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Survey the Dynamic of Inflation in Iran Since 1990

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Abstract:

This paper surveys the dynamics of inflation and money growth in IRAN economy since 1990. We use the error correction model (ECM) approach and the quantity theory of money (QTM) as a general theoretical framework to examine the complex interaction among money growth, economy growth and inflation rate in the short-run and long-run. The sample of data has been since 1990:Q2 to 2011:Q1. And the results of estimation show that, inflation is not a monetary phenomenon, but it is mainly Cost-Push problem in the long-run. This empirical result is conflict to the famous statement by Milton Friedman that 'inflation is always and everywhere a monetary phenomenon.

Key words: Inflation; Monetary Policy; Quantity theory of money; Co-integration, IRAN Economy

JEL: E31, E52, C32

1. Introduction

Inflation is a sustained increase in the general level of prices for goods and services. Inflation is a topic of great debate variously in the competing schools of economics[1] and theories of inflation are extremely broad. Someone could classify the scheme of origins of inflation as (Kibritçioğlu, 2002) into four-block: Demand-side (or monetary) shocks, supply-side (or real)

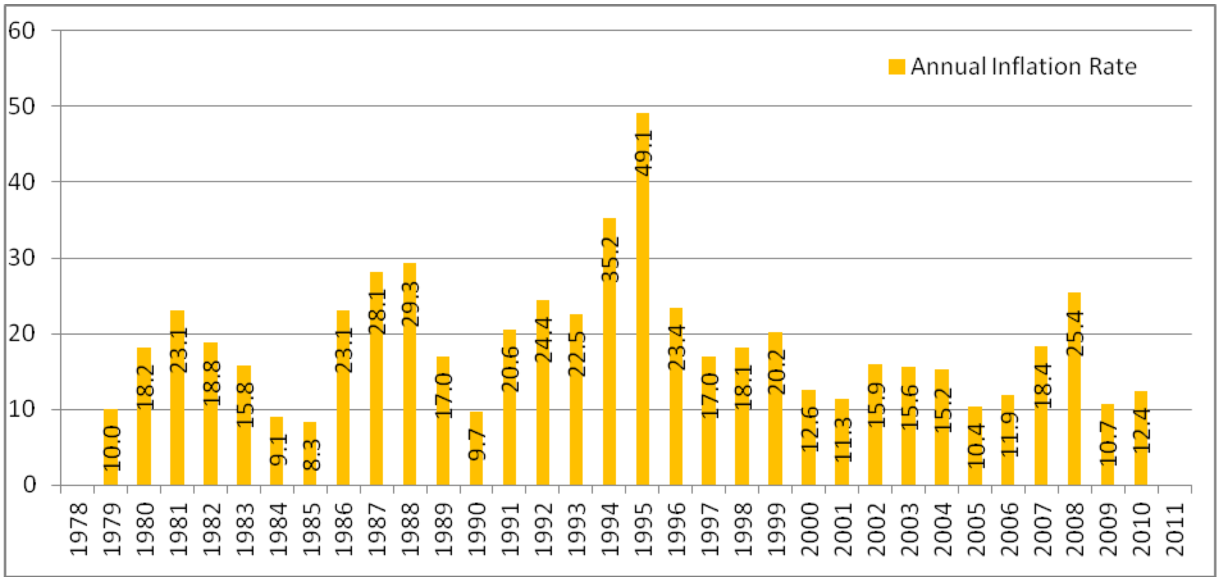
[1] - Short-run versus long-run inflation theories, closed vs. open economy models of inflation, theories of low-, high- or hyper-inflation, perfect competition (market-clearing) vs. imperfect (monopolistic) competition models, theories with assumptions of perfect or imperfect information, fiscal vs. monetary theories of inflation, etc. are various debates in economic schools. Classical and neoclassical economists state that inflation is only a monetary phenomenon.

shocks, adjustment (or inertial) factors, and political processes (or the role of institutions). The complex and dynamic interactions of four groups of these factors come together to explain inflation.

Inflation rate of Iran is double-digit since last three decades and this known as "chronic problem of macroeconomic (see figure 1). Neuromas of research conducted to solve this problem and there is large empirical literature on determinants of inflation in Iran. However, there is no consensus among them. (Hadian & Parsa, 2009) and (Hosseini & Mohtashami, 2008) suggest that the root of inflation in Iran is monetary policy of the central bank. They argue that the high inflation rate in the country related to the excess nominal money growth process (money growth less output growth), as postulated by the quantity theory of money (QTM). (Hosseini Nasab, Ebrahim; Rezagholizadeh, Mahdieh, 2011) Explain the contribution of the budget deficit and impact of earnings from Oil exporting on inflation. (Abbasi-Nejad & Tshkyny, 2011) Extract "House and Building" group's price indexes as a chronic base of inflation from consumer price indexes. They concluded that price index of "House and Building" influenced by expectation.

Such internal research, there are many empirical and theoretical studies has conducted to explain the main determinant of inflation in the other countries: (Morana & Bagliano, 2007) investigate the long-run link between inflation and money growth in the United States since 1960. They model the common persistence properties of the variables, as fractionally integrated and cointegrated series to construct a measure of the long-run inflation trend closely linked to monetary dynamics. (Almounsor, 2010) has used SVAR and VECM approach to study the underlying determinants of inflation dynamics in Yemen. He shows that inflation dynamics in Yemen driven by international price shocks, exchange rate depreciation, domestic demand shocks, and monetary innovations. (Osorio & Unsal, 2013) show that over the past two decades, the main drivers of inflation in Asia have been monetary and supply shocks.

Figure 1: Annual Inflation Rate of Iran since 1979



Source: central bank of Iran

In this paper we survey the dynamics of inflation since 1990 in Iran. To this end the Error Correction Model (ECM) approach has used to examine the complex interactions among the money growth, gross domestic product (GDP) growth and inflation rate in the short-run and long-run. And, parameters of an ECM model estimated by the quantitative econometric software R 3.0.2. The empirical results of estimation did not confirm the results of prior studies; it shows that inflation is mainly Cost-Push problem not a monetary phenomenon.

The rest of this paper is as following: Section 2 describes our data and analytical methods. Section 3 explains estimation results and discussion. Final section concludes the article.

2. Data and Analytical Methods

2.1. Data:

The data which used in this paper is: Consumer price index (CPI); Money supply M including the money supply under the narrow definition M1 plus Quasi-Money or short-term time deposits in banks; M1 include coins and notes that are in circulation and other money equivalents that could be converted easily to cash; Gross domestic product at market price, at constant 1987/88 (GDP). All row data are accessible from the web site of Central Bank of Iran (CBI). The sample of data has been since 1990:Q2 to 2011:Q1.

2.2. Analytical Method:

In accordance with the QTM, the inflation rate is determined in the long-run by the following equation: $\pi = m - g + u$ (1)

Equation (1) shows that Inflation rate, π, is equal to the growth rate of nominal money in excess of the rate of output growth, m-g, corrected for the drift in velocity, u which follows a stationary ARMA process.

In order to appropriately model the full dynamic behavior of inflation rate, we need to incorporate short-run adjustment factors along with the cointegrating equilibrium relationship of equation (1). This is best done using the error-correction model technique:

$$\Delta Z_t = \eta + \sum \quad (2)$$

The vector Z_t includes the integrated variables inflation rate, money growth and economy growth, and η is constant vector. The adjustments to equilibrium are captured over n lagged periods in the coefficient matrix Γ_i. The $\prod Z_{t-1}$ terms represent long-run equilibrium or cointegrating relationships and the rank of $\prod$ equals the number of cointegration vectors. To test the rank of $\prod$, (Johansen, 1988) and (Johansen, Søren; Juselius, Katarina, 1990) make use of maximum eigenvalue and trace statistics. The coefficient matrix can be decomposed into $\prod = \alpha\beta$. If all columns of matrix α has non-zero elements then $\prod$ has a full rank and all the variables are stationary. Furthermore, the absolute value of elements matrix α must be less than one and its sign should be negative since a positive shock to a system should result in adjustment in the opposite direction.

3. Estimation results and Discussion

3.1. Descriptive statistics

As shown in table 1 all variables follow $I(0)$ process and are stationary in level. The results of unit root test reported in table 5 at appendix. Inflation rate depends linearly on its' own previous season's values, two previous year's values and current and previous (unobserved) white noise error terms or random shocks.

Table 1- descriptive statistic of variables **π**, m, g and m1

	Variables:			
	π	**m**	**g**	**m1**
Min	-0.01	-0.01	-0.22	-0.11
Max	0.18	0.17	0.34	0.22
Average	0.04	0.06	0.01	0.05
S. d.	0.03	0.03	0.17	0.07
Process	ARIMA(2,0,0)(1,0,1)	ARIMA(1,0,2)(1,0,1)	ARIMA(1,0,1)(1,0,0)	ARIMA(0,0,0)(2,0,0)
Intercept	0.0436 (0.0211)	0.0592 (0.0077)	---	0.0513 (0.0268)
AR(1)	0.4259 (0.1088)	-0.9218 (0.0544)	0.5151 (0.1067)	---
AR(2)	0.1814 (0.1113)	---	---	---
MA(1)	---	1.0491 (0.1274)	-0.9457 (0.0353)	---
MA(2)	---	0.2539 (0.0717)	---	---
SAR(1)	0.9549 (0.0414)	0.9473 (NaN)	0.9673 (0.0224)	0.6533 (0.1063)
SAR(2)	---	---	---	0.2536 (0.1104)
SMA(1)	-0.7094 (0.1129)	-0.7643 (NaN)	---	---

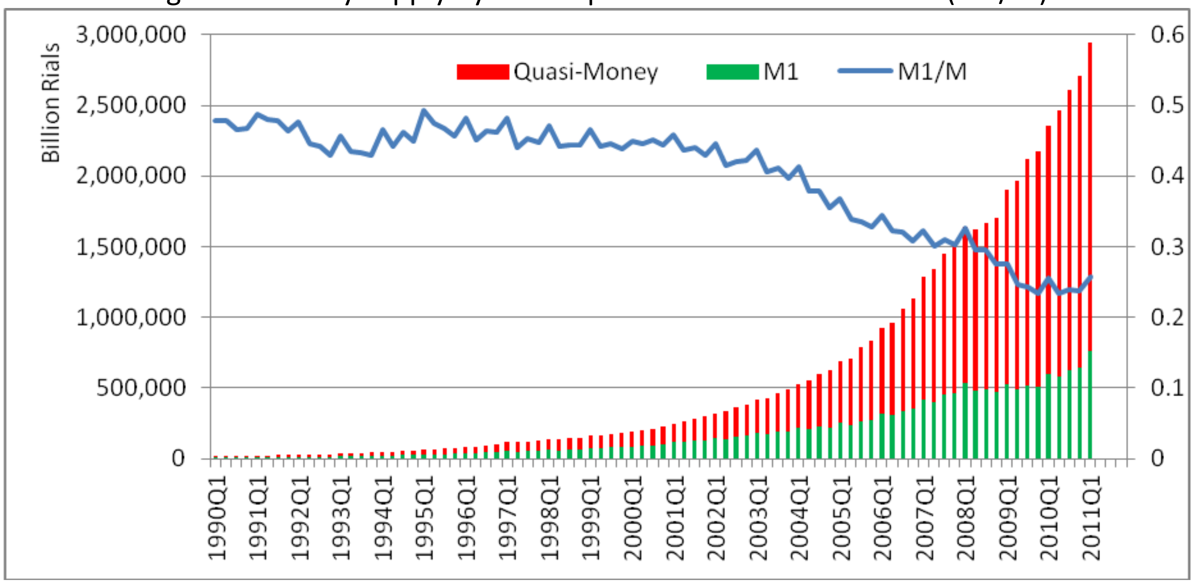
Note: Values in parentheses are the standard error of estimated parameters. Source: author foundations

Output growth rate is an ARIMA (1, 0, 1) (1, 0, 0) process and the estimated coefficients of SAR(1) term is significant and positive (0.9673) and MA(1) term is negative (-0.9457). These show that seasonality, changes in the economic growth and random shocks made decreasing the economic growth in Iran economy. Additive decomposition of economic growth to trend, seasonal and random component are shown in figure 3 at appendix.

The random shocks did not affect the narrow money growth rate (m1) and it is depends on its own two previous season's values. However, both seasonal and yearly random shocks affect the money growth. This is to some extent explains the root and psychological concept of money supply.

Figure 2 demonstrates money supply (Liquidity volume) by its' components: narrow money M1 and short-term time deposits (Quasi-Money). As a result of ex nihilo creation of credit and expansion of electronic banking system of Iran, the share of the M1 in money supply decreased from 0.48 at 1990Q1 to 0.26 at 2011Q1. Central bank of Iran is not independence and each year there are some obligations imposed on the monetary authorities by government to finance his budget deficit through money printing that stimulus credits created by banking system.

Figure 2: Money supply by its components and share of them (M1/M)



Source: central bank of Iran

3.2. Estimation of model

For the lag length of unrestricted VARs, we consider seasonal dummies and various information criterions to select appropriate model between different lag specifications. All of the Akaike information criterion (AIC), SC, HQ and FPE criterions suggest using 3 lag orders.

Further, when testing for cointegration, the question of whether a trend should be included in the long-run relationship arises. As (Hendry and & Doornik, 1994) pointed out, the trend is restricted to the cointegrating space, to take into account long-run exogenous growth that is not already included in the model. The results of Johansen's trace and eigenvalue tests for the cointegration test on the VECM are presented in table 2[2].

[2] - In this paper we used the quantitative econometric software R 3.0.2 to estimate the parameters; Therefore all programing code used are available upon the request through my email address.

Table 2: Result of Johansen's Cointegration Test

Vectors:	Trace Test			Eigenvalue Test	
$r = 1$ versus $r = 0$	40.6310	(0.0104)*	(0.0135)*	24.1023	(0.0249)*
$r = 2$ versus $r = 1$	16.5286	(0.1532)	(0.1641)	10.0002	(0.3458)
$r = 3$ versus $r = 2$	6.5284	(0.1585)	(< 0.001)	6.5284	(0.1582)

Notes: columns 2 and 5 table shows the trace and eigenvalue values and their p-value represented in parentheses. * indicates significance at the 5% level

Both the maximum eigenvalue test statistic and trace statistic reveals two significant cointegrating relationship. Table 3 shows the two normalized equations of the cointegrating vectors. And, table 4 present the estimated results error correction model.

Table 3: Normalized Equations of the Cointegrating Vectors

variables:	Inflation rate (π)	Money growth(g)	Economy growth(m)	Intercept(v)
Equation 1:	1	0	11.7265078	-0.1765808
Equation 2:	1.029992e-17	1.000000e+00	3.830238e+00	-1.041359e-01

Note: These coefficients are estimated for the long-run equation $\pi - m + g - v = u_{t-1}$ where u_{t-1} is a white noise process.

Table 4: Estimation result of ECM for variable inflation rate

Coefficients:	Dependent variable:		
	$\Delta\pi_t$	Δm_t	Δg_t
π_{t-1}	-0.3618 (0.1276)**	-0.0918 (0.1377)	0.1028 (0.2623)
π_{t-2}	-0.1626 (0.1266)	-0.2896 (0.1366)*	0.0604 (0.2601)
π_{t-3}	0.0114 (0.1219)	-0.0011 (0.1315)	0.2179 (0.2505)
m_{t-1}	-0.1809 (0.1603)	-0.4685 (0.1729)**	-0.1923 (0.3293)
m_{t-2}	-0.0629 (0.1466)	-0.2115 (0.1581)	0.0901 (0.3012)
m_{t-3}	0.0062 (0.1081)	-0.3448 (0.1166)**	-0.1202 (0.2221)

g_{t-1}	**0.0472** **(0.1527)**	**-0.0489** **(0.1647)**	**0.5329** **(0.3137)▪**
g_{t-2}	**0.0459** **(0.1036)**	**-0.0003** **(0.1118)**	**-0.0330** **(0.2129)**
g_{t-3}	**0.0897** **(0.0540)**	**-0.0071** **(0.0583)**	**-0.4048** **(0.1111)*** **
Speed of adjustments to Eq.1	**-0.1097** **(0.0622)▪**	**0.1705** **(0.0671)***	**-0.1625** **(0.1277)**
Speed of adjustments to Eq.2	**0.3154** **(0.1760)▪**	**-0.5017** **(0.1899)***	**-0.0053** **(0.3618)**
ARCH(12):	**Chi-squared = 9.8317 , p-value = 0.6307**	**Chi-squared = 15.3954, p-value = 0.2205**	**Chi-squared = 27.2544, p-value = 0.007101**
Box-Ljung test:	**X-squared = 6.2425, df = 10, p-value = 0.7945**	**X-squared = 3.8939, df = 10, p-value = 0.952**	**X-squared = 8.248, df = 10, p-value = 0.6046**
Jarque - Bera Normalality Test:	**X-squared: 44.771, Asymptotic p Value: 1.897e-10**	**X-squared: 2.3556, Asymptotic p Value: 0.3079**	**X-squared: 8.2241, Asymptotic p Value: 0.01637**

Note: **, * and ▪ indicates significance at the 0.001%, 0.01% and 5% level respectively. The values in parentheses represent standard error. Speed of adjustments to Eq.1 and Eq.2 are the coefficients of two contigrated long-run relationship in the ECM model of each variable. ARCH(12) is Engle's (1982) test for the 12th autoregressive conditional heteroskedasticity for the residuals of estimation. The Null hypothesis (no ARCH effects) for the residuals of third equation would reject at the level 0.01% but that is not rejected for the first and second equations. The statistics of Box-Ljung test for estimated residuals in all equations show no serial correlation in them. Normality test of residuals is significant only for the second equation.

Estimated value of the first elements of matrix α for variable $\Delta\pi_t$ or the speed of adjustments to the long-run relationship in the contigration Equation 1 is -0.1097 and significant. But the sign of estimated value of speed of adjustments to the contigration Equation 2 is positive; however, its' absolute value is less than one. Therefore the Equation 2 in the table 3 is not theoretically acceptable equation for the dynamics of inflation rate in the long-run. Adjustment of money growth to its long-run relationship as Equation 2 is stable and significant. However, stable adjustment of economy growth to its long-run relationship as Equation 1 and Equation 2 is not statistically significant.

3.3. Empirical results:

As shown in the table 3, the main determinant of inflation rate in long-run, as Equation 1, is economy growth and an intercept terms. And, there is no empirical evidence, during the periods of this research sample that nominal money growth would affect the long-run inflation rate. This empirical result is conflict to the famous statement by Milton Friedman that ‘inflation is always and everywhere a monetary phenomenon (Friedman, 1963). And, it supports the (Grauwe & Polan, 2005) claims that inflation seems to be an exogenously driven phenomenon, mainly unrelated to money growth. Thus, from this point views to the chronic inflation problem, we name it Cost-Push inflation problem. Higher indirect taxes imposed by the government, rising imported raw materials and final goods costs and rising labour costs are inherent in the Iran economy and these are reasons behind the Cost-Push inflation.

The most robust equation in our error correction model is that containing $\Delta\pi_t$ as dependent variable. The other two show a small but, somewhat ambiguous relationship between money and economy growth. We present the Impulse Response of inflation to shocks in figure 5 and Variance Decomposition of inflation in figure 6 at appendix to examine more clearly the response of the inflation rate to various shocks.

In the short-run, lags of inflation and current money growth and its’ lags has positive effect on the current inflation rate, but economy growth and its lags has negative effect on inflation[3]. And, money growth basically is determined by its own lags and inflation rate. The volatility in economy growth might affect itself only. Furthermore, there is no some evidence that money growth and inflation have significant effect on the economy growth in the short-run. Because estimated coefficients of these variables are not statistically significant at 5% level.

[3] - The following equation gives the short-run determined of inflation:

$$\pi_t = -0.013 + 0.528\,\pi_{t-1} + 0.199\,\pi_{t-2} + 0.174\,\pi_{t-3} - 0.011\,\pi_{t-4} + 0.134\,m_{t-1} + 0.117\,m_{t-2} + 0.069\,m_{t-3} - 0.006\,m_{t-4} - 0.031\,g_{t-1} - 0.001\,g_{t-2} + 0.043\,g_{t-3} - 0.089\,g_{t-4}$$

4. Conclusion

The article surveys dynamics of inflation and money growth to find out the root of double digit inflation rates which is known as "chronic problem" in Iran economy since 1990. We use ECM approach and the Quantity Theory of Money as a general theoretical framework to examine the complex interactions among money growth, GDP growth and inflation rate in the short-run and long-run. The parameters of an ECM model are estimated by quantitative econometric software R 3.0.2. The estimation results based on the sample of data 1990:Q2 to 2011:Q1 show that inflation is not a monetary phenomenon but it is mainly Cost-Push problem in the long-run and increasing economy growth decrease the inflation rate significantly. Therefore this result is conflict to prior studies in Iran and Friedman's QTM.

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5. Appendix

Figure 3.a: Decomposition of output growth rate in Iran.

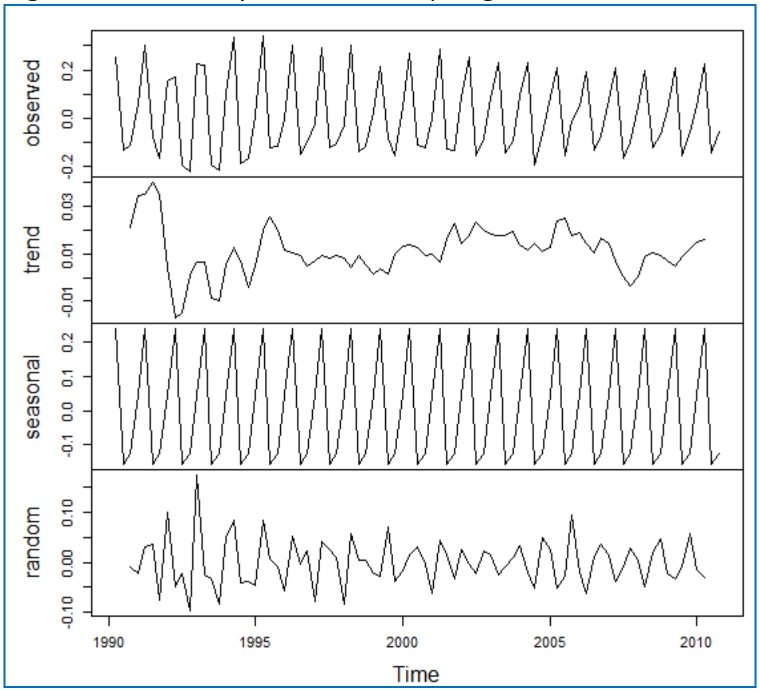


Figure 3.b: Decomposition of money growth rate in Iran.

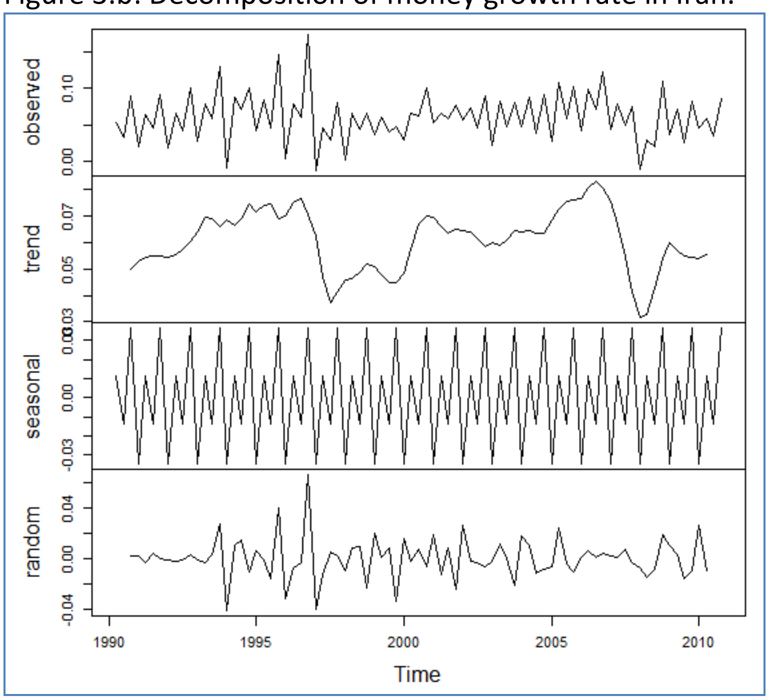
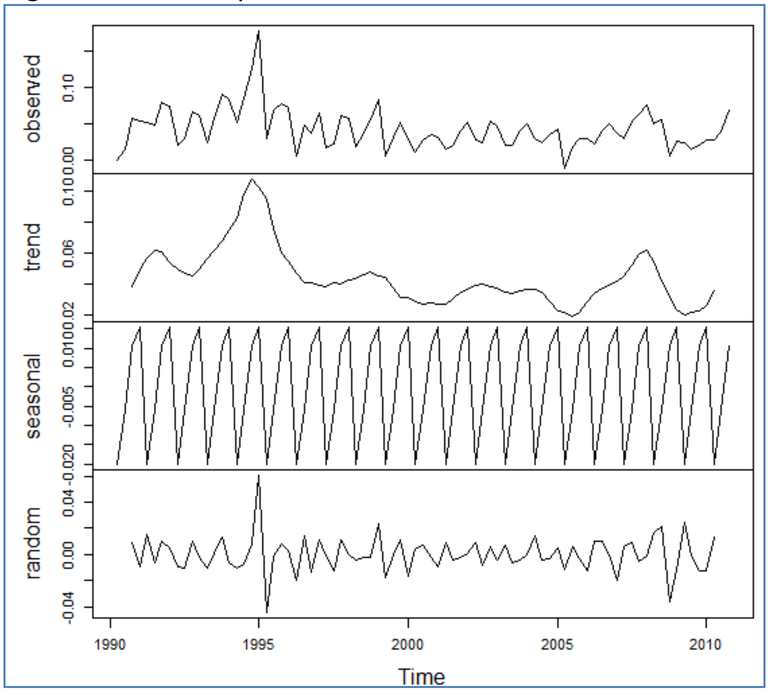
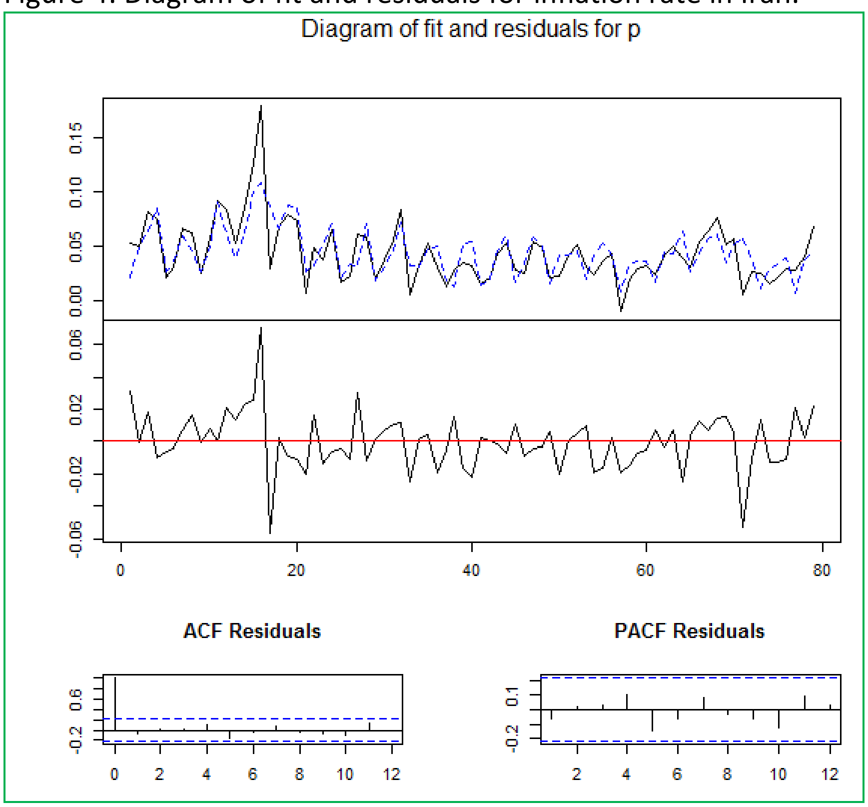


Figure 3.c: Decomposition of inflation rate in Iran.



Source: authors' foundation

Figure 4: Diagram of fit and residuals for inflation rate in Iran.



Source: authors' foundation

Figure 5: Impulse Response of inflation rate to shocks **m** , **p** and **g**

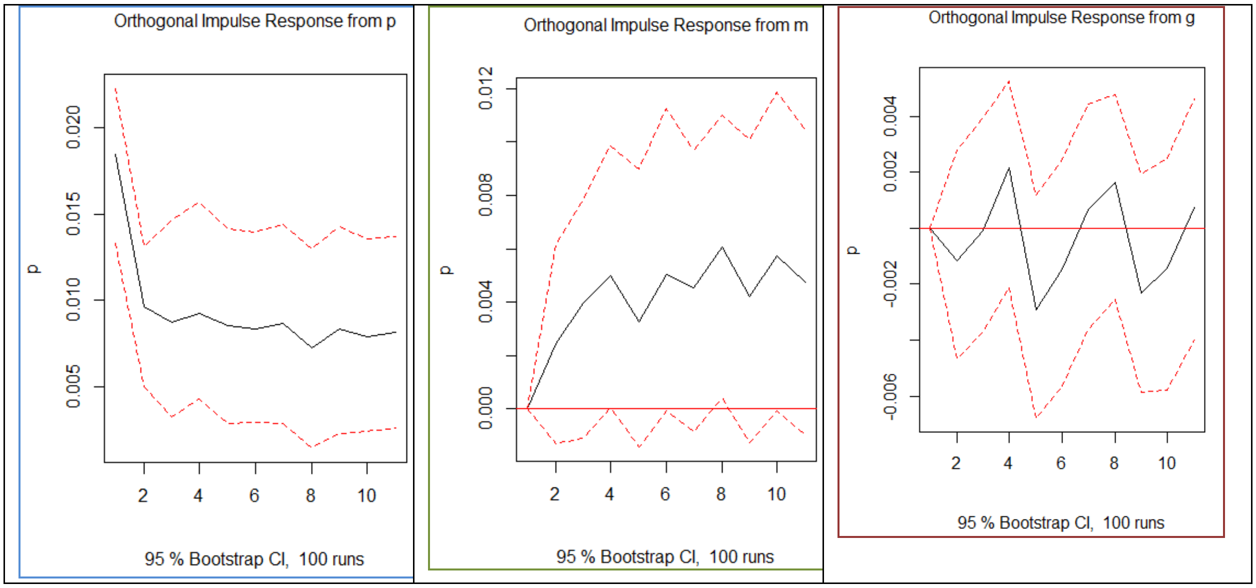
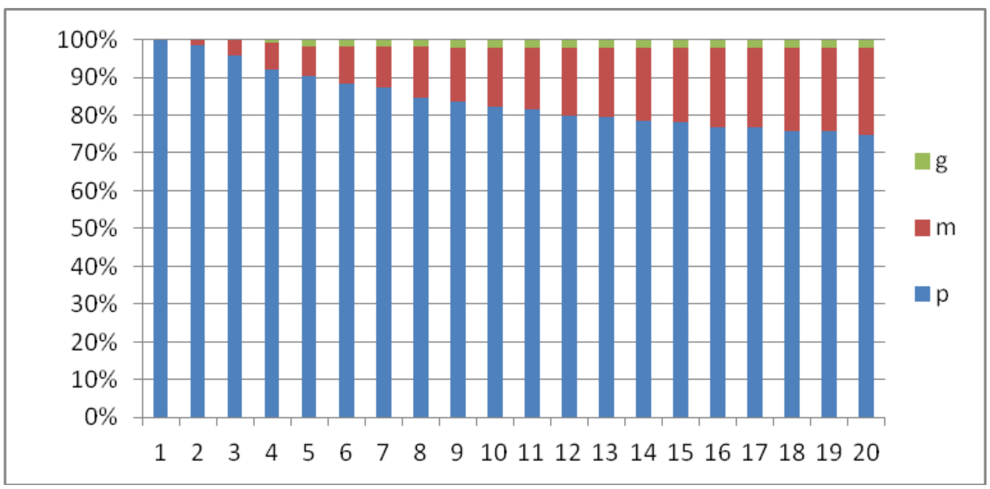


Figure 6: Variance Decomposition of Inflation Rate



Note: Contribution of money and economy growth volatility on the inflation is incredibly less than inflation volatility on itself only.

Table 5: Unit root test for variables

variables:	ADF	PP
π_t	**-3.02**	**-51.98**
	(0.15)	**(0.01)**
m_t	**-3.25**	**-128.65**
	(0.08)	**(0.01)**
g_t	**-4.48**	**-55.89**
	(0.01)	**(0.00)**

Notes: Seasonal dummies were included to control for seasonal unit roots. The p-value of critical ADF (Dickey & Fuller, 1981) and PP (Phillips & Perron, 1988) values are represented in the parentheses.

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