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THE MEDIATING ROLE OF OIL RETURNS IN THE RELATIONSHIP BETWEEN INVESTMENT IN HIGHER EDUCATION AND ECONOMIC GROWTH: THE EVIDENCE FROM SAUDI ARABIA

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ABSTRACT. This study aims to investigate the mediating role of oil returns in the relationship between investment in higher education and economic growth in Saudi Arabia, which has invested in higher education and knowledge creation as part of the sustainable development process. Expenditures on higher education, representing a large part of this country's budget, aims to develop its educational systems in alignment with the requirements of its development plans. This study initially overviews the trends in expenditure on higher education in Saudi Arabia and then articulates, using unit root, cointegration, granger causality and multiple regression tests, a standard model in which educational investment, as an independent variable, will be regressed against the measures of economic development, as dependent variables, in Saudi Arabia in the period of forty (40) years, since 1978 until 2017. The study model fails to find a mediating role of oil returns in the relationship between investment in higher education and economic growth in Saudi Arabia. Neither did it find that investment in higher education actually generates economic growth in Saudi Arabia. However, it has been found that oil wealth is the engine of investment in higher education.

JEL Classification: B22, B55, N1, N3, Q28, Q32

Keywords: economic growth, expenditure on higher education, oil-dependent economies, Saudi Arabia, mediation model

Introduction

Considering that human capital serves as one of the most important factors of production contributing to economic growth, the interest in investing in education as the driver of future human capital, has increased. The effective role of investment in education while achieving comprehensive economic and social development has been widely recognized by now. This has stimulated the appetites of companies to invest in scientific research and knowledge creation since the end of the twentieth century, due to large economic surpluses achieved by the adaptation of knowledge in consumer life, and the attributed competitive advantage. At the same time, governments have realized that investment in education and knowledge creation

provide wide benefits for economic growth and help with reaching the knowledge economy. Economic growth, social and economic stability are all dependent on the creation of knowledge and its practical applications (Bužinskienė & Rudytė, 2004).

Since its emergence in 1930, the Kingdom of Saudi Arabia has paid considerable attention to the issue of investment in education as a prerequisite for social and economic growth. So, was investment in education in Saudi Arabia an input to the development process? Or was it a way out of the oil boom and development process based on oil revenues?

The oil boom experienced by Saudi Arabia generated huge oil revenues. To bridge the gaps in skills and competencies required for development, expatriate labor has been relied upon. Due to gradually declining oil revenues, however, Saudi Arabiahas increasingly turned to developing own human capital to achieve sustainable growth and free itself from this heavy reliance on human resources from other countries.

The study seeks to evaluate the empirical evidence on the relationship of investment in higher education and economic growth in Saudi Arabia taking into consideration the role of oil returns as the key driver in governmental expenditures and the economy in general, unlike most of previous studies that evaluated the direct relationship between investment in higher education and economic growth. This study aims to draw cogent conclusions about the efficacy of investment in higher education as a driver of economic growth in Saudi Arabia over a relatively long period of time (1978-2018) taking in consideration the mediating role of oil returns in this relationship. In this context, the study initially proceeds with the measurement and identification of trends in investment in higher education and knowledge creation in Saudi Arabia through both descriptive and analytical approach involving deconstruction of the elements of higher education and knowledge creation, highlighting linkages between them. Subsequently, the study investigates the extent to which investment in higher education in Saudi Arabia has generated economic growth and also identifies the economic sectors especially responsive to investment in higher education in an effort to elucidate the precise relationship linking higher education investment to economic development.

The rest of the paper is organized as follows: literature review and hypothesis development; methodology and sampling technique underlying the study model, variables and metrics; followed by empirical results. In the final part, conclusions are drawn and implications from these conclusions receive some attention. Direction for future studies are also suggested.

1. Literature review and hypothesis development

Castells (1994) sees higher education as an engine for development in the new global economy. Higher education is a form of investment in human capital development and has a real contribution to the economic growth of countries. At present, higher education provides an input to the transformation of countries into knowledge economies. Higher education endows skills consonant with ever-changing market needs to empower a work-forcewith capacity to contribute to the knowledge economy. Higher education contributes to the socialization of individuals, fosters the modernization and transformation of societies and, perhaps more importantly, creates, absorbs and disseminates knowledge through teaching and scientific research (Pillay, 2010).

Controversy abounds among observers on the role of higher education in economic growth. Studies like (Psacharopoulos & Patrinos, 2004) have discerned no link between higher education and economic growth, especially in developing countries, where primary education is more important than higher education). For a long period of time, investment in higher education has been neglected in general, considering that investment in primary and secondary education gives better social returns than higher education. According to the logic of this line of thinking, higher education ought to be accorded minimal resources by society (Schultz,

1993). The increase in interest in higher education that took place in Developing Countries in the middle of the Twentieth Century, proved fleeting, taking a backseat to primary and secondary education, with the focus on rural development and institutions. In the course of a resurgence of interest in the 1990s, higher education was pigeonholed by a narrow focus on factors that directly affected human capital and the elimination of poverty. These factors were primary education and health (Kapur & Crowley, 2008).

Vedder (2004) has questioned whether increasing spending on higher education necessarily provides greater economic returns. Conducted in the United States, this study found an inverse relationship between spending by state governments on higher education and economic growth, casting doubt on the efficacy of public investment in higher education. Increments in state spending on higher education do not buoy the level of human capital outputted by universities, in terms of the quality of newly minted graduates, but, rather, serve to subsidize what Vedder dubs "non-instructional activities" with universities primarily serving as "credentialing devices" for the labor market. Building on Lemke and Shughart (2016) suggest that while higher education, where it brings needed skills to a future work-force, is an important factor in achieving economic growth, the emphasis on investing in universities, as opposed to investing in other institutions of higher learning like institutes offering distance learning and certifications and vocational training centers and trade schools.

Maintaining that the role of higher education in economic growth is limited, Bloom and his colleagues (2005) provide evidence of the role of higher education in economic growth and poverty reduction in sub-Saharan Africa, which features the lowest proportion of university education investment in the world (5%) reflective of international organizations that encourage African governments to concentrate on primary and secondary education at the expense of university education as a mechanism to improve economic growth. Bloom demonstrates that cutsin spending on tertiary education in Sub-Saharan have engendered the reverse effect resulting in the hobbling of economic growth. For, higher education contributes to economic growth in several ways, including: keeping up with technological development, transferring knowledge and raising awareness, which contributes to reducing the knowledge gap and poverty in this region. Moreover, Rita and Dalia (2014) credibly demonstrated that investment in knowledge creation plays an important role in achieving long-term economic growth. Indeed, econometric analysis undertaken by Michel (2014) identified that spending on education by 1% of GDP contributes to economic growth by 0.3 percentage points.As for the role of higher education in the knowledge economy, the World Bank Report (2001) concluded that higher education is essential for developing countries if they are to thrive in the new global economy, where knowledge has become the key productive factor determiningeconomic competitiveness.

Bloom and his colleagues (2005) criticized the traditional theory that links higher education solely to generating a return on investment at the individual and community level, while ignoring its role as a mechanism inducing entrepreneurship, buoying job creation, and engendering superior political and economic governance in minting educated cadres contributing positively to the welfare and social fabric of the nation. However, while finding a strong causal relationship between investment in higher education and economic growth in Japan, the UK, France and Sweden, Meulemeester and Rochat (1995) reported no relation between investment in higher education and economic growth in Italy and Australia.

Tracking investment in education against economic growth in Algeria during the period 1968-2007, Dahan (2010) found that the contribution of human capital,spurred by higher educational investment, while positive, varied in magnitude. The study found a significant long-term positive relationship between GNP and human capital in Algeria during the study period. Nonetheless, Dahan (2010) identified accumulated investment in capital, rather than human capital, as the key driver of economic growth in Algeria. Chaudhary et al. (2009) have shown

that investment in education contributes to the buoying of long-term economic growth in Pakistan. Examining data drawn from Iran in the period 1959-2005, Khorasgani (2008) showed that higher education played an important role in both short- and long-term economic growth with long-term effects trumping that of the short-term. Increasing investment in higher education in Iran by 1% is likely to contribute to improving GDP 0.198% in the short term and 0.314% in the long term.

Moving beyond an examination of the relationship between education and the GDP growth of non-oil sector in Saudi Arabia, Al-Malki and Bin Obaids, (2004) aimed to identify the effectiveness of government expenditure on education in the Saudi Arabia, the study found that, the greater the government investment in higher education, the stronger the relationship between higher education and economics growth (although a similar dynamic is imparted by the variable "total population").

In a comparative study, Boudia and Ben Zidane, (2013) found a positive relationship between investment in higher education and GDP growth in Algeria, Saudi Arabia, and Jordan. With respect to Syria, Alban (1982) showed that the contribution of investment in higher education to economic growth ranged between 6-9% during 1970-1980.

The present study examines the extent to which investment in higher education in the Saudi Arabia has contributed to building the human capital endowed with the capacity to contribute effectively to economic growth in its striving to sustain development beyond an economy predicated on fossil fuels. It seeks to address the question of whether oil revenues, appropriately channeled to investment in higher education, are enhancing the positive relationship of higher educational investment on economic growth.

Relying on the previous theoretical discussion, the study's null hypothesis may be formulated as follows:

Hypothesis. *Oil revenues have no effect on the relationship between higher educational investment and economic growth*.

2. Methodological approach

In order to answer the questions of the study and its basic problems, this study employs both descriptive and analytical methods to evaluate the effect of oil returns on the positive relationship between investment in higher education and economic growth.

2.1. Study data

Data on economic variables are drawn from World Bank and Saudi covering a period of 40 years from 1978-2017 including but not limited to: oil revenue, level of expenditure on higher education, economic growth, capital expenditure and population, student and overall, as well as labor force size as missioned in *Table 1*.

2.2. Study model

Depicting the study model, *Figure 1* shows all dependent, independent, and control variables. The classical production function, which examines the effect of both labor force and capital accumulation in economic growth, has been developed by adding oil revenues to the model as an important factor in determining economic growth in oil-exporting countries typical in the GCC countries such as Saudi Arabia.

Table 1. Statics of study data

Variable	Mean	SD	Max	Min	Kurtosis	Skewness
Government Investment in Higher Education	55,553	73,161	435,485	1,591	18.816	3.889
GDP	841,084	664,618	2,806,686	369,118	2.800	1.929
Growth of GDP	3.324	5.591	22.609	-10.389	3.223	0.489
Education to GDP	5.645	2.788	15.516	0.431	5.097	1.374
Number of students	327,217	324,299	1,356,602	9,471	1.237	1.243
Oil price	303.452	434.171	1,649.083	7.800	1.189	1.403
Labor Force	4,598,776	1,953,876	8,012,000	2,390,466	-1.623	0.485
Capital	164,119	159,484	651,232	62,563	3.263	2.078
Population	18,075,232	6,844,247	28,686,630	6,998,359	-1.281	-0.030

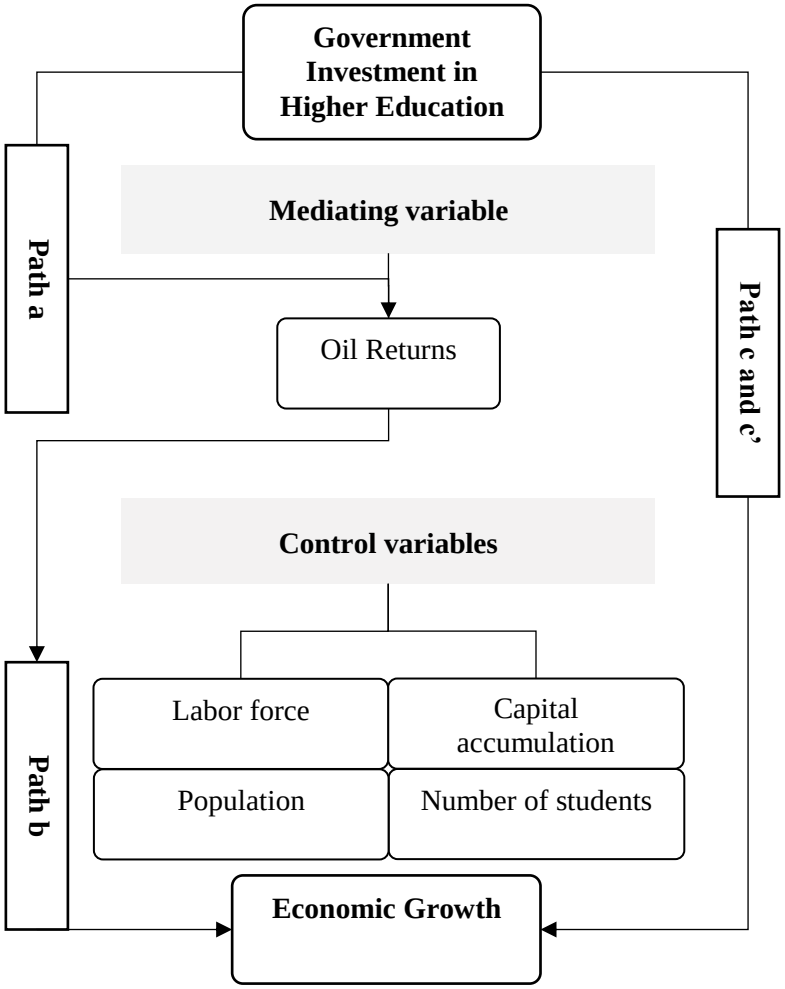


Figure 1. Unmediated and mediated Models

This study aims at measuring the mediating role of oil returns in the relationship between investment in higher education and economic growth. As a point of departure, it articulates an extended neoclassical production function based on the following production function:

$$GDP_t = \int(L_t, C_t) \quad (1)$$

where: GDP is gross domestic product, L is labor force and C is capital accumulation.

The previous relationship will be expanded by adding a set of variables for measuring investment in higher education and a set of control variables.

The expansion of the equation 1 begins with addition of the price of a barrel of oil at real prices (P). The extended production equation takes the following form:

$$GDP_t = \int(L_t, C_t, \bar{P}) \quad (2)$$

The price of a barrel of oil is one of the most important factors affecting the level of economic growth in the oil-dependent economies of the GCC that rely mainly on natural resource production and export. Therefore, it is expedient to include oil price as an independent variable driving economic growth along with traditional factors of production.

Equation 2 is then converted to the Multiplicative formula to become:

$$GDP_t = AL_t^{\alpha 1} C_t^{\alpha 2} P_t^{\alpha 3} \quad (3)$$

By converting the equation 3 into a linear aggregate formula by taking the logarithm of both sides, it becomes:

$$ln\ GDP_t = \alpha + \beta_1 lnL_t + \beta_2 lnC_t + \beta_3 lnP_t \quad (4)$$

Given the difference of equation 4 for time, the following equation obtains:

Considering differentiation of the relation in eq. no. (4) with time, equation (5) is obtained:

$$\overset{g}{GDP}_t = \alpha + \beta_1 \overset{g}{L}_t + \beta_2 \overset{g}{C}_t + \beta_3 \overset{g}{P}_t \quad (5)$$

where "g" refers to growth rate. In addition to investment in higher education variable, a series of variables are added as control variables encapsulating causal factors driving the relationship between investment in higher education and economic growth: population, number of students' enrollment in universities. By adding a random error term in the equation 5, the following standard modelultimately obtains:

$$\overset{g}{GDP}_t = \alpha + \beta_1 \overset{g}{L}_t + \beta_2 \overset{g}{K}_t + \beta_3 \overset{g}{P}_t + \beta_4 Edu_t + \beta_5 Pop_t + \beta_6 Stud_t + \ell_t \quad (6)$$

where: GDP_t: the growth in Gross Domestic Product for the year of (t); α: constant;$\beta_{1\text{-}6}$: Slope; L_t: labor force in the year (t); C_t: capital accumulation in the year (t); Edu_t: Investment in higher education in the year (t); Pop_t: Population in the year (t); $Stud_t$: number of students' enrollment in universities in the year (t); and ε_t: Random error.

2.3. Mediated model

In a mediated model, there is no relation between the dependent and independent variables. Inasmuch as the independent variable interacts first with the mediator variable and then with the dependent variable, a causal chain of effects between dependent and independent variables issues (Namazi & Namazi, 2016). *Figure 1* illustrates the interaction between oil returns as a mediating variable between the independent variable investment in higher education and the dependent variable economic growth. To test the mediated model, quantified in equation 6, investment in higher education should impact economic growth to a statistically significant extent along path c. In the next iteration, likewise, investment in higher education should impact economic growth to a statistically significant extent along path a. In the final iteration, a combined effect of investment in higher education and oil returns on economic growth manifests along paths path c'and b following Keller, (2006) the model can be written as follows:

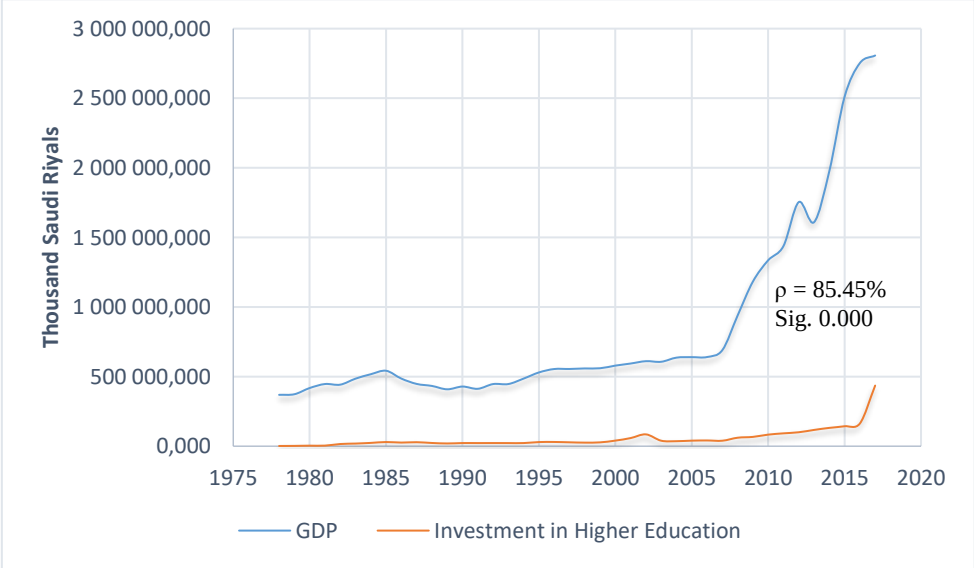
$$\overset{g}{GDP}_t = \alpha + \beta_1 \overset{g}{L}_t + \beta_2 \overset{g}{K}_t + \beta_3 \overset{g}{P}_t + \beta_4 Edu_t + \beta_5 OilReturns_t + \beta_5 Pop_t + \beta_6 Stud_t + \ell_t \quad (7)$$

In effect, the impact of oil returns in the relation between investment in higher education and economic growth obtains by multiplying paths c' and b.

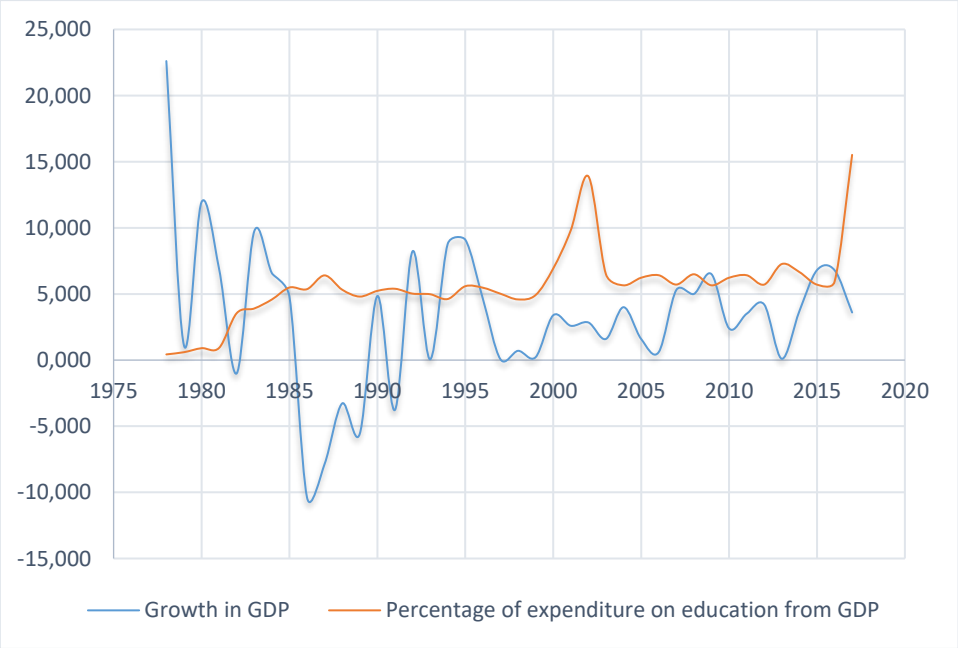
3. Descriptive analysis

3.1. Indicators of higher education in Saudi Arabia

Education spending, as an input, need not necessarily lead to the buoying of the quality of education as an output. Although allocating substantial budgetary resources to education, on the order of 1.21 trillion Saudi Riyals in the last 10 years, Saudi Arabia nonetheless wallows at a low level in terms of standards and quality of education according to the Pearson Foundation. Notwithstanding, ranking 34th globally and the second in the Gulf, Saudi Arabia has achieved an enviable score on the Human Development Index (HDI) (UNDP, 2014). With respect to study variables depicted in the model, *Figure 2* presents data on Saudi GDP and level of expenditure on education over a 40-year period.



Graph 2. GDP compared to the expenditure on higher education in Saudi Arabia during the period 1978-2017



Graph 3. The GDP growth compared with the growth rate in education expenditure during the period 1978-2017

Graph 2 shows that Saudi Arabia's gross domestic product GDP has increasing steadily from 2006 onward after a long period of virtual stagnation from 1985-2006. Expenditure on higher education has stayed level or has marginally risen (with the exception of a fleeting increment upward in 2002) until 2016, after which expenditure on education has sharply risen. Total GDP and investment in higher education are positively correlated (ρ 85.45%; *p*-value < 1%) throughout all study years, however, in the last 2008-2017 years, there was a gap between the two variables. Total GDP was had substantial increase due to increased oil prices in these years. While investment in higher education was not increased and maintained the same level.

However, GDP growth rates over the 40-year period bobbed up and down illustrative of a greater dispersal than that evinced by higher education expenditure as a percent of GDP as apparent in *Graph 3*.

Substantial growth in education expenditure as a percent of GDP manifests from 1978-1985, then remaining flat till 1999 with a peak in 2002 followed by a trough in 2003, after which growth remained largely flat till 2016. From 2016 onward, substantial growth in education expenditure as a percent of GDP again manifests. By and large, the growth in spending on education was the largest in the first years of the study and the last years of the study. Investment in education, largely flat in the period 1985-2016, did not closely mirror GDP growth rates (although, in years of negative GDP growth, investment in education did not for the most part commensurately fall but rather held its own). In high economic growth rate years in the mid-1970s, investment in education was low until 1981.

3.2. Analysis of the long-term relationship between investment in higher education and economic growth

Investment in higher education is an investment in human capital, which may only manifest after a time-lag of at least five years. In analyzing the long-term relationship between investment in higher education and economic growth in Saudi Arabia, it is expedient to divide the data over the span of 40 years into eight 5-year periods with a view to calculating the average

growth rate in investment in higher education in each period and the average growth rate of GDP in the next five year period. The results are as shown in *Table 2*.

Table 2. Analysis of the relationship between investment in higher education and economic growth

Growth of investment in higher education			Growth rate of GDP in the next five years		
Period	Years	Mean	Period	Years	Mean
1	1978-1982	96.227	2	1983-1987	0.603
2	1983-1987	15.211	3	1988-1992	0.095
3	1988-1992	-4.430	4	1993-1997	4.752
4	1993-1997	5.779	5	1998-2002	2.047
5	1998-2002	29.953	6	2003-2007	2.751
6	2003-2007	-11.536	7	2008-2012	4.536
7	2008-2012	23.825	8	2013-2017	4.410
8	2013-2017	48.241			
F-test		2.248			1.190
p-value		0.088			0.386

It should be noted that periods of higher investment in higher education were not followed by periods of economic growth. For example, in the first period of the study, for the years 1978-1982, the average growth rate in investment in higher education was 96.227%. In the next five years (1983-1987), economic growth was only 0.603%. On the other hand, in the sixth period (2003-2007), the growth rate in investment in higher education was negative -11.536 while the seventh period (2008-2018) witnessed a growth in GDP by 4.536%.

Long-term analysis did not show a relationship between investment in higher education and economic growth in Saudi Arabia. This suggests the absence of impact of investment in higher education on economic growth. However, subjective elements, including the choice of split periods, may have skewed these results.

4. Empirical study

4.1. Unit root test

In order to identify the degree of integration of the basic variables in the study model, the stability of the time series 1978-2017 (unit root) was tested as a first step in the analysis in order to avoid error in estimation (Ghedabna, 2015). Applied research using time series assumes the stability of these series (stationarity), which requires that the mean and the variance are constant. (Gujarati, 2003). To verify the variables, the extended Dicky-Fuller test ADF was used to test the stability of time series in the model described in the logarithmic formula.

Table 3. Unit root results

Variables		at the Level	The first difference
		ADF	ADF
GDP logarithm	LGDP	2.310	-4.187***
		(0.783)	(0.002)
Labor logarithm	LL	-0.594	-5.884***
		(0.860)	(0.000)
Capital logarithm	LK	2.514	-4.408***
		(0.875)	(0.001)
Oil price logarithm	LP	-0.964	-7.712***
		(0.757)	(0.000)
Investment in Higher Education logarithm	LEDU	-1.583	-4.926***
		(0.481)	(0.000)
Population logarithm	LPOP	-3.778***	-4.914***
		(0.007)	(0.000)
Number of student's logarithm	LSTUD	-2.626*	-3.790***
		(0.097)	(0.006)

Note: *ADF is the augmented Dickey-Fuller test. The ADF is based on the null hypothesis of a "not-stationary" unit root. ADF test (top), p-value (bottom). *, **, *** denote rejection of the null hypothesis at 10%, 5%, and 1%.*

The Dicky Fuller test in *Table 3* shows that the time series lacks stationarity at any level for all variables except for the "population variable" and the "number of students enrolled in national universities." Employing a single lag for all-time series to overcome non-stationarity enables the time series to become stationary and integrated -- a standard result in econometric studies for such time series (Arouri, 2011; Arouri & Fouquau, 2009).

4.2. Cointegration test

Cointegration and the number of integration vectors were tested for each equation using the Johansen 1985/1988 methodology. Since the Johansen methodology is sensitive to multicollinearity, the length of the appropriate delay was estimated employing a model that does not suffer from multicollinearity such that the multicollinearity of the specified delay length is tested. Previously, the unit root results showed that most of the variables lacked stationarity but all exhibited stationarity upon accounting for the specified delay length. Engel and Granger (1969) have pointed out that the instability of time series at this level does not negate the long-term linear relationship between the variables; therefore, employing a joint integration test was called for to detect the existence of that relationship using the Johansen Cointegration Test. The results are presented in *Table 4*.

Table 4. Cointegration results

Hypothesized No. of CE(s)	Unrestricted Cointegration Rank Test (Trace)		Unrestricted Cointegration Rank Test (Maximum Eigenvalue)	
	Trace test (*p*-value**)	Critical value at 5%	Max-Eigen (*p*-value**)	Critical value at 5%
None	191.689*	125.615	61.693*	46.231
	(0.000)		(0.001)	
At most 1	124.376*	95.754	47.898*	40.078
	(0.002)		(0.006)	
At most 2	72.115	69.819	28.271	33.877
	(0.117)		(0.216)	
At most 3	41.269	47.856	18.523	27.584
	(0.360)		(0.472)	
At most 4	21.059	29.797	12.479	21.132
	(0.534)		(0.518)	
At most 5	7.444	15.495	6.367	14.265
	(0.668)		(0.580)	
At most 6	0.497	3.841	0.455	3.841
	(0.553)		(0.507)	

Notes: *Trace test indicates 6 cointegrating eqn(s) at the 0.05 level. *denotes rejection of the hypothesis at the 0.05 level. **MacKinnon-Haug-Michelis (1999) p-values.*

From *Table 4*, the result of the impact test and the underlying root test indicate that the hypothesis that there is no single integrative vector in the model is not accepted. Therefore, the error correction vector must be estimated to test the causality.

4.3. Causality test

This part of the study attempts to identify the direction of the relationship between investment in higher education and economic growth; this step is to determine the direction of the long-term and short-term causality as per Granger. When there is one integrative vector, the error correction methodology is used [Engel and his colleague Granger (1969)]. By applying this test at two lags to overcome the problem of not stationarity of some series, the results obtain as illustrated in *Table 5*. Seven proposed models exhibit built-in dependent variables with six independent variables per model.

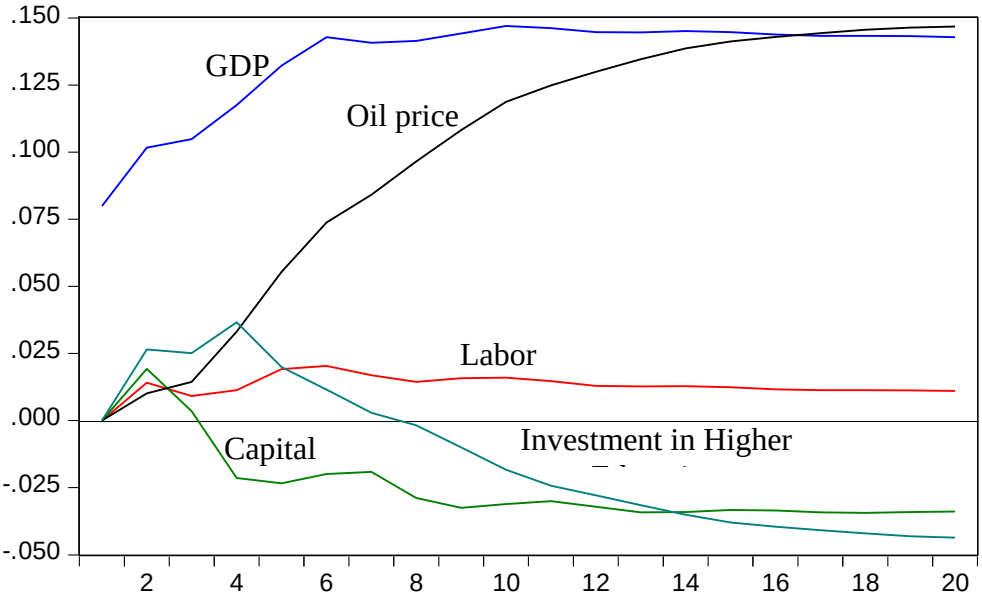
Table 5. Granger causality results

Dependent variable	Independent variables						
	GDP	Labor	Capital	Oil price	Investment in Higher Education	Population	Number of students
GDP		1.104	2.737*	3.303**	0.363	0.927	0.125
		(0.344)	(0.080)	(0.049)	(0.698)	(0.406)	(0.883)
Labor	0.312		0.900	0.386	3.292*	1.335	1.353
	(0.734)		(0.416)	(0.683)	(0.050)	(0.277)	(0.272)
Capital	7.150***	1.135		3.471**	2.139	0.827	0.430
	(0.003)	(0.334)		(0.043)	(0.134)	(0.446)	(0.654)
Oil price	0.336	1.822	0.781		1.447	1.615	2.052
	(0.717)	(0.178)	(0.467)		(0.250)	(0.214)	(0.145)
Investment in Higher Education	9.076***	2.540*	7.620***	4.717**		0.793	1.381
	(0.001)	(0.094)	(0.002)	(0.016)		(0.461)	(0.265)
Population	2.030	0.700	0.944	0.292	0.412		2.524*
	(0.147)	(0.504)	(0.399)	(0.749)	(0.666)		(0.096)
Number of students	2.828*	1.462	2.496*	1.769	2.396	1.155	
	(0.074)	(0.246)	(0.098)	(0.186)	(0.107)	(0.328)	

Notes: *The null hypothesis states that there is no causal relationship between independent variables (on the horizontal side) and the dependent variable (on the vertical side). The higher value is for the F-statistic test and below is the p-value. Symbols mean that there is a causal effect of the independent variable in the dependent at *** 1%, ** 5%, * 10%, respectively.*

Results of the causality testing depicted in *Table 5*, consistent with the traditional economic theory, show that labor and the capital drive economic growth, the dependent variable in the study model. In contrast, the variable "investment in higher education" was not the cause of economic growth in Saudi Arabia. Nevertheless, it would be premature to conclude that there is no causal linkage between investment in higher education and Saudi economic growth inasmuch as the fifth model - which expresses the dependent variable of investment in higher education - shows that economic growth in Saudi Arabia is one of the causes of investment in higher education. In other words, spending on higher education benefits from economic prosperity and high oil revenues rather than, in the reverse, economic prosperity being driven by investment in higher education.

Graph 4 tracks Saudi Arabia's economic growth over discrete time periods in relation to labor, capital and investment in higher education. The economic growth response of all variables appears after two periods. It is readily observable that oil prices march in lockstep with economic growth (whereas the impact of labor, while positive, is flat). Investment in higher education and, to a lesser extent, capital accumulation had a modest positive effect on economic growth in the first four and two periods, respectively. However, after the third period, accumulation of capital negatively impacted economic growth. After the eighth period, investment in higher education, likewise, negatively impacted economic growth.

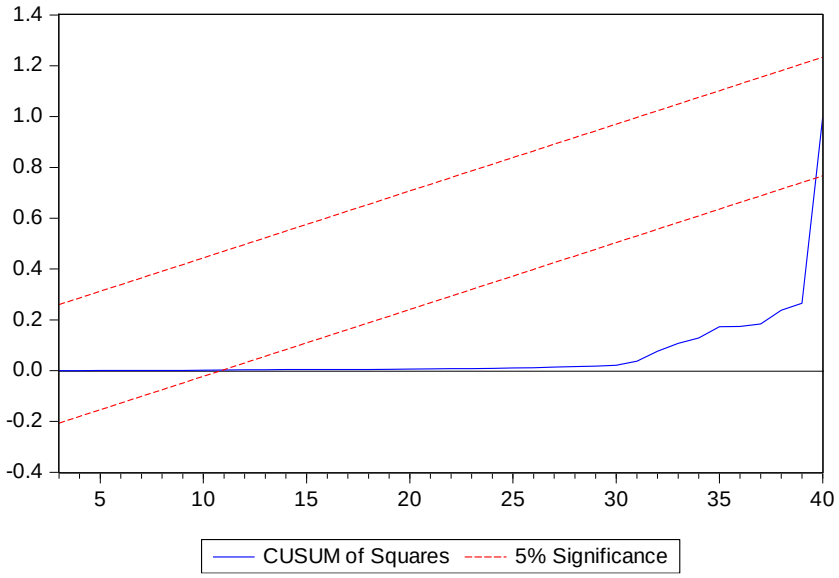


Graph 4. Response of economic growth to cholesky one investment in higher education

In the absence of a long-termcause-effect relationship between investment in higher education and economic growth, the study model cannot explain economic growth in Saudi Arabia.

4.4. Chow test

Chow Test for Structural Breaks is employed to capture structural breaks GDP. Several breaks documented in *Graph 5* and testing in *Table 6*.



Graph 5. Identification of structural breaks in GDP time series

Table 6. Testing the structural breaks

Break points	Time period	Chow Breakpoint Test	
		F-statistic	*p*-value
31	2008	26.683*	0.000
34	2011	37.505*	0.000
35	2012	43.279*	0.000
39	2016	57.774*	0.000

Notes: *Null Hypothesis: No breaks at specified breakpoints. *denotes rejection of the hypothesis at the 0.01 level.*

The structural breaks appeared statistically significant ($p<0.01$) in the four-period overlapping with the GDP. The structural breaks are included in the regression models as dummy variables when testing the mediating model in *Table 7*.

4.5. Testing the mediating model and discussion

In the mediated model the mediating effect of oil returns on the relation between investment in higher education and economic growth is assessed and measured. The results are in *Table 7*. In following "path c" positing the direct relation between investment in higher education and economic growth, investment in higher education positively affects economic growth given the following results: $\beta= 1.225$; $p<0.01$, $R^2 = 41.7\%$, Adj. $R^2 = 37.9\%$ with the F test for the model being statistically significant at a level less than 1%.

The second step in testing "path a" depicts the relation between investment in higher education and oil returns. The relation was statistically significant with an R^2 of 43.5% and an adj. R^2 of 42.7%. In the third step, path b and c' are evaluated by finding the effect of investment in higher education, oil returns and other control variables on the economic growth. $\beta=1.261$; $p<0.01$ for investment in higher education which is higher than its value in "path c" (in the unmediated model). In contrast, $\beta=0.043$; $p<0.01$ for oil returns is lower than results attributed to investment in higher education. Finally, multiplying betas associated with "paths" "a" and "b" yields a beta of 0.028 such that the null hypothesis, which posits the absence of any mediating role for oil returns in the relation between investment in higher education and economic growth in Saudi Arabia, cannot be rejected.

Table 7. Unmediated and mediated models

Testing Path	β	*t*-test	*p*-value	R-squared	Adjusted R Square	F-statistic	*p*-value
Path c: DV = GDP				0.417	0.379	10.879***	0.000
Independent variable:							
Investment in Higher Education	1.225	6.581***	0.000				
Production function and control variables:							
Labor	0.248	0.893	0.375				
Capital	0.227	1.192	0.237				
Population	0.452	1.714*	0.091				
Number of students	0.596	2.000**	0.049				
Path a: DV = Investment in Higher Education				0.435	0.427	61.475***	0.000
Independent variable:							
Oil Price	0.659	7.841***	0.000				
Path b and c': DV = GDP				0.411	0.364	8.716***	0.000
Independent variables:							
Investment in Higher Education	1.261	5.351***	0.000				
Oil Price	0.043	0.161	0.873				
Production function and control variables:							
Labor	0.178	0.575	0.567				
Capital	0.235	0.866	0.389				
Population	0.618	1.995*	0.050				
Number of students	0.358	1.387	0.170				
Total (a) * (b)	**0.028**						

Note: *Symbols mean Significance at: *10%; **5% and ***1% levels.*

Discussion and conclusion

This study sought to identify the mediating role of oil returns in relationship between government investment in higher education and economic growth in Saudi Arabia as exemplar of oil-dependent economies in the GCC. Using the data for a 40-year period (1978-2017) guided by a set of theoretical constructs that postulate the relationship between higher education and economic growth, an advanced econometric model is employed. Fitful growth in the investment in higher education in Saudi Arabia, notwithstanding a lack of uniformity, accompanied a marked growth in GDP. However; in the each of the eight five-year periods, growth in investment in higher education did not commensurately match levels of economic growth - casting doubt on the role of investment in tertiary education in Saudi economic growth. In testing for causality of investment in higher education on economic growth, results indicated an absence of a causality. Rather, cause and effect appeared reversed with economic growth driving investment in tertiary education. Finally, the study results did not support the mediating role of oil returns in the relationship between investment in higher education and economic growth. This casts doubt, lip service to the contrary, of aspirations of the Saudi government to transform its economy from a resource-based to a knowledge-based economy.

The expenditure on higher education in Saudi Arabia was the result of economic growth without any real contribution to development. However, components of expenditure on higher education would be worthwhile to decompose; for example, expenditure on buildings and facilities as opposed to scholarships for Saudis to study in foreign institutions. Certain components, if isolated, may well have an effect on economic growth rather than the reverse cause and effect. Investment may be misallocated resulting in weak educational institutions and

subpar human capital being outputted by universities so a control variable dealing with quality of tertiary education might be introduced as a means to gauge efficiency of educational investment. Saudi Arabia may be suffering from brain drain in which highly skilled human capital, the output of universities, do not contribute to the Saudi economy efficiently. Another issue that needs to be addressed in future studies is to examine the role of primary and secondary education in achieving economic development. Perhaps the Kingdom is one of those countries where primary and secondary education has a significant impact on economic growth.

Of course, Saudi Arabia may be an anomaly and what has been found to be true with respect to Saudi Arabia may not be generalizable to other oil-resource-based economies, so it would be expedient to carry out the same analysis on a wide array of oil producing economies.

This study suggests that the Saudi government rethink how it invests in education as the investment is not leading to returns in the form of generating economic growth.

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