

Study of target revenue model for oil supply of exporting member states of OPEC and non-OPEC selectees

Hossein Ostadi, Mohammad-Amin Shahbazi *

Department of Economics, Dehaghan Branch, Islamic Azad University, Isfahan, Iran

Abstract: Crude oil has always been considered as an important and strategic commodity for the countries. Among the oil producing companies, they have always been after creating positive effects of oil production on the economy of their countries. On the other hand, for the countries that import oil, the degree of supply of crude oil is considered as very important as far as the impact on oil price and its consequences on the economy of those countries are concerned. Hence the issue of degree of oil supply seems necessary due to the limited oil reserves as well as review of the effective factors on oil supply both for producing and consuming countries. The main goal of the study is to test Target Revenue Model for oil supply of OPEC member states and non-OPEC oil producers in the period between 2000 and 2012 using panel data method. According to the obtained results from the member states of OPEC, the contribution of Target Revenue Model is noticed to be weak. In non-OPEC exporting countries, the indexes are all significant and the signs show the first mode, i.e., the ordinary Target Revenue Model applies to these countries.

Key words: Oil supply; Target revenue model; OPEC member states; Non-OPEC oil producers; Panel data method

1. Introduction

One of the most important behavioral aspects of OPEC from production point of view is the members' inclination to violate from their shares. Some economists such as Griffin and Xiong in 1997 tested its behavioral aspects. The structural changes that happened in global oil markets caused speedy growth of oil supply by non-OPEC countries and fall of oil prices in the past century. That is why many OPEC members increased the level of their production more than their quotas in order to increase their revenues. These behavioral aspects of oil producers paved the ground for vast studies regarding assessment of the crude oil exporters' behavior. In this direction, study of oil supply models was very important. For this reason target revenue model is studied and tested in this research.

2. Theoretical grounds and research literature

Oil supply theories consist of competitive model, cartel theory, and target revenue model and ownership rights theory. The theoretical fundamentals of cartel theory are based on the ground that oil supply is a function of oil price and production of the other producers who are cartel members. Edelman described on this basis the market rationing model in which the actual OPEC behavior changes procedure as a cartel according to the market conditions between the two models of dominating firm and rationing of market. Following suggestion by Edelman, different theories were

presented about experimental formula regarding the effect of interest rate on the amount of oil supply and the 3 positive and negative and zero effects were studied accordingly.

Ali Jahani and Mid find the reason for increase of oil price in 1973 the result of transferring the ownership of oil wells from oil companies to the governments owning them and since the devaluation rate of oil owners is less than the devaluation rate of the oil companies, this caused reduction of oil supply by companies after transfer of ownership and the price of oil increased drastically in 1973 for the same reason.

The competitive model of non-maximizing the profit was raised against the oil cartel theory to express the reasons for increase of oil price and to explain the behavior of OPEC in 1990s by MacKay, 1982. He presented this theory in this book under the title of 'prices of crude oil' in 1982. According to that political and historical events imposed a shock on oil supply as external variables. In this theory, oil supply and demands are considered as the principal factors in oil market. What is meant by 'main principles of market' is a combination of total demand and supply functions and attractions affiliated to them. The conditions of oil supply and demand depend on the situation of their countries in short-term and long-term. Generally speaking, the 'main principles of market' determine the global price of crude oil and change them. According to this theory, increase of price of crude oil in 1970s shocked the oil supply and made the countries use the oil of their reserves and keep secure from the loss from shock in oil supply.

* Corresponding Author.

Ownership rights theory was raised in direct reaction to the increased price in 1973. According to this theory, the countries owning oil have lower devaluation rate than the oil companies. In fact oil companies exploit reserves more intensively and in shorter time during their ownership of oil reserves of oil-rich countries due to being afraid of nationalization of oil industry, but countries exploit oil less intensively and in longer time and use oil revenues less due to the restriction of access to capital market and being sure of the ownership of the reserves (or in other words with lower devaluation rate). In other words, at a certain price, the inclination of countries to produce less in comparison with the oil companies showed in one hand the transfer of ownership and control over production during 1970s and on the other hand caused transfer of curve of supply toward left and reduction of supply. Hence, this increased the balanced price.

Target revenue model expresses that reduction of production and increase of oil price in 1970s was not the result of OPEC coalition behavior, but reduction of production mainly met the requirements of the investments. There have been so far many attempts made to describe the behavior of OPEC in oil market. Griffin and Tiss, 1982 classified these models into two categories: Wealth maximizing models and models that do not maximize wealth. Target revenue model is one of the different non-maximizing models of wealth. Target revenue model expresses that reduction of production and increase of oil price in 1970s did not result from coalition behavior of OPEC, but reduction of production was mainly made in response to the investment needs. There have been many attempts so far to balance the OPEC behavior in oil market. Griffin and Tiss, 1982 classified these models into two categories: Wealth maximizing models and models that do not maximize wealth. Target revenue model is one of the different non-maximizing models of wealth (Alqahtai et al., 2008).

Target revenue model unlike the former models assumes that oil producing countries are not decision makers of oil price, but that the oil price is set by the international markets. It believes that oil producing countries specify the level of oil production considering the needs of their investors which is assumed to be output in here.

Hence for i country, R_{it} revenue is equal to multiplying the market price P_t by the amount of oil production Q_{it}

$$(1) R_{it} = P_t Q_{it}$$

Since the oil revenue is merely spent on investment I_{it}

$$(2) I_{it} = R_{it}$$

Replacing I_{it} in the relation between revenue and obtaining Q_{it} from it, the following formula is reached:

$$(3) Q_{it} = \frac{I_{it}}{P_t}$$

In other words, the level of oil production has a direct relation with the investment needs and has a

reverse relation with its level of price. To test the mentioned relation, natural logarithm (Ln) is taken from sides of the logarithm relation and as a result the variables coefficients could be estimated using the common economic assessment methods. Regression relation is estimated as follows:

$$(4) \ln Q_{it} = \alpha_i + \beta \ln P_t + \gamma \ln I_{it} + \epsilon_{it}$$

Here the

ϵ_{it} is Variable random, the following tests can be conducted by estimation β and γ :

1. First mode: If $\beta < 0$ and $\gamma > 0$ simultaneously exists for one country, ordinary target revenue model will apply to that country.
2. Second mode: If it is $\alpha = 0$ and $\beta = -1$ and $\gamma = 1$, a stronger model than this model will apply.
3. Third mode: If it is excluded β and $\gamma > 0$ the only one, a weaker mode than this model will apply.
4. Fourth mode: If it is excluded γ and $\beta < 0$ the only one, the supply curve will exist with a return backward.

David Tiss, (1982) also showed that classic models maximizing the cartel profit emphasize on the coordinated behavior of OPEC members and their coalition, while these models are inappropriate for analysis of OPEC behavior. He explains his approach as such that several important producers of OPEC regulate production of oil proportionate to budgetary needs and local and foreign political restrictions. If the revenues from oil export in addition to the foreign revenues supply their expenditures, the policies of oil production will be determined according to considerations such as maintenance of natural resources including oil and maintaining them under the ground. This will cause reduction of production in the future even if it adjusts with maximizing the current value of oil reserves and on the contrary, if the export revenues and foreign revenues are in a way not to supply the expenditures, production and capacity will develop, provided that the technical conditions are available. Economically speaking, it also seems that at least for an important sub-group of OPEC producers, the relation between price and current production in short-term is represented better by the bent supply curves backward. One use of bent supply curve backward is that the producers of OPEC that face this curve have no natural inclination to swindling.

Pesaran and Samiei in 1995 started making models and anticipating final use of irretrievable resources using the amended mixed model of Kaufmann. This study was conducted in 48 states of the USA during 1926-1990 periods. Pesaran and Samiei believed that the first stage of Kaufmann model required elimination of the variable and thus the results of the estimation made by this model cannot be reliable. They estimated Kaufmann model at one stage to remove the problem of variable elimination. The used variables in this study were similar to the variables of Kaufmann model and the results of estimating this model show that the price coefficient is insignificant in short-term, but the relation between price of crude oil and the amount of produced crude oil in long-term is positive and

significant. Applying production quota has positive and significant effect on the amount of production and subtraction coefficient of the first instance of the production curve after the peak point and the variable coefficient proportionate to the price of crude oil over price of natural gas are also insignificant.

AlHajji and Huether, (2000) studied the target revenue model for OPEC countries in the period 1971-1994. The goal of this study was to observe the issue whether the target revenue model explains the behavior of some of the OPEC member states whose production does not adjust with the Saudi Arabia. They also studied the issue whether increase or decrease of oil production of these countries depends on their investment needs or not. According to the results of their study, investment and budgeting of oil production does not affect the economies with free (open) markets, but affects the production decisions of closed and planned economies.

Kaufmann et al, 2008 in a study investigated the effect of economic and organizational factors on oil production of OPEC member states using DOLS and VECM methods. They conducted this study using the seasonal data from 1986 to 2003 of eight OPEC member states including Algeria, Indonesia, Iran, Libya, Nigeria, Saudi Arabia, UAE and Venezuela. The results showed that in the period under study, the quota had significant effect on the amount of production of OPEC members. The effect of price on production in Iran, Algeria and Indonesia was insignificant and in other member states the price effect on amount of production was significant. Also some members showed reaction to the made changes to production by other members and in short-term the reaction to changes of price, quotas and changes of production of other members was unsymmetrical.

Karimi and Salehi Isfahani, 1989 discussed that Saudi Arabia finds the increase of prices temporary, while others find it permanent. Of course, the weakness of most of the theories is that the anticipations were made on input basis, however they insist on that theory.

Hemmati, (1994) in a study investigated the model of oil supply of non-OPEC countries using linear and non-linear models. This study was

conducted on the producing countries of crude oil in the period between 1970 and 1990. According to estimation of linear and non-linear models of supply of oil of non-OPEC countries, the relation between oil supplies of non-OPEC countries was positive considering the expected price of oil and effective rate of foreign currency of major industrial countries against USD.

Shakibaei et al. (2009) in a study anticipated the supply of crude oil in eleven countries producing oil using nervous network and linear regression in the time span between 1980 and 2006. The studied countries were Iran, Algeria, Qatar, Saudi Arabia and Nigeria that were OPEC members and the six countries of Norway, USA, the UK, Mexico, Egypt and Russia that are non-OPEC members.

The results from this anticipation showed that the theory of competitive supply is able to explain the changes of crude oil supply of countries exporting oil in response to the price changes. Since this theory generally shows a reversible supply curve regarding developing countries exporting oil, the authenticity of target revenue theory or restriction of the ceiling of forex revenues can be found out regarding these countries. It is worth mentioning that the theory in question is not confirmed only in case of Saudi Arabia, but the reversible supply theory applies to the other OPEC member states. Regarding anticipation of oil supply the results also show that in general, the nervous networks show better results to anticipate the production of crude oil of linear regression models.

3. Specifying the model and introducing the variables

The used model in this study which shows target revenue model is as follows:

$$(5) \ln Q_{it} = \alpha_i + \beta \ln P_{it} + \gamma \ln I_{it} + \epsilon_{it}$$

It shows Q_{it} oil supply, P_{it} oil price and I_{it} demonstrates the investment.

3.1. Estimation of model for OPEC member states

The results from the model estimation for OPEC member states are shown in table 1 as follows:

Table 1: Results of model estimation for OPEC member states

Variable	Z statistic	Coefficient	Probability
Investment	1.87	0.04	0.062
Price	2.16	0.10	0.031
Limer F = 58.19 Prob. = 0.01		Hausman test statistic = 1.40 Prob. = 0.49	

Considering the results weak target revenue model is noticed. In other words, according to the third mode, there is a weak target revenue model. Also in this model, the investment degree coefficient is also positive and significant.

3.2. Estimation model for non-OPEC member states

Further on the target revenue model was estimated like the former section for five countries

that were selected as members of OPEC. The results of this estimation are shown in table 2.

Table 2: Results of model estimation for non-OPEC member states

Variable	Z statistic	Coefficient	Probability
Investment	44.2	0.10	0.015
Price	-2.68	-0.14	0.007
Limer F = 3.25 Prob. = 0.05		Hausman test statistic= 0.39 Prob. = 0.82	

All coefficients are significant and their signs show the first mode. It means that target revenue model applies to these countries.

4. Conclusion

In this study, the target revenue model for OPEC countries and non-OPEC oil producers will be estimated and studied. Considering the signs of the obtained coefficients for OPEC countries, the contribution of target revenue model is weak. In other words according to the third mode, there is a weak mode of target revenue model. Also in this model, the coefficient of the degree of investment is also positive and significant. In these countries, considering the high dependence of budgets and general, development and governmental costs on oil revenues and absence of suitable mechanism to create non-oil revenues, particularly in private sector, the revenues of these countries that mainly originate from sale of oil find their way to the consumption sector and do not go anywhere near the investment sector. In these countries that some of them are even considered as poor countries like Angola, sudden reduction of oil revenues creates problems to supply their budgetary revenues.

In non-OPEC countries, the model estimation coefficients are all significant and their signs show the first mode. It means that ordinary target revenue model applies to these countries. These countries are mainly developed countries and due to the experience of the northern Europe countries to have identified Dutch disease, they have separated oil revenues from their general budget and have led them toward investment in oil and non-oil sectors.

References

AlHajji, A., & Huether, D. (2000). The Target Revenue Model and the World Oil Market Energy Journal, 21(2).

Griffin, J. (1985). OPEC Behaviour: Attest of Altrenative Hypothesis. American Economic Review, 722(5).

Griffin, J., & Xiong, W. (1997). The incentive to cheat: on empirical analysis of OPEC. Law Economics, X1.

Kaufmann, R. (2001). Oil Production in the Lower 48 States: Economic, Geological, and Institutional Determinants, the Energy Journal, 22(1).

Kaufmann, R., Bradford, A., & Bradford, H. (2008). Determinants of OPEC Production: Implications for OPEC Behavior. Energy Economics, 30.

Pesaran, M., & Samiei, H. (1995). Forecasting Ultimate Resource Recovery. International Journal of Forecasting, 11.