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Effect of Oil Revenues and Non-Oil Exports on Industrial Production: A Case of Iran

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Abstract: *This study aims to examine empirically the effect of oil revenues and non-oil exports on industrial production in Iran, using secondary data over the period from1961-2010. For empirical analysis after checking the data for stationarity and co-integration test, the least square method has been used. The empirical results show positive and statistically significant impacts of explanatory variables of oil revenues and non-oil exports on industrial production of Iran during the study period. The study found that the relevant macro economic indicator real GDP have positive and significant effect on industrial production while impact of exchange rate is found negatively insignificant. Diagnostic tests also indicate that no serial correlation, no heteroskedasticity, and the residuals are normality distributed.*
Keywords: *Industrial Production, Oil Revenues, Non-oil Exports, Gross Domestic Product, Exchange Rate, Iran*

I. Introduction

One of the difficulties and challenges of Iranian economy is dependent on oil revenues.

The share of oil revenues in the public state budget has been more than 80 percent and only in recent years has ranged between 60 to 80 percent, which represents the country's high dependence on oil revenues. Share of oil exports in total exports accounted for 83.8 percent in 2010. This ratio shows how much of a country's exports depend on oil resources. This ratio reflects the fact that Iranian foreign exchange revenues (total exports) significantly depend on the oil industry and international oil markets; so that fluctuations in international crude oil prices have often exerted concurrent level of fluctuations in the revenue receipt from crude oil export. Share of oil export revenue to GDP accounted for 20 percent in 2010. This measure shows the relative importance of the oil sector revenue for the whole economy. Also, share of industrial sector to GDP (excluding oil) accounted for 25.8 percent in 2010, while the share was 12.1 and 20 percent in 1965 and 2000 respectively. It shows an increasing trend, but, in order to achieve development and goals outlined for the Iranian economy, the trend is not enough; and release from dependence on oil revenues highly depend on the industry sector boom.

Despite the rich natural resources, Iranian economy has experienced weak performance in recent decades while Asian countries that are poor in natural resources have experienced rapid economic growth (Gylfason, 2001). With the oil boom, production in traditional and agricultural sector decreased and the shock effect of oil prices on the value added in this sector has declined over time and has been eliminated (Pasban, 2004). Oil wealth has been used in a way that did not create the expected results, welfare and development, as if the country's has caught Dutch disease. This phenomenon is created due to inadequate policy responses to natural resources boom (Mc Mahon, 1997). Review on Iran's economy shows that always with the increase in foreign exchange earnings from the export of crude oil, sings of Dutch disease have emerged and governments have been stimulated to pursue ambitious goals and along with the increase in government spending and the injection of petrodollars into the economy, have led to turmoil in the economy.

The objective of this study is to empirically examine the impact of oil revenues and non oil exports along with other relevant factors on industrial production during the period 1961 – 2010 in the Iranian economy. The paper is structured as follows: Section one is the introduction. Literature review is the focus of section two. The third section is on data source and model specification. The empirical result is presented in section four while the final section is devoted to conclusions.

II. Literature Review

Using Granger Causality test and growth model of Feder (1982) and data covering the period from 1959 to 1993, Baradaran Shoraka & Safari (1998) find export growth and non oil export have positive significant impact on industrial growth in Iranian economy. Baradaran Shoraka & Safavi (1997), also using modified Chenery (1978) model, and measure industrial growth through export promotion. The results show that the effect of industrial export promotion on growth of industrial sector was negative during the period 1979-1989, but it has a little positive impact during the period 1989-1993 for Iran. Other study by Tavakoli & Hashemian Esfahani (1999), apply a Neo-Classical model and reveals positive impact of export growth on value added and manufacturing products in Iran. Mirzaie, H. (1999), using input-output techniques to measure the role of import substitution, export promotion and domestic demand expansion policies, and by applying Chenery (1955) method examine factors of industrial growth during periods of 1969-1974, 1974-1984, 1984-1988. The results indicate that the major factor in industrial growth has not been import substitution policy but the expansion of domestic demand was the main stimulus of this growth for the Iranian economy. Using Feder (1982) and Khalilian & Hafar Ardestani (2000) models, Samadi (2002) find that industrial, mining and oil exports have positive significant impact on growth of their sectors. The results also demonstrate instability of industrial and mining exports have negative significant impact on economic growth of industrial and mining sectors, while the impact of oil export instability on economic growth of oil sector was positive significant in the Iranian economy. Mohseni (2005) by applying Feder (1982) model examines the effect of export revenue instability on mining and industrial sector. The results show that export instability has not impact on mining and industrial value added in short run however its impact was negative in long run in Iran. Bazzazan & Mohammadi (2008) find export promotion strategy was the main factor in industrial production growth during 1989-1993. But in the period of 1994-1999, output growth in the industrial sector has been mainly affected by the expansion of domestic demand. In fact, domestic demand which has increased as a result of injection of oil revenue; has been major factor in industrial growth for the Iranian economy. The empirical evidence of the study carried out by Jahani Raeini et al. (2006) also suggests positive correlation between oil revenue and industrial value added growth for Iran. Uddin & Norman (2002) examine the pattern of long run relationship between exports earnings and industrial activities in Bangladesh. The study applied Granger causality tests to find the direction of causality between exports and industrial production index. The results reveal that there exists bi-directional causality between exports and industrial activities in Bangladesh. Mamun & Nath (2005) show that though industrial production and export were co-integrated at the long run, there exists a uni-directional causality running from export to economic growth in Bangladesh. Akpan et al. (2012), using Vector Error Correction Mechanism to establish the co-integrating relationship between industrial production, non-oil exports and GDP. The results reveal the existence of a positive and significant uni-directional relationship that runs from industrial production to non-oil exports in Nigeria. Riman et al. (2013) apply Vector Autoregressive model and co-integration technique to examine the long run relationship, while the Vector Error Correction Model was used to analyze the short-run behavior of the variables. The short-run result shows that the speed at which industrial output will converge towards long-run equilibrium after experiencing shock from oil revenue is very slow. It therefore would take a very slow process for industrial output to recover from shock arising from variation in oil revenue. The long run result shows that oil revenue shock and policy/regime shift had negative impact on industrial output and non-oil export in the Nigerian economy. Kemal et al. (2002) also find a positive association between export growth, industrial production and economic growth for India as well as other South Asian economies.

III. Methodology

Model Specification

For this empirical study, based on the preceding discussion, the following model specified in functional form:

$IP = f(OREV, NOX, GDP, EXR, DUM)$

The log linear regression model of above equation is set as follows:

$ln\ IP = C + \alpha_1\ lnOREV + \alpha_2\ lnNOX + \alpha_3\ lnGDP + \alpha_4\ lnEXR + \alpha_5\ DUM + \alpha_6\ AR(2) + \alpha_7\ MA(1)$

Where,

IP = industrial production or industrial sector value-added
OREV = oil revenues
NOX = non-oil exports,
GDP = real gross domestic product
EXR = exchange rate
DUM = Dummy variable for years 1980-1987 (war years)
AR (2) = the second degree auto-regressive error
MA (1) = first type of moving average,
C = intercept
α = variables coefficient

From the theoretical point of view, suggested variables, namely OREV, NOX, GDP and EXR, positively affect industrial production. For that reason their expected signs should be positive.

Data and Estimation Technique

In order to estimate the specified model, secondary time series data covering the period from 1961 to 2010 has been used. For analysis, the data obtained from the Time Series Database of Central Bank of Iran.

Simple log linear regression model and the method of least squares technique have been used. The choice of ordinary least squares (OLS) techniques of regression is not only as a result of its simplicity, but as a result of its optimal properties to produce the best linear unbiased estimates. In addition, for time series data analysis Augmented Dickey Fuller (ADF) test and Johansen co-integration test have been used. Also, E. View statistical software has been utilized for results derivation.

IV. Empirical Results

Unit Root Test

To check the order of integration, the study applied the Augmented Dickey Fuller unit root (ADF) test. This test confirmed the order of integration of the individual series. The ADF test is performed on level as well as on first difference of the series. The results as presented in table 1 show that all the time series under consideration are stationary at first difference i.e I (1).

Table-1: Unit Root Test Result using ADF Procedure

variables level	ADF stats	prob	variables First Difference	ADF stats	Prob	Results
LIP	-0.117210	0.9415	D(LIP)	-5.469496*	0.0000	I(1)
LEXR	-0.224720	0.9279	D(LEXR)	-3.484695*	0.0127	I(1)
LGDP	-1.701408	0.4241	D(LGDP)	-3.820613*	0.0051	I(1)
LNOX	0.799497	0.9931	D(LNOX)	-7.105603*	0.0000	I(1)
LOREV	0.116352	0.939	D(LOREV)	-6.490699*	0.0000	I(1)

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

Co-integration Test

The study has found number of co-integrated equations using Trace statistics and maximum Eigen value statistics. According to probabilities given in tables 2 and 3, the analysis rejects the null hypothesis that there is no co-integrated vector (None). These tests make us accept that one co integration vector. Based on these results, it can argue that a long run relationship exists among the time series employed in this study.

Table-2: Johansen Co-Integration Test Result (Trace)

Hypothesized No. of CE(s)	Eigen value	Trace Statistic	5% Critical Value	Prob.**
None*	0.578602	106.2275	95.75366	0.0078
At most 1	0.385357	64.74703	69.81889	0.1188
At most 2	0.305542	41.38473	47.85613	0.1767
At most 3	0.244205	23.88278	29.79707	0.2054
At most 4	0.152301	10.44350	15.49471	0.2482
At most 5	0.050997	2.512496	3.841466	0.1129

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.

Table-3: Johansen Co-Integration Test Result (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigen value	Max-Eigen Statistic	5% Critical Value	Prob.**
None*	0.578602	41.48050	40.07757	0.0345
At most 1	0.385357	23.36229	33.87687	0.5029
At most 2	0.305542	17.50195	27.58434	0.5370
At most 3	0.244205	13.43928	21.13162	0.4127
At most 4	0.152301	7.931008	14.26460	0.3857
At most 5	0.050997	2.512496	3.841466	0.1129

Max-eigenvalue 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.

Regression analysis

The OLS results are presented in Table 4. The following equation shows the estimated model:

IP = -11.105 + 0.561 OREV + 0.083 NOX + 1.260 GDP - 0.011 EXR - 0.367 DUM + 0.280 AR (2) + 0.674 MA (1)

R^2 = 0.9969 Adjusted R-Squared = 0.9964 D.W = 2.1635 F = 1877.7

From the result obtained in the regression, R^2 is 0.9969 showing a goodness of fit of 99.69%, on the grounds that the explanatory variable explains 99.69% of the explained or dependent variable. As compare to R^2, adjusted R squared is better and more precise goodness-of-fit measure because it allows degree of freedom to sum of squares therefore even after addition of new independent variable(s) the residual variance does not change. Table 4, also shows the value of adjusted R squared as 0.9964 or 99.64% which indicate that model is 99.64% accurate or best fitted. A positive significant relationship existed between oil revenues, non-oil exports, gross domestic product and industrial production of the country within the period under study; while exchange rate demonstrates a negative insignificant impact on dependent variable.

Table-4: Ordinary Least Square Estimates

Dependent Variable: LIP
Method: Least Squares
Sample: 1961 - 2010
Included observations: 48

Variable	Coefficient	Std.Error	t-Statistic	Prob.
C	-11.10555	3.094289	-3.589045	0.0009
LEXR	-0.011915	0.066139	-0.180148	0.8579
LGDP	1.260892	0.281673	4.476433	0.0001
LNOX	0.083240	0.039510	2.106798	0.0415
LOREV	0.561230	0.070629	7.946133	0.0000
DUM	-0.367236	0.129293	-2.840332	0.0071
AR(2)	0.286558	0.240872	1.189665	0.2412
MA(1)	0.674667	0.173190	3.895527	0.0004

R-squared	0.996966	Mean dependent var	9.461924
Adjusted R-squared	0.996435	S.D. dependent var	2.646032
S.E. of regression	0.157984	Akaike info criterion	-0.701637
Sum squared resid	0.998355	Schwarz criterion	-0.389771
Log likelihood	24.83930	Hannan-Quinn criter.	-0.583782
F-statistic	1877.784	Durbin-Watson stat	2.163522
Prob(F-statistic)	0.000000		

Inverted AR Roots	.54	-.54
Inverted MA Roots	-.67	

E- views version 8 used for computation analysis

In addition, table1 shows that the effect of explanatory variables, oil revenues, non-oil exports and GDP are found positively significant at the 0.05 level of significance. The coefficient size of oil revenues, non-oil exports and GDP are 0.56, 0.08 and 1.26 percent respectively. Therefore, in this case, one percent change in oil revenues, non-oil exports and GDP will change industrial production by 0.56, 0.08, and 1.26 percent respectively. The results also indicate that exchange rate has negative and statistically insignificant relationship with industrial production. Further, the present study found dummy variable is negative and significant at the 0.05 level of significance. It shows that the eight year period of the Iran/Iraq war has had a negative effect on industrial production. F-value is the true explanatory of the goodness of model. It is significant as its P_ value is 0.000. Meanwhile, the value of Durbin Watson (2.163) shows that autocorrelation does not exist in error term.

Diagnostic Tests

To evaluate the statistical properties of the model, a battery of tests was performed.

Test for Autocorrelation

To test for autocorrelation in research model, the study makes use of the Breusch-Godfrey Serial correlation LM test for autocorrelation. As shown in table 5, there is no problem of autocorrelation in the model as the null of no serial correlation cannot be rejected. Breusch-Godfrey Correlation LM test indicates that the residuals of the estimated model do not suffer from autocorrelation.

Table-5: Breusch-Godfrey Serial Correlation LM Test

F-statistic	0.047332	Prob. F(2,32)	0.9538
Obs*R-squared	0.138629	Prob. Chi-Square(2)	0.9330

Heteroskedasticity

This test is basically on the variance of the error term. The test helps to ascertain whether the variance of the error term is constant. Table 6 shows that the null of homoskedastic residuals cannot be rejected, using ARCH Test and implying that the residuals of the model are homoskedastic.

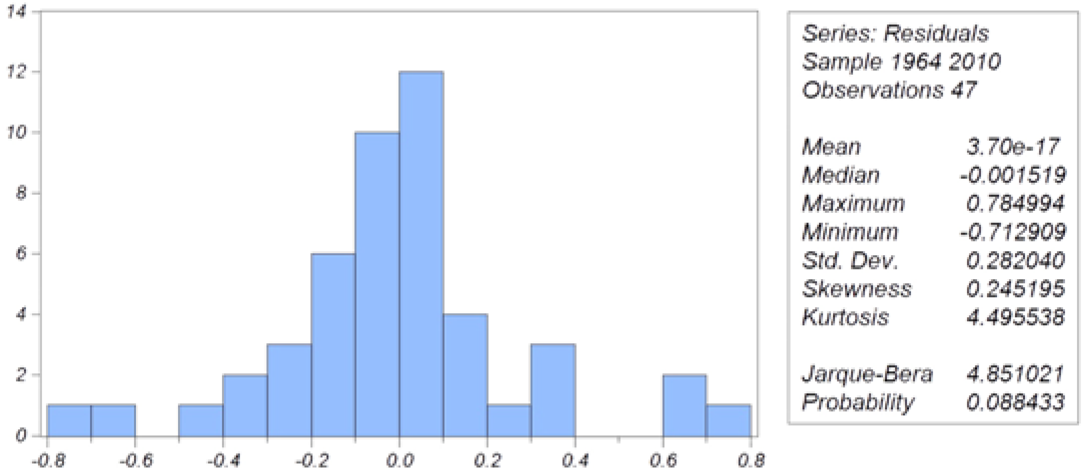
Table-6: Heteroskedasticity Test ARCH

F-statistic	1.228091	Prob. F(1,44)	0.2738
Obs*R-squared	1.249051	Prob. Chi-Square(1)	0.2637

Normality Test

This test is carried out to check whether the error term follow a normal distribution. The normality test adopted the Jarque-Bera (JB) Test of Normality. Table 7 shows the residuals are also normally distributed as Jarque-Bera test of normality fails to reject the null of normally distributed residuals. The same conclusion can be derived using Histogram-Normality test shown below.

Table-7: Normality Test



V. Conclusion

The specific purpose of this study is to examine the effect of oil revenues, non-oil exports, real GDP and exchange rate on industrial production of Iran, using data from 1961 to 2010. Oil revenues, non-oil exports and GDP have been found with expected positive sign and statistically are significant at 5% level of significance. In addition, the Iran/Iraq war had a significant effect during the investigated period. The study further demonstrates that exchange rate has negative and statistically insignificant relationship with industrial production. In this context, tests conducted in empirical studies also show contractionary effect of devaluation on production in Iran. These tests indicate that the expansionary effect of devaluation on aggregate demand will be offset by inflationary impact of this policy on aggregate supply. The study also shows strong factors that could boost industrial production are oil revenues and real gross domestic product. Diagnostic tests also indicate that no serial correlation, no heteroskedasticity, and the residuals are normality distributed.

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