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The Effect of Monetary Policy on Regime Changes of Financial Assets

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The main objective of this study was to investigate the effect of monetary policy on changes in the price of financial assets (including foreign exchange, gold and stocks) in Iranian economy. In this regard, this paper answers whether monetary policy could lead to regime changes in asset markets. To answer this question, monthly data during the years 1995 to 2017 and a combination of Markov Switching and Probit methods were used. First, using Markov Switching method, each market was divided into two high-volatility and low-volatility regimes with different average returns, and then, by a Probit model, the effect of monetary policy on the probability of markets being exposed to these regimes was studied. The results of this study show that in all three markets, the Markov Switching model offers better fit than the linear model, which indicates the occurrence of regime changes in the markets. The results of the Probit model show that monetary policy in all three markets is effective on their regime changes, and an expansionary monetary policy will strengthen the position of all three markets in the high-volatility regime with a positive average return. Also, inflation is also one of the factors affecting regime changes in all three markets. The market situation in the past period as well as the situation of other markets are among the factors that lead to regime changes in asset markets. The sanctions imposed on Iran's economy in the currency and gold markets are among the factors that have strengthened the likelihood of changing the regime of these two markets to a volatile environment.

Keywords: Regime Switching in Asset Markets, Markov Switching Model, Monetary Policy.
JEL Classification: C22, E52, G1.

1 Introduction

The financial crisis that occurred in 2008 in the United States and, consequently, in other developed countries, reflects the failure of economic theories to predict such crises (Stiglitz, 2011). The boom was a common feature of all the financial markets at that time, the housing market had experienced unprecedented growth since the early 2000s and the stock market

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was recording new historical records; other markets had a similar situation. The boom in financial markets led to a recovery in banks' balance sheets and reduced banks' exposure to risks; this also led banks to have a high risk appetite in lending and investment, which ultimately led to the collapse of financial markets and the banking system, and the economy drowned in a deep recession (Altunbas et al., 2014). Existing theories at that time could not predict the occurrence of a financial crisis since they did not pay much attention to the role of financial markets in the economy and its possible impact on the real sector of the economy. Taylor (2007) and many other scholars attribute the major factor behind the formation of bubbles in financial markets during that period to the expansionary monetary policies of that period.

Based on what has been said, monetary policy seems to be one of the most important factors affecting financial markets, and financial markets also play a crucial role in the economy and its real sector. Now, the question is whether monetary policy is also influencing regime changes in the price of financial assets, or not? Schaller and Van Norden (1997) have shown that prices in financial markets follow a changeable and nonlinear behavior that has a different production process for different regimes. Recently, some studies have shown that monetary policy can be a major factor in the occurrence of such regime changes in asset prices (Chatziantoniou et al., 2017; Angelidis et al., 2015).

Accordingly, the main objective of this study is to examine the effect of monetary policy on regime changes in Iranian asset markets (including the foreign exchange market, stocks and gold). for this purpose, each of these markets is first divided by the Markov Switching regime into two high- and low-volatility regimes (with a different average return), and then the effect of monetary policy on the continuity of the extracted regimes is studied in the form of a probit model. In fact, in the Probit model, we examine whether monetary policy can provide information about the current state of the markets. In this regard, in this study, in five sections it has been tried to answer the question. The research and studies are carried out in this area following the introduction and then in the next section, the data and method of econometric study of the research is introduced. In the fourth section, the experimental results of the research are presented, and finally the final section of the research deals with the conclusion.

2 Research Background

2.1 Theoretical Foundations

Monetary policy influences the different channels of the asset markets, which will be discussed in this section.

2.1.1 Common Channels

Interest Rate Channel

Changes in interest rates are one of the factors that can affect the housing market. This channel directly affects the asset markets. For example, lowering nominal interest rates could have a positive impact on demand in asset markets. The reason is, firstly, by lowering the nominal interest rate, because of the constant general level of prices, the cost of investing in the asset is reduced and the demand for it increases, and secondly, the income from depositing in the bank is reduced and the attractiveness of the deposit in the bank decreases, which ultimately leads to an investment in assets with higher risk and return and a boom in these markets. It also affects asset prices and increases them (Bernanke, 1995).

Optimal Portfolio Adjustment Channel

The optimal portfolio adjustment mechanism is the basis of monetarism for the mechanism of monetary transfer to asset markets and the economy as a whole. It is believed that an increase in the volume of money causes a change in the price of assets, thereby affecting the decisions of consumption and investment of economic agents (Meltzer, 1995; Nelson, 2003).

2.1.2 Effective Channels of Monetary Policy on the Stock Market

Wealth Effect Channel

The stock market can also affect the real sector of the economy through the wealth channel. Stock market price changes through the effect of wealth can affect the real sector of the economy. When prices rise in asset markets such as the stock market, homeowners face rising wealth. As consumption, according to the theory of life cycle consumption, is also a function of their wealth in addition to income, increases in stock prices increase their consumption. Increasing consumption also leads to an increase in total demand and production and economic growth. Changes in the real sector of the economy also directly affect the stock market. (Campbell and Cocco, 2007).

Exchange Rate Channel

An increase in money supply or a reduction in interest rates will reduce the exchange rate value and will improve the export and production situation.

Improvements in real variables also indicate an increase in companies' profitability and ultimately lead to an increase in share prices in the market. (Loayza & Schmidt, 2002)

Credit Channel

According to the credit channel, monetary policy can affect the amount of credit available to the economy by changing the balance sheet of companies (and individuals) and the value of the bonds that firms can provide banks for loans. This also changes the investment decisions and affects the real sector of the economy. Changes in the real sector of the economy also affect the stock market (Bernanke, 1995).

2.1.2 Effective Channels of Monetary Policy on the Foreign Exchange Market

Capital Flow Channel

An expansionary monetary policy that is accompanied by a decline in interest rates reduces the attractiveness of investment in the domestic economy and leads to the outflow of capital towards a foreign country, which increases demand for the foreign exchange and ultimately Increases its price (Loayza & Schmidt, 2002).

Inflatable Channel

An expansionary monetary policy will increase inflation and causes an increase in domestic commodity prices, while the rise in domestic prices also means an increase in the relative price of domestic goods compared to foreign channels. This will lead to loss of competitiveness of domestic goods in global markets, and imports increase and exports decrease. Reduction in exports, reduction in foreign exchange supply and increase in imports will lead to an increase in foreign exchange demand, which ultimately leads to an increase in foreign exchange prices (Andres, et al., 1997).

2.1.3 Effective Channels of Monetary Policy on the Gold Market

In the Iranian economy, the gold market is affected by two major factors: the first is the global price, and the second is the Dollar-Rial exchange rate. However, given the higher exchange rate fluctuations in Iran, the exchange rate seems to play a more important role in changing gold prices. Therefore, monetary policy can also affect the gold market by changing the exchange rate.

2.2 Internal and External Experimental Studies

2.2.1 Foreign Exchange Market

Bouakez and Normandin (2010) in their study examined the effect of monetary policy on dollar versus G7 currencies. In this study, the researchers used the SVAR model and the method of identification based on the conditional heteroskedasticity of structural error terms to examine the relationship between these two variables. Their study results suggest that contractionary monetary policy will initially increase the value of the dollar against other currencies, but the dollar will fall in value after ten months.

Kim and Lim (2018) studied the effect of monetary policy on the exchange rate in four countries: Britain, Canada, Sweden, and Australia. In this study, they used the SVAR approach with the Uhlig Symptom Method (2005). The results of their study indicate that monetary policy is effective on the exchange rate and, after a contractionary shock to monetary policy, the exchange rate rises in value.

Hoshmand et al. (2012) studied the relationship between monetary policy and exchange rate in Iran's economy. In this study, they used the autoregressive distributed lag model (ARDL). The results of their study indicate a positive and significant effect of monetary policy on the exchange rate.

Baghjeri et al. (2014) examined the effect of monetary policy on the pressure of the foreign exchange market in Iran. In this study, using structural vector autoregressive (SVAR) model, the researchers concluded that expansionary monetary policy would increase the pressure on the foreign exchange market.

2.2.2 Stock Market

Gurkaynak et al. (2005) studied the effect of monetary policy on assets price. In this study, which was conducted for the United States economy, they used the event study method and high-frequency data. He evaluated the effect of two variables related to monetary policy on the stock market. The first is the monetary policy itself, and the second is the speeches made by the head of the central bank and the announcement of future monetary policies. The results of this study indicate that monetary policy and monetary policies announcements both affect stock markets, with the difference that the effect of monetary policies announcement is greater.

Chatziantoninou et al. (2017) evaluated the effect of monetary policy on stock market regimes. In this study, the researchers initially extracted the high-volatility and low-volatility market (with different average returns) using the

Markov Switching method, and then evaluated the effect of monetary policy on stock market regimes in the form of a Probit model. The results of their study show that monetary policy can predict the stock market situation - in other words, monetary policy is effective on stock market regime changes.

Zainabvand et al. (2018) evaluated the effect of monetary policy on the stock market bubble in Iran's economy. In this study, the researchers used a structural vector auto-regressive approach. The results of their study show that monetary policy is effective on the stock market bubble, and an increase in the volume of liquidity will increase the stock market bubble.

2.2.3 Gold Market

Wang and Chueh (2013) examined the short-term and long-term effects of monetary policy on gold price. In this study, the researchers used a co-integration approach. The results of their study indicate that the rise in the US interest rate will in the short term reduce the price of gold for the future. The long-term outlook for the study also suggests an increase in gold price following a cut in interest rates.

Komijani et al. (2015) evaluated the effect of macro variables (liquidity and interest rates) on the gold market. In this study, researchers have used the ARDL co-integration approach. The results of their study show that there is a negative relationship between interest rate and gold price, and there is a positive correlation between liquidity volume and gold price.

An overview of empirical studies showed that monetary policy is one of the most important factors affecting the price of financial assets. As has been observed, in most studies, the effect of monetary policy on prices or market volatility has been examined. Among the studies, Chatziantoninou et al. (2017) have studied the effect of monetary policy on regime changes in the price of financial assets. Of course, this is not the only study that has examined the effect of macro variables on asset changes. In recent years, apparently, special attention has been paid to dietary changes in financial markets and the identification of factors influencing such changes. Among them, Chen (2010), Angelidis et al. (2015), studies have examined the effect of oil prices on the regime changes in the stock market. In this study, the main objective of the study was to investigate the effect of monetary policy on regime changes in Iran's financial markets (foreign exchange, stocks and gold), and is different from previous studies conducted within the country.

3 Data and Research Method

In this study, a combination of two Markov switching and Probit methods is used to study the effect of monetary policy on regime changes in asset market. Asset markets are split into two high-volatility and low-volatility regimes (with different average returns), and then different values of state or regime (which are determined by the smoothing algorithm) are transferred to the Probit model. In fact, the dependent variable in the Probit model will represent the regime in which the market is located in each period. If the asset market is in the high-volatility regime, the dependent variable of the Probit model is one, and if it is in the low-volatility regime, the dependent variable of the Probit model will be zero. Now, in the form of a Probit model, we can examine the effect of monetary policy and other variables on the likelihood of being in a high-volatility regime.

3.1 Markov Switching Model

The Markov Switching Model was developed by Quandt (1972) and Quandt-Goldfeld (1973) and developed by Hamilton (1989). Markov switching models can be divided into different models depending on which autoregressive model is dependent on the regime. The simple Markov-Switching model, in which only the mean of the equation is a function of the regime, is expressed as follows:

Assume that s_t is the unobservable variable of the status that only accepts two values of zero and one. The simple Markov-Switching model for the variable will be as follows:

$$y_t = \begin{cases} c_0 + a_t y_{t-1} + \varepsilon_t, & s_t = 0 \\ c_0 + a_t y_{t-1} + \varepsilon_t, & s_t = 1 \end{cases} \quad (1)$$

In which $|\alpha_i| < 1$ and ε_t are distributed in the same way and independently of each other, with a mean of zero and variance of σ_t^2. When $s_t = 0$, the process of y_t will be a stable process of AR (1), the mean of which is equal to $c_0/(1-\alpha_1)$, and when $s_t = 1$, the process of y_t will be a stable process of AR (1) with the mean of $(c_0 + c_1)/(1-\alpha_1)$. If the condition $c_1 \neq 0$ holds, then, depending on the value of the status variable, the equation y_t will be one of the two above equations. In other words, at any moment in time, the variable s_t will determine the process y_t to be the product of which equation.

You can get different models based on different definitions of s_t. For example, when $s_t = 0$ for the period $t = 1,2,\dots,\tau_0$, and for the interval $t = \tau_0,\dots,T$, $s_t = 1$ in this case, model 1 will be a structural transformation model in which only one time in the point $t = \tau_0$ the model parameter is allowed to change, and when s_t is an independent random Bernoulli variable, then model 1 will be the Quant stochastic variation model (1972). In a randomized model, the recent value of the variable s_t does not depend on any of the past and future values of this variable, and therefore y_t may be subject to turbulence.

If the value of the variable s_t is determined by the condition $\lambda_t \leq c$, so that if the condition holds, the value is zero and when it does not hold it is one, then the model 1 will be a threshold model in which the threshold value is equal to c and the threshold variable is λ_t. Usually, in such models, the lagged values of the dependent variable are chosen as the threshold variable.

While all of these models have the ability to explain the time series variable behavior in two regimes, each of them has its own limitations in turn. The structural modification model is very restrictive since it only allows the parameter to be changed once. Although it is easy to determine several change points for the model, in practice, estimating and testing the hypothesis of such a model is very difficult (Bai and Perron (1998) and Bai (1999)). Furthermore, these change points are also determined exogenously for such models over time, which in turn is a fault in the model. Although the random change model, unlike the structural change model, allows for several changes, the state variable in this model is also exogenous relative to the model. Another problem that the random change model faces is that the state variable is independent of its past and future values over time, and therefore not suitable for time series data. Unlike the above models, in the threshold model, the changes are endogenous and, in addition, there are several possible variations. The problem with this model is that the choice of the threshold value and threshold variable for this model is usually difficult. One way to overcome these problems is to consider a different specification for s_t. Assume that it follows a first-order Markov chain and its transition matrix is as follows:

$$p = \begin{bmatrix} p(s_t=0|s_{t-1}=0) & p(s_t=1|s_{t-1}=0) \\ p(s_t=0|s_{t-1}=1) & p(s_t=1|s_{t-1}=1) \end{bmatrix} = \begin{bmatrix} p_{00} & p_{01} \\ p_{10} & p_{11} \end{bmatrix}$$

In which, $p_{ij}(i,j = 0,1)$ indicates the probability of transition from $s_{t-1} = i$ to $s_{t-1} = j$. Obviously, the transition probabilities must satisfy the condition $p_{i0} + p_{i1} = 1$. The transition matrix contains only two parameters p_{00} and p_{11} and determines the random behavior of the state variable. Model 1, whose state variable has first-order Markov characteristics, is known as the Markov-Switching model.

In the Markov-Switching model, the characteristics of the process y_t are determined jointly by random behavior of ε_t and s_t. In other words, the state variable causes a repeated change in the structure (equation) of the model. Transition probabilities also indicate the durability and stability of each regimen. Although the threshold model has the same features as the Markov-Switching model, the Markov-Switching model is relatively simpler, since there is no need for a threshold variable to be determined; also, in this model, the classification of the regime is with probability and determined by the data. The problem with the Markov-Switching model is that its interpretation is not simple because the status variable is invisible.

One can generalize the above-mentioned model (Equation 1) to a general state including m regimes and p lags; in other words, y_t is a process of AR (p) and s_t *takes* values 1,2,…,m. In this case, depending on which of the components of the equation is dependent on the state variable, there are several general cases that we look at in Table 1:

Table 1
Markov-Switching Model Different Modes

Model Name	**Equation**	**Distribution of Error Sentences**	**The regime-dependent component**
MSM (m) - AR (p)	$y_t - \mu(s_t) = \sum_{i=1}^{p} \alpha_i (y_{t-i} - \mu(s_{t-i})) + \varepsilon_t$	$\varepsilon_t \sim IID(0, \sigma^2)$	Average
MSI (m) - AR (p)	$y_t = c(s_t) + \sum_{i=1}^{p} \alpha_i (y_{t-i}) + \varepsilon_t$	$\varepsilon_t \sim IID(0, \sigma^2)$	y-intercept
MSH (m) - AR (p)	$y_t = c + \sum_{i=1}^{p} \alpha_i (y_{t-i}) + \varepsilon_t$	$\varepsilon_t \sim IID(0, \sigma^2(s_t))$	Error Sentences Variance
MSA (m) - AR (p)	$y_t = c + \sum_{i=1}^{p} \alpha_i (s_t)(y_{t-i}) + \varepsilon_t$	$\varepsilon_t \sim IID(0, \sigma^2)$	The Coefficient of Auto-regressive Sentences

Source: Research Findings.

Also, combining the first and second modes with the second and third models can provide more detailed models and allow the dependence of different components of the equation to the regimes depending on the research needs.

One of the most important issues in estimating the Markov Switching Model is to select the best mode from the various states (as in Table 1) and determine the number of regimes. There are several basic approaches to choosing the number of regimens and the optimal model: 1) the first approach is to use the theory. In fact, in this approach, the researcher determines the number of regimens and components dependent on the regimen, based on the theory or purpose of the study, externally and without reliance on data. 2) The second approach is to use statistical tests such as LR test and compare the value of likelihood function of the linear model with the nonlinear model. Of course, this approach has fundamental problems, and because of the existence of intrusive parameters in the zero-hypothesis test (the hypothesis of this test is the linearity of the model, but the transition probabilities for a linear model are not defined), the distribution of the test statistic does not follow the standard distribution of Chi-2. Of course, to solve this problem, an approximate distribution of the test statistic is presented by Davies (1977) and Ang and Bekaert (2002). 3) The third approach is to use information statistics (such as Akaike, Schwarz and Henan-Quinn). The problem with this method is that there are very few studies on the characteristics of these statistics in small samples and even in large samples, and since these statistics, like the LR test, use the same asymptotic theory, similarly, the asymptotic function and their small samples are unclear (Guidolin, 2014).

After choosing the number of diets and the optimal model based on one of the three approaches above, if the choice of model and dietary regimen is done correctly, then the RCM index introduced by Ang and Bekaert (2002) can be applied to this topic. The RCM index always has a number between 0 and 100, and can be extracted according to equation (2). In this case $p_t$and $(1 - p_t)$ are smooth probabilities and Ω_T is the set of information for the whole sample. The RCM is closer to zero, the better the regime's classification is.

$$\text{RCM} = 400\frac{1}{T}\sum_{t=1}^{T} p(1 - p) \quad (2)$$

In fact, the overall idea of the RCM index is that if the separation of the regimes is done correctly, the amount of smooth probabilities is likely to be close to one, and if the differentiation of the regimen is not carried out with high precision, for a two-regimen model, the smooth probabilities will be equal to 0.5 (that is, the model cannot correctly identify that the data are in the regimen one or two). This will cause the RCM index to tend to be zero when the differentiation is performed well and 100 when it is not properly done.

In this model, in line with the aim of the study to identify high- and low-volatility regimes of asset markets, and also based on previous studies such as Chen (2010), Kurov (2010), Chatziantoniou et al. (2017) and Angelidis et al. (2015) the two-regime model is estimated in which both the mean and the variance of the error sentences are a function of the hidden variables of the regime and vary between regimes. Then, the RCM index is used to check the accuracy of differentiation of regimes.

$$y_{i,t} = \mu_{i,1} + \varepsilon_{i,t,1}\ ;\ \varepsilon_{i,t,1} \sim \mathrm{N}(0,\sigma_{i,1}^2) \tag{3}$$
$$y_{i,t} = \mu_{i,2} + \varepsilon_{i,t,2}\ ;\ \varepsilon_{i,t,2} \sim \mathrm{N}(0,\sigma_{i,2}^2) \tag{4}$$

In which $y_{i,t}$is the market return, $\mu_{i,1}$ the conditional mean of the yield variable under the regime 1, $\mu_{i,2}$ the conditional mean of the yield variable under the regime 2, $\sigma_{i,1}^2$Standard deviation of error sentences under regime 1, $\sigma_{i,2}^2$the standard deviation of error sentences under regime 2 and $\varepsilon_{i,t,1}$ and $\varepsilon_{i,t,2}$ are error sentences with normal distribution with a mean of zero and a constant but varying variance between regimes.

After estimating the above equations separately for each market and the dividing the study period into two regimes of high and low volatility (with different average yields) based on smooth probabilities, the variable with the title S_t (for each market individually) is defined. This variable is set to zero for high volatility periods of market and zero for its low volatility periods. After defining this variable, it is used as the dependent variable in the following Probit model. It should be noted that this equation is estimated for each market (gold, foreign exchange and stocks) and the effect of monetary policy and other variables are assessed on the regime changes of that market.

$$p_{s_t=1} = \mathrm{F}(\alpha, \beta_1 M_{t-1}, \beta_2 INF_{t-1}, \beta_3 s_{stock_{t-1}}, \beta_4 s_{Exchange_{t-1}}, \beta_5 s_{gold_{t-1}}, DU) \tag{5}$$

In which M reflects the volume of liquidity, INF inflation, s_{stock} stock market status (or regime), $s_{exchange}$ the foreign exchange market situation, and s_{gold} the gold market situation, and DU is also a virtual variable that represents the period of sanctions. The purpose of including the other markets and the market itself in the past period in Equation 5 is to examine the impact of markets on each other's position. The reason for using the lagged values of variables in Equation 5 is that, regardless of the interaction of economic variables that may occur simultaneously, a change in the regime of markets is a process that does not happen quickly and usually occurs slowly. Therefore, the effect of variables on market regime changes usually appears with a little delay; hence, instead of the current values of variables, in equation 5, the lagged values are used.

To estimate the main model of this study, we use the data of the price of Bahar Azadi gold coin of the old design, the exchange rate ($ / Rials), the volume of liquidity used as a representative of monetary policy, consumer price index (from the central bank), and the Tehran Stock Exchange Index (Listed on the Tehran Stock Exchange website) have been used. It should be noted that all variables in the Markov Switching Model and the Probit Model must have a stationarity property. So first, the variables are logarithmic and then the stationary variables are investigated. If the variable in question is not stationary, the variable is differentiated.

4 Estimation of Model and Analysis of Findings

4.1 Checking the Stationarity of variables

Since each stationarity test has its own strengths and weaknesses, in order to ensure the accuracy of the results, three generalized Dickey Fuller (ADF), Phillips-Perron (PP) and KPSS tests were used in this study. The Schwarz statistic with a maximum of 15 lags was used to determine the number of lags required to resolve the possible autocorrelation. Static test results are reported in Table 2.

Table 2
Stationarity Test of Research Variables

	Level			First Order Differentiation		
Variable	ADF	PP	KPSS	ADF	PP	KPSS
LEX	-1.13	-1.87	1.94***	-8.84***	12.80***	0.277
LSTOCK	-2.13	-2.22	0.117*	-11.85***	-12.02***	0.056
LGOLD	-1.71	-1.66	0.941***	-13.05***	-13.25***	0.316
LM	-0.44	-0.61	1.95***	-14.52***	-33.95***	0.068
LCPI	-0.50	-0.89	1.93***	-9.39***	-14.79***	0.137

* Significant at 10% level ** Significant at 5% level *** Significant at 1% level. LEX: Logarithm of the exchange rate / LSTOCK: Logarithm of the stock price index / LGOLD: Logarithm of the coin price of the spring release of the old plan / LM: Logarithm of liquidity / LCPI: Logarithm of the consumer price index. Source: Research Findings

As shown in Table 2, based on each of the three generalized Dickey-Fuller, Phillips-Perron and KPSS tests, the variables studied in this research are nonstatic and are static with one-time differentiation. So, in further analyses, the differentiation of variables will be used.

4.2 Estimation of Markov-Switching Model

After checking the stationarity of variables, the Markov Switching model shown in Equations 3 and 4 is estimated for each market individually. Table 3 shows the estimated results of the model for the foreign exchange market.

Table 3
Estimates of the Markov-Switching Model for the Foreign Exchange Market

Parameter	Estimated Value	Probability value
μ_1	-0.0952	0.000
μ_2	0.1094	0.007
σ_1	0.0585	0.000
σ_2	0.2525	0.000
p_{11}	0.9814	0.000
p_{22}	0.9573	0.026
RCM	6.4	-
LR	303.83	0.000

Source: Research findings
ŧ:To estimate the effect of heterogeneity of variance and probabilistic correlation, Robust estimator is used to estimate the coefficient variance covariance matrix. In other words, the standard deviation calculated for coefficients versus heterogeneity of variance and autocorrelation is robust.

As the results of Table 3 show, the LR statistic is 303.83, which is significant at one percent level and indicates the superiority of the estimated Markov Switching model versus the linear model. In other words, the price variable in the foreign exchange market seems to follow a nonlinear pattern, so the Markov Switching model has been able to achieve better fit with the linear model. The results obtained here are in line with the results achieved by Schaller and Norden (1997).

The RCM value obtained is also 4.6, which is a very low figure, indicating a perfect separation of regimes.

According to Table 3, the probability of transition from regime 1 to regime 1 is equal to 0.98 and the probability of transition from regime 2 to regime 2, is equal to 957%, indicating a high stability of both regimes. In other words, if the foreign exchange market is in any of the two regimes, it is unlikely to be transferred to another regime and is highly probable to remain in the same regime.

Based on the results reported in Table 3, the standard deviation of the regimen 1, is equal to 0.858 and the standard deviation of the error sentences of the regime is twice as high as 0.252. Therefore, it can be concluded that regime one is corresponding to the time of low-volatility and regimen two corresponds to the period of the high-volatility. The average for the first regime, is equal to -0.952, and the average of regime two, is equal to 109.10. This result also shows that regime one is consistent with periods in which the average foreign exchange return was negative. In regime two, the average foreign exchange return has been positive. Figure 1 shows the differentiation of regimes as well as the growth of foreign exchange prices (the difference in the logarithm of the foreign exchange rate). As we can see, the separation of regimes is completely logical and consistent with economic realities.

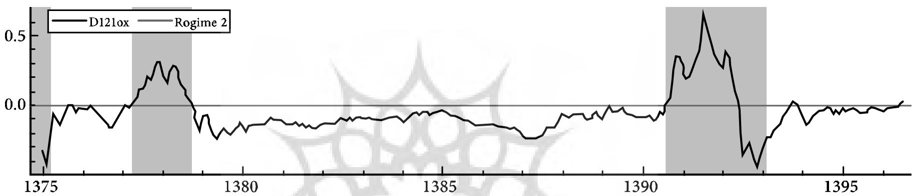

Figure 1. Differentiation of the First and Second Regimes for the Foreign Exchange Market

Source: Research findings

Table 4 shows the estimated Markov Switching model for the stock market. The results for the stock market are quite similar to those of the foreign exchange market. According to the LR test, the non-linear Markov switching model is superior to its linear competitor. According to the results of the RCM index, regimes have also been well differentiated. The value of the RCM index obtained is 6.85, which is a very good indicator of the exact differentiation of regimes.

Also, based on the results, all estimated coefficients are significant at 1% level. Regime one corresponds to periods of low-volatility and low returns, and regime two corresponds to high-volatility periods with high returns. The transitional probabilities of the one-to-one regime and the two-to-two regime are both high and indicate a high stability of both regimes. Of course, with little difference, the high-volatility regime with high returns appears to be more stable.

Table 4
Estimates of the Markov-Switching Model for the Stock Market

Parameter	Estimated Value	Probability Value
μ_1	-0.2203	0.000
μ_2	0.2509	0.000
σ_1	0.1163	0.000
σ_2	0.1839	0.000
p_{11}	0.9522	0.000
p_{22}	0.9679	0.002
RCM	6.85	-
LR	267.48	0.000

Source: Research findings

Figure 2 also shows the differentiation of the first and second regimes in the stock market and the growth of the total index. As you can see, regimes are differentiated with high degree of precision, and regime one is a representative of the market recession and the regime two is a representative of the market boom. Of course, as mentioned earlier, fluctuations in regime two are higher compared with regime one.

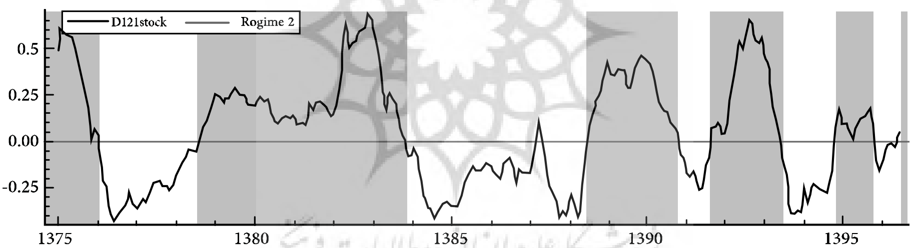

Figure 2. Differentiation of the First and Second Regimes for the Stock Market. Source: Research Findings

Table 5 shows the results of the estimation of the Markov Switching model for the gold market. The results of the LR test indicate that the gold market follows a nonlinear pattern, and the Markov Switching method is better fit than the linear approach to the gold market data. The value obtained for the RCM index is 10.19, which is slightly higher than that of the foreign exchange and stock markets, but in general is a decent amount, indicating a strict separation of regimes. For the gold market, all the coefficients are significant at 1% level, and regime one corresponds to periods of recession and low volatility and the regime two corresponds to the flourishing and volatile periods of the market. The transition probabilities obtained are also approximately the same and both are relatively high. As noted earlier, these high probabilities show that the market continuously spends more periods in each of the two regimes and does not fluctuate regularly between the two regimes. This is also evident in Figure 3.

Table 5
Estimates of the Markov-Switching Model for the Gold Market

Parameter	**Estimated Value**	**Probability Value**
μ_1	-0.1653	0.000
μ_2	0.1006	0.000
σ_1	0.0891	0.000
σ_2	0.1022	0.000
p_{11}	0.9509	0.000
p_{22}	0.9613	0.002
RCM	10.19	-
LR	175.91	0.000

Source: Research Findings

Figure 3 shows the differentiation of the first and second regimes in the gold market. As shown in the graph, regime one corresponds to the periods in which the average gold market return is negative and its fluctuations are less. Regime two also corresponds to the high volatility periods with positive returns.

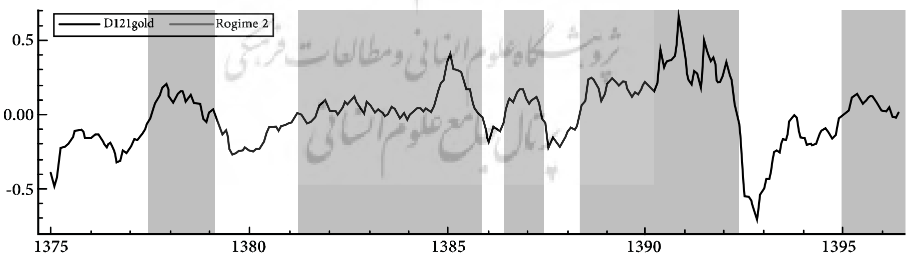

Figure 3. Differentiation of the First and Second Regimes for the Gold Market. Source: Research findings

After extraction of market regimes by the Markov Switching model, in the next step, using the Probit model, the effect of monetary policy on the probability of markets being exposed to high-volatility regimes (with high returns) is examined. For this purpose, using the smooth probabilities obtained above, we define a new variable in this way: if the smooth probability in the period t (t = 1,...,T) for regime two is greater than 0.5, the value of the variable is equal to one and otherwise is equal to zero. Then this variable is used as a dependent variable in the Probit model. Table 6 shows the results of the Probit model for the foreign exchange market.

Table 6
Estimates of the Probit Model (Equation 5) for the Foreign Exchange Market

Variable	Equation1	Equation2	Equation3	Equation4	Equation5
C	-1.041***	-1.531***	-2.103***	-1.888***	-1.754***
M_{t-1}	0.663	1.769*	2.677**	2.099*	2.048*
INF_{t-1}		0.766**	0.302	0.126	0.259
$S_{stock,t-1}$				-0.054	-0.168
$S_{exchange,t-1}$			0.194**	0.186***	0.197***
$S_{gold,t-1}$				0.0178**	-0.009
DU					5.813***

* Significant at 10% level ** Significant at 5% level *** Significant at 1% level
Source: Research findings

As shown in Table 6, in addition to the main variable of the research which is related to monetary policy, other control variables are also presented in the model to study the effect of new variables entering into the equation on the significance of the coefficient of monetary policy variable. As can be seen, the liquidity variable, except in the first equation, in the other three equations, have a significant and positive effect on the probability of a foreign exchange market being in a fluctuating regime and high returns. In other words, expansionary monetary policy will increase the probability that the foreign exchange market will be in a high-volatility state with high returns. In fact, this is what we expected from the theory. The inflation variable is also one of the variables that entered the model as a control variable. This variable, except for the second equation, is not significant in other equations and so it cannot be said that changes in inflation lead to regime changes in the foreign exchange market. The virtual variable of sanctions also has a significant positive effect on the possibility of a foreign exchange market in a fluctuating regime. The condition of exchange markets, gold and stocks are other control variables included in the model. As can be seen, both the foreign exchange market and gold market states in the past period are both significant and have a positive effect on the probability of a foreign exchange market being in a volatile and high-return regime. Of course, after entering the virtual variables related to the sanctions, the gold market condition is meaningless and the stock market situation is meaningful. The variable coefficient of the stock market situation in this equation is negative, which in some way indicates the replacement of the two markets for liquidity available to investors.

The important thing about the market condition variables is that these variables are defined as market conditions in terms of the number of successive periods of the relevant market in the regime rather than being simply defined. The reason for using such a definition is that markets can (as an alternative market) affect each other only if they are consistently assigned to a certain regime for several periods. For example, if the foreign exchange market is in a boom for a short period, it will not have much effect on the decision of stock market investors. But if the foreign exchange market is in a boom for a longer period of time, stock market investors will naturally consider it in their decisions. Therefore, more than the market conditions affect each other, the continuation of the condition is one that can be a factor in the impact of markets on each other.

Table 7 also shows the results of the Probit model for the stock market. As can be seen in the table, in the stock market, the monetary policy variable is one of the factors influencing the stock market's dietary changes, and expansionary monetary policy will increase the probability of a stock market being in a high-volatility regime with high returns. Inflation is also one of the factors influencing stock market regime changes. In other words, an increase in the inflation rate pushes the stock market into a volatile (high-return) regime. The situation of all three markets is also influencing the regime changes in the stock market. The foreign exchange market and stock market condition (in the past period) have a positive effect and the gold market situation has a negative effect on the probability that the stock market will be high-volatility regime with high returns. This result is not far off. An important part of the stock market is the foreign exchange rate-dependent shares. The presence of the foreign exchange market in high-volatility and high-return regimes leads to more fluctuations and, of course, an increase in corporate export earnings, and ultimately affects the stock market. Consistent presence of the gold market also reduces the probability of a stock market being in a high-volatility and high returns sate. This result is also natural. Gold markets and stocks are two successive markets. Naturally, the continuation of the gold market in a boom situation will lead to the withdrawal of part of the capital from the stock market towards the gold market and ultimately reduces the likelihood of a stock market in a volatile and high return state. Based on the results, it appears that the sanctions on the stock market were ineffective (the coefficient of this variable is obtained in Equation 5, meaningless). Of course, this result is related to the direct effect of the boycott on the stock market. The boycott indirectly affected the stock market through the foreign exchange market. As seen in the results of the currency market, sanctions have affected the currency market situation. In the results of the stock market, it is also observed that the foreign exchange market situation has a significant effect on the stock market. In other words, it can be said that sanctions have affected the stock market from the currency channel.

Table 7

Estimates of the Probit Model (Equation 5) for the stock market

Variable	Equation1	Equation2	Equation3	Equation4	Equation5
C	-0.259	-0.393*	-0.241***	-1.324***	-1.3 35***
M_{t-1}	1.623*	1.936**	1.906*	2.717**	2.735**
INF_{t-1}		0.223	0.756**	0.843**	0.851**
$S_{stock,t-1}$			0.092**	0.093**	0.093**
$S_{exchange,t-1}$				0.071***	0.073***
$S_{gold,t-1}$				-0.026***	-0.025***
DU					-0.109

* Significant at 10% level ** Significant at 5% level *** Significant at 1% level
Source: Research findings

Table 8 also shows the results of the Probit model for the gold market. The results for the gold market indicate the impact of monetary policy on the likelihood of a gold market in a volatile (high-yielding) regime. Inflation is also one of the effective factors in placing the gold market in a volatile regime. The effect of the stock market situation on the gold market situation has been positive but meaningless. The foreign exchange market effect has also been positive. According to the results, the effect of sanctions on the increase of the likelihood of changing the regime of gold market from the environment to the greenhouse has been positive and significant. Based on the empirical evidence, the result is expected, as the gold market was fluctuating during the sanctions period.

Table 8
Estimates of the Probit Model (Equation 5) for the Gold Market

Variable	Equation1	Equation2	Equation3	Equation4	Equation5
C	-0.408**	-0.868***	-1.170***	-1.312***	-1.620***
M_{t-1}	2.601**	3.735***	2.123**	1.934*	2.642**
INF_{t-1}		0.762**	0.437	0.635**	0.865***
$S_{stock,t-1}$				0.0247	0.021
$S_{exchange,t-1}$				0.0161**	0.0159**
$S_{gold,t-1}$			0.097**	0.095***	0.119**
DU					1.339**

* Significant at 10% level ** Significant at 5% level *** Significant at 1% level
Source: Research findings

5 Conclusion

The subject of monetary policy and its impact on financial markets is one of the issues that has always been the subject of economists' attention and many studies have been done in this area. Recently, a new issue has been raised in this area, and it is possibility for monetary policy to influence the regime changes in asset markets. In other words, monetary policy, in addition to affecting the price of the market, can also affect the overall market situation (recession or boom, high volatility or low volatility), hence the main purpose of this study is to examine the effect of monetary policy on the regime changes of asset markets (including the foreign exchange market, stocks and gold) in the Iranian economy. For this purpose, the combination of Markov Switching and Probit methods was used. First, asset markets were split into two high- and low-volatility regimes (with average returns) using the Markov Switching method, and then, in the form of a Probit model, the effect of monetary policy and other controlling variables on market regimes was investigated. Monthly data from 1995 to 2017 are used in this study. The results of this study indicate the effect of monetary policy on the regime changes of all three markets. Expansionary monetary policy can increase the probability that all three markets will be in a high-volatility (high-return) regime. In addition, according to the results, inflation and other markets and their past market condition can also be effective in determining the market situation in the current period.

The results obtained in this study are some important policy points. First, monetary policy does not simply lead to price changes in asset markets. Monetary policy can also change the overall market condition and cause changes in the regime in asset markets. Second, expansionary monetary policy, while increasing the likelihood of market moving towards a booming regime, also boosts volatility in markets. However, based on what has been achieved, it does not appear that fluctuations have been tending to increase undesirable risk; however, overall, fluctuations increase ambiguity in the future of the market and makes it difficult to make decisions. Based on what has been said, a monetary policymaker can use the tool he has and effectively push the market to his liking. But it should be noted that monetary policy does not only affect market returns, it also affects market turmoil. Of course, if the monetary policymaker does not consider asset markets in their target function and these markets do not have any weight in the target function, they must be prepared for their policy consequences in the asset markets and, hence, in the real sector of the economy.

References

Altunbas, Y., Gambacortab, L., & Marques-Ibanezc, D. (2014). Does Monetary Policy Affect Bank Risk? *International Journal of Central Banking*, 10(1), 95-136.

Andres, J., Mestre, R., & Valles, J. (1997). A Structural Model for the Analysis of the Impact of Monetary Policy on Output and Inflation. *Monetary Policy and the Inflation Process*, 23, 12-45.

Ang, A., & Bekaert, G. (2002). Regime Switches in Interest Rates. *Journal of Business & Economic Statistics*, 20(2), 163-182.

Angelidis, T., Degiannakis, S., & Filis, G. (2015). US Stock Market Regimes and Oil Price Shocks. *Global Finance Journal*, 28, 132-146.

Baghjeri, M., Hosseini Nasab, E., & Najarzadeh, R. (2014). The Effect of Monetary Policy on Foreign Exchange Market Pressure: A Case Study of Iran. *Economic Research and Policy*, 22, 53-78.

Bai, J. (1999). Likelihood Ratio Tests for Multiple Structural Changes. *Journal of Econometrics*, 91(2), 299-323.

Bai, J., & Perron, P. (1998). Estimating and Testing Linear Models with Multiple Structural Changes. *Econometrica*, 47-78.

Bernanke, B. S., & Gertler, M. (1995). *Inside The Black Box: The Credit Channel of Monetary Policy Transmission* (No. w5146). National bureau of economic research.

Bouakez, H., & Normandin, M. (2010). Fluctuations in the Foreign Exchange Market: How Important are Monetary Policy Shocks? *Journal of International Economics*, 81(1), 139-153. A., & Uhlig, H. (2005). New evidence on the puzzles.

Campbell, J. Y., & Cocco, J. F. (2007). How Do House Prices Affect Consumption? Evidence from Micro Data. *Journal of Monetary Economics*, 54(3), 591-621.

Chatziantoniou, I., Filis, G., & Floros, C. (2017). Asset Prices Regime-Switching and the Role of Inflation Targeting Monetary Policy. *Global Finance Journal*, 32, 97-112.

Chen, S. S. (2010). Do Higher Oil Prices Push the Stock Market into Bear Territory? *Energy Economics*, 32(2), 490-495.

Davies, R. B. (1977). Hypothesis testing when a nuisance parameter is present only under the alternative. *Biometrika*, 64(2), 247-254.

Goldfeld, S. M., & Quandt, R. E. (1973). A Markov model for switching regressions. *Journal of econometrics*, 1(1), 3-15.

Guidolin, M. (2014). Modelling, Estimating and Forecasting Financial Data under Regime (Markov) Switching.

Gurkaynak, R. S., Sack, B., & Swansonc, E. T. (2005). Do Actions Speak Louder Than Words? The Response of Asset Prices to Monetary Policy Actions and Statements. *International Journal of Central Banking*, 1(1).

Hamilton, J. D. (1989). A New Approach to the Economic Analysis of Nonstationary Time Series and the Business Cycle. *Econometrica: Journal of the Econometric Society*, 357-384.

Hoshmand, M., Daneshnia, M., Shahrivar, S., Qizilbash, A., & Eskandripour, Z. (2012). The Relationship between Monetary Policy and Exchange Rate in Iran. *Economics of Value*, 9, 109-127.

Kim, S., & Lim, K. (2018). Effects Of Monetary Policy Shocks on Exchange Rate in Small Open Economies. *Journal of Macroeconomics*, 56, 324-339.

Komijani, A., Elahi, N., & Bijani M. (2015). Effect of Monetary Policy on the Fluctuation of Prices For Real and Financial Assets. *Studies and Economic Policies*, 11, 3-24.

Kurov, A. (2010). Investor Sentiment and the Stock Market's Reaction to Monetary Policy. *Journal of Banking & Finance*, 34(1), 139-149.

Loayza, N., & Schmidt-Hebbel, K. (2002). Monetary Policy Functions and Transmission Mechanisms: An Overview. *Monetary Policy: Rules and Transmission Mechanisms*, 1, 1-20.

Meltzer, A. H. (1995). Monetary, credit and (other) Transmission Processes: A Monetarist Perspective. *Journal of Economic Perspectives*, 9(4), 49-72.

Nelson, E. (2003). The Future of Monetary Aggregates in Monetary Policy Analysis. *Journal of Monetary Economics*, 50(5), 1029-1059.

Quandt, R. E. (1972). A New Approach to Estimating Switching Regressions. *Journal of the American Statistical Association*, 67(338), 306-310.

Schaller, H., & Norden, S. V. (1997). Regime Switching in Stock Market Returns. *Applied Financial Economics*, 7(2), 177-191.

Stiglitz, J. E. (2011). Rethinking Macroeconomics: What Failed, and How to Repair It. *Journal of the European Economic Association*, 9(4), 591-645.

Taylor, J. B. (2007). *Housing and Monetary Policy* (No. w13682). National Bureau of Economic Research.

Wang, Y. S., & Chueh, Y. L. (2013). Dynamic Transmission Effects between the Interest Rate, the US Dollar, and Gold and Crude Oil Prices. *Economic Modelling*, 30, 792-798.

Zainabvand, A., Mohammadi, G., Ghobishai, A., & Abdollahi, F. (2018). The Effect of Monetary Policy and the General Level of Prices through the Channel of Asset Prices on the Stock Price Bubble in Iran. *Economics of Value*, 15, 1-26.