Comparative Approach of Economic Growth Engines (Senegal vs. Jordan) using Granger Causality Test

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Abstract

The purpose of this paper is to analyze the causality between eight purposefully selected variables and the economic growth in two countries (Senegal and Jordan) and to assess the relationship of these variables for the period 1990 to 2020. A time-series econometric technique (Granger causality) has been applied to test the hypothesis of the economic growth pillars in a comparative approach. The dependent variable in the model is the economic growth, measured by the GDP per capita. The eight variables which influence economic growth engines in the target countries for this study (Senegal and Jordan) are: gross fixed capital formation (% of GDP), gross capital formation (% of GDP), population aged 15-64 (% of total population), net official development assistance and official aid received (foreign aid), agriculture added value, industry added value, volume of imports and volume of exports. The results revealed the impact of economic growth drivers on GDP per capita in each country and provide governmental decision-makers valuable insights on finding the optimal balance between the macroeconomic indicators leading to economic growth.

1. Introduction

Recent studies focused on the relationship between financial variables related to economic development engines and economic growth, measured by the GDP per capita, reveal that the interaction between the variables requires further research work to be fully understood (Alenoghena et al., 2020). Economic growth is the major goal for any economy in the quest to achieve prosperity and better living standards on long term. There is no doubt that human capital is the key in affecting the level of productivity. The role of human capital in gross fixed capital

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formation, gross capital formation, agriculture added value, industry added value, volume of imports and volume of exports is crucial (Ahmadov, 2020).

The questions regarding the main drivers of economic growth and why countries grow at different rates lead to theoretical and empirical economic research attempts (Leimbach et al., 2017). The insights reflect technological relationship which expresses the level of output (economic growth) as a function of the level of inputs, such as GDP, foreign aids, human capital, industry, land etc.

At the best of our knowledge, few studies have analyzed the economic growth engines from multiple facets by comparing relevant data from countries located in different continents. Thus, the following research question arises: how governments confronted with the societal pressures to assure the premises of development are able to find a balance between the macroeconomic indicators leading to economic growth?

The goal of this paper is to explore by means of time series econometric with the Granger causality test the causal relationship between relevant variables (physical capital, human capital, labor, foreign aid, agriculture, industry, imports and exports) and economic growth in Senegal and Jordan over the period of time from 1990 to 2020. The empirical model examines the economic growth engines in Senegal and Jordan based on the work of Manga (2020).

The novelty of this research consists of the inclusion of net official development assistance and official aid received (foreign aid) in the list of relevant variables aiming to assure the sustainable economic growth.

The paper is structured as it follows. After presenting the main theoretical issues related to the research question, authors present the conceptual model, the research methods. After that, authors outline the findings, as well as the discussion and conclusions.

1. Theoretical background

The existent body of knowledge on economic growth engines mainly reflect the correlations between financial development and economic growth in transitional economies, most papers employing spectral Granger causality technique. Results retrieved from the research conducted by Skare and Porada-Rochoń (2019) identifies and argues the long-term relationship between financial development and economic growth in most transitional countries, looking for converge with advanced economies. The conflicting results found in the literature on economic growth drivers represent the key point for debate regarding whether financial indicators are the cause or the effect of the growth process in developed and developing countries and how other indicators related to human capital intervene in this process (Kandil et al., 2017).

Saymeh and Orabi (2013) consider that the process of measuring real economic growth of a country assesses whether growth can be corelated (correlated) with the increasing demands of the society, including the GDP, volume of imports and exports, but also prosperity growth rates induced by national natural

resources (Lábaj et al., 2014) highlight the advantages of a non-parametric approach in the situations of multiple inputs leading to a higher economic growth.

Based on longitudinal data from the World Bank and a sample of 38 developing economies, Dao (2014) found that the growth rate of GDP per capita (the most prominent indicator of economic growth) is linearly dependent on variables such as technological progress, gross capital formation, and labor productivity growth, determined as the growth rate of the value added per worker, as well as human capital formation. The research coordinated by Islam et al. (2020) explores the relations between economic development and foreign direct investments, while investigating the moderating effect of government decisions on these relations, since the culture of an economy significantly impact on shaping the financial system of that country.

Bouis et al. (2011) propose an economic growth regression framework that explicitly models technology diffusion, allows exploring the growth effects of a wider set of macroeconomic indicators retrieved from governmental statistics and outlines the determinants of long-run cross-country differences in economic growth. Proving a positive link between, gross capital formation (% of GDP), human capital contribution to business development, industrial added value, and economic growth should be perceived as a guideline for regulatory improvements in any country (Głodowska, 2017).

Comparative analyses between the drivers of economic growth in different countries broad highlight how these countries are interconnected into the international business cycle of financially connected countries (Gillman, 2021).

2. Research method

The analysis of the causal relationship between the variables enables to evaluate the dependence according to which the linear dependence between two series (for example between X_i and Y) can be evaluated by the sum of the causality from X_i to Y, from Y towards X_i and / or that between X_i and Y. In the case of the causal relationship between the variables of this study, the economic growth is function of physical capital, human capital, labor, foreign aid, agriculture, industry, imports and exports. The function of regression is described by the following equation:

$$Y = F(X) \text{ with } X = X_i, \text{ i=1, 2, ... k} \quad (1)$$

- ✓ Y is the dependent variable;
- ✓ $X_1, X_2, X_3, ... X_k$ are the independent variables.

Here, the dependent variable is the economic growth and it is measured by the real GDP per capita. The independent variables are:

- ✓ the physical capital, measured by the gross fixed capital formation (% of GDP);
- ✓ the human capital, measured by the gross capital formation (% of GDP);

- ✓ the labor, measured by the population aged 15 to 64 (% of total population);
- ✓ the foreign aid, measured by net official development assistance and official aid received (current US$);
- ✓ the agriculture, measured by agriculture, forestry, and fishing, value added (% of GDP);
- ✓ the industry, measured by industry (including construction), value added (% of GDP);
- ✓ the imports, measured by imports of gods and services (% of GDP);
- ✓ the exports measured by exports of gods and services (% of GDP).

Thus, the equation **(1)** become:

RGDPPC = F (GFCF, GCF, PA15.64, FOAID, AGR, IND, IMP, EXP) **(2)**

where:
- ✓ RGDPPC represents the real GDP per capita;
- ✓ GCF represents the gross formation of human capital;
- ✓ GFCF represents the gross fixed capital formation;
- ✓ PA15.64 represents the population aged 15 to 64;
- ✓ FOAID represents the net official development assistance and official aid received;
- ✓ AGR represents the agriculture added value;
- ✓ IND represents the industry added value;
- ✓ IMP represent the imports of gods and services;
- ✓ EXP represent the exports of gods and services

The null hypothesis implies the absence of causality, we use two annotations:
- ✓ $F_{xi \rightarrow y}$ represents the null hypothesis of the no causality of Y by X_i;
- ✓ $F_{y \rightarrow xi}$ represents the null hypothesis of the no causality X_i par la variable Y;

In order to examine the relation between these independent variables and the economic growth in Senegal and Jordan using Granger causality test, it become necessary to analyze the stationarity of the time series by employing the Augmented Dickey – Fuller (ADF) unit root test (Dickey and Fuller, 1979) since these variables have generally different evolution. This enables to detect the existence or not of the unit root in the variables entering into the estimation of the long-term relationship. In other words, this allows to verify on the one hand the stationarity of the series, that is to say determinate the order of integration of the series which leads to ensure the convergence of the paths and, on the other hand the hypothesis of co-integration of the variables over a long period.

For the purpose of this investigation, we employ three types of time series for each variable: natural logarithms, the first differences of natural logarithms and the double difference of the natural logarithms. Table 1 reveals abbreviations of variables.

Table 1. Variables description

l_RGDPPC	Natural logarithms of the real gross domestic product per capita
l_GCF	Natural logarithms of the gross formation of human capital
l_GFCF	Natural logarithms of the gross fixed capital formation
l_PA15.64	Natural logarithms of the population aged 15 to 64
l_FOAID	Natural logarithms of the net official development assistance and official aid received
l_AGR	Natural logarithms of the agriculture added value
l_IND	Natural logarithms of the industry added value
l_IMP	Natural logarithms of the imports of gods and services
l_EXP	Natural logarithms of the exports of gods and services
d_l_RGDPPC	First differences of l_RGDPPC
d_l_GCF	First differences of l_GCF
d_l_GFCF	First differences of l_GFCF
d_l_PA15.64	First differences of l_PA15.64
d_l_FOAID	First differences of l_FOAID
d_l_AGR	First differences of l_AGR
d_l_IND	First differences of l_IND
d_l_IMP	First differences of l_IMP
d_l_EXP	First differences of l_EXP
d_d_l_RGDPPC	First differences of d_l_RGDPPC
d_d_l_GCF	First differences of d_l_GCF
d_d_l_GFCF	First differences of d_l_GFCF
d_d_l_PA15.64	First differences of d_l_PA15.64
d_d_l_FOAID	First differences of d_l_FOAID
d_d_l_AGR	First differences of d_l_AGR
d_d_l_IND	First differences of d_l_IND
d_d_l_IMP	First differences of d_l_IMP
d_d_l_EXP	First differences of d_l_EXP

The choice of variables

This research paper uses the gross domestic product per capita to assess economic growth. The reason is that GDP per capita is generally used to determinate the nation economic growth. The GDP is an aggregate that represents the end result of the production activity of resident producer units. According to Mamane (2013), the factors responsible for growth usually appear as arguments in production functions. On the one hand, there are the physical capital stock and the workforce size retained by the classics and, on the other hand, the human capital integrated following the pioneering works of Schultz (1963) and of Becker (1964). For Mamane (2013), it is nowadays important to let people know that this

integration is expanding from the fields of production to other areas, particularly of politics, the environment, etc. In addition, CUA and CEA reports (2010) suggest two basic sources of economic growth: the rate of factor accumulation and the growth of aggregate factor productivity. Levine and Renelt (1992) established a positive and strong association between the rate of investment in physical capital and the rate of growth from cross-sectional data covering the period 1960-1989 (Mokime, 2014). Furthermore, Savy (2009), Ndiaye (2010), Mamane (2013), Sow (2013), Mokime (2014) and Ndiaye (2014) have demonstrated the major utility of human capital in economic growth.

Indeed, since these works indicate a positive relationship between economic growth and the three variables (physical capital, human capital and labor), we employ in the analysis these same variables so that to know if they also lead the economic growth in Senegal and Jordan.

In addition to these three variables, some researchers extend the analysis of determinants of economic growth to others variables. In the review of the literature presented above, some authors as Ekanayake and Chatrna (2010), Yiew and Lau (2018) and Headey (2008) indicate the main role of foreign aid in stimulating economic growth while others as Liew et al. (2012) evocate a negative relationship between these two variables. Indeed, the choice of the variable foreign aid in the study is explained by the will to determinate its impact on the economic growth in Senegal and Jordan.

Similarly, in the review of the literature evocated previously, Odetola and Etumnu (2013) ranked agriculture among the engines of economic growth. Ndiaye et al. (2017) came to the same conclusion by showing that agriculture contributes significantly to real GDP per capita in Senegal. Their study is based on the World Bank data from 1986 to 2014 using Granger causality test to analyze the causal relationship between real GDP per capita and agriculture. To verify this theoretical in Senegal and Jordan, we add the variable agriculture in the analysis.

In the same perspective of research, we employ in the study the variable industry in order to verify firstly the theoretical of Gibescu (2010) and Kilavuz & Topcu (2012) evocated in the review of the literature, and which consider industry as a determinant of economic growth, and secondly the theoretical presented in the works of Manga (2020) and Ben Amar (2013). For Manga (2020), he used the World Bank and African Development Bank data from 2000 to 2017 and shown via the fsQCA method that a combination of the three (3) sectors of the economy where the secondary sector is more developed results in strong economic growth in ECOWAS. On the other hand, Ben Amar (2013) determined a positive relationship between the level of industrialization and the level of GDP per capita following an econometric regression carried out on a sample of 30 developing countries using panel data.

Furthermore, the reason of the choice of the variables imports and exports used in the study is explained by the will to verify the works of Kilavuz and Topcu (2012) presented in the review of the literature and which indicate that for developing countries high-tech based exports affects positively economic growth,

while the imports of high-tech goods by countries in different stages of development level affects negatively economic growth. The variables imports and exports are also used to verify the works of Zang and Baimbridge (2012) indicating in the review of the literature that on the one hand, imports have a positive cyclical effect on economic growth in short-run, and on the other hand, some countries have experienced export-led growth, while in others, GDP growth had a negative effect on export growth. Diagne and Daffé (2002) demonstrate that through exports, outward-looking trade policies are supposed to lead to faster economic growth. Grossman and Helpman (1991), cited by Ben Amar (2013), have proposed a model where economic growth is dependent on the opening of the economy to the outside, an opening which opens the door to technological transfers and new developments markets.

3. Findings
Graphical representation of the economic
growth of Jordan and Senegal

Figure 1 shows a large disparity between the economic growth level of Jordan and that of Senegal in the period between 1990-2020. In Senegal, the economic growth has globally evolved by decreases and jumps from 1990 to 2013, before taking the following year a new growing and appreciable dynamic. In Jordan, the growth remained on the whole more constant and dynamic than in Senegal between 1990 and 2004 before experiencing an unprecedented regression the following year until 2012 when, it resumed a new positive but very weak pace.

In short, the analysis of the graph shows enough economic growth rates that are on the whole embryonic in Jordan and Senegal during the period 1990 - 2020, but more resilient in Senegal than in Jordan.
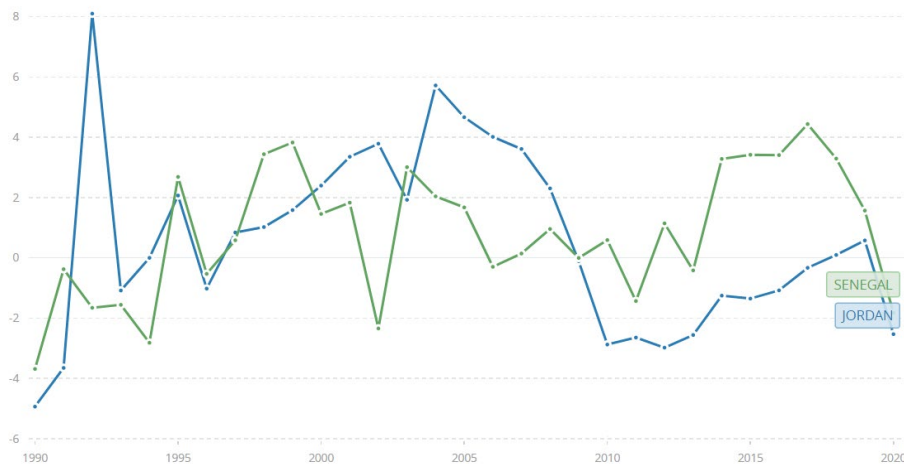
Figure 1. Economic growth of Jordan and Senegal
Source: authors, graph realized with the World Bank data

The empirical results

An analysis of eight factors enable to see if those that lead to an increase in the rate of economic growth in Jordan and Senegal are similar in these both countries. The representation of this causal analysis results past before by the stationarity results test of these difference variables studied.

The Stationarity test results

We start by performing the ADF unit root tests for the nine variables by considering for all the variables constant and time trend as deterministic term. The results presented in the Table 2 indicate, in Jordan, the stationarity in first difference of the variables GCF, GFCF, FOAID, IND, IMP and EXP. Only the variables RGDPPC, PA15.64 and AGR are integrated in order of 2.

In Senegal, the same results indicate the stationarity in level of the variables GCF, GFCF, PA15.64 and IND whereas others variables FOAID, AGR, IMP and EXP are stationary in first difference.

Table 2. Stationarity test results with the ADF tests

Country	Jordan			Senegal		
Variable	Number of lags	Statistic value	P-Value	Number of lags	Statistic value	P-Value
l RGDPPC	AIC : 2	-1,1733	0,9148	AIC : 2	-2,5293	0,3138
l GCF	AIC : 7	-2,7552	0,2143	AIC :0	-3,3258*	0,0814
l GFCF	AIC : 0	-2,1239	0,5124	AIC :8	-3,2254*	0,0794
l PA15.64	AIC : 4	-1,7338	0,7364	AIC :5	-6,5311***	0,0000
l FOAID	AIC : 0	-2,6722	0,2541	AIC :0	-2,7463	0,2267
l AGR	AIC : 1	-2,4279	0,3649	AIC :0	-3,1545	0,1126
l IND	AIC : 0	-1,6932	0,7293	AIC :0	-3,9221**	0,0235
l IMP	AIC : 1	-1,7739	0,7176	AIC :0	-3,0133	0,1453
l EXP	AIC : 7	-2,6983	0,2372	AIC :0	-2,5826	0,2901
d l RGDPPC	AIC : 3	-2,4971	0,3296	AIC :0	-4,8130	0,0031
d l GCF	AIC : 0	-5,9588***	0,0002			
d l GFCF	AIC : 8	-3,8555**	0,0139			
d l PA15.64	AIC : 1	-1,6844	0,7585			
d l FOAID	AIC : 0	-7,0481***	0,0000	AIC :0	-7,4069***	0,0000
d l AGR	AIC : 8	-2,5539	0,3019	AIC :2	-4,7195***	0,0006
d l IND	AIC : 0	-5,3494***	0,0008			
d l IMP	AIC : 1	-4,2484***	0,0037	AIC :0	-6,1907***	0,0001
d l EXP	AIC : 0	-5,2039***	0,0012	AIC :0	-5,9273***	0,0002
d d l RGDPPC	AIC : 0	-7,7153***	0,0000			
d d l PA15.64	AIC : 0	-9,1819***	0,0000			
d d l AGR	AIC : 0	-4,2627**	0,0111			
Note: ***, ** and * mean significant respectively at 1%, 5% and 10% levels.						

Source: authors, results obtained from GRETL with data from the World Bank.

The Granger causality test results

The results of Granger causality tests between the eight independent variables and the real gross domestic product per capita, reported in the Table 3, indicate a significant causality from the gross fixed capital formation to the real GDP per capita and from agriculture added value to the real GDP per capita in Senegal.

Unlike in Senegal, the results show firstly a significant causality from the gross formation of human capital, population aged 15 to 64 and imports of gods and services to the real GDP per capita. Secondly, the results show a significant causality from the real GDP per capita to gross formation of human capital and, to gross fixed capital formation and to agriculture added value.

Table 3. Results of the Granger causality tests

Variable	Jordan		Senegal	
	Statistic value	P-Value	Statistic value	P-Value
$F_{GCF \rightarrow RGDPPC}$	12.9064***	0.0007	0.0962	0.7576
$F_{RGDPPC \rightarrow GCF}$	3.7212*	0.0594	0.0325	0.8577
$F_{GFCF \rightarrow RGDPPC}$	2.3602	0.1308	4.4206**	0.0404
$F_{RGDPPC \rightarrow GFCF}$	3.2261*	0.0785	1.3925	0.2434
$F_{PA15.64 \rightarrow RGDPPC}$	15.4228***	0.0003	0.0150	0.9030
$F_{RGDPPC \rightarrow PA15.64}$	1.0362	0.3136	0.3382	0.5634
$F_{FOAID \rightarrow RGDPPC}$	1.5926	0.2128	1.4868	0.2282
$F_{RGDPPC \rightarrow FOAID}$	0.1206	0.7298	2.1488	0.1487
$F_{AGR \rightarrow RGDPPC}$	0.3059	0.5827	7.1607***	0.0099
$F_{RGDPPC \rightarrow AGR}$	2.8244*	0.0991	0.0052	0.9430
$F_{IND \rightarrow RGDPPC}$	1.0502	0.3104	0.5273	0.4710
$F_{RGDPPC \rightarrow IND}$	1.1638	0.2859	0.6298	0.4310
$F_{IMP \rightarrow RGDPPC}$	4.5106**	0.0387	0.7493	0.3907
$F_{RGDPPC \rightarrow IMP}$	0.2687	0.6065	0.0002	0.9885
$F_{EXP \rightarrow RGDPPC}$	0.7269	0.3980	1.8915	0.1749
$F_{RGDPPC \rightarrow EXP}$	0.2589	0.6131	0.0500	0.8240

Note: ***, ** and * mean significant respectively at 1%, 5% and 10% levels.
Source: authors, results obtained from JMulti with data from the World Bank.

The comparative analysis of the level of economic growth of Senegal and Jordan reveals, through a statistically causal relationship, different factors driving the growth in these two countries.

4. Discussion and conclusions

In Senegal, where the economic growth is stronger than in Jordan, the growth is driven by the gross fixed capital formation and agriculture. These results show that significant efforts are being made in Senegal to maintain and improve these two factors. Moreover, the positive effect of the gross fixed capital formation on Senegal's economic growth shows the major importance of the investment in the economic growth of this country. This confirms the work of certain authors, including CUA and CEA (2010), Mamane (2013) and Mokime (2014), who have listed the physical capital among the determining factors of growth. Also, the positive impact of agriculture on Senegal's economic growth demonstrates the major utility of the primary sector in economic growth. This attests the previous works of Ndiaye et al. (2017) according to which agriculture improves economic growth in Senegal and those of Odetola and Etumnu (2013) from which agriculture is ranked among the engines of economic growth.

In Jordan, the economic growth is mainly driven by the gross human capital formation, labor and imports of goods and services. The positive effect of the gross human capital formation on economic growth reflects the importance of knowledge in economic growth. This ties in with the works of Savy (2009), Ndiaye (2010), Mamane (2013), Sow (2013), Mokime (2014) and Ndiaye (2014), who consider the human capital as a fundamental factor for the economic growth. Likewise, the positive effect of the labor factor on Jordan's economic growth consolidates the thesis defended by the classics, which considers population growth as an explanatory factor for the economic growth. This thesis is firstly opposed to the works of Malthus, described by Wrigley (1988) the first to question the existence of a positive relationship between population growth and economic growth. Secondly, to those of Birdsall et al. (2001), who believe that the effect of population growth on economic growth depends on the position of a country in relation to the transition because a high fertility before the transition reinforces poverty. and therefore, reduces the growth. They believe that population growth must be coupled with education, training and health for there to be a positive effect. Thirdly, to the works of Mokime (2014) who consider that the relationship between demographic expansion and economic growth is quite complex. Because, in many cases, the history has shown that the population growth has had a negative impact on the individual income levels, requiring a caution in analyzing the relationship. In addition, the influence observed of imports of goods and services on Jordan's economic growth could find its explanation in the consequent efforts that the rulers of this country are making to the opening of the economy to the outside world, oriented towards imports. This influence indicates that the more the level of imports of goods and services increases, the stronger the economic growth is in Jordan. It therefore reflects the major advantage of openness to the outside world for a country. This consolidates the thesis of Diagne and Daffé (2002), Zang and Baimbridge (2012), Ben Amar (2013) and Mamane (2013), which places openness to the outside at the heart of improving economic growth.

Moreover, it is also important to note that in Jordan, the economic growth causes in Granger's sense the gross human capital formation, gross fixed capital formation and agriculture. Indeed, the positive impact of real GDP growth per capita on these factors testifies the importance of economic growth through its fallouts which spill over to all sectors of the economy. This shows that the more economic growth is improved, the more it contributes to the development of the entire economy. In other words, this argument confirms the thesis of Mokime (2014) indicating that generally, when an economy realizes a strong and sustained growth, a strong job creation follows.

This study contributes to the existing literature and provides practical implications in various ways. First, to the best of the authors' knowledge, the impacts of gross fixed capital formation (% of GDP), gross capital formation (% of GDP), population aged 15-64 (% of total population), net official development assistance and official aid received (foreign aid), agriculture added value, industry added value, volume of imports and volume of exports on economic growth of Senegal and Jordan have not been analysed until now. Second, we have employed Granger causality test in order to test the long run relationship among the longitudinal statistical data from both target countries. In addition, we check the robustness of the empirical results through appropriate statistical methods.

Referring to the results of this study, it becomes crucial to retain that the achievement of strong economic growth should be the consequence of the improvement of the factors such as the gross fixed capital formation and agriculture in Senegal, and the factors such as the formation of human capital, labor and imports of goods and services in Jordan. This indicates that the more these factors develop, the greater their influence on real GDP growth; therefore, the faster economic growth would contribute to improving the living conditions of the populations in these respective countries. In addition, a considerable improvement of the economic growth, which will have the effect of reducing poverty in Senegal and Jordan, requires that the authorities of these countries also aim to improve the factors that have not hitherto been able to have a positive impact in the sense of Granger on their economic growth. This increases the number of factors that positively impact growth and therefore, increases the level of economic growth.

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