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Determinants of Inflation: The Case of Iran

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Abstract

This study examines the factors that affect the rate of inflation in Iran. The data used in this study were collected from the period of 1965 to 2012. Using Augmented Dickey Fuller (ADF) test for ascertaining the presence of unit root and stationarity of the series and Johansen co-integration test is used to explore the presence of long-run relationship among the series. An Error Correction Model is also used to capture the convergence of the inflation determining factors to achieving long run equilibrium. Findings show there exist a long run relationship between variables of money supply, gross domestic product, oil export revenue and Inflation. Error correction model shows short-run equilibrium takes place to equalize the model in long-run.

Key words

Inflation, Money Supply, Gross Domestic Product, Oil Export Revenue, Iran.

1 Introduction

Inflation is an important issue for a country. One of the important challenges for the government is to stabilize price and control it. Inflation causes various types of economic and political problems. The inflationary impulses, in particular, not only worsen the general economic well-being of the population by eroding the little purchasing power it has but also increase social tension and shake the confidence of general public in the social and economic fabric of the country. Worse still, such an environment makes rational economic calculations increasingly difficult for the national policy-making bodies. For the purpose of spearheading the task of economic development in Iran, a better understanding of the country's inflation determinants is, therefore, warranted to initiate appropriate policy measures to contain the price pressures. This study is an attempt to contribute additional insights toward that understanding.

The objective of present research is to study factors affecting inflation in Iran during the period of 1965-2012. Specifically, the study examines empirically the impact of money supply, gross domestic product and oil export revenue on inflation. For this purpose, the study makes a set of following testable hypotheses:

There is positive relationship between money supply and inflation.

There is negative relationship between gross domestic product and inflation.

There is positive relationship between oil export revenue and inflation.

The rest of this paper is organized as follows: The next section contains literature review and the section III deals with the data and methodological issues. Section IV presents empirical results, while Section V concludes the paper.

2 Literature Review

2.1. Theoretical Literature

Inflation is a persistent and appreciable rise in the general level of prices. There are several theories explaining the determinants of inflation. Some of the major theories include; Quantity theory of money, Keynesian theory, monetarism and structuralism.

Quantity Theory of Money is used by Classical and neoclassical economists to explain the sources of inflation. The Quantity theory of money as expressed by Irving Fisher (1911) is given as: MV=PY where, M is money supply, V is velocity of money, P is general price level and Y is real output. The theory is built around two assumptions: constant velocity of money and full employment of resources. The assumption of full employment implies that the level of real output (Y) is constant. Alfred Marshall (1923) modified the quantity theory of money by introducing liquidity preference into the quantity equation: M = k PY where M is money supply, k is the fraction of income people wish to hold in the form of money, P is price level and Y is real output. Change in the preference of holding money reflected in change in k may produce large and quick changes in output and prices. The implication of Alfred Marshall's version of Quantity theory of money is that inflation is explained not only by increase in money supply, but also by psychological change in liquidity preference. The classical/neoclassical theory of inflation has two essential characteristics: first, inflation is a full

employment phenomenon and second, inflation is a money supply phenomenon.

Monetarism has its roots in the classical/neoclassical economic theory. Monetarists follow the same line of reasoning as the classical/neoclassical theorists. They only differ in respect to the assumptions on constant velocity of money and constant level of real output. Friedman (1968, 1970), consider money as an asset or capital good thus, its demand is like the demand for a capital good. Based on the fact that velocity of money does not change in the short-run but does in the long-run in a steady manner, Friedman concluded that, money supply and velocity of money could be treated as existing independently of one another. Considering this as the case, he concluded that, money national income (Y) in the original quantity could be traced almost exclusively to changes in the money supply. This argument by the monetarists therefore suggests that in the long-run, growth in the money national income could only be achieved through adherence to steady long-term growth in the money supply. Based on this, since velocity of money is constant in the short-run, it implies that changes in money national income (Y) must be equal to and move in the same direction as money supply changes, if the price level is to remain steady. This implies that any increases in money supply beyond the increases in money national income will lead to increases in the general price level. Hence when the rate of growth in money supply is greater than that of gross domestic product in the long run, inflation is the ultimate result. A famous statement of this theory is that "inflation is always and everywhere a monetary phenomenon".

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Keynesian theory argues that, excess demand for goods and services result in inflation which is in line with the monetarist theory, but they differ in respect to what generate the excess demand in the economy. For the Keynesian, excess-demand is the result of increases in aggregate demand in the economy rather than just increases in money supply. They argue that, money supply is only one of the factors that influence aggregate demand and therefore cannot solely be responsible for increases in the general price level. In the Keynesian case money has inflationary impact indirectly through interest rate.

Structuralism argue that a conventional explanation of inflation in terms of aggregate demand and supply does not apply in the presence of structural constraints or bottlenecks which are inherent in the economic fabric of the developing countries. Hence the structuralism hypothesis stresses on the "structural vulnerability" of the developing economies that makes them particularly inflation-prone. The idea linking inflation to country-specific structural factors, date back to the influential studies of Streeten (1962) and Baumol (1967).The structuralism distinguishes between the autonomous and the propagation elements in inflation in developing countries. The autonomous elements represent shocks that impinge on the system initiating or accentuating inflation. There are the four major autonomous elements: output mix between agricultural and non-agricultural origins of gross domestic product, export instability, rigidity of food supply and scarcity of foreign exchange. The propagation elements represent the ways that system responds to or accommodate shocks. The major propagation elements are the wage-price spiral, "induced" budget deficits and exchange rate changes. The structuralism argues that price stability can only be achieved through selective and managed policies for economic growth.

2.2. Empirical Studies

In this part, some empirical studies which examine the relationship between inflation and its determinants will be reviewed.

Bahmani-Oskooee (1995) investigated the causes of inflation during post- revolution in Iran. He used a monetary model of inflation, which enter variables such as exchange rate and import prices to expand it. Results show that inflation is not a monetary phenomenon and other factors such as exchange rate and production play an important role in creating inflation in Iran.

Tavakoli & Karimi (1999) investigated factors affecting inflation in Iran using data for the period 1959 to1996. Vector Auto-Regression (VAR), Variance Decomposition (VADs), and Impulse Response Function (IRFs) methods have been used. The study found that import price index has most important impact on inflation in the period of study and it is more strongly affected as compared to money supply and government expenditure.

Olin & Olumuyiwa (2000) examine the major determinants of inflation in Iran during 1989-1999. In their model, inflation is a function of excess money supply, monetary growth, exchange rate premium, and lagged value of inflation. More specifically, the study demonstrates that the combined effect of excess money supply and monetary growth are main determinants of inflation.

Kazerouni & Asghari (2002) tested the compatibility of monetarist inflation model with rational expectation and the characteristic of Iranian economy on the basis of theoretical framework. Results show that inflation and money growth are convergence and in long run 1 percent increase in money growth leads to 0.9 percent increase in inflation growth. On the other hand, the relation of one-to-one hypothesis between cited variables cannot be rejected. It means that inflation in Iran is a monetary phenomenon.

Nasr Esfahani & Yavari (2003) analyzed the effects of real and nominal variables on inflation in Iran. The study employed the seasonally adjusted quarterly data from 1971 to 2001. The analysis by applying Vector

Autoregressive (VAR) model revealed that the root of inflation is not just monetary. In Iran, the chronic inflation is also related to the actual variables. In short term inflation shocks, liquidity and exchange rate were effective variables and in the medium term, stable inflation largely depends to expected inflation but in long term actual sector shocks have important impact on inflation.

Abbasi Nejad & Tashkini (2004) investigated long run relationship between inflation rate and monetary policies in the case of Iran. The study employed the Engle Granger, Julius Johansen and Autoregressive Distributed Lag (ARDL) methods by utilizing data for the period 1960 to 2001. The results show that 10 percent of money growth leads to 3 percent increase in the general price level. Also, they have not accepted hypotheses of inflation as a monetary phenomenon and believe that GDP, import price index and exchange rate are as important factors influencing inflation in Iranian economy.

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Emadzadeh et al. (2006) examined factors influencing inflation in Iran during the period 1959-2003. The analysis by applying simultaneous equations system revealed that liquidity, imported inflation, expected inflation, production gap, have respectively positive impact.

Pahlavani & Rahimi (2009) examined the major determinants of inflation in Iran, using annual time series data between 1971 and 2006 and adopted the ARDL approach. Results reveal that the main determinants of inflation in the long-run are the liquidity, exchange rate, the rate of expected inflation and the rate of imported inflation. These variables also have significant effects on the inflation rate in the short run. The error correction estimate obtained (-0.3995) was negative and statistically significant.

Sadeghi et al. (2010) studied factors influence inflation, emphasizing the size of government in the economy of Iran. Results show that the import price index, liquidity, and real interest rate have positive impact on inflation and there is a negative significant relationship between inflation and the size of government in the Iranian economy.

Jouhari Salmasi & Heidari (2011) investigate the causal relationship between inflation and money growth for the Iranian economy. The bounds test results reveal that a long-run co-integration relationship exist between money growth and inflation.

3 METHODOLOGY

3.1 Model Specificatio

Based on the literature cited above, a variety of models has been employed to explain factors affecting inflation. This study suggests that inflation is the function of money supply, gross domestic product and oil export revenue. In other words, money supply, gross domestic product and oil export revenue were used as independent variables. In order to determine the impact of these variables on inflation, the simple regression equation is explicitly specified in functional form as follows:

INF = F (M2 + GDP + OREV)

Where

INF= inflation rate, M2= money supply, GDP= gross domestic product and OREV = oil export revenue.

3.2 Data and Estimation Technique

In order to perform the required analysis, secondary time series data covering the period from 1965 to 2012 has been used. For analysis, the data has been taken from Central Bank of Iran. Data include the annual series data on variables of inflation rate, money supply, real gross domestic product, and oil export revenue.

First, the Augmented Dickey-Fuller (ADF) test was conducted on the series in order to detect the presence of unit root, the presence of which could make the regression result spurious. The unit root test also helps ascertain the order of integration of the series, which is necessary to explore the long run relationship among the variables via the co-integration test. Second, Johansen co- integration has been applied to examine the long run relationship among the variables. A necessary condition for co-integration is that variables are integrated of the same order, i.e. I (d), d >o. So, we will use the Augmented Dickey Fuller test (ADF) to establish the stationary status of all variables. Third, Error Correction Model (ECM) is employed due to determine the short run relationship among the variables. Also, E. views computer software, version 8, has been used for results derivation.

4 EMPIRICAL RESULTS

4.1 Unit Root Test

The Augmented Dickey-Fuller (ADF) unit root test was applied to the logarithms of the four time series employed in the study. Table 1 reports the empirical results of the (ADF) unit root tests. The results indicate that the absolute values of ADF statistics on the level of all variables are smaller than that of the critical values which implies that these variables on their levels are non-stationary. When the first differences of these variables are considered, the test statistics exceed the critical values at 5%. Thus, we may conclude that all the variables of the model are non stationary at level but stationary at first difference, i.e., they are

integrated of first order I (1).

Table 1: Unit Root Test Result using ADF Procedure

variables level	ADF stats	prob	variables First Difference	ADF stats	Prob	Results
LINF	-3.163397	0.1045	D(LINF)	-6.425773	0.0000	I(1)
LGDP	-0.609105	0.9737	D(LGDP)	-12.70474	0.0000	I(1)
LM2	-2.464709	0.3433	D(LM2)	-3.603443	0.0405	I(1)
LOREV	-2.071770	0.5476	D(LOREV)	-6.377753	0.0000	I(1)

NOTE: * denotes significance at 5% I (1) Indicates Unit Root in level and Stationary after first difference.

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4.2 Co-integration Test

Since all the variables are non stationary and are integrated of same order, i.e., I (1), Johansen co-integration test is conducted to examine the existence of long run relationship among them. The result of co-integration test is presented in Table 2. Based on trace statistics null hypothesis of no co-integration among the variables, trace statistic is 52.24211 which is well above the 5% critical value. Thus, we reject the hypothesis of no co-integration among these variables at 5% and accept that there is one co-integrating equation. Now considering the null hypothesis of at most one co-integrating relation, trace statistics is 27.00184 which is less than 5% critical value of 29.79707. Thus we accept the null hypothesis of at most one co-integrating equation at 5% significance level. Therefore, the results of tests suggest the existence of at least one co-integrating relationships among the variables in the series at 5% level of significance. It shows a long run association between explanatory and dependent variables used in current study.

Table 3: Johansen Co-Integration Test Result (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	5% Critical Value	Prob.**
None*	0.429302	52.24211	47.85613	0.0183
At most 1	0.366033	27.00184	29.79707	0.1016
At most 2	0.113593	6.492722	15.49471	0.6373
At most 3	0.023425	1.066664	3.841466	0.3017

Trace test indicates 1 co-integrating eqn(s) at the 0.05 level.
* denotes rejection of the hypothesis at the 0.05 level.
** MacKinnon-Haug-Michelis (1999) p-values.

Estimate of long run co-integrating relationships are given below in Table 3.

Table 3: Long Run Co-integrating Equation (Normalized Coefficients)

INF	GDP	M2	OREV
1.000000	-2.508612 (0.83750)	0.007239 (0.22103)	0.294615 (0.24969)

Notes: The figures in small parentheses indicate standard error of the coefficients.

Hence the long run relationship between variables can be expressed as following equation (t-statistic in parentheses):

INF = -2.508612GDP + 0.007239M2 + 0.294615OREV
(-2.995357) (0.032751) (1.179923)

The results show that the coefficients of all the variables are as expected by hypotheses. The money supply and oil export revenue are positively related with inflation and GDP have a negative relationship with inflation. When money supply and oil export revenue increase inflation also increases. The negative sign associated with GDP suggest that increase in GDP leads to decrease in inflation in the economy. The coeffi-

cient size of GDP shows 1 percent increase in GDP will decline inflation rate by 2.5 percent.

4.3 The Error Correction Model

Now, an error correction model (ECM) is established to determine the short-run regression model. It is a convenient model measuring the correction from disequilibrium of the previous period which has a very good economic implication. ECM formulated in term of first differences, which typically eliminate trend from the variable involved, they resolved the problem of spurious regressions. ECM comes from the fact that disequilibrium error term is a stationary variable.

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The above discussion shows that co-integrating relationship exists among the all variables under consideration. When all the variables are co-integrated, so, we can run the error correction model. The results of final estimated error correction model are given in Table 4.

Table 4: Error Correction Estimates dependent variable D(INF)

Variables	Coefficients	Standard errors	t-statistics	Prob.
D(INF(-1))	-0.004608	0.15098	-0.03052	0.9758
D(INF(-2))	-0.166474	0.12635	-1.31759	0.1962
D(GDP(-1))	-1.485226	0.44179	-3.36182	0.0019
D(GDP(-2))	-2.167605	1.32377	-1.63745	0.1105
D(M2(-1))	0.665854	1.28046	0.52001	0.6063
D(M2(-2))	-0.325509	1.15486	-0.28186	0.7797
D(OREV(-1))	0.132654	0.18561	0.71469	0.4795
D(OREV(-2))	0.276761	0.22483	1.23100	0.2265
EC(-1)	-0.593003	0.13467	-4.40334	0.0001
/// Constant	0.171079	0.25999	0.65802	0.5148
R-squared	0.447662	Mean dependent var	0.080908	
Adjusted R-squared	0.305633	S.D. dependent var	0.509465	
S.E. of regression	0.424530	Akaike info criterion	1.317464	
Sum squared resid	6.307915	Schwarz criterion	1.718945	
Log likelihood	-19.64294	Hannan-Quinn criter.	1.467132	
Durbin-Watson stat	2.109427			

Besides, the estimated equation for INF along with co-integration component can be expressed as:

D(INF) = C(1) (INF(-1) - 2.5086 GDP(-1) + 0.0072 M2(-1) + 0.2946 OREV(-1) + 26.0605)
+ C(2) D(INF(-1)) +C(3) D(INF(-2)) +C(4) D(GDP(-1)) +C(5) D(GDP(-2)) + C(6) D(M2(-1)) +C(7) D(M2(-2)) + C(8) D(OREV(-1)) + C(9) D(OREV(-2)) + C(10)

Table 4 shows that the error correction term, namely C(1) in the above estimated equation, is negative expected sign which is highly significant, indicating that inflation, money supply, gross domestic product and oil export revenue are co integrated. The estimated coefficient or error correction term indicates also the

speed of adjustment any disequilibrium towards long run equilibrium state. This implies that disequilibrium created in previous time period gets corrected in successive time period. Also, in short run, the relationship between change in GDP and change in INF is negative sign, showing that increase in production leads to decrease in inflation. The relationship between change in M2, OREV and INF is positive sign; except for the two periods lagged M2 coefficient which is negative sign.

Other coefficients from C(2) to C(9), they are short run coefficients. Whether short run coefficients such as C(2) and C(3) jointly can influence dependent variable or not? We can check the question by performing Wald test. The results of Wald test are given in Table 5.

Table 5: Wald Test

Null Hypothesis	Chi-Square	Df	Probability
C(2) = C(3) = 0	1.784831	2	0.4097
C(4) = C(5) = 0	11.34242	2	0.0034
C(6) = C(7) = 0	0.270461	2	0.8735
C(8) = C(9) = 0	1.648524	2	0.4386

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As results show only short run coefficients C(4) and C(5) jointly can affect the inflation. So, one period lagged GDP and two periods lagged GDP jointly can influence dependent variable. In other words, one and two period lagged M2 and one and two period lagged OREV have no influence on the inflation. This is short run decision.

Now, in order to extract the validity of the estimated model, we use the standard diagnostic tests.

Table 6: Diagnostics Tests

Test	F-Statistics	Probability
Heteroskedasticity	1.365661	0.2285
Serial Correlation	0.333397	0.6404
Normality (Jarque-Bera)	1.001255	0.606150

The results are given in Table 6 show that the residual passed the diagnostic test of no serial correlation, no heteroskedasticity, and the residual is normality distributed.

5 Conclusion

The present study has been conducted with the aim to study factors affecting inflation in Iran, using data from 1965 to 2012. The result of co-integration shows that the inflation has long run relationship with money supply, GDP and oil export revenue. Results found support the study hypothesis. Money supply and oil export revenue have positive relationship and GDP has negative relationship with inflation during the period of study. The estimate of Error Correction Model shows short-run equilibrium takes place to equalize the model in long-run. The negative impact of GDP on inflation demonstrates that expansion of GDP is highly important for declining of the country's inflation rate. Oil export revenue plays a dual role in the country's inflation process. Due to dependence of real variables on oil export revenue, when oil export revenue boosts, real variables can be improved and it will be effective in curbing inflation by reducing aggregate demand surplus. But, on the other hand, the increase in oil export revenue, may increases public spending, so that leads to increase in aggregate demand, resulting expand monetary base through exchange earnings. Further, fluctuation in oil export revenue is also effective on inflation. Therefore, the role of oil export revenue and its fluctuations in determining of real and policy making variables must be restricted.

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