previous studies on Markov Switching model in the stock markets, the amount of intercept with regard to the type of regime was determined. In fact, minus intercept shows the regime with low return and positive intercept shows the regime with high return in stocks. Therefore, the regime has high return on stocks is regime number one, and the regime with low return on stocks is zero regime. We found that crude oil prices have positive effects on low return regimes, which is in line with Halaç (2013). Besides, it has negative effects on stock return in high return regime, which is in line with Najaf (2016), Taşkin et al (2016), Şahin (2014), and Mediaa Swies (2016). In addition, this study's result is in line with Sonmez Saryal (2007), Karagöz et al. (2009), Olaoluwa S. Yaya and Olanreaju I. Shittu (2010), Torrecillas and Jareño (2013) who concluded that inflation has a positive effect on Istanbul Stock Market Return in high level regimes and a negative effect in case of low return regimes. Finally, the effect of exchange rate on Istanbul Stock Market Return is negatively meaningful in high return regime, which is in line with Dinçergök (2016), Yudakul and Akçoraoğlu (2005), Kasman et al. (2011), and Demirhan and Aydemir (2009). The probability matrix shows the probability of transfer in each regime, and the results indicated 0.592 % of stability in zero regime. The average of staying in each regime during the selected time is represented in Table 3:

Table 3. Regime Classification Based On Smoothed Probabilities

	Regime number 0	**Regime number 1**
Total months	151	62
Average duration of months	3.51 months	1.48
Probability of being in each months	70.89%	29.11%

Source: Research Finding.

As a result, in order to achieve an optimal estimation, the model should fit the data. The following diagram shows the estimated model on which the red color line specifies the real model diagram and blue color line represents the fitted diagram of model. As the figure depicts, the fit model could cover the real model, showing that our estimate model is optimal.

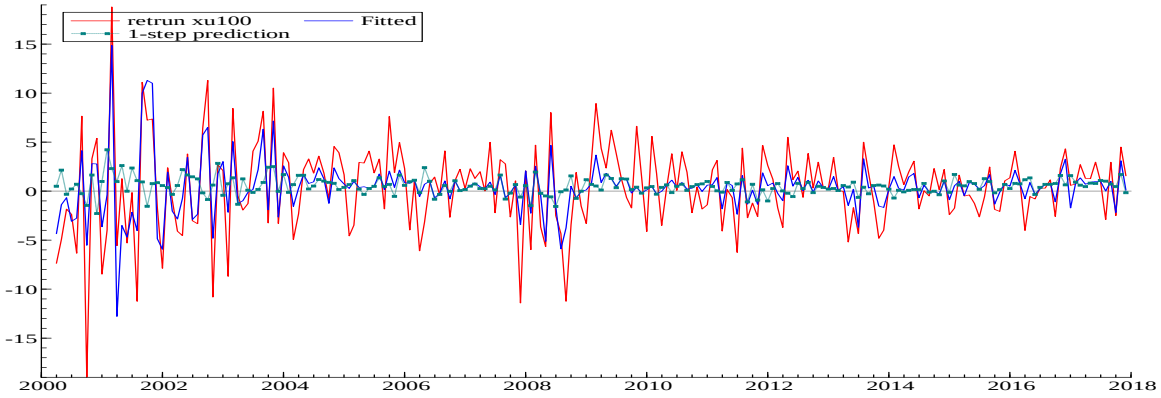

Figure 1. The Estimated Model Diagram
Source: Research finding.

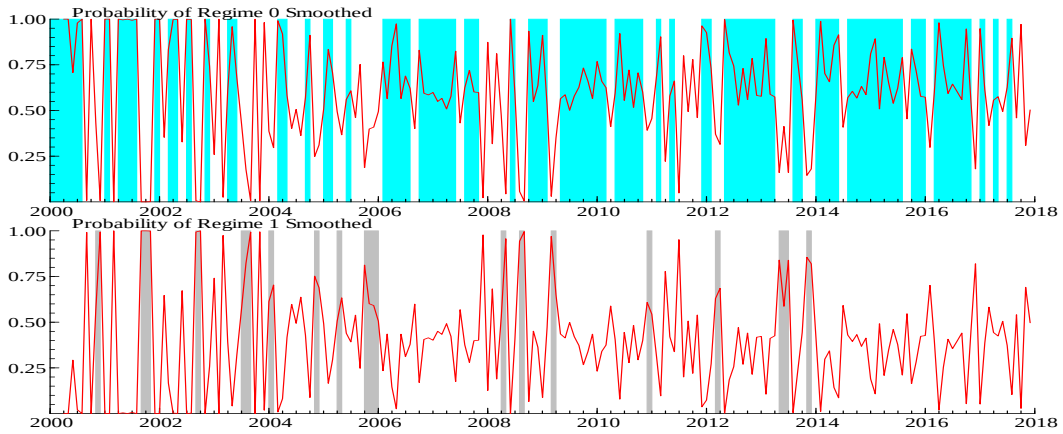

Figure 2. The Probability of Regime 0 and 1 Smoothed Diagram
Source: Research finding.

Based on the results, we recommend investors be more sensitive on Crude oil price volatility, inflation, and exchange rate volatility Ruture researcher are suggested to compare the same situation of Stock market in Turkey with other emerging Stock markets and try to control Turkey's Market by predicting the shocks.

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