The relationship between construction sector and the national economy of Sri Lanka

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Abstract: The causal relationship between construction and a country's economy has received much attention in the past. However, the results provide contrasting views on the nature of this relationship. This paper therefore investigates the direction of the causal relationship between construction and the economy of a developing country, Sri Lanka. It uses empirical data for selected economic and construction indicators for the period 1990 to 2009. The pattern of the causal relationship was determined using Granger causality test. The findings reveal that for all indicators except construction investment, national economic activities precede that of construction. The study therefore concludes and strengthens the body of knowledge on Sri Lanka that the causal relationship between its construction sector and national economy tend towards a uni-directional relationship with the national economy inducing growth in the construction sector and not vice versa.

1. Background

The construction industry encompasses a variety of activities and is a vital sector in any economy [1,2]. Construction has a strong linkage with most of the other economic activities of a country [3,4,5]. It is considered to be an important partner in economic growth and mirrors the stage of economic development [3,6,7]. There are opposing views with regard to the relationships between construction and the economy of a country. One view is that construction causes the economy to grow as it creates physical facilities that are needed in the development of other productive activities [2,8,9,10]. The opposing view holds that GDP causes the construction output growth [11,12,13]. Interestingly some other studies suggest a bi-directional relationship between different sub-sectors of the construction industry and the national economy [3,14,15,16]. This paper believes that a better understanding of this lead/lag relationship requires more evidence from other countries. It is particularly necessary for developing countries because most of the previous studies used data from developed countries. This paper presents a test on the link between construction and the economy using empirical data from Sri Lanka. It is intended to extend knowledge on causal relationships and other general construction issues related to the case study country, Sri Lanka.

Sri Lanka is a developing country with a per capita income of US$2041 [17]. Sri Lanka has a strong construction sector which contributes significantly to its GDP. The total value of new construction is above 60% of the total gross domestic fixed capital formation and the industry provides employment to around 7% of the total labour force [18]. The construction industry in Sri Lanka is expected to grow steadily and systematically in the long run while being a significant and integral part of the economy [4].

2. Description of Methods

The study, on which this paper is based, uses Granger Causality Test to determine the above relationship. Granger Causality Test is an econometric technique pioneered by Granger and Newbold [19] which is applied to find relationships between economic variables. Granger causality uses regression to find the causal relationships between two variables, ‘Xt’ and ‘Yt’ [19,3,11]. The regression provides statistical evidence whether the current ‘Y’ value can significantly be explained by the past values of ‘Y’ and ‘X’. Granger causality test considers two autoregressive (AR) models illustrated below:

$$Xt = \sum \text{á0i}\ Yt\text{-}i + \sum \text{â0i}\ Xt\text{-}1 + ut \qquad (1)$$

$$Yt = \sum \text{á1i}\ Xt\text{-}i + \sum \text{â1i}\ Yt\text{-}1 + vt \qquad (2)$$

Where n is the maximum number of lagged observations included in the model and Ut and Vt are the random error terms for each time series. Where causality implies, X is Granger causing Y when á0i is not zero in equation 1. Similarly, Y is Granger causing X if á1i is not zero in equation 2. If both of these events occur, then feedback effects exist.

Testing causality involves using F-tests to ascertain whether lagged information on a variable Y provides any statistically significant information about a variable X in the presence of lagged X. If not, then "Y does not Granger-cause X." There are four possible outcomes in a Granger causality test [20];

- no causal relationship between two variables,

- unidirectional causality from X to Y,
- unidirectional causality from Y to X, and
- bidirectional causality (X causes Y and Y causes X).

Two sets of indicators are used in the current study. One set represents construction while the second national economy. Construction performance is measured using construction value added (CVA), value of construction in the total gross domestic fixed capital formation (CGDFCF), and construction cost indices (CCI). For the national economy, Gross Domestic Product (GDP), Gross Domestic Product Deflator (GDPD), Unemployment Rate (UE) and Balance of Trade (BT) were considered. Previous studies commonly used GDP as an indicator of economic growth, except [9] who used balance of payment and domestic prices. The indicators used for this study were based on constant prices for the period 1990-2009, and were obtained from published data by the Central Bank of Sri Lanka [18, 21, 22].

3. Results

Time series, especially economic data in level form is non-stationary and most statistical methods including Granger causality require the time series to be transformed to stationarity [23,19]. Stationary could be detected using three methods: autocorrelation function (ACF), correlogram (Q-statistic), and the Unit Root Test. Among them Unit Root Test is widely used to detect and transform the series into stationary forms [23]. Unit root test provides several tests such as Dickey Fuller (DF), Augmented Dickey Fuller (ADF) and Phillips Perron (PP) for testing the order of integration [24,25]. For the purpose of this study, Augmented Dickey Fuller (ADF) test is used following recommendations of past studies because the test considers the situation where the white noise error terms are correlated, which is an improvement of Dickey Fuller (DF) test. Table 1 presents the critical and calculated values for the selected indicators at 5% significance level. The comparison of critical values with calculated values reveal that BT and CGDFCF are stationary at first difference. The calculated values fall within rejection region implying that the null hypothesis is rejected, and that the time series has no unit root. Similarly the values for GDP, GDPD, and CVA indicate that they are stationary at second difference. CCI was however found to be non-stationary at second level of difference.

Table. 1 unit root test results for variables

Variable	At level		At first difference		At second difference	
	No trend & intercept	With trend & intercept	No trend & intercept	With trend & intercept	No trend & intercept	With trend & intercept

CV at 5%	-1.9504	-3.5386	-1.9504	-3.5386	-1.9504	-3.5386
GDP	4.4199	1.6445	-0.4968	-3.9661	-9.0553	-9.1952
GDPD	3.2519	3.0933	2.0211	-0.6578	-5.2603	-6.0771
BT	6.0741	4.1637	-4.2139	-6.2124	-	-
CVA	2.9577	0.2734	-0.8241	-2.8046	-7.8325	-7.7790
CGDFC	4.4524	0.1212	-3.1690	-6.1378	-	-
CCI	1.4116	-0.5006	0.5475	-1.5328	-2.7339	-2.7542

The regressions (1) and (2) described previously was run for the possible lag values of each variable. The number of lags in causality test is arbitrary. It depends on the relationship between the variables. The causality between variables is described in the following three sections. Each section takes one economic indicator and runs the pair-wise regression with all three indicators for construction. To test causality, the results were validated using the residual plots, auto correlation function (ACF) and Durbin-Watson (DW) statistic. This paper considers the DW statistic method only.

3.1 Causality between CGFCF[1], CVA[2], and CCI[3] and GDP[2]

The direction of the causality between GDP and CVA was investigated by testing the hypothesis that GDP does not cause CVA and CVA does not cause GDP, which is reported in Table 2. Using the probability value of 0.02702, DW statistic of 1.94, it can be concluded that CVA does not cause GDP. Similarly, the causality between GDP and CGDFCF; and between GDP and CCI; were tested and the results are presented in Tables 3 and 4. Results indicate that CGDFCF does not cause GDP and CCI does not cause GDP for any lag. On the contrary, GDP is found to cause CGDFCF for lags 2 and 4. DW statistics of 1.85 and 1.64 for the latter models shows that there is no serial correlation between the error terms.

Table. 2 causality between GDP^2 and CVA^2

Lag length	GDP2 does not cause CVA2		CVA2 does not cause GDP2	
	F Statistics	Prob.	F Statistics	Prob.
1	5.37134	0.02702	0.22668	0.63723
2	2.76753	0.07943	0.16561	0.84817
3	2.38952	0.09171	0.11444	0.95086

[1] *First difference*
[2] *Second difference*
[3] *Third difference*

4	2.08922	0.11510	0.20169	0.93485
5	1.67726	0.18608	0.14546	0.97913
6	1.52228	0.23021	0.27120	0.94287

Table. 3 causality between GDP^2 and $CGDFCF^1$

Lag length	GDP2 does not cause CGDFCF1		CGDFCF1 does not cause GDP2	
	F Statistics	Prob.	F Statistics	Prob.
1	0.00033	0.98567	0.46519	0.50011
2	4.50393	0.01980	0.82644	0.44765
3	4.86264	0.00814	0.71893	0.54970
4	3.80471	0.01623	0.50978	0.72908
5	2.15563	0.10033	1.09763	0.39241
6	1.52796	0.22847	1.59569	0.20871

Table. 4 causality between GDP^2 and CCI^3

	GDP2 does not cause CCI3		CCI3 does not cause GDP2	
Lag length	F Statistics	Prob.	F Statistics	Prob.
1	10.5863	0.00994	1.88745	0.20274
2	3.50508	0.09809	0.92860	0.44530
3	1.91193	0.30394	0.48098	0.71845
4	NA	NA	NA	NA

3.2 Causality between $GDPD^2$ and CVA^2, $CGFCF^1$, and CCI^3

The results of the hypothesis test for causality between GDPD and CVA are given in Table 5. It shows that GDPD causes CVA for lag 7 and not vice-versa with a DW statistic value of 1.92. The column 3 in Table 6 indicates that the probability for hypothesis GDPD does not cause CGDFCF are insignificant at 5% level for lags up to 6. However, column 4 indicates that the probabilities for null hypothesis of ‘CGDFCF does not cause GDPD’ are significant for lags up to 5. The respective DW statistics of 1.86 and 1.93 confirms the validity of the models. Therefore, it can be inferred that CGDFCF does cause GDPD and not vice-versa. Table 7 shows that probabilities for hypothesis ‘GDPD does not cause CCI’ are significant up to lag 2 while for the null hypothesis ‘CCI does not cause GDPD’ none of them are significant. Thus, it can be inferred that GDPD does cause CCI and not vice-versa. The DW statistic value of 1.87 indicates no auto correlation between residuals.

Table. 5 causality between GDPD^2 and CVA^2

Lag length	GDPD2 does not cause CVA2		CVA2 does not cause GDPD2	
	F Statistics	Prob.	F Statistics	Prob.
1	1.42167	0.24190	2.16629	0.15083
2	0.91315	0.41249	0.82027	0.45027
3	1.17538	0.33821	0.75831	0.52766
4	1.12230	0.37034	1.47566	0.24208
5	1.51200	0.23067	1.05663	0.41304
6	1.34620	0.29109	0.45969	0.82836
7	3.61273	0.01951	0.43628	0.86342

Table. 6 causality between GDPD^2 and CGDFCF^1

Lag length	GDPD2 does not cause CGDFCF1		CGDFCF1 does not cause GDPD2	
	F Statistics	Prob.	F Statistics	Prob.
1	0.30710	0.58332	6.60690	0.0150
2	0.71116	0.49944	6.22659	0.0056
3	0.98857	0.41354	6.11313	0.0027
4	1.24627	0.31938	5.14313	0.0041
5	0.70637	0.62544	4.54295	0.0063
6	0.78163	0.59579	2.13252	0.1026

Table. 7 causality between GDPD^2 and CCI^3

Lag length	GDPD2 does not cause CCI3		CCI3 does not cause GDPD2	
	F Statistics	Prob.	F Statistics	Prob.
1	17.7051	0.00228	2.20771	0.17149
2	5.33804	0.04658	0.46986	0.64629
3	3.81882	0.15009	0.80662	0.56801
4	NA	NA	NA	NA

3.3 Causality between BT^1 and CVA^2, CGFCF^1, and CCI^3

Table 8 shows that probabilities for the null hypothesis 'BT does not cause CCI' and 'CCI does not cause BT' are insignificant at 5% level for all possible lags except 2. According to Table 9 the probabilities for null hypothesis 'BT does not cause CVA' and 'CVA does not cause BT' are insignificant for all possible lags except 7. Table 10 indicates that probability values for null hypothesis 'BT does not cause CGDFCF' are not significant at 5% confidence level up to lag 4 while for null hypothesis 'CGDFCF does not cause BT' is insignificant for all possible lags.

Table. 8 causality between BT and CCI[3]

Lag length	BT does not cause CCI3		CCI3 does not cause BT	
	F Statistics	Prob.	F Statistics	Prob.
1	0.45888	0.51518	0.15628	0.70181
2	29.2586	0.00080	0.45222	0.65625
3	7.23194	0.06920	0.43803	0.74230
4	NA	NA	NA	NA

Table. 9 causality between BT and CVA[2]

Lag length	BT does not cause CVA2		CVA2 does not cause BT	
	F Statistics	Prob.	F Statistics	Prob.
1	1.33693	0.25614	1.43061	0.24045
2	1.38886	0.26546	0.50999	0.60579
3	1.20648	0.32702	0.30651	0.82043
4	1.78810	0.16563	0.94168	0.45766
5	1.71127	0.17804	0.66962	0.65100
6	1.34025	0.29340	0.39395	0.87275
7	4.12858	0.01156	0.51084	0.81180

Table. 10 causality between BT and CGDFCF[1]

Lag length	BT does not cause CGDFCF1		CGDFCF1 does not cause BT	
	F Statistics	Prob.	F Statistics	Prob.
1	0.20437	0.65418	2.83183	0.10185
2	0.91902	0.40985	1.77411	0.18697
3	0.66661	0.57987	1.82647	0.16615
4	2.14497	0.10623	2.13341	0.10773
5	3.05490	0.03164	2.67362	0.05071
6	4.84435	0.00415	1.72193	0.17315

4. Conclusions

As it is well documented in construction economics literature, when an economy is booming, the construction sector also booms. Conversely a slowing down in the economy slows down construction activities. Hence, a causal relationship between them could be postulated. What is unknown is which causes what?. Such information is useful in policy planning to prioritize investment opportunities. The current study considered the most appropriate among the available indicators to represent both the construction sector and the national economy. A summary of the results obtained from the Granger causality test is given in Table 11. For all indicators except CGDFCF and GDPD the cause-effect analysis reveals that the economy leads the construction sector and not vice versa. This supports the viewpoints of [11,12] that GDP tends to lead construction flow. The results however contradict the views expressed by [2,10] that construction lead the national economy and that growth in construction precedes growth in GDP.

Table. 11 causality between construction and the national economy

	GDP	GDPD	BT
CVA	GDP leads by 1 year	GDPD leads by 7 years	BT leads by 7 years
CGDFCF	GDP leads by 2-4 years	CGDFCF leads by 1-5 years	BT leads by 5-6 years
CCI	GDP leads by 1 year	GDPD leads by 1-2 years	BT leads by 2 years

This finding could be justified for a developing country like Sri Lanka where generally construction is subject to fluctuations. During periods of rapid economic expansion, construction output usually grows faster than those of other sectors but during periods of stagnation the industry is the first to suffer. Government being the major client of the construction industry (contributing nearly 2/3 of the total annual output in construction) could use the construction sector as an economic regulator whereby it could reduce construction demand by cutting back on construction projects or investment funds when an economy is overheating. This deliberately stimulates investment during periods of unemployment and slack demand. Thus, the Sri Lankan economy could prioritize investment so as to increase economic growth and optimize the use of the construction sector.

5. References

[1] Bielsa, J. and Duarte, R. (2011). Size and linkages of the Spanish construction industry: key sector or deformation of the economy?. Cambridge Journal of Economics, 35: 317–334.

[2] Anaman, K.A. and Osei-Amponsah, C. (2007). Analysis of causality links between the growth of the construction industry and the growth of the macro economy in Ghana. Construction Management and Economics, 25: 951-61.

[3] Ozkan, F., Ozkan, O., and Gunduz M. (2012). Causal relationship between construction investment policy and economic growth in Turkey. Technological Forecasting & Social Change, 79: 362–370.

[4] Rameezdeen, R., Ramachandra, T. (2008). Construction linkages in a developing economy: the case of Sri Lanka. Rameezdeen and Ramachandra (2008), 26(5): 499-506.

[5] Lewis, T.M. (2004). The construction industry in the economy of Trinidad and Tobago. Construction Management and Economics, 22: 541-549.

[6] Wilhelmsson, M. and Wigren, R. (2011). The robustness of the causal and economic relationship between construction flows and economic growth: evidence from Western Europe. Applied Economics, 43: 891–900.

[7] Ruddock, L., Lopes, J., 2006. The construction sector and economic development: the 'Bon curve'. Construction Management and Economics, 24: 717-723.

[8] Hosein, R. and Lewis, T.M. (2005). Quantifying the relationship between aggregate GDP and construction valve added in a small petroleum rich economy – a case study of Trinidad and Tobago. Construction Management and Economics, 23:185-197.

[9] Lean, C.S. (2001). Empirical tests to discern linkages between construction and other economic sectors in Singapore. Construction Management and Economics, 19(4): 355-63.

[10] Ofori, G. (1990). The construction industry: Aspects of its Economics and Management. Singapore University press, Singapore.

[11] Tse, R.Y.C. and Ganesan, S. (1997). Causal relationship between construction flows and GDP: Evidence from Hong Kong. Construction Management and Economics, 15: 371-6.

[12] Yiu, C.Y., Lu, X.H., Leung, M.Y., Jin, W.X., 2004. A longitudinal analysis on the relationship between construction output and GDP in Hong Kong. Construction Management and Economics, 22, 339-345.

[13] Lopes, J., Nunes, A. and Balsa, C. (2011). The long-run relationship between the construction sector and the national economy in Cape Verde. International Journal of Strategic Property Management. 15(1): 48-59.

[14] Jackman, M. (2010). Investigating the relationship between residential construction and econmic growth in a small developing country: The case of Barbados. International Real Estate Review, 13(1): 109-116.

[15] Hongyu, L., Park, Y. W. and Siqi, Z. (2002). The interaction between housing investment and economic growth in China. International Real Estate Review, 5(1): 40-60.

[16] Green, R.K. (1997). Follow the leader: how changes in residential and non-residential investment predict changes in GDP. Real Estate Economics, 25(2): 253-70.

[17] International Monetary Fund. (2010). World Economic Outlook Database. Available from: http://www.imf.org/external/pubs/ft/weo/2010/01/index.htm [Accessed 07 May 2011].

[18] Central Bank of Sri Lanka (2010). Central Bank Annual Report. Colombo.

[19] Granger, C.W.J. and Newbold, P. (1986). Forecasting economic time series. Academic press, Orlando, FL.

[20] Mukherjee, C., White. H., and Wuyts, M. (1998). Econometrics and data analysis for developing countries. [e-book]. Routledge: Spon Press. Available at: http://www.books.google.lk/books. [Accessed 20 October 2011].

[21] Central Bank of Sri Lanka (2002). Central Bank Annual Report. Colombo.

[22] Central Bank of Sri Lanka (2007). Central Bank Annual Report. Colombo.

[23] Huang, B. N. (1995). Do Asian stock market prices follow random walks? Evidence from the variance ratio test. Applied Financial Economics, 5: 251-256.

[24] Dickey, D.A. and Fuller, W.A. (1979). Distributions of the estimators for autoregressive time series with a unit root. Journal of the American Statistical Association, 74: 427-31.

[25] Perron, P. (1988). Trends and random walks in macroeconomic time series: further evidence from a new approach, Journal of Economic Dynamics and Control. 12: 297-332.