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The Influence of Housing Investment as an Asset Price Channel on Inflation

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The housing market plays a significant role in the economies of countries, and as an asset price channel, is considered as one of the main channels for monetary transmission mechanism. Considering the structure of the country's economy and the characteristics of housing as a capital commodity, the assessment of the impact of housing investment on inflation is important. This research evaluates the impact of housing investment, as an asset price channel, on inflation in Iran's economy by self-regression model with the possibility of changing the regime of Markov (MS-VAR) and using seasonal data for the period of 1369-1395. In general, it is concluded that the investment channel, as an asset price channel, in the housing sector contributes to inflation in each period of recession and boom, and increases inflation. Also, the channel does not affect the exchange rate during the recession, but it leads to a devaluation of the national currency during the boom.

Keywords: Monetary Transmission Mechanism, Business Cycles, Markov Switching VAR Model
JEL Classification: C34, L85, R20

1 Introduction

Based on empirical and theoretical studies on the relationship between inflation and economic growth, efforts to introduce sustainable patterns for the monetary policy have recently expanded through relevant channels. In this regard, if policymakers apply a strategy, that brings inflation to its optimal level, according to the characteristics of each economy, in a way that does not

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negatively affect other macroeconomic variables including saving and investment, then this monetary policy will improve the economic welfare in the society.

The high inflation rate has direct effect on household welfare so the price stability has always been the main concern of monetary authorities. Inflation will change the distribution of income on behalf of non-monetary assets and exacerbate imbalances in the income distribution and causes the expansion of injustice and social inequalities.

With the Great Recession in 2007, it became clear that assets price are an important and primary indicator for the real economy and inflation. Taking into account future expectations of assets price, it can provide useful information on future changes in the economy, in particular future changes in output and / or inflation (Stock & Watson, 2001; Forni et al., 2003; Gupta & Hartley, 2013).

On the other hand, the monetary authority outlines monetary policy through its monetary transmission mechanism which applies its policies, therefore, the Central Bank has to be fully aware of the mechanisms of monetary transmission for successful and on time implementation of its policies, otherwise it will have difficulty in designing and implementing its policies and may impose a lot of costs on the economy.

This issue is importance because Iran is an underdeveloped economy with no sustainable growth and with less developed financial system and capital market, which has made it vulnerable to internal and external shocks. Although several studies have investigated the investment in the housing sector as an asset price channel in different countries, most studies in the framework of linear models have examined this issue in a way that the role of variables is the same during business cycles, which is not a true concept.

The integration of nonlinear behaviors of economic agents and macroeconomic factors is first introduced in the theoretical models proposed by Bernanke and Gertler (1989), and Kiyotaki and Moore (1997). These models include the costs of financial intermediation agencies (financial constraints), state that when there is asymmetric information on financial markets, the agents behave as if they are constrained financially. In addition, financial constraints are more severe during periods of recession than boom. Therefore, according to the degree of financial frictions during the business cycles, it is imperative that applied policy will have dissimilar effects on the economy over different stages of the business cycles.

The aim of the policymakers is usually achieving high economic growth and low inflation. Numerous studies have focused on evaluating of asset price

channel through the influence of production and inflation from housing section investment. For example, Hong Kong monetary authorities (2008) have found that housing investment has lower impact on economic growth, but it has higher impact on inflation (Andres Espinosa Torres & Sanin Restrepo, 2016).

When analyzing the asset price channel, for some reasons, there is a special emphasis on housing investment. First, housing involves a large part of the net wealth of the private sector in most economies. Secondly, unlike other financial assets that are mostly owned by the top group of society, housing ownership is distributed more evenly among households. Also, housing plays an important role in lending. In total, the share of housing from GDP in Iran's economy is estimated to be between 21% and 24%, which illustrates the importance of this sector in the economy.

Since we use the housing rental index to enter into the housing price model, and the housing rental index have always been up trend due to shocks of the economy which are generally external shocks, while the purchase price of housing is fluctuating and in some occasions (periods of recession) is decreasing; therefore, the results of the analysis will not be reliable. On the other hand, housing rental index and the purchase price of housing do not have a fixed and positive correlation.

Also, in this article, it is assumed that monetary policy (housing prices) has been transferred to the real section of the economy through asset price channel, and this is an incentive to increase or decrease investment in times of recession and boom. Therefore, in order to assess the effect of this channel on inflation (for the appropriateness of applying monetary policy), evaluation of the effect of housing investment on Iran's economy is studied to determine whether this channel is an important channel for implementing monetary policies on Iran’s economy to reduce/control of inflation or not?

It needs to be explained that when monetary policy is implemented, asset prices fluctuate with the degree of monetary shocks and may affect the production and the general level of prices. Taylor (1995) state that there is a strong empirical evidence of the fundamental effects of interest rates on investment demand and consumer spending. Also, the factors affecting investment are less or more similar for fixed investment in residential buildings and planned investment on the inventory. Housing prices could affect housing demand and, consequently, investment in residential buildings, by affecting total demand and production and the general level.

It should be noted that in the research conducted by Milcheva and Sebastian (2016), entitled “The Housing Market Channel of Monetary Policy

Transmission in the Euro Area", in two separate models, housing market channel has been assessed, both through price and investment in this section, and emphasized the importance of the housing investment role. It is explicitly stated that previous studies have focused on housing prices, and the investment in the housing sector can better justify fluctuations in the housing market than the housing price.

The housing market is closely linked to the money market, and wherever money is discussed, Friedman's viewpoint of inflation is also needed to be discussed. Therefore, this study has evaluated the impact of housing investment as an asset price channel on inflation during periods of recession and boom in the Iranian economy, using a self-regression vector model with the possibility of changing the Markov regimen (MS-VAR).

One of the reasons for the usefulness of the above model is the analysis about cyclical behavior of the housing sector (Figure 1): "A look at the process of issuing permits for construction over the past years suggests that after provocation of market and rise in prices, construction license issuance increases, but due to the time-consuming nature of the production of housing, the market faces a surplus of demand, which ultimately results in a price bubble. Most manufacturers, after seeing the rise in price and the appropriate construction profit, inject their funds into the market (in the worst possible time to start the investment).

Usually, one to two years after a leap, nominal prices remain constant. Due to the time of construction, the projects made by the group during the recession are exploited, and therefore the group does not mainly benefit from expected profits. In fact, these constructors start their projects in a boom and sell in a recession. A look at the process of issuing building permits suggests that major manufacturers act in the same way. These people, with a massive supply of housing during the recession, deepen the recession."[1]

This study is important due to several reasons: first, since most studies on the influence of housing investment as asset price channel on inflation are done by linear approach, therefore, according to new studies on the asymmetric effects of housing investment on the economy, nonlinear methods are more desirable. Second, it helps in identifying the effects of housing investment as an asset price channel on inflation during recession and boom periods. Thirdly, unlike the linear studies, the impulse response functions are

[1] Planning and Housing Newsletter /spring 1393 /No. 1 / Deputy of Housing and Building, Ministry of Roads and Urban Development.

individually determined for each regime to determine the effects of different policies during recession and boom periods.

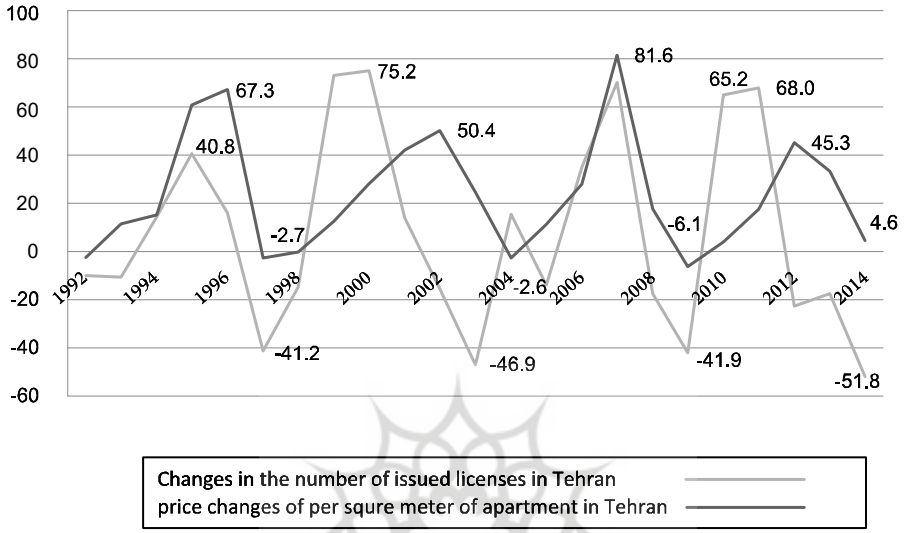

Figure 1. Changes in housing prices in Tehran and changes in construction permits between 1993 and 2014 (in percentage). *Source:* Azarmand (2017)

The above study has been compiled in six sections; after mentioning the introduction to the research topic and its importance, the second part has provided the theoretical basis concerning the role of the housing market in the mechanism of monetary policy transfer and the background of the research. In section 3, the pattern is explicitly addressed and in section 4, the basic characteristics of the data are examined. In the fifth section, the experimental results are presented through MS-VAR approach, and in the final section a summary and a general conclusion has been presented.

2 Theoretical Background and Literature Review

Monetary policy transmission is the process that transmits the changes in the key policy rates or money supply to a series of other changes in economic variables such as market interest rates, asset prices, exchange rates, cash flow, bank credit supply, private spending, consumption, and ultimately aims at price, output and unemployment (Mankiw & Taylor, 2011). According to the monetary policy rules, monetary policy is transmitted through monetary

transmission channels to aggregate demand, the price of domestic goods and imported goods, and ultimately to output and prices.

According to Mankiw and Taylor (2011) view, monetary transmission channels are as follows: 1- Interest rate channel 2- Exchange rate channel 3- Asset price channel 4- Credit channel.

Applying policies through monetary transmission mechanism especially housing as asset price channel and through this channel to the economy is one of the interesting issue for most of the policy makers. MacLennan et al. (2000), argue that applying policies through direct channels (Keynes interest rate channel) and indirect channel (credit channel) influence house prices. According to direct effect or Keynes interest rate channel, a drop in policy rates leads to lower interest rates, which leads to lower capital costs and ultimately leads to higher housing demand and price. The indirect effects or effects of the credit channel will be effective on the price and housing demand through the bank lending channel and the balance sheet.

Due to the lending channel, banks take secured deposits during the expansion of monetary policy. Therefore, the demand for uncertain deposits is decreasing and, as a result, banks' lending capacity will be raised. The monetary policy balance sheet channel stated that the decline in monetary policy rates would increase net wealth, which would reduce the moral hazard and adverse selection between borrowers and lenders, thus receiving mortgages would be easier and ultimately would increase housing price. In general, the existence of credit constraints also leads to asymmetry, so that when in the boom period banking rates are high, bank can create credit constraints, and as a result not to lend those who are not able to repay their loan.

Hence, if contraction policy is applied, then interest rate increases and subsequently credit constraint is created, which might have no effect on the economy, but if expansionary policy is applied, because interest rates decreases, it affects the economy. In addition, if the economy has a limitation on the provision of loans and facilities by banks, this leads to asymmetric effects of monetary shocks in business cycles. So that, in the recession condition, creating limit for the loan will cause increase in market interest rate, consequently, the borrowing amount in the economy will be declined.

Usually, changes in housing prices are transmitted through the wealth channel to GDP. Thus, rising house prices increases the wealth of companies and households, and will consequently affect consumption and output. Elbourne (2007) using Structural Vector Auto Regression (SVAR) have found

that contractionary monetary policy shock reduces house prices and consequently from the housing channel affected consumption and output.

One of the major drawbacks of the above discussed studies is that the mentioned studies have been carried out under a linear framework where in real world, the behavior of economic agents change over the business cycles. Asymmetric nature of the house prices to exogenous shocks can also be explained by the theory of loss aversion, which originated from the prospect theory, proposed by Kahneman and Tversky (1979), who argue that people have an asymmetric attitude to gains and losses, and people obtain less utility from gaining than losing.

Dobrynskaya (2008) have shown that real estate agents would decide not to sell during bad market conditions because they are unwilling to recognize capital losses. The precautionary price of the seller is higher than the expected buyer price during a depression. Thus more time is needed to reduce the price of housing, and to recover during recession. The impact of a decrease in policy rate might have less effect on house prices during this period, compared to normal times.

Many recent studies have found that the dynamics associated with different periods of the economy are very useful in MS-VAR model, especially in identifying structural changes in monetary transmission mechanism. Gonzalez and Garcia (2006), state that there were significant structural changes in the mechanism of monetary policy transition in Mexico in early 2001. Structural changes indicate the low importance of the role of real exchange rate fluctuations in the process of price formation and in the formation of inflationary expectations and also the nominal interest rate has a lower role in this regard.

Fujiwara (2003, 2006) uses regime dependent MS-VAR model and impulse responses function for studying of changing in monetary affects in 1990s. Whether bond with zero coupon rate has had distorting effects on macroeconomic dynamics on this period or not? The results indicate that structural changes existed in the 1990s and the traditional interest rate channel has not been active, so the role of expansionary monetary policy has been limited.

Herwartz and Lutkepohl (2014) use the MS-VAR model to study U.S. economics, taking into account oil price, output, inflation and short-term interest rates to show that variations in the residual in the VAR model require the identification of structural impacts. For example, they show how the identification of statistical information about monetary policy should be combined with economic constraints for identifying impulses of monetary

policy from oil price impacts, to make meaningful interpretations of monetary impulses.

Similarly, Hubrich and Tetlow (2015), use the five-variable MS-VAR model for the US economy. Variables include private consumption expenditure, consumer price index (CPI), Federal Reserve interest rate, liquidity growth rate (M2), and financial stress index to indicate that changes in variances and coefficients for the relationship between financial stress and macroeconomics are needed.

2.1 Literature Review

After Hamilton's 1989 study of business cycles, Markov Switching approach widely has been used by researchers. Early studies are related to Auto Regression (AR) models. However, the recent models propose the Vector Auto Regression Model (VAR) for solving simultaneous equations.

Most studies of housing as an asset price channel are related to the effects of monetary policy on housing price which can be cited as follows:

Studies of Smets and Peersman (2001), Lo and Piger (2005) suggest that monetary policy is much more active during the recession.

Comprehensive studies by Sims and Zha (2006) have been the foundation to the American Economy for future macroeconomic research in business cycles. They introduce the Markov-Chain Monte-Carlo (MCCM), a way to solve MS-VAR model.

Using the Markov Switching Method, Dolado and María-Dolores (2006) examine the asymmetric effects of monetary shocks during boom and recession in Spain, and conclude that during 1977-1997, the effects of monetary shocks on the growth of output were asymmetric during business cycle.

Aragon and Portugal (2009), using monthly data from 1995 to 2006, examine the asymmetric effects of monetary shocks on real economic activity by Markov-Switching method in different periods, and conclude that in the periods of recession and boom, monetary shocks on real variables of the economy have asymmetric effect. Such that, firstly, during the boom period, the effects of negative monetary shocks are more than the effects of positive monetary shocks; secondly, during the recession, positive and negative monetary shocks have the same effects on output; thirdly, there is no evidence that any asymmetry exists between the effects of anti-cyclical monetary policies.

Tan and Habibullah (2007), using time series information for ASEAN countries, analyze the effects of monetary shocks in recession and boom

periods by nonlinear Markov- switching Hamilton model. The results of the study, while confirming the existence of two regimes of recession and boom, show that the impact of monetary policies on output during the recession periods is significantly higher in the studied countries than during the boom periods.

Simo-Kegne et al. (2013), using two variable MS-VAR model, analyzed monetary transmission mechanism through housing as an asset price channel in South Africa in the bear and bull markets. The results indicate that contractionary monetary shocks have greater impacts on the price of housing at the time of the bear market than the bull market.

Tsai (2013) has used a threshold co-integration technique to examine housing prices and money supply using seasonal data (1986-2011) in The Great Britain. The results indicate the asymmetry between monetary policy and housing price.

Milcheva and Sebastian paper in 2016, entitled "The Housing Market Channel of Monetary Policy Transmission in the Euro Area", use the vector auto regression model in two separate models to evaluate the housing market channels, including price and investment. Also, the importance of the investment role in the housing sector is emphasized. It is explicitly stated that although past studies have focused on housing prices, but the investment in the housing sector relative to prices can better justify fluctuations in the housing market.

Empirical studies about the structural changes in monetary transmission mechanism include the studies of Christiano and Eichenbaum and Evans (1999), regarding the use of SVAR model for estimating monetary transmission mechanism. Some of the major studies in this area are found in the studies of Bernanke and Mihov (1998), Christiano et al. (2005), and Smets and Wouters (2002). However, studies on the asymmetric effects of the monetary transmission mechanism on business cycles are relatively few.

Some studies on the asset price channel and inflation are as follows:

Stock and Watson (1998 and 1999), refer to the housing cycle behavior in their research and suggest that housing as an asset price channel play an important role in predicting the real sector of the economy and inflation.

Goodhart and Hofmann (1999), collect data on 12 OECD countries. They find that the inflation survey of the housing sector play an important role in predicting total inflation in the economy.

Stock and Watson (2001), use a VAR model to examine the predictive power of assets price about inflation and output trend.

Forni et al. (2003) and Gupta and Hartley (2013) state that considering future expectations of asset prices, they can provide useful information on future changes in the economy, especially future changes in production and/or inflation.

Alavi Zerang (2002) has investigated the role of Housing Bank credits on the housing market fluctuations. He divides the sources of cyclical fluctuations in the housing market into two parts of the real business cycle and the monetary business cycle. He analyzes the statistical data in two scenarios of seasonal (1987-1998) and annual (1981-1998) by using VAR and Engle Granger co-integration model. According to the results, in Iran, in the short and medium term, fluctuations in banking credits and national income, and in the long run, fluctuations in the price of wholesale materials of construction have the largest share in creating the housing market fluctuations.

Jafari Samimi et al. (2007), study the effect of some macroeconomic variables on the housing price index. In this research, seasonal data for the years of 1313-1383 are used to estimate an Auto Regressive Distributed Lag model. The results of his study have indicated that macroeconomic variables such as household income per capita, money, inflation rate, stock price index and etc. have good explanation for the behavior of the housing price index in Iran.

Gholi-Zadeh and Kamyab (2008) have divided the factors influencing housing price into micro factors and macro factors. The macro factors such as monetary policies have more effects on housing price that their role in changing housing price has been given enough attention. In this paper, the effect of monetary policy on the housing price bubble in periods of boom and recession has been explored. Based on this, the rental price ratio has been used to calculate the price bubble in the market and to estimate the model using the ARDL technique by seasonal data during the years 1371-85. Based on some results, the pattern of formation of bubbles is different during the periods of recession and boom, and the effective variables and their final effects on the bubble are not the same. It can be concluded that in both periods the expansionary monetary policy has caused the formation of a bubble. In the recession period, asset price variables are more effective than the boom period. In the boom period, the interest rate variable is the most important variable affecting the housing bubble and the effect of liquidity growth during the recession is stronger than the boom period.

Beheshti et al. (2010) study the housing market in the framework of monetary transmission mechanism in Iran's economy. The results of SVAR model show that expansionary monetary policy shock, through liquidity

shock, have a significant effect on housing prices. The effect of liquidity shock on housing prices stay stable for up to three years. Housing price explain for about 20% of GDP changes; therefore, housing price is an important intermediary in transferring monetary shocks to GDP fluctuations.

Moshiri and Vasheghani (2010) have examined credit, exchange rates, asset prices and interest rates channels in Iran's economy. The results of the study indicate that the effect of monetary shocks on output is not statistically significant, but the reaction of inflation to monetary shocks is almost simultaneous and significant. Due to the ineffectiveness of monetary shocks on output, transmission channels also do not contribute to the transfer of monetary shocks to the output, but they are effective in transferring the effects of inflationary shocks.

3 Methodology

This study adopted the Markov regime-switching methodology which is developed by Ehrmann et al. (2001, 2003). The reason for choosing this model is because of the fact that the Markov Switching model is effective in detecting changes, and is consistent with changing the regime. The use of this model become very famous for determining asymmetries. This methodology is initially proposed by Goldfield and Quandt (1973). Hamilton (1989) and Krolzig (1997) have made important contributions by combining switching models with vector auto regression model to develop a MS-VAR model which is well structured to characterize macroeconomic fluctuations in the presence of regime changes. Also, in examining monetary transmission mechanism, it is possible to model during recession and boom periods by changing the regime.

3.1 MSVAR Model

Using time series models is very common in the study of the dynamic behavior of economic variables. Among these models, linear models such as Auto-Regression (AR) and Moving Average (MA) and their combination (ARMA models) are distinctive. Although these models have succeeded in many cases, but they are not able to explain nonlinear behaviors and asymmetries.

Since the degree of asymmetric information and information stickiness in different business periods varies according to the state of the economy, the use of nonlinear models is necessary. MS-VAR model is one of the nonlinear models used in this research.

This research has been based on the methodology, proposed by Ehrmann, Ellison and Valla. (2001 & 2003). They use the regime-dependent impulse

response functions to find out how the fundamental disturbances affected the variables of the model that are dependent on different regimes. This model combined Markov-Switching and identification in a two-stage procedure of estimation and identification.

In the first step, an unrestricted model of MS-VAR is estimated, allowing means, intercepts, autoregressive parameters, variances and covariance to switch. Estimation of the Markov-Switching model use the expected maximum likelihood technique of Hamilton (1990), because the recursive nature of the likelihood, stemming from the hidden Markov chain, preclude likelihood maximization with standard techniques. Second, they identify the system by imposing restrictions on the parameter estimates to derive a separate structural form for each regime, from which, it was possible to compute the regime-dependent impulse response functions.

The general Markov-Switching Vector Auto Regression model may be written as

$$X_t = \begin{bmatrix} X_{1t} \\ \dots \\ X_{mt} \end{bmatrix} = \begin{bmatrix} \vartheta_1 + B_{11}X_{t-1} + \cdots + B_{P1}X_{t-p} + A_i\mu_t \\ \dots \\ \vartheta_m + B_{1m}X_{t-1} + \cdots + B_{Pm}X_{t-p} + A_m\mu_t \end{bmatrix}$$

$$\text{If} \begin{bmatrix} s_t = 1 \\ \dots \\ s_t = m \end{bmatrix} \quad \mu_t \sim N(0; I_K) \qquad (1)$$

Where K endogenous variables Xi are explained by an intercept term νi, a K-dimensional autoregressive matrix B of order p, and $A_{im}\mu_t$. In this general specification, all parameters may switch between m different regimes; so there is coefficient switching, and hence, nonlinear dynamics. The intercepts νI for i=1,…, m in equation (1) are simply the regime-weighted average of the means of the residuals from the VAR. This specification has the advantage of allowing the mean intercept to smoothly approach a new level after the transition from one state to another. The μ_t is a K-dimensional vector of normally distributed fundamental disturbances uncorrelated at all leads and lags. The fundamental disturbances are pre multiplied by a regime-dependent matrix (A_i); so the variance-covariance matrix $\sum_i$ of the residual ($A_i\mu_{ti}$) also will be dependent to the regimes.

$$\sum_i = E\left(A_i\mu_t\acute{\mu}_t\acute{A}_i\right) = A_iE(\mu_t\acute{\mu}_t)\acute{A}_i = A_iI_K\acute{A}_i = A_i\acute{A}_i \qquad (2)$$

In order to prevent biasing of results, a switching in the coefficient, possibility of the variance switching is important. Therefore, variance and parameter switching are rivals in explaining the data.

The description of the data-generation process is not sufficient by the observational equation (1). Therefore, a model for the regime-generating process is needed to allow inference about the creation of regimes from the data. The specific feature of the Markov-Switching model is the assumption that the unobservable realization of regime $s_t \in \{1, \dots, m\}$ is governed by a discrete-time, discrete-state Markov stochastic process. The stochastic process is defined by the transition probabilities (P_{ij}):

$$P_{ij} = \Pr(s_{t+1} = j | s_t = i), \sum_{j=1}^{m} P_{ij} = 1 \; \forall_i, j \in \{1, \dots, m\} \quad (3)$$

Specifically, s_t is assumed to follow an ergodic and irreducible m-state Markov chain of order one with the transition matrix:

$$P = \begin{bmatrix} p_{11} & p_{12} \cdots & p_{1m} \\ p_{21} & p_{22} \cdots & p_{2m} \\ \vdots & \vdots & \vdots \\ p_{m1} & p_{m2} \cdots & p_{mm} \end{bmatrix} \text{ That } p_{im} = 1 - p_{i1} - \cdots p_{i,m-1} \text{ for i=1,…, m} \quad (4)$$

Given the possibilities of unobserved regimes, conditional on an available data set, then regimes can be regenerated. For an ergodic Markov chain, regime shifts are persistent if $p_{ij} \neq p_{ii}$ for $i \neq j$ and not permanent if $p_{ii} \neq 1$ for all i. As shown by Ehrmann, Ellison and Valla (2003), regimes predicted by the transmission matrix must be highly persistent in order to have useful regime-dependent impulse functions.

In this study s_t stands for recession and boom periods corresponding to "high mean and low volatility of GDP growth rate" and "low mean and high volatility of GDP growth rate" respectively.

$$X_t = \begin{cases} \vartheta_1 + B_{11}X_{t-1} + \cdots + B_{P1}X_{t-p} + A_i\mu_t, \text{if } s_t = 1 \\ \vartheta_m + B_{1m}X_{t-1} + \cdots + B_{Pm}X_{t-p} + A_m\mu_t, s_t = 2 \end{cases} \quad (5)$$

3.2 Regime Dependent Impulse Response

One of the benefits of using MS-VAR model is regime-dependent Impulse Response Functions which is used to determine cyclical variation in the responses of variables to the particular shock. Equation (6) gives the mathematical definition of it:

$$\frac{\partial}{\partial \mu_{k,t}} E_t X_{t+h} | s_t = \cdots s_{t+h=i} = \theta_{ki,h} \text{ for } h \geq 0 \quad (6)$$

The regime-dependent impulse response functions illustrate the relationship between endogenous variables and fundamental shocks between each Markov switching regime. Where the expected change in the endogenous variables X_i at time $t + h$ to a shock to the kth fundamental disturbance at time t is conditional on regime i. A series of K-dimensional response vectors $(\theta_{ki,1\ldots,}\theta_{ki,h})$ predict response of the endogenous variables. Estimation of response vector is derived by combining the unrestricted parameter of the reduced-form Markov-Switching vector auto regression B in equation (1) with the estimate of the matrix $\widehat{A_1}$.

4 Data and Preliminary Specification

The estimation period is both based on seasonal data from 1990 to 2016 and on the year 2010. The macroeconomic variables for the estimations includes growth domestic production without oil (gdp), investment in housing section (real estate), oil income (oil), inflation and unofficial exchange rate of the US dollar against the Iranian Rial (e_t) that all variables are extracted from the Central Bank database. The data of the real exchange rate (ex) is also calculated as a logarithm according to the following equation:

$$ex = e_t + p_t^* - p_t \tag{7}$$

Unofficial exchange rate of the US dollar against the Iranian Rial (e_t), p_t is domestic consumer price and p_t^* is US consumer price index.

It should be explained that according to the studies conducted by Cushman and Zha (1997) for Canada, Kim and Roubini (2000) for non G-7 countries other than the United States and Afandi (2005) for Indonesia, oil shock has been used in our study. Because, the above studies stated that monetary authorities use a rule of thumb to respond to the news in the economy in their policies, while it is important to take into account the dominant oil shock in oil exporting countries.

On the other hand, according to the research of Azarmand (2017), in oil country, the main factor driving the fluctuations in housing prices is oil revenues. This feature has caused that in economy such as Iran economy, which faces oil revenue shocks and the risk of Dutch disease, the housing sector is a good place for speculating and increasing demand for investment and also the scarcity of land exacerbates this issue. Because this commodity, like other commodities, could not be imported, and the price could not be controlled through the import. Due to the mechanism provided in Dutch disease, tradable industries are in the process of bankruptcy, which in this case

exacerbated the tendency to enter the housing sector radically. The reason for this additional demand is that the opportunity to invest and earn profits by entering the manufacturing sector and creating value added has declined.

Natural logarithm of all the time series have been used to eliminate potential heteroscedasticity. The existence of unit root in variables also has been conducted. Variables are all nonstationary except inflation that its first difference is stationary (Table 1). So we use the first difference form of each variable in estimation. Variables are seasonally adjusted by X-12-ARIMA method.

We use Akaike Information (AIC), Hannan-Quinn (HQ) and the Schwarz Bayesian (SB) Criteria to choose the lag order for the VAR model. The results are reported in table 1.

Table 1
Result of Stationary by KPSS Test

Variable	level	First difference
Log of growth domestic production without oil	1.17	./28***
inflation	./21***	-------
Log of investment in real estate section	1.07	./065***
Log of oil income	1.21	./18***
Real exchange rate	-1.09	./086***

*** indicates significance level at 1%, Source: authors' calculations

5 Empirical Results

The LR test is used to ensure nonlinearity of the model. The statistical value of this test is calculated from the maximum likelihood values of the two competing models, a model with one regime (linear model) and the other with two regimes (nonlinear model) and it have a chi-square distribution.

Table 2
LR Result

Value	P-Value
773.13	0.0000

Source: Authors' calculations

According to Table 2, the LR test statistic is larger than its critical value at a significant level of 5%. Therefore, it could be concluded that instead of linear models, it is better to use nonlinear one. Figure 2 depicts that the regimes are classified into two groups.

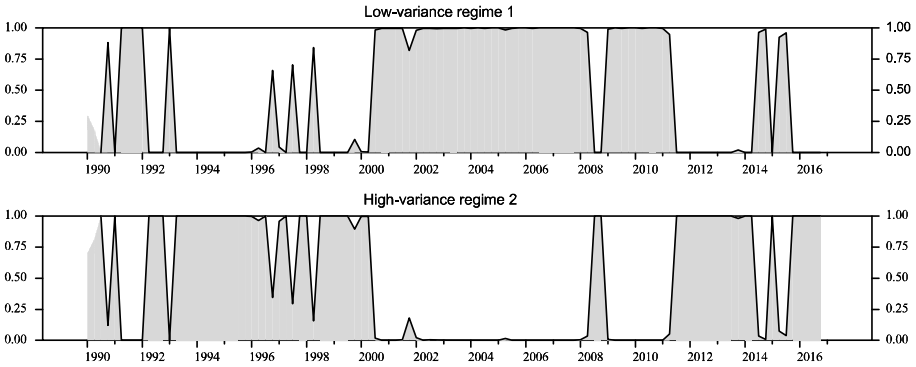

Figure 2. Recession and Boom Periods. *Source*: Authors' calculations

The transition matrix:

$$p = \begin{bmatrix} 0.75 & 0.11 \\ 0.25 & 0.89 \end{bmatrix}$$

shows that the persistence of the two regimes is very high. The probability of the transition of the first regime, which is high growth and low volatility of the GDP, have a transition probability of 0.75. The transition probability of the second regime, which has low growth and high volatility, have a transition probability of 0.89. Also, the probability of a transition from a recession to a boom is equal to 0.11 and a probability of a transition from a boom to a recession is 0.25.

5.1 Impulse Response Functions

The impulse response functions of the MS-VAR model in figure 3 are presented over a 16-quarter horizon for the shocks of investment in housing section on the other variables. The calculation of impulse response functions for each regimes give us a more complete picture of the difference between the two regimes. In Figure 3, the effect of the investment shock in the housing section is conducted 1% in both regimes. In both regimes, the effect is almost the same on inflation and caused an increase in inflation in both regimes to about 0.33 percent. While the response of the exchange rate is insignificant in regime 1, but it is effective in regime 2 and it causes appreciation in exchange rate (depreciation of the Rial).

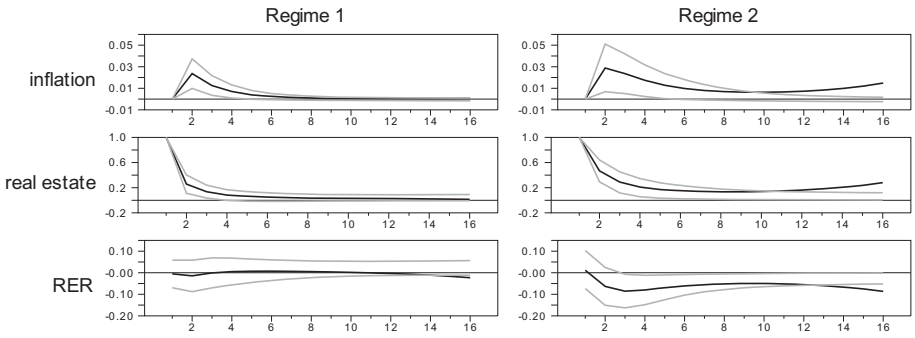

Figure 3. Impulse response of the variables to the shocks of investment in housing sector (inflation is dependent variable). *Source:* authors' calculations

6 Summary and Conclusion

Housing, as one of the most important and basic human needs, has been always played an important role in the economy of the countries, because housing is indispensable and cannot be replaced. What distinguishes housing from other essential goods such as food and clothing is the low variety of alternative products. The Housing market in Iran's economy has always been profitable for investors and speculators, due to excessive changes in oil revenues that brings uncertainty and instability to the economies of oil exporting countries, including Iran. Therefore, housing market has the opportunity to increase speculation. Also, the easy investment of this sector to other sectors, such as investment in agricultural, is another factor for speculation in this sector.

In order to maintain the value of the property, the household and some enterprises have always been trying to invest in this sector. As a result, housing has a large share of household wealth in Iranian economy. It should be explained that from the perspective of firms, the desire to invest in this sector can be noted as valuable, because there is no proper validation system in the money market, therefore, housing can be used as a collateral to receive the credits.

This study adopted the Markov Regime-Switching methodology, developed by Ehrmann et al. (2001, 2003) to assess the role of investment in housing section on the inflation in Iran's economy based on seasonal data since 1990 to 2016 and the year 2010. First, LR test has been used to ensure nonlinearity of the model.

As it is shown in Table 1, the LR test statistic is larger than its critical value at a significant level of 5%. Therefore, it is concluded that instead of linear

model, it is better to use nonlinear model. As shown in Figure 2, regimes are classified into two groups. Regime 1 indicate expansionary period corresponding to high mean and low volatility of GDP growth rate and regime 2 indicate recession period corresponding to low mean and high volatility of GDP growth rate. Also, the matrix of transition probabilities indicate that the stability of both regimes is high. The probability of the first regime transition, which is high growth and low volatility, is 0.75 and transition of second regime is 0.89. Also, transition from recession period to the boom is 0.11 and in reverse is 0.25.

In order to accurately examine the effect of investment in the housing sector as an asset price channel on inflation, the impulse response functions are extracted. In Figure 3, the effect of investment shock is almost the same and causes an increase in inflation in both regimes to about 0.33 percent. While the response of the exchange rate is insignificant in regime 1, but it is effective in regime 2 and it causes appreciation in exchange rate (depreciation of Iranian Rial).

In general, it is concluded that if a policymaker wants to apply his policies through this channel, then he should take into account the consequences of increasing inflation and exchange rates. Also, according to the results, it is recommended that the policymaker considers the impact of the policies on the monetary and currency policy and since the housing sector's investment has the same effects on inflation on both regimes, if the goal is to stabilize prices, it is better to try to reduce exchange rate fluctuations.

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