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THE CAUSAL RELATIONSHIP BETWEEN MONETARY POLICY AND HOUSING PRICES IN IRAN USING THE NON-LINEAR MARKOV-SWITCHING VECTOR AUTOREGRESSION (MS-VAR MARKOV) MODEL (CASE STUDY: TEHRAN)

Mohammad Alizadeh*, Gholam Reza Nemati and Maryam Khodaverdi Samani*****

Abstract: *Numerous empirical studies have been conducted on the causal relationships between monetary policy and housing prices. Vector autoregression (VAR) models are of the most common methods used in these studies. However, proper and accurate methods must be used due to some drawbacks of VAR models such as the assumption of constant parameters over time. In this study, the causal relationship between monetary policy and housing prices in Iranian economy during 1993:1-2015:3 is investigated using the non-linear Markov-Switching vector autoregression (MS-VAR) model. The most important feature of the MS model is its ability to consider the changes in the relationship between these two variables over time. Considering two different regimes, the results of MS model showed that in the Regime 1 the (the period of rising housing prices), a one-way causal relationship was observed from the liquidity growth to the growth of housing prices so that the monetary policy was the Granger cause of housing prices and thus is not neutral. In the Regime 2, there was a one-way causal relationship from the housing price to the liquidity, but there was no causal relationship from the liquidity growth to the housing price index.*

JEL Classification: *E31, E52, C34*

Keywords: *Granger causality, monetary policy, housing price, Markov-Switching model, Vector autoregression.*

1. INTRODUCTION

Housing is of great importance as an asset providing both services and facilities as a shelter. From the macroeconomic perspective, housing is the major asset in the household portfolio. The housing market as one of the asset markets in Iran has received much attention by investors for many years. Investors enter housing as an asset in their portfolios. However, the housing market is distinct from

* Assistant Professor, Economics Department, Lorestan University, Iran.

** PhD Student of Economics, Economics Department, Lorestan University, Iran. Email: grezanemati@gmail.com

*** PhD Student of Economics, Economics Department, Lorestan University, Iran.

other markets in terms of liquidity, immovability and the lack of microfinance investment. According to Shinm *et al.*, (2009), the housing sector has a large share of the economy. Liu (2010) believes in housing as a key issue to have healthy and interesting communities.

Land and housing prices in the past two decades have experienced unprecedented jumps and fluctuations. However, the performance of the housing sector has not been rather favorable. Instead of a manifestation of the investment process and proper interaction with other sectors to provide public welfare, it is a manifestation of Dutch disease, mismatch and divergence of the distribution of income in the economy. Fluctuations in the housing price, particularly its sharp increases challenge people's accessibility to housing. The boom and downturn of the housing sector and its business cycles is a manifestation of the business cycles of the economy. Among the economic, political and demographic factors influencing the housing market, inflation, and liquidity are the main variables on the demand side. In recent years, the high money stock growth in the Iranian economy led to a significant increase in housing prices.

According to Friedman (1998), there may be numerous interdependencies between monetary growth and housing price inflation. For example, due to the increase in the net household wealth or due to the high turnover of housing and construction markets, the sharp rise in housing prices may be associated with an increased demand for mobile money. On the other hand, Adalid and Detken (2007) argue if monetary policy provides sufficient liquidity, it will cause an inflation in the asset prices leading to a causality from monetary changes to the housing market. This raises questions about possible relationships between the liquidity and housing prices, especially since the boom of real estate markets in the recent years has been affected by increased liquidity. Is there a causal relationship between the housing prices and liquidity? To gain a better attitude on the transmission mechanism of monetary policy, it is essential to investigate the relationship between monetary policy and housing prices. To apply a successful monetary policy, monetary authorities should make a proper evaluation of the time and the effect of this policy on economic variables. For this purpose, sufficient understanding of the tools and mechanisms through which monetary policy affects economic sectors is necessary to achieve different goals such as price stability in the housing sector. Monetary policymakers should be aware of the effects of monetary policy on the housing market variables.

The aim of this study is to investigate the relationship between monetary policy and house prices in the economy of Iran. So the question that arises is that how does Iran's monetary policy affect housing prices? This study aims to answer this question to investigate the causal relationship between the monetary policy and housing prices. This article is organized in five sections. Section 2 reviews literature and research background on the housing market. The model is explained in the

Section 3 and the results are analyzed in the Section 4. Concluding remarks are given in Section 5.

2. LITERATURE REVIEW

2.1. Theoretical Background

According to Mishkin (2007) and considering economic theories, monetary policy directly or indirectly influences housing prices and therefore the whole economy through six channels. Monetary policy affects the housing prices through direct impact of interest rates on: (1) cost of capital, (2) expectations of future housing price changes and (3) housing supply. Monetary policy influences the housing prices indirectly through: (1) the effects of wealth resulting from changes in housing prices, (2) the impact of housing loans on consumer spending and (3) the impact of housing loans on the housing demand. Therefore, the relationship between money, housing and inflation can be justified in different channels called money demand channel (Friedman, 1988), asset price channel Meltzer (1995) and credit channel (Bernanke and Gertler (2000). Theoretically, monetary policy is able to affect housing demand and supply and thus influences the housing prices. Empirical evidence and studies show that the medium-term and short-term elasticity of housing supply is not significant. Due to the low elasticity of housing supply in the short and medium-term, increased housing demand is reflected in increased housing price. The most important theoretical approach to investigate the relationship between monetary policy and asset prices is monetarists' optimized portfolio adjustment. Monetary expansion influences the marginal utility of stocks and other assets. In this condition, economic factors try to return the equilibrium condition through a moderation in spending and portfolios of assets as long as the ratio of marginal utility to prices becomes equal for all assets and consumption. This would suggest that an increase in the money supply results in a higher demand for assets including housing leading to an increase in asset prices.

According to Gioliodori (2005), if the interest rate is reduced by the central bank, this will result in a decrease in mortgage rates. In other words, the cost of borrowing for the purchase of housing will decrease leading to an increase in the housing demand. Given the low elasticity of housing supply, this will lead to an increase in the housing prices.

According to Kachiap and Stein (2000), as a result of the expansionary monetary policy, by increasing the money stock due to an increase in required reserves of banks, bank deposits are increased and thereby bank lending increases. On the other hand, since much of investments and consumer spending of durable goods such as housing is funded through bank loans, lending growth will cause an increase in demand for such goods.

2.2. The Relationship between Liquidity and Housing Prices in Iran

Liquidity growth rate is one of the most important factors affecting fluctuations in housing prices. It directly affects housing demand, because of its key role in the transfer of oil revenues or compensation of the government deficit. On the other hand, oil revenues cause exogenous fluctuations of liquidity due to oil shocks. With the increase in liquidity in Iran, wandering assets are created than can be absorbed by the housing market. Thus, increasing liquidity will lead to increased housing demand. Since increased housing supply in the housing market is not possible in the short term, the market will face excess demand with the high liquidity growth rate and this ultimately leads to a price bubble. Price bubble leads people to housing construction and thus housing supply increases with a delay of one to two years (on average, one to two years are required for the completion of residential buildings*). On the one hand, demand decreases due to speculative bubbles. On the other hand, simultaneous increased supply and reduced demand lead to a reduction or price stability in the years after the boom. This cycle usually repeats periodically in the housing market.

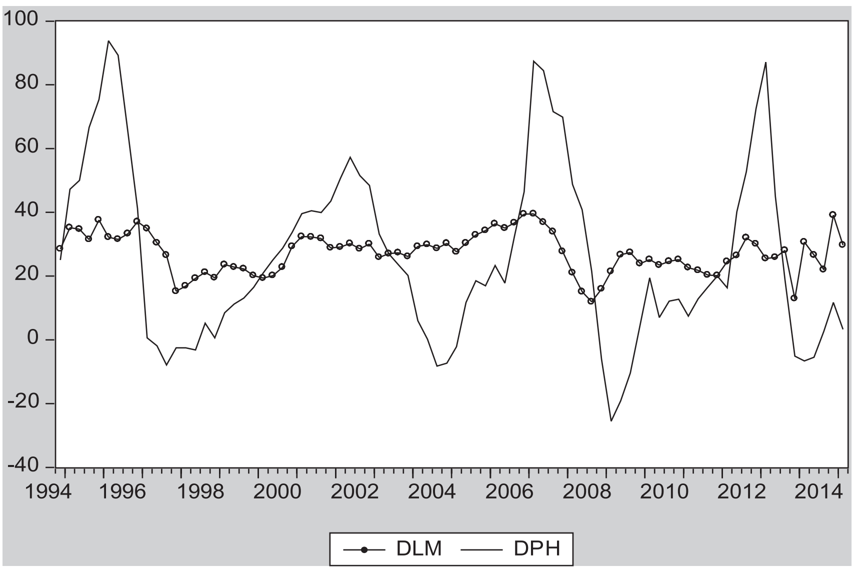


Figure 1: Seasonal monetary growth and the growth of housing prices (in Tehran) from 1994 to 2015

Chart 1 indicates jumps in housing prices after the increase in liquidity so that liquidity growth rate is higher than the housing growth rate in 2000 leading to a price jump in the housing market in 2002. The repeating trend led to price jumps in 2007. After each jump in the housing price where the growth rate of housing prices exceeded the liquidity growth rate, immediately a fall in the growth rate of

* A detailed report on the building statistics, the Central Bank of the Islamic Republic of Iran

housing prices is observed. Liquidity growth rate fluctuations affect the housing market through lags. The main reason for this lag is time-consuming construction and housing supply. On the other hand, if expansionary monetary prices and the growth of liquidity in the community occur simultaneously with the booms in the housing market, housing market boom will be intensified (as in the periods: 1994-1996, 2000-2002, 2005-2007 and 2011-2012). When monetary tightening policies coincide with the downturn of the housing market, housing downturn will be intensified (as in the periods: 1996-1998, 2007-2009 and 2014-2015). It should be noted that the combination of liquidity components and its quality were moved towards near money (quasi-money) from 2013 onwards (deposit in transit) and bank accounts also tended more towards time deposits. The cost of bank resources has been also increased. Due to an increase in the cost of banks' financial resources and increased share of quasi money in liquidity, the interest rate of facilities also increased. So changes in the composition of liquidity in recent years reduced inflation while increasing the interest rate and the housing downturn duration.

The liquidity injected into the economy is not reflected in the price growth according to a stable base and a one-to-one relationship so that price growth after including the limited growth of GDP is much lower than the growth of liquidity. One of the reason is that the liquidity is formally and informally injected much greater than usual into the housing sector. This is why the growth of land and housing prices in the last decade is greater than double the growth in the general level of prices. This means that when the ratio of liquidity to GDP increases and more liquidity is injected into the land and housing sector, the housing price index becomes higher than the total price index. However, it may be inversed and the housing price in a tumultuous speculative environment may increase dramatically than the general price level. Private banks and authorized and unauthorized financial institutions and even state-owned banks (indirectly) facilitate and fund speculative land and housing activities.

2.2. Foreign Studies

Lastrapes (2002) evaluated and interpreted dynamic response of housing prices to the money supply shocks using dynamic equilibrium model of the housing market and monthly data. The results indicated real and positive effects of monetary shocks on the housing market.

Giese, Tuxen Giese and Tuxen (2007) found that the effect of global liquidity is a result of the irregular monetary policy on asset prices and increased inflation. Using seasonal data over the period (1982-200) for six countries including France, Germany, Japan, Italy, England and the United States, the asset pricing model was estimated. The results of VAR estimation showed that liquidity shock leads to an increase in the price of housing so that inflation and interest rates were adjusted positively. However, the effect of liquidity on the stock price is very low and excess global liquidity with longer lags leads to an inflationary pressure.

After studying the relationship between housing investment and business cycles in the United States in the aftermath of World War II, Limer (2007) found that in 8 downturn cases, 26% of the reduction in the level of economic activities in the year before the downturn is related to reduction in the level of activities in the housing sector. In addition, the role of the central bank's monetary policy in the recent downturns is important because of its effect on the activities of the housing sector and its spread to other economic sectors. Therefore, the effect of monetary policy (and, in general, monetary shocks) on the housing sector is of great importance in theoretical and empirical macroeconomic literature.

Adams and Foss (2010) provided evidence regarding the effect of variables related to economic activity such as industrial production, unemployment levels and the money supply on the housing demand and prices.

Ncube and Ndou (2011) used the eight-variable SVAR model in South Africa to investigate the role of housing prices in transmission of monetary shocks through wealth and housing price credit channels to the final consumption expenditure of households.

In an article entitled "Housing market fluctuations under expansionary monetary policy in Australia", Junxiao Liu (2012) investigated the effect of monetary policy on the housing market in Australia from 1996 to 2009 using SVAR model. He found that monetary policy is significantly provided with interest rates in the housing market in Australia.

Kengne *et al.*, (2013) used the bivariate Markov-Switching (MS-VAR) model to analyze the impact of monetary policy on house prices in South Africa in the boom and downturn periods. The results showed that the shock of tight monetary policy during the market downturn has a greater impact on the housing prices than during the boom period. The positive shock of housing prices significantly affects the monetary policy during the boom period as compared with the downturn period.

Using a collective threshold, money supply data and housing prices in Great Britain, Tsai (2013) analyzed the asymmetric relationship between monetary policy and housing prices in Great Britain from the third season of 1986 to the fourth season of 2011. The evidence showed that housing prices regulate the money supply shock asymmetrically.

Gupta *et al.*, (2014) used time-varying parameter vector autoregression model (TVP-VAR) for examining the interaction between monetary policy and asset prices in South Africa since 1966. The results showed at least two regimes in which expansionary fiscal policy affected the asset prices.

2.3. Domestic Studies

Jafari Samimi *et al.*, (2007) studied the effect of macroeconomic variables such as per capita income, stock price index, building service price index, the number of completed buildings, the money stock and inflation rate on the housing prices using ARDL model.

Gholizdeh (2010) examined the effect on the liquidity on the housing market in Iran and 20 OECD countries in which the housing price fluctuations in recent decades were more than other countries. Panel data estimates (1980-2009) suggest that liquidity has a significant and positive effect on housing prices.

Heidari and Suri (2010) studied the relationship between the interest rates of bank deposits and housing prices in Iran using vector autoregression (VAR) model. Based on the results of impulse response functions, stimulation of demand-side factors (increasing the liquidity growth rate and per capita income) causes housing prices to rise, expect that the effect of liquidity on housing prices is appeared with a delay of about a year.

Shahbazi and Kalantari (2011) investigated the effect of monetary and fiscal shocks on the housing sector variables using SVAR model and seasonal data of 1991-2008. The results of the impulse response functions showed that financial shocks have no significant impact on the housing market variables, but the shock to the money supply significantly increased the housing market variables.

Safari (2013) studied the factors affecting the housing price index using ARDL method. The results indicated that an increase in the money stock leads to an increase in housing prices in the long term.

Hajizadeh (2014) investigated the downward rigidity in housing prices and asymmetric effects of changes in the money stock on the seasonal housing prices in Iran from 1998 to 2010 using asymmetric error correction model (ECM) and threshold GARCH (TGARCH) model. The results of the threshold GARCH model showed the asymmetric impact of changes in the money stock on the housing price changes in Iran. The results of asymmetric error correction model indicated that following a reduction in the money stock in Iran, a decline in prices in the housing market was not statistically significant, while following an increase in the money stock, a significant increase in housing prices was observed. This shows a downward rigidity in the housing prices in Iran.

3. RESEARCH METHODOLOGY

To investigate the causal relationship between the liquidity growth rate and housing prices, Markov-Switching (MS) and VAR models are used. These models are able to include the changes in the relationship between these two variables by establishing different regimes. They are also able to indicate the nature of the relationship between the housing prices and money in different regimes. This method is based on VAR models. However, the parameters are dependent on the time and can be variable in different regimes. So, changes in the causality during the study period can be extracted easily with no assumptions. The causality obtained by the MS method is also called contingent causality, because it depends on the regime and is not necessarily same in all regimes. The changes in causal relationship are caused by the Markov chain process. This a stationary process, but is latent. In the meantime, this model determines the precise times of changes and structural failures endogenously. MS models capabilities in explaining the behavior of economic variables (which often change in different regimes) led to their increasing use in the economy.

3.1. Markov-Switching Vector Autoregression (MS-VAR) Model

When a system is exposed to a regime change and the VAR model is changed with time, this can be explained by incorporating the process parameter θ in the VAR model. Most economic variables change over time for various reasons including policy changes, economic and natural crises and so on. Various methods have been proposed to incorporate these changes in the economic modeling process. Markov regime change models are among the models developed to solve this problem.

The main idea of this method is that VAR model parameters are dependent on the regime parameter (s_t). Meanwhile, s_t is latent and only its probability can be achieved. Assuming that there are M modes as possible regimes so that $s_t = \{1, \ldots M\}$, the conditional probability density of the observed time series vector, y_t, is assumed as follows:

$$\rho\left(y_{t|Y_{t-1},S_t}\right) = \begin{cases} f\left(y_t | Y_{t-1}, \theta_1\right) & \text{if } s_t = 1 \\ f\left(y_t | Y_{t-1}, \theta_M\right) & \text{if } s_t = M \end{cases} \tag{1}$$

where θ_M is the vector of VAR model parameters in different regimes and $Y_{(t-1)}$ represents $\{y_{t-j}\}_{j=1}^{\infty}$ observations. Accordingly, for a hypothetical regime, s_t, the time series vector, y_t, is shown by a P-order vector autoregression process (VAR(P)) as follows:

$$E[y_t | Y_{t-1}, S_t] = v(S_t) + \sum_{j=1}^{p} A_j (S_t)\, y_{t-1} \tag{2}$$

where $u_t = y_t - E[y_t | Y_{t-1}, S_t]$ is a new process with a co-variance matrix, $\sum(S_t)$ which is normalized as $u_t \sim \text{NID}\left(0, \sum(S_t)\right)$. If the conditional VAR process is defined on a latent regime, the information creation mechanism is described by assumptions about the regime creation process. In the Markov model (MS-VAR), it is assumed that the regime s_t S is developed by the first order Markov chain as follows:

$$\Pr[s_t \mid \{s_{t-j}\}j^{\infty} = 1, \{y_{t-j}\}j^{\infty}_{=1}] = \Pr\{s_t \mid s_{t-1}; \rho\} \tag{3}$$

ρ is the vector of possibility parameters in the regimes. Based on this assumption, the probability of transition between different regimes is obtained:

$$p_{ij} = pr(s_{t+1} = j \mid s_t = i), \sum\nolimits_{i=0}^{n} p_{ij} = 1 \ \forall i, j \in \{1, ..., \mathrm{N}\} \tag{4}$$

It in fact shows the probability distribution of s_t. Putting the probabilities in an M × M matrix, the transition probability matrix (P) is obtained in which each element (p_{ij}) shows the probability of the regime j after the occurrence of the regime i where $\sum\nolimits_{j=1}^{n} p_{ij} = 1$ and $0 \le p_{ij} \le 1$.

$$p = \begin{bmatrix} p_{11} & p_{21} & \cdots & p_{\mathrm{M}1} \\ p_{12} & p_{22} & \cdots & p_{\mathrm{M}2} \\ \vdots & \vdots & \cdots & \vdots \\ p_{1\mathrm{M}} & p_{2\mathrm{M}} & \cdots & p_{\mathrm{MM}} \end{bmatrix}$$

Considering the changes in parameters in different regimes, the linear VAR model is turned to the following MS-VAR - MS model:

$$y_t = v(s_t) + \mathrm{A}_1(s_t)y_{t-1} + ... + \mathrm{A}_p(s_t)y_{t-p} + u_t \tag{5}$$

In this model, all parameters are dependent on the regime variable (s_t). Therefore, the model can also be shown as follows:

$$y_t = \begin{Bmatrix} v_t + \mathrm{A}_{11}y_{t-1} + \ldots + \mathrm{A}_{p1}y_{t-p} + \sum\nolimits_{1}^{1/\mathrm{M}} u_t & \text{if } s_t = 1 \\ v_n + \mathrm{A}_{1\mathrm{M}}y_{t-1} + \ldots + \mathrm{A}_{p\mathrm{M}}y_{t-p} + \sum\nolimits_{1}^{1/\mathrm{M}} u_t & \text{if } s_t = \mathrm{M} \end{Bmatrix} \tag{6}$$

Optimization is used to estimate the model parameter vector, θ, to maximize the logarithm of the conditional probability with the use of the initial value assuming an ergodic Markov chain*.

Assuming an ergodic Markov chain, the non-conditional probability of placement in the position j is used as the initial value. The non-conditional probabilities are defined as follows:

$$\xi_j = pr[s = j] = \frac{1 - p_{ii}}{2 - p_{ii} - p_{jj}} \tag{7}$$

The model can be changed in experimental studies so that some of the parameters would be dependent on the regime while other parameters would not change with the change of regime.

Table 1
Various modes of MS-VAR models

		MSM		*MSI*	
		Variable average	*Constant average*	*Intercept*	*Without intercept*
Constant A*i*	Constant	MSM-VAR	Linear VAR	MSI-VAR	Linear VAR
	Variable	MSMH-VAR	MSH-VAR	MSIH-VAR	MSH-VAR
Variable A*i*	Constant	MSMA-VAR	MSA-VAR	MSIA-VAR	MSA-VAR
	Variable	MSMAH-VAR	MSAH-VAR	MSIAH-VAR	MSAH-VAR

Source: Krolzig (1997)

These models provide a nonlinear flexible framework to include heteroskedasticity, occasional transfers and predictions.

3.2. Granger Causality Test in MS Models

Suppose that the causality between X_1 and X_2 should be studied considering the possibility of regime change. A change in the regime enables us to find the variable causal relationship between the variables depending on the variable regime. In these models, there is no need for assuming a constant causal relationship between the variables. For this purpose, the MS-VAR model is used as follows assuming two possible regimes:

$$\begin{bmatrix} x_{1,t} \\ x_{2,1} \end{bmatrix} = \begin{bmatrix} \mu_{10} + \mu_{11} s_{1,t} \\ \mu_{20} + \mu_{21} s_{2,t} \end{bmatrix} + \sum_{\tau=1}^{k} \begin{bmatrix} \phi_{10}^{(\tau)} + \phi_{11}^{(\tau)} s_{1,t} & \psi_1^{(\tau)} s_{1,t} \\ \psi_2^{(\tau)} s_{2,t} & \phi_{20}^{(\tau)} + \phi_{21}^{(\tau)} s_{2,t} \end{bmatrix} + \begin{bmatrix} x_{1,t-\tau} \\ x_{2,t-\tau} \end{bmatrix}$$

$$+ \sum_{\tau=1}^{h} \begin{bmatrix} \varphi_{10}^{(\tau)} + \varphi_{11}^{(\tau)} s_{1,t} \\ \varphi_{20}^{(\tau)} + \varphi_{21}^{(\tau)} s_{2,t} \end{bmatrix} z_{t-\tau} + \begin{bmatrix} u_{1,t} \\ u_{2,t} \end{bmatrix}, \quad t = 1, \ldots, \mathrm{T}.$$

Zt can be used as a control variable in the model or it can be removed. In the above model, $s_{1,t}$ and $S_{2,t}$ represent latent random variables and range from 0 to 1. The disturbance components are white noise processes independent of the regime. The method of maximum likelihood (ML) is used to estimate this model. In addition to the model coefficients, using calculated probabilities (filtered and smoothed probabilities), the regime (0 or 1) to which the observations belong can be determined.

The filtered and smoothed probabilities are respectively calculated using the $1 - t$ observations (the point under study) and all observations (from 1 to T).

The causal relationship between the two variables can be investigated based on the estimated parameters of the model. The non-zero parameters $\psi_1^{(1)}, \ldots, \psi_1^{(k)}$

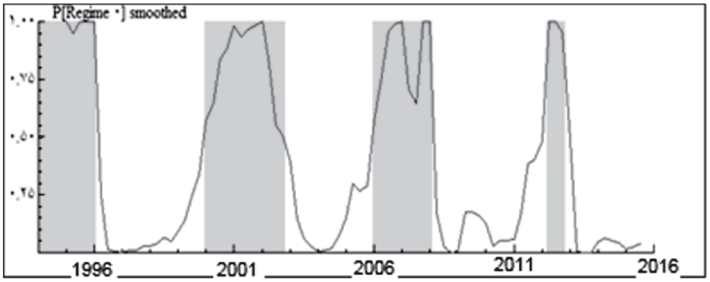
($X_{2,\, \tau - t}$ coefficients) indicate that x_2 is the Granger cause of x_1 when $S_{1,\, t} = 1$. x_2 is not the Granger cause of x_1 when $S_{1,\, t} = 0$. If any of the parameters $\psi_2^{(1)}, \ldots, \psi_2^{(k)}$ ($X_{1,\, t - \tau}$ coefficients) is not zero, x_1 is the Granger cause of x_2 when $S_{2,\, t} = 1$. x_1 is not the Granger cause of x_2 when $S_{2,\, t} = 0$ (Perlin, 2012).

The above model has several unique advantages to investigate the causal relationship between the variables. First, it allows arbitrary variations of the causal relationship in the study period. This method is a powerful tool for analyzing variables experienced several structural failures, especially when the exact time of the occurrence of the structural failures is not known in advance. Second, the change in the causal relationship can be model using this technique in compliance with the principle of paucity of variables. Third, based on the results of this method, the time to change the causal relationship can be determined endogenously (Falah and Hashemi Dizaj, 2010).

4. RESULTS

4.1. Analysis and Forecast of the Housing Market in 2016

Over the past two decades, the housing market has been one of the "efficient" markets and a place for "speculation" through attracting productive investments. Jumps in the housing prices have been accompanied by possible liquidity. So the growth of liquidity has been undoubtedly effective in unprecedented jumps and instabilities in the housing sector. But due to the speculative nature of the housing sector activities, passive money is stimulated by the housing sector boom affecting the "quantity and quality" of liquidity. Despite the growth in land and housing prices and the growth of liquidity in the same direction, the growth of land and housing prices in the last decade was much higher than the liquidity growth. The main reason for this difference is that the liquidity growth was higher than the growth of production and prices and a slightly higher share of liquidity has been spent on land and housing transactions. To investigate the relationship between the growth of liquidity, housing price growth and consumer price inflation in Iran, M_2 is used as a measure of the total amount of money, the housing price index (HP) as a measure of housing prices and the consumer price index (CPI) as the measure of price index obtained from the Central Bank and the Statistical Center of Iran. First, the features of the boom and downturn periods in the housing market are explained. Then, the probability of continued downturn in 2016 is predicted. According to the housing price growth time series in Figure 2, the housing market follows a repetitive behavior and periodically enters the boom and downturn phases. Figure 2 shows the boom and downturn of the housing market in Tehran obtained from Markov-Switching model (based on the rate of growth in housing prices over the same period of the last year).



Source: Research findings

Figure 2: Housing market downturns and booms obtained from Markov-Switching model

In Figure 2, the blue areas represent the boom while the white areas represent the downturn periods. As can be seen, the housing market in Tehran experienced four cycles of boom and downturn from 1994 to 2015. The results are summarized in Table 2.

Table 2
Boom and downturn periods in the housing market of Tehran (from spring 1994 to autumn 2015)

Notes	*Boom*	*Boom duration (seasons)*	*Downturn*	*Downturn duration (seasons)*
Boom-first downturn	1994 (1) – 1996 (1)	9	1996 (2) – 2000 (4)	15
Boom-second downturn	2000 (1) – 2002 (4)	12	2003 (1) – 2005 (4)	12
Boom-third downturn	1999 (2) – 2006 (1)	11	2008 (3) – 2011 (4)	15
Boom-fourth downturn	2012 (1) – 2012 (4)	4	2013 (1) – 2015 (3)	10
Average boom and downturn duration	–	9	–	13

The important point is that the average duration of downturns is higher than booms so that the average periods of downturn and booms in the housing market of Tehran are 13 and 9 seasons, respectively. In the other words, after entering the downturn period, it is expected that the housing market remains in downturn for 13 seasons on average.

According to above discussion, it can be concluded that the housing market will remain in downturn as long as there is no demand for previous housing supplies (as a result of the boom in 2012 and early 2013) or in other words until there is no new demands in the housing market. Table 2 shows the probabilities of booms or downturns of the housing market in future seasons. These probabilities were calculated using the Markov-Switching model. As can be seen, the probability of downturn in 2016 is higher than boom. But it should be noted that the probability of boom increases at the end of the year and reaches about 35% in the winter of 2016 showing a significant increase compared with 14% boom in the winter of 2015. Accordingly, the downturn in 2016 is likely to continue at least until the middle of 2016.

Table 3
The probability of boom and downturn of the housing market in 2016 (percent)

Notes	*Boom probability*	*Downturn probability*
Winter 2015	13.8	86.2
Spring 2016	29.5	70.5
Summer 2016	32	68
Autumn 2016	33.5	66.5
Winter 2016	34.3	65.7

After describing the features of boom and downturn periods and predicting the trend of housing prices, due to the high liquidity growth in 2015 and 2016, the causal relationship between the liquidity growth and the growth of housing prices will be discussed.

First, the stationarity of variables was ensured to prevent false econometric estimation. Thus, the stationarity of the variables was examined using the generalized Dickey-Fuller (ADF) test. The results are shown in Table 4.

Table 4
The generalized Dickey-Fuller unit root test

Variable	*With intercept and trend*	*With intercept and without trend*
DLPH	–6.465**	–6.405**
DLM	–15.584**	–15.63**
DLCPI	–3.551*	–3.003*

* and ** respectively show significance levels of 5% and 1%
Source: Research computations

According to the ADF test results, the growth in the housing prices, inflation index and liquidity growth are stationary variables. As a result, these stationary variables are used to determine the causal relationship. Markov Switching model is a good estimation model when nonlinear data is used in the model. LR test was used to ensure the non-linearity of the data pattern.

Table 5
LR test results

Statistics	*Degree of freedom*	*Probability*
1209	38	0.000

Source: Research findings

As shown in Table 5, the LR test statistics is larger than its critical value at a significance level of 5% and thus it can be concluded that the nonlinear Markov-Switching method is more suitable than linear models to estimate the model.

4.2. Model Estimation

The first step in using the MS-VAR models is to determine the optimal degree of the VAR model using the Akaike or Schwartz-Bayesian criteria. Table 6 shows the AIC and Schwartz-Bayesian statistics for the lags 1 to 5. The minimum value of these criteria is selected according to the data length and the Schwartz criterion for optimal lag in the model 3.

Table 6
The optimal degree of VAR model

HQ	*SC*	*AIC*	*LR*	*LogL*	*Lag*
–10/39459	–10/23649	–10/00064	NA	439/5263	1
–10/62707	–10/31087	–10/03918	42/41163	462/4062	2
–10/81345	–10/33916*	–10/13161	37/37226	483/3961	3
-–10/86736*	–10/23497	–11/29157*	26/56321*	498/9546	4
–10/76027	–9/969779	–11/29054	14/63792	507/9121	5

* significant at a significance level of 1%

The next step is to determine the optimal number of regimes in the model. For this purpose, Akaike information criteria can be used to determine the number of regimes. The Markov-Switching model can have different modes. According to the strategy used to select the model in the previous section, the optimal model is determined based on the Akaike information criterion. The MSIAH model with three lags is best fitted on the data. In fact, the results indicate that all components of the equation including the intercept, the dependent variable coefficients and the variance of disturbance terms should be functions of the regime.

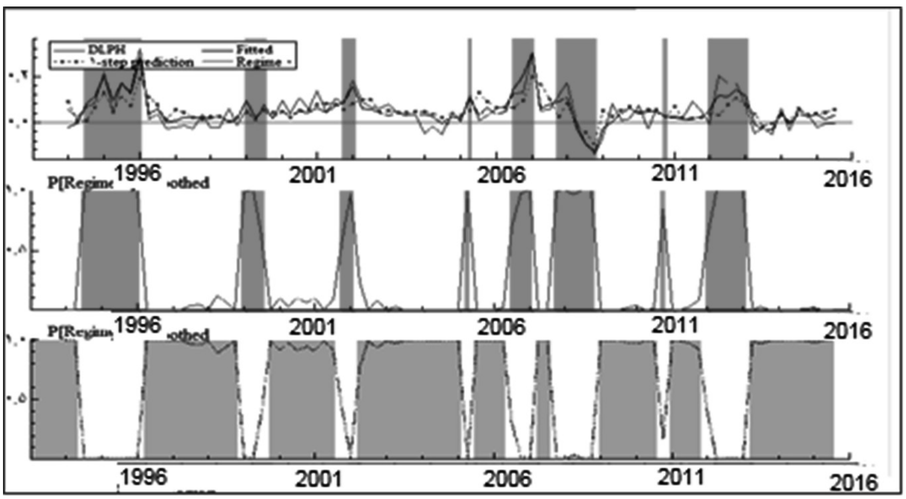


Figure 3: Regimes 1 and 2 based on the smoothed and filtered probabilities

Figure 1. The regimes estimated by the model

Table 7
The results estimated by MSIAH (3)-VARX (3)

Dependent variable: housing price index (DLPH)			*Dependent variable: liquidity (DLM)*		
	Regime 1			*Regime 1*	
Variable	*Coefficient*	*t statistics*	*Variable*	*Coefficient*	*t statistics*
Intercept	0.1952	–3.56**	Intercept	0.424	1.87***
DLPH_1(1)	–0.0597	–0.298	DLM_1(1)	–0.0545	–0.346
DLPH_2(1)	0.2248	1.35	DLM_2(1)	0.6375	2.7**
DLPH_3(1)	–0.0815	–0.640	DLM_3(1)	–0.0110	–0.046
DLM_1(1)	2.093	5.88**	DLCPI_1(1)	–0.0931	–0.602
DLM_2(1)	2.347	4.09**	DLCPI_2(1)	–0.36690	–2.12**
DLM_3(1)	0.9764	1.58	DLCPI_3(1)	0.6774	4.66**
DLCPI_1(1)	–0.4640	–1.38	DLPH_1(1)	–0.1194	–1.34
DLCPI_2(1)	–0.3661	–0.851	DLPH_2(1)	–0.1095	–1.44
DLCPI_3(1)	0.2283	0.742	DLPH_3(1)	–0.475	0.826

*, ** and ***: significant respectively at significance levels of 1, 5 and 10%.
Source: Research findings

Dependent variable: housing price index (DLPH)			*Dependent variable: liquidity volume (DLM)*		
	Regime 2			*Regime 2*	
Variable	*Coefficient*	*t statistics*	*Variable*	*Coefficient*	*t statistics*
Intercept	0.709	2.34	Intercept	0.1245	6.24
DLPH_1(2)	–0.2595	–1.49	DLM_1(2)	–0.5926	–5.17
DLPH_2(2)	0.0100	0.052	DLM_2(2)	–0.0519	–0.406
DLPH_3(2)	0.0795	0.452	DLM_3(2)	–0.0852	–0.739
DLM_1(2)	–0.3741	–1.20	DLCPI_1(2)	–0.3977	–1.99***
DLM_2(2)	–0.3550	–1.12	DLCPI_2(2)	–0.3245	–1.63
DLM_3(2)	–0.3675	–1.29	DLCPI_3(2)	–0.0559	–0.299
DLCPI_1(2)	0.0695	0.0859	DLPH_1(2)	–0.0088	–0.165
DLCPI_2(2)	0.2099	2.77**	DLPH_2(2)	–0.0134	0.269
DLCPI_3(2)	–0.0597	–0.675	DLPH_3(2)	0.1698	2.88**

*, ** and ***: significant respectively at significance levels of 1, 5 and 10%.

Table 7 shows the results obtained from OX MATRIX7 software for this model. The model is derived using the maximum likelihood method. In this table, the first column represents an equation with the dependent variable of housing price index. Below, the lag coefficients for housing price index and liquidity and inflation in two different regimes are shown. The second column represents the second equation with a dependent variable of liquidity. The independent variables include lag variables of liquidity, housing price index and inflation.

The sum of coefficients can be used to investigate the Granger causality between the variables. But it should be noted that the calculated value or insignificancy of some estimated coefficient is not decisive, but the presence of even a significant coefficient indicates the existence of causality between the variables. In other words, causality does not exist when none of the estimated coefficients are significant (Firouz Fallahi)

Table 8
The causality estimated by MSIAH (3)-VARX (3) model

MSIAH (3)-VARX (3) model	*Null hypothesis*	*p-value*
Dependent variable: DLPH (Regime 1)	DLM is not the causality of DLPH	0.000
	INF is not the causality of DLPH	0.1975
Dependent variable: DLPH (Regime 2)	DLM is not the causality of DLPH	0.7002
	INF is not the causality of DLPH	0.0032
Dependent variable: DLM (Regime 1)	DLPH is not the causality of DLM	0.0096
	INF is not the causality of DLM	0.234
Dependent variable: DLM (Regime 2)	DLPH is not the Granger causality of DLM	0.004
	INF is not the Granger causality of DLM	0.001

According to the housing price index in the Regime 1 (period of rising housing prices), the first and second lags of the liquidity are significant as shown in Tables 7 and 8. The sum of liquidity lag coefficients equals 5.304 which is statistically significant.

DLM(1) DLPH(1) linRes Chi^2(1) = 30.259 [0.000]**

However, in the second equation for the liquidity, none of the housing price index lags are significant. As a result, the direction of causality in the Regime 1 is not from housing price index to liquidity and thus changes in the house prices have no effect on the liquidity. Therefore, the direction of causality in the Regime 1 (period of rising housing prices) is from liquidity to the housing price index.

In the equation for the housing price index in the Regime 2, none of the liquidity lags are significant. There is no causality from liquidity to the housing price index. Also, in the second equation for the liquidity, the sum of housing price index lags equals 0.1476 which is statistically significant. As a result, there is a causal relationship from the housing price index to liquidity.

DLPH(2) DLM(2) LinRes Chi^2(1) = 7.905 [0.0049] **

As a result, there is no causality of the liquidity to the housing price in the Regime 2, but the causality is from the housing price index towards the liquidity.

Table 9 shows the characteristics of the regimes. As can be seen, the Regime 2 is the most stable regime, because when the economy enters this regime, it will remain in this regime 2 for 6.76 periods on average. Also, this regime shows the highest probability. If a sample is selected randomly, it will be in this regime with a probability of 68.97%.

Table 9
The characteristics of the regimes

	Number of observations in each regime	*The probability of placement in the regime (%)*	*Average periods in the regime (seasons)*
Regime 1	27	31.03	3.38
Regime 2	63	68.97	6.67

Source: Research findings

Table 10 shows the probability of transition from one regime to another regime. As can be seen, the Regime 2 is the most stable regime, because of very high probability (0.86) for transition from this regime to itself. In other words, if the economy is in the Regime 2 in the period $t-1$, it will be in the same Regime in the period t with an approximate probability of 0.86. The Regime 2 is more stable than the Regime 1.

Table 10
The probability of transition from one regime to another regime

	Regime 1	*Regime 2*
Regime 1	0.67	0.14
Regime 2	0.33	0.86

Source: Research findings

The disturbance terms are included in the Markov-Switching model for normality, autocorrelation and heterosce dasticity. Below, the results of the tests related to the above features are listed.

Table 11
The disturbance terms estimated by the model

Test	*Statistics*	*Statistics value*	*Probability*
Portmanteau auto-correlation test	Chi^2 (72)	67.45	0.629
Normality test	Chi^2 (6)	17.24	0.08
ARCH test	F (9,17)	0.089	0.999

Autocorrelation test results show that the absence of auto correlation cannot be rejected at the significance level of 5%. It can be concluded that the disturbance terms lack auto correlation. The normality test showed that the distribution of disturbance terms in the estimated model is not normal. The results of ARCH test showed homoscedasticity of variance of disturbance terms indicating the validity of estimates and correct selection of lags.

5. CONCLUSION AND RECOMMENDATIONS

Many studies have been conducted on housing prices and liquidity in Iran and across the world. This is an important issue, because if the causal relationship between the housing price index and liquidity growth is obtained, both productivity and efficiency can be improved by allocating resources and necessary investments to the housing sector. On the other hand, if there is no correlation between the housing prices and liquidity, policies that promote the housing sector would be a waste of scarce resources so that unnecessary emphasis on the housing sector will divert the other policies that may be more essential for economic growth. For this purpose, the causal relationship between the housing prices and liquidity was investigated using the Markov-Switching (MS) models. The advantage of MS models is that they allow studying the changes in the causal relationship over time taking into account the distinct regimes. The model used in this study is a vector autoregression (VAR) model with variable regime-dependent parameters. The Granger causality between the housing prices and liquidity growth in different regimes was investigated using the coefficients of this model.

This model considers two different regimes. According to the experimental findings. In the Regime 1 (period of rising housing prices), the causality direction is from the liquidity growth toward the growth of housing prices. The monetary policy is the Granger cause of housing prices and thus is not neutral. In the Regime 2, the causality direction is from the growth of housing prices toward the liquidity growth.

Despite high liquidity, housing price forecasts for 2016 showed that probability of continuous downturn in 2016 is more than the boom of housing market. Thus, it is suggested to develop a policy framework by applying a controlled monetary policy, setting transparent and efficient financial regulation and continuous monitoring of asset markets by the government and the Central Bank. More importantly, banks should control and restrain the monetary multiplier.

Prudential and gradual, not once allocation of the savings in the bank system to the best investment projects including housing projects with careful monitoring can be among policies to finance the housing sector. The government can release mortgages through capital markets to exit the housing sector of downturn to increase the economic growth. In fact, the banks will lose their liquidity by granting facilities, but the liquidity will return again to the banks by converting it to mortgage and this will increase the lending power of banks providing the ground for grating more facilities in the housing sector.

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