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Analysis of Domestic Price and Inflation Determinants in Iran

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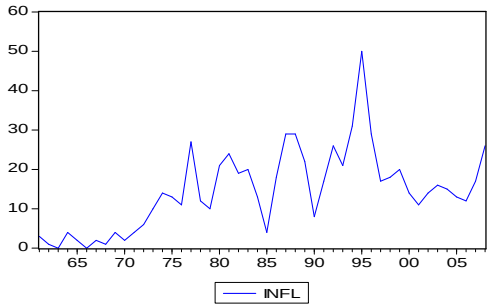
ABSTRACT

The objective of this study was to investigate both behaviour and determinants of domestic prices and inflation rate in Iran as a developing oil export based economy. We applied two models; the first model was for investigating the main determinants of domestic prices while the second model considered the main determinants of inflation rate. The period of study was from 1973 to 2008. Some econometrics techniques such as unit root test, cointegration test, error correction model and causality test were used. The results of the first model indicated that foreign prices, gross domestic product (GDP), exchange rate and the two dummy variables DT80 and DT88 (respectively for capturing the effects of Iran-Iraq war and the subsequent reconstructions after war) have significantly affected the domestic prices in Iran. Furthermore, in the short run the main determinants of domestic prices were foreign prices and DT88.
In the second model considering the Iranian economy as a developing oil export based economy we applied the model which had been suggested by Aljebrin(2006) to investigate the inflation in this kind of economies. The results show that money growth, oil production growth, non-oil GDP growth and two dummy variables DT80 and DT88 have affected Iranian inflation in long run. Moreover in the short run the main determinants of inflation were non-oil GDP growth and DT88. Our results implied that the rapid development of the non-oil sector and performing some useful policies for restructuring the economy such as diversifying the economy from the oil sector would strengthen the economy and reduce the importance of oil production as a source of inflation.
Keywords: Iran, Inflation, Domestic Prices, Oil Exports, Developing Country

1-INTRODUCTION

Iran has a history of relatively high inflation. The oil price explosion of 1973-74 fuelled rapid economic growth, but at the cost of increased volatility in the Iranian economy and an unprecedented rate of inflation. After the 1979 revolution, annual CPI inflation has been more than 19 percent on average.

Figure 1: Plot of inflation rate



Data Source: World development indicators data

The oil and gas sector is the most important driver of economic growth in Iran, because it comprises over 80% of fiscal and export revenue. The volatility of international hydrocarbons prices exposes Iran to important economic risks. Moreover, during the last fifty years, the Iranian economy has experienced several important critical events. Such as the 1979 revolution, the 1980-88 war with Iraq, and the 1993 balance of payments crisis. These shocks have affected the main Iranian macroeconomic variables and specially the inflation rate. Increases in the oil prices have increased GDP, and because of these increases, government expenditures, money supply, demand of goods and services, and other macro variables increased as well. Therefore the increases in the GDP have often been accompanied by increases in inflation rates.

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Generally, the costs resulting from inflation is not incurred by the sheer rise in prices. These costs are in fact redistribution of wealth from one group to another. For example, the employees are harmed by disproportionate rise in the price while the employer benefits. The evidence indicates that for Iranians high inflation rate has been more important than a low economic growth, because their wages, based on labour laws, increase a certain percentage annually. This increase is independent from rate of economic growth and it is not inflation adjusted. Moreover, public dissatisfaction with inflation, has forced policy makers to concern more this issue and reducing inflation to single digits has been in forefront of the policy agenda.

The objective of this study is to examine and investigate both behaviour and determinants of inflation and domestic prices in Iran as a developing oil export based economy for the period from 1973 to 2008. Obviously if we can identify the causes and determinants of inflation more clearly, the treatment of problematic inflation becomes much easier.

Developing oil export based economies have special economic structures. In these countries the government is the owner of natural resources, public services (electricity, transportation, drinking water, etc) and also the lion share of large production companies. Oil exports are the main sources for government income. Also the government is the most important employer of labour force. There are no taxes on sales and income or the rates are very low and the central bank is not independent enough. Therefore it seems that maybe it is useful to make a difference between this kind of countries with other developing and developed countries in the analyzing of inflation (Aljebrin, 2006).

The paper estimates two models for Iran. The first model uses a simple theoretical model, based on the general approach used in other studies to investigate the determinants of domestic price level in Iran. The second model investigates the determinants of inflation in Iran with this view that she has a special economical structure and her economy heavily relies on the oil. We examine that whether the inflation in Iran can be affected by the changes in oil sector and also we consider if the inflation rate has been affected by the war and the related reforms after that.

Section 2 includes a brief review over the previous studies. Section 3 introduces the structure of Iranian economy, its problems and characteristics; Section 4 discuses about the models and methodologies that we use in this research for investigating price level and inflation rate; the empirical results and econometrics estimations are included in section 5, and finally section 6 will discuss about the findings and recommendations.

2-LITERATURE REVIEW

Keynesian economists argue that changes in supply and demand in goods market cause inflation. Monetarists state that inflation is a monetary phenomenon and it is caused by excessive increase in the money supply. Structuralists consider the structure of the economy as the reason of inflation. Other economists believe that higher prices of goods and services imported from foreign countries can result in transmitted effects to the domestic economy in the form of inflation. For investigating and testing of the determinants and causes of inflation, especially in developing oil export based economies like Iran, we should consider and take into account a combination of several theories. Because this kind of economies have special characteristics and different structures. There are great deal of models and empirical studies trying to investigate the main determinants of inflation in Iran and other developing oil export based countries.

Barry (1980), investigates the effects of changes in the money supply, the government domestic expenditure, and the rate of foreign inflation on the domestic consumer price index in Saudi Arabia. His results show that for the period 1964 to 1972 excess monetary demand is caused by a high rate of increase in both the money supply and government expenditures, in addition, foreign inflation is a dominant variable in explaining the domestic rate of inflation. Government domestic expenditures and the money supply were found to be statistically significant and hence supported their importance in explaining the high rate of inflation during the period 1973 to 1978.

Darrat (1985), investigates empirically the validity of the monetary approach to inflation in the three OPEC countries Saudi Arabia, Libya, and Nigeria over the quarterly period 1960-1979. In deriving the monetary model, he has given explicit attention to the underlying money demand function. In his model, foreign monetary factors affect the domestic inflationary process through money demand. His finding that foreign interest rates positively affect inflation in each of the three economies suggests that these countries have open economies whose inflation problem is partly caused by foreign monetary factors outside the control of the domestic authorities. He argues that growth in real income has a strong dampening effect on domestic inflation (especially in Libya and Nigeria). His results indicate that the money supply growth exerts a significant and rapid impact on inflation in these countries.

Salih (1993), examines the role of the monetary stimulus and imported inflation on domestic inflation by modifying and applying Hagen's analytical framework in both aggregative and disaggregative lag schemes over the period 1970:1-1990:2 for oil exporting developing countries(especially for Kuwait). His results indicate that the depreciation of Kuwait's domestic currency had an important effect on inflation, and its effect together

with direct imported inflation continued over ten lagged quarters. He claims that the monetary policy has been a major cause of inflation.

Ghavam Masoodi and Tashkini (2005), by using auto regressive distributed lag (ARDL) method investigate the long term relationship between the inflation rate and its effective factors in Iran (during 1959-2002). Their results showed that GDP, the imported goods price index, liquidity and the exchange rate are the most significant factors contributing to inflation in Iran.

Pahlavani and Rahimi (2009), in another study, examined the major determinants of inflation in Iran using annual time series data (1971 to 2006) by applying the ARDL approach. They state that in the long-run, the main determinants of inflation are the liquidity, exchange rate, the rate of expected inflation and the rate of imported inflation. Also all of these variables had significant effects on the inflation rate in the short run. They recommend that, to reduce inflation, based on the structuralist theory, policy makers should take into account issues such as change in the production system and also changes in income distribution. They argue that the unification of exchange rate and decreasing the risk related to the exchange market causes a reduction in inflation.

Kia (2006) has used a monetary model of inflation rate, capable of incorporating both monetary and fiscal policies as well as other internal and external factors to identify the factors which influence the inflation rate in Iran for the period 1970Q1-2002Q4. He found that over the long run, a higher exchange rate leads to higher price level; moreover an unanticipated reduction in the money supply has been a powerful tool to reduce inflation. In general, he argues the major factors affecting inflation in developing countries, at least for Iran, over the long run, are internal rather than external factors. For example, the foreign interest rate has a deflationary effect in Iran over the long run while imported inflation does not exist in that country. His overall conclusion over the short run is that the sources of inflation are both external and internal factors. The external factors include the foreign interest rate and sanctions. The fiscal policy as an internal factor has been the most effective tool over the short run to fight inflation in Iran.

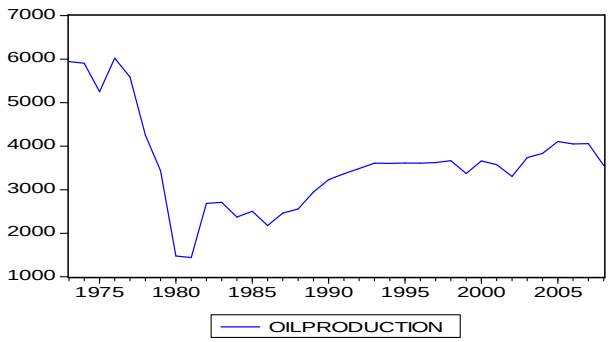
Aljebrin (2006) tries to investigate the main determinants of inflation in Saudi Arabia, Kuwait and Bahrain, using annual data from 1968 to 2002. He argues that for the purpose of considering the inflation we should make distinction between developing oil export economies and other economies. Therefore taking into consideration the characteristics of the developing oil-export based economies, he constructed a new testing model to investigate the main determinants of inflation in these economies. His finding (for Saudi Arabia) indicates that the main determinants of inflation in the long run are growth of money, growth of non-oil GDP and growth of oil prices. Also, his results show that, in the short run the main determinants of inflation are money growth and non-oil GDP growth. Because of some econometrics problems he could not consider his suggested model for Kuwait and Bahrain.

In our study we should note that for Iranian economy the oil sector plays an important role, so its inflation can be affected by oil sector fluctuations. Most of the previous studies for analyzing of the inflation in developing oil-export based countries have used the monetary approach. In this study according to Aljebrin (2006) we try to use several approaches to identify both the internal and external determinants of inflation. Also, unlike to other inflation studies for Iran, in this study we want to investigate the direct effects of oil-sector and non-oil sector changes on Iranian inflation rate by dividing the total GDP to oil GDP and non-oil GDP.

3-Economic overview

The structure and fate of the Iranian economy continues to be determined by its dependence on oil sector, as it has for most of the past 40 years." A crude oil producer since the first decade of the last century, Iran has passed through periods of boom and bust as oil prices have risen and fallen on the volatile international markets. As the recipient of the crude oil revenue, the state became, and remains, the dominant economic sector.

Figure 2: Plot of the oil production (thousand barrels per day)



Data source: Central Bank of Iran(CBI) data

The oil sector's share of nominal GDP has declined from 30-40% in the 1970s to 10-20%, mainly as a result of war damaged to production facilities (Iranian output still stands below its pre-war highs) and OPEC output ceilings. However, oil revenue still provides some 80-85% of export earnings and anywhere between 40% and 80% of government revenue. The development of the non-oil industrial sector has been undermined by a poorly functioning state-dominated banking system and the dominance of state or quasi-state actors."[1]

Table 1: Government oil revenue (% share of government total revenue)

Year	%	Year	%	Year	%	Year
1973	67	1982	68	1991	51	2000
1974	86	1983	64	1992	52	2001
1975	79	1984	52	1993	73	2002
1976	77	1985	45	1994	73	2003
1977	74	1986	25	1995	71	2004
1978	63	1987	39	1996	67	2005
1979	72	1988	39	1997	58	2006
1980	67	1989	48	1998	42	2007
1981	60	1990	60	1999	48	2008

Data Source: Central Bank of Iran

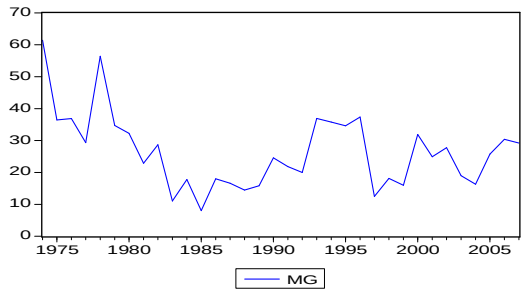
"The services sector has weathered currency-exchange restrictions, excessive bureaucracy and uncertain long-term planning better than industrial sectors and, despite some volatility, has seen the greatest long-term growth in terms of its share of GDP. State investment has boosted agriculture, and some liberalization of production and the improvement of packaging and marketing have helped to develop new export markets."[2]

The chaos of the post-revolution environment, the demands of the eight-year war with Iraq, and later by international isolation, US sanctions and a severe power struggle inside the political institutions hit the economy policy-making so that it has been irregular for much of the post-revolutionary period. There has not been a continuous and coherent strategy to develop the economy and to increase the role of the private sector for diversifying the economy away from its dependence on oil revenues. The economy has been dominated by the state and using of multiple exchange rates, heavy subsidy payments on a wide range of goods and severe trade control has distorted the growth, as Iran, up until the end of the 1990s, was compelled to preserve foreign exchange to meet its heavy foreign-debt obligations. On the other hand, foreign investment flows have been very low, because a variety of legal obstacles and business environment failings has mainly limited foreign capital to oil sector.

However, for collecting above-budget oil revenue an oil stabilization fund (OSF) was established at the start of 2000/01. This fund wanted to compensate revenue deficits during years when oil earnings are low and also to lend to export-oriented private-sector non-oil projects approved by central bank. A privatization process was also started and some sectors of the economy which previously used to be controlled by the state have been opened to the private sector. Bank Markazi has followed to encourage the performance of the state-owned banks through a process of recapitalization and there were some actions to liberalize trade rules by removing of monopolies on the import of some goods that previously were under the control of politically powerful firms and organizations.

The central bank is not independent enough and it has only limited tools to affect monetary conditions. The government dictates what proportion of lending by the state banks is allocated to each sector and according to production goals, the profit rates are set at the start of each year. The government is also responsible for targeting broad money. However, because of the lax credit lending and historically low profit rates money supply has increased which, in turn has become an important factor in rising up the inflation of Iran.

Figure 3: Money (M2) growth



Data Source: Central Bank of Iran (CBI) data

[1] Economist Intelligence Unit, 2008, Country Profile.
[2] Economist Intelligence Unit, 2008, Country Profile.

4-Methodology and Modeling

In this study we will apply some econometrics tests. The unit root test is important to ensure that all variables included in the model are stationary. This makes prediction of future values sensible. When variables are non-stationary, we still can investigate the relationship among them using the cointegration test. The idea is to test if we can build a long run relationship among variables that are non stationary. The error correction model (ECM) combines the short run and the long run relationships of the variables in one equation. It confirms the existence of the long-run relationship among the variables. Finally, the causality test helps testing if a causal relationship exists between two variables. If one variable is causing the other variable, then the first variable contains some useful information about the latter that enables us to predict its future values efficiently. In this study we try to follow the approach proposed by Aljebrin (2006). We estimate two models for considering the main determinants of domestic prices and inflation rate.

4.1 The first model

Our first model presents a simple theoretical model which is constructed from the basis of the general approach used in other inflation determinants studies on developed and developing economies following e.g., Ubide, (1997); Kim, (2001); Aljebrin, (2006).

The standard assumption is that the general price level can be expressed as a weighted average of the price of tradable goods (P^T) and non-tradable goods (P^{NT}):

$$LogP_t = \theta(LogP_t^T) + (1-\theta)(LogP_t^{NT}) \quad (1)$$

Where θ is the share of tradable goods in the consumption basket and 0< θ <1.

The standard assumption of small country and purchasing power parity (ppp) implies that the price of tradable goods is determined in the world market and depends on foreign price (P^f) and on the exchange rate (e):

$$LogP^T = Loge_t + Logp_t^f \quad (2)$$

The price of non-tradable goods is determined by the money market equilibrium condition, where real money supply ($M^s / p = m^s$) equals real money demand (m^d):

$$LogP_t^{NT} = \beta(Logm_t^s - Logm_t^d) \quad (3)$$

β is a scale factor and it shows the relationship between economic-wide demand and demand for non-tradable goods. Moreover we assume that the demand for real money balances depends on real income (y) and inflationary expectations[3]. ($E(\pi_t)$)

$$m_t^d = h(y_t, E(\pi_t)) \quad , \quad f_1 > 0, f_2 < 0 \quad (4)$$

According to the theory of rational expectations, rational agents can predict the changes in policy stance and they adjust their behaviour with changes in the policies, then any inference that does not clearly take into account expectations can make systematic predictive errors. There are different ways to model expected inflation (E (π_t)). Here we will use the following form:

$$E(\pi_t) = d(L(\pi_t)) + (1-d)\Delta LogP_{t-1} \quad (5)$$

Where $L(\pi_t)$ illustrates a learning process for the agents of the economy. We will have adaptive expectations if all the weights in $L(\pi_t)$ are equal, and we will have a learning process if the weights decrease with time. Hence, people with considering previous inflation and past experience in forecasting inflation will form their expectations. For simplifying, we assume that d=0.

Then we will have

$$E(\pi_t) = \Delta LogP_{t-1} \quad (6)$$

With substituting we can write:

[3] - We assume that the relevant substitution is between goods and money, and not among different financial assets. So the interest rate is not included in our money demand function as an explanatory variable.

$$LogP_t = \theta(Loge_t + Logp_t^f) + (1-\theta)\beta(Logm_t^s - Logm_t^d) \quad (7)$$

And

$$Logm_t^d = h(Logy_t, \Delta LogP_{t-1})) \quad (8$$

Therefore

$$LogP_t = H(Loge_t, Logp_t^f, Logm_t^s, Logy_t, \Delta LogP_{t-1}) \quad (9)$$

Finally, we can estimate the following equation as our first model,

$$LogP_t = \alpha_1 \log m_t + \alpha_2 \log y_t + \alpha_3 \Delta \log P_{t-1} + \alpha_4 \log e_t + \alpha_5 \log P_t^f \quad (10)$$

4-2-The second model

Aljebrin(2006), taking into consideration the characteristics of developing oil export countries has proposed another testing model to investigate the causes and determinants of inflation in these economies. In the second model we disaggregate the total GDP to oil-GDP and non-oil GDP, bearing in mind that oil is a wealth not a GDP, whose revenue is used to modernize the infrastructure of country and improve the social lives of citizens through government expenditures. Also, bearing in mind that, non-oil GDP is tied to the oil GDP and it changes as a result of the oil GDP changes. So, we will use each sector (oil and non-oil) separately (disaggregate GDP) as explanatory variables in this model, because each sector is hypothesized to have its own dynamic effect on inflation.

Base on Keynesian and Monetarists schools of thought we can say that inflation (π) is a function of money supply growth ($\dot{M}$) and total output growth ($\dot{Y}$).

$$\pi_t = f(\dot{M}_t, \dot{Y}_t) \quad (11)$$

Total output growth rate ($\dot{Y}$) is a function of oil output growth rate ($\dot{OY}$) and non-oil output growth rate ($\dot{NOY}$).

$$\dot{Y}_t = h(\beta \dot{OY}_t, (1-\beta)\dot{NOY}) \quad (12)$$

Where β represents the contribution of oil GDP to total GDP and $1-\beta$ represents the contribution of non-oil GDP to total GDP.

Oil GDP growth rate ($\dot{OY}$) is a function of the oil price growth rate ($\dot{OP}$) and the oil production growth rate ($\dot{OPRO}$). Therefore:

$$\dot{OY} = \dot{OP} + \dot{OPRO}_t \quad (13)$$

With substituting, we will have:

$$\dot{Y}_t = h(\beta \dot{OP}_t, \beta \dot{OPRO}_t, (1-\beta)\dot{NOY}_t) \quad (14)$$

Finally we can estimate the following equation as our second model.

$$\pi_t = f(\beta \dot{OP}_t, \beta \dot{OPRO}_t, (1-\beta)\dot{NOY}_t, \dot{M}_t) \quad (15)$$

5-Empirical results

In this section we will use annual data from 1973 to 2008 to estimate the models. The data has been collected from different sources such as the Energy Information Administration (EIA), the Central Bank of Iran (CBI), the National Iranian Oil Company (NIOC) and the World Development Indicators (WDI).

5-1-Estimation of the first model

The testing model includes domestic prices (p) as dependent variable and the explanatory variables are gross domestic product (GDP), money supply (m), exchange rate (e), the past change in domestic price (ΔP_{t-1}), and foreign prices (P^f). Moreover to capture the effect of the Iran/Iraq war period (1980-1988) as an important structural break in Iran's economy and also the subsequent reconstructions after the war, two trend shift dummy variables DT(80) and DT(88) have been included in the model which DT(80) is equal to (t-1980) if (t>1980) and zero otherwise. DT (88) is equal to (t-1988) if (t>1988) and zero otherwise.

In this model, we will use the logarithmic form (Log) of the variables and we will estimate the following

equation (L represents the Log):

$$LP_t = \alpha_1 LM_t + \alpha_2 LGDP_t + \alpha_3 \Delta LP_{t-1} + \alpha_4 Le_t + \alpha_5 LP^f + \alpha_6 DT80 + \alpha_7 DT88$$

$$\alpha_1, \alpha_3, \alpha_4, \alpha_5, \alpha_6, \alpha_7 > 0 \quad , \quad \alpha_2 < 0 \qquad (16)$$

According to the literature and especially under the quantity equation (MY=PY) the relationship between the money supply and price is found to be positive. According to economic theories, the relationship between the real GDP and prices is negative, in the other words when prices decrease, real income (Y/P) increases and vice versa. It is clear that the relationship between the past change in price and current price will be positive, because when inflation has been high in the past, it is expected that prices will increase in the future. According to the small open economy model with fixed exchange rate, the relationship between exchange rate and the domestic prices is positive. According to the price effect channel, which is one of the international inflation transmission channels to domestic economies, the international inflation can affect the domestic prices through the higher prices of imported goods and services, in the other words the relationship between foreign prices and domestic prices is positive.

After the Islamic revolution of Iran and especially after the starting of war with Iraq, the Iranian economy was faced with some serious restrictions which seem they have affected the domestic prices positively. On the other hand, after finishing the war Iranian government started some programs to reconstruct the ruins which had reminded from the war and it followed some policies to revive the economy which also they could influence the domestic prices positively.

Because of the problem of multicollinearity among the variables in equation (16) we will drop the multicollinear variable (ΔP_{t-1}) and will carry out our estimations with other variables. Therefore our final estimation is as follows:

$$LP_t = \alpha_1 LM_t + \alpha_2 LGDP_t + \alpha_3 Le_t + \alpha_4 LP^f + \alpha_5 DT80 + \alpha_6 DT88 \qquad (17)$$

Unit root test results in table (2) indicate that all variables are integrated of order one, i.e. I(1).

Table 2: ADF Unit Root Test

Variables	First difference
LP	-3.646**
Le	-5.758***
LGDP	-3.753***
Lm	-3.662***
LP^f	-2.697*

***: Null hypothesis rejection at 1%
**: Null hypothesis rejection at 5%
*: Null hypothesis rejection at 10%

We will apply the Johansen cointegration test to determine the long run relationship between the variables in our model, to reveal whether they are cointegrated or not. The cointegration rank is examined by comparing the Max-Eigen statistic to the critical values at five percent. Table (3) shows the results of the Johansen cointegration test. The hypothesis of at most four cointegration equations is not rejected at 0.05 level of significance. So, there are four cointegration vectors among the variables of the equation. Therefore the outcome of the cointegration equations shows that there is a long-run relationship between the variables.

Table3: Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob**
None*	0.846	61.806	46.231	0.001
At most 1*	0.819	56.448	40.077	0.000
At most 2*	0.667	36.311	33.876	0.025
At most 3*	0.568	27.732	27.584	0.048
At most 4	0.442	19.296	21.131	0.088
At most 5*	0.367	15.133	14.264	0.036
At most 6	0.038	1.285	3.841	0.256

Max-eigenvalue test indicates 4 coitegration eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-value

From the one cointegration equation, the coefficient for Le is (-0.05) with a t-stat of (-1.81). According to the t-test at five percent level of significance it is nearly to be significant and the sign is what was expected. For

Lm, the coefficient is (-0.068) with a t-stat of (-0.53). The sign is what was expected but it is not significant. In addition, for LP^f, the coefficient is (-0.93) with a t-stat of (-2.11) which is significant and the sign is what was expected. The coefficient for LGDP is (2.05) with a t-stat of (11.39), which is significant and the sign is what was expected. Finally for DT80 and DT88 the coefficients are (-0.07) and (-0.15) respectively with t-stat's of (-5.69) and (-5.51) which are significant and it means that, starting the war between Iran and Iraq and also the restructuration of the economy after the war have positively affected the level of prices (CPI).
The testing for a long-run relationship between LP and Le, Lm, LP^f, LGDP, DT80 and DT88 generated the following cointegration equation (t-statistic in parentheses):

$$\underset{}{LP} - \underset{(-0.53)}{0.068Lm} + \underset{(11.39)}{2.05LGDP} - \underset{(-2.11)}{0.93LP^f} - \underset{(-1.81)}{0.05Le} - \underset{(-5.69)}{0.07DT80} - \underset{(-5.51)}{0.15DT88} = ECT_{t-1} \qquad (18)$$

We will use a causality test to identify the direction of the long-run and short-run relationship among the variables. In our case, because the variables are nonstationary, we will not use the standard causality test, instead we will use a technique which involves taking the first difference and estimating the equation by adding the Error Correction Term (ECT). This technique is called Error Correction Model (ECM).
Using the following Error Correction Equations:

$$\Delta Y = \beta_1 + \sum_{i=1}^{p} [\alpha_1 \Delta Y_{t-i} + \gamma_1 \Delta X_{t-i}] + \lambda_1 ECT_{t-1} + \varepsilon_{t1} \qquad (19)$$

$$\Delta X = \beta_2 + \sum_{i=1}^{p} [\alpha_2 \Delta Y_{t-i} + \gamma_2 \Delta X_{t-i}] + \lambda_2 ECT_{t-1} + \varepsilon_{t2} \qquad (20)$$

Where X_t and Y_t have been identified as first-differenced stationary, cointegration time series, ECT_{t-1} is the error correction term lagged one period and represents the disequilibrium residuals of a cointegrating equation. Four cases for the causality test can be possible. First, no causality exists between X and Y. Second, there is unidirectional causality from X to Y. Third, there is unidirectional causality from Y to X. Fourth, there is bidirectional causality or two-way causality. One of the causation sources can be recognized by testing for significance of the coefficients on the dependent variables in equations (19 and 20). In other words testing $H_0 : \gamma_i = 0$ for all i in equation (19), or $H_0 : \alpha_i = 0$ for all i in equation (20), show a Granger causality. Other causation sources are the Error Correction Term (ECT_{t-1}), in both equations (19 and 20). The ECT_{t-1} coefficients symbolize how fast the departure from the long run equilibrium is eliminated following change in each variable, by testing a simple t-test, if β_1 is zero, then Y does not respond to a departure from the long-run equilibrium in the past period.
The two sources of causality significant must be analyzed together to check for causality. The analysis of causality in the ECM is applied in three stages according to Anwer et al. (1996). Combined hypothesis $H_0 : \beta_1 = 0$ and $H_0 : \gamma_i = 0$ for all i in the equation (19) or $H_0 : \beta_2 = 0$ and $H_0 : \alpha_i = 0$ for all i in equation (20) is tested. If the null hypothesis is not rejected, that means the variables don't have causality and no further testing will be performed. On the other hand, in the case of rejection of the null hypothesis, then causality exists and an evaluation of the source of the causality is required. It is important to find out if the causality is related to the terms of the error correction or to short term stationary variation. The second step of the analysis of causality in the ECM is to test the significance of the γ_i and α_i to verify the possibility of a short run causality. The third step is to analyze the direction of the β's to check if there exists a long run equilibrium relationship (Aljebrin,2006).
According to the results of the error correction model illustrated in table (4), we can find that the sign of error correction term for LP is different from the sign of the cointegration equation. This means that LP adjusts to the shock in the long run and t-statistic is significant. Le, LP^f ,LGDP, DT80 and DT88 signs of ECT are also different from the sign of cointegration equation but the t-statistic's are not significant. Lm sign of the error correction term is not different than the sign of the cointegration equation, which means it does not adjust to the shock in the long run and the t-statistic is not significant.

Table 4: Granger (Long run) causality test based on VECM

		ΔLP	ΔLe	ΔLm	ΔLPf	ΔLGDP	ΔDT80	ΔDT88
	ECT_{t-1}	-0.43	2.73	-0.34	0.01	-0.23	0.83	0.45
	t-stat	-2.41	1.43	-1.85	0.19	-1.30	0.67	0.69

The results of the error correction model demonstrate that there exists a long run unidirectional causality(one way causality), from exchange rate(Le), GDP(LGDP), money supply(Lm), foreign prices (LP^f), DT80 and DT88 to domestic prices(LP), but there is not any long run causality from LP to other variables. In other words the results of the error correction model show that the domestic prices(LP) is Granger caused by the exchange rate(Le), money supply(Lm), GDP(LGDP) , foreign prices(LP^f) , the dummy variables (DT80) and (DT88).

Table (5) illustrates the results of the chi-statistics and associated P-value for the short-run causality between domestic prices and the explanatory variables (Le, Lm, ΔLP^f , LGDP, DT80 and DT88).

TABLE 5

Granger (Short run) causality test based on VECM

ΔLP ←	ΔLe	ΔLm	ΔLP^f	ΔLGDP	ΔDT80	ΔDT88
P-Value	0.294	0.621	0.061*	0.602	0.342	0.022**
& Chi-sq	2.443	0.951	5.578	1.014	2.142	7.661
ΔLP →	**ΔLe**	**ΔLm**	**ΔLP^f**	**ΔLGDP**	**ΔDT80**	**ΔDT88**
P-Value	0.323	0.999	0.190	0.943	0.462	0.791
& Chi-sq	2.256	0.002	3.318	0.117	1.543	0.469

*,**,*** indicates that a test is significant at the 10%, 5%, 1% level of significance, respectively. (Chi-sq in parenthesis)

According to the results, there exists a unidirectional causality from LP^f and DT88 to LP. The results indicate that foreign prices and DT88 cause domestic prices in the short run, but there is not any causality between LP and Le ,Lm, LGDP,DT80.

In table (6), a summary of causality direction in long-run and short-run is demonstrated.

Table 6: Summary of causality directions

In the Short-Run			**In the Long-Run**		
LP	No	Le	LP	←	**Le**
LP	No	Lm	LP	←	**Lm**
LP	←	LP^f	LP	←	**LP^f**
LP	No	LGDP	LP	←	**LGDP**
LP	No	DT80	LP	←	**DT80**
LP	←	**DT88**	**LP**	←	**DT88**

Unlike to Aljebrin, who applied this model for other countries, our estimations for Iranian economy illustrated acceptable results which are to a large extent consistent with the theories.

5-2-Estimation of the second model

In the second model the domestic inflation rate (π_t) is the dependent variable, and the explanatory variables are weighted non-oil income growth rate (WNOGDPG), weighted oil price growth rate (WOPG), weighted oil production growth rate (WOPROG), and money supply growth rate (MG). Moreover, two dummy variables DT80 and DT88 have been used. Therefore our estimated equation is as follows:

$$\pi_t = \alpha_1 WOPG_t + \alpha_2 WOPROG_t + \alpha_3 WNOGDPG_t + \alpha_4 MG_t + \alpha_5 DT\,80 + \alpha_6 DT\,88$$

$$\alpha_1, \alpha_2, \alpha_4, \alpha_5 > 0 \qquad , \alpha_6 < 0 \qquad , \alpha_3 > 0 \;\; or < 0$$

(21)

The proxy used for oil prices is the price of light Iranian Oil. The oil price will be weighted by the percentage contribution of oil GDP to the total GDP. According to the cost push inflation model, we can expect that the relationship between oil price growth and the inflation rate to be positive. Oil production is measured by barrels. The oil production will be weighted by the percentage contribution of oil GDP to the total GDP. In the economics literature, the relationship between growth rate of oil production and the inflation rate is discussed to be positive. According to the Keynesian, when price increases, the suppliers increase their supplies. This means that when the growth rate of oil price increases, the oil production growth rate increases; therefore, the inflation rate will increase and vice versa.

The non-oil GDP will be weighted by the percentage contribution of non-oil GDP to the total GDP

(WNOGDPG). The relationship between growth of non-oil GDP and inflation is not clear. Depended on the aggregate demand or aggregate supply model, the relation could be negative or positive. On the demand side, when prices decrease, the aggregate demand increases which lead to increase in the total output (negative relationship between non-oil GDP and inflation). On the other hand, on the supply side, when prices increase, the aggregate supply increases which lead to increase the total output (positive relationship between non-oil GDP and inflation). In the literature and especially according to the monetarists, the relationship between money growth and inflation rate is argued to be positive. Also, we expect that the occurrence of war with Iraq, affected the Iranian inflation positively. Because it damaged the production sector and created some limitations for import and caused some sanctions against Iran, but after the war Iranian government started to do some policies for restructuring the economy with a tendency for reducing the inflation rate.
Unit root test results in table (7) illustrate that all variables are stationary at their first differences.

Table 7: ADF Unit Root Test

Variables	First difference
π	-3.98**
MG	-3.28*
WOPG	-6.09***
WOPROG	-5.53***
WNOGDPG	-3.95**

***: Null hypothesis rejection at 1%
**: Null hypothesis rejection at 5%
*: Null hypothesis rejection at 10%

To determine the long run relationship between the variables in our model, we will use the Johansen cointegration. The cointegration rank is examined by comparing the Max-Eigen statistic to the critical values at five percent. The results of the cointegration test are illustrated in table (8). The test was performed for all variables in level.

TABLE 8: Unrestricted Cointegration Rank Test (Maximum-Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob**
None*	0.931	85.743	46.231	0.000
At most 1*	0.876	67.035	40.077	0.000
At most 2*	0.798	51.331	33.876	0.000
At most 3*	0.638	32.541	27.584	0.011
At most 4*	0.562	26.424	21.131	0.008
At most 5*	0.373	14.961	14.264	0.038
At most 6	0.011	0.351	3.841	0.553

Max-eigenvalue test indicates 6 coitegration eqn(s) at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
** Mackinnon-Haug-Michelis (1999) p-value

According to the cointegration test the hypothesis of at most six cointegration equations is not rejected at 0.05 level of significance. Accordingly, there exists six cointegrating vector among the variables of equation. Since we are interested in the long run relationship between the dependent variable and the independent variables in our model, then we will use the one cointegrating equation in our analysis of the long run relationship between the variables in our model.
The test for a long-run relationship between variables produced the following cointegration equation (t-statistic in parentheses):

$$\pi - 0.48MG + 0.32WNOGDPG - 0.31WOPG - 5.72WOPROG - 4.25DT80 + 4.9DT88 = ECT_{t-1} \quad (22)$$

$$(-3.87) \qquad (1.52) \qquad (-0.82) \qquad (-16.29) \qquad (-6.44) \qquad (7.17)$$

The coefficient for MG is (-0.48) with a t-stat of (-3.87), which is significant according to t-test at 5% level of significance and the sign is what was expected. The WNOGDPG coefficient is (0.32) with a t-stat of (1.52), which is not significant, and the sign is negative and it was expected based on the demand side analysis. For WOPG, the coefficient is (-0.31) with a t-stat of (-0.82). The sign is what was expected, but it is not significant. The coefficient for WOPROG is (-5.72) with a t-stat of (-16.29) which is significant and the sign is what was expected. Finally, the coefficient for DT80 and DT88 are (-4.25) and (4.9) respectively with t-stat's of (-6.44) and (7.17) which are significant and their signs are what was expected.

To apply the causality test, the Error Correction Model (ECM) will be used. According to the results of the error correction model illustrated in table (9), we can find that the sign of the error correction term for π is

different from the sign of cointegration equation and the t-statistic is significant, which means that π adjusts to the shock in the long run. The signs of error correction term for MG, WNOGDPG, WOPG, DT88 are different from the signs of the cointegration equation, but the t-statestic's are not significant for them. For WOPROG and DT80, the outcome shows that the sign of the error correction term are the same of the sign of the cointegration equation and the t-statistic's are not significant which means that they are not adjust to the shocks in the long run.

The results of error correction model indicate that there exists a long run unidirectional causality(one way causality) from money growth (MG), oil production growth(WOPROG), non-oil GDP growth(WNOGDPG), oil price growth(WOPG), DT(80) and DT(88) to inflation rate (π), but inflation does not Granger cause other variables.

Table9: Granger (Long run) causality test based on VECM

		Δπ	**ΔMG**	**ΔWNOGDPG**	**ΔWOPG**	**ΔWOPROG**	**ΔDT80**	**ΔDT88**
	ECT_{t-1}	-0.433	0.38	-0.182	0.179	-0.155	-0.003	-0.007
	t-stat	-2.26	1.54	-1.596	1.66	-3.83	-0.875	-1.589

Table (10) shows the results of the chi-statistic and their associated P-value for short-run causality between the inflation rate (π) and the explanatory variables.

TABLE 10
Granger (Short run) causality test based on VECM

Δπ ←	ΔMG	ΔWNOGDPG	ΔWOPG	ΔWOPROG	ΔDT80	ΔDT88
P-Value	0.907	0.007***	0.412	0.128	0.108	0.011**
& Chi-sq	5.002	9.75	1.77	4.098	4.447	8.9
Δπ →	**ΔMG**	**ΔWNOGDPG**	**ΔWOPG**	**ΔWOPROG**	**ΔDT80**	**ΔDT88**
P-Value	0.42	0.27	0.62	0.0004***	0.168	0.394
& Chi-sq	1.72	2.55	0.94	15.749	3.56	1.858

*,**,*** indicates that a test is significant at the 10%, 5%, 1% level of significance, respectively. (Chi-sq in parenthesis)

The analyses show that there is a unidirectional short-run causality (one-way causality) from non-oil GDP growth (WNOGDPG) and DT (88) to inflation rate (π) respectively at one and five percent level of significance. Also there is a unidirectional short-run causality (one-way causality) from inflation rate to oil production growth (WOPROG) at one percent level of significance. Moreover, the analyses do not indicate the existence of short run causality between inflation rate (π) and oil price growth (WOPG) or money supply growth (MG).
The direction of the causality in the long-run and short-run is summarized in table (11):

Table 11: Summary of causality directions

In the Short-Run			In the Long-Run		
π	No	MG	**π**	←	**MG**
π	←	WNOGDPG	**π**	←	**WNOGDPG**
π	No	WOPG	**π**	←	**WOPG**
π	→	WOPROG	**π**	←	**WOPROG**
π	No	DT80	**π**	←	**DT80**
π	←	DT88	**π**	←	**DT88**

6-Conclusion and suggestions

In this study we wanted to investigate the main determinants and factors of inflation and domestic prices changes in Iran as a developing oil export based economy. There are many studies which tried to examine the inflation in Iran and also other developing and developed economies. But in this study we tried to consider the direct role of the oil sector in Iranian inflation. Also we wanted to explore if the other models and theories which they explain the domestic price changes in other developing and developed countries can be helpful for consideration of domestic prices in Iran as a developing oil export economy. The oil industry is a very important sector in Iranian economy and the oil exports provide a major part of government earnings. The fluctuation in oil prices and the changes in oil market conditions have a tremendous impact on all economic factors and

activities, including the inflation rate in Iran.

For the purpose of this study at first we used a simple theoretical model of inflation which mostly had been used for studying of inflation in other economies. Some econometrics techniques and tests such as unit root test, cointegration test, ECM model, and causality were applied. The outcomes of the empirical tests of the first model illustrated that there was a long run relationship between the variables. The findings were a positive relationship between domestic prices and exchange rate, foreign prices, money and the dummy variables DT(80) and DT(88). Also there was a negative relationship between domestic prices and GDP. The signs were consistent with theories. The sign of DT(80) illustrated that the destructive war with Iraq had increased the domestic price levels. Also the sign of the DT(88) illustrated that policies which used after the war to revive the economy have increased the domestic prices.

Consequently, the empirical outcome of the error correction model indicated that the changes in the explanatory variables (exchange rate, money supply, foreign prices, GDP, DT(80) and DT(88)) determine the changes in the domestic prices in the long run. The results indicated the existence of unidirectional causality from exchange rate, money supply, foreign prices, GDP, DT(80) and DT(88) to domestic prices. Moreover in the short run the outcomes showed that changes in foreign prices and the dummy variable DT(88) cause change in domestic prices. Based on the significances of these results, we can say that the main determinants of domestic prices in Iran in the long run are foreign prices, GDP, exchange rate, DT80 and DT88. Furthermore, in the short run, the main determinants of domestic prices are foreign prices and DT(88).

Aljebrin (2006) had concluded that this model can not be a good model for explaining the changes of the domestic prices in Saudi Arabia, Kuwait and Bahrain. In contrast with him our estimations of first model demonstrated some acceptable results about the factors that have affected the domestic prices of Iran. The results of this model imply that by developing the production sector and enhancing GDP we can control the increases of domestic prices, in addition because of the positive relationship between domestic prices and foreign prices, developing of the domestic economy will decrease the needs for imported goods and can control the increases of domestic prices. Following the presence of a positive relationship between the money supply and domestic prices and regarding to previous studies in Iran which have indicated that the excessive liquidity has been due to budget deficit we can conclude that the central bank must have independence and control the budget deficit. Moreover, the existence of positive relationship between domestic prices and the exchange rate, together with this fact that the instability of the exchange rate has a destructive impact on the economy, indicates that the increases of domestic prices can be controlled if we pursue an exchange rate unification policy and decrease the risks of the exchange market.

But, in the next step we used another model to explain the inflation rate in Iran with concerning this fact that Iran is a developing oil export based economy. In the second model the inflation rate was as independent variable. Our results showed that there is a long run relationship between the variables. The findings were a positive relationship between inflation rate and money growth, oil price growth, oil production growth and DT(80), and a negative relation between inflation rate and non-oil GDP growth and also DT(88). The signs were consistent with theories. The sign of DT(80) showed that the war with Iraq has affected the inflation rate positively. But the negative sign for DT(88) showed that the policies which started after finishing the war to revive the economy have affected the inflation rate negatively, and they were useful for controlling the inflation rate. Also in order to examine the dynamics of the variables in the second model an Error Correction Model (ECM) was performed. Like Aljebrin, our empirical outcome indicated that the change in the explanatory variables determines changes in inflation rate in the long run. The results showed the existence of unidirectional causality from explanatory variables to inflation rate.

Moreover, in the short run, the results indicated the existence of unidirectional causality from growth of non-oil GDP and DT88 to inflation rate. Based on the significances of these results we can say that the main determinants of inflation in Iran in the long run are growth of money, growth of oil production, growth of non-oil GDP, DT80 and DT88 and in the short run are growth of non-oil GDP and DT88.

Our results showed that growth of the non-oil GDP and DT88 have been anti inflationary, therefore rapid development of the non-oil sector and performing some useful policies for restructuring the economy such as diversifying the economy from the oil sector, development of the private sector and completion of the infrastructures will strengthen the economy and reduce the important of oil production as a source of inflation. In addition the results show that the growth of money is a source of inflation in the long run. Therefore, a more independent central bank is recommended to obtain other economic objectives such as controlling inflation.

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