Causality between Money and Inflation in Iran

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Abstract

The main goal of this paper is to investigate the causality between money and inflation in the Iranian economy. In doing so, we have first reviewed theoretical and empirical literature of causality throughout the world and then we used Granger's method for detecting causality between money and inflation in the Iranian economy. We then used Johansen procedure in order to test weak exogeneity for taking result that weather money affect inflation or vice versa. The results show that in the short run, money causes inflation but in the long run money cannot affect the inflation. Moreover in the short run monetary policy is effective, whereas in the long run money stock is only passive.

Keywords: narrow money, broad money, inflation, weak exogeneity, Granger causality, Johansen Procedure.

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چکیده :

هدف اصلی این مقاله بررسی رابطه سببی بین پول و تورم در اقتصاد ایران است.

بد ین منظور ، ابتدا یک مرور نظری و تجربی بر اد بیات موضوع در کشورهای مختلف دنیا داشته و سپس از روش گرنجر برای کشف رابطه سببی بینی و تورم در ایران استفاده شده است.

آنگاه روش جوهن سون(مرحله برونزایی ضعیف) بکار گرفته شده به این منظور که آیا تورم بر پول تاثیر دارد یا برعکس.

نتایج تحقیق نشان می دهد که در کوتاه مدت پول بر تورم تاثیر داشته ولی در بلند مدت نمی توا ند پول بر تورم موثر باشد

هم چنین می توان نتیجه گرفت که در کوتاه مدت سیاست پولی موثر است در حالی که در بلند مدت پول حالت ا نفعالی داشته و سیاست پولی بی اثر است.

کلید واژه ها : رابطه سببی ، حجم پول ، نقد ینگی ، تورم، برونزائی، آزمون علیت گرنجری، روش جوهن سون

1. Introduction

Obviously the future cannot cause the present or past. If event A occurs after event B, we know that A cannot cause B. At the same time, if A occurs before B, it does not necessarily imply that A causes B. For instance we see money and prices as two time series and we intend to understand whether money precedes prices, or it is the opposite, or they are contemporaneous. This is the main purpose of this paper.

In order to investigate whether money or inflation are active or passive, there are two tests namely Granger causality test and egogeneity test. An exogeneous variable is related primary to the external sector of the economy and its value is directly determined by the policy maker. For instance the theory tells us that money demand depends on production and inflation. Now we would like to know that whether inflation's value is not determined by any relationships in the model under consideration. If so, it could said to be exogenous variable and could affect money stock. In the opposite case it should be passive. As Sims (1972) states Granger non-causality is necessary for exogeneity. He also regards tests for Granger causality as tests for exogeneity. In this study we would like to test those and compare the findings.

This paper is organized in 6 sections. Section 2 devotes to theoretical debates of the topic, section 3 discusses the methodology of the research and database, section 4 reviews a short report of the causality between money and inflation in other countries. Section 5 carries out the causality relationship between money and inflation using Granger method. Section 6 tries to do weak exogeneity test for real narrow money (RM1). Section 7 examines similar test for real broad money (RM2). Section 8 is empirical finings of the tests and finally section 9 includes concluding remarks.

2.Theoretical Basis

We should define two terms of econometrics namely Granger causality and weak exogeneity.

Causality in econometric terminology is a somewhat different concept from philosophical use. It refers more to the ability of prediction. Econometricians refer to Granger causality[2] which is defined in here:

Consider two following models

$$y_t = \alpha_0 + \alpha_1 y_{t-1} + \alpha_2\, y_{t-2} + \ldots + \beta_1 x_{t-1} + \beta_2 x_{t-2} + \ldots + \zeta_t \qquad (1)$$

$$x_t = \alpha_0 + \alpha_1 x_{t-1} + \alpha_2\, x_{t-2} + \alpha_3 x_{t-3} + \ldots + \beta_1 y_{t-1} + \beta_2 y_{t-2} + \ldots + U_t \qquad (2)$$

If $\sum e_1^{\,2} < \sum e_2^{\,2}$ in Granger causality definition, it could said to be X causes Y

Obviously if $\sum e_1^{\,2} > \sum e_2^{\,2}$ the result is exactly the opposite.

Engle, Hendry (1983) Argue that if a variable can be taken as "given" without losing information for the purpose of statistical inference, it call weak exogenous

3. Methodology and database

In this paper Granger causality test via Akaike's final prediction error (FPE) criterion plus weak exogeneity test via Johansen procedure for three time series data namely narrow money, broad money and inflation will be applied.

Looking first at the available data, the data for Iran is usually presented in an annual publication called Iran Statistical Yearbook, prepared by the Statistical Centre of Iran. As for the accuracy of the data, given that the Central Bank of Iran is the oldest and most accurate data source, most of the necessary data for this study (such as M1, M2, and the price of durable goods, the CPI) and other national accounts data from 1970 to 2005 are taken from the Central Bank's bulletins.

4. A Review of the literature

In this section we will present a short report of the empirical studies regarding causality between money and inflation.

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[2] See Granger (1969)

Jones and Uri (1987) used three econometric methods[3] to examine causality between money and inflation in the USA during the period 1953-1984. Failing to find a clear causal direction, they concluded that the broadly money stock does not determine inflation, though the effect of narrow money on inflation was suggested.

Anderson et al (1988) reexamined Cagan's model for two hyperinflation cases, Greece (1943-44) and Hungry (1945-46). They find evidence in favour of a one-way causality from inflation to money growth.

Quddus et al (1989) studied Chinese hyperinflation during the period 1946-1949. They found that in Mainland China there was a bidirectional causality, whereas in Taiwan and Manchuria the causal direction was from inflation to money.

Makinen and Woodward (1989) studied hyperinflation in Taiwan. Their empirical findings show that while causality from money growth to inflation is countered, causation in the opposite direction cannot be ruled out. This implies a unidirectional causality from inflation to money.

Lahiri (1991) studied causality in Yugoslavia and concluded that there is a bidirectional causal relationship between money and inflation.

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[3] The Granger direct, Sims, and Haugh-Pierce

Beltas and Jones's (1993) investigated causality between money, (M1 and M2), and inflation using the Granger methodology in Algeria for the period 1970-1988. Their conclusion was a unidirectional causality from money to inflation.

Choudhry (1995) applied a causality test between money stock and inflation in Argentina during the period 1935-1962. He concluded that there was a bidirectional causality between aggregate real money and inflation both in the long period and short period exists.

Kamas (1995) tested the impact of money on inflation in Colombia with a crawling pegged exchange rate. Using a VAR model, Kamas proved that domestic money has little role in changing for inflation, while income has much effect in inflation.

Cointegration techniques are used by **Ahumada (1995)** to reexamine a monetary model on monthly data for Argentina over the period 1978-1991. His results suggest a long-run relationship between money and inflation, however, in order to test the monetarist contention that money determines inflation, he used weak exogeneity tests but the results of his tests showed there to be no evidence for the monetary argument. This in turn means that money appears to grow passively.

Nell (1999) studies causality between rate of change of money (gM3) and inflation using Pesaran et al (1996) methodology in South Africa over the period 1966-1997. He deflated inflation by CPI, GDP, and GDE separately, and he further applied two types money: gM, and excess money[4] (egM). Nell concluded that both types of money cannot cause inflation in South Africa, and it has merely been passive in the inflationary process. The only exception was the causality between egM and inflation, which there was a bi-directional causality between them.

In general, the empirical findings of the different studies tend to suggest that endogeneity of money supply cannot be rejected, implying that governments often allow money supply to act as an endogenous variable.

5. Causality between Money and Inflation (Granger Causality)

There is no fixed answer concerning causality between money stock and inflation in different countries. We investigate the issue in the Iranian economy during the period 1979-1996. We have applied Granger's concept of causality

[4] gM3 minus rate of change of income

and Akaike's final prediction error (FPE) criterion for money-inflation causality detection. In this procedure the variance of dependent variables arising from fluctuations in error terms has been minimized. As Hsiao (1981) argues, to choose the order of lags in Akaike's criterion by minimizing FPE is equivalent to applying an approximate F-test with varying significant levels. Akaike's criterion procedure has been conducted in this study through the following three steps:

5.1. By determining the order of uni-dimensional autoregressive process, like money stock, the FPE criterion is used.[5] We tried this process from one to 15 lags for money stock. As Table 2 indicates, with nine lags there is minimum value of FPE, which it is equal to 0.003195.

5.2. By treating the money stock as the only output of the system and assuming inflation to be the manipulated variable there will be, control of the outcome of money stock; and by using the FPE criterion we determine the lag order of inflation, assuming that the order of the lag operator on money stock is nine, which has been specified in step one. As Table1 indicates, the

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[5] This criterion is the expectation of errors squared for dependent variable, i.e. FPE of

$y_t = E\,(y_t - \hat{y}_t)^2$

optimum number of lags for inflation is five when the controlled variable is M1, and is 8 when the controlled variable is M2.

5.3. By comparing the smallest FPEs of steps one and two, it was decided that should the former be less than the latter, a uni-dimensional autoregressive representation for money stock would be used, whereas if the converse is true, the judgment would be exactly opposite. As we can see in Tables 1 and 2, the reverse is true since by comparing the correspondent figures in the two tables, the following inequality holds: 0.0004499<0.003195. This means that for M1 and inflation pair, treatment of inflation as an independent variable reduces the FPE of M1 equation. On the other hand if we refer to the third row of Tables 1 and 2, we can see this inequality: [8.704<10.79]. As a result narrow money could reduce FPE of the inflation equation. Hence, we could conclude that there is a bi-directional causality between M1 and inflation, and between broad money and inflation pair. This is because by comparing the ninth row of Table 1 and second row of Table 2, we will reach this inequality: [0.0003131<0.0007824], so inflation affects M2, and the opposite direction is true as well. This is because the third row of Table 1 and fourth row or Table 2 show us that this inequality holds: [8.20,10.79]. These three steps show that there is a bidirectional causality between money stock and inflation, meaning that money stock causes inflation and inflation causes money stock.

Table 1: The FPE of fitting a one- dimensional autoregressive process for M1, M2, and inflation

The order of lag	FPE of M1 x 10^{-3}	FPE of M2 x 10^{-4}	FPE of Inflation
1	3.225	8.74	32.420
2	3.310	8.86	20.28
3	3.291	8.258	**10.79**
4	3.319	8.534	11.06
5	3.244	8.6	11.49
6	3.366	8.497	11.63
7	4.077	8.794	11.89
8	3.308	7.991	11.24
9	**3.195**	**7.824**	11.47
10	3.348	8.147	12.17
11	3.504	8.520	11.46
12	3.592	8.562	11.95
13	3.760	8.919	12.32
14	3.868	9.148	12.83
15	4.087	9.639	12.73

Since a causality test indicates that money can affect inflation, while an exogeneity test in Johansen Procedure shows that money is endogenous and it is affected by the inflation, we can conclude that in the short run, money causes the inflation but in the long run money cannot affect the inflation. Hence we can conclude that in the short run monetary policy is effective and can change the prices, whereas in the long run money stock is only passive.

This issue confirms Kiani's finding which says that: based on the experimental studies made of the Iranian economy the effect of money supply on the inflation is definitive. In recent years the Central Bank of Iran has succeeded in controlling the inflation rate by means of reduction of liquidity. See: Kiani (2000:7).

Table 2:The optimum lags of manipulated variable and the FPE of the controlled variable

Controlled variable	**Manipulated variable**	**The optimum lag of manipulated variable**	**FPE**
M1 (9)	Inflation	5	0.0004499
M2 (9)	Inflation	8	0.0003131
Inflation (3)	M1	4	8.704
Inflation (3)	M2	8	8.204

6. Testing for weak exogeneity for narrow money: According to Harris: (1995:98), testing for weak exogeneity reduces to testing restrictions on the row(s) of α matrix, which contains the speed of adjustment coefficients. On the other hand, the matrix π is the product of α to β', so that if we impose a zero row restriction on α matrix, this affects the corresponding row of matrix π. Thus a comparison equivalent to testing the significance of imposing restrictions. Consequently, if the likelihood ratio statistics calculated with imposing restrictions on the rows of that matrix are statistically zero, the correspondent variable in the VAR should not be included in the model.

In this study π_1*, π_2*, and π_3* are matrices π after imposing restriction on the second, third and last two rows respectively. For explain when we impose zero restriction on the second row of the α matrix, the product matrix ($\alpha\beta$') will become π_1*. Then we should compare π with π* via exogeneity test. By the null hypothesis to be tested for the weak exogeneity of the first independent variable, GDP would be

$$H_0 : \alpha_{1i} = 0 \quad \text{against } H_1 : \alpha_{1i} \neq 0 \quad \text{for } i = 1,...4.$$

Imposing zero restriction in the second row of α matrix affects the trace matrix, because this leads to produce a correspondent zero row in the new π (π^*_1). The null hypothesis is not to be rejected, because the likelihood ratio is less than its critical value. This means that the diagnostic statistic $-T\sum[(Ln\ (1-\lambda i^*) - Ln\ (1-\lambda i)$ is not significantly different from zero. Therefore, GDP is exogenous to the system and does not need to be modeled explicitly. In other words, π and π_1* are not statistically different from each other.

A similar test was carried out for the inflation rate, and, since imposing zero restriction on the third row of α matrix gives the likelihood ratio, which is less than the critical value, here too the null hypothesis could not be rejected. According to the exogeneity test, therefore, the inflation rate is exogenous to the system and this variable should be deleted from the left side of the system. This means that the two matrices π and π_2* are not statistically different from each other.

We have also performed an exogeneity test for GDP and inflation. The result was the acceptance of the null hypothesis. This is because the diagnostic statistic $-T\sum[(Ln\ (1-\lambda i^*) - Ln\ (1-\lambda i)]$ is not significantly different from zero.

In other words, the two matrices π and π_3* are not statistically different from each other. Therefore, the exogeneity tests on GDP and inflation imply the uniqueness of the cointegration vector. Imposing restrictions (i.e the second

Table3: Long run Matrix π (before imposing restrictions)

Variable	RM1	GDP	Inflation	Trend
RM1	-0.15	0.07	-0.04	-0.006
GDP	-0.02	-0.06	0.000015	-0.0005
Inflation	16.42	-6.36	-0.40	0.78

Table 4: Long run Matrix π_1*(after imposing restrictions on the second row)

Variable	RM1	GDP	Inflation	Trend
RM1	-0.20	0.09	-0.04	-0.008
GDP	0.00	0.00	0.00	0.00
Inflation	2.09	-0.95	0.45	0.09

Table 5: Long run Matrix π_2* (after imposing restrictions on third row)

Variable	RM1	GDP	Inflation	Trend
RM1	0.19	0.08	-0.04	-0.008
GDP	-0.005	0.002	-0.001	-0.0002
Inflation	0.00	0.00	0.00	0.00

and third rows) gives rise to a LR- statistic, χ^2 (2) = 1.44, which strongly confirms the validity of the restrictions.

Table 6: Long run Matrix π_3* (after imposing restrictions on the second & third rows)

Variable	RM1	GDP	Inflation	Trend
RM1	0.19	0.08	-0.04	-0.008
GDP	0.00	0.00	0.00	0.00
Inflation	0.00	0.00	0.00	0.00

7. Testing for weak exogeneity for broad money:

As explained earlier, testing for weak exogeneity reduces to testing restrictions on the row(s) of α matrix, which contains the speed of adjustment coefficients. On the other hand, matrix π is the product of α to β'. So, if we impose a zero row restriction on α matrix, this affects the corresponding row of matrix π.

Hence a comparison between π and π^* (the two matrices before and after imposing restriction) respectively is equivalent to testing the significance of imposing restrictions. Consequently, if the likelihood ratio statistics calculated imposing restrictions on the rows of that matrix are statistically zero, the corresponding variable should be non modelled in the VAR.

In this study, π_1^*, π_2^*, and π_3^* are matrices π after imposing restrictions on the second row, the third row and the last two rows respectively. For instance, the null hypothesis to be tested for the weak exogeneity of the first independent variable, GDP, would be

$$H_0 : \alpha_{1i} = 0 \quad \text{against } H_1 : \alpha_{1i} \neq 0 \quad \text{for } i = 1,...4.$$

Imposing zero restriction gives the likelihood ratio, which is less than its critical value, leading the null hypothesis not to be rejected. This means that the diagnostic statistic $-T\sum[(\text{Ln}\ (1-\lambda i^*) - \text{Ln}\ (1-\lambda i)]$ is not significantly different from zero. Therefore, GDP is exogenous to the system and does not need to be modeled explicitly. In other words π and π_1^* are not statistically different from each other.

A similar test has been carried out for the inflation rate, and since imposing zero restrictions on the third row of α matrix gives the likelihood ratio, which is less than the critical value, the conclusion also followed that the null hypothesis could not be rejected. Therefore, according to the exogeneity test the inflation rate is exogenous to the system, and this variable should be deleted from the left side of the system. This means that two matrices π and π_2* are not statistically different from each other.

Table 7: Long run Matrix π (before imposing restrictions)

Variable	RM2	GDP	Inflation	Constant
RM2	-0.24	0.08	-0.01	-0.61
GDP	-0.06	-0.008	0.0009	-0.41
Inflation	17.99	1.03	-0.40	-10

Table 8: Long run Matrix π_1*(after imposing restriction on second row)

Variable	RM2	GDP	Inflation	Constant
RM2	-0.26	0.08	-0.01	0.74
GDP	0.00	0.00	0.00	0.00
Inflation	3.54	-1.16	0.15	-10.15

Table 9: Long run Matrix π_2* (after imposing restriction on third row)

Variable	RM2	GDP	Inflation	Constant
RM2	-0.26	0.08	-0.01	0.74
GDP	-0.01	0.006	-0.008	0.05
Inflation	0.00	0.00	-0.00	0.00

We have also carried out an exogeneity test for both GDP and inflation. The result was accepting the null hypothesis. This is because the diagnostic statistic $-T\sum[(Ln\ (1-\lambda i^*) - Ln\ (1-\lambda i)$ is significantly different from zero. In other words,

The two matrices π and π^* are not statistically different from each other. Therefore, exogeneity tests on GDP and inflation imply the uniqueness of the cointegration vector. Imposing restrictions (second and third row), gives rise to a LR- test, χ^2 (2) = 0.89, which strongly confirms the validity of the restrictions.

Table 10: Long run Matrix π_3* (after imposing restrictions on the second & third row)

Variable	RM2	GDP	Inflation	Constant
RM2	-0.25	0.08	-0.01	0.70
GDP	0.00	0.00	0.00	0.00
Inflation	0.00	0.00	0.00	0.00

8. Empirical Findings

Since a causality test indicates that money can affect inflation, while an exogeneity test in Johansen Procedure shows that money is endogenous and it is affected by the inflation, we can conclude that in the short run, money causes the inflation but in the long run money cannot affect the inflation.

9. Conclusion

The main goal of this paper is to investigate the causality between money and inflation in the Iranian economy. In doing so, we have first reviewed theoretical and empirical literature of causality throughout the world, and then we used Granger's method for detecting causality between money and inflation in the Iranian economy. After using FPE criterion we calculated a causality test and concluded that money and inflation in the Iranian economy share a bi-directional causal relationship. We then used Johansen procedure in order to test weak exogeneity for taking result that weather money affect inflation or vice versa, and we concluded that in the short run, money causes the inflation but in the long run money cannot affect the inflation. Hence we can conclude that in the short run monetary policy is effective and can change the prices, whereas in the long run money stock is only passive.

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