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TESTING FISCAL SUSTAINABILITY UNDER INTER-TEMPORAL BUDGET CONSTRAINT IN SAUDI ARABIA [*]

This paper tests fiscal sustainability for Saudi Arabia under the inter-temporal budget constraint for the variables of public revenues and expenditures as ratio of GDP for the period 1980−2014. Both variables are found stationary at their first differences. Cointegration result proves the cointegrating relationships but the slope of public expenditures on public revenue is found to be less than one. Therefore, this study concludes about weak fiscal sustainability in Saudi Arabia and suggests fiscal reforms to maintain a strong sustainability.
Keywords: fiscal sustainability; public expenditures; public revenues; Saudi Arabia.

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ПЕРЕВІРКА ФІНАНСОВОЇ СТІЙКОСТІ ЗА МІЖЧАСОВОГО БЮДЖЕТНОГО ОБМЕЖЕННЯ: ЗА ДАНИМИ САУДІВСЬКОЇ АРАВІЇ

У статті проведено аналіз фінансової стійкості економіки Саудівської Аравії в умовах міжчасового бюджетного обмеження. Аналіз проведено за даними за 1980−2014 рр., основні змінні дослідження — державні прибутки та видатки у відношенні до ВВП. Обидві змінні виявились стаціонарними в першій різниці. Тест на коінтеграцію довів її присутність, однак нахил видатків до прибутків — менше одиниці. Зроблено висновок щодо слабкої фіскальної стійкості в Королівстві Саудівська Аравія. Запропоновано фіскальні засоби, що можуть її посилити.
Ключові слова: фіскальна стійкість; державні видатки; державні прибутки; Саудівська Аравія.
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ПРОВЕРКА ФИНАНСОВОЙ УСТОЙЧИВОСТИ ПРИ МЕЖВРЕМЕННОМ БЮДЖЕТНОМ ОГРАНИЧЕНИИ: ПО ДАННЫМ САУДОВСКОЙ АРАВИИ

В статье проведён анализ финансовой устойчивости экономики Саудовской Аравии в условиях межвременного бюджетного ограничения. Анализ проведён по данным за 1980−2014 гг., основные переменные исследования — государственные доходы и расходы в соотношении к ВВП. Обе переменные выявлены как стационарные в первой разности. Тест на коинтеграцию доказал её присутствие, однако наклон расходов к доходам — меньше единицы. Сделан вывод о слабой фискальной устойчивости в Королевстве Саудовская Аравия. Предложены фискальные меры, которые могут её усилить.
Ключевые слова: фискальная устойчивость; государственные расходы; государственный прибыли; Саудовская Аравия.

Introduction. Fiscal sustainability issue has been attracting the attention of policy makers and economists around the world for a while already. Government budget

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imbalance and government loans are common features of the world economies. Saudi Arabia is also facing this problem in the recent decades. It is the largest oil producing country in the world and its government revenues are majorly depending on oil production, oil prices and ultimately − oil revenues. Its oil consumption is rising at 7% with a rising population, economic growth and subsidies on local oil price. At the same consumption growth rate, it is expected to consume more than 20% of total oil production in the coming years. Due to subsidies on oil and basic needs of community, Saudi Arabia is facing low government revenues from taxes and high government spending. On the other hand, with a negative oil price shock, it would be very hard to maintain its spending pattern. Today oil prices are going down very sharply and creating problems with generating public revenues to meet the spending needs. Furthermore, Saudi Arabia has disputes with neighboring countries and is spending a lot on its army. All these problems may lead to the issue of fiscal unsustainability and may create a burden for the upcoming government spending plans. Thus, future net discounted government revenues surplus must be planned to repay government loans. Then, future generation of any country will enjoy a sustainable economic growth and welfare. In case of fiscal unsustainability, there is a need for fiscal reforms.

Oil producing countries have lesser control over economic cycles. In the prosperous period of oil revenues, government expenditures may rise to support economic growth and in turn inflation may also rise. But a fall in oil revenues requires a reducion in public spending. Otherwise, there will be budget deficits and public debt may rise. Therefore, for long-term fiscal sustainability, government must save some revenues in the times of prosperity to support economic growth and to spend on very important projects in the times of recession. This task is also very important to support the sustainable development in the country (Medas and Zakharova, 2009).

There have been a very limited number of studies on Saudi Arabia economy investigating a very important issue of fiscal sustainability. All studies have been more of descriptive debate on the issue of fiscal sustainability by showing the trends of data (see i.e. A. Al-Hamidy (2012)). There has been no single study to check empirically the hypothesis about fiscal sustainability in Saudi Arabia and quantify this problem through applying the government budget constraint in the analysis to avoid the burden of fiscal imbalances today on future generations. This study is pioneering in two ways. First, it is a very first attempt to inspect fiscal sustainability of Saudi Arabia. Secondly, the most of previous literature on fiscal sustainability has been based on the unit root test to verify this issue and ignore the cointegration test (Habib et al., 2016). This study intends to find fiscal sustainability of Saudi Arabia in the inter-temporal budget constraint by employing the most efficient econometric techniques, i.e., ARDL, DOLS and FMOLS by using data for the period of 1980−2014. Our results will be helpful in formulating appropriate fiscal policies in order to maintain long-term fiscal sustainability in Saudi Arabia.

Empirical literature. There have been different attempts to test fiscal sustainability. This study divides these into two main streams. The first group of literature checks the fiscal sustainability with unit root test only. For example, R. MacDonald (1992) verifies the sustainability of the US fiscal policy by means of integration analysis. He estimates monthly data for the period of 1951−1984. And rejects the sustainability hypothesis for the US economy. A. Baglioni and U. Chrubini (1993) estimate an

intertemporal budget constraint by using monthly data on Italian public debt for the period of 1979–1991. They found a unit root problem in public debt and point to an unsustainable fiscal policy.

Most of such literature focuses on the relationship between government expenditures and revenues to test fiscal sustainability. G. Hakkio and M. Rush (1991) found a cointegrating relationship between public expenditures and publics revenue of the US economy. They proved a weak fiscal sustainability and recommended to reduce public spending and to increase public revenues. Furthermore, they stated that fiscal deficit has been a short-run phenomenon. G. Smith and S. Zin (1991) proved an unsustainable borrowing policy for Canadian economy through cointegration analysis on monthly data. E. Tanner and P. Liu (1994) probed this issue for the US fiscal policy by using a cointegration after incorporating structural break into their analysis. They found a significant structural break in 1981 and confirmed a long-run relationship after adjusting the break. Further, they found evidence of a stationary fiscal deficit and one to one relationship between fiscal variables; hence they concluded a strongly sustainable fiscal policy for the US economy. A. Papadopoulos and M. Sidiropoulos (1999) used unit root, structural break and cointegration tests to check this issue for 5 EU countries. After adjusting structural breaks in their analysis, deficit for Greek, Portuguese and Spanish economies were found sustainable. However, sustainability hypothesis was not proved for Italy and Belgium. N. Olekalns (2000) explored inter-temporal budget constraint of Australia by considering the fiscal reforms in the analysis. After a reasonable testing, Australian fiscal policy was found to be unsustainable. P. Claeys (2007) investigated fiscal sustainability for the European Union economies by the single country analysis and as a panel model. He found a cointegration and concludes sustainability for the EU panel. But the analysis of the single country case showed mix evidence on fiscal sustainability. A. Habib et al. (2016) found fiscal sustainability in 20 developed countries' panel after using the most recent cointegration and structural breaks techniques on quarterly data set.

Model specification and econometric strategy.

1. Budget constraint (BC). BC starts from the following equation:

$$PE_t + (1+r_t)PD_{t-1} = PR_{t-1} + PD_t, \tag{1}$$

where PE_t is public expenditure; r_t is the rate of return on public loans; PD_t — government loans; PR_t — public revenues. We need to divide it by GDP to include the size of economy into the eauation:

$$PE_t \frac{PE_t}{GDP_t} + \frac{(1+r_t)}{(1+q_t)} \frac{PD_{t-1}}{GDP_{t-1}} = \frac{PR_t}{GDP_t} + \frac{PD_t}{GDP_t}, \tag{2}$$

where q_t is the GDP growth rate. Under intertemporal budget constraint, public loans can be expresses as:

$$PD_{t-1} = \sum_{j=t+1}^{\infty} \left(\frac{1}{1+r^*}\right)^{j-1} \left(PR_{j-1} - PE_{j-1}\right) + \lim_{j \to \infty} \left(\frac{1}{1+r^*}\right)^{j-1} PD_{j-1}. \tag{3}$$

Imposing restriction on public debt:

$$\lim_{j \to \infty} E_t \left(\frac{1}{1+r^*}\right)^{j-1} PD_{j-1} = 0. \tag{4}$$

This is a condition for non-Ponzi game principle. According to this principle, we may check the validity of budget constraint to be sustainable through cointegration between government revenues and expenditures as ratio of GDP. That is given below as:

$$PR_t = \alpha + \beta PE_t + \mu_t. \tag{5}$$

If there is a cointegration, then we may say there is sustainability. Secondly, the coefficient of government expenditure on revenue will guide us about the strength of fiscal sustainability. For example, a positive and unit slope is a sign of strong sustainability.

2. Estimation strategy. To test the cointegration in the model, integration analysis is required. For the unit root analysis, ADF test is applied (Dickey and Fuller, 1981). The equation for the test is as follows:

$$\Delta Y_t = \tau + \rho Y_{t-1} + \sum_{i=1}^{k} \gamma_i \Delta Y_t + \varepsilon_t, \tag{6}$$

where Δ is for differencing the variable; Y_t assumes public revenues and expenditures one by one to test stationarity; $\sum_{i=1}^{k} \gamma_i \Delta Y_t$ is used to remove autocorrelation in the equation. Null hypothesis is a unit root problem in individual time series ($\rho = 0$). Its rejection will ensure stationarity. This equation is also tested by including trend in the analysis.

To ensure the strength of the analysis, a unit root test as recommended by G. Elliot et al. (1996) has been also employed. This is an augmented version of ADF test that utilizes generalized least square (GLS) estimation procedure, also known as DF-GLS test. It is more efficient than other test due to utilizing detrended series in the analysis. The test equation is as follows:

$$\Delta z_t^d = \varphi z_{t-1}^d + \sum_{j=1}^{k} t_j \Delta z_{t-j}^d + \upsilon_t, \tag{7}$$

here z_t assumes variables of our model one by one. The null hypothesis is the same as in ADF test ($\varphi = 0$).

After confirming the integration level, this study uses the ARDL model by M.H. Pesaran et al. (2001) to validate the cointegration. The test is as follows:

$$\Delta PR_t = \eta_1 + \eta_2 PR_{t-1} + \eta_3 PE_{t-1} + \sum_{i=1}^{k} \kappa_{1i} \Delta PR_{t-i} + \sum_{i=0}^{k} \kappa_{2i} \Delta PE_{t-i} + \omega_t, \tag{8}$$

where k is for optimum lag length. $\eta_2 = \eta_3 = 0$ is of no-cointegration hypothesis and long-run relationship will be proved with its rejection. This test helps deciding on fiscal sustainability. Fiscal policy will be sustainable if cointegration will be proved in (8). After confirming the cointegration, long-run parameters can be calculated with the following formula:

$$\beta_i = \frac{\sum_{i=0}^{\hat{k}} \hat{\kappa}_{2i}}{1 - \sum_{i=1}^{\hat{k}} \hat{\kappa}_{1i}} \forall i = 1, 2, \dots, k. \tag{9}$$

After assessing the long-run coefficients from the ARDL framework, this study uses FMOLS and DOLS to verify the coefficients' consistency. Further, Wald test is performed on the estimated slope of public expenditures on the revenues from ADRL, FMOLS and DOLS to validate the authenticity of the slope. This test has

been performed in the two competing hypothesis, i.e., $\beta = 1$ and $\beta = 0$. If $\beta = 1$ is not rejected then it will show a strong sustainability and if $\beta = 0$ is not rejected − it will show sustainability.

Empirical results. This section investigates fiscal sustainability by applying integration and cointegration analyses. Integration analysis based on unit root tests is presented in Table 1. The present study applies two tests to ensure the authenticity of conclusions about the integration level in the variables. The null hypothesis is a non-stationary variable. The results show that both variables are non-stationary at their levels, i.e., have unit roots and are stationar at their first difference.

Table 1. **Unit root tests,** *author's*

Variable	ADF		DF-GLS	
H_0 = A variable has unit root.				
	C	C & T	C	C & T
PR_t	-2.3730 (0)	-2.0832 (7)	-0.8835 (2)	-2.0705 (8)
PE_t	-2.0081 (0)	-2.5098 (0)	-1.8891 (0)	-2.5242 (0)
ΔPR_t	-5.8767*** (1)	-4.5991*** (0)	-2.9272** (8)	-5.9549*** (1)
ΔPE_t	-7.3916*** (0)	-7.3347*** (0)	-5.8163***(0)	-6.8992***(0)

Note: *, ** and *** show stationarity at 10%, 5% and 1%. () contains lag lengths.

Table 2 displays the F-value calculated by the selected ARDL model with optimum lag lengths (1, 1). The diagnostic tests are presented in the table. p-values are greater than 0.1 and showing a good health of the selected model as there is no econometric disease in the model. F-value of the selected ARDL is 11.7204 this is higher than that of upper bound values at 1%. Therefore, a strong cointegration exists between public expenditures and revenues and fiscal sustainability has been proved for KSA. The next step is to verify the strength of sustainability. This can be tested through the coefficient of public spending on the public revenue.

Table 2. **ARDL bound test: dependent variable is** ΔPR_t**,** *author's*

Variable	F-statistics	At 0.01		At 0.05	
		I(0)	I(1)	I(0)	I(1)
ΔPE_t	11.7204	5.3709	6.2637	4.2628	5.0799
Diagnostic tests					
Serial correlation (χ^2)		Functional form (χ^2)		Normality (χ^2)	Heteroscedasticity (χ^2)
0.0384 (0.845)		0.5885 (0.443)		0.1757 (0.916)	2.6475 (0.104)

Table 2 presents the slopes of public expenditures on public revenue. Long-run coefficients are calculated through the selected ARDL framework, FMOLS and DOLS. 3 estimates are considered as long-run and are very important in deciding on the strength of sustainability. The estimated long-run parameters are 0.7084, 0.6519 and 0.6267 as calculated through ARDL, FMOLS and DOLS, respectively. These parameters are positive and significant that is again proves fiscal sustainability. But, magnitudes of the parameters are less than 1 and are showing weak fiscal sustainability in the case of KSA. Therefore, KSA government requires fiscal reforms to meet the strongly sustainable fiscal policy. In short run estimations, the parameter of ECT_{t-1} is

negative and significant. Therefore, it can be concluded for a short-run relationship in the model. And short-run slope is also positively significant. It gain shows the sustainability even in the short run.

Table 3. **Long-run and short-run results,** *author's*

Long-run regression: dependent variable is PR_t			
Regressor	**ARDL**	**FMOLS**	**DOLS**
PE_t	0.7084 (0.000)***	0.6519 (0.000)***	0.6267 (0.000)***
Intercept	0.0575 (0.0450)**	.0713 (0.054)*	0.0737 (0.083)*
Short-run results based on ARDL model: Dependent Variable is ΔPR_t			
ECT_{t-1}	-0.7287 (0.000)***		
ΔPE_t	0.8695 (0.000)***		

Note: ***,** and * indicate significance at 1%, 5% and 10% respectively.

The results in Table 3 proves weak sustainability of the fiscal policy in KSA. To verify this result, Wald restriction test is employed with two null hypothesis of slope $C(1) = 1$ and $C(1) = 0$, see Table 4. The chi-square values are high and their p-values are low in the estimations. This is rejecting the both null hypotheses and verifies that slope is neither zero, nor unit. Therefore, the estimated slopes are valid and the fiscal policy is again proved to be weakly sustainable.

Table 4. **Wald test,** *author's*

Estimators	**ARDL**	**FMOLS**	**DOLS**
Chi-Square ($C(1) = 1$)	20.189 (0.001)	11.786 (0.0017)	11.802 (0.0020)
Chi-Square ($C(1) = 0$)	54.9965 (0.000)	42.3134 (0.000)	33.2542 (0.000)

Conclusions and implications. The present study investigates an important issue of fiscal sustainability in the case of Saudi Arabia under the intertemporal budget constraint. For this purpose, annual time series data for the period of 1980–2014 has been tested by applying ARDL cointegration, FMOLS and DOLS on the relationship of public expenditures on revenues after testing the order of integration. Both variables have a unit root problem that is indicating the unsustainability of Saudi fiscal policy but the first differences of these variables are remained stationary and are indicating a chance being sustainable fiscal policy. Further, fiscal sustainability has been investigated with a cointegration analysis and it proves sustainability with cointegration between the fiscal variables: public expenditures and revenues. After confirming the sustainability, the next step is to verify the strength of sustainability. This is confirmed by long run slope of public expenditures on public revenues in ARDL, FMOLS and DOLS analyses. It has been found positive and significant between zero and one. This slope is most important in deciding the strength of sustainability as advocated by A. Habib et al. (2016). Therefore, the Wald restriction test on slope equal to zero and equal to one has been employed to verify this. It also confirms the magnitude of slope between zero and one and thus proves weak fiscal sustainability in Saudi Arabia. So, there is a need for fiscal reforms to manage a strongly sustainable

fiscal policy and thus we recommend Saudi government to increase tax base instead of relying on just oil revenues as tax is only 10% of the public revenues in Saudi Arabia. An increased tax based economy can resolve this weak sustainability issue by collecting more public revenues. Moreover, the burden of budget deficits would be shifted on to present generation instead of future ones.

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