
Modelling Fiscal Sustainability in the Middle East and North African Region: A Pooled Mean Group Approach

¹George Tweneboah & ²Daniel Agyapong

¹*Ghana Baptist University College, Email: opokutweneboah@yahoo.com*

²*University of Cape Coast, Email: dagyapong@ucc.edu.gh*

ABSTRACT

This paper assesses the sustainability of fiscal policies in a panel of eight Middle East and North African countries over the period 1990 – 2010. Employing recent panel unit root and co-integration techniques, we find that fiscal policies are consistent with inter-temporal budget balance in accordance with the present value approach. The Pooled Mean Group estimator shows that there was no significant causality between government revenues and expenditures in the short-run. However, there is a long-run fiscal synchronization which demonstrates that fiscal sustainability strategies should aim at increasing revenues and cutting spending concurrently to avoid fiscal deficits and its attending problems such as high taxation, reduced savings and investments.

JEL Classification: C23; E62; H62; H63

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Introduction

In determining the sustainability of fiscal policies, the issue of rising and persistent debt levels are matters of great concern. This subject has become a very significant indicator in World Bank and IMF assessments, since a number of financial crises in the past have been associated with it. This phenomenon has engendered extensive research into the sustainability of budget deficits and public debt levels in both academic and policymaking fronts. The 2008 global financial crisis and the ongoing European Sovereign debt crisis (Lane, 2012) have presented great lessons for governments and fiscal policymakers all over the world to strenuously ensure fiscal discipline. The considerable attention given to the subject since the crisis in 1980s has yielded a large body of literature, albeit with unclear conclusion (Hakkio & Rush, 1991; Trehan & Walsh, 1988; Quintos, 1995). Most current researches have been based on the Present Value Budget Constraint (PVBC) methodology, which focuses on the time series properties of government revenues, expenditures, fiscal balance or level of public debt.

The paper focuses on the Middle East and North African (MENA) countries because despite the huge oil and mineral deposits in the region, there have been concerns about the rising levels of debt and deficit that characterise most countries in the region. The region is an interesting case, because, in aggregate, the MENA has recorded a fiscal surplus position since 2003 – increasing from 1.5 percent of the region's GDP in the early 2000s to 14.5 percent by 2006 (IMF, 2012). However, within this high regional surplus are individual countries with high deficits. For instance, while Kuwait realised a surplus of 39.0 percent of GDP in 2007, Lebanon recorded a deficit as high as 10.8 percent of GDP for the same period. In terms of public debt, most countries in the region have seen increasing levels with a number of them running debt levels over 50 percent of GDP. A typical example is Lebanon, with central government gross debt exceeding 130 percent of GDP as at 2011 (IMF, 2012).

High level government debt means a substantial government resources must go into debt servicing by way of interest payment (Foster, 2013). As a strategy of mobilising resources, governments either increase tax or issues debt instrument on the open market. This imposes tax burden on households and businesses. This impacts negatively on savings and private investments as high taxes are disincentive to investments. An alternative to fiscal policy is the monetary policy through the issue of debt instruments by the government, normally on the domestic financial market. However, such a policy results in the crowding out effect – a situation where government debt instrument competes private borrowers. The medium to long term consequences is that businesses finds it difficult to access both equity and debt financing for their operations.

The growing demands for social spending in response to the financial crisis of 2008, the political unrest in the region (since 2010) dubbed the “Arab spring”, and the increasing concern over the negative consequences of rising

government debt and fiscal deficits, have crucial implications for fiscal policy formulation. As such, it makes it imperative to revisit the question of debt and fiscal sustainability in the region and proffer policy recommendations on how to ensure sustainability of fiscal stance.

This study follows the recent course and applies a battery of recently developed linear panel unit root and co-integration techniques to data on government revenue (*grev*) and expenditure (*gexp*) for the Middle East and North African countries¹ (hereafter known as MENA). The paper makes contribution to the ongoing debate on fiscal sustainability and adds to the inadequate literature with respect to the MENA region.

We extend the literature on the short-run as well as long-run causal relationship between government expenditure and revenues. Using more advanced dynamic heterogeneous long-run estimation techniques, such as Pooled Mean Group (PMG), the relationship is further explored to establish whether countries in the MENA are characterized by either the tax-spend, spend-tax or fiscal synchronization hypothesis, as it holds critical implications for any fiscal consolidation process in the region. Justifiably, it is important to understand the causal linkages or relationship between expenditure and revenue as; it may provide practical insights into the dynamics and processes involved in fiscal policy adjustments and serve as a guide on how policy makers should approach budget deficits in future.

The remainder of the paper is structured as follows. Section 2 presents a review of the theoretical and analytical framework of public finance sustainability. Section 3 is a brief description of the data and methodology. The different unit root tests along with the battery of co-integration techniques are explained. The results of applying them to the panel data for eight MENA countries are presented in Section 4. We capture the long-run as well as short-run dynamics of the relationship in this section, and present the conclusion in the last section.

Literature Review

In modelling the panel model for fiscal sustainability, a number of key assumptions are considered within the inter-temporal budget constraint of the government. The ‘no Ponzi game rule’ or transversality condition (Azizi, Canry, Chatelain & Tinel, 2012) necessitates that the public debt must not grow at a rate greater than the interest rate. If this condition is fulfilled, then the inter-temporal budget constraint would bring about equality between the stock of the market value of public debt (Chatterjee, Gibson & Rioja, 2016) and the sum of

¹The World Bank classifies the following countries as belonging to the MENA region: Algeria, Bahrain, Djibouti, Egypt, Iran, Iraq, Israel, Jordan, Kuwait, Lebanon, Libya, Malta, Morocco, Oman, Qatar, Saudi Arabia, Syria, Tunisia, United Arab Emirates, West Bank and Gaza and Yemen

discounted future budget surpluses. If this condition is valid, the IBC theory predicts the fiscal policy of the government to be sustainable.

Based on this assumption, the empirical literature proposes several frameworks to examine the sustainability hypothesis. One direction of the studies suggests test for the stationarity of the primary budget surplus in order to check whether the transversality condition holds. Hamilton and Flavin (1986) make the assumption about the constant real interest rate, and argue that the stationarity of the primary budget deficit is a sufficient condition for fiscal policy to be sustainable. This test based on the univariate properties of public debt has seen a number of applications in the literature (Davig, 2005; Wilcox, 1989). However, Wilcox (1989) derives the condition for sustainable fiscal policy, which suggests that the present value of the stock of public debt must go to zero in the infinite future when allowing for time-varying interest rate. In other words, solvency implies that the government cannot leave a debt with positive expected value asymptotically. This condition predicts that future primary surpluses are sufficient to repay existing as well as future debt at its market value.

Hakkio and Rush (1991), and Quintos (1995) extend this framework to imply examination of co-integration between revenue and expenditure. According to the proponents, given that both revenue and expenditure are non-stationary and of the same order of integration, and the transversality condition holds, a long-run relationship between them must yield a co-integrating coefficient close to unity as the *necessary and sufficient* condition for inter-temporal budget constraint to be valid. When this is the case, it is said that it is strongly sustainable where as a co-integration with slope less than unity is considered weakly sustainable. Hakkio and Rush (1991), and Quintos argue further that, when government revenues and expenditures are expressed as a percentage of GDP (or in terms of per capita), it is necessary to have $b = 1$ in order for the course of the government debt to GDP ratio not to diverge in an infinite horizon.

Based on this theoretical framework, intensive empirical scrutiny has emerged. The disappointing conclusion from these earlier studies based on the stationarity approach has turned away more recent research towards a more flexible co-integration-based test. Although this method has brought some flexibility, the outcome from this approach has not been conclusive either (Afonso, 2005; Bravo & Silvestre, 2002; Papadopoulos & Sidiropoulos, 1999).

Arguments have emerged on the possible causes of failure of econometric techniques to establish fiscal sustainability (Westerlund & Prohl, 2010). According to Westerlund and Prohl (2010) this could be attributed to at least two dimensions of defects in most previous studies. The fact is that earlier studies tested the null hypothesis of unit root in debt series or public deficit or no co-integration, and Westerlund and Prohl argue that low power in the tests could be one reason why it has been difficult to use co-integration to establish

validity of the inter-temporal budget constraint. Another source of argument has been based on the application of conventional unit root and co-integration techniques to individual countries. Westerlund and Prohl claim that this approach does not really bring any more information into the analysis and essentially disregards the information contained in the cross-sectional dimension. This has led to the introduction of panel unit root and co-integration methodologies as an attempt to correct these flaws. A number of articles that apply panel techniques have been able to establish fiscal sustainability. In the case of the EU, studies that are based on panel co-integration framework have provided strong evidence to support the validity of the inter-temporal budget constraint (Prohl & Schneider, 2006; Westerlund & Prohl, 2006; Afonso & Rault, 2007). The majority of those studies have centred on the EU 15 and some have properly accounted for possible structural breaks in the dataset.

Panel co-integration methodologies have been tested using OECD countries and there is some evidence to support the validity of fiscal sustainability within the Present Value Budget Constraint. For example, Ehrhart and Llorca (2007) apply panel co-integration to a sample of 20 OECD countries for the period 1975 to 2005. Based on the evidence of a long-run relationship linking revenue and expenditure, they conclude that fiscal policies are consistent with inter-temporal budget constraint. In the same year, Ehrhart and Llorca applied panel techniques to establish that the fiscal sustainability hypothesis could not be rejected using quarterly panel data that covers eight rich OECD countries over 1977 to 2005.

For the fact that the panel approach makes provision for countries with short span datasets, other regions have also benefited from the recent improvement in the literature. For example, the Asian region has recorded a number of studies. Some of these studies have found that, although fiscal sustainability could be established for the region, the evidence points to 'weak' fiscal sustainability (Lau & Baharumshah, 2005; and Adedeji & Thornton, 2010). They suggest that policy measures would be required to put the public finances on a more sustainable basis. Also, for the South-Mediterranean region, the recent application has been tested by Ehrhart and Llorca (2008). They considered the validity of long-run sustainability in the fiscal policies for a panel of six countries (including Egypt, Israel, Lebanon, Morocco, Tunisia and Turkey) and concluded that fiscal policies are sustainable in these countries.

A study by Mahdavi and Westerlund (2011) in the US applied a co-integration-based test within the panel framework to test the Inter-temporal Budget Constraint (IBC) using the fiscal balance, revenue and expenditure. Two different definitions for the fiscal balance were used for a panel of 47 units at the sub-national government level from 1960-2006. The results indicate evidence of strong sustainability (based on co-integrating coefficient that was not significantly different from unity) in relation to the more broadly defined balances and weak sustainability for the narrowly defined balances.

Since the main proposition by Engle and Granger (1987) within the co-integration framework implied causal relationships, the direction of causality between revenue and expenditure has been another strand of empirical discourse. If no co-integration is detected, we say that there is no evidence of causality running between the variables. However, if co-integration is established, three different outcomes are possible since causality implies that a change in one variable necessitates or drives a change in another variable. We can assess whether causality runs from revenue to expenditure, from expenditure to revenue, or in both directions. The tax-and-spend hypothesis is based on evidence of a unidirectional causality running from revenue to expenditure, as championed by Friedman (1978). Friedman argues that tax cuts lead to higher deficits, and if the government cares about its implications it would then reduce its level of spending.

An alternative version of this hypothesis was advanced by Wagner (1976), and Buchanan and Wagner (1978). They found taxes unidirectionally induce negative changes in expenditure. This means that increase in tax would lead to spending cuts. The thrust of Buchanan and Wagner's (1978) argument is that taxpayers suffer from fiscal illusion. They point out that when taxes are cut, the taxpayer will assume that the cost of providing goods and services has fallen and for that matter will demand more programmes from the government. If such programmes are undertaken, it will result in an increase in government spending. As this continues, it will result in higher budget deficits. While tax changes induce changes in spending, the relationship is an inverse one, as postulated by Buchanan and Wagner. Therefore, increase in taxes is the only cure to budget deficits.

The spend-and-tax hypothesis advanced by Peacock and Wiseman (1979) and Barro (1979) are based on causality directed from expenditure to revenue. Under this, the fiscal illusion problem does not apply and proponents argue that an increase in government spending induces tax hikes. On this basis, they suggest that spending cuts is the solution to budget deficit problems. Another hypothesis, termed fiscal synchronization, is based on Musgrave's (1966) classical view of public finance where there is a bidirectional causal relationship between revenue and expenditure. Under this theory, revenue and expenditure are determined simultaneously and the public is said to weigh the benefits of government services to their costs (Musgrave, 1966). Within this theory, the best strategy to deal with problems of fiscal deficit is to cut spending and undertake revenue intensive measures.

The empirical evidences on this aspect have provided mixed results. Studies based on the United States alone have provided contentious results. While some researchers provide support for a positive relationship between revenue and expenditure (Hoover & Shefrin, 1992; Bohn, 1991; Ram, 1988; Blackley, 1986), others have found results to confirm the negative tax-spend relationship (Niskanen, 2002; 2006; Darrat, 1998; 2002). Also, some studies

report findings that maintain the spend-and-tax hypothesis (Ross & Payne, 1998; Jones & Joulfaïn, 1991; Anderson, Wallace & Warner, 1986), while others also suggest that the fiscal synchronization hypothesis holds (see, for example, Owoye, 1995; Miller & Russek, 1990).

Data and Methodology

Data description and sources

This study draws on recent advances in the econometrics of panel unit root and co-integration techniques to investigate the relationship between government revenue (*grev*) and expenditure (*gexp*) for eight Middle East and North African Countries (MENA) over the period 1990 – 2010. Based on the available data, the countries included in the panel are Bahrain, Iran, Jordan, Kuwait, Tunisia, Egypt, Israel, and Lebanon. Since most macroeconomic variables exhibit trend behaviour, the co-integration analysis begins with establishing the data generation properties of the variables. Starting from the present value borrowing or inter-temporal budget constraint of governments, we investigate past fiscal data to see if they follow a stationary process, or if there is co-integration between government revenue and government expenditure as a percentage of GDP. The data are obtained from the World Development Indicators (WDI) database. Going by the usual caveat in the literature, we take the logarithms of both variables.

Panel Unit Root and Stationarity Tests

The analysis involved the application of panel unit root methodology to analyse the time series properties of the data to verify whether or not the variables are integrated of order 1. Several authors have proposed unit root tests based on different sets of assumptions. These include the six distinct panel unit root and stationarity tests as proposed by Levin, Lin and Chu (2002) or the LLC, Im, Pesaran, and Shin (2003) or IPS, Breitung (2000), Hadri (2000) as well as Maddala and Wu (1999). The LLC, Breitung and Hadri tests are based on the common unit root process assumption that the autocorrelation coefficients of the tested variables across cross sections are identical. Conversely, the IPS, PP-Fisher, and ADF-Fisher tests rely on the individual unit root process assumption that the autocorrelation coefficients vary across the cross sections. In the LLC, IPS and ADF-Fisher tests, cross-sectional means are subtracted in order to minimise problems arising from cross-sectional dependence. However, Hadri and Breitung tests allow for cross-sectional dependence. The Schwarz-Bayesian information criterion (BIC) is used to determine the country-specific lag length for the ADF regressions, with a maximum lag of 4 regarding the LLC, Breitung, and the IPS tests. Further, the Bartlett kernel was used to estimate the long-run variance in the LLC and Hadri test, with the maximum lags determined by the Newey – West bandwidth selection algorithm.

Panel Co-integration Methodology

After confirming the unit root and integrated nature of the series, we test for co-integration between government revenue and expenditure in the panel. This was done by employing Pedroni (1999, 2000, 2004), Kao (1999), Maddala and Wu (1999) (Johansen Fisher combined tests) and Westerlund (2005, 2007, 2008). Both Kao and Pedroni tests are based on the two-step co-integration approach of Engle and Granger (1987) and assume the presence of a single co-integrating vector, although Pedroni's test allows it to be heterogeneous across individuals. The proposed Johansen Fisher combined tests are based on the multivariate framework of Johansen (1988). The Westerlund tests are based on structural rather than residual dynamics and do not impose any common parameter constraint. For purposes of this paper, we employ only the Pedroni and Westerlund panel error correction model (ECM) tests.

The seven co-integration tests for heterogeneous panels provided by Pedroni (1999, 2004) are based on the two-step co-integration approach of Engle and Granger (1987). Although the tests allow for heterogeneity, there are different versions of the test. The four within-dimension ("panel statistics") tests assume homogeneity of the AR term, whilst the three between-dimension ("group statistics") tests allow for heterogeneity of the AR term. The test is based on the equation:

$$r_{it} = e_{it}\beta_i + \delta_i + \theta_i t + \varepsilon_{it} \quad (1)$$

Where r is a vector of the dependent variable, e represents a vector of explanatory variable(s), β is a vector of long-run coefficient, δ_i and θ_i are country and time fixed effects, respectively. Deviations from the long-run relationship are represented by estimated residuals and denoted ε_{it} . Also, $i=1, \dots, N$ represents each country in the panel, and $t=1, \dots, T$ denotes the time period. The estimated residual has the following structure:

$$\varepsilon_{it} = \rho_i \varepsilon_{it-1} + \varphi_{it} \quad (2)$$

The four tests based on the within-dimension statistics have the alternative hypothesis $\rho_i = \rho < 1$ for all i , while the three tests based on the between-dimension statistics have the alternative hypothesis $\rho_i < 1$ for all i . ρ is an autoregressive coefficient of the residuals across sample. One limitation of these tests is the common factor restriction, which suggests that the short-run parameters for the first differences of the variables equate the long-run parameters for the levels of the variables. This condition does not take into account possible cross-country dependence and failure to satisfy it can cause a significant loss of power for the residual-based co-integration tests.

Westerlund (2007) puts forward an extension of Banerjee, Dolado, and Mestre's (1998) four panel co-integration tests. Contrasting the Pedroni residual tests, Westerlund's tests are based on structural dynamics and allow for a large degree of heterogeneity. A data generating process in the form:

$$\Delta r_{it} = \delta'_i d_t + \alpha_i (r_{it-1} - \beta'_i e_{it-1}) + \sum_{j=1}^{pi} \alpha_{ij} \Delta r_{it-j} + \sum_{j=0}^{pi} \gamma_{ij} \Delta e_{it-j} + \varepsilon_{it} \quad (3)$$

where $t = 1, \dots, T$ and $i = 1, \dots, N$ indicate the time-series and cross-sectional units, respectively, while d_t contains the deterministic components, for which there are three cases; no deterministic terms, constant, and constant and trend; the parameter α_i measures the speed at which the system $r_{it-1} - \beta'_i e_{it-1}$ reverts back to its equilibrium after an unexpected shock in one of the model variables. If $\alpha_i < 0$, it means there is co-integration and the model is error-correcting. On the other hand, if the parameter $\alpha_i = 0$, there is no co-integration and the system would not return to its equilibrium status after a sudden shock.

The Westerlund tests make provision for possible cross-country dependence and overcome the problem of common parameter constraint. The tests are designed to test the null hypothesis of no co-integration by inferring whether the error-correction term in a conditional error-correction model is equal to zero. A rejection of the null hypothesis of no error-correction can, therefore, be viewed as a rejection of the null hypothesis of no co-integration.

The four different statistics are based on least squares estimates of α_i and its test ratio. The panel statistics, denoted Pa and Pt , test the null hypothesis of no co-integration against the alternative that the whole panel is co-integrated. Also, the group-mean statistics, Ga and Gt , test the null hypothesis of no co-integration against the alternative that at least one constituent in the panel is co-integrated. The tests make no provision for heterogeneity, but provide p -values which are robust against cross-sectional dependencies by bootstrapping.

Panel co-integration estimation

The study proceeds to estimate the short-run and long-run coefficients to investigate the causal relationship between **grev** and **gexp** after establishing the existence of co-integrating relationship amongst the variables by utilizing the pooled mean group (PMG) estimator proposed by Pesaran, Shin, and Smith (1999). In order to ensure robust analysis, results of alternative estimation strategies are reported – the mean group (MG) and the dynamic fixed effects (DFE). The estimator extends the single equation autoregressive distributed lag (ARDL) model and takes advantage of the error correction representation. It provides information about the contemporaneous shocks and the speed of converging towards the long-run equilibrium position after a shock.

The dynamic heterogeneous panel regression based on Pesaran *et al.* (1999) can be incorporated into an error correction model using the autoregressive distributed lag (ARDL) (p,q)² technique represented as follows:

$$\Delta r_{it} = \sum_{j=1}^{p-1} \gamma'_{ij} \Delta r_{it-j} + \sum_{j=0}^{q-1} \delta'_{ij} \Delta e_{it-j} + \varphi^i [r_{it-1} - \{\beta_0^i + \beta_1^i e_{it-1}\}] \varepsilon_{it} \quad (4)$$

²p represents the lag of the dependent variable, and q is the lag of the independent variable.

Where r is the dependent variable, e is a vector of independent variable(s), γ' and δ' represent the short-run coefficients of lagged dependent and independent variables respectively, β contain information about the long-run impacts, and φ is the error correction term (or speed of adjustment) to the long run equilibrium. The subscripts i and t represent country and time effects, respectively. The square brackets contain a term that provides information about the long-run regression.

Besides, while the short-run coefficients are allowed to vary across the sections of the panel (i.e. heterogeneous), the long-run coefficients are assumed to be identical across panels (i.e. homogeneous). Also, the MG estimator, which allows the long-run parameters to be heterogeneous and the DFE estimator which assumes homogeneity for both the short- and long-run parameters are included. In order to see whether there are significant differences among these three estimators and choose the most consistent estimates, the Hausman h-test was applied. The test has a null hypothesis that the difference between PMG and MG or PMG and DFE estimation is not significant.

Results and Discussion

Table 1 shows the results of the panel unit root tests. The results provide evidence that the null hypothesis of unit root processes in both the *grev* and *gexp* variables for the panel of eight MENA countries cannot be rejected. The Hadri test which has the null hypothesis of stationarity provides strong evidence that all the variables have unit roots in levels. This implies that the panel variables are non-stationary in levels. In order to confirm the order of integration as I(1), we found the unit roots of first differences and demonstrated that both variables are I(1).

Table 1: Panel Unit Root tests in Levels

	LLC t-stat	Breitung t-stat	Hadri z-stat	IPS w-stat	ADF- Fisher X ²	PP- Fisher X ²
<i>gexp</i>	-0.18 [0.43]	1.13 [0.87]	4.37* [0.00]	-1.57*** [0.06]	12.62 [0.70]	7.19 [0.96]
<i>grev</i>	3.06 [0.99]	0.26 [0.60]	3.02* [0.00]	-1.20 [0.11]	5.30 [0.99]	5.97 [0.99]

Notes: Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality. Automatic selection of lags based on SIC: 0 to 2. The Newey-West bandwidth is selected using a Bartlett kernel. *, **, and *** indicates significance at 1%, 5% and 10% levels respectively. Values in [] are p-values. We assume constant and trend in the variables.

The results, thus, evaluate whether logarithm of revenue and its covariates as well as logarithm of expenditure and its associated covariates share a common stochastic trend. According to the results shown in Table 2, the different tests provide strong support for the presence of co-integration, particularly when logarithm of revenue was taken as the dependent variable. In the case of the Pedroni Residual tests, with the exception of the Panel v -statistics, which fails to reject the null of no co-integration, there is evidence of co-integration. There is also evidence of co-integration, according to three out of the four tests proposed by Westerlund reported in Table 3. Only the G_a statistic fails to reject the null of no co-integration. The findings imply in a panel perspective, $grev$ and $gexp$ are co-integrated, so that fiscal policies are sustainable in the long run.

Table 2: Pedroni Residual Co-integration Tests with Revenue as Dependent Var

Test	Alternative Hypothesis	Statistic	Prob.
Panel v -Statistic	Within-dimension	-0.42	[0.66]
Panel rho-Statistic	Within-dimension	-3.52*	[0.00]
Panel PP-Statistic	Within-dimension	-3.07*	[0.00]
Panel ADF-Statistic	Within-dimension	-4.10*	[0.00]
Group rho-Statistic	Between-dimension	-1.68**	[0.04]
Group PP-Statistic	Between-dimension	-3.49*	[0.00]
Group ADF-Statistic	Between-dimension	-4.37*	[0.00]

*Notes: Results generated by Eviews 7.2. Pedroni's panel statistics assume homogeneity of the AR term. The group statistics tests assume heterogeneity of the AR term. *, **, and *** indicates significance at 1%, 5% and 10% respectively.*

Table 3: Westerlund ECM panel co-integration tests with Revenue as Dependent Var

Statistic		Z – value	Prob.
Gt	Group	-2.50**	[0.01]
Ga	Group	-0.85	[0.20]
Pt	Panel	-3.29*	[0.00]
Pa	Panel	-4.20 *	[0.00]

*Notes: Results generated by xtwest command in Stata 12. Values in [] are robust p-values. *, **, and *** indicates significance at 1%, 5% and 10% respectively.*

Also, with *gexp* as the dependent variable, we confirm that all the tests support the presence of co-integration except Pedroni's Panel ν -statistics and Westerlund's *G*tests.

The long-run and short-run estimates, the convergence coefficients based on the different estimation strategies along with results of the Hausman test, are reported in different columns of Table 4. The results indicate that the lag of the *gexp* variable has a negative impact on the current values of *grev*. This means that an increase in *gexp* causes a decline in *grev*. Similarly, the lag of the *grev* variable has a negative impact on the current values of *gexp*. Again, we found an increase in *grev* causes a fall in *gexp*. However, based on the PMG results the coefficients are not significant in both cases. This means that the effect of *grev* or *gexp* on the other is not significant in the short-run. This implies that there is no strong evidence to support short run causality between *grev* and *gexp*. Although this may seem insignificant, we argue that such a behaviour resembles the fiscal illusion theory posited by Wagner (1976), and Buchanan and Wagner (1978).

In all three instances, the error correction terms or convergence coefficients that capture the speed of adjustment are statistically significant at the one percent significant level. This strong significance lends more support to the evidence of long-run relationship or causality between the variables. This means further evidence of co-integration is established by the error correction term (convergence coefficient), which is statistically significant. Again, the error correction terms are negative. This negative adjustment is expected as it implies that for any deviations of *gexp* in the previous period, there would be a positive change in *grev*. In the same manner, if *grev* in the past period have overshoot the equilibrium, then it is forced to come back towards equilibrium.

Table 4: Long-run Coefficient Panel Estimation Results

Dependent variable	<i>grev</i>			<i>gexp</i>		
	PMG	MG	DFE	PMG	MG	DFE
Convergence coefficients	- 0.30* [0.00]	- 0.52* [0.00]	-0.26* [0.00]	- 0.29* [0.00]	-0.48* [0.00]	- 0.36* [0.00]
Long-run coefficients	0.83* [0.00]	0.31 [0.32]	-1.40* [0.00]	0.68* [0.00]	0.16 [0.44]	-0.02 [0.91]
Short-run coefficients	-0.14 [0.42]	0.06 [0.62]	-0.47* [0.00]	-0.06 [0.63]	0.05 [0.55]	- 0.54* [0.0]
Hausman test		0.78 [0.38]	3.02*** [0.08]		2.80*** [0.09]	0.13 [0.72]

xtpmg command in Stata 12 was used to generate the *mg*, *pmg* and *DFE* estimates. Values in [] are *p*-values. *, ** and *** indicate significance at 1%, 5% and 10% significant levels. Based on the Schwartz Bayesian criterion we impose the lag structure (1, 1) for both variables. According to the Hausman test, the PMG is favoured in both instances.

Also, the somewhat large magnitudes imply that the model returns to its equilibrium state immediately after a shock has pushed it away from the original arrangement. There is a strong tendency to revert back to the equilibrium relationship after unexpected shocks or deviations are experienced by the model. Both *grev* and *gexp* adjust in response to deviations and approach the long-run equilibrium condition.

Furthermore, Table 3 indicates that the long-run coefficients are positive and statistically significant based on the PMG. This connotes that *grev* and *gexp* have a significant positive impact on each other and by that an increase in *grev* or *gexp* would bring about a response from the other variables in a similar direction. This supports the evidence of long-run fiscal synchronization hypothesis. The fiscal synchronization hypothesis asserts that expenditure and revenue decisions are made simultaneously by national authorities. It implies that, in an attempt to tackle the problem associated with persistent rising levels of budget deficit, MENA governments need to be cautious, as pointed out by Manage and Marlow (1986), about simply cutting expenditures, increasing revenue or simply altering both revenues and expenditures without taking into consideration that the dependence of one variable on the other variable may lead to ambiguity in their impacts on fiscal situation.

Our evidence lends support to findings of studies by Manage and Marlow (1986), Joulfaian and Mookerjee (1990), Bhat *et al* (1993), Baffes and Shah (1990, 1994), Owoye (1995), Ewing and Payne (1998), Cheng (1999) and Nyamongo, *et al.* (2007), who provide evidence of the fiscal synchronization hypothesis.

Conclusion

Fiscal policies in the region are in harmony with their inter-temporal budget constraints, indicating the ability to repay financial obligations in the form of debt without explicit default. Sustainable fiscal policies can be continued in perpetuity without changes in policy directions, and when there is validity of inter-temporal budget constraint in present value terms.

The short-run evidence based on the error correction models hint of fiscal illusion problems, albeit insignificant. Conversely, we find that there is a long-run bidirectional causality between them, suggesting that both government revenue and government expenditure help push the budget towards equilibrium should there be deviations from the long-run relationship. This finding supports the hypothesis of fiscal synchronization demonstrating the impact fiscal and

institutional reforms have had on budgetary outcomes in the region over the study period. In order to be able to tackle issues of persistent fiscal deficits in the region, policymakers need to come out with strategies intended to increase revenues and cut government spending concurrently. Such strategies should be devoid of policies that result in the crowding out effect and huge tax imposition on households and businesses, especially private investments.

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APPENDIX

Table 1: Panel Unit Root tests in Levels

	LLC t-stat	Breitung t-stat	Hadri z-stat	IPS w-stat	ADF- Fisher X ²	PP- Fisher X ²
<i>gexp</i>	-0.18 [0.43]	1.13 [0.87]	4.37* [0.00]	-1.57*** [0.06]	12.62 [0.70]	7.19 [0.96]
<i>grev</i>	3.06 [0.99]	0.26 [0.60]	3.02* [0.00]	-1.20 [0.11]	5.30 [0.99]	5.97 [0.99]

Table 2: Pedroni Residual Co-integration Tests with Revenue as Dependent Var

Test	Alternative Hypothesis	Statistic	Prob.
Panel v-Statistic	Within-dimension	-0.42	[0.66]
Panel rho-Statistic	Within-dimension	-3.52*	[0.00]
Panel PP-Statistic	Within-dimension	-3.07*	[0.00]
Panel ADF-Statistic	Within-dimension	-4.10*	[0.00]
Group rho-Statistic	Between-dimension	-1.68**	[0.04]
Group PP-Statistic	Between-dimension	-3.49*	[0.00]
Group ADF-Statistic	Between-dimension	-4.37*	[0.00]

Table 3: Westerlund ECM panel co-integration tests with Revenue as Dependent Var

Statistic		Z – value	Prob.
Gt	Group	-2.50**	[0.01]
Ga	Group	-0.85	[0.20]
Pt	Panel	-3.29*	[0.00]
Pa	Panel	-4.20 *	[0.00]

Table 4: Long-run Coefficient Panel Estimation Results

Dependent variable	<i>grev</i>			<i>gexp</i>		
	PMG	MG	DFE	PMG	MG	DFE
Convergence coefficients	- 0.30* [0.00]	- 0.52* [0.00]	-0.26* [0.00]	- 0.29* [0.00]	-0.48* [0.00]	- 0.36* [0.00]
Long-run coefficients	0.83* [0.00]	0.31 [0.32]	-1.40* [0.00]	0.68* [0.00]	0.16 [0.44]	-0.02 [0.91]
Short-run coefficients	-0.14 [0.42]	0.06 [0.62]	-0.47* [0.00]	-0.06 [0.63]	0.05 [0.55]	- 0.54* [0.0]
Hausman test		0.78 [0.38]	3.02*** [0.08]		2.80*** [0.09]	0.13 [0.72]