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The Effect of Sovereign Debt on Economic Growth: The Case of Oil-rich Countries

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ABSTRACT

Key studies have identified the need to study the role of sovereign debt on economic growth, particularly in relation to countries with heavily oil-based status economies. This paper applies a panel vector autoregressive approach to examine the impact of sovereign debt on economic prosperity in several oil-rich countries between 2002 and 2017. The results show that in oil countries, like other developing countries, government debt has not had a positive impact on enhancing economic growth, resulting in a reluctance of such countries to invest debts in production, and a desire for the type of diversification of sources of income observable in most advanced countries.

Keywords: Co-integration, Sovereign Debt, Oil-rich Countries
JEL Classifications: A10, B22, B23, E23, E52, E62

1. INTRODUCTION

The Greek budget deficits from the last decade transferred themselves by contagion across Europe. As a result, market interest rates on sovereign debt started to rise. The impact of sovereign debt on economic growth has thus become one of the hottest topics globally. Recently, oil-rich countries and the Gulf Cooperation Council (GCC) created a special excess fund (yet to be employed) due to their dependence upon oil exports, with a view to removing the risk of debt-related financial failure. From another point of view, the lower cost of the debt feature encouraged them to use debt in their financing instead of using only their own capital. This topic is of importance to the oil-rich companies in their search for the nexus between debt and growth, as the debt crises in indebted nations affected their economic growth. In consequence, several questions were raised: Does the growth in general gross government debt for oil-rich countries create significant shocks on economic growth – or vice versa? Is there a relationship between gross debt and economic growth in the short and long run? Through answering these questions, these countries will gain a greater insight into (and assistance in) their future fiscal policy. This paper makes several major contributions to existing literature on this topic. First, this is, to the authors' knowledge, one of the few studies that illustrate a new overview and relevant information on the future effectiveness of sovereign debt for oil-rich countries. The second contribution is that this work checks the standard deviation shocks of debt on growth, and vice versa.

The results of empirical literature concerning the short- and long-run relationship between debt and growth and the impulse of debt shock on growth (or vice versa) are mixed. The authors hereby present the latest articles on this issue. Lof and Malinen (2014) revealed that sovereign debt produced no effect on economic growth; butsuch growth had a significant negative reverse effect on sovereign debt. By contrast, Zouhaier and Fatma (2014), Szabó (2014), Matei (2014) and Pegkas (2018) found that debt/GDP had an adverse effect on growth. Antonakakis (2014) found that non-sustainable debt-ratios > or <60% threshold affect short-run growth detrimentally, while sustainable debt-ratios <90% threshold influences short-run growth positively. In the long-run, both non-sustainable ratios >90% or <60% threshold and sustainable debt-ratios >90% threshold compromised growth. Furthermore, Bakke (2016) found that elevated sovereign debt has a non-linear negative effect on GDP-per-capita growth, starting at a 90%-100% threshold. He also discovered that the negative growth effect of high government debt might be linear, starting at a 70%-80% threshold. Moreover, Baum et al. (2012) suggested that the short-run impact of debt on growth is positive and highly significant, but decreases to around zero and loses significance at debt/GDP <67% for dynamic and non-dynamic threshold models. For high debt/GDP >95% additional debt has a negative impact on economic activity. Further, Herndon et al. (2013) found that the average growth rate for countries with debt/GDP >90% is actually 2.2%, due to coding errors, selective exclusion of available data, and unconventional weighting of summary statistics, which contradicts Reinhart and Rogoff's claim that debt/GDP >90% reduce GDP growth.

In fact, there have been few studies on sovereign debt, and those that do exist have tended to focus on developed countries. This study is different. As far as the authors are aware, this article is the first study that analytically tests the impact of sovereign debt on economic growth on oil-rich countries and opens the door to future studies on the role of sovereign debt on economic growth.

Therefore, the main purpose of this paper is to consider the role of sovereign debt on the economic growth of several oil-rich countries and offer new insights. In an attempt to discuss all aspects of these two fields, the rest of the paper is organised as follows: the theoretical framework, followed by the method of study, the empirical results and, finally, the conclusion drawn there from.

2. METHODOLOGY AND DATA SELECTION AND COLLECTION

In the current research's data base, the aim was to construct data for the dependent variable real gross domestic product (RGDP) from the National Statistical Office while the main independent variable general gross government debt was collected from Ministry of Finance and Treasury. The dataset consists of annual data on 7 oil-rich countries (the Kingdom of Saudi Arabia, Iran, United Arab Emirates, Kuwait, Qatar, Oman and Algeria) over the period 2002-2017 and includes 112 observations for each of the variables of the log model, plus 105 observations of the growth model. To analyse the relationship between the variables debt and GDP, the authors used panel vector autoregressive (PVAR) (where debt is the dependent variable) and VECM (where growth is the dependent variable) and computed the impulse-response functions from estimated PVAR when growth rate was used as one of the variables.

2.1. Vector Auto-regressions (VARs)

The VAR is commonly used for forecasting systems of interrelated time series and for analysing the dynamic impact of random disturbances on the system of variables. The VAR approach sidesteps the need for structural modelling by treating every endogenous variable in the system as a function of the lagged values of all of the endogenous variables in the system. The mathematical representation of a VAR is:

$$y_t = A_1 y_{t-1} + \dots\dots\dots\dots + A_p y_{t-p} + Bx_t + \epsilon_t$$

where y_t is a k vector of endogenous variables, x_t is a d vector of exogenous variables, $A_1, \dots, A_p$ and B are matrices of coefficients to be estimated, and ϵ_t is a vector of innovations that may be contemporaneously correlated but are uncorrelated with their own lagged values and uncorrelated with all of the right-hand side variables.

Since only lagged values of the endogenous variables appear on the right-hand side of the equations, simultaneity is not an issue and OLS yields consistent estimates. Moreover, even though the innovations ϵ_t may be contemporaneously correlated, OLS is efficient and equivalent to GLS since all equations have identical regressors. As an example, let us suppose that real gross domestic product (RGDP) and general gross government debt (GGGD) are jointly determined by a VAR, and let a constant be the only exogenous variable. Assuming that the VAR contains two lagged values of the endogenous variables, it may be written as:

$$RGDP_t = a_{11} RGDP_{t-1} + a_{12} GGGD_{t-1} + b_{11} RGDP_{t-2} + b_{12} GGGD_{t-2} + c_1 + \epsilon_{1t}$$

$$GGGD_t = a_{21} RGDP_{t-1} + a_{22} GGGD_{t-1} + b_{21} RGDP_{t-2} + b_{22} GGGD_{t-2} + c_2 + \epsilon_{2t}$$

Where a_{ij}, b_{ij}, c_i are the parameters to be estimated.

2.2. Vector Error Correction (VEC) Models

A VEC model is a restricted VAR designed for use with non-stationary series that are known to be co-integrated. Co-integration may be tested using an estimated VAR object; the Equation object may be estimated using non-stationary regression methods, or using a Group object (see "Co-integration Testing"). The VEC has co-integration relations built into the specification so that it restricts the long-run behaviour of the endogenous variables to converge to their co-integrating relationships while allowing for short-run adjustment dynamics. The co-integration term is known as the error correction term since the deviation from long-run equilibrium is corrected gradually through a series of partial short-run adjustments. To take the simplest possible example, consider a two-variable system with one co-integrating equation and no lagged difference terms. The co-integrating equation is:

$$y_{2,t} = \beta y_{1,t}$$

The corresponding VEC model is:

$$\Delta y_{1,t} = \alpha_1 \left(y_{2,t-1} - \beta y_{1,t-1} \right) + \epsilon_{1,t}$$

$$\Delta y_{2,t} = \alpha_2 \left(y_{2,t-1} - \beta y_{1,t-1} \right) + \epsilon_{2,t}$$

In this simple model, the only right-hand side variable is the error correction term. In the long-run equilibrium, this term is zero. However, if y_1 and y_2 deviate from the long-run equilibrium, the error correction term will be nonzero and each variable adjusts

Table 1: Panel unit root test/Summary test (none) for stationary

Method	Variables							
	Real gross domestic product (RGDP)				General gross government debt (GGGD)			
	Level	P value	1st diff.	P value	Level	P value	1st diff.	P value
Levin, Lin and Chu t*	9.76303	1.0000	−4.50532***	0.0000	1.10666	0.8658	−3.19066***	0.0007
ADF-Fisher Chi-square	1.23930	1.0000	43.3451***	0.0001	10.5197	0.7233	29.9369***	0.0078
PP-Fisher Chi-square	0.06132	1.0000	47.8523***	0.0000	2.5983	0.9996	35.0208***	0.0015

Significance at 1%***, 5%**, 10%*

Table 2: Kao residual co-integration test

Null hypothesis: No co-integration					
Series: RGDP GGGD			Series: GGGD RGDP		
	t-statistic	Prob.		t-statistic	Prob.
ADF	−2.3566***	0.0092	ADF	−1.5697*	0.0582

Significance at 1%***, 5%**, 10%*

to partially restore the equilibrium relation. The coefficient α_i measures the speed of adjustment of the *i*-th endogenous variable towards the equilibrium.

2.3. Impulse Responses Function

A shock to the *i*-th variable not only directly affects the *i*-th variable but is also transmitted to all of the other endogenous variables through the dynamic (lag) structure of the VAR. An impulse response function traces the effect of a 1-time shock to one of the innovations on current and future values of the endogenous variables. If the innovations ϵ_t are contemporaneously uncorrelated, interpretation of the impulse response is straightforward. The *i*-th innovation $\epsilon_{i,t}$ is simply a shock to the *i*-th endogenous variable $y_{i,t}$. Innovations, however, are usually correlated, and may be viewed as having a common component which cannot be associated with a specific variable. In order to interpret the impulses, it is common to apply a transformation *P* to the innovations so that they become uncorrelated:

$$\upsilon_t = P_{\varepsilon t} \approx (0, D)$$

where *D* is a diagonal covariance matrix. As explained below, E-views provides several options for the choice of *P*.

3. RESULTS

3.1. Panel Unit Root

The results in Table 1 show that the null hypothesis of the unit root for both variables (real gross domestic product and general gross government debt) haven't been rejected under the panel unit root test/summary (in case None) at 1% significance level at the level I(0) (under the methods: Levin, Lin and Chu t*, ADF - Fisher Chi-square, PP - Fisher Chi-square), which means that this variable is not stationary under the three methods. From the other side, the null hypothesis of the unit root for both variables (real gross domestic product and general gross government debt) have been rejected under the panel unit root test/summary (in case none) at 1% significance level at the first difference I(1) (under the methods: Levin, Lin and Chu t*, ADF - Fisher Chi-square, PP - Fisher Chi-square), which means that the series is stationary at the first difference I(1) at 1% significance level for both variables (real gross demotic product and general gross government debt). To implement PVAR test, the variables have to be stationary at I(1) and the unit root test shows that the variables are stationary at first difference I(1).

3.2. Kao Residual Co-integration Test

The results in Table 2 show that when the real gross domestic product is the dependent variable and general gross government debt is the independent variable, the null hypothesis that says there is no co-integration between the variables can be rejected. The PVAR cannot therefore be used; instead, the vector error correction model (VECM) can be employed, which means that there is a long-run relationship between the variables. When the general gross government debt is the dependent variable and the real gross domestic product is the independent variable, the null hypothesis that says there is no co-integration between the variables can't be rejected. The PVAR model (VAR) is therefore used, which means that there isn't a long-run relationship between the variables.

3.3. Panel VAR Fixed and Random Effects Models Dependent Variable GGGD

Table 4 below illustrates that the cross-section random effects model is appropriate. Therefore, the results in Table 3 show that the Probability value of c, GGGD (−1), GGGD (−2) coefficients are <5% and significant, which means we can reject the null hypothesis and accept the alternative hypothesis. Therefore, the intercept, general gross government debt lag 1 and lag 2 independent variables have an effect on the dependent variable general gross government debt. Furthermore, Table 3 shows that the Probability value of RGDP (−1) and RGDP (−2) coefficients are more than 5% and are insignificant, which means the null hypothesis can't be rejected: and has to be accepted. Therefore, there is no effect of independent variables real gross domestic product lag 1 and lag 2 on the dependent variable general gross government debt.

3.4. Hausman Test

Table 4 shows that the probability value of Chi-square is more than 5% and insignificant, which means the null hypothesis can't be rejected; and it has to be accepted that the means random effect model is appropriate; therefore, the authors are going to depend on the random effect model in their analysis.

3.5. Joint Causality (Wald Test)

Table 5 shows that depending on the coefficient of RGDP (−1) and RGDP (−2): (C [4] and C [5]) in the cross-section random effects model, the authors found the Probability of calculated F statistics and the Probability value of Chi-square for the independent variables (Real GDP) is <5% and significant; this means the null hypothesis can be rejected for all independent variables and the alternative hypothesis has to be accepted. Therefore, the

Table 3: Panel VAR fixed and random effects models/Dependent variable: GGGD

Variable	Fixed			Cross-section random effects		
	Coefficient	t-statistic	Prob.	Coefficient	t-statistic	Prob.
C	−1.0128**	−2.2866	0.0246	−0.0995*	−1.9655	0.0523
GGGD (−1)	1.3440***	13.7282	0.0000	1.4380***	15.8307	0.0000
GGGD (−2)	−0.5081***	−5.2102	0.0000	−0.5507***	−6.1051	0.0000
RGDP (−1)	0.4124	0.5769	0.5655	0.1175	0.2028	0.8397
RGDP (−2)	0.0294	0.0441	0.9649	0.0020	0.0035	0.9972
R-squared		0.995987			0.995579	
Adjusted R-squared		0.995526			0.995388	
F-statistic		2159.291***			5235.231***	
Prob. (F-statistic)		0.0000			0.0000	

Significance at 1%***, 5%**, 10%*. The authors assume, when taking 2 lags, that the value of Akaike info criterion is lowest and that this is optimal. There is no error correction term because the variables aren't co-integrated

Table 4: Correlated random effects - Hausman test

Test summary	Chi-sq. statistic	Chi-sq. d.f.	Prob.
Cross-section random	8.629129*	4	0.0711

Significance 1%***, 5%**, 10%*

Table 5: Jointly causality (Wald test)

Coefficients of RGDP (−1) with RGDP (−2)	Calculated F-statistic=4.734624**	Prob.=0.011
Ho: C(4)=C(5)=0, H_1: C(4)≠C(5)≠0	Chi-square=9.469248***	Prob.=0.0088

Significance 1%***, 5%**, 10%*

Table 6: Johansen Fisher panel co-integration test

Series: RGDP GGGD				
Hypothesized no. of CE (s)	Fisher stat.* (from trace test)	Prob.	Fisher stat.* (from max-eigen test)	Prob.
None (Ho: r=0, Ha: r≥1)	34.01***	0.0021	30.17***	0.007
At most 1 (Ho: r≤1, Ha: r>2)	14.83	0.3898	14.83	0.3898

Significance 1% ***, 5% **, 10%*

coefficients aren't zero and the independent variable Real GDP lag 1 and lag 2 can jointly cause short-run Real GDP (there is a short-run causality running from Real GDP to general gross government debt).

3.6. Johansen Fisher Panel Co-integration Test

The results in Table 6 show that the Probability value of none for both tests (trace test and max-eigen test) is <5% and significant, which means that we can reject the null hypothesis (none: number of co-integrated equations is zero or the variables are not co-integrated) and the alternative hypothesis has to be accepted, which means that at least one of the two variables are co-integrated. Accordingly, as the second hypothesis is moved to, the Probability value of at least one of the two variables in a co-integrated hypothesis for both tests (trace test and max-eigen test) is more than 5% and insignificant, which means that the null hypothesis can't be rejected (at least one of the two variables are co-integrated) and has to be accepted, whilst the alternative hypothesis that there are more than two co-integrations must be rejected. This means that there is one co-integration between the variables and the vector error correction model (VECM) can be used.

3.7. Discussing Vector Error Correction Model/ Dependent Variable RGDP

The result in Table 7 shows the results of the error correction model, which illustrate the coefficients and standard error and t statistic but not the P value. Therefore, to get the P value we make a system and order by variable, and then we get two equations (these appear in the second and third row in Table 8) with 12 coefficients.

Table 8 shows the results of OLS regression for the two systems, but the authors are concerned with model one, where the dependent variable is D(RGDP). The P value of the coefficient of C(1) error correction term is insignificant because it is more than 5%, and the sign of C(1) coefficient is negative, which means that there is an insignificant long-run causality running from the independent variable general gross government debt to the dependent variable real GDP. The speed of adjustment towards long run equilibrium would be insignificant.

3.8. Finally, Joint Causality (Wald Test)

Table 9 shows that the Probability value of Chi-square for the independent variable general gross government debt is more than 5% and insignificant, which means that the null hypothesis for the independent variables can't be rejected, and it must therefore be accepted that the coefficients are zero and the independent variable general gross government debt lag 1 and lag 2 can't jointly cause short-run Real GDP. There is no short-run causality running from general gross government debt to real GDP).

3.9. Discussing the Impulse Response Function

Figure 1 shows the impulse response function derived from the estimated PVAR equation. As shown in the graphs, the blue line is the impulse response function while the red lines are the 95% confidence intervals. The impulse response line must always lay between the 95% interval confidence red lines. Also, the positive zone means that when a positive change happens in one variable the impact on the other variable is positive, while the negative zone means that the impact of one variable on the other variable is opposite.

3.10. Interpretation of RGDP to SD Shock GGGD

The right top graph shows the response of RGDP to a 1-time standard deviation shock (innovation) to GGGD. The result shows that from period 1 to period 2 the response (reaction) of RGDP to GGGD was positive, and the curve moving upward means that there is an increase in GDP. The curve starts moving downwards

Figure 1: Response to Cholesky one standard deviation. Innovations±2 standard errors

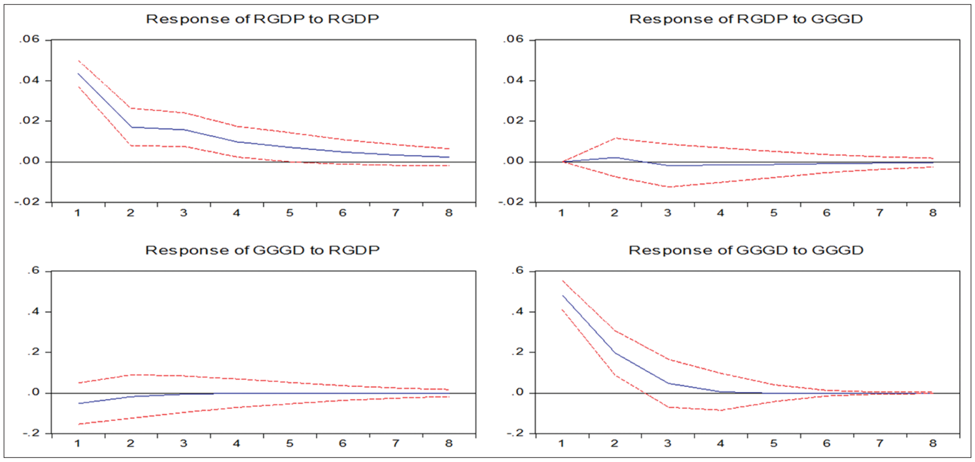

Table 7: Vector error correction model/Dependent variable: RGDP

Variable	Coefficient	S.t	t-statistics	Variable	Coefficient	S.t	t-statistics
CointEq1	−0.00438	(0.00643)	[−0.68094]	D(GGGD(−1))	−0.001431	(0.01494)	[−0.09580]
D(RGDP(−1))	0.394902	(0.10411)	[3.79316]	D(GGGD(−2))	−0.007185	(0.01695)	[−0.42402]
D(RGDP(−2))	0.174196	(0.09949)	[1.75082]	C	0.006336	(0.00292)	[2.16657]
R-squared			0.279287		Adjusted R-squared		0.236892
F-statistic			6.587756				

Significance at 1%***, 5%**, 10%*. The authors assume when taking 2 lags that the value of Akaike info criterion is lowest and that this is optimal S.t is standard error

Table 8: Two equations system according to VECM ordinary least squares OLS regression

Model (1): D(RGDP)=C(1)*(RGDP(−1)−0.936834665871*GGGD(−1)−1.07833311315)+C(2)*D(RGDP(−1))+C(3)*D(RGDP(−2))+C(4)*D(GGGD(−1))+C(5)*D(GGGD(−2))+C(6)

Model (1): D(GGGD)=C(7)*(RGDP(−1)−0.936834665871*GGGD(−1)−1.07833311315)+C(8)*D(RGDP(−1))+C(9)*D(RGDP(−2))+C(10)*D(GGGD(−1))+C(11)*D(GGGD(−2))+C(12)

Variable	Coefficient	t-statistic	Prob.	Variable	Coefficient	t-statistic	Prob.
C(1)	−0.004381	−0.68094	0.4968	C(7)	0.129449***	2.841952	0.005
C(2)	0.394902***	3.793159	0.0002	C(8)	−0.000993	−0.001347	0.9989
C(3)	0.174196*	1.750819	0.0818	C(9)	0.085858	0.121898	0.9031
C(4)	−0.001431	−0.095797	0.9238	C(10)	0.544977***	5.153265	0.0000
C(5)	−0.007185	−0.424023	0.6721	C(11)	0.020438	0.170375	0.8649
C(6)	0.006336**	2.166567	0.0317	C(12)	0.026693	1.289323	0.199
R-squared			0.279287	R-squared			0.299293
Adjusted R-squared			0.236892	Adjusted R-squared			0.258075

Significance at 1%***, 5%**, 10%*

Table 9: Jointly causality (wald test)

Coefficients of GGGD (−1) with GGGD (−2) H_0: C(4)=C(5)=0, H_1: C(4)≠C(5)≠0	Chi-square=0.274041 Df=2	Prob.=0.872

Significance 1%***, 5%**, 10%*

after period 2 until period 3 and enters the negative zone at 2.5 years, then from year 3 to year 4 the response of RGDP to GGGD rises but is still in the negative zone. Finally, from year 4 to year 8 the response has a tendency to increase but has no noticeable impact, and the curve moves upwards until it reaches zero at year 8 but stays in the negative zone. In other words, there is a very weak reaction in these years – it is stable and is almost at zero.

3.11. Interpretation of GGGD to SD Shock RGDP

Staying with our analysis in Figure 1, the bottom left graph shows the response of GGGD to a 1-time standard deviation shock (innovation) to RGDP. The result shows that the response (reaction) of GGGD to RGDP will be negative (negative zone) from period 1 to period 3, even though the curve is moving upward until it reaches zero, then from year 3 until year 8 it stays steady and is almost at zero at the X-axis line.

3.12. Interpretation of RGDP to SD Shock RGDP

In observing the reaction to one SD shock (innovation) to RGDP with no shocks, a sharp fall can be seen until period 2. From period 2 until period 8 it declines but less sharply and stays in the positive zone.

3.13. Interpretation of GGGD to SD Shock GGGD

The reaction of the GGGD to one SD shock (innovation) was a sharp fall from period 1 to period 4 followed by stability; it was almost at zero at the X-axis line after period 8 but stayed in the positive zone.

4. CONCLUSION

The results reflect the fact that sovereign debt does not affect the economic growth of several oil-rich countries in relation to their oil sectors. The analysis of the long-term relationship between these two variables found that sovereign debt does not have a strong influence on economic growth. Therefore, oil-rich nations should re-direct their economic policies more and more towards promoting sovereign debt to achieve sustainable growth and development.

It seems that oil-rich countries do not require the debt-based economic tools to achieve economic growth in the way that other developing countries do, and in fact the use of debt negatively affects their economic prosperity. On the other hand, experience shows that developed countries use government debt instruments for productive purposes, thereby promoting their growth and prosperity. US government debt, for example, currently accounts for about 104% of the US GDP, compared to 64% for China, which represents the optimal use of such debt to support economic growth.

In general, the results of this study indicate that the exclusion of the sovereign debt variable and its impact on economic growth in oil countries, and a focus only on the role of exports (especially oil) may not reflect a new outlook of economic prosperity. Hence, this paper has theoretical and practical implications.

Theoretically, by including the sovereign debt variable as a determinant of economic growth of oil-rich countries, the study has identified and highlighted the potential role of sovereign debt as a critical future factor that could change the view of these nations on economic growth.

In practice, these results are directed at policy makers in oil-rich countries with regard to key future variables to focus on to ensure growth and sustainable development. Highlighting sovereign debt as a future driver of growth means that policymakers must think about ways to exploit and improve this variable to ensure economic prosperity, and this can be done by investing in a variety of productive sectors.

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