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Causality between the Construction Industry and the GDP in the United Arab Emirates

Hasan S. Mahmoud, Salwa M. Beheiry, Vian Ahmed

***Abstract*—**In light of the repercussions of the 2008 global economic crisis, the response of the United Arab Emirates economy and growth, and the vast construction activities that are undergoing, there is a need to investigate the relationship between construction activities and the Gross Domestic Product (GDP). This study aims to investigate the causality relationship between the construction industry in the United Arab Emirates and the GDP of the country in the last decade. For that, this study will investigate the relationship between the growth of the GDP and the growth of construction activities and their value addition to the economy. To ascertain this relationship, Granger Causality method is used to identify the causality between the time-dependent series.

***Keywords*—**Construction value addition, Granger causality, Growth of GDP, UAE.

I. Introduction

THROUGH the course of history, nations strived to develop and improve both their infrastructure and their building assets, and the United Arab Emirates (UAE) is no different. The UAE has aimed to develop the country since the start of its union in 1971 and realized the importance of cultivating and fostering the construction industry. With the introduction of foreign investment and the attraction of expatriates to settle in the UAE, a massive need for developments of new projects has been noticed. This increase has led to more projects that have contributed to the economy of the UAE massively, while the wise leadership of the UAE has identified the construction industry to be a large contributor to the growth of the country's economy; for that, it has made sure that the construction industry is incentivized and that construction activities are encouraged.

The UAE economy is a growing economy which is based on three main drivers which are the construction industry, trade, and oil. These three drivers have been the focus of the UAE government, from investing to encouraging investors, while the UAE has always made sure that the growth of the economy must be steady and stable.

The stature that the construction industry has gained in the UAE as a large driver of the economic growth was due to the fact that the construction industry has a lot of sub industries that are required such as the supply of materials, machineries, supply chains and logistics. Moreover, the construction industry requires government entities to service it, which has created new government arms that led to the development of the overall government procedure and structure. Another major benefit of the construction industry is the creation of jobs and the requirement of a huge labor pool. Furthermore, the construction industry has contributed to decreasing the unemployment rate and also the activation of the unskilled labor pool that has been linked to the welfare of the society as well as increasing the buying power of the general public. This paper intends to investigate the relationship between the construction industry and the performance of the economy in the UAE.

H. S. Mahmoud is a Doctoral Candidate in the American University of Sharjah, UAE, (phone: +971502525753; e-mail: B00038979@aus.edu).
S. M. Beheiry is an Associate Professor with the Civil Engineering Department, of the American University of Sharjah, UAE, (phone: +97165152976; e-mail: sbeheiry@aus.edu).
V. Ahmed is a Professor with the Industrial Engineering Department, of the American University of Sharjah, UAE, (phone: +97165155555; e-mail: vahmed@aus.edu).

A. Background

The construction industry and its growth have a positive impact on the economic growth of the UAE. Creating jobs, increasing the GDP, and influencing and promoting the country's image and reputation are some of the major impacts that the construction industry can have on the stature of the UAE in the global arena.

To better visualize the relationship between the construction industry and the economic growth of the UAE, Table I shows the share of the construction industry in the GDP from the 1975 and 2018 with the constant prices of 2010. From the table, it can be seen that the share of the construction industry in the UAE GDP is always greater than 40% [8]. Furthermore, the growth of GDP in the UAE has always been tied to the growth of the construction industry. Table II compares the growth of GDP with respect to the growth of the construction industry share in the GDP; it is clear that there is a strong relationship between GDP and the share of the construction industry in the GDP. Moreover, in the years when the GDP of the UAE declines, the growth of the construction industry shares in the GDP declines as well. This can only prove the strong tie that exists between GDP and the construction industry.

B. Research Problem and Question

There are many drivers to the development or the growth of the GDP of the UAE. The construction industry is considered to be one of the major drivers of the UAE economy; however, statistical evidence on the contributions of the construction industry to the UAE economy is not available. This statistical tool can identify the effect of the construction industry on the growth of the country's economy and whether there is an actual relationship between the two, which in turn can direct the decision makers to consider effective measures to be adopted in order to enhance the growth of the economy in the

UAE.

TABLE I
GDP AND SHARE OF CONSTRUCTION IN GDP [8]

Year	GDP (constant 2010 US$)	Construction, value added (constant 2010 US$)	Construction, value added (% of GDP)
1975	56806.67	42034.39	74.00
1976	66195.03	47537.78	71.81
1977	80386.80	54648.32	67.98
1978	79108.97	53840.62	68.06
1979	95661.40	68259.72	71.36
1980	118500.34	86106.62	72.66
1981	124021.48	84785.18	68.36
1982	115688.08	73059.40	63.15
1983	110197.73	67666.01	61.40
1984	114624.32	71996.36	62.81
1985	110504.18	67686.18	61.25
1986	93974.81	49011.97	52.15
1987	97153.02	53124.34	54.68
1988	94608.68	50156.07	53.01
1989	106281.39	58536.53	55.08
1990	125760.63	74075.97	58.90
1991	126842.27	59334.66	46.78
1992	131085.08	72487.46	55.30
1993	132738.31	68333.58	51.48
1994	141892.14	65639.84	46.26
1995	151381.73	68947.07	45.55
1996	160159.45	74261.14	46.37
1997	173277.15	78717.06	45.43
1998	173783.11	69554.14	40.02
1999	178826.67	75144.15	42.02
2000	198234.19	96177.31	48.52
2001	201007.66	99853.25	49.68
2002	205899.09	97896.26	47.55
2003	224019.33	110040.56	49.12
2004	245450.00	126844.50	51.68
2005	257366.94	143208.27	55.64
2006	282684.95	163683.38	57.90
2007	291686.74	159961.67	54.84
2008	300996.90	174632.32	58.02
2009	285215.87	148440.47	52.04
2010	289787.34	152282.10	52.55
2011	309870.39	179883.35	58.05
2012	323766.92	186048.23	57.46
2013	340127.98	187138.64	55.02
2014	355089.18	187409.36	52.78
2015	373073.38	163812.92	43.91
2016	384222.46	159255.14	41.45
2017	387259.36	168832.66	43.60
2018	392773.32	183776.67	46.79

This research aims to create a statistical measure of the effect of the construction industry on GDP in the UAE and the relationship between the growth of the construction industry and the growth of the GDP. This will be done through quantitative statistical studies.

II. LITERATURE REVIEW

There are many researches that have investigated the relationship between the construction industry and a country's economy. Those studies have employed different approaches and methodologies to identify whether the construction industry is a driver that can be developed to further grow the economics of countries, or if it is a short-time driver that has little to no effect on a country's economy in the long run.

TABLE II
GROWTH OF GDP AND GROWTH OF THE SHARE OF CONSTRUCTION IN GDP [8]

Year	GDP growth (annual %)	Construction value added (annual % growth)
1976	16.53	13.09
1977	21.44	14.96
1978	-1.59	-1.48
1979	20.92	26.78
1980	23.87	26.15
1981	4.66	-1.53
1982	-6.72	-13.83
1983	-4.75	-7.38
1984	4.02	6.40
1985	-3.59	-5.99
1986	-14.96	-27.59
1987	3.38	8.39
1988	-2.62	-5.59
1989	12.34	16.71
1990	18.33	26.55
1991	0.86	-19.90
1992	3.34	22.17
1993	1.26	-5.73
1994	6.90	-3.94
1995	6.69	5.04
1996	5.80	7.71
1997	8.19	6.00
1998	0.29	-11.64
1999	2.90	8.04
2000	10.85	27.99
2001	1.40	3.82
2002	2.43	-1.96
2003	8.80	12.41
2004	9.57	15.27
2005	4.86	12.90
2006	9.84	14.30
2007	3.18	-2.27
2008	3.19	9.17
2009	-5.24	-15.00
2010	1.60	2.59
2011	6.93	8.48
2012	4.48	3.46
2013	5.05	3.02
2014	4.40	1.62
2015	5.06	5.58
2016	2.99	2.32
2017	0.79	-1.11
2018	16.53	13.09

Chiang et al. [1] argue that there is no apparent relationship between construction industry investment and economic growth due to the variances regionally or nationally, different analytical methods, and the limitation of data. Furthermore, they also discussed that government should focus on other sectors of the market to enhance the economy of Hong Kong.

The authors explain that the relationship between the GDP and other sectors must be studied to highlight the contribution of those sectors to the growth of the Hong Kong economy. Furthermore, Bolkol [2] proved that there is no long-term relationship between GDP and building production in Turkey. Moreover, he shows that in the short run that GDP leads the building production and not vice versa. Furthermore, at the start of a project, the building production affects the GDP but after the completion, the non-building production such as services has a greater effect on GDP. Therefore, focusing on the construction industry to develop the economy of Turkey is a bad idea, since the contribution of the construction industry to the country's economy in the long run is non-existent. On the other hand, Hosein and Lewis [3] explain that there is a causal relationship between GDP and the construction industry and that this relationship runs from the GDP to the construction sector in Trinidad and Tobago. They explain that since the country is under development, the construction industry contributes to the country's economy the most. This causal relationship indicated that a change in the GDP affects the change in the construction value addition to the GDP. Moreover, they have also highlighted that there is a small positive relationship between the oil and gas revenues and the construction industry value addition. This relationship could be due to the allocation of the revenues of the oil and gas industry towards the construction industry. Likewise, Anaman and Osei-Amponsah [4] proved that in the case of Ghana and similar developing economies, there exists a causal relationship between the construction industry value addition and GDP. They have also highlighted the role of the construction industry in eliminating unemployment and reducing the levels of poverty in Ghana. This is due to the fact that the construction industry employs a lot of unskilled laborers.

Lopes et al. [5] argued that there are different studies that were conducted to examine the relationship between the construction industry and the economy. As such, they explain that early studies in this topic that are based on cross sectional data have identified positive relationships between the construction industry and economic growth. However, more recent studies that are based on longitudinal data have identified non-linear relationships between the construction industry and the economy. In their study and based on time series analysis, they have proven that the construction industry follows the same trends as the general economy, but has no apparent causal relationship.

III. Research Methodology

To study the relationship between the output of the construction industry and the performance of the economy in the UAE, the authors collected data from the World Bank about the UAE. There are many indicators that can be found in the data bank, but for the aim of this study, three indicators were chosen which are GDP (constant 2010 US$), Construction, value added (constant 2010 US$), and Non Construction value added (constant 2010 US$) from 1975 to 2018 The data were denoted as follows: GDP, C_GDP, NC_GDP to represent the GDP, Construction, value added, and Non Construction value added, respectively. The software Eviews 10 was used to identify the relationships with these time dependent series.

All the variables were converted to the natural logarithm to highlight the differential differences between the variables. Moreover, expressing the variables in natural logarithm allows the estimated coefficient to represent the elasticity of the variables, and in general, it is more convenient to use natural logarithm in economic data.

To identify the causal relationship between the variables, Granger Causality test is used. However, before conducting the analysis, the nature of stationary or non-stationary for all variables have to be tested. This is done using the Phillips-Perron (PP) root test. This test is chosen due to the fact that it is a robust approach and there is no need to identify a lag structure beforehand as per [6]. Afterward, cointegration shall be investigated on the variables to identify the presence of a long-term relationship. This means that all variables should be studied to identify the level of cointegration; this was done using the Johansen Cointegration test for all the variables.

If there is no cointegration between the variables, Granger Causality will be used to detect the relationship in the short run. This will be done after developing a VAR model and testing the Granger Model in that model. For the results to be reliable the VAR model should be stable; hence, all the roots of the VAR system should be less than one.

One important step for all the analysis is the identification of the lag length. This is done via judging the Schwarz information Criterion (SC), since there are less than 120 variables in the data set [7].

IV. Findings and Models

To test the variables for stationarity, the PP root test is conducted on all the three data sets to identify the level of integration. To test whether the variables are stationary or not with a level of significance of 5%, the following hypotheses has been developed:

- Ho: Variable has a unit root (Non-stationary)
- Ha: Variable is stationary

The same hypotheses have been developed for all variables at their level, the 1st difference, and the 2nd difference, with two cases of intercept, and trend and intercept. The results are as shown in Table III.

TABLE III
PP UNIT ROOT TEST

Variable	Case	Level	1st Difference	2nd Difference	Result
GDP	Intercept	0.5554	0.0002	0.0000	1
	Trend and Intercept	0.1719	0.0016	0.0000	
C_GDP	Intercept	0.7237	0.0000	0.0001	1
	Trend and Intercept	0.4988	0.0000	0.0000	
NC_GDP	Intercept	0.5682	0.0003	0.0000	1
	Trend and Intercept	0.1765	0.0019	0.0000	

As seen from the above results, the probability values for all the variables at the 1st difference are significantly smaller than the α = 0.05; thus, we can say that we reject the null hypothesis. Therefore, with a 95% level of confidence we can say that all the variables are integrated to the same order, this means that the cointegration test should be done to identify whether there is a long run relationship between the variables or not.

Before doing the cointegration test, the optimal lag length should be identified, which is done in Fig. 1. According to the SC criteria and the result is that the optimal lag length is found to be equal to 2.

TABLE IV
SC CRITERIA AT DIFFERENT LAG LENGTHS

Lag	1	2	3	4	5
SC Criteria	-10.995	-10.803	-10.323	-11.218	-10.751

To perform the cointegration test, the VAR model with lag length of 2 was estimated and the Johansen Cointegration test was performed to identify the long-term relationship between the variables; the results are summarized in Fig. 1.

Series: C_GDP NC_GDP GDP
Lags interval: 1 to 2

Selected (0.05 level*) Number of Cointegrating Relations by Model

Data Trend:	None	None	Linear	Linear	Quadratic
Test Type	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
Trace	0	1	1	0	1
Max-Eig	0	1	1	1	1

*Critical values based on MacKinnon-Haug-Michelis (1999)

Information Criteria by Rank and Model

Data Trend:	None	None	Linear	Linear	Quadratic
Rank or No. of CEs	No Intercept No Trend	Intercept No Trend	Intercept No Trend	Intercept Trend	Intercept Trend
	Log Likelihood by Rank (rows) and Model (columns)				
0	245.65123...	245.65123...	251.71616...	251.71616...	252.27811...
1	253.17111...	259.28654...	265.17940...	265.21065...	265.67106...
2	255.79981...	265.80159...	266.74170...	269.32076...	269.66533...
3	257.29020...	267.33365...	267.33365...	270.87939...	270.87939...
	Akaike Information Criteria by Rank (rows) and Model (columns)				
0	-11.10494	-11.10494	-11.25445	-11.25445	-11.13552
1	-11.17908	-11.42861	-11.61851*	-11.57125	-11.49615
2	-11.01463	-11.40496	-11.40203	-11.43028	-11.39831
3	-10.79464	-11.13823	-11.13823	-11.16485	-11.16485
	Schwarz Criteria by Rank (rows) and Model (columns)				
0	-10.35264	-10.35264	-10.37676	-10.37676	-10.13245
1	-10.17601	-10.38375	-10.49006*	-10.40101	-10.24232
2	-9.760792	-10.06753	-10.02282	-9.967476	-9.893709
3	-9.290044	-9.508244	-9.508244	-9.409482	-9.409482

Fig. 1 Cointegration Test Results

As Fig. 1 shows, there is no cointegration between the variables at the 0.05 level. This indicates that there is no long-term relationship between the GDP of the UAE and construction GDP and non-construction GDP. As such, the proposed VAR model shall be constructed to lag length of 2 to determine the VAR Granger Causality between the variables. Fig. 2 below shows the results for the VAR Granger Causality test. In order to perform the Granger Cause between the variables with a 5% level of significance, the below hypotheses have been developed:

- Ho: Variable 1 Granger Causes Variable 2.
- Ha: Variable 1 does not Granger Causes Variable 2.

The same hypotheses have been developed for all variables to determine the direction of causality and the results are summarized in Fig. 2.

Dependent variable: GDP

Excluded	Chi-sq	df	Prob.
C_GDP	0.81724942...	2	0.66456358...
NC_GDP	0.12844881...	2	0.93779453...
All	1.14038781...	4	0.88781242...

Dependent variable: C_GDP

Excluded	Chi-sq	df	Prob.
GDP	0.35553413...	2	0.83713739...
NC_GDP	0.25755156...	2	0.87917106...
All	2.88482940...	4	0.57728019...

Dependent variable: NC_GDP

Excluded	Chi-sq	df	Prob.
GDP	0.87457568...	2	0.64578552...
C_GDP	0.63727942...	2	0.72713748...
All	1.76769066...	4	0.77838792...

Fig. 2 Cointegration Test Results

Root	Modulus
0.966484	0.9664841786209408
0.842569	0.8425689793127142
0.552745 - 0.611181i	0.8240568862138771
0.552745 + 0.611181i	0.8240568862138771
0.299386	0.2993858259437838
-0.201103	0.2011033937005993

FIG. 3 VAR Root Results Table

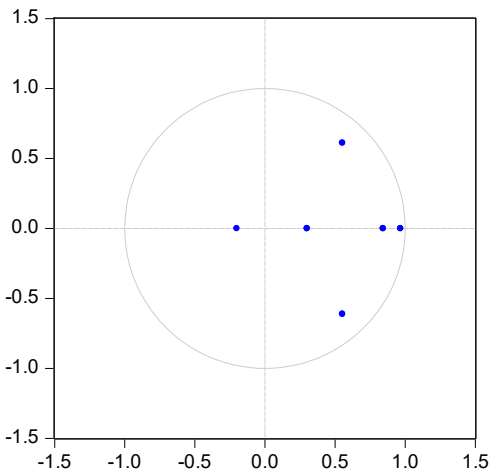

Fig. 4 VAR Unit Circle

From Fig. 2, it is proven that there is no causality between

any of the variables; therefore, this means that the variables lags cannot be used in predicting other time series and there are no short-term relationships between any of the variables.

To test the validity of the VAR model, the stability of the model is tested in order to judge the credibility of the results and the analysis outcomes. Fig. 3 shows that all the roots are less than one; this indicates that all the roots are within the unit circle. This is also shown in the unit circle presented in Fig. 4.

V. Conclusion

The results of this study prove that there is no cointegration between the variables. This indicates that there is no long-term relationship between the variables. On the other hand, to assess the short-term relationship between the construction industry and the GDP, VAR Granger Causality Test was conducted and the results prove that there is no short-run relationship or causality between the variables either. This coincides with the literature on the causality between the construction industry and the GDP of developed countries. Although at the beginning of the cycle, some causality and relationship between the construction industry and GDP was observed, however, as the country develops, this relationship diminishes. This relationship is also true at the beginning of a construction project, but since such projects are relatively short term, their contribution is also short lived, and the major long-term contribution to GDP is identified to come from the service industry. Therefore, economic strategies in the UAE based on construction activities are not a valuable option, since no long-term relationship between construction activities and GDP was observed. On the contrary, a noticeable change in GDP will have an effect on the construction industry as the allocation of funds may vary based on the willingness of the UAE to spend on the construction industry.

This study is based on data collected from the World Bank relating to the UAE, therefore, the data are limited and further developments to the study could include the addition of other indicators to further separate the effect of other economic activities on GDP and the construction industry.

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