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Cointegration and Causality between Economic Growth and Social Development in Saudi Arabia

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This paper presents an attempt to examine the causal relationships between economic growth and social development in Saudi Arabia between 1980 and 2011. For that, statistical and econometric techniques, such as unit root test, cointegration and Granger Engels causality through Vector Error Correction Model (VECM) are applied.

Based on the aggregation of several indicators to construct a single social composite index, results show that there is significant long run causality from social development to economic growth. This indicates that trickle-up hypothesis is more active dominantly and that development strategies in Saudi Arabia have succeeded to reach significant social development enough to cause economic growth in the long run.

Keywords: *Social development; economic growth; causality; statistical tests; Saudi Arabia.*

JEL Classification: *A13, C22, O11, C12*

Introduction

The combination of economic growth and social development is the optimal condition for individual well-being in the country. However, for attending this situation, a natural question arises: which is the by-product of the other?

During the 1950's and 1960's, economic growth was considered as the main element affecting development strategies. The increase in gross domestic product was supposed to ensure the achievement of other objectives such as reducing unemployment and enhancing living condition of individuals.

However, since the late 1960s, the importance attributed to the rapid economic growth effect on social development comes under increasing criticism and considered as non-evident. Indeed, several countries witnessed spectacular growth rate in gross domestic product but reached different scenarios. For example, some East Asian countries such as Southern Korea, Taiwan, Malaysia, Indonesia, Thailand and Philippines experienced high growth rate and were successful in enhancing well-being on individuals. On the other hand, some South Asian countries such as Pakistan, India, Nepal, etc. failed to reach a real social development despite their economic growth performances.

Several researchers have studied the causal relationship between economic growth and social development for different countries. However, the literature has not yet provided a consistent and clear answer of the causal priority. In addition, it is never tested for an interesting model, which is petroleum Asian country with high Gross Domestic Product (GDP) as Saudi Arabia.

In this context, this paper aims to analyse the causal relationship between economic growth and social development in Saudi Arabia by using statistical and econometric techniques, such as Unit root test, Co-integration and Granger Engels causality through Vector Error Correction Model.

In the present work and after a brief literature review, a theoretical description is introduced for the suggested methodology of social index measurement and the adequate statistical and econometrics tools allowing the analysis of the causal relationship between economic growth and social development. After that, an empirical application is presented for the Saudi Arabian case. Eventually, concluding remarks are offered in the end of this paper.

Literature review

Two approaches regarding the causal relationship between economic growth and social development are discussed in the literature, according to which affects the other. The first approach named “trickle down”, considers that social development is a by-product of economic growth i.e. the increase in gross domestic product was supposed to ensure the achievement of other objectives such as social development. “Trickle down” approach is thus based implicitly on the Rostov’s stages of growth model, where economic development is the impetus for the passage through the various stages to a fully modernized society.

Several researchers support this approach. For instance, Hagen (1980) finds that the distribution of material well-being is improved by the increase of per capita income. Goldstein (1985) shows that economic growth affects necessarily at least one component of social factors. Several other researchers support this conclusion (Ram (1985), Bruno et al. (1996), Deininger and Squire (1996), etc.).

The second view suggests a 'trickle-up' phenomenon where social development makes a major contribution to economic growth. In this context, Streeten(1981) finds that education and health affect significantly economic growth. Barbara and Randall (1989) find that Physical Quality of Life Index (PQLI) has a significant and positive effect on gross domestic product (GDP). Hicks (1979) explore the relationship between economic growth and basic human capital and conclude that "the development of a critical minimum level of basic human capital may be an important prerequisite for accelerating the growth of economic output". Temple and Johnson (1998) show that social development indices have considerable predictive power, which indicates the importance of "social capability" for economic growth.

According to this literature review of the causal relationship between economic and social growth, we deduce that there is no consistent and universal answer of the causal priority. The relationship varies from case to case.

Methodologies and data

Definition of economic and social indicators

In order to test the causal relationship between economic growth and social development, we need first to define the used variables that allow their measurement. For economic growth, it is widely known in the literature that its standard measure is the per Capita Gross Domestic Product (GDPC). However, social development present more difficulties in its measure because it depends on several indicators related to different subset such as demographic, health and education. Thus, we need to aggregate these indicators to a single composite index.

Different propositions are made in the literature for determining a composite social indicator. For example, Barbara and Randall (1989) generate a Physical Quality of Life Index (PQLI) as social indicator, Union Nations Development Programme (UNDP, 1990) recommends Human Development Index as proxy for social development, and others use the Principal Component Technique techniques (Mazamdar, K (1996), Kalim and Shahbaz (2010)).

In this paper, we follow the methodology of the Human Development Index (HDI) and we calculate the Social Development Index (SDI) of year t by averaging the selected variable scores n, based on the following formula:

$$SDI_t = \sum_{i=1}^{n} \frac{X_{it} - Xmin_i}{Xmax_i - Xmin_i} * 100 \qquad (1)$$

Where X_{it} is the value of the i^{th} variable in year t.
$Xmin_i$ is the minimum value of variable i over time.
$Xmax_i$ is the maximum value of variable i over time.

Thus, each variable that enters the index is normalized to be between 0 and 100.

Using data from the World Development Indicators (WDI) for Saudi Arabia between 1980 and 2011, which is a commonly used data set for macro level data, four broad categories for measuring Social Development Index are taken: demographic, health, Education and economics. The selected variables X_{it} are: (a): the urban population as a percentage of total

population which indicates the total population with urban facilities such as transport, medical services, safe water etc., (b): the life expectancy at birth, (c): infant Survival rate per 1,000 live births (which reflect the level of health and nutrition in the country), (d): telephone lines (per 100 people), (e): Electric power consumption (kWh per capita, reflects the demand of electricity which indicates the level of the use of new technologies), (f): Energy use (kg of oil equivalent per capita), (g): school enrollment in tertiary (% gross), (h): the ratio of female to male tertiary enrollment (%) and (i): teachers (% female) in tertiary education.

The appropriate statistical and econometric methods

In order to test the causal relationship between economic growth and social development, the author proposes to use statistical and econometric methods such as unit root test, cointegration and Granger Engels causality through Vector Error Correction Model (VECM). Indeed, Engle and Granger (1987) show that, if two variables are individually integrated of order one and cointegrated, then there is possibility of a causal relationship in at least one direction.

The procedure consists first on testing for stationarity of the two time series for determining the order of their integration. For that, the Dickey-Fuller (1979) Unit Root Test is used.

Dickey-Fuller Unit Root Test is based on the estimation of an autoregressive model, AR (1) for y_t, as following:

$$y_t = \emptyset y_{t-1} + \varepsilon_t \text{ , where } \varepsilon_t \sim WN(0, \sigma^2) \qquad (2)$$

The unit root null hypothesis against the stationary alternative corresponds to:

$$H_0: \ \emptyset = 1 \qquad (y_t \sim I(1))$$
$$H_1: \ |\emptyset| < 1 \qquad (y_t \sim I(0))$$

The Dickey-Fuller (DF) test is simply the t-test for H_o

$$t_{\emptyset=1} = \frac{\widehat{\emptyset}-1}{SE(\widehat{\emptyset})} \qquad (3)$$

where $\widehat{\emptyset}$ is the least squares estimate and $SE(\widehat{\emptyset})$ is the usual standard error estimate.

Note that if y_t is stationary (i.e.,$|\emptyset| < 1$) then following Hamilton (1994)

$$\widehat{\emptyset} \sim N(\emptyset, \frac{1}{T}(1-\emptyset^2)) \quad (4)$$

Then, a cointegration test is applied for knowing the existence of a long run equilibrium relationship between social development and economic growth. Note that the cointegration test was first introduced by Engel and Granger (1987) and then developed and modified by Johansen (1988) and, Johansen and Juselius (1990). In this context, the author uses Johansen Maximum Likelihood (ML) approach to test the existence of cointegration between social development and economic growth.

However, cointegration implies that causality exists between the two time series but it does not indicate the direction of the causal relationship. For exploring the direction of causality between social development and economic growth, the author uses the Granger (1969) causality test and the Granger Engels causality through the Vector Error Correction Model.

The concept of causality in the Granger sense is based on two assumptions: (i) Future cannot cause the past, it is the past and present that cause the future, and (ii) Detection of causality is only possible between two stochastic variables.

Thus, Granger causality simply tests the significance of past values (time lags) of two stochastic (stationary) time series: for a pair of linear covariance-stationary time series X and Y : Y is said to be Granger-caused by X if X helps significantly in the prediction of Y i.e. the coefficients on the lagged X's are statistically significant.

Formally, to test causality between economic growth and social development and its direction in Granger sense, the following equation to be estimated are specified:

$$GDPC_t = \alpha_1 + \sum_{i=1}^{n} \alpha_{i2} GDPC_{t-i} + \sum_{j=1}^{m} \alpha_{j3} SDI_{t-j} + \varepsilon_1 \quad (5)$$

$$SDI_t = \beta_1 + \sum_{i=1}^{n} \beta_{i2} SDI_{t-i} + \sum_{j=1}^{m} \beta_{j3} GDPC_{t-j} + \varepsilon_2 \quad (6)$$

Where GDPC is the per capita Gross Domestic Product (indicator of economic growth), SDI is the Social development index, α_{ki} and β_{kj} (k=1,2,3; i=1,...,n ; j=1,...,m) are the coefficients, ε_1 and ε_2 are the error terms, n and m indicate the maximum number of lags to be taken of running variable.

The causality test can be performed, based on the null hypothesis that there is no causal flow between social development and economic growth (in both directions), formally:

$$H_o : \sum_{j=1}^{m} \alpha_3 = 0 \quad \text{and} \quad \sum_{i=1}^{n} \beta_2 = 0 \ (7)$$

Where the alternative hypotheses are:

There is unidirectional causality from SDI to GDPC:

$$H_1 : \sum_{j=1}^{m} \alpha_3 \neq 0 \quad \text{and} \quad \sum_{i=1}^{n} \beta_2 = 0 \ (8)$$

There is unidirectional causality from GDPC to SDI:

$$H_1 : \sum_{j=1}^{m} \alpha_3 = 0 \quad \text{and} \quad \sum_{i=1}^{n} \beta_2 \neq 0 \ (9)$$

There is mutual causality:

$$H_1 : \sum_{j=1}^{m} \alpha_3 \neq 0 \quad \text{and} \quad \sum_{i=1}^{n} \beta_2 \neq 0 \ (10)$$

Note also that Granger procedure test the long run relationship between the two variables. Engle and Granger (1987) extend this procedure and recommend a two-step procedure for cointegration analysis to test simultaneously the short and long run relationship.

The first step consists in applying the traditional Granger (1969) test, then in the second step, estimating a Vector Error Correction Model as following:

$$\Delta GDPc_t = \alpha_1 + \sum_{i=1}^{n} \alpha_{2i} \Delta GDPc_{t-i} + \sum_{j=1}^{m} \alpha_{3j} \Delta SDI_{t-j} + EC_{t-1}^{1} + \mu_1$$

(12)

$$\Delta SDI_t = \beta_1 + \sum_{i=1}^{n} \beta_{2i} \Delta SDI_{t-i} + \sum_{j=1}^{m} \beta_{3j} \Delta GDPc_{t-j} + EC_{t-1}^{2} + \mu_2 \quad (13)$$

Where Δ is a first difference operator, α_1, α_{2i}, α_{3i}, β_1, β_{2j} and β_{3j} (i=1,...,n and j=1,...,m) are the coefficients to be estimated, EC^1 and EC^2 are the lagged error-correction term derived from the long-run cointegrating relationship i.e. models (5) and (6) respectively, μ_1 and μ_2 are the error terms.

For equation (12) H_0: $\alpha_{3j} = 0$ for j=1,.., m is tested against H_1: $\alpha_{3j} \neq 0$ for at least one j.

For equation (13) H_0: $\beta_{3j} = 0$ for j= 1,..., n is tested against H_1: $\beta_{3j} \neq 0$ for at least one j.

Empirical analysis for the Saudi Arabian case

Saudi Arabia has an oil-based economy by possessing 18% of the world's proven petroleum reserves and thus it is ranks as the largest exporter of petroleum and plays a leading role in OPEC.

Since the discovery of oil in the 1930s and particularly since the 1973 "oil price shock", the country saw rapid growth. The Gross Domestic Product in Saudi Arabia passed from 4.2 USD Billion in 1968 to register a record level of $745 billion in 2013, which according to the World Bank makes it the largest GCC and Arab economy and the 19th economy in the world in GDP size.

According to official sources, the Kingdom's development has been overseen by a series of five-year plans. The first two development plans, in 1970s, was concentrated to emphasizing infrastructure. Consequently, the total length of paved highways tripled, power generation increased by a multiple of 28 and the capacity of the seaports grew significantly.

The third development plan, between 1981 and 1985, target especially education, health, and social services. The fourth plan (1986-1990) continues enhancing education and training. In addition, special concern to encouraging the growth of the private sector, in order to diversify the Saudi Arabian economy and to employ more Saudi nationals. Diversification efforts are focusing on power generation, telecommunications, natural gas exploration and petrochemical sectors. The private sector became more important, rising to 70% of non-oil GDP by 1987.

The fifth plan (1991–95) aimed particularly to improve government social services, regional development and creating employment opportunities for Saudis by reducing the number of foreign workers.

The sixth to eighth plan (1996–2010) are focused on lowering the cost of government services and continues reducing the kingdom's dependence on the petroleum sector by diversifying economic activity, in

addition to supporting education by establishing new universities and new colleges with technical specializations.

The ninth plan (2010-2014) aims to eliminate poverty and to increase development in infrastructure, medical services, educational capacity and residential housing. Indeed, the ninth five-year plan allocates $73 billion (273.9 billion SAR) to various initiatives including the construction of 117 hospitals, 750 primary healthcare centers, and 400 emergency centers.
The plan also aims to increase real GDP by 15% over 5 years and calls for substantial government investment in human resource development, in order to decrease Saudi unemployment from 9.6% to 5.5%.

Following the method explained below, the Social Development Index (SDI) is calculated. Descriptive statistics of the used variables are presented in Table 1.

Note that the SDI and the GDP per capita have different unit of measurement. To be able to compare graphically their evolution over time, we have converted the GDP per capita by using the same formula for calculating the SDI i.e. as calculating an index of GDP per capita using a single variable. The used formula is the following:

$$GDPc\ index = \frac{GDPc - GDPc_{Min}}{GDPc_{Max} - GDPc_{Min}} \qquad (14)$$

Where GDPcMin and GDPcMax are the minimum and the maximum value of GDPc respectively.

Table 1: Descriptive statistics on used variables: Saudi Arabia 1980-2011

Variables	Mean	Std. Dev	Min	Max
Urban population (% of total)	77.179	4.579	65.86	82.29
Telephone lines (per 100 people)	10.918	4.178	3.260	16.498
Life expectancy at birth, total (years)	70.561	3.538	63.105	75.288
Infant survival rate (per 1,000 live births)	969.44	18.93	929.1	992.1

School enrollment, tertiary (% gross)	18.535	9.873	6.45	41.18
Tertiary education, teachers (% female)	29.37	5.398	19.05	38.02
Ratio of female/male tertiary enrollment (%)	96.27	31.79	38.98	150.25
Electric power consumption (kWh per capita)	4990.54	1699.58	1940.71	8161.2
Energy use (kg of oil equivalent per capita)	4836.88	1016.85	3159.56	7043.84
Social Development Index (SDI)	53.878	27.400	0.410	94.725
GDP per capita (current US$)	10898.27	4754.53	5841.761	24116.17

Figure 1. illustrates the SDI and the GDP per capita index between 1980 and 2011. We deduce that social development has a more sharply than GDP increasing curve. In addition, Social development is more pertinent than economic growth for the most studied period, since 1984, as the curve of SDI is over the other during this period.

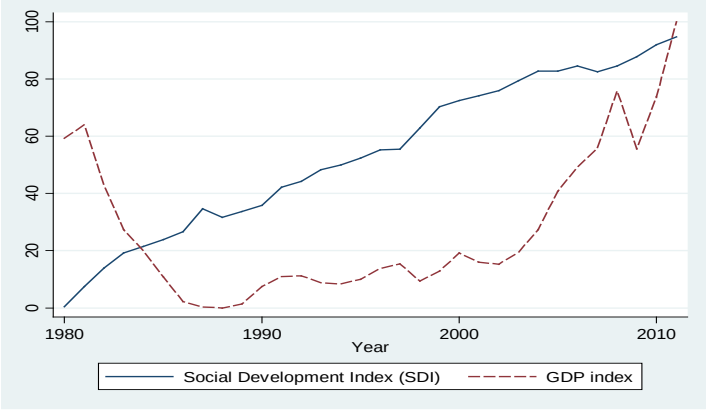

Figure 1: SDI and GDP per capita in Saudi Arabia between 1980 and 2011

In order to test relationships and the sense of causality, the author continues by applying statistical tests described below concerning the order of integration, cointegration and causality over time.

The results of Dickey-Fuller Unit Root test applied on SDI, GDP per capita and their first differences (ΔSDI and ΔGDPC) are presented in Table 2. The results show that economic growth (GDPC) and social development (SDI) are stationary at I(1) rather than at I(0).

Table 2: Dickey-Fuller Unit Root Tests

Variables	Test statistics	1% Critical value	5% Critical value	10% Critical value	p-value
SDI	-1.967	-3.709	-2.983	-2.623	0.3010
GDPc	0.421	-3.709	-2.983	-2.623	0.9823
ΔSDI	-5.332	-3.716	-2.986	-2.624	0.0000
ΔGDPc	-3.666	-3.716	-2.986	-2.624	0.0046

Thus, if the two series are both I(1) then we will often reject the hypothesis of no relationship between them even when none exists. For there to be a long run relationship between these variables, they must be cointegrated. For that, the author presents in Table 3 the result of the Johansen tests for cointegration between social development and economic growth.

Table 3: Result of Johansen tests for cointegration

Maximum rank	LL	Eigenvalue	Trace statistic	5% critical value
0	-335.81134	.	17.0273	15.41
1	-327.48294	0.42606	0.3705*	3.76
2	-327.29766	0.01228	.	

Table 3 shows that there is one cointegration (CI(1,1) case) between social development and economic growth. This confirms that they have a long run relationship. Note that, as indicated below, cointegration between variables suggests that there must be causal relation at least running from one side.

For testing the direction of the long run causal relationship between social development and economic growth, we report in Table 4 the result of granger causality test. The significant F-ratio reveals that causality is running significantly from social development to economic growth. This indicates that trickle up hypothesis is more active dominantly in case of Saudi Arabia between 1980 to 2011.

Table 4: Result of granger causality test

Equation	Excluded	chi2	Prob> chi2
SDI	GDP	1.5503	0.461
GDP	SDI	23.508	0.000

Note also that, as indicated below, granger's method only tests the long run causal relationship. For this reason and for too testing the shirt run association between economic growth and social development, Table 5 presents the results of estimation of the Vector Error Correction Model (VECM) according to models (12) and (13).

Long run association depends on the significance of the lagged error-correction terms, EC1 and EC2, in the Vector Error Correction Model (VECM). Thus, as only EC1 in the $\Delta GDPc$'s model is statistically significant, we deduce that in the long run social development causes significantly economic growth in Saudi Arabia between 1980 and 2011, which confirms the result obtained by the granger causality test.

In the short run, coefficient of both first and second differenced lagged $GDPc$ and SDI ($\Delta GDPc_{-1}$, $\Delta GDPc_{-2}$, ΔSDI_{-1} and ΔSDI_{-2}) are not statistically significant in the two models. We thus deduce that there is no short run causality between social development and economic growth.

Table 5: Result of the Vector Error Correction Model estimation

Equation	Explicative Variables	Coefficient	z	P>|z|
$\Delta GDPc$	EC^1	-0.0900706	-3.60	0.000
	$\Delta GDPc_{-1}$	-0.2283041	-1.02	0.309
	$\Delta GDPc_{-2}$	-0.300429	-1.38	0.168

	ΔSDI_{-1}	-79.40172	-0.65	0.518
	ΔSDI_{-2}	-27.71175	-0.23	0.814
	Constant	0.0002779	0.00	1.000
ΔSDI	EC^2	6.91e-06	0.16	0.871
	$\Delta GDPc_{-1}$	-0.0004714	-1.24	0.215
	$\Delta GDPc_{-2}$	-0.0000589	-0.16	0.873
	ΔSDI_{-1}	-0.1433861	-0.69	0.491
	ΔSDI_{-2}	-0.1145851	-0.57	0.567
	Constant	3.629137	3.46	0.01

Conclusions

This paper aimed to analyze the causal relationships between economic growth and social development in Saudi Arabia between 1980 and 2011. For that, following the methodology for the Human Development Index (HDI), a social development index is calculated based on the aggregation of several indicators related to different subset such as demographic, health and education. While, following the literature, the gross domestic product per capita is assumed to be the economic growth indicator.

Then, empirical illustration using unit root test, Cointegration and Granger Engels causality through Vector Error Correction Model (VECM) showed that in the long run, causality is running from social development to economic growth in Saudi Arabia. This means that trickle-up hypothesis is assumed. However, in the short run, there is no significant causal relationship.

These results are important for evaluating the impact of the development strategies in Saudi Arabia, which are involved essentially by five-years plans started in the 1970s and target all socioeconomic levels such as education, health, social services, infrastructure, regional development, diversifying industrial activities etc. We can thus conclude that these strategies have succeeded to reach significant social development enough to cause economic growth in the long run.

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