Inter-Sectoral Linkages and Economic Growth in Saudi Arabia: Toward a Successful Long-term Development Strategy

Abdulkarim K. Alhowaish[1], Faez S. Al-shihri[2], Sayed M.S. Ahmed[3]

[1, 2,, 3] University of Dammam, College of Architecture and Planning,
Department of Urban and Regional Planning, Dammam 31451, Saudi Arabia

Abstract: *The main objective of this research paper is to investigate the causal relationship between sectoral development (namely: agriculture, oil, industry and services sectors) and economic growth in Saudi Arabia over the period 1970 to 2012 using multivariate econometric analysis approach. Real GDP is used as proxy for economic growth; value added for agriculture, oil and gas, industry and services sectors is used as proxy for inter-sectoral development. The results suggest that there exists bidirectional causality among the sectoral output of Saudi economy at least in the short run. The findings of this study suggest that the income of Saudi economy largely depends on the income generating from services and industrial sectors, and the income growth of these two sectors, in turn, depends on growth of oil and gas sector. The findings also revealed that the income growth of agricultural sector largely depends on growth of industrial sector. The overall research outcomes also suggest that the oil and gas sector continue to be the dominant driver of other sectoral output growth.*

Keywords: Sectoral Development, Economic Growth, Saudi Arabia, Multivatiare Econometric Analysis Approach.

1. Introduction

The neoclassical growth approach is based on the view that structural change is an unimportant side effect of the economic growth [1]. On the other side economists associated with the World Bank, including Rostow [2], Fuchs [3], Kuznets [4], Chenery and Syrquin [5] and Baumol et al [6], claim that growth is obtained by the process of structural transformation of an economy. Historical experience has shown that developed countries have obtained their economic growth by transitioning their economies from agrarian to an industrialized and service based society. As far as the developing countries are concerned, there is a general agreement that the validity of comparative advantage for developing countries weakens, as they try to follow the model of developed countries [7]-[8]. The greatest challenge developing countries facing today is not only to react to external events but also to positively influence and shape the transformation process of their economies in order to benefit from opportunities that emerge from these processes both internally (solving their own socio-economic development problems) and externally (remaining competitive in the global economy).

The main objective of this research is to model the dynamic relationship between economic sectors growth (i.e. agricultural, oil and gas, industrial and services sector growth) and economic growth of Saudi Arabia; using the advanced multivariate econometric technique for the period of 1970-2012. The economy of Saudi Arabia is an oil-based economy with strong government control over major economic activities. Major part of total exports (90%) and government revenue (92%) in 2013, is dominated by oil and gas sector products [9]. Economic activities are primarily dominated by industrial sector activities, including oil and gas, petrochemical, chemicals, fertilizers, cement, plastics and metals manufacturing which represent about 62% of the GDP. The services sector accounts for another 35% of the GDP and finally, agricultural sector accounts for the last 2% of the GDP. According to the Aljazira Capital report [10], the industrial sector continues to be one of the economy's largest employers in the country; representing more than half (57%) of all jobs.

Investigation of structural relationships among the economic sectors becomes important from the policy perspective. It helps one understand not only the evolution and progression of such relationships but also the inter-sectoral adjustments over time. A clear perspective on the inter-sectoral dynamics could be useful in devising a conducive and appropriate long-term development strategy. Furthermore, the study of sectoral inter-linkages is all the more important for a developing country like Saudi Arabia so that positive growth stimuli among sectors could be identified and fostered to sustain the economic growth and development momentum. This would go a long way in redressing various socio-economic problems such as oil dependency syndrome, unemployment and inequality.

In this backdrop, the present paper focuses on examining the dynamic relationship and inter-linkages among the sectors of the Saudi economy. The remainder of this research is structured as follows. Section 2 presents a review of literature. Section 3 provides a brief description of the data and econometric methodology employed. This is followed by the empirical results and discussion (section 4) and finally, section 5 concludes and discusses the policy implications of the study.

2. Literature Review

The interaction between economic growth and sectoral growth is extensively studies in developing countries on the theoretical and empirical bases. For example Lewis [7] and

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Hirschman [11] provide pioneer theoretical literature on the dynamic relationship between agricultural growth and industrial growth of an economy. They argued that growth in agriculture sector has a direct stimulating impact on industrial growth through its forward and backward supply-demand linkages in terms of resource outflow (e.g. capital, labour and raw material). On the other side, the industrial growth can also foster agriculture production demand indirectly through its higher wages and directly through its products related to agriculture production such as irrigation technology, chemical and biochemical technology. Hence, two-way feedback linkages (i.e. a bidirectional causal relationship) between these two sectors which in turns leading to greater productivity in the use of resources, and sustainable economic growth. The law of comparative advantage, however, implies a negative link between agricultural growth and industrial growth [12]-[13]. According to this view, the industrial sector has to compete with the agricultural sector for labour. Low productivity in agriculture implies an abundant supply of 'cheap labour' which the industrial sector can exploit. Adding to that, rising labour wages in industrial sector is a direct cause of labour force decline in agriculture sector. More recently, however, some researchers have acknowledged the prominent role of services in the development process [14], [15], [16], [17].

On the empirical base, however, Katircioglu [18] examined the link between economic growth and sectoral growth in a case study of North Cyprus; using co-integration and granger causality model. He has found a long-run relationship between economic growth and sectoral growth in the country. The causality result of his investigation indicates unidirectional causality running from GDP growth to agricultural sector growth and also concludes that GDP growth gives unidirectional causation to industry and services sector growth. In another study, Katircioglu [19] investigated the impact of agricultural sector growth on the overall economic growth in the case of North Cyprus. He has found bidirectional relationship between agricultural output growth and economic growth. Hye [20] investigated the link between agricultural and industrial output growth in the case of Pakistan; using the data of autoregressive distributed lag model. The author found bidirectional long-run relationship between agriculture and industrial output growth. Chebbi [21] examines the link between agriculture growth and other sectors growth of economy in the case of Tunisia; using co-integration and granger causality model. The author concluded the existence of long-run association between agricultural growth and other sectoral growth of the economy. In another research, Sepehrdoust and Hye [22] investigated the inter-sectoral linkages and economic growth in the case of Iranian economy; using time series date of 1959-2010. The authors found that the long run relationship exists between sectors growth and economic growth. They also concluded that the long run elasticity shows that one percent increase in value added of industrial, agriculture, services and oil and gas sectors will cause the GDP to increase by 0.219, 0,091, 0.431 and 0.156 percent respectively. Recently, Alhowaish [23] examines the dynamic inter-sectoral relationship between economic growth and sectoral growth in eight Arab countries; using multivariate econometric model. The author found that the

incomes of most Arab economies depend largely on income generated from growth in either the industrial or services sectors, while the agricultural sector has a neutral effect in most cases. He also concludes that the interaction between growth of the industrial and services sectors appears to be much stronger than the interaction between other sectoral pairs.

Researchers argued that the linkages between the economic sectors of an economy are more complicated and multi-directional in nature and not an easy task to be predicted. They also argued that the contribution of these sectors to economic growth are varies markedly from country to country as well as from one time period to another within the same economy.

3. Data and Methodological Approach

The main objective of this research is to examine the dynamic relationship between economic sectors growth (i.e. agricultural, oil and gas, industrial and services sector growth) and economic growth of Saudi Arabia; using the advanced multivariate econometric technique for the period of 1970-2012. Real GDP is used as proxy for economic growth; value added for agriculture, oil, industry and services sectors is used as proxy for inter-sectoral development. The dataset employed in this paper consisted of annual data (in local currency − Saudi Riyal) on inter-sectoral development and real GDP from 1970 to 2012. The Data is obtained directly from the Saudi Arabian Monetary Agency (SAMA) database and various secondary database sources such as Ministry of Economic and Planning, Central Statistics for Information agencies [24]. All variables are expressed in natural logarithms, allowing the estimated coefficients to be considered as the elasticity of the relevant variables. The natural logarithm does not change the original co-integration relationship of variables under investigation, but can linearize the data trend and eliminate time-series heteroscedasticity.

To explore dynamic relationship between sectoral growth and economic growth of Saudi economy, the standard econometric tool of the Granger causality test [25] has been used. One important precondition for conducting the Granger causality test is to examine the time series properties of the variables in study. Because if the vector auto regressive equation used to conduct the Granger causality test is estimated with data that are non-stationary, the results would not be reliable. To be specific, the t-statistics of the estimated coefficients will be unreliable since the underlying time series would have theoretically infinite variance [26].

To investigate stationary property of time series, the test for a single unit root has been conducted using Phillips-Perron (PP) panel unit root tests. One advantage of using this test over the Augmented Dickey and Fuller (ADF) test is that the PP-test has greater power than ADF test [27]. Another advantage is that the PP tests are robust to general forms of heteroskedasticity in the error term u_t [28]. Besides, unlike the ADF technique, the user does not have to specify a lag length for the test regression in the PP technique. Once the order of integration is determined, the series can be further

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tested for the existence of long-run relationships among them using the co-integration technique, and the Johansen-type panel co-integration test as developed by Maddala and Wu [29] has been used.

The co-integration test merely shows the degree of association between variables and not the direction of linkage. Therefore, in order to examine the direction of linkage, Granger causality tests have been conducted. But for a VAR first-differences system with co-integrated variables the Granger causality test must be conducted in a vector error correction model (VECM) setting [30]. Thus, to analyse in details the long-run adjustments between sector shares, the following dynamic panel vector error correction models are formulated as follows:

$$\Delta GDP_t = \alpha_1 + \sum_{i=l}^{n} \beta_{1,i} \Delta AGR_{t-1} + \sum_{i=l}^{n} \vartheta_{1,i} \Delta OIL_{t-1} + \sum_{i=l}^{n} \delta_{1,i} \Delta IND_{t-1} + \sum_{i=l}^{n} \theta_{1,i} \Delta SRV_{t-1} + \gamma_1 ECT_{t-1} + \varepsilon_{1,t} \quad (1)$$

$$\Delta AGR_t = \alpha_2 + \sum_{i=l}^{n} \beta_{2,i} \Delta GDP_{t-1} + \sum_{i=l}^{n} \vartheta_{2,i} \Delta OIL_{t-1} + \sum_{i=l}^{n} \delta_{2,i} \Delta IND_{t-1} + \sum_{i=l}^{n} \theta_{2,i} \Delta SRV_{t-1} + \gamma_2 ECT_{t-1} + \varepsilon_{2,t} \quad (2)$$

$$\Delta OIL_t = \alpha_3 + \sum_{i=l}^{n} \beta_{3,i} \Delta GDP_{t-1} + \sum_{i=l}^{n} \vartheta_{3,i} \Delta AGR_{t-1} + \sum_{i=l}^{n} \delta_{3,i} \Delta IND_{t-1} + \sum_{i=l}^{n} \theta_{3,i} \Delta SRV_{t-1} + \gamma_3 ECT_{t-1} + \varepsilon_{3,t} \quad (3)$$

$$\Delta IND_t = \alpha_4 + \sum_{i=l}^{n} \beta_{4,i} \Delta GDP_{t-1} + \sum_{i=l}^{n} \vartheta_{4,i} \Delta AGR_{t-1} + \sum_{i=l}^{n} \delta_{4,i} \Delta OIL_{t-1} + \sum_{i=l}^{n} \theta_{4,i} \Delta SRV_{t-1} + \gamma_4 ECT_{t-1} + \varepsilon_{4,t} \quad (4)$$

$$\Delta SRV_t = \alpha_5 + \sum_{i=l}^{n} \beta_{5,i} \Delta GDP_{t-1} + \sum_{i=l}^{n} \vartheta_{5,i} \Delta AGR_{t-1} + \sum_{i=l}^{n} \delta_{5,i} \Delta OIL_{t-1} + \sum_{i=l}^{n} \theta_{5,i} \Delta IND_{t-1} + \gamma_5 ECT_{t-1} + \varepsilon_{5,t} \quad (5)$$

Where index t refers to the time period (t = 1,..., T) and l to the lag. $\varepsilon_{1,t}$, $\varepsilon_{2,t}$, $\varepsilon_{3,t}$, $\varepsilon_{4,t}$, and $\varepsilon_{5,t}$ are supposed to be white-noise errors. γ_1, γ_2, γ_3, γ_4, and γ_5 are coefficients for the error-correction terms. These coefficients are expected to capture the adjustments of ΔGDP_t, ΔAGR_t, ΔOIL_t, ΔIND_t, and ΔSRV_t towards long-run equilibrium. Equation (1) is used to test causation from agriculture sector, oil and gas sector, industrial sector services sector to GDP growth in Saudi Arabian economy. If all the $\beta_{1,1}$, $\vartheta_{1,1}$, $\delta_{1,1}$, and $\theta_{1,1}$, = 0, then it implies that change in AGR, OIL, IND and SRV does not Granger cause change in GDP. Similarly, Equation (2) is used to test causality from GDP, oil and gas sector, services sector and industrial sector growth to agricultural output growth. Changes in GDP, OIL, IND and SRV growth does not Granger cause change in AGR growth, if all the $B_{2,1}$, $\vartheta_{2,1}$, $\delta_{2,1}$, and $\theta_{2,1}$, = 0 respectively. Furthermore, if all the $B_{3,1}$, $\vartheta_{3,1}$, $\delta_{3,1}$, and $\theta_{3,1}$, are equal to zero in Equation (3), then neither change in GDP nor change in AGR, SRV and IND would Granger cause change in OIL output growth respectively. Equations (4) and (5) follow similar explanation.

4. Results and Discussion

Table 1 presents the results of PP panel unit root tests with lag length chosen by downward search (*t*-test on the longest lag). The null hypothesis of a unit root is not rejected for any of the three variables in levels. However, each of the series is found to be stationary in fist difference. Therefore, all the variables are integrated of order one, (I (1)). The results are in line with the view that most macroeconomic variables are non-stationary in level but stationary in the first difference [31].

Table 1: Unit Root Test Results (Phillips-Perron)

Series	Level	First Difference
GDP_t	-1.962 (0.301)	-3.707 (0.007)
AGR_t	-2.237 (0.196)	-5.631 (0.000)
OIL_t	-2.617 (0.097)	-5.726 (0.000)
IND_t	-1.775 (0.387)	-2.550 (0.011)
SRV_t	-1.795 (0.377)	-2.852 (0.059)

Notes: Figures in the parenthesis are the probability value. GDP-gross domestic product, AGR-agriculture sector, OIL-oil and gas sector, IND-industrial sector, and SRV-services sector.
Source: Authors estimation using EViews8.

Since all the series are integrated of the same order – integration of order 1 (I (1)) – the series can be further tested for the existence of long-run relationships among them using the co-integration technique. Table 2 shows the results of panel co-integration tests under the null hypothesis of no co-integration. The results indicate that the null hypothesis of the zero co-integrating vector is rejected using the 99% critical value. This implies that the variables are co-integrated with at least two co-integrating vector.

Table 2: Co-integration Test Results (Johansen and Juselius)

Hypothesized Number of Co-integrating Equation(s): H_0	Trace Test		Maximum Eigenvalue	
	Statistic	P-Value	Statistic	P-Value
None (r = 0)	174.84	0.000	84.270	0.000
At most 1 (r≤1)	90.576	0.000	55.544	0.000
At most 2 (r≤2)	35.032	0.011	18.063	0.127
At most 3 (r≤3)	16.968	0.029	16.851	0.019
At most 4 (r≤4)	0.1167	0.732	0.1167	0.732

Source: Authors estimation using EViews8.

According to the Granger representation theorem [32], a system of co-integrated variables has an error correction representation that combines the short-run dynamics of the variables with their long-run properties, as implied by the co-integrating relationships. Consequently, the VECM approach, besides showing the direction of Granger causality among the variables, enables one to distinguish between "short-run" and "long-run" Granger causality. The former is generally referred to as the Channel 1 source of causation and can be evaluated by testing whether the estimated coefficients on lagged values are jointly statistically significant. This can be done using the F test or χ^2 statistic test. On the other hand, long run Granger causality is generally referred to as the Channel 2 source of causation and can be evaluated by testing whether the coefficient of the error-correction term in each equation [that is, $\gamma_1=0$; $\gamma_2 = 0$; $\gamma_3=0$; $\gamma_4 = 0$; and $\gamma_5=0$] is statistically different from zero by a t-test. The empirical results of causality through these channels are shown in Table 3. We report five causality tests relating to zero restriction of relevant variables in the VECM where the null hypothesis is that there is no Granger causality against the alternative that there is Granger causality.

Table 3: Granger Causality Test Results under VECM

Dependent Variables	Explanatory Variables					ECT
	ΔGDP_{t-1}	ΔAGR_{t-1}	ΔOIL_{t-1}	ΔIND_{t-1}	ΔSRV_{t-1}	
	$\chi^2 - Statistics$					
ΔGDP_t	--	7.44 (0.05)	11.93 (0.00)	1.03 (0.79)	9.44 (0.02)	-0.21 (0.36)
ΔAGR_t	7.97 (0.04)	--	4.16 (0.24)	14.54 (0.00)	4.16 (0.24)	0.00 (0.03)
ΔOIL_t	6.44 (0.09)	5.03 (0.16)	--	0.29 (0.96)	4.48 (0.20)	-0.08 (0.76)
ΔIND_t	31.03 (0.00)	1.99 (0.57)	22.02 (0.00)	--	18.89 (0.00)	0.48 (0.00)
ΔSRV_t	38.38 (0.00)	2.24 (0.52)	24.66 (0.00)	23.05 (0.00)	--	-0.20 (0.00)

Notes: Figures in the parenthesis are the probability value. The optimal lag-structure determined through AIC criterion is 3. Diagnostic tests (not reported) conducted for residual autocorrelation are overall found to be satisfactory.
Source: Authors estimation using EViews8.

Focusing first on the GDP equation (1), the change in agriculture sector (ΔAGR), oil and gas sector (ΔOIL) and services sector (ΔSRV) appears to 'Granger cause' a change in the GDP growth (ΔGDP) at 5%, 1% and 5% significance level, respectively. The inclusion of past information on ΔAGR, ΔOIL and ΔSRV improves the forecast for ΔGDP. Nevertheless, from the agriculture, oil and services sectors equations, it is found that ΔGDP are driven by ΔAGR, ΔOIL and ΔSRV. Therefore, we observe the presence of bidirectional causality between these three sectors and economic growth in the short run. Further, the null hypothesis that ΔIND does not 'Granger cause' ΔGDP is accepted, however, the reverse hull hypothesis (i.e. is ΔGDP does not 'Granger cause' ΔIND) is rejected at 10% level. This shows a unidirectional causality running from economic growth to industrial sector output without any feedback effects.

The outcome revealed that there is no shout run causal relationship exists between agriculture growth and oil and gas sector output and between agriculture output and services sector output in any direction. However, the analysis revealed that there is a one-way causal relationship running from industrial sector to agriculture output at the 1% level of significance. The analysis also revealed that the change in oil and gas sector (ΔOIL) appears to 'Granger cause' a change in the industrial (ΔIND) and services (ΔSRV) outputs at1 significance level. The reverse causality, however, does not hold true. Therefore, there exists a short run unidirectional causal relationship between these two sectors and oil and gas sector growth. Another attractive outcome is that ΔIND seems to 'Granger cause' change in services sector (ΔSRV), and also ΔSRV seems to 'Granger cause' ΔIND at the 1% level of significance. Thus, bidirectional causality existed between services and industrial output of Saudi Arabian economy in the short run.

Based on the t-statistics of the error correction terms, it follows that the error-correction terms in Equations (1) and (3) are insignificant; this suggests that ΔGDP and ΔOIL do not react to the co-integrating errors. Therefore, these variables are exogenous in the long run. However, the error-correction term in Equation (5) is highly significant with the correct sign. Therefore, the null hypothesis of no long-run causality from GDP, AGR, OIL and IND to SRV is rejected at 1% level. The estimated error correction coefficient (-0.21) of Equation (5) indicates that the annual adjustment of SRV will be 21% of the deviation of SRV_{t-1} from its co-integrating value. That is if SRV is above its equilibrium value by one point in any time, SRV falls by 0.21 points on average in the next year and vice versa.

5. Conclusion and Policy Implications

The purpose of this study was to empirically investigate the dynamic relationship between sectoral linkages and economic growth of Saudi Arabian economy over the period 1970 to 2012 using multivariate econometric analysis approach. The PP test was used to check whether the time–series of variables under investigation were stationary. The co-integration test was performed to obtain the number of co-integrating vectors between series, and VECM Granger causality was employed to examine the nature of interdependence between variables. Results of Granger causality test reveals that there exists bidirectional causality among the sectoral output of Saudi Arabian economy at least in the short run. The findings points to a large degree of interdependence between industrial and services sectors growth. This study is certainly revealed that the income of Saudi economy largely depends on the income generating from services and industrial sectors, and the income growth of these two sectors, in turn, depends on growth of oil and gas sector. The findings also revealed that the income growth of agricultural sector largely depends on growth of industrial sector.

Given the nature of the Saudi economy as oil-rich country, the oil and gas sector continue to be the most important and strongest player in the national economy and the dominant driver of other sectoral output growth. Thus, in order to

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sustain the agricultural, industrial and services sectors growth, high levels of oil and gas growth need to be maintained and developed. Otherwise, growth of economic sectors will decline in tandem with any fall in oil and gas growth. Indeed, oil and gas sector growth is uncertain for a longer period of time given the potential volatility of international oil markets and the geo-political instability in the Middle East in general and in the Gulf States in particular. Accordingly, policy makers should create a far-reaching long-run development strategy based on industrial and services sectors and their sub-sectors that will eventually separate the Saudi economic structure from its current dependency on oil and gas resources.

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Author Profile

Abdulkarim K. Alhowaish - Following his Ph.D in Regional Economic Development from University of Guelph in 2007, Dr. Alhowaish is currently an associate Professor in Department of Urban and Regional Planning, College of Architecture and Planning, University of Dammam. Dr. Alhowaish has acted as a director manager for Ministry of Municipal and Rural Affairs on developing the National Strategy for Municipal Services Delivery in Saudi Rural Areas. He is currently a consultant for Ministry of Economic and Planning on developing the 10th National Development Plan. Dr. Alhowaish has more than 25 scientific publication and conference papers and five funded development project. His research interest is the economics of regions, both urban and rural regions. Recently, Dr. Alhowaish received the distinguished Professor Award from University of Dammam in October 7, 2013.

Feaz S. Al-shihri - Following his Ph.D in Environmental Urban and Regional planning and Sustainable Development from University of Newcastle upon Tyne, School of Architecture, Planning and Landscape, UK, in 2001, Dr. Alshihri is currently an Associate Professor and Head of the Department of Urban and Regional Planning, College of Architecture and Planning, University of Dammam. Dr. Alshihri has supervised several Master's and Doctoral theses and taught undergraduate and graduate courses in URP. Dr.Alshihri has 18 scientific publication,three funded projects and more than 500 Public newspaper articles covering issues in urban & Regional Planning, Sustainable Development, Smart city, and Public Participation .

Sayed M.S. Ahmed - Following his Ph.D in Urban Development from University of Newcastle upon Tyne, School of Architecture, Planning and Landscape, UK, in 2009, Dr. Sayed is currently an Assistant Professor in Department of Urban and Regional Planning (URPL), College of Architecture and Planning, University of Dammam. Dr. Sayed has supervised 5th year undergraduate projects and taught undergraduate and graduate courses in URPL Department. His research interest is in urban development issues; new town policy; urban development theories; and comprehensive development planning process model (CDPPM).