To What Extent GDP, Trade and Cost of Transport are Interdependent in GCC Countries? Unrestricted VAR Approach

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Abstract :

This paper aims to analyze the interdependencies among GDP, trade, and cost of transport. For this purpose, the study tested a 360 cointegrated stationary observation for the GCC countries over the period 2000 to 2010. The results revealed that a high alternate adverse interdependence is only between GDP and cost of transport. While a shock of GDP has led to a parallel impact on the level of foreign trade and vice versa, in which the economic growth is significantly contributing in the variance of trade.

Key words: GCC countries, GDP, Trade, Transport Cost, VAR model

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1. Introduction:

The global trade has grown rapidly by 5.9 per cent through the period from 1950 to 2004 due to declining of level of transportation cost (Hummels 2007). A number of empirical studies have paid more attention about trade and the impact of transportation cost via using a gravity approach in which its major variables are distance, and GDP as a main representative of size of an economy. Thus, this model basically measures the negative and positive signals of both GDP and distance and their impact on the level of trade between two countries. However, the key idea of this paper has derived from the assumption of the basic gravity model which predict trade based on the distance between countries and the interaction between size of economies represented by GDP (Bergeijk and Brakman 2010; De Benedictis and Taglioni 2011). As well known, the gravity model basically measures how much the distance as a proxy of the cost of transport, and GDP affect the level of trade, but it does not explain the interdependence among these variables as endogenous. Accordingly, this paper aims to investigate whether the gravity's model variables are interdependent or not. This target will be revealed via using un-restricted vector autoregressive model, VAR. It provides an interesting a dynamic system of equations which are feasible to estimate large-scale macro-models that treating all variables as endogenous (Mukherjee and Naka 1995; Swanson and Granger 1997). However, the contribution of this paper is to explain the reaction of one variable of the gravity model to an impulse in another variable in the GCC economies for the period 2000 to 2010. The test will be conducted in a system that involves trade, GDP and cost of transport in order to illustrate the impact of shocks on the adjustment path of the variables. Hence, it will test how a shock to economic variable reverberates through the system of equations.

2. Literature Review:

In the "Wealth of Nations" Adam Smith had mentioned that more extensive division of labor will lead to develop sea coast areas when the level of cost of transport is low. He put a stress on the relationship between geographical location and international trade (Smith, Stewart et al. 1825). This infers that the existence of a low rate of transport cost is a significant agent for trade and economic growth alike. And the recent literature has emphasized the importance of transport costs in explaining trade, where the gravity model is widely used to analyze the relation between distance or cost of transport, and size of the economy, and their impact on trade (Sohn 2001; Carrillo 2002; Vido 2003; Abid Mawlah 2010). However, a number of scholars have concerned about key related factors such as trade policies, productivity, and economic openness degree as a tool to strengthen the rate of growth, but despite of adding extra variables to the gravity model, the majority of these studies found that the GDP and distance are the key factors for trade between countries (Rodrik 1999; Fischer 2003; Anderson 2008). On the contrary, many studies confirm that the elasticity of trade to distance is declining over the time due to the technology of container transport system and globalization (Hummels 1999; Brun 2003) in which the cost of transport does not constitute an important factor for determining level of trade, particularly among countries that have a similarity in terms of pattern of production such as oil exporting economies (Saddam and Kari 2012). In this context, another study (Ghemawat 2001) depicted that level of income of consumers is the most significant factor which affect level of trade, and rich countries engage in relatively more cross-border economic activity relative to their economic size. It is also shown that the geographic distance affects the cost of transport and it is important to companies that deal with heavy products.

However, The relation between cost of transport and trade has addressed in various directions that reflect its impact on the level of trade and a country's economy, for instance, (Bougheas, Demetriades et al. 1999) tackled the level of infrastructure to analyze its influence in the gravity model via using data from European countries. The result of this study is strongly supporting the theory of gravity, where this study found that availability of infrastructure will lead to reduce cost of transport and enhance the level of trade. Accordingly, we see that the transportation cost is not a determinant factor to state the direction of trade and its level in an economy. And the assumption of gravity model cannot be fit for all countries in the world.

From the above, it was noted that the pattern of trade is not mainly built at the cost of transport, it became a modest factor. However, recently this view is widely accepted due to the role of technology in reducing cost of transport over the time (Radelet and Sachs 1998; Clark, Dollar et al. 2004; Hummels 2007) where it has declined by over 90 per cent during the twentieth century (Glaeser and Kohlhase 2004). In this respect (Baier and Bergstrand 2001) infers that increased vertical specialization and outsourcing of intermediate production is beyond the declining transport cost and increasing level of growth. This means that the level of transport cost is highly related factor to the level of economic growth, in which the economies of scale will lead to reduce the cost of each unit produced. Therefore, it is a logic status when a shock occurs at the level of transport cost does not affect as the shock of GDP.

Overall, we can say that the cost of transport does not matter as much as the size of the economy. As formerly stated, this alteration is due to the technological progress of the transportation system in general which has come as a response to a high level of world economic growth, as well as the increase of the level of international trade among countries, particularly developed and most diversified economies (Baier and Bergstrand 2001; Wacziarg and Welch 2008). Therefore, this analysis would also extrapolate how much oil producing economies like GCC countries are consistent with other related literature of other economies. In other words, investigating the status of GCC's trade and which variable has more significance. This analysis will be revealed by the result of the model adopted for this purpose.

3. Methodology:

The methods of this paper are based on using an unrestricted VAR model which includes a complete system of equations. The annual time series data spanning from 2000 to 2010 measured by USD million. And the model will be comprised three variables which are; Trade (TD), Gross Domestic Product (GDP) and cost of transport (CT). The functional model is specified as follows:

$$TD = f\,(CT, GDP) \quad \ldots\ldots (1)$$

The study will use a logarithmic data, therefore the equation (1) above could be written into the equation (2) below:

$$Log\,(TD) = \alpha 0 + \theta 1\, log\,(CT) + \theta 2\, log\,(GDP) + u_{ti} \quad \ldots\ldots (2)$$

Where; $\alpha 0$ represents the intercept, $\theta 1$ and $\theta 2$ are the coefficient of the econometric model. u_1 is the error term. Since the study employs the VAR model, so the complete system of this model is written as follows:

$$Log\,(TD) = \alpha 0 + \theta 1\, log(CT)_{t-i} + \theta 2\, log\,(GDP)_{t-i} + \theta 3\, log\,(TD)_{t-i} + u_{t1} \quad \ldots\ldots (3)$$

$$Log\,(CT) = \alpha 1 + \theta 4\, log(TD)_{t-i} + \theta 5\, log\,(GDP)_{t-i} + \theta 6\, log\,(CT)_{t-i} + u_{t2} \quad \ldots\ldots (4)$$

$$Log\,(GDP) = \alpha 2 + \theta 7\, log(CT)_{t-i} + \theta 8\, log\,(TD)_{t-i} + \theta 9\, log\,(GDP)_{t-i} + u_{t3} \quad \ldots\ldots (5)$$

Furthermore, and in order to specify whether or not the data used are stationary, we have conducted a group unit root test. The null hypothesis assumes that there is a unit root test. However, ADF-Fisher Chi-square and PP- Fisher Chi-square are conducted for this study, and the result is statistically significant at the 5 percent level. Accordingly, the null hypothesis is rejected and we accepted the alternative one. Meaning that, the data are stationary and statistically valid for regressing the model that we adopt. Hence, the economic analyzing of the result estimation of this model would be meaningful. The obtained result is shown in table (1) as follows:

Table (1): Group Unit Root Test for the data of the study

Source: By the author based on using Eview software.

Group unit root test: Summary
Series: COST, GDP, TRADE

Sample: 1 121
Exogenous variables: Individual effects
Automatic selection of maximum lags
Automatic lag length selection based on SIC: 0
Newey-West automatic bandwidth selection and Bartlett kernel
Balanced observations for each test

Method	Statistic	Prob.**	Cross-sections	Obs
ADF - Fisher Chi-square	12.4198	0.0532	3	360
PP - Fisher Chi-square	12.7300	0.0475	3	360

In addition, and to state the lag of the model adopted, a VAR lag order selection criteria are engaged. However, table (2) below depicts that five criteria illustrated that lag 1 is an ideal lag length for this model. It shows the optimal selection according to the methods adopted for this purpose. Hence, this model will be utilized for the analysis of this study.

Table (2): VAR lag order selection criteria

** Probabilities for Fisher tests are computed using an asymptotic Chi -square distribution. All other tests assume asymptotic normality.

VAR Lag Order Selection Criteria
Endogenous variables: COST GDP TRADE
Exogenous variables: C

Sample: 1 121
Included observations: 113

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-510.6536	NA	1.781729	9.091214	9.163623	9.120597
1	-205.7626	588.1968*	0.009473*	3.854205*	4.143839*	3.971736*
2	-204.7244	1.947848	0.010910	3.995121	4.501981	4.200800
3	-198.3668	11.58997	0.011443	4.041889	4.765975	4.335716
4	-194.0631	7.617090	0.012456	4.125011	5.066321	4.506985
5	-193.4267	1.092622	0.014482	4.273038	5.431575	4.743161
6	-192.4133	1.686049	0.016747	4.414394	5.790156	4.972664
7	-190.4804	3.113053	0.019081	4.539476	6.132464	5.185894
8	-187.4896	4.658269	0.021376	4.645834	6.456047	5.380399

Source: By the author based on using Eviews software.
(*) indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

4. Model Estimation and Analysis:

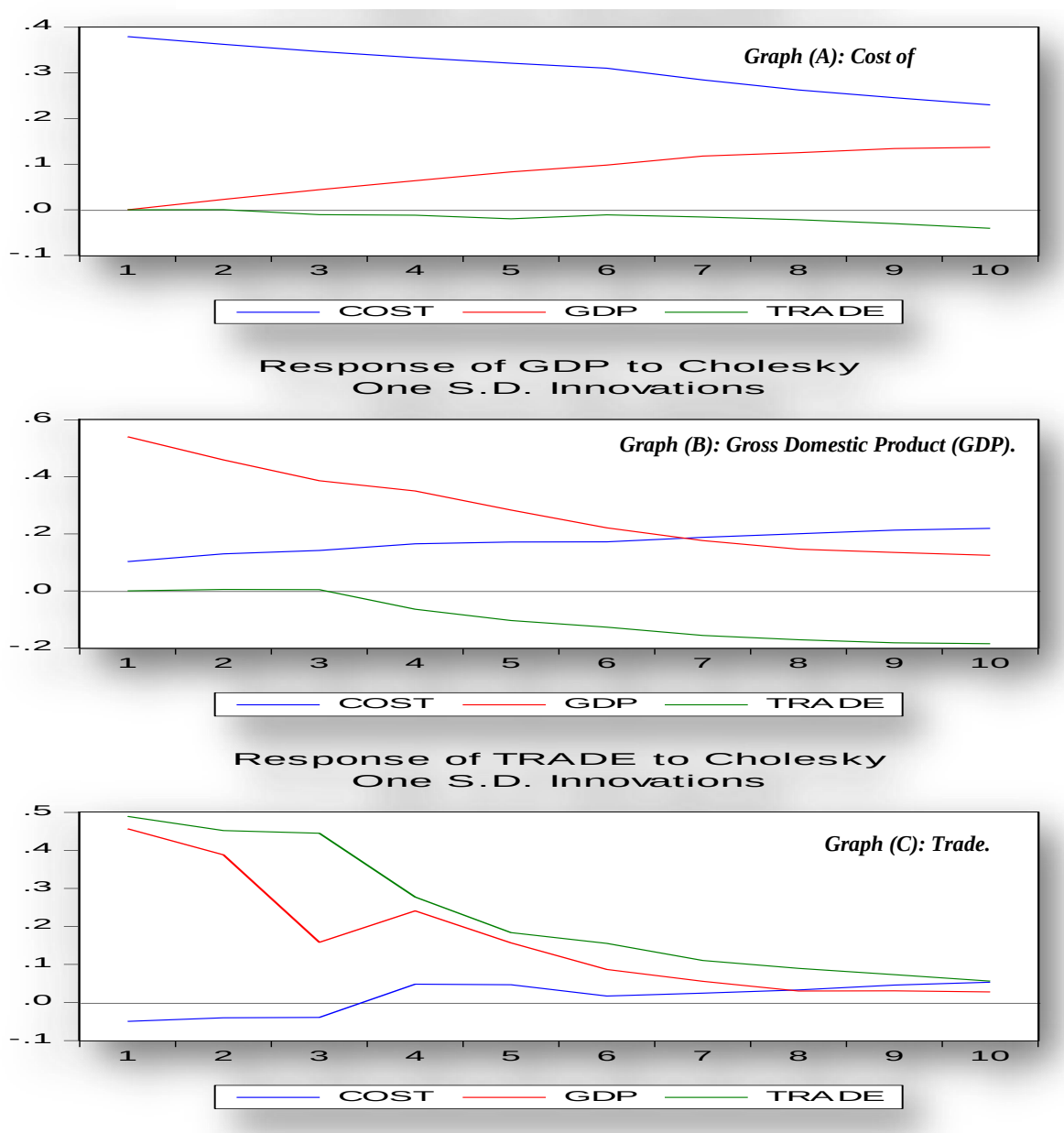
4.1 Impulse Response:

The model is estimated via using unrestricted VAR model, however, in figure (1:A) impulse response function represented that a shock of transport cost is caused by its own shock, where it has dropped over the horizon of predicted period. While it affected positively on the level of GDP, where there is an incremental increase in its level. While trade has witnessed a slight negative impact started from second to five period, as well as, from seven to ten years forecasted. Accordingly, we note that there is an inverse relationship in the increase of level of GDP. This result could be interpreted by the progress of transport system, particularly sea transport and container fleets (Gal 2011). It has led to achieving economies of scale within the period predicted and then reducing the level of transport cost, for instance, this progress could be considered a major motivation in the increase of level of imported capital goods that can broaden the level of

production and then enhance economic growth due to the high importance of trade in these countries (Sturm, Strasky et al. 2008).

Graph (B) depicts that the adverse impact of GDP is attributed to its own shock. And shock of GDP would also influence inversely on the GCC's transport cost. While trade has slashed sharply from the third year to the end period. However, this result explains a logic status of GCC countries, where the trade curve has declined dramatically due to the shocks of GDP. This result also infers a high linkage between trade and level of GDP. While the increase of Level of transport cost could be attributed to the fixed cost of transport sectors, in which decreasing level of production will be reflected in rising level of the transport cost. From this finding, simply put that declining level of GDP will not only affect the level of trade, but also increasing transport cost and vice versa.

Figure 1: Impulse Response of transport cost, GDP and Trade



Source: By the author based on a VAR model by using Eviews software.

Graph (C) illustrated that the trade of GCC countries will be affected negatively by its own shock, especially the period spanning from fourth to sixth year forecasted. Furthermore, GDP has a sharp negative impact from one to third period forecasted, while transport cost will be increased. This result infers that the level of trade of GCC countries has a significant association with the GDP compared to the cost of transport. However, it could be explained by the role of trade in encouraging producing sectors to increase their final products in order to meet the demand of partner countries, where the rising of level of producing good units will lead to reduced levels of each unit produced within a certain time of period and mitigate the transport cost consequently.

4.2 Variance Decomposition:

In order to describe the proportion of the forecast error variance of the independent variables due to each of the shock, the variance decomposition is used (Saltelli, Chan et al. 2000) as shown in the following tables:

Table 3: Variance Decomposition of cost of transport

PERIOD	S.E.	COST	GDP	TRADE
1	0.379392	100.0000	0.000000	0.000000
2	0.525209	99.81322	0.186765	1.24E-05
3	0.630980	99.35827	0.613331	0.028400
4	0.716516	98.68219	1.267447	0.050367
5	0.789740	97.74745	2.147767	0.104778
6	0.854093	96.74882	3.143925	0.107258
7	0.907989	95.41544	4.458411	0.126152
8	0.953571	94.07786	5.756039	0.166097
9	0.994185	92.64123	7.111718	0.247050
10	1.030364	91.22733	8.387314	0.385353

Table 4: Variance Decomposition of GDP

PERIOD	S.E.	COST	GDP	TRADE
1	0.549962	3.477001	96.52300	0.000000
2	0.728309	5.146611	94.84806	0.005327
3	0.836561	6.764425	93.22839	0.007186
4	0.924152	8.727086	90.78174	0.491172
5	0.987112	10.65551	87.80631	1.538185
6	1.034048	12.48491	84.59342	2.921671
7	1.077053	14.54870	80.65020	4.801093
8	1.118400	16.69633	76.50062	6.803053
9	1.160701	18.85705	72.37134	8.771603
10	1.202185	20.90810	68.53944	10.55246

Table 5: Variance Decomposition of Trade

PERIOD	S.E.	COST	GDP	TRADE
1	0.671395	0.543278	46.28808	53.16864
2	0.898729	0.501875	44.51448	54.98365
3	1.015993	0.544001	37.26261	62.19339
4	1.081328	0.677497	37.85111	61.47139
5	1.108995	0.822317	37.98529	61.19240
6	1.123287	0.824348	37.62009	61.55556
7	1.130363	0.861418	37.39223	61.74635
8	1.134808	0.940414	37.16964	61.88994
9	1.138492	1.095642	37.00232	61.90204
10	1.141484	1.309522	36.86876	61.82172
CHOLESKY ORDERING: COST GDP TRADE				

Source: By the author based on the result of the VAR model by using Eviews software.

The variance decomposition method measures the contribution of each type of shock to forecast error variance (Campbell 1991). However, the results obtained in table (3) chart that 100 to 91.22 per cent of variance of transport cost is referring to its own shock over the forecasted period. While trade and GDP have depicted a modest contribution, especially trade. Furthermore, we note that with the increase level of GDP contribution which spanning from the first year to the end period there is an alternate decrease in the level of transport cost within the said period. This result can be state the role of economies of scale in GCC countries, where with a high growth level there is an impact to reduce shocks of transportation cost. This result, however, is consistent with the result that we obtained in figures (1:A) and (1:B).

Table (4) indicates that the variance of GDP in GCC countries is highly related to its own shock, where it is ranged between 96.5 per cent and 68.5 per cent variance interpreted by GDP through the period predicted. And the contribution of transport cost shock is relatively higher than that of trade, proportion of transport cost soared from 3.4 per cent to 20.9 per cent, while trade from 0.00 per cent to 10.5 per cent. However, this result asserts the dynamic interdependence between the GDP and cost of transport as proven in figure (1).

Table (5) illustrated that the forecast error variance of trade is highly linked to its own shock and GDP, while the contribution of transport cost does not exceed 1.5 per cent. Overall, we see that there is an alternate interdependencies between transport cost and GDP, and not between trade and GDP. Furthermore, GDP has a significant contribution in the variance of trade. Meaning that, the cost of transport is not matter for GCC countries' trade as the GDP. And this finding could be considered a logic in reality, since GCC as an oil producing countries tend to trade more with

countries further than their nearby countries, for instance, the trade between Saudi Arabia and the UAE is less than Saudi's trade with the UK (Saddam 2013).

5. Concluding remarks:

This study has mainly based on unrestricted VAR model for 360 cointegrated stationary observations of GCC countries over the period 2000 to 2010. However, we found that the positive influence of shock of GDP has led to a negative shock and reducing levels of the transport cost, and vice versa. This exhibits the existence of an alternate interdependence between GDP and cost of transport, where an increase in the level of economic growth will directly lead to dropping the transport cost. Moreover, there is an important linkage between level of trade and GDP, in which GCC's trade is significantly determined by the GDP, It does not by transport cost. Finally, we can conclude that the cost of transport, in comparison to GDP, is not important factor that determine the level of trade in GCC countries. And this finding is a parallel to the consensus of other studies that used a gravity model approach which assures the declining of the cost of transport.

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