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Growth Linkage between Oil and Gas and Construction Industry of Malaysia (1991-2010)

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Abstract

Oil and gas sector has become very important and fundamental sector of any economy. Oil and gas are essential and, high-value commodities for both developed and developing countries. These two products are indispensable for industry, industrial process, and industrial output. The demand for these commodities are continues to grow because of their various use and direct link to the industry and social well-being of the society. The two characteristics high consumption and high value increases the hopes and expectations of governments, citizens, local communities, and the oil and gas companies that provide the essential services of exploration, extraction, and distribution. The construction sector play significant role to manage these activities. The objective of this study is to describe and identify the causal link and the direction of the link between the Malaysian construction industry (MCI) and oil and gas sector (O&G) of Malaysia over the period of 1991 to 2010. The Granger causality technique is used to determine the effect of one sector to another sector. The outcome of the study is neither O&G lead to MCI nor MCI lead to O&G. The O&G and MCI are independent and there is no causality link between them during study period 1991-2010.

Keywords: Linkage, causality,

1. Introduction

1.1 Introduce the Problem

Oil and gas are essential, high-value products for both developed and developing economies. These commodities are not only using for operating vehicles and home appliances but equally important for industrial process and economic development of a country. The demands for these products are continually increasing due to diversified consumption in modernized manufacturing sector. Oil and gas also use as a traditional source of energy for such industry like chemical, metal, paper, plastics and oil refining industry. The two products have direct links with economy and social well being of the society.

Oil and gas sector presumable has strong backward and forward linkage with other sector of the economy due to its multidisciplinary nature, which implies that the development in oil and gas sector play important role in the growth of other sectors. The growth in oil and gas sector generating the demand for the output of associated sectors like the heavy machinery and equipment's and different kinds of chemical that use in oil and gas industry received from the manufacturing sector. The construction industry facilitates it by constructing heavy offshore structure, building and platforms. Similarly the output of oil and gas sector consumed as input in the manufacturing, construction and other sectors of the economy such as diesel fuel, motor oil, kerosene, jet fuel, , asphalt, paraffin wax, gasoline and many other commodities. Therefore it is necessary to understand the nature of the link among the sectors. Particularly there is a need to conduct an empirical analysis for measuring the nature of the relationship and direction of linkage between the sectors.

The purpose of this study is to examine the causal link between construction and oil and gas sector of Malaysia and to find out the direction of link, whether there is a uni-directional or bi directional association between the two sectors. The finding of the study is useful for government, policy makers, economic planning unit of Malaysia and interested parties.

1.2 Oil and gas and construction industry of Malaysia

The oil and gas and construction are the two key sectors of the Malaysian economy. They have significant socio-economic environment and manpower effect in the Malaysian economy.

The Malaysia is ranked 28th in the world in term of crude oil reserves and the 14th largest in term of gas

reserves(CIA, 2012). It has approximately 615,100 km2 of acreage available for oil and gas exploration. The oil and gas sector contributes approximately 40% of the nation's total revenues. It is continuously rising and expected to generate RM131billion in Gross National Income by 2020. Therefore it has been identified as a significant sector for national economy under Malaysia's Economic Transformation Program (Lee, 2013).

First Oil in Malaysia was discovered in 1909 and production started in 1910. Before 1975 oil companies had exclusive rights to explore and produce resources and paid royalty and tax to the Malaysian government. However 30 years ago the Malaysian government passed the Petroleum Development Act (1974). By this act oil and gas resources considered as a state property and PETRONAS is the custodian of resources.(Razalli, 2005). Since then the industry has developed and recognized as one of higher value economic sectors of Malaysia. From 1974 to the end of 2011 the industry had contributed RM653 billion to the federal government and various state governments of Malaysia (Lee, 2013).

The O&G industry of Malaysia is continuously engaged in developing the building blocks at each level of production and consumption in such major sectors of the Malaysian economy like construction, agriculture, manufacturing, and services, chemicals, and petrochemical industries.

The construction industry and construction professionals play a very important role in oil and gas industry. The civil engineers have plentiful opportunities to contribute to the various aspects of the O & G industry, from front-end engineering design and construction of oil production facilities to the design and construction of heavy structure oil refineries and chemical plants (Solbai, 2005).

The Malaysian Construction Industry (MCI) is another important and valuable industry of the Malaysian economy. It plays a significant role in the development of Malaysia. The average contribution of MCI to GDP is around 4%, which is relatively small as compared to other sectors of the economy. However it has a powerful role in the growth and development of the other key sectors of the economy because of its strong backward linkages. It approximately facilitates to 140 other industries of the Malaysia including O&G. Furthermore more than one million people are engaged in this industry which is 8-9 % of total available work force (*Malaysia Economic Statistics Time Series*, 2011)

In short the two industries O&G and MCI have a significant role in the socio- economic development of Malaysia, generate considerable amount of foreign exchange, attract foreign investors and a generate good amount of revenue for the Federal government in term of taxes and duties.

2. LITRATURE REVIEW

The growth in aggregate economy is the function of the sectoral growth rate in the economy, which is highly depended on the linkages among the sectors of the economy (Hoen 2002 CHUSER). The rationale of linkage theory is that an industry that has potential to motivate and improve the growth of the other sectors should be given more attention to accelerate the overall economic development process (Saka & Lowe, 2010).

Today oil and gas has become an essential component of the industrialized and competitive world. The Petro products have revolutionized human lives, improved standard of living and generating lots of revenue for oil and gas producing countries. The O&G products support to grow a number of other key sectors of the economy through its forward and backward linkages such as manufacturing, chemical and construction (Forde, MacKenzie, Stuart, & Perrett, 2005).

The numbers of research studies are available on the role of the O&G sector in the economy and its linages with the rest of the economy. In the light of available literature O&G industrial linkages can be divided into four main categories (Fiscal, Environmental, Backward and Forward linkage).

(1) Fiscal linkages deal with resource management, revenue issues and social political and cultural incidences.

(2) Environmental linkages deal with environmental issues

(3) Forward linkages deal with pricing and supplying of industrial output

(4) Backward linkages deal with factor of production such as material, machinery, equipment and technology

(Griffin & H., 1986; Teka, 2011)

The available literature on backward linkage in the oil and gas industry suggests that spillovers between the oil and gas and the aggregate economy arose in the manufacturing sector because the intermediate industry development process takes place in the manufacturing sector. The manufacturing sector supply factors of production like machinery, equipment, material and other technical inputs (Teka, 2011).

A study was conducted under the title "Forests and poverty alleviation. In: Food and Agriculture Organization"

concluded that backward linkage of the O&G projects demanded input from the other sectors of economy at different stages like designing and planning, installation and construction and operational stage (Sunderlin, Angelsen, & Wunder, 2003). Similarly another study on backward linkage of oil and gas industry conducted by Al-moneef (2006), pointed out that the backward linkages affect the oil and gas sector and its operation (Al-moneef, 2006).

Hanson (2013) conducted study on linkage between the world oil price shock and the agriculture sector. The main finding of this study is the oil price shock impact on agriculture is not limited to the direct and indirect energy cost (Hanson, Robinson, & Schluter, 1993).

Gergeas (2009) submitted a report to Alberta Finance Enterprise under the title "improving construction productivity on Alberta oil and gas capital projects" reveals the link between construction mega projects and rapid growth in oil and gas sector of Alberta. The outcome of the report is a significant increase in the growth of oil and gas sector in Alberta, Canada over the past decade setting a trend of constructing "mega" projects that are both labour and capital intensive (Oyejide & Adewuyi, 2011).

The available literature suggests that O&G sector plays very strong role in the industrialized economy because of its wide ranging linkages with the other sectors of the economy. However very few studies are available on the nature of the linkage between construction and O&G sector. The objective of this study is to examine the relationship and the causal link between MCI and O&G sector of Malaysia

3. Data and Methodology

The quantitative paradigm of research is used to examine the linkage between the concerned sectors (O&G and Construction). The annual time series data of MCI and O&G growth for the period 1985-2010 is obtained from the Department of Statistics Government of Malaysia. The descriptive statistical analysis is conducted to understand the basic properties of data and making a comparison of the growth of the two sectors O&G and Construction. The inferential statistical analysis used to measure the relationship and causal link between the sectors. The data series are transformed in the natural logarithm form for causal analysis i.e. LOGS and LCONS. The Granger causality model is used to know the direction of linkage between the LOGS and LCONS.

The basic requirement of Granger analysis is the variable series should be stationary and free from unit root. Therefore unit root test for each variable series is conducted to satisfy the Granger causality assumption. The most popular Augmented Dickey Fuller (ADF) and Phillip Peron (PP) tests are used here to examine the stationary problem with the variable series. The equations for stationarity /unit root test are as under.

$$\Delta LOGS_t = \propto_0 + \alpha_1 T + \alpha_2 LOGS_{t-1} + \sum_{t=1}^{n} \gamma_i \, \Delta LOGS_{t-1} + \mu_{1t} \quad (1)$$

$$\Delta LCONS_t = \beta_0 + \beta_1 T + \beta_2 LCONS_{t-1} + \sum_{t=1}^{n} \gamma_i \Delta LCONS_{t-1} + \mu_{2t} \quad (2)$$

Where LOGS and LCONS are log series for growth of O&G and construction sectors respectively.

$\Delta LOGS_t = LOGS_t - LOGS_1$

$\Delta LCONS_t = LCONS_t - LCONS_1$

$\propto_0$ = drift term

T = trend in the series

The equation 1 is used to test stationarity and unit problem in LOGS series, while equation 2 is used to test same problem in LCONS series.

The null hypothesis for equation one is LOGS series has unit root or stationary problem, statistically H0: $\alpha_2 = 0$ against the alternate hypothesis LOGS series is free from unit root statistically H1: $\alpha_2 \neq 0$. Similarly LCONS series test with the null hypothesis that LCONS has a unit root problem H0: $\beta_2 = 0$ against the alternate hypothesis H1: $\beta_2 \neq 0$.

Once series become stationary and free from the unit root than Granger causality analysis can be conducted. The following causality equations are developed in the light of Granger causality model equations for testing the causality between the concerned series LOGS and LCONS.

$$LOGS_t = a_0 + \sum_{J=1}^{J} b_1 \, LOGS_{t-j} + \sum_{k=1}^{k} c_1 \, LCONS_{t-k} + \varepsilon_1 \quad (3)$$

$$LCONS_t = a_2 + \sum_{l=1}^{l} b_2 \, LCONS_{t-l} + \sum_{m=1}^{m} c_2 \, LOGS_{t-m} + \varepsilon_2 \quad (4)$$

Where

LOGS = Log of O&G sector output series

LCONS = Log of construction sector output series

ε_1 and ε_2 = Uncorrelated error terms

The Granger causality between O&G and MCI can be determined by testing equation (3) and equation (4) for the following null and alternate hypothesis.

Null hypothesis for equation (3) is LOGS does not cause LCONS, statistically H0: $c_1 = 0$ tested against alternate hypothesis LOGS cause LCONS, statistically H1: $c_1 \neq 0$

Similarly null hypothesis for equation (4) is LCONS does not cause LOGS, statistically H0: $c_2 = 0$

tested against the alternate hypothesis LCONS cause LOGS, statistically H1: $c_2 \neq 0$. Noted that if the c_1 is significant but c_2 is not significant or vice versa implies that there is a uni directional relationship. If c_1 and c_2 both coefficients are significant for their respective equations imply that there is a bi-directional relationship between the variables.

The decision regarding accepting or reject the null hypothesis is taken on the basis of the F-statistics. If the estimated value of F-statistic greater than the F-critical at 1%, 5% or 10 % significance level, it represents reject the null hypothesis and accept the alternate and vice versa.

4. Results and Discussions

4.1 Basic Fact of O&G and MCI

Table 1 depicts the basic statistical information about the two major industries O&G and MCI of the Malaysian economy for the last two decades 1991-2010. The average output of the O&G sector during 1991 – 2010 was 3.6 times higher than the MCI i.e. RM.52201 and RM.14416 respectively. The average growth rate of O&G sector was doubled and the average contribution to GDP was tripled as compared to MCI during the last twenty years. The O&G sector of Malaysia is rapidly expanded during the last two decades. The average output of O&G during 1991-2000 was RM27301 million, while in 2001-2010 it was RM 77101 million, which is three times higher than 1991-2000. Similarly the average growth and average contribution to GDP were almost double in the same period of time. The average growth rate of MCI during 1991-2010 was approximately 2% higher than the O&G sector i.e. 7.22%, but it sharply declined in 2001-2010 and reached to 2.27% due to various reasons such as global financial crises, lack of investment and support from the government, and completion of the heavy structure running project..

Table 1. Comparison of Output, Growth and Contribution to GDP

Description	1991-2000		2001-2010		1991-2010	
	OGS	CONS	OGS	CONS	OGS	CONS
Average Output RM (Million)	27301	13508	77101	15324	52201	14416
Average Growth %	5.78	7.22	11.6	2.27	8.69	4.74
Average Contribution to GDP %	9.65	4.77	16.2	3.41	12.93	4.1
Total Output RM(Million)	273009	135083	771009	153246	1044018	288329

4.2 Correlation Test

The association of the two concerned sectors is examined through Pearson correlation technique and found that that there is a moderate relationship neither strong nor week between O&G and MCI output during the study period as shown in Table 2.

Table 2. Pearson correlation

Sectors	O&GS	CONS
O&GS	1	0.43
CONS	0.43	1

4.3 Unit Root Test

Prior to conducting causality analysis, stationarity / unit root tests by using equation 1 and equation 2, are conducted for each variable data series to satisfy the Granger causality test assumption and also determine the order of integration of the variables series. As mentioned in the methodology section, ADF and PP test at level and first difference are used to examine the unit root and stationary problem with the series. The Mackinnon critical value used as a reference for rejection of the null hypothesis of a unit root.

Table 3 shows that the null hypothesis of a unit root statistically cannot be rejected at level for both data series that implies the both variables have stationarity and unit root problem at the level. However at the first difference of series unit root problem removed from the series and both variables series have become stationary. Both ADF and PP tests reject the null hypothesis of a unit root at first difference and suggested that series are integrated

order 1, I(1) mean there is a possibility of the long run relationship between the variables.

Table 3. Unit Root Test Results

Series	# of Lag	DF (Level)	ADF (First Diff.)	PP (First Diff.)
		Without intercept	Without intercept	Without intercept
LOGS	0	2.108	-3.096***	-3.096***
LCONS	0	1.602	-2.522**	-2.522**

Steric ***and ** indicate significance at 0.01 and 0.05 levels respectively

4.4 Pair wise Granger Causality Analysis

The Granger causality results are obtained by testing equation 3 and equation 4 and reported in Table 4. These results provide some interesting and surprising information about the two concerned sectors. The O&G and MCI are independent and there is no causality link between them during study period 1991-2010. Neither O&G lead to MCI nor MCI lead to O&G. The estimated value of F-statistics and corresponding p- value does not provide significant evidence to reject the two set null hypothesis, even the changing in lag order has not able to change the results.

Table 4. Granger Causality Results

Null Hypothesis	F- Statistics	Probability	Decision
LOGS does not Granger cause LCONS	0.3576	0.7059	Accept
LCONS does not Granger cause LOGS	0.6402	0.5430	Accept

5. Conclusion

The O&G and construction sector are the key sectors of the Malaysian economy, play a significant role in the socio economic development of Malaysia. In the last two decades oil and gas industry of Malaysia rapidly expand its output and contribution to GDP. It's greatly affected the Malaysian economy through its backward and forward linkages with other sectors of the economy. However this study concludes that the O&G sector of Malaysia does not have an impact on MCI out output and similarly MCI does not influence the O&G sector of Malaysia. Their behavior is indifferent to each other and there is a moderate correlation between the two sectors means neither strong nor week during the study period.

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References

Al-moneef. (2006). *Creating Local Linkages by Empowering Indigenous Entrepreneurs.* Paper presented at the United Nations Conference on Trade and Development., Nigeria.

CIA. (2012). *CIA World Factbook* USA: CIA

Forde, C., MacKenzie, R., Stuart, M., & Perrett, R. (2005). Good industrial relations in the oil industry in the United Kingdom. Geneva International Labour Office

Griffin, J., & H., S. (1986). Energy Economics and Policy,. *New York: Academic Press*.

Hanson, K., Robinson, S., & Schluter, G. (1993). Sectoral Effects of a World Oil Price Shock: Economy wide Linkages to the Agricultural Sector. *Journal of Agricultural and ResourceEconomics., 18*(1), 96-116.

Lee, E. T. H. (2013). Scope For Improvement: Malaysia's Oil And Gas Sector Malaysia: REFSA.

. *Malaysia Economic Statistics Time Series*. (2011). (ISSN 0127-9181). Malaysia: Department of StatisticsGovernment, Malaysia.

Oyejide, T. A., & Adewuyi, A. O. (2011). Enhancing linkages of oil and gas industry in the Nigerian economy *MMCP Discussion Paper No. 8*.

Razalli, R. b. M. (2005). THE MALAYSIAN OIL AND GAS INDUSTRY : An Overview. *JURUTERA*(1).

Saka, N., & Lowe, J. (2010). *An Assesment of Linkages between Construction Sector and Other Sectors of Nigerian Economy.* Paper presented at the COBRA 2010, Dauphine Universite Paris.

Solbai, S. b. (2005). MALAYSIAN ENGINEERS AND THE OIL & GAS INDUSTRY. *JURTERA*(1).

Sunderlin, W. D., Angelsen, A., & Wunder, S. (2003). *Forests and poverty alleviation. In:Food and Agriculture Organization*. Rome: Food and AgricultureOrganization.

Teka, Z. (2011). Backward Linkages in the Manufacturing Sector in the Oil and Gas Value Chain in Angola. *MMCP Discussion Paper No 10 University of Cape Town and Open University*.