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The Effect of Oil Price Increase on Economic Growth and Income Convergence (Case Study: Evidence from GCC and Iran)

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Abstract

Considering the fact that the main income source of the oil producing countries such as members of Gulf Cooperation Council (GCC) and Iran is earned by exporting oil, it is expected that an increase in oil price creates economic convergence. Nevertheless, by considering the low level of intra-regional trade and dissimilarity of their trade cycles, many experts point out the lack of economic convergences in these countries. Hence, the hypothesis considered in this research is that an increase in oil price would not have convergence in per capita income and will not lead to a steady state path. In order to test this hypothesis, we applied Solow-Swan model by using panel data method. The results showed that absolute and conditional convergences have been rejected although the effect of oil price increase on the economic growth is confirmed during the investigated period (1998-2008).

Keywords: Solow-swan Growth Model, Absolute Convergence, Conditional Convergence, Oil Price.

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1. Introduction

With regard to the trend of globalization and its effects on the economy of the countries, what is more taken into consideration is that various trade integrations, on a smaller scale than globalization, can prepare the countries to face globalization. In fact, in this condition it is advisable to consider the economy in a lower level in comparison with the similar situation (in the regional level rather than world level), to reveal its strengths and weaknesses in the international context, and then to enter the wide global range.

The size of economy, economic similarity, country's size, geographical location or a combination of these indicators can be considered as the basis of the creation of various economic integration. In this respect, income convergence can also play an important role in creating trade blocks. In addition, by creating business blocks even with political aims, it is expected that the income of member countries becomes closer and converges to a steady state. The matter which is more considered here is economic similarity of the countries for creating regional trade, and this similarity would be assessed by applying the criterion of per capita income. Since the per capita income of two countries to some extent can represent the similarity of economic structures of the countries and more similar structures lead to more economic relations, consequently, the advantages of these relations decrease the income gap of the countries.

In this study, with regard to these matters that Persian Gulf region is selected for assessment and oil income and is the main income of these countries, the effect of an increase in oil price on the convergence of per capita income in these countries was assessed. It is expected that economic structures of these countries converge by the increase in oil price. The structure of their economies remains dominated by the oil sector, very limited intra-regional trade, and, unlike what many believe, there does not seem to be evidence of convergence in their main macroeconomic fundamentals nor in the synchronization of their business cycles. (Laabas & Limam, 2002)

In this paper, Solow-Swan growth model was used to investigate the convergence of per capita income. The reason is that Solow model predicts countries converge to their balanced growth paths. Thus, to the extent that differences in output per labor force arise from countries being at different points relative to their balanced growth paths, one would expect the poorer countries to catch up to the richer.

In addition, the Solow model implies that the rate of return on capital is lower in countries with more capital per worker. Thus, there are incentives for capital to flow from rich to poor countries; this will also tend to cause convergence (Romer, 2001). Section 2 discusses the conceptual concept of economic growth and Section 3 represents the empirical results. Finally, Section 4 concludes the remarks.

2. Conceptual Discussion

Considering the fact that economic growth is based on a neoclassical growth model, and that neoclassical school takes into consideration supply side of economy, at first the effect of oil price on supply side and specifically on the production function will be analyzed. Then, its effect on economic growth and convergence will be presented within the following conceptual model. For a Cobb Douglass Production Function such as:

$$Y = AK^{\alpha}L^{1-\alpha} \quad (1)$$

where Y is production, A is technology, K is capital and L is labor. In the first state, utility capital stock is determined where value of marginal product of capital equals the factor-price of capital (rental cost of capital)[1] that is:

$$VMP_K = RC \Rightarrow K^* = \frac{\alpha Y}{\frac{RC}{P}} \quad (2)$$

where VMP_K is the value of marginal product of capital and product of marginal product (MP_K) and the price of products (P). RC is the cost of quasi-rent of capital, and Y is

[1] In this model, it is assumed that supplied capital is called quasi-rent cost of capital.

aggregate output (demand).

In the second state, utility capital stock (K^*) is determined according to the following condition:

$$\frac{MP_L}{MP_K} = \frac{W}{RC} \Rightarrow K^* = \frac{1}{A}\left[\frac{\alpha W}{(1-\alpha)RC}\right]^{1-\alpha} Y \qquad (3)$$

where MP_K and MP_L are marginal product of capital and marginal product of labor, respectively, W and RC are the wage of labor and quasi-rent of cost of capital, A is technology and Y is the aggregate output (demand). As it can be seen in both states, utility capital stock (K^*) is a direct function of aggregate output level and decreasing function of cost of quasi-rent of capital or factor-price of capital.

As discussed previously, a decrease in the rental cost of capital leads to an increase in utility capital stock and consequently to the increase in investment, because when utility capital stock increases, the necessary investment for reaching the desired level will increase. This process is more considered in partial adjustment model:

$$K_t - K_{t-1} = \lambda(K_t^* - K_{t-1}) \qquad (4)$$

where K_t, K_{t-1} and K_t^* are capital stock in period t, capital stock in period t-1, and utility capital stock, respectively. λ is also the coefficient of adjustment (a gap between real capital and desired stock of investment goods). It is noted that $K_t - K_{t-1}$ is the net investment in period t, it can be written as:

$$I_{nt} = \lambda(K_t^* - K_{t-1}) \qquad (5)$$

Regarding the fact that quasi-rent cost of capital is one of the determinants of utility capital stock, the factors which affect this cost will also affect the utility capital stock. Interest or a variable replacing it which belongs to the spent money for buying investment goods is one of the determinants of quasi-rent cost of capital. Another determinant that will raise cost is depreciation expense of investment goods. Inflation is expected to increase the price of investment goods and so the investor gains benefit. The fourth determinant is a net tax that is obtained from the difference between total weighted taxes and unilateral payments and tax abatement. Therefore, the following equation can be written for quasi-rent cost of capital (RC):

$$RC = i - \pi^e + d + nt \qquad (6)$$

where RC is rental cost of capital, i, π^e and d are stated interest rate, expected inflation rate and depreciation rate, respectively, and *nt* is net rate of taxation of the government (Dornbush & Fisher, 1994).

Now it is possible to assess the effect of oil price on rental cost of capital (RC) and so on utility capital stock and investment. When oil price and consequently oil income of governments rise, government expenditure (G) will rise; and because government expense is one of the determinants of aggregate demand (AD), when government expenses rise, the aggregate demand will rise which leads to the increase in general level of prices and consequently in expected inflation. As it can be seen from the above equation, an increase in expected inflation (π^e) leads to the decrease in rental cost of capital (RC), and thus an increase in utility capital stock and consequently in investment. The details of this process can be observed in Figure 1.

Another case of effect of oil price on utility capital stock (K^*) is its effect on "nt" which is the net rate of governmental taxation. In fact, by an increase in oil price and oil income of the governments, unilateral payments and tax exemption and abatement will increase which lead to decrease in net tax rate (nt) and quasi-rent cost of capital (RC) and consequently to an increase in utility capital stock and investment. Moreover, an increase in oil price and oil incomes will lead to the increase in λ and investment.

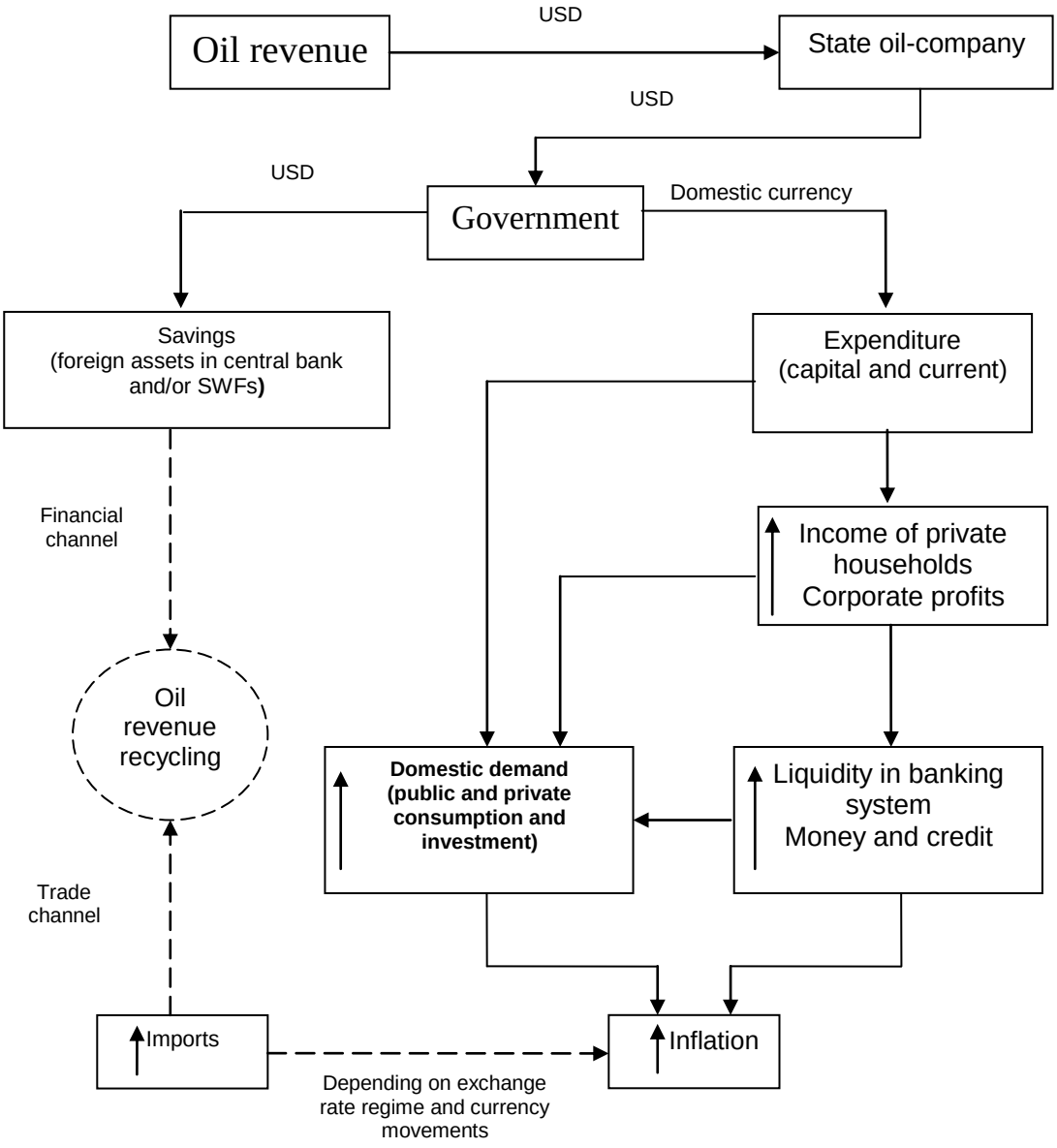

Figure 1. The Impact of Oil Price on Inflation
Source: Beck, Kamps, and Mileva (2007)

3. The Empirical Model

In order to estimate the model related to convergence that was mentioned in the previous section, the specification of the empirical framework follows Barro and Martin's (1995) Model. This framework is in conjunction with the real per capita income growth rate to the initial level of state variables (such as physical-capital stock and human-capital stock) and some control variables such as life expectancy, literacy rate, and so on. In addition, in Solow-Swan model, control variables are determiners of steady-state level of production. According the theory of Barro and Martin (1995), it is assumed that if the initial level of per capita GDP is high, physical-capital stock will also be high. Moreover, according to Soto (2000), the human-capital stock is reflected in lagged value of per capita output. Solow-Swan model predicts that for given values of the control variables, an increase in initial levels of state variables reduces the growth rate. Therefore, per capita production growth rate in the panel data model can be written as follows (Ledyaeva & Linden, 2006):

$$\frac{y_{it}-y_{i,t-1}}{y_{i,t-1}} = a y_{i,t-1} + X_{it}\beta + v_i + \tau_t + \varepsilon_{it} \qquad (7)$$

where y_{it} is per capital production in i_{th} economy in t period. $y_{i,t-1}$ is the initial level of per capital production of economy *i* in t-1 period, *a* is a negative parameter and represents the speed of convergence, matrix X_{it} is related to the control variables in economy *i* in the period *t*, and β is the parameters related to it. v_i is the country-specific effect of an economy, and τ_t is the period-specific effect and ε_{it} is error term of the model.

Assuming $\frac{y_{it}-y_{i,t-1}}{y_{i,t-1}} \approx \ln\left(y_{it}/y_{i,t-1}\right)$,

equation (7) will be re-written as follows:

$$\ln\left(y_{it}/y_{i,t-1}\right) = a\ln y_{i,t-1} + \beta \ln X_{it} + v_i + \tau_t + \varepsilon_{it} \qquad (8)$$

If $\ln y_{i,t-1}$ is transferred from left to right, dynamic model of panel data will be as follows:

$$\ln(y_{it}) = (a+1)\ln y_{i.t-1} + \beta \ln X_{it} + v_i + \tau_t + \varepsilon_{it} \qquad (9)$$

As it was stated, X includes a matrix of control variables. Generally, these variables are those which affect the economic growth of countries. In neo-classical models such as Solow-Swan and Ramzi, the effect of control and environmental variables on growth rate is the same as their effect on steady-state. Barro and Martin (1995) suggested some control variables such as measures of market distortions, home investment, and rate of openness of economy, financial development and political instability.

In this study, four control variables- among those stated by Barro and Martin- were used which seemed to have effects on the growth rate of the countries in the considered period. The first variable was the logarithm of government expenditure to GDP ratio (Barro & Martin, 1995). Regarding the fact that the countries under study are among developing countries, government plays an important role in these countries, hence this ratio affects the economic growth and it is expected that when it increases, the steady-state of per capita production increases. The second control variable was the logarithm of ratio of investment to GDP that according to the theory, an exogenous increase in the rate of I/Y leads to the increase in steady-state of effective per capita production, and growth rate will increase in proportion to specific rate of state variable (Barro & Martin, 1995). The third reason is that the oil price affects investment directly. The third variable was the logarithm of ratio of trade (sum of exports and imports) to GDP which was considered as a representative for rate of openness of an economy and it was predicted that this variable has also positive relationship with economic growth (Ledyaeva and Linden 2006). The fourth variable was also the logarithm of ratio of savings to GDP which was related to the previous matters and affected the steady-state of economic growth.

3.1. Empirical Results

It is assumed that in the period of oil price increase, per capita income of member countries of GCC and Iran converge to a steady-state. The following equation is used to test defined:

$$(1/T).\log\left[y_{iT}/y_{i0}\right] = a - \frac{(1-e^{-\beta T})}{T}.\log\left[\hat{y}_{i0}\right] + u_{io.T}$$

As it is observed in the equation, if the only explanatory variable in the model is per capita income logarithm of the previous period, the hypothesis of absolute convergence will be tested. If β>0 and is statically significant, absolute convergence hypothesis among selected countries will be confirmed; this means all of these countries converge to a steady-state. In this case, growth speed of poorer countries of the sample which have lower initial per capita income will be higher. The result of the test is presented in the following equation:

$$(1/10).\log[y_{iT}/y_{i0}] = 2/13 - \frac{(1-e^{-(-0/083)})}{10}.\log[\hat{y}_{i0}]$$

$$R^2 = 0/99, \overline{R}^2 = 0/98$$

T=(2.08) (22.06)

The results show that β is negative, therefore, the hypothesis of the absolute convergence among member countries of GCC and Iran is rejected.

As it was determined, although the economies of selected countries in this study have oil-based structures and oil income plays an important role in their economies, their per capita incomes in the period of oil price increase do not converge to a common steady-state. In other words, the hypothesis of absolute convergence is rejected. Hence, in this section, the factors which affect growth rate are added to the model.

According to Barro and Martin (1995), variables such as literacy rate, life expectancy, ratio of government consumptions to GDP and democracy index are the main determinants affecting the steady-state equilibrium. Among these variables those which have effects on the economic growth rates of the selected countries are added to the model to justify the difference in income level of various economies' steady-state. As it was stated in previous sections, these variables are: logarithm of the ratio of government consumptions (G) to GDP, logarithm of the ratio of investment (I) to GDP, logarithm of the ratio of trade (volumes of both export and import) to GDP and logarithm of the ratio of savings (S) to GDP. Model (8) is applied to test the absolute convergence as follows:

$$(1/T).\log[y_{iT}/y_{i0}] = x_i + \frac{(1-e^{-\beta T})}{T}.\log[\hat{y}_i^*] - \frac{(1-e^{-\beta T})}{T}.\log[\hat{y}_{i0}] + u_{io.T}$$

A framework of the panel data model is defined as follows:

$$\ln(y_{it}) = (a+\backslash)\ln y_{i.t-\backslash} + \beta \ln X_{it} + v_i + \tau_t + \varepsilon_{it}$$

where βs are related to each country in the sample and the estimated coefficient related to the oil price for each country is presented in Tables 1 and 2. Except for KSA and Qatar, according to Table 1, all estimated βs are statistically significant with the negative signs.

Table 1. Absolute Convergence Test for GCC + Iran

Country	β	t-Statistic
King Saudi Arabia	-0.94319	-0.122056
Bahrain	-0.85354	-3.73142
United Arab Emirate	-0.96205	-2.879934
Iran	-0.96462	-16.6284
Kuwait	-0.95257	-8.70179
Oman	-0.92531	-2.164017
Qatar	-0.91163	-0.103541
$R^{۲}$	0.99	
$\overline{R}^{۲}$	0.98	
D-W	2.5	

Source: Authors

Table 2. Oil Price Coefficient Estimated of Economic Growth Model for GCC + Iran

Country	Oil price Coefficient	t-Statistic
King Saudi Arabia	0.583751	14.63769
Bahrain	1.093548	11.51201
United Arab Emirate	0.526157	15.46782
Iran	0.69516	23.43668
Kuwait	1.390713	26.00989
Oman	0.434989	8.319058
Qatar	0.909526	8.564623
$R^{۲}$	0.99	
$\overline{R}^{۲}$	0.98	
D-W	2.5	

Source: Authors

In addition, Table 2 reports that estimated coefficients of the oil price are significant and positive for all the sampling countries.

According to the results, the negative sign

of the β coefficient and the rejection of absolute convergence hypothesis across the selected countries represent the existence of difference in steady-state of these countries and heterogeneity of their economic conditions. Thus, the factors which have effects on the steady-state of these countries should be taken into consideration and consequently the conditional convergence is considered that is each country should move toward its steady-state.

Regarding the rejection of conditional convergence hypothesis in the case of the countries under study, it can be said that these results represent that conditional convergence hypothesis in the case of Bahrain, United Arab Emirates, Iran, Kuwait and Oman is rejected, that is, these countries do not converge to their steady-state and this represents that such economies are not in their way to long-run growth. In the case of Saudi Arabia and Qatar where $\beta<0$, while is not statistically significant, it can be said that conditional convergence hypothesis is not acceptable. Rejection of conditional convergence hypothesis is due to the absence of steady state equilibrium in the above countries' perspective of planning.

As it was stated, oil price coefficient was significant in growth model and the positive effect of oil price on economic growth was confirmed. This result was predictable beforehand, because economy in all these countries is based on oil and main part of their income is related to oil sector. Moreover, the selected countries are among developing countries where there is no enough planning for using the obtained income equivalently, so economic growth variation will have a process similar to the process of oil price.

4. Conclusion

The results of the estimation of models show that absolute convergence hypothesis in the case of member countries of GCC and Iran is rejected. That is, poor countries in the sample under study do not necessarily grow faster than rich countries.

According to the results of conditional convergence hypothesis test in the case of member countries of GCC and Iran, although oil price significantly affected the economic growth of these countries, this hypothesis in the case of the selected countries has been rejected. This is because of the lack of long-run solid planning as well as the existence of political tension in the region.

Considering the rejection of absolute and conditional convergence hypothesis and also the effect of oil price on trade between the countries of the region on the one hand and sensitive situation of the region in political geography of the world on the other hand, it is suggested that these countries which have main resources of energy of the world and have common cultural similarities attend in the international arena with more power and union and use their chances such as an increase in oil price for developing and gaining power and independence for the region instead of having enmity and conflict to each other.

Hence, considering the results, although oil price affected the economic growth of the selected countries, effectiveness coefficient of this variable was too low and these economies did not converge toward their steady-state. On the other hand, regarding the fact that the main income source of these countries is oil, so it is suggested that these countries use their chances effectively by long-run and accurate planning and consider long-run political and economic benefit instead of entering superficial political tensions.

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