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Shaping Economic Growth of Thailand through Crude Oil Dynamics: Role of its Exploration, Consumption and Prices

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ABSTRACT

The exploration, consumption and prices of crude oil are very important aspects for the enhancement of the economy of any country. Therefore in order to check the impact of these three aspects of crude oil on economic growth of the country, this study has been conducted by the author. Data collection process has been done in Thailand and 26 years data has been accumulated for analysis purpose. Unit root test, co-integration test and VAR model estimation are the most important tests that have been employed in this particular study. The results of all these tests have been discussed in the study in detail. The impacts of exploration, consumption and prices of crude oil as well as population growth and energy consumption have been found to be significant in regard to economic growth. Various theoretical, practical and policy making benefits of these results have been identified and explored by the author all of which point towards the enhancement of economic growth. In addition, the limitations found in the study along with some recommendations have also been described so that the future researchers may consider them and work on them in order to overcome these limitations.

Keywords: Economic Growth, Crude Oil Dynamics, Exploration, Consumption, Prices

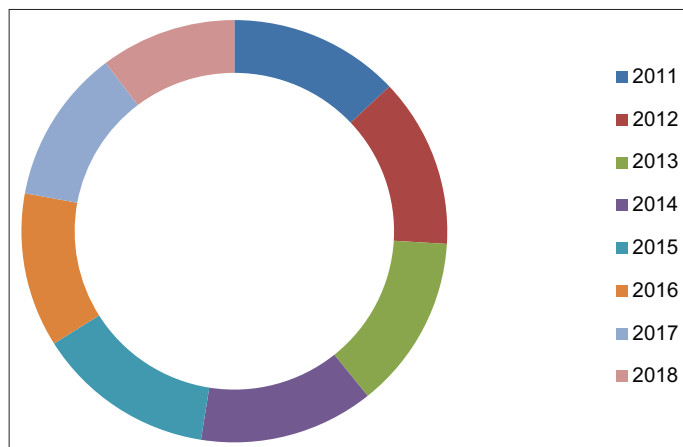
JEL Classifications: F43, E211

1. INTRODUCTION

Thailand is the biggest economy of Southeast Asia with the Gross domestic product of USD505 billion, after Indonesia, which GDP is highly dependent on the export that constitute about two third of Thailand's GDP. According to Figure 1, GDP growth of Thailand depicts the unstable pattern, 10 years on average growth of the country decrease from 8.2% during 1960s to 3.3% during last 10 years. The crude oil dynamics also has very strong implication for the economic growth of the country (Ftiti et al., 2016; Sodeyfi and Katircioglu, 2016). The reason is that country has very strong domestic demand of crude oil consumption because of its high consumption in transportation, power and industrial sector (Oteng-Abayie et al., 2018; Ozturk and Arisoy, 2016). However, the government of Thailand is giving considerable attention on the exploration of the oil reserves in the country to boost up the economic growth in Thailand. The government struggles for exploration of oil reserves in Thailand is conducted by the both

private sector and defense energy department of Thailand. Most of the exploration of reserves are centered towards the Andaman Sea in Thailand (Chaichana and Kaewtathip, 2016; Hogg et al., 2016).

The objective of research is to examine the consequences of crude oil dynamics on the economic growth of Thailand. In our study we have picked three variable pertaining to the oil price dynamics such as: exploration of crude oil reserves, oil consumption, oil price. Growing energy consumption also influence the fiscal and external budgeting of the country by exerting much pressure of subsidies and import bill during the regime of high oil prices (Khandelwal, 2015). Increasing consumption of crude oil, during the stagnant growth in domestic supply and production also negatively impact the oil importing countries. Furthermore, oil price dynamics of crude oil is also a key factor which affect the economic growth in Thailand. Many studies highlighted that oil price vulnerability transmitted into budget deficit which may led the crisis in the economy.

Figure 1: Crude oil reservoirs

Crude oil dynamic and fluctuation considerably impact the industrialized economy due to its heavy reliance on oil for energy generation.

After the Asian crisis, the Thailand economy is in phase of steady recovery which is mainly derived by the production of machineries, metal products, and electronic goods that is heavily relying on power generated by crude oil and natural gas. Oil price shock of 2008 has dragged many oil dependent economies into the crisis of fiscal and current account deficit. Various studies have explored the role of oil prices fluctuation in economic upheaval in the country (Baumeister and Kilian, 2016; Lee et al., 2017). Novelty of this manuscript is to empirically analyze the impact of crude oil exploration, consumption and price on the economic growth in case of Indonesia. They study serves to fill gaps in literature by exploring the energy related determinants of economic growth by employing the multivariate regression model.

This research objectives of the study is:

- To find the consequences of crude oil exploration on economic growth in Thailand.
- To inspect the relationship between crude oil consumption and economic growth in Thailand.
- To examine the role of oil price fluctuation in economic growth of Thailand.

Various studies have been found in the literature which has explored the determinants of GDP growth in Thailand has very positive implications (Asongu, 2016; Chirwa and Odhiambo, 2016). In addition, different studies have also explored the effect of oil prices fluctuation on the economic crisis in the state (Bastianin et al., 2017) that entice government bodies to give considerable importance to issuing the licensing gas and oil exploration to overcome the growing demand in the economy. Furthermore, the studies enlighten about the perspective of future research on the basis of strong theoretical framework. This study has goals to serve on the same lines. The study is arranged as follows: Section two shed lights on the existing literature and research; Section three encompasses the detail on methodology and data analysis; Section four discuss the empirical outcomes of the study; and the last section includes concluding remarks and policy recommendation.

2. LITERATURE REVIEW AND THEORETICAL FRAMEWORK

Economic development of a country is taken as key macroeconomic variable to measure the health of the economy and living standards of the aborigines. Literature on economic growth highlights various contributing factor of economic growth including labor, capital, investment, government expenditures, human capital, trust, and financial inclusion (Naseer, 2019). The growing demand of crude oil for energy generation has enhanced its role in GDP growth. The reason is that energy is also argued as an essential determinant of GDP growth and it must take in line with the other key determinant of growth such as labor and capital. Generally, the oil importing and oil dependent countries has strong linkages between the economic growth, conflicts, and poverty due to lacunas in structural reforms. In order to mitigate the detrimental impacts of crude oil dynamics on the economic performance, government attention is required to spare stabilization funds to circumvent oil price shock, and striking demand. Moreover, reforms to issue the frequent licensing to oil exploration companies in order to offset the growing demand.

2.1. Crude Oil Exploration and Economic Growth

Crude oil supply has key importance in the ongoing economic activities of industrial country including Thailand. Pressure on crude oil demand due to cut in supply or increase in demand disturb the business cycle of oil importing countries as well as fiscal budget of the country (Hussain et al., 2012). Crude oil exploration has positive impact on the country and as well as on the oil importing economies of Asia but relaxing the pressure on demand due to increase in supply (Arezki et al., 2017; Dahl and Duggan, 1998; Mannes, 1985). Moreover, the oil exploration has association with strong fiscal bonanza which likely to positive impact the development. Various studies also supported the role of oil exploration on the poverty and unemployment reduction in oil dependent countries (Ebegbulem et al., 2013; Ugwu, 2009).

Cavalcanti et al. (2019) also indicated in their study that oil discoveries and exploration has constructive contribution in the economic development of the exploring country. The study took the novel data of all the oil wells drilled in Brazil from 1940 to 2000 to perform the quasi experiment. The finding of the research support the positive impact of crude oil discoveries and exploration on the local production as well as the economic development by relocating the labor from agriculture sectors to high end activities in industry. Further, oil discoveries also bring structural transformation in service sector and urbanization which will increase the share of services industry in GDP. The structural revolution skewed towards the urban sectors such as services, is viewed as favorable impact of oil exploration on urbanization services industry (increasing share of workers in services) and the magnitude of services firms. Allcott and Keniston (2017) also investigated that impact of natural resource discoveries on the local economies in United States by taking the census data of micro manufacturers in USA. For analysis purpose, data of oil and gas exploration from 1969 to 2014 are used. The results of the study illustrate that oil and gas exploration positively impacts the local wages, demand, and also manufacturing industry. According to

estimation, 1 S.D increase in gas and oil exploration will cause 1% increase in real wage. The manufacturing industry do not crowded out by oil exploration but benefited due to growth in upstream and locally trader sectors. Therefore, on the basis of above literature the following hypothesis is constructed:

H₁: Oil exploration and discoveries has positive contribution in the economic growth of Thailand.

2.2. Crude Oil Consumption and Economic Growth

The increasing oil consumption has equivocal impact on various world economies. However, increasing oil consumption has very pronounced detrimental impact on the fiscal and current account balances of oil importing countries, including Thailand.

Waleed et al. (2018) empirically took the oil consumption data of Pakistan from 1965 to 2015 to investigate its influence on the GDP growth. For estimating the results, the study used Granger Causality test based on the error correction model (ECM). The findings of the study support the negative impact of increasing oil exploitation on the economic growth of the country (Khan and Nawaz, 2010). The high oil consumption shift the government spending from key sectors to oil bill payment. Thus, in order to circumvent the adverse consequences of high oil consumption, special attention is required to offset the limitation of high oil consumption such as environmental degradation. Contrastingly, Yoo (2006) also identified the long run causal relationship between oil consumption and economic growth of South Korea by employing the time series co-integration techniques. For analysis, the annual data of oil consumption in South Korea from 1968 to 2002 is employed. The Granger Causality also indicates that oil consumption positive impact the economy of Korea, and high economic growth further increase the oil consumption. Nasiru et al. (2014) Similarly, Rezitis and Ahammad (2015) also support the positive causal relationship between oil consumption and economic growth of Nigeria, which is leading oil producing country in Africa, by employing the time series data during 1980-2011. Johnson and Granger causality endorse the trend of causality such as from oil consumption to economic development in Nigeria. Also investigated the linkages between oil consumption and economic growth of South Asian and Southeast Asian economies including Thailand, Indonesia, Singapore, Malaysia, and India by employing the panel data from 1990 to 2012. For analysis of data, the study used the impulse response function to capture the effect of shocks. The results indicate the presence of bilateral causality between oil consumption and economic growth. According to the study the energy production has positive impact on economic growth of energy dependent countries as a stimulus of growth. Therefore, on the basis of above literature the following hypothesis is built:

H₂: Consumption of crude oil positively influence the economic growth of Thailand.

2.3. Crude Oil Price and Economic Growth

The oil prices have different consequences on the economic growth of oil importing and oil exporting economies. Oil price shock has key contribution in exacerbating the inflation in oil

importing countries by worsening their external balances. The effect of oil price on the domestic inflation in Thailand during 1993 to 2016. The study used the co-integration techniques to explore the linkages between price level in country, oil price, and industrial output. Moreover, study also took into account the domestic inflation. The empirical findings denote the positive role of oil price shock on domestic inflation and discouraging impact on industrial production. Bastianin et al. (2017) also proposed that shock in oil prices negatively influence output growth of Mediterranean countries. Due to high import bill of energy, the output growth of the countries is negatively affected by high oil prices. Moreover, the negative impact oil price shock is more severe on highly oil energy dependent countries. Various studies has supported the positive impact of high oil prices on oil exporting countries. Gummi et al. (2017) proposed that presence of short run relationship between oil prices and economic growth of Nigeria by employing the Dicky Fuller test of causality on the annual time series data from 1974 to 2014. The empirical findings of the study proposed the positive role of oil price on total export bill and economic growth of Nigeria. The studies indicate that oil price shock has detrimental impact on net oil importing countries including Thailand. Hence, on the light of above discussion the following hypothesis is proposed:

H₃: High oil prices are negatively associated with the economic growth of Thailand.

3. METHODOLOGY

3.1. Data

This study was aimed to investigate the impact of the exploration, consumption and prices of crude oil on economic growth of the country; the data has been gathered by the author for the above mentioned aspects. The collected data comprises the time period of 26 years and has been gathered in context of Thailand. The author has used the reliable databases such as World Bank and Global Economy for data collection purposes as well as to identify the measurement unit of each variable.

3.2. Model Specification

When the data about exploration, consumption and prices of crude oil and economic growth of the country has been collected by the author, their measurement units are designated for each of the particular variable. This will lead towards the formation of the regression equation to be used in this study for research purposes. In this regard, economic growth ECON has been measured in terms of rate of change in GDP in the country. Exploration of crude oil EXP has also been measured in terms of barrels per day. The consumption of crude oil CON has been measured in terms of barrels per day. The price of crude oil PRI, on the other hand, has been measured in terms of US dollars. As the author has used two control variables i.e. population growth and energy consumption in the study, their measurement units have also been mentioned here. The population growth POP has been measured in terms of number of people of a country while energy consumption ENE has been measured in terms of billion kilowatt hours. By using the notations of the above mentioned variables, the regression equation can be formed as follows:

$$ECON_t = \alpha + \beta_1 EXP_t + \beta_2 CON_t + \beta_3 PRI_t + \beta_4 POP_t + \beta_5 ENE_t + \varepsilon_t$$

In this equation, economic growth has been represented by *ECON*, exploration of crude oil has been represented by *EXP*, consumption of crude oil has been denoted by *CON*, price of crude oil has been represented by *PRI* and energy consumption has been shown by *ENE*. The notation ε_t shows the error term.

3.3. Estimation Procedure

After data collection and regression equation formation, the author has applied several tests and approaches in order to scrutinize the collected data. As the data is time series, therefore the unit root test, co-integration test and VAR model has been applied on it. The details of these tests and approaches have been given in this section.

3.3.1. Unit root test

First of all, the author has applied unit root test, the main purpose of which is to find out the order of integration and the stationary or non-stationary state of the collected data. For this purpose, generally Levin Lin Chu LLC and Im, Pesaran and Shin tests are used but the author has selected LLC test to be applied in this study. If the mean and variance of a particular series of data remains constant in a particular period of time, the variables are considered to be stationary. The unit root tests are very important because only the variables with specific order of integration must be applied the next test otherwise the results of the tests may be inaccurate (Enders, 1995). Therefore, to find out order of integration and stationarity of the variables, unit root test must be applied. Null and alternate hypotheses are involved in the unit root test. The null hypothesis involves that there is unit root in the data and is non stationary. While the alternate hypothesis involves that there is no unit root in the data and is stationary. Based on the acceptance and rejection of these hypotheses, the order of integration and stationary properties are evaluated in context of the collected data.

3.3.2. Co-integration test

After finding out the order of integration and stationary properties of the collected data, the author has applied co-integration test so that the co-integrated or long run relationships between the variables can be estimated. The author has used Engle Granger two-stage test for this purpose (Engle and Granger, 1987). The purpose of the author to apply this test is that the collected data is time series and this test is very much suitable for this data. In this regard, the author has applied augmented Dickey Fuller ADF and Dickey Fuller DF tests. Again in this case, the null and alternate hypotheses are involved. The null hypotheses showing the absence of co-integrated relationships while the alternate hypothesis showing the presence of co-integrated relationships. It must be noted here that if the non stationary variables are having same order of integration, then variables are said to have co-integrated relationships among them. The following equation can be used in this regard:

$$\Delta e_t = \alpha_1 e_{t-1} + \varepsilon_t$$

OR

$$\Delta e_t = \alpha_1 e_{t-1} + \sum_i \alpha_{i+1} \Delta e_{t-1} + \varepsilon_t$$

3.3.3. VAR model

After the estimation of order of integration and co-integrated relationships, the author has further employed VAR estimation model introduced by Sims (1980) so that the short term relationships between the variables can be studied (Sims, 1980). According to Sims, when the long run relationships are not confirmed, the short run relationships can be obtained. VAR model is specially used for study of economic related time series data as it provides a flexible framework for study. All the variables involved in the VAR model are endogenous in nature. If the data is non stationary in level series, it must be applied with first difference so that it may get stationary and after that VAR model will be applied. It must be noted here that error correction term has no significance in this model. The following equation can be used in accordance with the VAR model:

$$\begin{pmatrix} \Delta A_t \\ \Delta B_t \end{pmatrix} = \alpha_0 + \alpha_1 \begin{pmatrix} \Delta A_{t-1} \\ \Delta B_{t-1} \end{pmatrix} + \alpha_2 \begin{pmatrix} \Delta A_{t-2} \\ \Delta B_{t-2} \end{pmatrix} + \dots + \alpha_p \begin{pmatrix} \Delta A_{t-p} \\ \Delta B_{t-p} \end{pmatrix} + \alpha_{p+1} \begin{pmatrix} D_{t-4} \\ D_{t-4} \end{pmatrix} + U_t$$

In this equation, α_0 represents the constant, U_t is the innovation term. The number of lags can be determined by AIC criterion. According to some past studies, VAR model can be used in different aspects related to economics. Determination of relationships between different variables is the basic function that is related to this model but there is some chance of error in this case. Sometimes the results are accurate but sometimes they show fluctuations and variations. A p^{th} order of VAR equation can be shown as,

$$Y_t = c + A_1 y_{t-1} + A_2 y_{t-2} + \dots + A_p y_{t-p} + e_t$$

4. EMPIRICAL RESULTS

4.1. Results of Unit Root Test

As discussed in the earlier section, unit root test is used to find out and investigate the order of integration as well as stationarity of the variables; the author has got the following results by applying unit root test. These results have been given in the Table 1. According to this table, all the variables included in the level series have accepted the null hypothesis but the control variable, energy consumption has rejected the null hypothesis. The significance level of this rejection is 5%. This can be observed that as most of the variables have accepted the null hypothesis therefore in level series the variables are non stationary. When

Table 1: Panel unit root test – LLC

Variable	Level	1 st Difference
ECON	-3.7575 (0.643)	-8.0637*** (0.000)
EXP	-3.8753 (0.425)	-6.7435** (0.000)
CON	-4.7468 (0.854)	-11.6375*** (0.000)
PRI	-4.3657 (0.633)	-8.7463*** (0.000)
POP	-5.8543 (0.442)	-10.4253** (0.000)
ENE	-4.6526** (0.003)	-9.8647*** (0.000)

the first difference is applied to the data, it can be seen that all the variables in this series have rejected the null hypothesis with 5% and 10% significance levels indicating the fact that the unit root is absent and the data is stationary. These results can be effectively concluded in such a way that the variables are non stationary in level series while they become stationary when they are first differenced.

4.2. Results of Co-integration Test

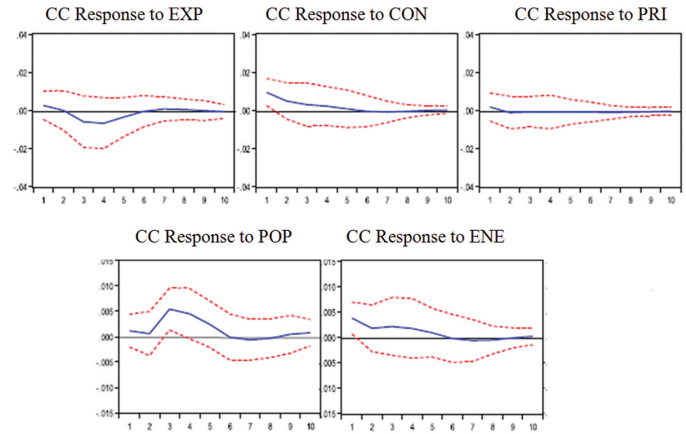
After unit root test, the author had applied co-integration test so that the co-integrated or long run relationships can be identified between the variables. The author had applied ADF and DF tests, the results of which have been presented in Table 2 in detail. It can be clearly seen in the table that different values regarding ADF and DF tests have been given and these values have not rejected the null hypothesis at all. As the null hypothesis indicated the absence of co-integrated relationships therefore these results point towards the absence of co-integrated or long run relationships between the variables involved in this study. In other words, the linear combination of any two variables included in this study is not integrated in the long run.

4.3. Results of VAR Model

As discussed in the previous section, VAR model is used in order to study the short term relationships between the variables, the results of this model have been given in the Table 3. It can be clearly seen in the table that F statistic value is greater that indicates the significance of results of VAR model. In addition, the R square value is within the range of zero to one. This fact also increases the validity of the results shown by VAR model. Coming towards the basic interpretation of the results, it can be observed that crude oil exploration has significant impact on price of the crude oil. Moreover, in case of crude oil consumption, it has been found that consumption has significant impact on all the independent and control variables of the study. Price of crude oil has significant impact on its exploration. In the same fashion, the control variables show almost similar

results. To conclude all these results, it can be stated that all the independent and control variables have significant impacts on the dependent variable, economic growth. These results have been affirmed by the values of F statistics as well as R square. The detailed results and values associated with each of the variable can be seen in the Table 3.

4.3.1. Response CC to independent and control variables



The independent and control variables i.e. exploration, consumption and prices of crude oil, population and energy consumption show responses to the shocks given by the dependent variable, economic growth in the form of the graphs given above. In these graphs, dotted red line as well as solid blue line has been observed. The red dotted line indicates the limit that has been set in accordance with the shock given by economic growth and the response of the other variables has been represented by the blue solid line given in between. The results will be smooth and fine only if the blue line remains in between the red line. If at any point in the graph, the blue line crosses the red line, the results will be ultimately disrupted and inaccurate. Therefore, to maintain the authenticity of the results, CC response must be measured and interpreted.

Table 2: Co-integration test

Co-integration	ECON	EXP	CON	PRI	POP	ENE
Dickey fuller	-3.376	-4.276	-2.747	-1.746	-2.757	-4.747
Augmented DF	-4.365	-6.473	-4.435	-6.423	-9.647	-7.536

Table 3: Vector autoregressive estimates

VAR estimation	EXP	CON	PRI	POP	ENE
EXP (-1)	0.827362***	-0.756475	-0.753677*	-0.074689	-0.035447
EXP (-2)	-0.754786***	0.035467	0.643546	-0.034248	0.006438
CON (-1)	-1.463758***	-0.563684*	-0.523546**	0.743578**	0.754678**
CON (-2)	0.355976**	-0.745286**	-0.643575***	-0.754357**	-0.345479***
PRI (-1)	-0.632354**	-0.006386	0.743577***	0.063688	-0.046765
PRI (-2)	-0.746547***	-0.024544	0.078774***	-0.074768	-0.036578
POP (-1)	-0.747584***	0.743587**	0.232353***	0.246557**	0.004675
POP (-2)	0.346478***	0.046375	-0.846475	0.364574**	-0.534757***
ENE (-1)	3.746386***	0.743475***	0.452657***	-0.637863**	-0.743786*
ENE (-2)	-0.637589***	0.747657***	-0.563748***	0.635785**	0.676849**
C	20.75486***	-9.754638***	22.74668**	5.643578*	11.25465***
R-squared	0.864249	0.235884	0.725389	0.287548	0.273684
Adj. R-squared	0.874264	-0.247429	0.725388	0.284693	0.826843
F-statistic	9.267358	0.236749	28.27354	44.82563	28.24758

5. DISCUSSION AND CONCLUSION

5.1. Discussion

It has been very clear from the previous discussions that the main motive behind this study is to investigate and explore the impact of exploration, consumption and prices of crude oil, for which three hypotheses have been given in the literature review section of this study. Let them discuss one by one. Exploration of crude oil has significant impact on economic growth was the first hypothesis. The results obtained by the tests declared this hypothesis as accepted. This behavior has been experienced. The consumption of crude oil has significant impact on economic growth was another hypothesis made by the author. This hypothesis was also accepted as the consequence of the results obtained. This result is in accordance with a past study (Behmiri and Manso, 2013). The price of crude oil has significant impact on economic growth was the last hypothesis made in regard of this study, which has also been accepted by the results. This result is consistent with a study conducted in the past (Sodeyfi and Katircioglu, 2016). In the same fashion, the impacts of the control variables, population growth and energy consumption have also been found as significant on economic growth. This result is exactly in concordance with study conducted in the past (Kelley and Schmidt, 1995).

5.2. Conclusion

Crude oil can be considered valuable for any country as it has impact on the industry as well as economy of that particular country in one way or the other. The same aspect has been studied in this research that how the exploration, consumption and price of the crude oil impacts the economic growth of a country. Data collected for this purpose for 26 years is in context of the above mentioned variables and has been collected from Thailand through various sources. Several tests and techniques were applied on that data for various purposes and results were obtained respective of each test. The crux that was derived from these results is that the exploration, consumption and prices of the crude oil have significant impact on economic growth along with the control variables i.e. population growth and energy consumption. After explaining these results, the author has further discussed some implications that may be derived from this study and also mentioned some of the limitations along with recommendations that must be considered by future researchers in order to improve the quality of the study.

5.3. Implications

Several implications in different contexts may be related to this study. The theoretical aspect refers to the presence of literature and detailed knowledge about different aspects of crude oil, its exploration, its consumption, its prices etc. The information related to the impact of these aspects on economic growth has also been given. Researchers may be benefitted by this literature. This study will also show the crude oil companies the impacts of crude oil on economic growth so that they may consider it to improve the conditions of crude oil production better. The policy making department may also get guidance from this study in order to make policies and regulations that will be in favor of the crude oil companies, so that the economic growth of the country may be enhanced.

5.4. Limitations and Future Research Indications

The future researchers may consider these points in order to improve and increase scope of their studies. The first limitation is related to the sample size of the data, which is very less and must be increased by the future researchers. In the same way, this research is limited to Thailand and the future researchers may go to other countries and regions too. Moreover, the tests used in this study include unit root test, co-integration test and VAR model. However, other tests for the time series data study may also be employed in future studies.

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