Journal of Money and Economy
Vol. 10, No.2 Spring 2015

The Impact of Exchange Rate Misalignment on the Persistence of Inflation in Iran

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Received: 12/15/2015 Approved: 6/7/2016

Abstract

The purpose of this study is to investigate the impact of exchange rate misalignment on inflation persistence. For this purpose, Vector Auto Regression method and Markov Switching model is used for quarterly data during 1989:4 -2014:3. The results show that, the impact of liquidity growth and exchange rate misalignment on inflation persistence is positive. On the other hand, GDP growth has a negative effect on inflation persistence. By Markov Switching model the nonlinear relationship between variables was investigated; based on Markov Switching model, quarterly inflationary environment (inflation regime) were extracted for economy of Iran, and the results show three different regimes for quarterly inflation. Markov model findings are consistent with VAR model findings. Results also show that, the impact of exchange rate misalignment on stable inflation regime is positive and the impact of exchange rate misalignment on unstable inflation regime is negative.

Key words: *Inflation persistence, Exchange rate misalignment, Economy of Iran, Vector Auto Regressive model, Markov Switching model.*

JEL Classifications*: F31, E3, D31, C22, H5*

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1. Introduction

Inflation is one of the most important variables affecting macroeconomics. In fact, a long rapid inflation wave can cause a lot of damages to economic, social and cultural structures of a society. It can adversely affect the effective performance of policy-making institutions and macro level management of community; it also puts the economic stability in jeopardy. Because the economy of Iran has experienced high rates of inflation since late 1971 and especially after the war, many economists attempted to study the statistical properties of inflation. One of the significant features of inflation in Iran is its persistence. The stationary and persistent inflation rate in economy shows that when inflation shock happens, its effects remain for a long time. Inflation persistence prevents its reduction toward controllable levels (Dargahi and Sharbat Oghli, 2010). Also, inflation persistence has prevented the monetary policy to reduce inflation rate and delays the response of the economy to monetary and fiscal policies. Exchange rate misalignment is one of the important variables affecting the persistence of inflation. This study focuses on the behavior of inflation persistence and try to explain its' behavior in accordance with exchange rate developments. When money is over vaulted, it may lose competitive power in international trade, while undervaluation of money causes inflationary pressures. The impact of exchange rate misalignment on persistence of inflation in Iran is tested experimentally in this paper.

2. Literature Review

2.1. Real exchange rate

The real exchange rate is a key variable which represents the weakness and strength of a country's currency compared to foreign ones. Usually, there are two definitions for the real exchange rate in the economic literature.

a. Based on foreign exchange value: The ratio of general level of foreign price to general level of domestic price or costs of foreign production to domestic production costs, based on the single currency.

b. Based on domestic exchange value: The ratio of non-tradable goods' prices to tradable goods within a particular country which is difficult to be calculated due to the lack of access to information (Mohammadi and NabiZadeh, 2013).

2.2. Equilibrium exchange rate and its determinants

Real equilibrium exchange rate is the relative price of tradable to non- tradable goods in which the relative price is the stable long-term equilibrium of variables such as commercial taxes, international prices and capital flows that cause simultaneous access to both domestic and foreign equilibrium (HH Alafi et al., 2004). One of the main obstacles in estimating the equilibrium exchange rate is that it is unobservable. Many researchers have tried to estimate the equilibrium value of this variable, but no comprehensive agreement exists among experts about how to do it. Among the many factors that affect the equilibrium exchange rate are economic openness, social tendency to consumption, relationship between trade and capital account.

2.3. Exchange rate misalignment

Financial markets show a keen interest to determine whether the value of national currency is higher than the equilibrium or not. Comparison of the current value of the exchange rate with its adequate value is not an easy task, as no appropriate method exists to determine the equilibrium exchange rate. Researchers use the concept of the equilibrium real exchange rate to define the misalignment, and express misalignment as a deviation between the equilibrium real exchange rate and potential real exchange rate. In other words, misalignment of exchange rate is real exchange rate deviation from the equilibrium (long-term) path. Deviation of the real exchange rate is a phenomenon that occurs in two forms, if the real exchange rate is below the real equilibrium exchange rate, deviation is appeared as over-valuation of the national currency (to make national currency more expensive) and if the real rate is higher than the balance, deviation will be by devaluation of the national currency (making the national currency cheaper).

2.4. Inflation and inflation persistence

Inflation refers to a situation where the general price level constantly increases over time (Emadzadeh et al., 2005). The important point in the definition of inflation is the element of time and the continued rise in the general level of prices, i.e. prices should have increased steadily over time. If the prices rise in a certain period and then the ascending trend stops, this is not inflation, because ascending increase in prices should be continuous (Ghaffari and NaimiPajoh, 2012). One of the problems that policy-makers, especially monetary authorities have in terms of inflation is inflation persistence. When

a variable is deviated as a result of a shock from its average and stays in its new position for a long time, the variable has a durable, stable or lasting behavior. In this case, if the inflation rate deviates from the target value which is determines by monetary authorities, it needs at least several quarters to return to its desirable level (Dargahi and Sharbat Oghli, 2010).

Although economists have agreed on the persistence of inflation and costs of lowering it, there is not much consensus about the causes of this phenomenon. In general, inflation persistence may be ensured due to several reasons, including sustainability of aggregate demand, sticky price levels, wages based on formal contracts, lack of transparency of adopted monetary policies, lack of credibility of monetary authorities and thus, the lack of appropriate reaction of economic agents to monetary policies and ultimately, lack of independence of the monetary authorities in using monetary tools (Dargahi and Sharbat Oghli, 2010).

2.5 Relationship between the misalignment of exchange rates and inflation persistence

The process of transmission of exchange rate changes to domestic prices could be classified as direct and indirect effects:

a. Direct effect: The effect shows exchange rate changes transmit to import prices through a country's foreign sector. Transmission effect will be complete when the extra fee and marginal costs are fixed. With the constancy of the extra fee and the marginal costs, producers do not apply any type of price discrimination and import price varies according to the exchange rate change. If manufacturers reduce extra fee by change in prices, and apply price discrimination, transfer of exchange rate changes to prices will not be complete. If the power of price making based on market conditions is higher (in fact, there will be the possibility to change prices according to changes in market conditions), there will be less transmission (Goldberg and Conter, 1977).

b. Indirect effect: The effect of exchange rate changes transfer linked to good competitiveness in international markets.

Studies show that the exchange rate change transmission to domestic prices level is not complete. The transfer of exchange rate changes into consumer prices largely depends on the share of imports. The higher the share of imports in consumption goods, the higher the rate of transfer of exchange

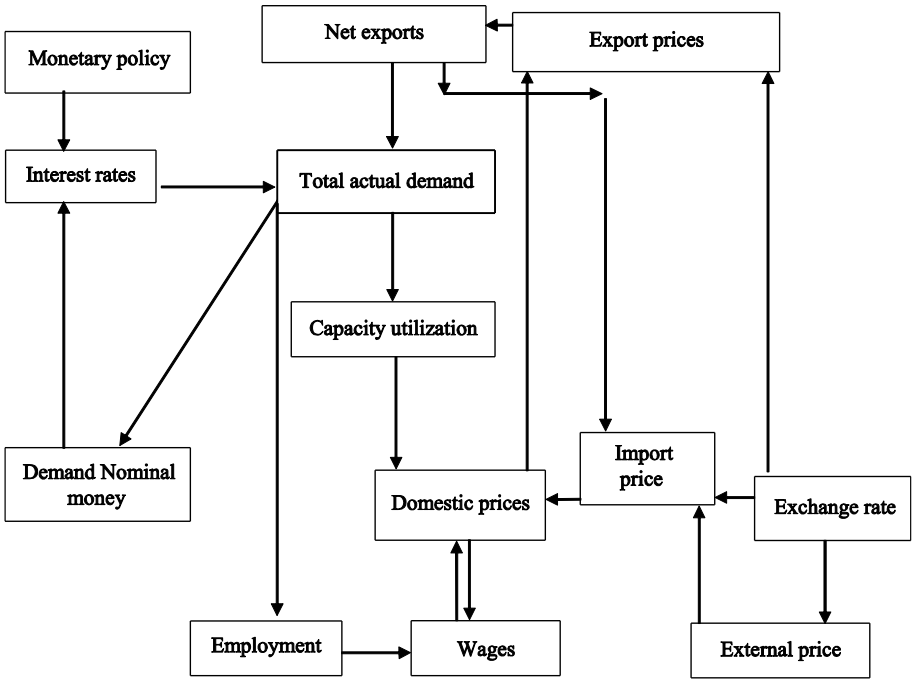
rate changes will be. By increasing the share of imports in consumption expenditures, it is expected that the price of imports be able to fully explain domestic inflation (Khoshbakht and Akhbari, 2007).

In an open economy, with total freedom of international trade and capital mobility, exchange rate and prices interact with each other (Kim, 1995). In semi-industrial countries, such as most countries in the Middle East, where production units are heavily dependent on import institutions and inputs are not easily accessible in the country, with devaluating the currency, import prices and thus cost of imported inputs will be increased and subsequently, cost of firms increases and results in an increase in domestic goods' prices (Kandilli and Mirzaei, 2008). Therefore, with devaluation of domestic currency, production and domestic prices will be affected and this factors the increase of domestic inflation and weakens the trade equation (Abasinejad and Tashkini, 2004).

The effect of transfer of exchange rate changes is linked to competitiveness of goods in international markets. Domestic currency depreciation makes domestic goods cheaper for foreign buyers, leading to increased exports and aggregate demand, and with excess demand in the domestic market, the domestic price level increases. Since in the contracts, nominal wages are fixed in the short term, the level of real wages declines as a result of these developments and production increases. As the time goes by, wages will be adjusted and return to their initial levels, by increasing the cost of production, prices will be increased and as a result, production will be reduced. So devaluation leads to a steady increase in prices and temporary increase in production (Hafner and Schroeder, 2002).

With the devaluation of national currency, firms' liquidity demand increases and thus, it increases the demand for money (Geilefson and Smear, 1982). With the increasing demand for nominal money balances, if the money supply is fixed by policy makers, the interest rate increases and real aggregate demand reduces. On the other hand, if interest rates are kept constant by policy makers, total demand increases and in this case, the inflation will affect devaluation (Tayyebi et al., 2006).

Figure 1: The Channels of influence of exchange rate on domestic prices



Source: MunHeng, 1999

If external source is the main cause of inflation, domestic inflation rates are expected to be persistent in periods of high undervaluation rates of the home currency, while they are expected to be transitory when exchange rates follow an equilibrium process (Giannellis & Koukouritakis, 2013).

3. Empirical Studies

Shahab (1997) has empirically analyzed exchange rates and inflation in Iran. For this purpose, the statistical data from 1968-1995 and Vector Error Correction model were used. His findings show that the impact of exchange rate variations is strong on the consumer price and is weak on producer price index.

Nasr Esfahani (2002) examined the nominal and real factors affecting inflation in Iran. Using data from 1971-2001 and VAR model, the researcher, showed that there is a positive relationship between exchange rate and inflation.

Tayyebi and Torki (2006) examined the relationship between exchange rates and inflation in Iran. In this study, statistical data of 1959-2001, and Granger Causality test, VAR, Analysis of Variance and Impulse Response functions were used. The results showed that the hypothesis of a causal effect relationship between the exchange rate and inflation in the economy of Iran during the mentioned period is rejected. Also, results of Variance Analysis and Impulse Response functions indicated that the impact of the exchange rate and inflation on each other increases during time.

Khoshbakht et al. (2007) examined the impact of exchange rate changes on consumer price indices and imports in Iran. For this purpose, the seasonal data for 1990-2004 and Structural VAR model and Impulse Response functions and Cholesky Variance Analysis were used. The results showed that the transition of exchange rate changes on consumer prices was declining, and the growth of the money supply play an important role rather than of import prices in increasing the consumer price index.

Rana and Dowling (1985) examined the inflationary effects of changes in exchange rates among 9 Asian developing countries. For this purpose, the statistical data of 1973-1979 were used. Findings show that changes in exchange rates and excess money supply effects were not significant on inflation rate and rising prices in those countries is due to import inflation or increase in prices of imported goods and services.

Onis and Ozmaker (1990) studied the exchange rate, inflation and money supply in Turkey (1987-1978). By using Vector Autocorrelation model, the researchers showed that the interaction between exchange rate, price levels, money volume and exports can explain inflation in Turkey.

Ganles and Cocontakis (2013), investigated the relationship between exchange rate misalignment and volatility of inflation in Latin American countries (Brazil, Mexico, Uruguay and Venezuela).The researchers used statistical data of 1980-2010. In TAR method framework, they also showed that an increase in the exchange rate misalignment causes stable inflation. If exchange rate is close to its equilibrium, inflation will be unstable.

4. Methodology

The VAR model and nonlinear Markov Switching model is used in this study to investigating the relationship between the variables. The data gathering method in this survey is based on library databases and this survey is an empirical study. The model which is used in this study is based on the works of Bafs et al. (1997), Nasrallah et al. (2013) and Dargahi and Kachlou (2001). Also, according to the purpose of this survey which is investigating the effect of exchange rate misalignment on inflation persistence, the econometrics model of vector auto regressive (VAR) is used. The model used to investigate the effect of exchange rate misalignment on inflation persistence based on the VAR model is defined as follows:

$$ST_t = F(MIS_t, GM_t, GGDP_t) + \varepsilon_t \quad (1)$$

Where ST_t is stable inflation, MIS_t is exchange rate misalignment, GGP_t is GDP growth, GM_t is liquidity growth. Smoothed values of inflation are calculated using the HP filter. Filter HP, calculates smoothed quantities of (S) time series of y by minimizing the variance of y around S. in This filter, quantities are selected so that the following function is minimized (Bafs et al., 1997).

$$\sum_{t=1}^{I}(y_{t-}s_t)^2 + \lambda\sum_{t=2}^{T-1}[(S_{t+1} - S_t) - (S_t - S_{t-1}]^2 \quad (2)$$

Exchange rate misalignment, which is the difference between the real exchange rate and equilibrium exchange rate, is measured as follows (Nasrallah et al., 2013):

$$MIS = \frac{(ERER-RER)}{RER} \quad (3)$$

where, ERER is equilibrium real exchange rate and RER is the real exchange rate. To calculate the misalignment of exchange rates, we should first estimate the equilibrium real exchange rate. The model used for estimating the equilibrium real exchange rate is defined as follows:

$$LERER = f(LSP, L\,TOT, LOPEN, LCAP) \quad (4)$$

where, LERER is logarithm of the equilibrium real exchange rate, LSP is logarithm of the social tendency to consumption, LTOT is logarithm of the

trade equation, LOPEN is logarithm of openness, and LCAP is logarithm of net capital account.

Social tendency to consumption is defined as the ratio of private and public consumption to GDP. By increasing the income or wealth of consumers, their consumption preferences changes to use more non-tradable goods. In other words, due to high income elasticity of non-tradable goods (non-tradable goods are considered as luxury goods), demand and prices for these goods will be increased and thus the equilibrium real exchange rate decreases by increasing consumer income or wealth. The argument is not true for the developing countries because of low quality non-tradable goods, because in these countries, demand for tradable goods that are mainly imported, will increase with increasing wealth or income of consumers (Dargahi and Kachlou, 2001). The trade equation deficits and the real exchange rate increase by increasing the demand for imported goods.

Other factors affecting the equilibrium exchange rate is the trade equation. Trade shocks affect the real equilibrium exchange rate through their impact on relative prices. The commercial trade equation of any country is calculated by the ratio of exported good prices to imported good price index. Changes in the trade equation, such as its improvement, reduce the real exchange rate and this reduction can be achieved if the income effect of changes in the trade equation dominates its substitution effect. In general, it can be said that the effect of trade equation on real exchange rate is ambiguous (Hosseini et al., 2010). The trade equation calculated by the ratio of exporting good prices to importing good price index is as follows:

$$\mathrm{TOT} = \frac{P_X}{P_M} \tag{5}$$

where (P_X) is exported good price index and (P_M) is imported goods price index.

Trade restrictions are among the factors affecting the real exchange rate which affects its movements in the long run. One of these restrictions is setting tariffs on various types of imported goods. A reduction in the tariff reduces the domestic price of imported goods and therefore, increases import demand. An increase in imports; results in the external imbalance that is, the trade deficit and thus declining reserves and foreign assets of the central bank. In this case, we assume that the Marshall-Lerner condition is true; the real exchange rate must be increased to re-balance the external sector of the

economy (Hosseini et al., 2010). Economy openness is calculated by the ratio of exports and imports sum to GDP. VX and VM are imports and exports respectively.

$$\text{OPEN} = \frac{VX+VM}{GDP} \quad (6)$$

Capital inflows are other factors affecting the exchange rate. To calculate this variable, the net trade balance is deducted from the net change in the central bank's foreign reserves, and the result is used as a net flow of capital outflow. With capital inflows into the country, the demand for tradable and non-tradable goods increases. The price of tradable goods is determined in world markets and their price does not change by increasing domestic demand for these commodities, but demand for non-tradeable goods goes up and increases their prices and, ultimately, the real exchange rate will be decreased (HojabrKiani and Eqbali, 1990). Net capital account as inflow and outflow of funds is considered as an indicator. To calculate capital inflows, the net trade balance is deducted from the net change in foreign reserves of the central bank, and the result is used as a net inflow and outflow of capital.

$$CAPFLOW_t = \Delta FR_t - NX_t \quad (7)$$

where ΔFR is the change in foreign reserves and NX is the net trade balance.

In this study, the real exchange rate is calculated as follows:

$$RER = E\frac{P^*}{P} \quad (8)$$

where *P*is* America's consumer prices, P, domestic consumer price index and E, shows the nominal exchange rate for US dollar. This variable is used as a logarithm. After estimating the equilibrium exchange rate, exchange rate misalignment is calculated.

5. Findings

5.1. Estimation of the real equilibrium exchange rate:

In order to test the stationary situation of the variables we conducted unit root tests. For this purpose, we choose Augmented Dickey-Fuller test from among different methods.

Table 1: The Results of Augmented Dickey-Fuller Test (ADF)

Variable	Degree of significance	Level of significance	Test statistic
Log of the real exchange rate	First differences	-3.49	-11.15
Log Terms of trade	First differences	-3.49	-7.76
log Net capital account	First differences	-3.49	-10.03
Log Social tendency to consumption	First differences	-3.49	-10.57
Log openness	First differences	-3.5	-6.70

Source: Authors.

As it can be seen, all the variables are stationary at first difference.

To determine the optimal lag, the criteria Akaike, Schwartz and Hannan-Quinn were used. Results of these criteria are presented in Table 2.

Table 2: The Results of the Determination of the Optimal Lag Model

lag	AIC	SC	HQ
1	-6.43*	-5.78*	-6.16*
2	-6.27	-4.97	-5.74
3	-6.17	-4.22	-5.38
4	-5.99	-3.39	-4.94

Source: Authors.

Notes: AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

According to the results of Table 2, the lowest value of Schwartz criterion is obtained at lag1. Thus, the optimal lag for estimating the model is 1.To investigate the long-term equilibrium relationship between the variables, Johansen test is used. The results of this test are shown in Table 3.

Table 3: The Results of Johansen Integration Test

Hypothesized H_0	Hypothesized H_1	Trace statistic	Critical value (5%)	Probability	Max-Eigen statistic	Critical value (5%)	Probability
r = 0	r = 1	70.43	60.06	0.005	33.42	30.43	0.02
r ≤ 1	r = 2	37.01	40.17	0.10	20.06	24.15	0.16
r ≤2	r = 3	16.94	24.27	0.31	12.82	17.79	0.23
r≤3	r = 4	4.11	12.32	0.69	3.96	11.22	0.63
r≤4	r = 5	0.15	4.12	0.74	0.15	4.12	0.74

Source: The authors

According to the results of trace Statistic and Max-Eigen Statistic, the number of Model's integration vector is one. The equilibrium exchange rate is estimated as follows:

Table 4: The Results of Estimating the Equilibrium Exchange Rate

Variable	LERER	LOPEN	LSP	LTOT	LCAP
Coefficient	1	0.31	0.21	1.84	-0.87

Source: The authors

Table (4) shows that if openness, social tendency to consumption, net capital account and trade equation increase about one percent, the equilibrium real exchange rate increases about 0.31, 0.21, 0.87 and 1.84 percent, respectively.

5.2. VAR estimation

The first step in estimating VAR model is testing stationarity of data. Here also, the augmented Dickey-Fuller test (ADF) is used. The results of ADF test are presented in Table 5. Based on the results of table (5), liquidity growth, GDP growth and misalignment in the exchange rate are stationary and inflation persistence is stationary in first difference.

Table 5: The Results of Augmented Dickey-Fuller Test (ADF)

Variable	Degree of significance	Level of significance	Test statistic
ST	First differences	-2.58	-2.7
GGDP	Level	-3.49	-9.3
MIS	Level	-3.49	-3.41
GM	Level	-3.5	-4.02

Source: The authors

Convergence test results are shown in Table 6. According to Trace Statistic and Max-Eigen Statistic, this model has two integration vectors.

Table 6: The Results of Johansen Co-integration Test

Hypothesized H_0	Hypothesized H_1	Trace statistic	Critical value (5%)	Probability	Max-Eigen Statistic	Critical value (5%)	Probability
r = 0	r = 1	69.67	40.17	0.000	33.87	24.15	0.001
r ≤ 1	r = 2	35.8	24.27	0.001	31.11	17.79	0.0003
r ≤2	r = 3	4.69	12.32	0.61	4.5	11.22	0.54
r≤3	r = 4	0.15	4.12	0.1	0.15	4.12	0.74

Source: The authors

To determine the instability caused by the variables in the model, we use variance decomposition. The results of analyzing model (1) are shown in Table 7.

The third column in Table (7) shows the percentage of variance due to a sudden change or given shock. Although in the first period, 100% of changes in inflation persistence are due to the inflation itself, but in the second period, changes in this index are related 98% to inflation persistence index, 0.59% to GDP growth shock, 0.04% to exchange rate misalignment shock, 1% to the liquidity growth shock. And, the GPD in long-term has the greatest impact on the persistence of inflation. So, GDP growth and exchange rate misalignment are among those factors that affect inflation persistence the most.

Each of these figures is depicting the effect of inflation persistence itself, liquidity, exchange rate misalignment and gross domestic product on inflation persistence, respectively. As we can see in Figure (2), the effect of inflation persistence on itself is positive and increasing. The effect of liquidity is also positive and increasing (Figure 3). In Figure (4), the effect of exchange rate misalignment on inflation persistence is volatile. That is positive in two first periods, and then the effect became positive and decreasing until the tenth period. And at last, the effect of GDP on inflation persistence is negative in Figure (5).

Table 7: The Results of Model Variance Analysis

Period	S.E	ST	GDP	MIS	GM
1	0.012	100	0.00	0.00	0.00
2	0.28	98.35	0.59	0.04	1
3	0.4	95.36	1.56	0.22	2.84
4	0.07	92.19	2.63	0.53	4.63
5	0.09	89.27	3.63	0.91	6.15
6	0.12	86.78	4.46	1.34	7.39
7	0.15	84.63	5.10	1.8	8.44
8	0.18	82.76	5.63	2.3	9.29
9	0.21	81.12	6.08	2.82	9.96
10	0.24	79.68	6.42	3.38	10.49

Source: The authors

5.3. Markov Switching Rotational model

Markov Switching model is one of the best models to study the relationship between variables when the relationship between the variables is non-linear. For this purpose, likelihood ratio test is used, the H_0 hypothesis of this test is the presence of a nonlinear relationship between variables, since in accordance with Table 8, the test statistic of this model is high and the likelihood of this statistic is very small, therefore, test null hypothesis is rejected, which represents a non-linear relationship between the variables.

Table 8: The Results of Testing the Nonlinear Relationship between Variables (LR)

Probability	Degrees of freedom	Test statistic
0.0001	18	61.98

Source: The authors

After ensuring that the Markov Switching non-linear model is a proper model compared with a linear model, different models of Markov Switching were estimated and based on Akaike's criterion, the optimal regime would be chosen. Then, based on Akaike's criterion and maximum likelihood, the optimal lag in each Markov model have been selected. Then, we compared various estimated models based on; a. Lack of violation of the classic assumptions (BLUE), and b. The value of maximum likelihood (Higher is better), c. The value of mean and intercept calculated for different regimes, and d. Probabilities of transition between different regimes), in a way that results are consistent with the theory proposed in different macroeconomics approaches, thus the optimum model selected is MSMAH (3) - AR (3) model, with three regimes and three optimal lags. The results of the model's estimation of given model is reported in Table 2. It should be noted that the research model fits with the MSMAH (3) - AR (3) model is given in the following equation:

$$\Delta LnCPI_t - \mu(s_t) = A1(S_t)(\Delta LnCPI_{t-1} - \mu(s_{t-1})) + A2(S_t)(\Delta LnCPI_{t-2} - \mu(s_{t-2})) + A3(S_t)(\Delta LnCPI_{t-3} - \mu(s_{t-3})) + B_1\Delta LnGDP + B_2\Delta LnM + \theta_1(St)MIS_t + e_t \quad (9)$$

With this model, we explored the effects of exchange rate misalignment in different inflation regimes. The number of regimes and lags of inflation and exchange rate misalignment based on the strategy is selected in the previous section, based on work by Klingi and Mantra (2006).

AR is representation of the expected inflation in the model. According to the results in Table 9, this variable has a positive significant impact on all three regimes. This means that the expected inflation from three previous periods has a positive effect on present inflation. On one hand, the impact of GDP growth on inflation is significant and negative and the result is expectable, on the other hand, the impact of liquidity growth on inflation in the economy is positive and significant and this result is also consistent with theories. But what is considered as important in this research is the estimated coefficients for the exchange rate misalignment. According to the results of the Table (9), the impact of exchange rate misalignment on inflation in zero regime (a regime that reduced inflation) is negative and significant. This means that at a time when inflation is declining, exchange rate misalignment increases inflation. The impact of inflation on regime one (a regime in which inflation is moderately increased) is positive and significant. This means that if inflation in a country increases steadily, then misalignment of exchange rate would continually increases inflation. Also, the effect of exchange rate misalignment

on the regime two (a regime that inflation is strictly increased) is negative, but the value of this factor is not statistically significant. According to Table (9), it is observed that seasonal inflation mean is 4.6 percent in the whole period.

Table 9: Results Estimate of the Model Markov - Switching the dependent Variable Inflation (P)

Variable	Coefficients
AR 1(0)	0.788
AR 1(1)	0.047
AR 1(2)	0.104
AR2(0)	0.726
AR2(1)	0.973
AR2(2)	0.610
AR3(0)	0.609
AR3(1)	0.206
AR3(2)	0.282
Ggdp	-0.034
GM	0.55
Constant(0)	103
Constant(1)	-0.03
Constant(2)	0.35
Mis(0)	-0.496
Mis(1)	0.176
Mis(2)	-0.139
$\boldsymbol{\sigma^2(0)}$	0.001
$\boldsymbol{\sigma^2(1)}$	0.006
$\boldsymbol{\sigma^2(2)}$	0.02
Statistics Log – Likelihood	292.74
Statistics AIC	-5.55
The average quarterly inflation in the period under review: 4.6% The number of observations: 96 Variance inflation: 0.00095	

Source: The authors

Figure 2: Regimes Extractive the Model and the Fitted Model

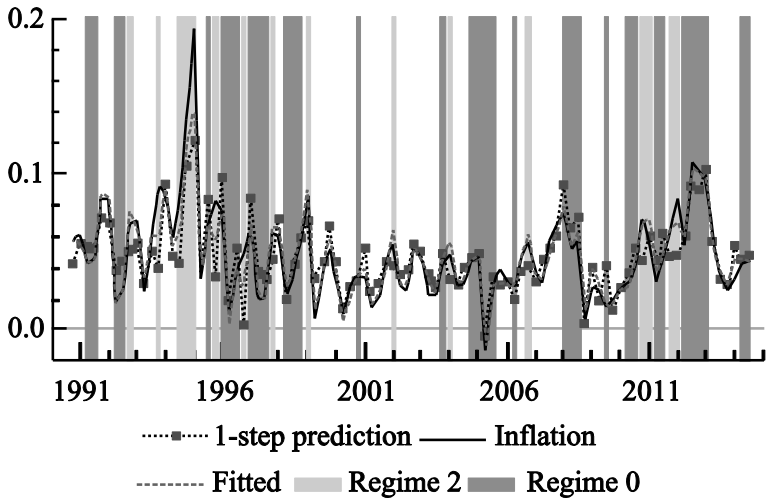


Figure 3: The Probability of Exposure in Every Regime

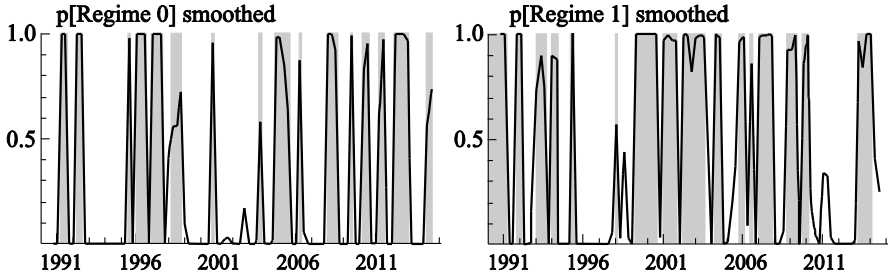


Figure 2 shows the probability of each season's exposure in the model's regimes. Moreover, Figure 3 shows the probability of each season exposure in each regime. Total possibilities of zero regime (a regime that reduces inflation) and one (a regime in which inflation increases at a moderate rate) and the regime two (a regime in which inflation has a sharp increase) is equal to one for each season. Meanwhile, red lines show Iran economic inflation trend during the study period and blue ones represents the estimation of models during the study period. According to Figure 2, the model is well

estimated, because one line has almost completely covered the other line. Also according to figure 2, regimes can be identified and can be separated.

Table 10 shows seasons exposure in each regime. While regarding this table and Figures 2 and 3, we can have a correct definition of the regime and attributes. So that the zero regime represents a period in which inflation is decreasing compared to the previous period and regime one shows a state that inflation has increased compared to the previous period, but this increase has not been severe. Regime two represents a regime in which inflation is severely increased.

Table 10: Seasons' Inflation in Iran

Regime 0	1991:4 , 1991:5 , 1992:4 , 1992:5 , 1995:5 , 1996:3 , 1996:5 , 1997:1 , 1997:5 , 1998:4 , 1998:6 , 2000:6 , 2003:6 , 2004:6 , 2005:4 , 2008:3 , 2008:5 , 2009:5 , 2010:5 , 2010:6 , 2011:4 , 2011:5 , 2012:4 , 2013:3 , 2014:4 , 2014:5
Regime 1	1992:6 , 1993:6 , 1994:5 , 1995:3 , 1995:6 , 1996:6 , 1997:6 , 1999:3 , 2002:3 , 2004:3 , 2006:6 , 2010:6 , 2011:3 , 2011:6 , 2012:3
Regime 2	1990:6 , 1991:3 , 1991:6 , 1992:3 , 1993:3 , 1993:5 , 1994:3, 1994:5 , 1995:4 , 1998:3 , 1999:4 , 1995:4 , 1998:3 , 1999:4 , 2000:5 , 2001:3 , 2001:6 , 2002:4 , 2003:5 , 2004:4 , 2004:5 , 2006:6 , 2007:3 , 2007:5 , 2008:3 , 2008:6 , 2009:6 , 2010:4 , 2010:6 , 2011:3 , 2013:4 , 2014:3

Source: The authors

Table 12 shows the characteristics of each regime. According to the results, from 96 economic seasons of Iran during 1989:4-2014:3, 35 seasons are placed in zero regime and 45 seasons in regime one and 16 in regime two. On the other hand, according to the mean period of staying in estimated regimes in the economy of Iran, the highest average of exposure is related to a regime that is stably increased. This means that the probability of exposure to regime one is more than two other regimes.

According to the results presented in Table 12, the stability in regime one is more than the other two regimes (the possibility of staying in regime one equals to 72%). This means that the stability of a regime that inflation in Iran is increasing at a smooth rate is more than the other two regimes. Zero regime

stability is also less than the other two regimes; it means that a regime with decreasing inflation is more unstable compared to the other two regimes.

Table 11: Features Regime

Type of the regime	The number of observations in each regime	The probability of being in each regime	The average period of being in each regime
Regime 0	35	36.46	1.19
Regime 1	45	46.88	2.81
Regime 2	16	16.67	2.33

Source: The authors

Table 12: Probability of Transition from one Regime to Another Regime

	Regime 0	Regime 1	Regime 2
Regime 0	0.27	0.214	0.378
Regime 1	0.725	0.723	0.008
Regime 2	0.25	0.101	0.642

Source: The authors

6. Concluding Remarks

According to VAR model, liquidity growth has the highest impact on inflation stability and, based on monetary approach, there is a causal relationship between increasing money supply and inflation stability. GDP growth has a negative effect on the persistence of inflation. Exchange rate misalignment has a positive effect on inflation persistence; these findings are consistent with theoretical principles. While, VAR model findings show a linear relationship between these variables, the likelihood ratio test confirms a nonlinear relationship between variables. According to Markov Switching model, inflation is related to three regimes: zero, (inflation is decreased compared to past), one (inflation has increased compared to before but it is not a sharp rise) and, two (inflation increase is severe). Comparing the coefficients of liquidity growth and GDP growth, we can conclude that the positive effect of liquidity on the stability of inflation is more than the negative impact of GDP

growth. Since exchange rate misalignment is considered as transmission variable in this model, its impact on all three inflation regimens is studied. The effect of this variable in zero regime is more than regime number one; also, its impact in regime number one is more than regime number two. It should be noted that the coefficient of this variable is negative in regime number two which is known as unstable regime, but it is not statistically significant. Misalignment factor in the exchange rate in regime number one which is a stable regime is positive and statistically significant, also variable coefficient in zero regime is negative which is more unstable in zero regime, and statistically significant. Finaly, the results can be expressed as follow:

The impact of exchange rate misalignment on persistent inflation and negative on inflation instability. Since more than 85% of Iran's imports consists of capital and intermediate goods, increasing exchange rate misalignment (devaluation of national currency) through increasing the value of inputs, leads to production reduction, as well as increase in the cost of products manufactured domestically, on one hand, while the increase in the exchange rate will also stimulate inflationary expectations on the other, which will affect inflation. Fiscal and monetary policies should be designed compatible with exchange rate policies. If these policies are designed to control the demand behavior and reduce domestic prices, they will cause compatibility with exchange rate policy and prevent incorrect regulation of exchange rates. Thus policy makers and central bank authorities should choose monetary and fiscal policies consistent with exchange rate policy so that they do not interact adversely.

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Appendix

The effect of variables shocks on inflation persistence is shown by IRF function as follow:

Figure 1: The Effect of One Percent Shock in Inflation Persistence on Inflation Persistence

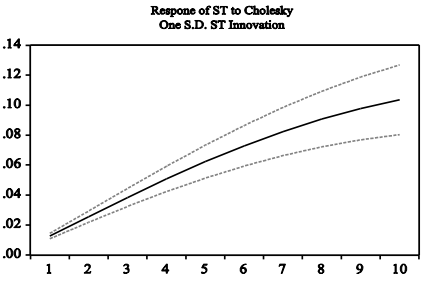

Figure 2: The Effect of One Percent Shock in Liquidity on Inflation Persistence

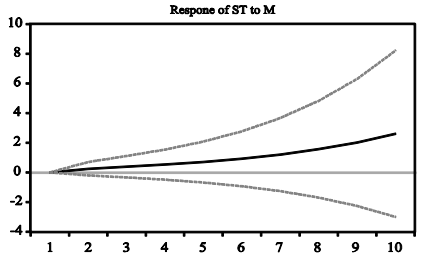

Figure 3: The Effect of One Percent Shock in Exchange Rate Misalignment on Inflation Persistence

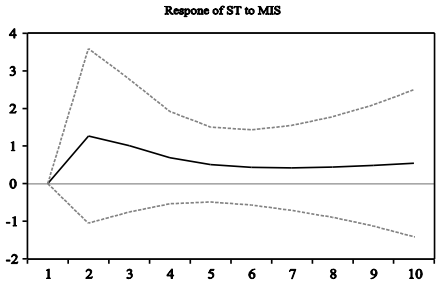

Figure 4: The Effect of One Percent Shock in GDP on Inflation Persistence