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# The Economic Role of Petrochemical Industry in Iran

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**Abstarct**

Iran's economy is characterized by over dependence on the oil sector. Iran has been gradually growing into a centre for production of petrochemicals in the world. Petrochemical industry is one of the significant components of oil industry and is one of the principal industries in Iran which has an influential role in Iran's economy. Although it is widely acknowledged that exports, particularly through manufactured components, play an important role as a potential source of economic growth. Hence, the aim of this research is to analysis the impact of petrochemical products export revenue on economic growth. Therefore the main objective of this research is the study of export-led growth hypothesis (ELG hypothesis) of Iran's economy in the petrochemical industry by taking a time series data for the period of 1990-2010. It applies ordinary least square (OLS) method to investigate the relationship between gross domestic product, exports of petrochemical products, real exchange rate and inflation. The results of the study show that there is a positive relationship between export of petrochemical products and economic growth which validate export-led growth hypothesis in petrochemical industry while negative impact of inflation and real exchnage rate is observed.

**Keywords:** export-led growth, petrochemical industry, foreign trade, export, Iran

## 1. Introduction

The relation of exports on economic growth has been the subject of numerous debates in the economic development and related literatures. Export promotion policy can help to decrease the foreign exchange gap, and consequently promote the importing of capital goods and technical knowledge, encouraging the internal production that leads to reduction in the unemployment, increase profitability, improve capacity utilization which in overall would cause to economic growth. In addition it will raise competition between domestic firms for achieving better production technology and output and effective allocation of recourses. This, in turn results enhancing the sales of goods in domestic and foreign markets, increasing in the income, economic growth and productivity of a country, an order of events that called the Export-Led Growth Hypothesis (ELG) (Bhagwati, 1978 and Krueger, 1978).

The export-led growth (ELG) hypothesis has been generally applied to examine the impact of export on economic growth. There are numerous studies advocate this hypothesis with discovering the positive correlation between exports and economic growth (e.g., Tyler, 1981; Feder, 1982; Krueger, 1986, Grossman and Helpman, 1991; Giles and Williams, 2000). In fact export performance has beneficial effect on economic growth due to the expansion of export can demand for output of country which consequently the country increase its output. In addition export expansion may support specialization in the making of export goods which can increase productivity level which may lead to output growth. Also increasing of export might relax a foreign exchange restriction. This assists importing input and in turn output expansion (Giles and Williams, 2000). Therefore raising export can be suggested as a scheme that entitles an economy to growth.

Furthermore to date, the relation between inflation and economic growth is debaTable issue (Yogeswari *et al*. 2012). There are several empirical studies such as Faira and Cameiro (2002) and Singh and Kalirajan (2003) that argued on negative impact of inflation on economic growth. In contrast researcher such as Tobin (1965), Lucas (1973) and Gillman (2002) stated the positive relation of inflation and economic growth. However some of research mentioned the mix relation of economic growth and inflation which have non-linear interactions (Lee and Wong, 2005; Hwang and Wu, 2011). In addition, real exchange rate has important in the literature on export-

led growth. Therefore earlier studies that link the real exchange rate with GDP are considered. Rodrik (2008) noted that overvaluation suffer growth which this idea supported by several researchers such as Paul (2006) and Gala (2007). Rodriks's study come under critical examination with subsequent studies (Gluzmann, 2012) which general accepted the positive relationship between higher growth and undervalued exchange rate, this relation can affect increasing saving and investment that facilitate growth and moreover higher real exchange rate assist diversify exports and increase technological intensity of exports (Mario *et al*.). Therefore in this context relationship between these macroeconomic variables, GDP, export, inflation and real exchange rate, are considered. In addition due to oil dependency of developing countries and fluctuation of global oil market, this study turn its attention to the case of Iran which beside having huge reserves of oil resource and export, has tried to use a policies aim at increasing non oil exports. In fact the high rate of world oil prices has influenced the Iran government to have public investment, mainly in petrochemicals industries, and they achieve rapid grow. According to the economic development plan, the Iran government tries to elevate petrochemical output and because of this, the industry has obtained substantial foreign investment. Consequently, they doubt over the government's hope to make 47 petrochemical operations by the end of the fifth five-year development plan in 2015, adding a total of 43mn tones per annum (tpa) of capacity (Central Bank of IRAN, 2009). Based on officials, once the projects become operational, Iran will show at least 6.3% of global petrochemical output and 34% of Middle Eastern production. In the past, all Iranian petrochemical companies exported the products of Iran's petrochemical commercial company (IPCC) but today because of privatization in Iran, most of them export their products directly. Hence, nowadays, expansions of non-oil exports, especially petrochemical products are strategies for development of economy in Iran. Therefore this study tests the validity of ELG hypothesis in the case of petrochemical industry in Iran for the period of 1990-2010.

## 2. Methodology

It is widely acknowledged that exports, particularly through manufactured components, play an important role as a potential source of economic growth, the relationship between exports and economic growth is still ongoing. With regard to the general economic importance of foreign trade for the national economy and considering the importance of petrochemical products export in Iran, hence, the aim of this research is to analysis the impact of petrochemical products export revenue on economic growth. Therefore the main objective of this study is to investigate the relationship between export of petrochemical industry and economic growth of Iran. To do this, Ordinary Least Square (OLS) model are used. In particular, the study proposes to investigate link between export of petrochemical products and economic growth in order to test the degree of meaningful effects of export promotion policies in a branch of non-oil sector on the country's economic growth through empirical investigation of the Export-Led Growth (ELG) hypothesis.

### *2.1 Research Methodology Framework*

In responding to the aim and objective of the study, quantitative approaches with mathematical and statistical methods for the period of 1990-2010 were used. Therefore the hypothesis has been evaluated by using Gretl software and ordinary least square (OLS) method.

### *2.2 Model Specification*

The thesis uses Ordinary Least Square (OLS) model to test the export-led growth hypothesis in the context of the Iranian petrochemical exports products. Theoretically exports can contribute to economic growth by a simple model:

$$\mathbf{Y= f (X)}$$

Where, Y refers to GDP and X to exports.

To capture the constant response of exports to GDP the below linear form model could be employed.

$$\mathbf{Y_t = \beta_0 + \beta_1 X_t}$$

While for the non constant response of the same variable, the logarithmic model is effective.

$$\mathbf{Y_t = \beta_0 X_t^{\beta_1}}$$

The following model is suggested for estimating the effect of exports in the case of petrochemical products on gross domestic products along with real exchange rate and inflation during the study period of 1990 to 2010.

$$\mathbf{GDP = f (EXP, RER, INF)}$$

Where,

GDP: Gross Domestic product

EXP: Exports of petrochemical products

RER: Real Exchange Rate

INF: Inflation rate

In this study, Gross Domestic product (GDP) is the dependent variable, while the variables of Exports of petrochemical products (EXP), Real Exchange Rate (RER) and Inflation rate (INF) are the independent variables or explanatory variables.

On the base of above model, the following symbolic form of the logarithmic linear regression model are specified and estimated:

$$\ln (GDP) = \beta_0 + \beta_1 \ln (EXP) + \beta_2 \ln (RER) + \beta_3 \ln (INF) + \mu$$

As can be seen, the model is non-linear. The theoretical reason for this is that we do not necessarily expect a constant impact of an export stimulus on the economy over time, and hence a logarithmic model is more appropriate.

## 3. Results and Discussion

Regression through logarithmic technique prescribes relationship between independent and dependent variable. Table 1 indicates that there is a positive relationship between gross domestic product and exports of petrochemical products. In contrast both real exchange rate and inflation exhibit negative relationship with gross domestic product.

Table 1. OLS, using observations 1990-2010 (T = 21)

Dependent variable: GDP

| | *Coefficient* | *Std. Error* | *t-ratio* | *p-value* | |
|---|---|---|---|---|---|
| Const | 25.3805 | 0.169064 | 150.1238 | <0.00001 | *** |
| EXP | 0.159675 | 0.00602918 | 26.4838 | <0.00001 | *** |
| RER | -0.0684502 | 0.0242158 | -2.8267 | 0.01163 | ** |
| INF | -0.135221 | 0.0240522 | -5.6220 | 0.00003 | ** |
| | | | | | |
| Mean dependent var | 25.76188 | S.D. dependent var | | 0.266225 | |
| Sum squared resid | 0.027298 | S.E. of regression | | 0.040072 | |
| R-squared | 0.980742 | Adjusted R-squared | | 0.977344 | |
| F(3, 17) | 288.5830 | P-value(F) | | 8.93e-15 | |
| Log-likelihood | 39.97950 | Akaike criterion | | -71.95899 | |
| Schwarz criterion | -67.78090 | Hannan-Quinn | | -71.05224 | |
| Rho | 0.153192 | Durbin-Watson | | 1.673244 | |

Asterisk ** and *** show significant at 5%.

Source: Authors Computation from Gretl software.

p-value shows the probability value for significance of variable. All of independent variables are showing significant part in economic growth. In addition t-value also confirms all of independent variables are significant at 5% of confidence level. $R^2$ shows how much variation in dependent variable is because of independent variable. Value of $R^2$ is 0.98 in this result, which it satisfied the required range.

In statistics, the Durbin Watson statistic is used to detect the presence of autocorrelation (a relationship between values separated from each other by a given time lag) in the residuals (prediction errors) from regression analysis. The Durbin-Watson test is based on the following statistic, If $e_t$ is the residual associated with the observation at time *t*, then the test statistic is:

$$DW = \frac{\sum_{t=2}^{T}(e_t - e_{t-1})^2}{\sum_{t=1}^{T} e_t^2}$$

The Durbin Watson (DW) statistic is 1.67, that indicate DW is in the interval of <dU;2>, that means statistically

no autocorrelation in 5% critical values for Durbin Watson statistic (Table 2).

Table 2. Durbin Watson (DW) critical values

| | | | | | |
|---|---|---|---|---|---|
| **DW=** | 1.673244 | **dL** | 1.0262 | **4-dL** | 2.9738 |
| | | **dU** | 1.6694 | **4-dU** | 2.3306 |

Source: Authors Computation from Gretl software.

The Breusch-Godfrey test is used also to assess the validity of some of the modeling assumptions inherent in applying regression-like models to observed data series. In particular, it tests for the presence of serial dependence that has not been included in a proposed model structure and which, if present, would mean that incorrect conclusions would be drawn from other tests, or that sub-optimal estimates of model parameters are obtained if it is not taken into account. The regression models to which the test can be applied include cases where lagged values of the dependent variables are used as independent variables in the model's representation for later observations. This type of structure is common in econometric models. Therefore for being sure if autocorrelation exist, Breusch-Godfrey test also calculated by Gretl software. According to calculation results there are not first order autocorrelation at 5% of confidence level (Table 3).

Table 3. Breusch-Godfrey test for first-order autocorrelation

OLS, using observations 1990-2010 (T = 21)

Dependent variable: uhat

| | *Coefficient* | *Std. Error* | *t-ratio* | *p-value* |
|---|---|---|---|---|
| Const | -0.0460943 | 0.184904 | -0.2493 | 0.8063 |
| EXP | -4.98887e-05 | 0.00612851 | -0.008140 | 0.9936 |
| RER | 0.00631720 | 0.0263316 | 0.2399 | 0.8134 |
| INF | 0.00611990 | 0.0260733 | 0.2347 | 0.8174 |
| uhat_1 | 0.185734 | 0.275116 | 0.6751 | 0.5092 |
| Unadjusted R-squared = 0.027697 | | | | |
| Test statistic: LMF = 0.455778, | | | | |
| with p-value = P(F(1,16) > 0.455778) = 0.509 | | | | |
| Alternative statistic: TR^2 = 0.581640, | | | | |
| with p-value = P(Chi-square(1) > 0.58164) = 0.446 | | | | |
| Ljung-Box Q' = 0.537034, | | | | |
| with p-value = P(Chi-square(1) > 0.537034) = 0.464 | | | | |

Source: Authors Computation from Gretl software.

The possible existence of heteroscedasticity is a major concern in the application of regression analysis, including the analysis of variance, because the presence of heteroscedasticity can invalidate statistical tests of significance that assume that the modeling errors are uncorrelated and normally distributed and that their variances do not vary with the effects being modeled. When using some statistical techniques, such as ordinary least squares (OLS), a number of assumptions are typically made. One of these is that the error term has a constant variance. This might not be true even if the error term is assumed to be drawn from identical distributions.

One of the assumptions of the classical linear regression model is that there is no heteroscedasticity. Heteroscedasticity does not cause ordinary least squares coefficient estimates to be biased, although it can cause ordinary least squares estimates of the variance (and, thus, standard errors) of the coefficients to be biased, possibly above or below the true or population variance. Thus, regression analysis using heteroscedastic data will still provide an unbiased estimate for the relationship between the predictor variable and the outcome, but standard errors and therefore inferences obtained from data analysis are suspect. Biased standard errors lead to biased inference, so results of hypothesis tests are possibly wrong. For example, if OLS is performed on a heteroscedastic data set, yielding biased standard error estimation, a researcher might fail to reject a null hypothesis at a given significance level, when that null hypothesis was actually uncharacteristic of the actual

population. The White test is a statistical test for detecting heteroskedasticity which are applied for data under study (Table 4). The calculation indicates that there are no Heteroscedasticity at 5% level of significant.

Table 4. White's test for heteroskedasticity

OLS, using observations 1905-06-12:1905-07-02 (T = 21)

Dependent variable: uhat^2

| | *Coefficient* | *Std. Error* | *t-ratio* | *p-value* |
|---|---|---|---|---|
| Const | -0.0921111 | 0.220806 | -0.4172 | 0.6846 |
| EXP | -0.0156484 | 0.0123100 | -1.271 | 0.2299 |
| RER | 0.0360778 | 0.0572793 | 0.6299 | 0.5416 |
| INF | 0.0450531 | 0.0524067 | 0.8597 | 0.4083 |
| sq_x1 | 0.000193477 | 0.000241538 | 0.8010 | 0.4401 |
| X2_X3 | 0.00265616 | 0.00225592 | 1.177 | 0.2639 |
| X2_X4 | 0.000177643 | 0.00110159 | 0.1613 | 0.8748 |
| sq_x2 | -0.00448087 | 0.00426419 | -1.051 | 0.3159 |
| X3_X4 | -0.00451917 | 0.00739296 | -0.6113 | 0.5534 |
| sq_x3 | -0.00431552 | 0.00317780 | -1.358 | 0.2017 |
| Unadjusted R-squared = 0.583092 | | | | |
| Test statistic: TR^2 = 12.244933, with p-value = P(Chi-square(9) > 12.244933) = 0.199851 | | | | |

Source: Authors Computation from Gretl software.

An alternative to the White test is the Breusch–Pagan test. The Breusch–Pagan test is used to test for heteroscedasticity in a linear regression model. It tests whether the estimated variance of the residuals from a regression are dependent on the values of the independent variables. In fact the Breusch–Pagan test uses for conditional heteroscedasticity. It is a chi-squared test. If the Breusch–Pagan test shows that there is conditional heteroscedasticity, the original regression can be corrected by using the Hansen method, using robust standard errors, or re-thinking the regression equation by changing and/or transforming independent variables. Therefore to be sure if heteroscedasticity exist, Breusch–Pagan test also applied, which the results presented in Table 5. The calculation indicates that there are no Heteroscedasticity at 5% level of significant.

Table 5. Breusch-Pagan test for heteroskedasticity

OLS, using observations 1905-06-12:1905-07-02 (T = 21)

Dependent variable: scaled uhat^2

| | *Coefficient* | *Std. Error* | *t-ratio* | *p-value* |
|---|---|---|---|---|
| Const | 5.24783 | 6.51641 | 0.8053 | 0.4318 |
| EXP | -0.295565 | 0.232389 | -1.272 | 0.2205 |
| RER | -0.998958 | 0.933374 | -1.070 | 0.2995 |
| INF | 0.801982 | 0.927070 | 0.8651 | 0.3990 |
| Explained sum of squares = 12.6648 | | | | |
| Test statistic: LM = 6.332389, with p-value = P(Chi-square(3) > 6.332389) = 0.096512 | | | | |

Source: Authors Computation from Gretl software

The last test to our data analysis is normality test (Table 6). Normality tests are used to determine if a data set is well-modeled by a normal distribution and to compute how likely it is for a random variable underlying the data set to be normally distributed. One application of normality tests is to the residuals from a linear regression model. If they are not normally distributed, the residuals should not be used in any tests derived from the normal distribution, such as t tests, F tests and chi-squared tests. If the residuals are not normally distributed,

then the dependent variable or at least one explanatory variable may have the wrong functional form, or important variables may be missing, etc. Correcting one or more of these systematic errors may produce residuals that are normally distributed. The calculation indicates that random error has normal distribution at a 5% level of significant (Figure 1).

Table 6. Frequency distribution for uhat1, obs 1-21

number of bins = 7, mean = 1.52259e-015, sd = 0.0400723

| *Interval* | *midpt* | frequency | rel. | cum. |
|---|---|---|---|---|
| < -0.055809 | -0.069409 | 1 | 4.76% | 4.76% * |
| -0.055809 - -0.028610 | -0.042210 | 3 | 14.29% | 19.05% ***** |
| -0.028610 - -0.0014112 | -0.015011 | 6 | 28.57% | 47.62% ********** |
| -0.0014112 - 0.025788 | 0.012188 | 8 | 38.10% | 85.71% ********** |
| 0.025788 - 0.052987 | 0.039387 | 2 | 9.52% | 95.24% *** |
| 0.052987 - 0.080186 | 0.066587 | 0 | 0.00% | 95.24% |
| >= 0.080186 | 0.093786 | 1 | 4.76% | 100.00% * |
| Test for null hypothesis of normal distribution: | | | | |
| Chi-square(2) = 3.255 with p-value 0.19646 | | | | |

Source: Authors Computation from Gretl software.

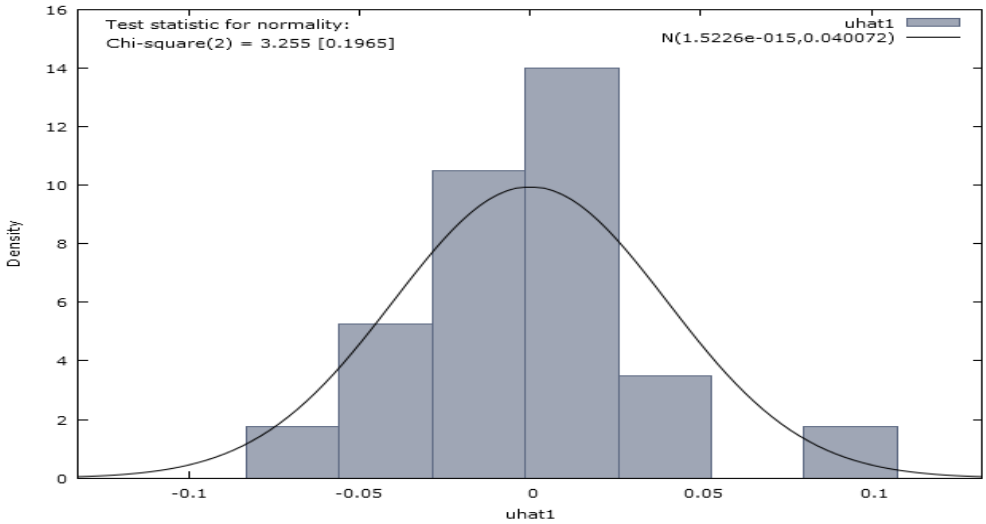


Figure 1. Test of normality of residual

Source: Authors Computation from Gretl software.

If we consider α = 0.05 as a main level of significance for final decision, there are no autocorrelation in the model. Heteroscedasticity as well not exist in the model which is measured by white test and the Breusch–Pagan test. Normality of random variable is also in satisfying range. The summary is presented in Table 7.

Table 7. Evaluation of econometric verification at a 5% level of significance

| **p-value** | **comparison** | **α** | **conclusion** |
|---|---|---|---|
| Autocorrelation (Breusch-Godfrey test ) | | | |
| 0.509 | > | 0.05 | no authocorrelation |
| 0.446 | > | 0.05 | no authocorrelation |
| 0.464 | > | 0.05 | no authocorrelation |
| Heteroscedasticy (White's test) | | | |
| 0.199851 | > | 0.05 | homoscedasticy |

| | | | |
|---|---|---|---|
| Heteroscedasticy (Breusch-Pagan test ) | | | |
| 0.096512 | > | 0.05 | homoscedasticy |
| Normality of random variable | | | |
| 0.19646 | > | 0.05 | normal distribution |

Source: Authors Computation from Gretl software.

This implies that increasing in this variable encourage better performance while a fall decrease economic growth. Data fully is in agreement of export-led growth hypothesis. Growth of economy can be enhanced by exports of petrochemical product as a non-oil export through accessing the markets globally that in turn enhances economics of scale. Iran can enlarge its market for petrochemical products by exporting to international markets and with outward oriented strategy, able to account for an important share of the global market.

Therefore policies concentrating on export promotion, especially for petrochemical products which raw material is easily accessible in domestic market, should use effectively to fabricate export capacity in order to increase economic growth. Therefore trade barrier in this context should be overcome through proper policies with new and high technology should be considered. In addition In order to achieve high and sTable economic growth and to protect the economy from the negative effects of oil price fluctuations, the Iranian government should continue its quest for more efficient and effective non-oil export promotion policies as well as its diversification strategies aimed at weaning the economy from its dependence on the oil sector. However oil will undoubtedly continue to be the leading sector of the Iranian economy, pulling the other sectors in its wake. In this context trade barrier should be overcome through proper policies and an open trade policy will be an effective strategy for Iran in the long run. Therefore, it is proposed that the Iranian government continue the policy of trade liberalization, increasing its global competitiveness by decreasing barriers and restrictions on exports and imports.

The stabilization of the exchange rate helps to prevent overvaluation or devaluation, which can blunt the international competitiveness of potential export industries.

## 4. Conclusion

The result of our study shows that there is a positive relationship between export of petrochemical products and economic growth of Iran and validate export-led growth hypothesis. This shows that any increase in the export of petrochemical products can lead growth of economy, while any decreasing in the export of petrochemical products will decline economic growth. In fact growth of export can be raised by exports of petrochemical products via accessing the global markets that in turn increase economic growth. Therefore Iran should apply policies to make non-oil exports especially in petrochemical industry more competitive in order to gain access to international markets. For this reason, joining the WTO and raising the share of and diversity of non-oil exports in total exports should be considered as high priorities. Raising the quality of petrochemical export products, stabilizing the exchange rate, deregulating the banking sector as well as reforming the public sector would also lead to non-oil export expansion. As well, in order to utilize its comparative advantages, Iran should apply oil as much as possible in the domestic industrial sector via extensive enlargement of energy-based industries such as petrochemical industries. In addition, since the price of both crude oil and natural gas fluctuates highly, the Iranian government needs to look beyond these unrefined products. More investment in other petrochemical products will be necessary in order to use Iran's comparative advantage in oil- and gas-based industries as well as support the country from the wild fluctuations of these resources in their unrefined state.

However based on our data analysis inflation rate and real exchange rate exhibit negative relationship with GDP therefore it is better to apply proper exchange rate policy in the country to maintain international competitiveness and sustainable external balance of payments, hence, exchange rate policies should be revised and eliminate exchange rate instability.

In addition it is highly recommended to control fluctuation of inflation to overcome its negative impact on economic growth to achievement of macroeconomic stability through monetary and fiscal policies reforms which target inflation. Internal and external balances are necessary for macroeconomic stability, which leads to the trade-growth nexus dynamic.

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