A Quantification of Causality between the Construction and Agriculture Sectors of Malaysia (2000-2010)

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Abstract—**Malaysia has been trying to shift toward from developing nation status to developed nation status. Hence it becomes important for Malaysian government to study and understand the dynamics of inter sectoral linkages in order to obtain positive growth, develop to sustain the economic growth momentum and to achieve higher level of socio economic development. The objective of this study is to investigate the linkage and causal relationship between the two key sectors (construction and agriculture) of Malaysian economy by using sophisticated econometric techniques. Granger causality test and the vector auto regression (VAR) technique is used to determine the causality between the two sectors and measure the effect of changes in output of one sector on the output of other sector. Results of empirical analysis exhibit that there is strong correlation and bi-directional causal relationship between construction and agriculture sectors of Malaysia. Agriculture sector takes only 3 quarter to respond to the impact of shock emanating from construction industry while construction sector responding time is 13 quarter against the shock of agriculture sector.**

Keywords-sectoral linkages, causal relationship, vector auto regression

I. Introduction

Agriculture and construction sectors are two fundamental sectors of developing and developed economies. The history of the world provides overwhelming global evidence that the two sectors play crucial role in the growth and survival of an economy. These sectors are not only important because they provided basic necessities of life, food and shelter but they are also important because they provided significant amount of employment opportunities, raw materials for other sectors of economy, earning and saving the foreign exchange and alleviating poverty, for a large percentage of the population. The significance of the agricultural sector is reflected in terms of contribution to the GDP, employment, releasing labor for the growing industrial sector, export revenue, export tax and duty, as well as social and economic development [1]. While the contribution of construction sector in development process is significant in terms of scale and share for both developed and developing countries. The basic public infrastructure and private physical structures for development and many productive activities such as services, commerce, utilities and other industries are provided by construction sector. Thus the sector has strong impact on the economy of a country/region during the actual construction process [2].

When construction and agriculture sector are discussed in an economy linkage and spillover effects are presumed to be stronger between the two sectors as construction sector provides a significant support to the agriculture sector by constructing dams, reservoirs, canals for irrigation purpose, construct roadways, railway lines etc for transporting the agriculture products from fields/farms to market and provide buildings for storing the output, while the agricultural sector is significant for construction industry as it provides greater employment opportunities in the construction of these projects, and other such activities.

This study examines the causality link between construction and agriculture sectors in the Malaysian economic environment. As Malaysia is in the process of industrialization, and wants to change it status from developing nation to develop nation, the construction and agriculture construction sectors can play effective role in achieving this goal. The construction sector build the economic and social infrastructure for industrial development, basic services and also infrastructure for society. It also provides the infrastructure needed in a country for basic developments required by the society to improve in social living standards and create opportunities for other sectors of economy to develop and grow [3]. The agriculture sector supply adequate and affordable healthy food for increasing population, supply raw materials to growing and diversifying domestic industrial sectors, expand the size of an effective market for the products of the domestic industrial sector, earn and save foreign exchange for the country [4].

Both construction and agriculture sectors are considered to be major productive sectors in Malaysia. An average output, employment level and contribution to gross domestic product (GDP) for the two sectors over the study period 2000-2010 are given in Table 1. The contribution of agriculture sector in term of output and employment is greater than construction sector by 4%.

TABLE 1
AVERAGE OUTPUT, EMPLOYMENT, & CONTRIBUTION

Description	Construction Sector	Agriculture Sector
Output in (RM)	15202	35777
Employment (%)	9	13
Contribution (%)	3.43	7.99

The main objective of this study is to make critical assessment of linkage between construction and agriculture sector of Malaysia over the period 2000-2010, and to identify the direction of causal relationship between the two sectors.

II. Literature Review

The construction and agriculture both are very important sectors for national and international economy due to their job creating ability for professional and non professioal people. The two sectors in production process received inputs and production factors (labour, land and capital) from other sectors of economy. This could generate considerable employment through multiplier effects [2].

There are numbers of research studies available on the causality linkages between agriculture and industrial sector. For example, [5] investigate VAR and Hsiao's Granger causality for export-led growth in agriculture sector. [6] studies the co-integration relationship among manufacturing, services and agriculture sector in Malaysia from 1960 to 1998 under the title "Inter-sectoral Integration in Malaysian Economic Transition and Change: A Co-integration Analysis". He found that the manufacturing sector has a little impact to the agriculture production in the short run. [7] found that all sectors i.e. agriculture, industrial and services sector, have tendency to move jointly in the long run. Another study conducted by [8] regarding to the relationship between agricultural and industrial sectors, establish that the agricultural sector plays a significant role in promoting modern sector to achieve economic development. Industrial sector is including the value added of mining, construction, water and gas, while agricultural sector is classified which including forestry, hunting and fishing, cultivation of crops, and livestock production [9]. Similarly the number of research studies has been conducted on role of construction in the national economy and important literatures are available on the relationship between construction sector and other sectors of the economy. A good number of studies have shown that there is a strong linkage between construction and other economic activities like,[10], [11],[12], [13],[14],[15], [16], [17], and [18]. Whatever changes occurs to the construction sector it will directly and indirectly affect other sectors of economy and finally, the national economy. Hence, the construction sector is considered as an crucial and highly observable contributor to the process of social and economic development [19].

Unfortunately in available literature very few studies available that addressed the relationship and linkage between the two fundamental sectors construction and agriculture of the economy. The concern of this study is to make empirical analysis over linkage between Malaysian construction and agriculture sector and measure the causal relationship between the two sectors over the period 2000-2010.

The study of sectoral linkages is important for Malaysia, so that positive growth spurs among sectors can be identified and developed to sustain the economic growth momentum. This would go a long way in redressing various socio-economic problems such as poverty, unemployment and inequality [20]. One more significant reason to understand these inter-sectoral linkages is that government policies in developing countries are often aimed explicitly at boosting the output of particular sectors or they implicitly favor certain sectors (by protecting different activities to varying degrees for instance) [21].

III. Data and Methodology

The data used for this study was obtained from the statistic department Government of Malaysia, and being used in value term for practical and realistic quantitative analysis. The frequency of the data is quarterly and the sample ranges from 2000:1 to 2010: 4. Data in local currency i.e. ringgit in million is used to examine the dynamic relationship between construction and agriculture sectors of Malaysia. The variables are used construction output in money term (CON), and Agricultural output in money term (AGR). The two variable data series are used in natural logarithm form for time series analysis in order to measure elasticity of the concerned variables i.e. LCON and LAGR. A descriptive statistical analysis is used to recognize the basic properties of data, and econometric approach used to measure causal linkage between the concerned variables. The Granger causality test and the vector auto regression method, used to determine the impact of changes in construction output on the output of the agriculture sector and the effects of changes in output of agriculture sector on the construction sector.

The Granger causality test used for this study is based on the assumption that future values cannot predict past or present values. The test consists of estimating the following equations (1) and (2) for the construction sector and the agriculture sector respectively over the periods 2000: Q1 to 2010: Q 4 [22]

$$LCON_t = \beta_0 + \sum_{j=1}^{i} \beta_j LCON_{t-j} + \sum_{k=1}^{k} \gamma_k LAGR_{t-k} + \mu_t \quad (1)$$

$$LAGR_t = \beta_0 + \sum_{j=1}^{i} \beta_j LAGR_{t-j} + \sum_{k=1}^{k} \delta_k LCON_{t-k} + \mu_t \quad (2)$$

Where, μ_t is uncorrelated and white noise error term series, and causality may be determined by estimating equations 1 and 2 and testing the null hypothesis that H_0: $\sum_{k=1}^{K} \gamma_k = 0$ and $\sum_{k=1}^{k} \delta_k = 0$, against the alternative H_1: $\sum_{k=1}^{K} \gamma_k \neq 0$ and $\sum_{k=1}^{k} \delta_k \neq 0$, for both equations respectively. From equation 1 and 2 if γ_k are statistically significant but δ_k are not statistically significant, then there exist relationship between construction and agriculture sector is known as unidirectional and causation moving toward to agriculture sector from construction industry. The reverse causation holds if δ_k are statistically significant while γ_k are not, that means causal direction will be moving from agriculture sector to construction. However, if the coefficients of γ_k and δ_k both are statistically significant then there exist relationship between the two sectors is termed as bidirectional, means causality runs both ways. Conversely, we can apply the Granger causality test to ascertain the relationships between the variables in the economy. The null hypothesis of no causality is rejected if the F statistics exceed the critical values at the 1 percent, 5 percent or the 10 percent levels of significance. Whenever time series data is used for regression most of the time variables have the problem of stationarity and unit root that leads to spurious regression [23]. For satisfying the stationarity properties for each series and overcome the unit root problem, most popular tests Dicky Fuller, Augmented Dicky Fuller (ADF) and Phillip Perron (PP) are conducted for each variable series.

These tests are not only investigating the problem of unit root but also determined the degree of differences for stationarity in each data series. The following equation 3 and equation 4 are used for ADF test

$$\Delta LCON_t = \propto_0 + \propto_1 T + \propto_2 LCON_{t-1} + \sum_{t=1}^{n} \gamma_i \Delta LCON_{t-1} + \mu_t \quad (3)$$

$$\Delta LAGR_t = \beta_0 + \beta_1 T + \beta_2 LAGR_{t-1} + \sum_{t=1}^{n} \gamma_i \Delta LAGR_{t-1} + \mu_t \quad (4)$$

Where $\Delta LCON_t = LCON_t - LCON_1$ and $\Delta LAGR_t = LAGR_t - LAGR_1$, $\propto_0$ and β_0 are drift terms, T is the time trend in both data series tested with the null hypothesis construction is non-stationary ($H_0 : \alpha_2 = 0$) and agriculture series is non-stationary ($H_0 : \beta_2 = 0$) against the alternative hypothesis $H_1 : \alpha_2 \neq 0$ and $H_1 : \beta_2 \neq 0$ (series are stationary). Failing to reject the null hypothesis means variable series has stationarity and unit root problem. μ_t is the error term and n is the number of lags necessary to obtain white noise error term. The order of integration will decide by the number of times the data have to be differenced to become stationary. If a series is differenced "n" times to become stationary, it is said to be integrated of order I (n). In this case, the variables are said to be co-integrated and the co-integrating equation may be developed and interpreted as a long run equilibrium relationship between variables[16]. The existence of stable long run relationship between the variables is calculated through Johansen's co-integration test; mathematical equation is as under;

$$LCON_t = \propto_1 LCON_{t-1} + \cdots + \propto_p LCON_{t-p} + \beta LAGR_t + \varepsilon_t \quad (5)$$

Where $LCON_t$ is a K- vector of non-stationary I(1) variables, $LAGR_t$ is a d-vector of deterministic variables and ε_t is a vector of innovations.

IV. Empirical Analysis and Results

A. *Results of Descriptive Statistical Analysis:*

Summary of descriptive statistical analysis of two major sectors construction and agriculture of Malaysian economy, for the period 2000-2010 is presented in Table 2 below. The mean value of quarterly output in ringgit millions for construction and agriculture sectors were 3837 and 8938 respectively with standard deviation of 360 and 160. The total contribution of construction sector to national economy was RM 168816 and agriculture sector was RM 393285 with minimum values of 3269, 6729 and maximum values of 4814, 10831 respectively. Results also show that the data distribution of construction sector is positively skewed by 1.17 while for agriculture sector it is negatively skewed by - 0.136.

TABLE 2
DESCRIPTIVE STATISTICAL ANALYSIS

Description	Construction Sector	Agriculture Sector
Mean	3836.727	8938.295
Standard Error	54.20196	160.484
Median	3758	9003.5
Mode	3734	7522
Standard Deviation	359.5351	1064.533
Sample Variance	129265.5	1133231
Kurtosis	1.280829	-0.841
Skewness	1.178531	-0.136
Range	1545	4102
Minimum	3269	6729
Maximum	4814	10831
Sum	168816	393285
Count	44	44

The Pearson correlation test result is reported in Table 3, indicate that there was strong correlation between the two sectors of Malaysia during the study period.

TABLE 3
CORRELATION MATRIXES

Construction	1	0.728
Agriculture	0.728	1

B. Unitroot Test Results

Unit root test is performed for each variable, to scrutinize the stationary properties in data series by using the DF, ADF and PP method. The test is conducted for two situations, first regress on intercept without trend with assumption that series does not contain trend and then regress on intercept with trend with assumption that series has trend. For this purpose equation 3 and 4 are used and the results are presented in Table 4 and 5.The null hypotheses of non-stationarity are performed at the usual one, five and ten percent levels of significance using the Mackinnon critical value for rejection of hypothesis of a unit root[24]. The critical values for the test are presented in Table 6.

The results from DF test indicates that both series LCON and LAGR have unit root and stationarity problem at level since unit root test without time trend cannot be rejected the null hypothesis at conventional level of significance 1%, and 5%. But though trend introduced in the data series, both LCON and LAGR becomes stationary at 5% and 1% level of significance respectively. The null hypotheses of stationarity are rejected in both with and without trend situations at first difference of data for the concerned data series on the basis of ADF and PP tests statistics, which suggest that the two series LCON and LAGR are to be first difference stationary, that is integrated order one I(1).Define abbreviations and acronyms the first time they are used in the text, even after they have been defined in the abstract. Abbreviations such as IEEE, SI, MKS, CGS, sc, dc, and rms do not have to be defined. Do not use abbreviations in the title or heads unless they are unavoidable.

TABLE 4
UNIT ROOT TEST (DF &ADF)

Series	DF test at level		ADF test (First difference)	
	Intercept Without trend	Intercept With trend	Intercept Without trend	Intercept With trend
LCON	-2.201	-3.827**	-9.154***	-9.129***
LAGR	-2.768	-5.597***	-6.483***	-6.403***

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

TABLE 5
UNIT ROOT TEST (PHILIPS PERRON TEST)

Series	PP test (First difference)	
	Intercept Without trend	Intercept With trend
LCON	-9.368***	-9.375***
LAGR	-6.483***	-6.403***

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

TABLE 6
MACKINNON CRITICAL VALUES FOR REJECTION NULL HYPOTHESIS OF A UNIT ROOT

Critical value	DF test at level		ADF test (First difference)		PP test (First difference)	
	Without trend	With trend	Without trend	With trend	Without trend	With trend
1%	-3.589	-4.184	-3.593	-4.190	-3.593	-4.190
5%	-2.930	-3.516	-2.932	-3.519	-2.932	-3.519
10%	-2.603	-3.188	-2.604	-3.190	-2.603	-3.190

C. Results for Johanson Cointegration Tests

Johansen co-integration method is used to test the co-integration between the two data series LCON and LAGR, with null hypothesis that no co-integration between the series. Results of co-integration tests are reported in Table 7 and 8 below. Table 7 demonstrates that the null hypothesis of no co integration cannot be rejected between LCON and LAGR series at 5 % significance level with intercept, no time trend and with assumption of linear deterministic trend in the data, since the likelihood ratio is less than the critical value at 5%. However when specification of test has been changed and test conducted with intercept together with trend, and assumption of linear deterministic trend in the data, then null hypothesis of no co integration is rejected at 1% significance level, results are expressed in Table 8 below. The establishment of co-integration also suggests that the series must have causal relationship in at least one direction; however it cannot define the direction of causality between construction and agriculture sector of Malaysia.

TABLE 7
JOHANSEN CO-INTEGRATION TEST

Series	Eigen value	Likelihood ratio statistic	1 %	5 %	Hypothesized No. of CE(s)
LCON&	0.193	9.041	20.04	15.41	None**
LAGR	0.000	0.012	6.65	3.76	At most one

*(**) denotes rejection of the hypothesis at 5% and (1%) level of significance respectively

TABLE 8
JOHANSEN CO-INTEGRATION TEST

Series	Eigen value	Likelihood ratio statistic	1 %	5 %	Hypothesized No. of CE(s)
LCON&	0.831	78.672	25.32	30.45	None**
LAGR	0.090	3.966	12.25	16.26	At most one

*(**) denotes rejection of the hypothesis at 5% and (1%) level of significance respectively

TABLE 9
NORMALIZED CO-INTEGRATING COEFFICIENT (1 CO-INTEGRATING EQUATION)

LCON	LAGR	Trend	C
1.000	2.500 (0.513)	-0.025 (0.004)	-30.411
Likelihood ratio		168.91	

The normalized co-integrating coefficients for 1 co-integrating equation are shown in Table 9. LR test indicates 1 co-integrating equation at 1% significance level; the estimated co-integrating equation is;

LCON -30.411 - 0.025 T+ 2.5 LAGR

D. Reults for Granger Causality Tests

The Granger causality test is conducted to identify the direction of causality between the construction and agriculture sector of Malaysia and to test whether construction industry motivates the agriculture sector or changes in agriculture sector stimulates the construction sector or both construction and agriculture sectors support and encourage to each other in the process of development.

The test results are obtained by estimating the equations (1) and (2). Results of causality from construction sector to agriculture sector of Malaysia and vice versa are presented in Table 10. Results depict that there is bi-causal relationship between construction and agriculture sector during study period 2000-2010, since the estimated F values are greater than F critical at 5% level of significance. The LCON leads LAGR by 13 quarter (3.25 year), while the agriculture sector leads the construction sector by 3 quarter (9 months).This causal linkage between the two sectors can be considered as forward and backward linkage. The lag length of causality analysis represent that the Malaysian Construction sector takes greater period of time (3.25 years) as compared to agriculture sector to respond to the shock received from the agriculture sector of Malaysia, while the agriculture sector responding period is only 9 months against the shock from construction sector.

TABLE 10
GRANGER CAUSALITY TEST

Hypothesis	Lag length	F-statistic	P value
LCON does not granger cause LAGR	13	16.073	0.0080
LAGR does not granger cause LCON	3	22.212	0.0000

V. CONCLUSION

The two sectors construction and agriculture are not only important for an economy because they provided food and shelter but they are also important because they provided significant amount of employment opportunities, raw materials for other sectors of economy, earning and saving the foreign exchange and alleviating poverty, for a large percentage of the population.

The construction and agriculture sectors play important role in Malaysian economy and make significant contribution to the socio economic development of Malaysia through their backward and forward linkages with other sectors of the economy. The analysis exhibits that the agriculture sector provide investment and work opportunities for construction industries as an input to construction sector output and construction sector facilitate agriculture sector by constructing roadway, buildings for storing agriculture output, irrigation canals etc. The study shows that there is bi-directional causal relationship exist between the two sectors and they have strong positive correlation. This implies that there is backward and forward linkages between the sectors. Furthermore these sectors have multiplier effect on aggregate economy of Malaysia. The lag length of causality analysis represent that the Malaysian Construction sector takes 13 quarter (3.25 years) to respond to the shock received from the agriculture sector of Malaysia, while the agriculture sector responding period is 3 quarter (9 months) against the shock from construction sector. These results are informative regarding the relative importance of changes in the construction and manufacturing on the size of sectors over the long term.

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