Does the Twin-Deficits doctrine apply to the Gulf Cooperation Council? A dynamic panel VAR-X model approach

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Abstract:

Economies around the world tend to show a strong link from fiscal to current accounts deficits. The phenomenon is recognized as the twin-deficits doctrine, which stipulates the presence of a uni-directional causal relationship from the fiscal account deficit (FD) to the current account deficit (CD). This relationship is also apparent for the commodity-based economies of the Gulf Cooperation Council States (GCC). The region is well-documented to rapidly succumb to deteriorating fiscal and current account deficits with any prolonged decline in international crude oil prices. This study extends the research of Granger non-causality between budget deficits by employing a macro-panel in a two-dimensional vector autoregression model with an exogenous variable (VAR-X) process where oil is included as the exogenous control variable. The study uses a homogeneous model in the generalized method of moments framework to conduct a comprehensive investigation between the two deficits and analyze if the twin-deficits doctrine applies to the GCC. A heterogeneous model with fixed time coefficients is then used as a robustness check to assess if the twin-deficits phenomenon applies to any of the GCC States. The results indicate that the pooling of data from six GCC States and the inclusion of international oil prices, as the third latent element, leads to the dismissal of the twin-deficits doctrine for the GCC as an integrated unit of analysis, and, for each member State of the GCC individually. Interestingly, the analysis uncovers a reverse direction of causality running from CD to FD.

Keywords: Twin-Deficits, Granger non-causality, Gulf Cooperation Council, Macro-panels, VAR-X.

JEL Classification: E62 – F32 – F41 – C23

1. Introduction

Expansionary fiscal policy, low international oil prices, coupled with continuing global economic slump due to Covid-19 have all placed the Gulf Cooperation Council (GCC) members in a precarious budgetary situation. The council comprising of United Arab Emirates, Kingdom of Bahrain, Kingdom of Saudi Arabia, Sultanate of Oman, State of Qatar, and State of Kuwait are all in a trajectory predicting prolonged fiscal and current accounts deficits in the years ahead. Due to this, the International Monetary Fund (IMF) is predicting that several members of the GCC might deplete their cash reserves in the coming years if decisive underlying structural changes are not implemented (Mirzoev et al., 2020). Moreover, the government of these countries will likely accentuate the situation by raising funds internationally or dipping into their foreign-exchange reserves. In its simplest definition, the twin or double deficits is the view that an economy that runs a fiscal account deficit will eventually run a current account deficit. More formally, the presence of a uni-directional causal relationship from the fiscal account deficit to the current account deficits. Thus, the GCC States will have to grapple with the systemic vulnerabilities and risks stemming from both the fiscal account and current account balances being in deficits. Though finances are still robust, due to many years of surplus, fiscal, and current accounts deficits management, in the next coming decade, will play a pivotal role in the overall economic and financial stability of these countries.

The objective of this paper is to assess if the twin-deficits hypothesis applies to the GCC economies by conducting a comprehensive investigation on the inter-relationship of its budget deficits. To do this, I use the Granger non-causality framework to test four empirical hypotheses. A macro-panel data set is used for the six GCC States from the period 1993 – 2017. However, as

oil receipts, and not taxes, are the main source of revenue for the GCC governments, the causal analysis differ in that oil prices contribute directly to both deficits. This makes oil prices a confounding variable requiring particular attention. Hence, to capture the theoretical prediction of the interaction of the two budget deficits for the GCC, the framework controls for the role of oil prices, and augment its interpretation with institutional features of the GCC that impact the transmission channels between the two deficits. Therefore, the study employs a bivariate VAR-X homogeneous model in a generalized method of moments (GMM) framework adapted to a panel context as in Holtz-Eakin, Newey, and Rosen (1988). To estimate the model, Arellano and Bover (1995) forward orthogonal deviation transformation for models with predetermined variables is used to avoid the Nickell Bias. As a robustness check, a heterogeneous framework is then utilized that modifies the assumption that the panel VAR-X regression model is valid for all the States of the GCC. I use a model proposed by Dumitrescu and Hurlin (2012) to test for Granger non-causality where causality is applicable if all the members, or any of the members of the GCC States, have (has) a causal relation.

The results from the homogeneous panel VAR-X model concluded that ΔFD_{t-1} does not Granger-cause ΔCD_t. Therefore, the twin deficit doctrine does not apply to the GCC as a single integrated unit of analysis. Instead, the results uncover that ΔCD_{t-1} does Granger-cause ΔFD_t. This indicates that the causal relationship between the deficits runs from the current account to the fiscal account. Hence, the budgets are linked but are not twins[1]. As for the robustness test using a heterogeneous panel VAR-X model, test results also concluded that ΔFD_{t-1} does not Granger – cause ΔCD_t for any member States of the GCC. Consequently, the twin-deficits doctrine is also

[1] Governor Edward M. Gramlich during his Federal Reserve Board remarks at the Isenberg School of Management Seminar Series also argued that " Budget and trade deficits should be viewed as linked, but not as twins (Gramlich, 2004).

rejected. This reinforces the conclusion that for the GCC, ΔCD_{t-1} does Granger-cause ΔFD_t at least for some of the member States, if not all of them, as indicated by the homogeneous model. The study concludes that the twin-deficits doctrine does not apply for the GCC, not only as an integrated unit of analysis (homogeneous model), but also for any of the GCC States when treated individually (heterogeneous model).

The remainder of the paper is organized as follows. Section 2 presents the theory behind the inter-relation of the two budget deficits and the importance of including oil in the equation. Section 3 introduces the data used in the study. The empirical methodology, tests, and results are conducted in Section 4 for the homogeneous panel VAR-X model. This is followed by a brief explanation on how the institutional features of the GCC enable us to capture the model theoretical predictions. An extension to the model, as a robustness test, is presented in Section 5. Section 6 reviews the literature, and section 7 concludes.

2. Preliminaries: An Accounting Framework

The theoretical link of the causal relationship between the fiscal and current account deficits can readily be seen via the analysis of the national income accounting identities. Here, I closely follow Bernheim (1987, 1988).

In any economy, individuals dispose of income (Y) either as consumption (C), saving (S^p), or taxes (T):

(i) $$Y = C + S^p + T.$$

Additionally, income must arise from either the domestic sale of consumption goods (*C*), investment goods (*I*), governmental goods (*G*), or net sale of goods to foreign agents (exports, *X*, minus imports, *M*):

$$(ii) \qquad Y = C + I + G + (X - M).$$

Combine *(i)* and *(ii)* and rearrange to get the following accounting identity:

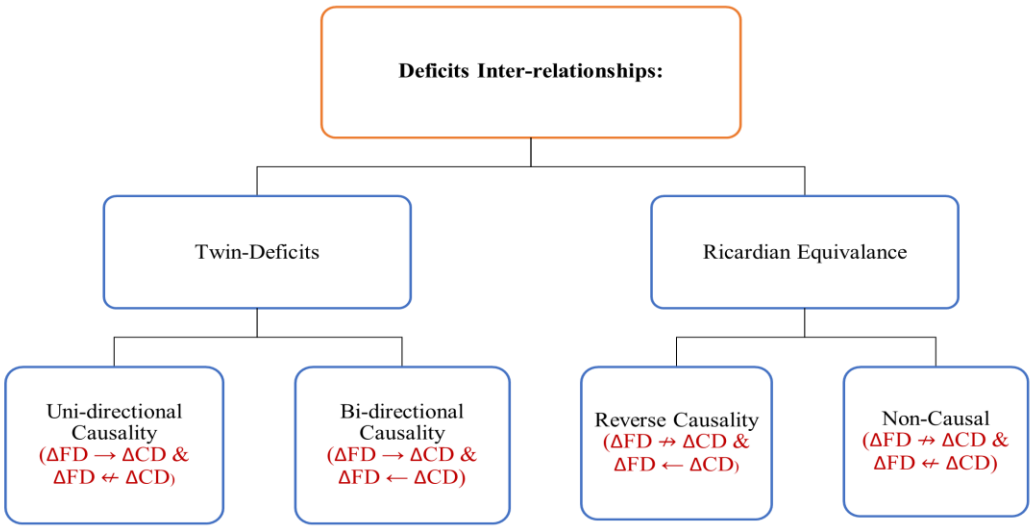
$$(iii) \qquad I = S^p - (G - T) + (M - X),$$

$$(iv) \qquad I = S^p - FD + CD.$$

From the above conclusion in (*iv*), the transmission channel from the fiscal deficit (FD) is directly linked to the excess of investment over private saving $(I - S^P)$ and the current account deficit (CD). Therefore, a higher fiscal deficit, indicates either the trade deficit must rise or the excess of investment over saving must decline, or both. This inter-relationship between the deficits, as indicated in equation (*iv*), has been profusely debated with emphasis placed on both the causal relationship and the direction of causality.

To investigate if the twin-deficits doctrine applies to the GCC taking into account the different interpretations leading to the debates, the study will employ four commonly used empirical hypotheses in the literature. The following flow chart is provided for clarification:

Figure 1: The Inter-Deficit Relationships Flow Chart



Two theoretical underpinnings divide the inter-relationships between the deficits in the flow chart: the Ricardian equivalence proposition and the twin-deficits proposition. The two approaches are discerned in the general literature by the presence or absence of a uni-directional causal relationship from $\Delta FD_{t-1}\ to\ \Delta CD_t$.

Advocates of the Ricardian school of thought claim that a fluctuation on the fiscal side (ΔFD) in equation (*iv*) due to a government debt or tax finance is offset by changes in the net private saving (S^p) and not the trade position (ΔCD). As a result, ΔFD_{t-1} does not cause ΔCD_t. According to the seminal work by Robert J. Barro (1974) on the Ricardian equivalence fiscal deficit will be offset by an increase in desired private saving that would rise by enough to avoid having to borrow from abroad causing a current account deficit. Forward – looking rational economic agents would match government borrowing by their demand for bonds anticipating and saving for future tax liabilities. Therefore, both the non-causal ($\Delta FD_{t-1} \nrightarrow \Delta CD_t$ & $\Delta FD_t \nleftarrow$

ΔCD_{t-1}) and reverse causality ($\Delta FD_{t-1} \nrightarrow \Delta CD_t$ & $\Delta FD_t \leftarrow \Delta CD_{t-1}$) hypotheses validate the Ricardian equivalence proposition. It is worth indicating that the reverse-causality hypothesis includes a causal relationship between the two deficits, albeit not from ΔFD_{t-1} to ΔCD_t as per the twin deficit requirement. Sometimes referred to as "Current Account Targeting Hypothesis," a uni-directional causality runs from ΔCD_{t-1} to the ΔFD_t. This occurs either naturally when deterioration in current account impacts the fiscal account due to diminishing economic growth, or when policy makers attempts to eliminate external imbalances using the budget deficit by "targeting the current account," (Marinheiro, 2008).

The twin-deficits approach, in contrast, postulate a uni-directional causal relationship from ΔFD_{t-1} to ΔCD_t. This traditional view, associated with Keynes, rejects Barro's notion of "dynastic families" that behave as a single infinite-lived individuals neutralizing future tax liabilities with current savings due to intergenerational altruism (Bernheim & Bagwell, 1988; Buchanan, 1976). To the adherence of the twin-deficits proposition, an increase in fiscal deficit will be offset by both an excess of private saving over investment ($I \prec S^p$) and an excess of imports over exports ($X \prec M$). This logic stems from the conviction that the change in fiscal deficit (ΔFD_{t-1}) is only partially compensated for by the increase in private savings (S) owing to the deficit-financed tax cuts. Though the boost in disposable income and expected lifetime wealth increases savings, it also stimulates aggregate demand in the short run. Hence, the increase in private savings do not commensurate the fiscal deficit entirely. As a result, net private saving will not be equivalent to the sum of investment and government borrowing. According to Keynesian income-expenditure identity, an increase in the fiscal account deficit indicates an upsurge in domestic absorption (Keynes, 1936). Domestic absorption is the sum of investment and consumption regardless of its origin. As a by-product, this will also decrease saving (increase

imports), which will worsen the current account if absorption is more than domestic production (Alexander, 1952, 1959)[2]. Therefore, both the uni-directional causality ($\Delta FD_{t-1} \rightarrow \Delta CD_t$ & $\Delta FD_t \nleftarrow \Delta CD_{t-1}$) and the bi-directional causality ($\Delta FD_{t-1} \rightarrow \Delta CD_t$ & $\Delta FD_t \leftarrow \Delta CD_{t-1}$) where feedback channels exist between the two deficits with each having a causal effect on the other, are part of this category.

This theoretical prediction of the interaction of the two budget deficits will be tested for the GCC but enhanced with institutional features. Unlike typical theoretical analysis of national accounts, the analysis of the GCC States differs in that traditional non-oil taxes play a non-essential role in the government constraint[3]. Saudi Arabia (2018), United Arab Emirates (2018), and Bahrain (2019) have only recently introduced value added tax, while income tax, still does not exist for any of the six-member countries (Malik & Nagesh, 2021)[4]. According to the IMF, non-oil tax revenues averaged 1.6 percent of the total GDP and 3 percent of non-oil GDP in 2012-14, while oil revenues, on the other hand, accounted for between 70 and 95 percent of total government revenue during the same period for the GCC States (IMF, 2015). Moreover, exports are also dominated by the energy sector in all the GCC States (Shehabi, 2021). Table 1 shows the immense role this commodity plays in the GCC economies that cannot be ignored in any analysis of the region. Though the data suggests a declining trend on oil dependency, both fiscal and trade positions in the GCC are still directly linked to crude oil. The sector accounts for the lion's share of its export earnings and government revenues. Consequently, this study will differ from

[2] The same logic applies from a general equilibrium perspective. The Mundell - Fleming framework (Fleming, 1962; Mundell, 1963) postulates that a growing fiscal deficit puts upward pressures on real interest rates due to the decline in national saving. This in turn leads to an inflow of capital which appreciates the domestic currency leading to the deterioration of the current account due to the decline in exports and an increase in imports.
[3] The government budget constraint is that "the present value of its purchases of goods and services must be less than or equal to its initial wealth plus the present value of its tax receipts net of transfer payments" (Romer, 2012).
[4] Oman introduced a value added tax system on April 2021.

comparable research of causality detection between fiscal and current accounts deficits by considering international oil prices as the third latent element due to its paramount role.

Table 1: GCC Oil Dependency in 2011 - 2017

Year	*Share of oil sector (%)*	
	In exports	*In government revenue*
2012	84	85
2013	84	81
2014	82	77
2015	72	72
2016	70	58
2017	73	62

Source: GCC - STAT (2018)

To further illustrate this special situation of the GCC economies, I refer to equation (*iii*) from the accounting framework. As export earnings and government revenues are mainly from crude oil, assume for a moment that both taxes (T) and exports (X) can conveniently be substituted by oil fiscal revenues (OR)[5] and oil exports (OE) in the national income accounting identities:

$$(iii) \quad I = S - (G - OR) + (M - OE).$$

[5] Setser (2007), for example, pointed out that most oil exporting economies consequently use revenues from the national oil company as a substitute for tax revenue.

The transformed equation indicates that a fluctuation in oil prices affect both the change in fiscal account deficit $(G - OR)$ and the change in current account deficit $(M - OE)$. To understand the linkage formally, an analysis of the terms-of-trade disturbances in an open economy is merited. Defined as the relative price of exports in terms of imports, a deterioration of the terms-of-trade influences in the GCC States impacts both the budget balances.

From the fiscal side, it reduces government revenues because of the change in receipts inflows (foreign exchange). If this change in revenues does not correspond to the ongoing government outlays, it triggers a fiscal account deficit. The channel is even more apparent for major commodity producers (Macklem,1993). For GCC States, not only are export taxes, oil royalties, and the profits of the state-owned oil companies an important (main) source of government revenues, but the reduction of government outlays maybe difficult to implement due to the dominant government role in these economies. Furthermore, the majority of GCC states are either producing at capacity or to an OPEC agreed upon quota. As a result, increasing the volume of production to make up for declining prices is limited if not impossible, all else equal.

On the other hand, the influence of the terms-of-trade on the current account balance can be captured through the *Harberger-Laursen-Metzler* effect (H-L-M) in the short run. According to Svensson & Razin (1983), who examined the effects of the terms-of-trade changes on a small country's spending and current account, they explain that Harberger (1950) and Laursen & Metzler (1950) contend that "a terms-of-trade deterioration decreases 'real income,' and the decrease in real income reduces saving out of any given income, both measured in terms of exportables". The assertion that a deterioration in terms-of-trade cause a reduction in savings, implies that the national income, and therefore savings, of the GCC States will decrease.

While Obstfeld-Svensson-Razin framework have criticized the Keynesian based H-L-M effects analysis on the terms-of-trade shocks by showing instead that its impact depends on the perceived duration of those shocks (Mendoza, 1995). Our analysis is based on a short run prognosis, which follows the H-L-M effect. Moreover, a systemic relationship between the current account and oil prices is expected in countries with low level of export diversification and a prominent oil sector as this will have a current account strongly linked to the oil balance (Gnimassoun et al., 2017). This significant role of oil prices in the budgets of oil-exporting economies can be so vital, like in the case of the GCC States, that specific terms have been coined to allude to the relationship. According to the IMF, the fiscal break-even oil price is the price of oil at which the fiscal account balance is zero, while the external break-even oil price, is the price of oil at which the current account balance is zero.

Moreover, unlike the original twin-deficits assumptions, where the deficit begins from the fiscal side $(T - G)$ and moves to the current account $(X - M)$, the impact of a large decline in oil prices can transform the two accounts into deficits simultaneously. This is due to the institutional feature of low taxation coupled with high dependence on oil for both export earnings and government revenues. Therefore, the variable, international oil prices, is known as a confounding variable in the model: A hidden variable being the true cause that influences both variables (fiscal deficit and current account deficit). This concern of omitting relevant variables in studying causality have been pointed out in the literature. Lütkepohl (1982) stated "it is well-known that Granger-causality in a bivariate system may be due to an omitted variable. It is also known that non-causality in a bivariate system may theoretically result from neglected variables".

Although, exchange rates and interest rates are also two pertinent variables proposed in the theoretical literature (C.-H. Kim & Kim, 2006), GCC States have fixed U.S. dollar pegs apart from

Kuwait that relies on a basket of currencies most likely dominated by the U.S. dollar[6]. As a result, both exchange rates (exogenously determined) and interest rates roles as transmission channel between the fiscal and current account deficits are muted due to the uncovered interest rate parity requirement with the anchor currency[7]. Therefore, the three variables incorporated in the study of the causal model will be the change in the fiscal account deficit (ΔFD), current account deficit (ΔCD), and international crude oil prices (ΔOP).

3. Data

The data used to conduct the empirical analysis for the four hypotheses is from the International Monetary Fund World Economic Outlook (IMF, 2020) and BP Statistical Review of World Energy (BP, 2020) for the period 1993 – 2017. Details of the data and manipulations can be found in Appendix A. For the study, the annual data of the six individual GCC States is pooled together into a balanced macro-panel data ($T = 25$ *and* $N = 6$). Table 2 shows the descriptive statistics of each variable of the GCC after they were transformed into a macro-panel.

Table 2: Descriptive Statistics

	observations	mean	st.dev.	min	max
Fiscal Deficit (% of GDP)	150	4.488	12.394	-21.309	43.304
Current Account Deficit (% of GDP)	150	-8.748	14.760	-45.462	30.859
Oil Prices (US dollars)	25	62.576	34.365	19.943	126.449

[6] Effective 20 May 2007 by virtue of the Decree No. 147/2007, the KD exchange rate was repegged to an undisclosed weighted basket of international currencies of Kuwait's major trade and financial partner countries. (Central Bank of Kuwait, 2021)

[7] For uncovered interest parity condition to hold in a fixed exchange rate system, the interest rates between two countries must be equal.

I use panel data for several reasons[8]. First, panel data contains more degree of freedom and sample variability. This is important for the GCC States due to the absence of long time series for each individual entity. By using macro-panels, the number of data points increase to 150 observations ($T * N$) instead of only 25 time series observations for each country. This improves efficiency of the econometric estimates by reducing collinearity among explanatory variables. Second, panel data mitigates the impact of omitted variables by controlling for entity fixed effects, time fixed effects, or both[9]. Even mismeasured or unobserved factors can be held constant by using panel data. Third, panel data can capture the inter-individual differences and intra-individual dynamics. This enables controlling for heterogeneity and avoiding biased results.

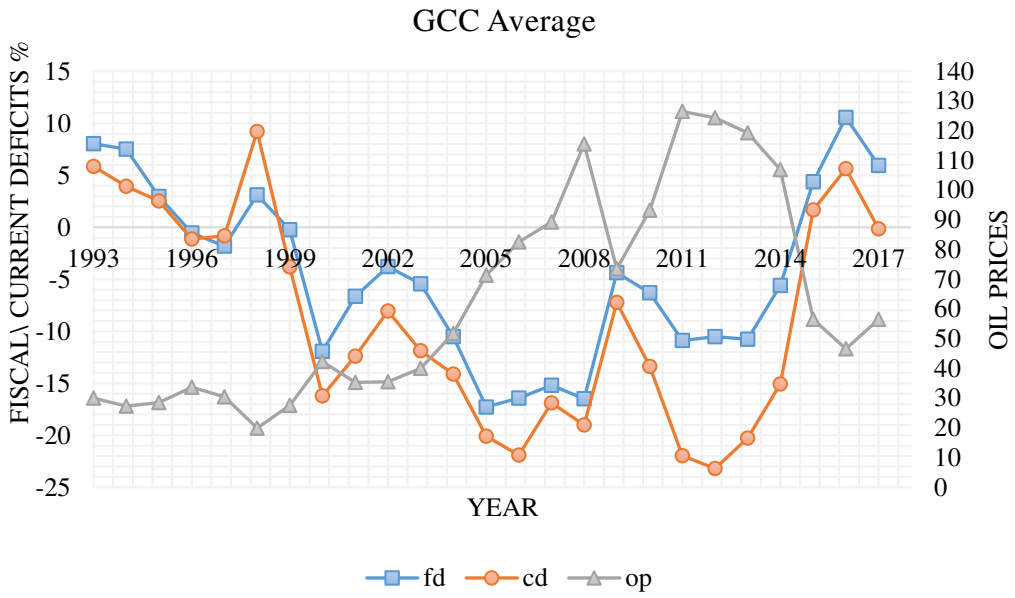
As an integrated unit of analysis, the GCC, had on average, in the past 25 years maintained a fiscal deficit of about 4.5 percent of GDP. However, the current account balance, on average, had a surplus of about 8.8 percent of GDP. Figure 2 shows the movement of the three variables of interest in the model. An arithmetic average of the fiscal account deficits and the current account deficits for the six GCC States are calculated for the analysis. Oil prices are internationally determined and therefore are identical for all. As the figure illustrates, the average GCC fiscal and current account deficits moved closely together throughout the period of analysis (1993-2017). This indicates a strong positive correlation of the two variables. Moreover, as previous argued about the fundamental role of oil prices in any analysis of the region, a clear pattern can be discerned between oil prices movement and the two deficits. In an almost synchronized pattern,

[8] For more discussion on the benefits of using panel data, please refer to Hsiao (1985; 1986), Baltagi (2005); and Baltagi, Griffin, and Xiong (2000).

[9] Fixed effects are the omitted variable effects that differ across entities but are constant overtime such as culture. Time fixed effects, on the other hand, are those omitted variable effects that are constant across entities but differ overtime. A good example of this is technology.

low oil prices (1993-2004) meant an increase in both deficits, while high oil prices (2004 – 2014) meant a decrease in both deficits.

Figure 2 : GCC average inter-relationship between decifits and oil prices



The inverse pattern (negative correlation) is repeating itself again with the recent decline in oil prices (2014 – current), which has led to the deterioration in both the fiscal and current account deficits for all the GCC States. When a similar exercise was repeated for each State of the GCC individually, a comparable pattern also existed with oil prices playing the role of a leading indicator for both deficits (Appendix B). Clearly the two deficits move in tandem, but which causes (precedes) the other after controlling for oil prices will have to be methodologically demonstrated.

4. Empirical Method

1.4.1. Model Specification

I estimate a bivariate VAR-X model adapted to a panel context as in Holtz-Eakin, Newey, and Rosen (1988) in the form:

$$\Delta FD_{i,t} = A + \sum_{j=1}^{p} \alpha_{1,j}\, \Delta FD_{i,t-j} + \sum_{j=1}^{p} \beta_{1,j}\, \Delta CD_{i,t-j} + \gamma_1 \Delta OP_t + \eta_i + \varepsilon_{i,t}$$

$$\Delta CD_{i,t} = B + \sum_{j=1}^{p} \alpha_{2,j}\, \Delta FD_{i,t-j} + \sum_{j=1}^{p} \beta_{2,j}\, \Delta CD_{i,t-j} + \gamma_2 \Delta OP_t + \xi_i + u_{i,t} \qquad (1.1)$$

where index " i " refers to the country (i =1, …, N), index " t " to the time period (t =1, …, T) and j to the lags. $\varepsilon_{i,t}$, $u_{i,t}$ are the stochastic error terms. The error terms are assumed to be independently distributed across countries with a zero mean and may display heteroscedasticity across time and countries. η_i and ξ_i are individual fixed effects for the panel member i. $\Delta FD_{i,t}$ is the change in the fiscal account deficit and $\Delta CD_{i,t}$ denotes the current account deficit fluctuation. Both variables are determined within the model. ΔOP_t denotes the changes in international crude oil prices and is a vector of exogenous covariates (predetermined variable). The above equation implies that each endogenous variable is related to the past values of itself, the other endogenous variable, and an exogenous variable. The homogeneous model assumes that the GCC States share the same underlying data generating process with the reduced-form parameters to be common among them.

To employ a VAR-X model in a panel context, the GCC six-members data is pooled (stacked on top of each other) to convert it from cross-sectional into a macro-panel. However, an oversimplified homogeneous specification is avoided. Assuming that the intercepts, autoregressive coefficients, and the slope coefficients, to all be constant across time and space is making a highly restrictive assumption of a "representative agent" approach for the entirety of the GCC. Moreover, this conjecture implies that only the error term captures the differences over time and individuals in the GCC. Consequently, in practice, heterogeneity does exist in the micro-level (States), and the properties of the aggregate data (macro-panel) for the time series will be different from the disaggregated cross-sectional data. This leads to inconsistent or meaningless estimates of parameters, which has come to be known in the literature as heterogeneity bias (Granger, 1980; Hsiao, 1986; Stoker, 1993 ; Hashem Pesaran, 2003). Therefore, the dynamic panel VAR model used to detect causality, for the study, is a homogeneous panel VAR model in a generalized method of moments (GMM) framework which incorporate heterogeneity. I base the framework on the procedure proposed by Holtz-Eakin et al. (1988) and applied by Love and Zicchino (2006)[10].

Albeit, the title of homogeneous panel might indicate the usage of a representative agent approach, however, the functional form in equation (1) as specified allows to model heterogeneity. This is done by capturing two types of changes occurring in the model. The heterogeneity in the means of the variables via the VAR-X intercepts (η_i , ξ_i), and the heteroskedasticity of its innovations ($\varepsilon_{i,t}$, $u_{i,t}$). Hence, heterogeneity is introduced in the model via a panel-specific fixed effects and the variation of the variance of innovation in each country.

[10] Stata is used as it is the standard application package for most panel data applications in economics (B. E. Hansen et al., 2002)

Furthermore, the functional form of the model is a VAR-X in a macro-panel context also known as a dynamic panel data model. This specification was selected due to three reasons. First, studying the dynamic causal effects between the variables using a distributed lag regression model is not feasible. The GCC States control about 40 percent of the world's known oil reserves and 23 percent of proven natural gas reserves (Freudmann, 2010). Moreover, three of the GCC States (Saudi Arabia, United Arab Emirates, and Kuwait) are part of the organization of the petroleum exports countries (OPEC) that set global oil prices. Hence, oil prices are endogenously determined by these States and as a result by the GCC. This violates strict exogeneity under which the error terms have a conditional mean of zero given past, present, and future values of the regressors (Stock and Watson, 2011).

As a result, the primary objective of the model becomes that of prediction instead of inferring true causal relationships. This makes the utilization of reduced form equations viable and desirable instead of using the more challenging structural equations[11]. These reduced form equations are the VAR-X equations used for the macro-panels of the study. Second, oil prices play a key role in both the fiscal and current accounts in the GCC, which raises the possibility that the time series of the two deficits in the model are jointly determined (endogenous). This fits into a panel VAR-X forecasting framework that captures the dynamic and inter-dependent relationship by treating some variables in the model as endogenously determined, while others as independent (predetermined). Third, feedback between the two deficits and their relationship vis-à-vis oil prices might exist in

[11] Structural VAR models are used for causal inferences and are demanding due to specific assumption requirements of what constitute an exogenous variable in the model. However, structural parameters due to the assumed autonomous nature of structural relationships are more stable than composite reduced form coefficients (Griffiths, Hill, and Judge 1993, page 608)

the GCC. Fortunately, panel VAR framework incorporates feedback among the dependent and independent regressors using their lag values.

1.4.2. Model Estimation

Though incorporating heterogeneity is feasible, estimations using Least Square Dummy Variables (LSDV), a traditional method for estimating fixed effects, lead to dynamic panel bias also known as the Nickell Bias (Nickell, 1981). This is due to the presence of lagged dependent variables in a VAR system of equation, which by construction, are correlated with the cross-section specific effects causing endogeneity that lead to biased and inconsistent coefficients (Das, 2019). This bias may be equal to as much as 20 percent of the true value of the coefficient of interest even with a time dimension as large as 30 according to a study done by Judson and Owen (1999).

Several methods exist in the literature to correct for this problem (Ahn & Schmidt, 1995; Anderson & Hsiao, 1982; Arellano & Bond, 1991; Blundell & Bond, 1998; Holtz-Eakin et al., 1988). However, following Love and Zicchino (2006), I use Arellano and Bover (1995) forward orthogonal deviation transformation for models with predetermined variables. Their framework uses system GMM to estimate the coefficients where lagged regressors are used as instruments. This is possible because the transformation preserves the orthogonality between transformed variables and lagged regressor by only removing forward mean. Therefore, to get a consistent estimator for the homogeneous panel VAR model of the GCC as an integrated unit of analysis, GMM estimator are employed. To select, estimate, and infer, the reduced form panel VAR-X in equation (1) using the GMM estimator, I follow closely Abrigo and Love (2016) who updated the original work of Love and Zicchino (2006).

The empirical GMM estimation of the model begin by looking for stationarity of the variables. Here, we examine the presence of unit root in the three variables of interest: fiscal account deficit, current account deficit, and international oil prices. This is a necessary step because non-stationarity makes the moment conditions completely irrelevant in a GMM estimation. Moreover, even near unit root makes the GMM estimator suffer from weak instrument problems in linear dynamic panel models (Blundell & Bond, 1998; Han & Phillips, 2010; Phillips, 2014).

For the panel unit root tests, Augmented Dickey Fuller[12] (ADF) and Phillips – Perron Tests[13] (PP) are performed for all the three variables. As the mean of any of these variables is non-zero, I include a drift for the ADF tests but remove this specification for the PP Tests, which does not permit it for panel data. Moreover, the mean of the cross-sectional is eliminated for the two deficits as the GCC economies have many similarities and the results could be affected by cross-sectional correlation. The inverse normal Z statistic results from the Fisher-type tests are used as it offers the best trade-off between size and power (Choi, 2001).

As a cross-check, the panel stationary tests are likewise performed for the macro-panel. This is done due to the criticism that panel non-stationary tests have low power if the process is stationary but with a root close to the non-stationary boundary. I use the Hadri Lagrange multiplier test, which is a "residual-based Lagrange multiplier test for a null that the individual observed series are stationary around a deterministic level or around a deterministic trend against the alternative of a unit root in panel data" (Hadri, 2000). This test is a generalization of the KPSS test (Kwiatkowski et al., 1992) from time series to panel data. The test is again performed for all

[12] The tests perform a unit root test on each panel's series separately, then combine the p-values to obtain an overall test of whether the panel series contains a unit root (Cagala and Glogowsky, 2015)
[13] Unlike the ADF test, the PP test is robust to serial correlation by using the Newey–West heteroskedasticity- and autocorrelation-consistent covariance matrix estimator.(Phillips & Perron, 1988)

the three variables and is conducted with and without a Bartlett kernel to control for serial correlation.

To select the best homogeneous panel VAR-X model for the GCC, I use a combination of different tests and criteria (Appendix C). These include (*i*) Andrews and Lu (2001) Moment and Model Selection Criteria (MMSC) for GMM models; (*ii*) Hansen's (1982) *J*-statistic and corresponding p-value; and (*iii*) the model overall coefficient of determination (CD). The MMSC tests for over-identifying restrictions require moment conditions to be greater than the number of endogenous variables. This test resembles likelihood-based selection criteria such as the Bayesian information criteria (BIC), Hunnan-Quinn information criteria (HQIC), and Akaike information criteria (AIC). As optimal lag order selection is a salient concern[14] in both panel VAR specification and moment condition, the overall coefficient of determination (CD) is also provided as an alternative criterion for lag selection. Higher values for the CD are preferable to lower ones as it captures the proportion of variation explained by the panel VAR model.

1.4.3. Hypotheses

The methodological framework used to analyze the homogeneous macro-panel data is the well-known Granger non-causality test. Granger (1969) explained the concept as following: "Let X_t, Y_t be two stationary time series with zero means. The simple causal model is

$$X_t = \sum_{j=1}^{m} a_j X_{t-j} + \sum_{j=1}^{m} b_j Y_{t-j} + \varepsilon_t \tag{1.2}$$

[14] Stock and Watson (2011) state that if the number of lags selected is too high, the model may estimate more coefficient than necessary introducing forecast estimation errors. Conversely, if lags are too low, valuable information contained in the more distance past can be omitted by the model.

$$Y_t = \sum_{j=1}^{m} c_j X_{t-j} + \sum_{j=1}^{m} d_j Y_{t-j} + \eta_t$$

where ε_t , η_t are taken to be two uncorrelated white-noise series, i.e., $E\ [\varepsilon_t\ \varepsilon_s] = 0 = E\ [\ \eta_t\ \eta_s]$, *s* $\neq$ t , and $E\ [\varepsilon_t\ \varepsilon_s] = 0$ all *t,s*. In [2] *m* can equal infinity but in practice, of course, due to the finite length of the available data, *m* will be assumed finite and shorter than the given time series. The definition of causality given above implies that Y_t is causing X_t provided some b_j is not zero. Similarly, X_t is causing Y_t if some c_j is not zero. If both events occur, there is said to be a feedback relationship between X_t and Y_t".

Accordingly, the study extends the logic of equation (2) for a two-dimensional VAR-X process employing a macro-panel to detect causality for the homogeneous dynamic model. A total of three tests will be implemented for the change in the fiscal ($\Delta FD_{i,t}$) and the current accounts deficits ($\Delta CD_{i,t}$) in the GMM estimation. The first test is with the other endogenous variable autoregressive lags. The second is with its own lags, and the third test is with the change in the exogeneous variable (ΔOP_t). This will then be followed with a panel VAR-Granger non-causality Wald test to enable us to resolve which of the four commonly used empirical hypothesis in the literature on the inter-deficit relationships apply for the GCC. For each of these hypotheses, the following criterion must be met:

1. Uni-directional Causality $\alpha_{2,j} \neq 0$ and $\beta_{1,j} = 0,\ \ j = 1, 2, \dots, p$
2. Bi-directional Causality $\alpha_{2,j} \neq 0$ and $\beta_{1,j} \neq 0,\ \ j = 1, 2, \dots, p$
3. Reverse Causality $\alpha_{2,j} = 0$ and $\beta_{1,j} \neq 0,\ \ j = 1, 2, \dots, p$
4. Non-causal $\alpha_{2,j} = 0$ and $\beta_{1,j} = 0,\ \ j = 1, 2, \dots, p$

5. Results

The unit root test results of $FD_{i,t}$, $CD_{i,t}$, and OP_t, for the homogeneous model, Appendix C, indicate as per the literature that most macroeconomic variables tend to be non-stationary. To prevent moment conditions in the model from becoming completely irrelevant due to unit root, all the variables are transformed using first differencing. As for the selection of the best homogenous model, the conducted tests and criteria conclude that a bivariate first-order panel VAR-X model using the first four lags of the endogenous variables as instruments was optimal (Appendix D). Following the implementation of the required tests for ΔFD and ΔCD, the results of the Granger non-causality tests for the model are provided in table 3.

Table 3: Homogeneous model Granger non-causality tests

Type of Causality	**Statistic**	**p-value**	**Results**
Fiscal Account Deficit			
$\Delta FD_{t-1} \rightarrow \Delta CD_t$	0.283	0.595	ΔFD_{t-1} does not Granger-cause ΔCD_t
Current Account Deficit			
$\Delta CD_{t-1} \rightarrow \Delta FD_t$	28.589	0.000	ΔCD_{t-1} does Granger-cause ΔFD_t

The homogeneous panel VAR-X model indicates that the twin-deficits doctrine does not apply to the GCC as an integrated unit of analysis. A preceding change in the fiscal account deficit (ΔFD_{t-1}) does not Granger-cause a change in the current account deficit (ΔCD_t). However, a causal relationship does exist between the two deficits but in reverse order ($\Delta CD_{t-1} \rightarrow \Delta FD_t$). Thus, upon controlling for the effects of a change in oil prices, the deficits are linked but are not

twins[15]. These results, according to the flow chart of the inter-deficit relationships in figure 1, fall under the Ricardian equivalence proposition. Does this mean that GCC inhabitants' smooth their consumption both within a lifetime and across generations as Ricardian savers? If so, then what explains the reverse causation between the deficits also picked-up by the model?

To answer the above two questions that will help understand why the deficits are linked but are not twins, a closer look at the definition of Granger non-causality logic and the transmission channels between the two deficits can put things into perspective. First, it is worth noting that the term "causality" in Granger non-causality implies that the two variables (ΔFD and ΔCD) are sufficiently correlated that one is useful in forecasting the other. Figure 1 is a clear illustration of this argument. Second, according to the model results, past values of the change in current account deficit (ΔCD_{t-1}) contain useful predictive content for forecasting the current change in the fiscal account deficit (ΔFD_t). This precedence prerequisite for forecasting, as laid out in the logic of Granger non-causality in equation (2), emphasizes the role of dynamic transmission channels between the deficits. Thus, understanding how the institutional features of the GCC impact the transmission channels between the deficits enabling us to capture the model theoretical predictions: $\Delta FD_{t-1} \nrightarrow \Delta CD_t$ & $\Delta FD_t \leftarrow \Delta CD_{t-1}$.

As pointed out in section 3, the theoretical links between the deficits indicate that the transmission channel from $\Delta FD_{t-1} \rightarrow \Delta CD_t$ is mainly through saving. This is because a drop in fiscal revenues due to tax cuts (Keynesian case), albeit will also increase savings, it does not commensurate the fiscal deficit entirely. This as a result, worsens the current account deficit. In the case of the GCC, the role of taxation however is limited. The decline in exports earnings is

[15] Governor Edward M. Gramlich during his Federal Reserve Board remarks at the Isenberg School of Management Seminar Series also argued that " Budget and trade deficits should be viewed as linked, but not as twins (Gramlich, 2004).

what leads to a fall in government revenue and not tax-cuts that might increase net wealth via bonds purchases as suggested by Robert Barro. Therefore, the rejection of the twin-deficits proposition is not due to the Ricardian GCC inhabitants' who view government choice between debt and tax finance as irrelevant, but it is a consequence of the limited role of taxation that are part of the institutional features of the GCC. Consequently, the model is unable to pick-up on the uni-directional causal relationship running from ΔFD_{t-1} to ΔCD_t, *whether it exists or not*.

But why did the model also uncover a reverse causality even after controlling for international oil prices? The answer to this question is found in the direct and indirect transmission channels from $\Delta CD_{t-1} \rightarrow \Delta FD_t$ and the negative and positive implications derived from the process. In the direct channel, a widening ΔCD_{t-1} has a negative implication on ΔFD_t as it worsens the fiscal balance though diminishing economic growth. Though the literature is unclear on the topic of whether a current account deficit is bad in itself, the general consensus is that "it all depends" on the underlying economic trends and the factors giving rise to that deficit (Ghosh & Ramakrishnan, 2020). For the GCC states, even when controlling for oil prices, current account deficits arise due to the inability of the States to immediately rein in fiscal spending after a decline in export revenues or a rise in import prices. This is because GCC economies are centered around government outlays where the majority share of these expenditures goes to finance public sector wages, infrastructure projects, and non-oil diversification programs. As a result, retrenchments or fiscal adjustments are difficult, costly, and usually contractionary leading to diminishing economic growth.

In the case of the indirect transmission channel, which is sometimes referred to as the "Current Account Targeting Hypothesis," policy makers intentionally strive to reduce the existing fiscal deficit as an attempt to narrow the parallelly ongoing current account imbalances (Summers,1986). An example of this strategy is the initiation of a tax hike by policy makers to reduce budget deficits.

This is justified on the ground that it will reduce trade deficits, and therefore, improve the current account. This is part of the expenditure-reducing policies that attempt to reduce the overall spending in the economy. A second mechanism that the government can also initiate to target the current account are the expenditure-switching policies. Here, the government increases trade barriers to entice domestic consumers to switch away from imports to domestically produced goods and services. These fiscal policies are indirectly used to reduce the current account deficit. Clearly, a relationship exists between the deficits, but the causal implication on ΔFD_t is of a positive nature. An empirical study on the U.S economy by S. Kim & Roubini (2008), for example, also illustrated this positive effect where contrary to most economic models, their results showed that an expansionary fiscal shocks or government budget deficit shocks are associated with an improvement of the current account and a depreciation of the real exchange rate.

This relationship has been extensively used by the GCC States as their fixed regime do not allow for smooth adjustments to real shocks. In a recent study by Malik & Nagesh, (2021), a total of 88 amendments were identified as key fiscal reforms taken by the GCC countries from 2014 to mid-2019 to combat the deterioration of both budget deficits after the decline in international oil prices. However, as the GCC States' economies are government dominated with an extensive welfare system, expenditure reduction and switching can only play a limit role and for a short period of time. Likewise, the fixed exchange rate regime put GCC States in a precarious situation where they "simply have to live with the effects of the negative shock" until domestic prices change and pull the countries out of the recession (Broda, 2001).

Albeit the discussion clarifies why the two deficits are linked but are not twins, both methodologically and in practice, does this result also apply for every member State of the GCC individually?

6. Model Extension

In this section, I consider a potential extension to the baseline model specification. Specifically, I focus on the heterogeneity of the parameters. Albeit the homogeneous model captured heterogeneity via the panel VAR-X intercepts and the heteroskedasticity of its innovations, several papers have argued that the use of cross-sectional information requires the heterogeneity of the parameters (Dumitrescu & Hurlin, 2012; Im et al., 2003; Kónya, 2006; Nair-Reichert & Weinhold, 2001). Therefore, a plausible extension would be a model utilizing a framework that rejects the assumption that the panel VAR-X regression model is valid for all the GCC States. Hence, the extension used to detect causality is a heterogenous panel VAR-X model.

This model was proposed in testing for Granger non-causality in heterogeneous panels by Dumitrescu and Hurlin (2012). Unlike the homogeneous version, specified earlier, the model relaxes the constraints employed by Holtz-Eakin et al. (1988) that the countries share the same underlying data generating processes. Heterogeneity of the GCC States is modeled in this framework in two ways. First, individual effects via the intercept leads to change in the mean of the variable. Second, heterogeneity of the remaining parameters implies that the function of interest for all the States are different. According to Dumitrescu and Hurlin (2012), this second source of heterogeneity is crucial as it "directly affects the paradigm of the representative agent" and therefore, the causality relationships between the variables. In view of that, coefficients can differ across the GCC member States but remain time invariant. Therefore, the following bivariate heterogeneous panel VAR-X model is considered:

$$\Delta FD_{i,t} = A_i + \sum_{j=1}^{p} \alpha_{1,i,j}\, \Delta FD_{i,t-j} + \sum_{j=1}^{p} \beta_{1,i,j}\, \Delta CD_{i,t-j} + \gamma_1 \Delta OP_t + \varepsilon_{i,t}$$

$$\Delta CD_{i,t} = B_i + \sum_{j=1}^{p} \alpha_{2,i,j}\, \Delta FD_{i,t-j} + \sum_{j=1}^{p} \beta_{2,i,j}\, \Delta CD_{i,t-j} + \gamma_2 \Delta OP_t + u_{i,t} \quad (1.3)$$

Analogous to equation (1), $\Delta FD_{i,t}$ is the change in the fiscal account deficit and $\Delta CD_{i,t}$ denotes the change in the current account deficit. ΔOP_t denotes the fluctuations of international oil prices and is the exogenous variable. All variables are assumed to be stationary where index " i " refers to the country (i =1, …, N) and index " t " to the time period (t =1, …, T). Contrasting the homogeneous model, subscripts " i " is added to all the coefficients to signify cross-sectional heterogeneity. Slopes of the regression coefficient ($\beta_{1,i,j}$, $\gamma_{1,i}$, $\alpha_{2,i,j}$, $\gamma_{2,i}$) and the autoregressive parameters ($\alpha_{1,i,j}$, $\beta_{2,i,j}$) differ across groups, while individual effects (A_i , B_i) are fixed in the time dimension.

Three assumptions are stipulated for the heterogeneous GCC model. First, each GCC State i =1,..,6 individual residuals $\varepsilon_{i,t}$, $u_{i,t}$ $\forall$ t =1,..,25 are assumed independently and normally distributed with an expected value of zero and finite heterogeneous variances. Second, each State individual residuals are independently distributed across groups. Third, all individual variables are covariance stationary, and their expectations are independent of t. Two major issues are salient in estimating the heterogeneous panel VAR model. The first involves the estimation of the optimal lag lengths and the second is the empirical issue of cross-sectional dependence. To select, estimate, and infer the heterogeneous model, I follow the work of Lopez and Weber (2017).

As in the previous model, stationarity of variables is essential in detecting the correct causality in the heterogeneous model. All variables used in the model are the same as in the homogeneous panels, and therefore, as indicated in table 3, they are integrated of order one. Two additional tests will be added due to the heterogeneity considerations (Appendix E). The first is the Im-Pesaran-Shin (2003) test for unit root. This test relaxes the assumption of a common autoregressive parameter. The second is a test suggested by Pesaran (2007) for testing unit roots in dynamic panels subject to possible cross-sectionally dependent as well as serially correlated errors. For this test, only fiscal and current account deficits will be considered as oil prices are identical in all the cross-sections. To select the optimal lags for the heterogeneous model, I base my selection on the different information criterion (BIC/AIC/HQIC).

Parallel to the homogeneous model, the methodological framework used to analyze the heterogeneous macro-panel model is the Granger non-causality test. However, the pooling of data from six GCC member States complicate using the definition of causality for the heterogeneous model. This is because each observation of the variables (ΔFD and ΔCD) is on six countries. Dumitrescu and Hurlin (2012) point out that assessing causality in this setting depends on the optimal information set employed to forecast the dependent variable in each equation. To this end, the authors explain that causality in panel data can be examined in three methods.

The first approach, tests causality from variable x observed from *ith* individual to the variable y observed for the *jth* individual, with $j = i$ or $j \neq i$. The second approach tests for causal relationship for a given individual and uses the cross-sectional information only to improve specification and the power of the test. This is Holtz-Eakin et al. (1988) original specification which is employed for the homogeneous panel VAR-X model for the study with stipulations: The model is fit into a system of equation for efficiency, and, GMM is used to calculate consistent estimates. The third

approach, which will be used for the heterogeneous model, assumes the existence of "a minimal statistical representation which is common to *x* and *y* at least for a subgroup of individuals".

Therefore, although the same criterion will be tested by the Granger non-causality tests in the heterogeneous panel VAR-X, the mean of the variables and the coefficients heterogeneity will be taken into consideration. This is because unlike the homogeneous model, causality is applicable if all the members or any of the members of the GCC States, have (has) a different economic behavior. For example, to test the significance of the past values of the current account deficit on the present values of fiscal deficit, the null hypothesis is defined:

$$H_0: \beta_{1,i,1} = \cdots = \beta_{1,i,p} = 0 \qquad \forall\, i = 1, \ldots, N$$

This implies that the failure to reject the null hypothesis means reverse causality is not applicable for the GCC. However, unlike the homogeneous model, the Dumitrescu and Hurlin (2012) test takes into consideration both the heterogeneity of the regression model and that of the causal relation. It assumes there can be causality for some individuals but not necessarily for all. Hence, the alternative hypothesis is defined:

$$H_1: \beta_{1,i,1} = \cdots = \beta_{1,i,p} = 0 \qquad \forall\, i = 1, \ldots, N$$

$$\beta_{1,i,1} \neq 0\ or \ldots or = \beta_{1,i,p} \neq 0 \qquad \forall\, i = 1, \ldots, N$$

where $N_1 \in [0, \mathrm{N} - 1]$ is unknown. If $N_1 = 0$, there is causality for all individuals in the panel. N_1 must be strictly smaller than N; otherwise, there is no causality for all individuals, and H_1 reduces to H_0. Like the homogeneous model, a total of three tests will be implemented. The first test is with the other endogenous variable autoregressive lags and the second is with its own lags.

The third test is with the exogeneous variable. This will then be followed with a panel VAR-Granger non-causality Wald test.

7. Results

Though the Granger non-causality test by Dumitrescu and Hurlin (2012) examines causality using a cross-section average of individual Wald statistics, the outcome of its tests are comparable to the homogeneous model results. Table 4 presents tests results with optimal lags, test statistics, and p-values for the heterogeneous model.

Table 4: Heterogeneous model Granger non-causality tests

Type of Causality	**Information Criteria**	**Optimal Lags**	**Statistic**	**p-value**	**Results**
Current Account Deficit					
	BIC	1	1.0401	0.2983	ΔFD_{t-1} does not Granger-cause ΔCD_t
$\Delta FD_{t-1} \rightarrow \Delta CD_t$	AIC	2	0.3443	0.7306	ΔFD_{t-1} does not Granger-cause ΔCD_t
	HQIC	2	0.3443	0.7306	ΔFD_{t-1} does not Granger-cause ΔCD_t
Fiscal Account Deficit					
	BIC	1	11.094	0.0000	ΔCD_{t-1} does Granger-cause ΔFD_t
$\Delta CD_{t-1} \rightarrow \Delta FD_t$	AIC	6	12.8605	0.0000	ΔCD_{t-1} does Granger-cause ΔFD_t
	HQIC	6	12.8605	0.0000	ΔCD_{t-1} does Granger-cause ΔFD_t

The results of the heterogeneous model indicate that ΔCD_{t-1} does Granger-cause ΔFD_t at least for some of the GCC member countries, if not all of them as indicated by the homogeneous

model[16]. Lag order selection with different information criterions (BIC/AIC/HQIC) were attempted but the results persisted. Hence, this model also rejects the premises of the twin-deficits doctrine and concludes that a causal relationship exists, but it is in reverse order. Therefore, the path of the deficit is from the current account to the fiscal account and not the other way around ($\Delta FD_{t-1} \nrightarrow \Delta CD_t$ & $\Delta FD_t \leftarrow \Delta CD_{t-1}$). The rejection of the twin-deficits doctrine in the heterogeneous model is important for the study. This is because it indicates that a uni-directional causality between ΔFD_{t-1} and ΔCD_t is not only rejected for the GCC as an integrated unit of analysis but that it also does not apply for any of the member States individually.

8. Existing literature

The inter-relationship between deficits and the direction of causality have been extensively studied. Both country specific and panel of countries investigations have been conducted to detect twin-deficits in the literature. Yet, no consensus exists up to the present time even for an individual country. This is likely due to the alternative estimation techniques, specifications, and samples used in the various studies. A few examples, from the 1990's onwards, are presented to illustrate the variety and mix results of the twin-deficits literature.

Abell (1990), Enders & Lee (1990), Rosensweig & Tallman (1993) conducted specific country investigations for the United States and found support for the twin-deficits. Vamvoukas (1998) studied the Greek economy and found a uni-directional relationship between budget deficits and the demand for money, also supporting the Keynesian proposition. For the case of bi-directional causality in a country setting, Kónya (2006) used a panel data approach on twenty-four OECD

[16] One of the drawbacks of the model as pointed out by the authors is that the rejection of the null of Homogeneous Non-Causality does not provide any guidance with respect to the number or the identity of the particular panel units for which the null of non-causality is rejected (Dumitrescu & Hurlin, 2012)

countries from 1960 to 1997. Two-way causality between exports and growth was found in Canada, Finland, and the Netherlands, while the remaining countries showed mixed results.

Findings validating Ricardian equivalence between the deficits are also present in the literature. For country specific investigations, Kaufmann et al. (2002) on Austria and Al Khalifa (2015) for Bahrain results concluded a non-causal inter-relationship between the budgets. As for country specific investigations supporting reverse causality, assessments on Saudi Arabia (Alkswani, 2000), South Korea (C.-H. Kim & Kim, 2006), Kuwait (Merza & Alawin, 2012), Greece (Kalou & Paleologou, 2012), and Peru (Sobrino, 2013) all indicated the existence of a uni-directional causal relation running from the current account to the fiscal account.

For panel of countries investigations, Salvatore (2006) confirms the twin-deficits relationship empirically for the G-7 countries over the past three decades. Akanbi & Sbia (2018) investigated the twin-deficits phenomenon among oil-exporting countries concluding that all countries estimations reveal the existence of twin-deficits in the total economy. However, in the non-oil economy, on the other hand, the evidence of twin-deficits disappears.

Kouassi et al. (2004) used data from a sample of twenty developed and developing countries found evidence of uni-directional or bi-directional causality for some developing countries but results for developed countries were less credible.

Xie & Chen (2014) studied eleven OECD countries where the results indicated that the Ricardo Equivalence hypothesis is applicable to France and the UK. When bootstrap critical values are used, the empirical findings indicate that there is a bi-directional causality between the current account deficit and the government budget deficit for eleven OECD countries.

This study expands on the analysis of detecting the twin-deficits but differs in the scope and methods used. First, a comprehensive investigation between the fiscal and current accounts of all

the GCC States is conducted using four empirical hypotheses. Second, the GCC States are treated as an integrated unit of analysis using annual macro-panel data from 1993 to 2017. Third, a bivariate VAR-X framework is used taking into consideration the importance of international crude oil prices for the region. Fourth, the study uses the Granger non-causality approach for a homogeneous panel VAR-X model in a generalized method of moments framework and then compares and contrasts it with a heterogeneous panel VAR-X model as a robustness check. To the best of my knowledge this treatment of the GCC States and the methodologies used is the first of its kind.

9. Conclusion

This study attempts to assess if the twin-deficits doctrine applies to the GCC economies. I test both the presence and direction of causality between the fiscal and current accounts deficits using the Granger non-causality framework. A VAR-X homogeneous and heterogeneous models are tested with oil-prices being the controlled exogeneous variable. Two interesting conclusions emerged. The first is that the twin-deficits doctrine, as defined in the literature, is rejected both when GCC States share the same underlying data generating process or when each States' parameters are heterogeneous. The second conclusion uncovers a uni-directional causal relationship between the two deficits but in reverse order. Therefore, it is the current account that Granger-cause the fiscal account. Moreover, though a synchronized pattern exists between oil prices and the movement of the two deficits due to its direct contribution to both deficits, it is the institutional features that clarify why the current accounts of the GCC States causes (precedes) the fiscal accounts, all else equal.

The study is worthy of attention as the GCC countries not only possess about half of the world's oil reserves, but also plays a central role in the financial and economic stability of the Middle East. Additionally, policy makers and researchers interested in the consequences of unsustainable fiscal and current account deficits in the region will be able to foresee and understanding the channels, linkages, and direction of contagion between the two deficits. Safeguards and early warning systems can be put into place to prevent the woes and troubles of unsustainable debt, that if not anticipated, and managed, may lead to both internal and external crises with grandeur negative effects.

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APPENDIX

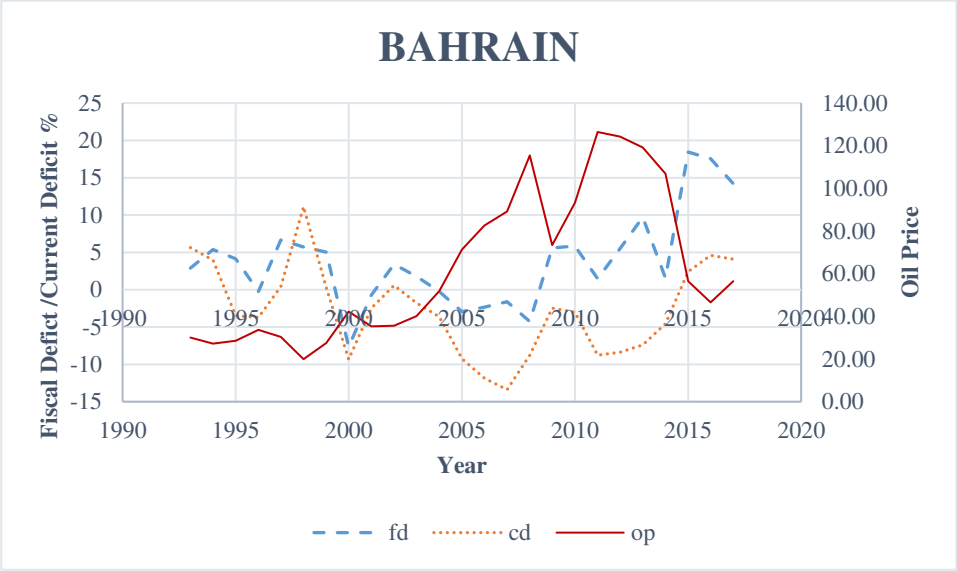
Appendix A: Data Sources

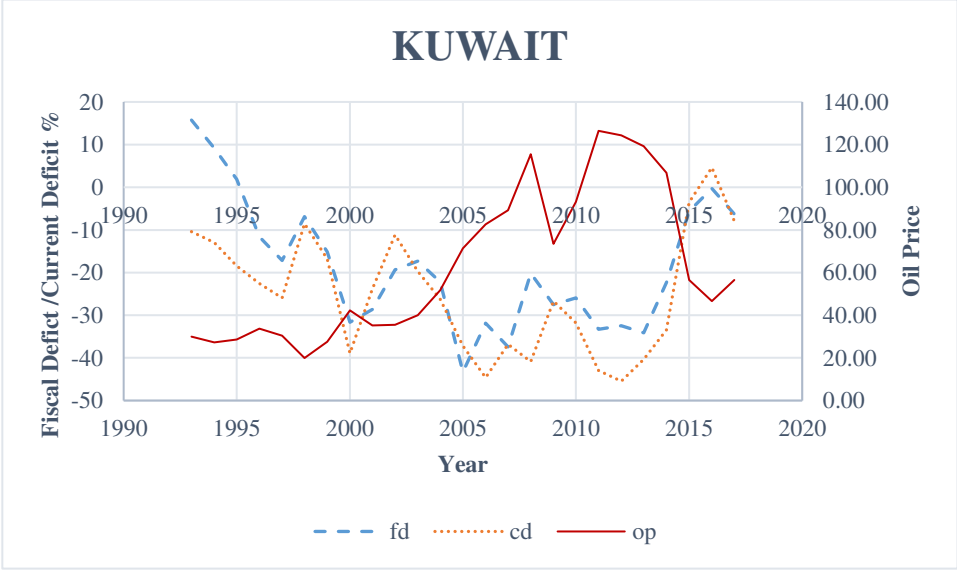
The Fiscal account deficits data: For all the GCC member countries, are taken from the World Economic Outlook (WEO) October 2020 edition database. WEO subject code for fiscal account deficit is GGXCNL_NGDP and is described in the database as the general government net lending/borrowing percent of GDP. More compactly, according to the government and finance statistics manual, it is calculated as the government revenue minus total expenditure (GFSM, 2014). The data was transformed by multiplying it by negative one to transform it into a deficit for convenience of use since in its original state it represents the balance and not deficit.

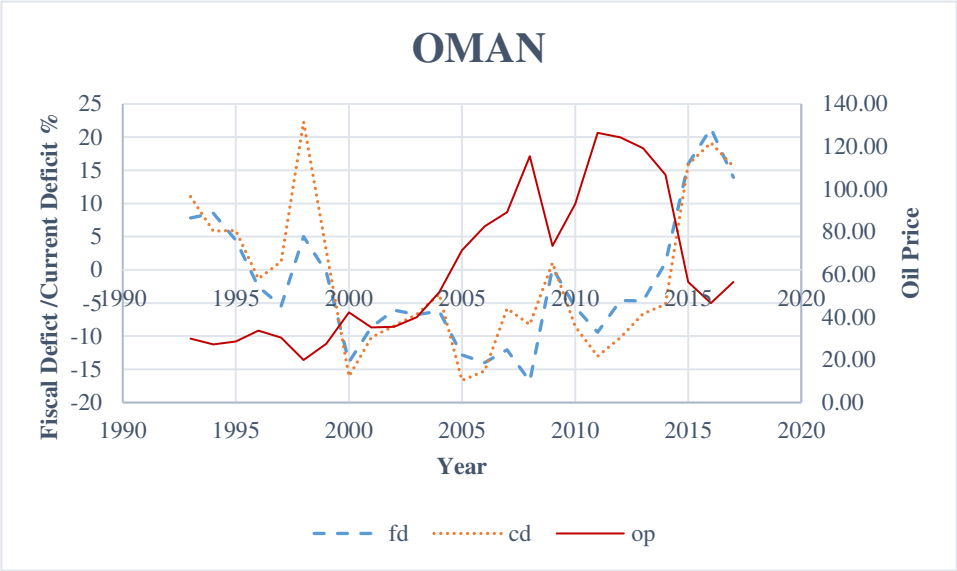
The current account deficits data: For all the GCC member counties, were also taken from the WEO database October 2020 edition. WEO subject code for the current account deficits is BCA_NGDPD and it is described as the current account balance scaled to the per centage of GDP. Hence, "it shows the difference between the sum of exports and income receivable and the sum of imports and income payable. The current account balance represents the saving-investment gap for the economy (GFSM, 2014)". Like the fiscal deficit, the data again was transformed by multiplying it by a negative one to transform it into a deficit from a budget balance.

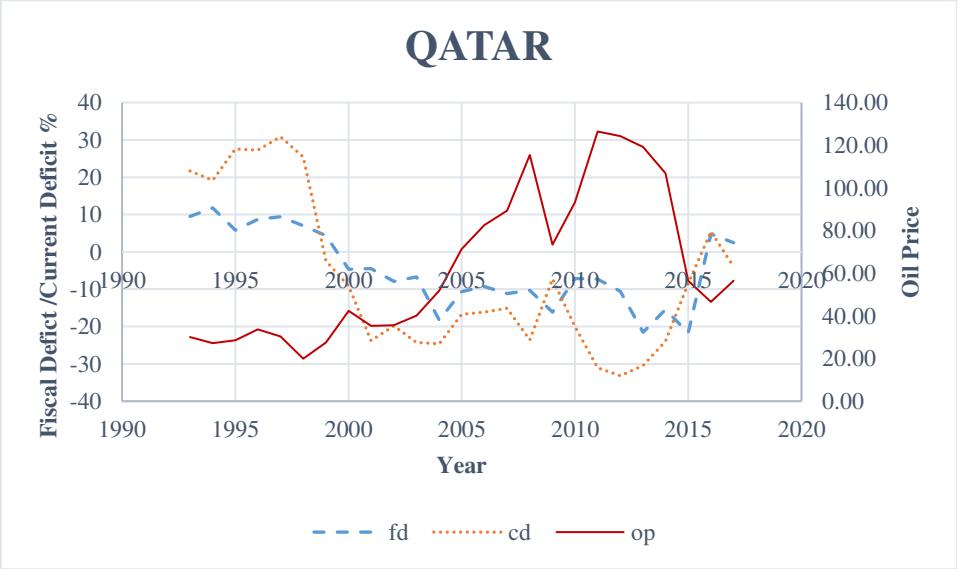
Crude Oil data: I used BP statistical review of world energy edition of Brent US dollars per barrel. All the data were measured in real terms (2019 prices). Brent crude prices are used as they are considered the industry anchor and benchmark. Brent is based on light sweet crude oil produced in the North Sea. Oil producers often price their grades on crude at a premium or a discount to Brent depending on whether the quality is higher or lower. Roughly two-thirds of the international traded oil is priced against Brent. Other benchmarks include West Texas Intermediate, Dubai and Oman (Van Schaik, 2015)

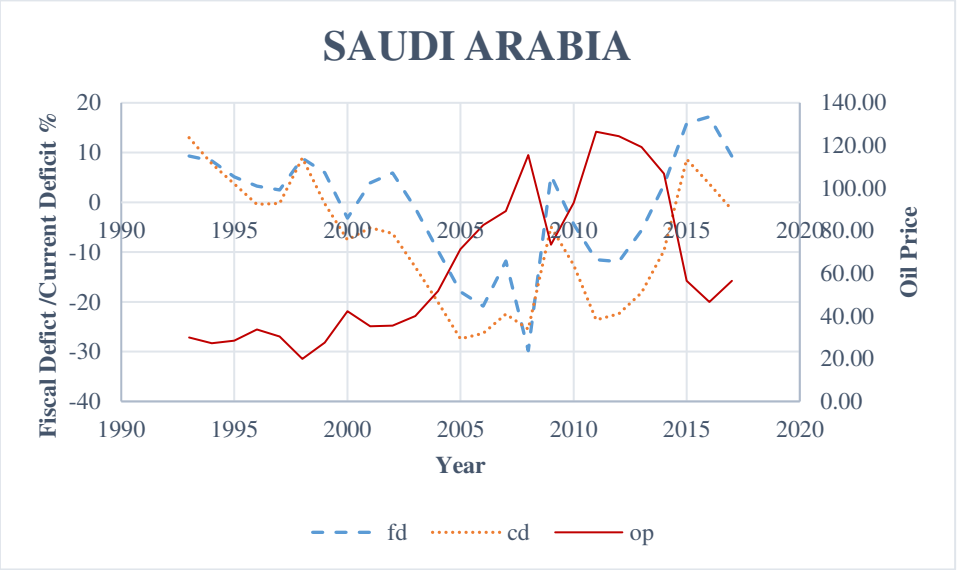
Appendix B: Average inter-relationship between deficits and oil prices in GCC States

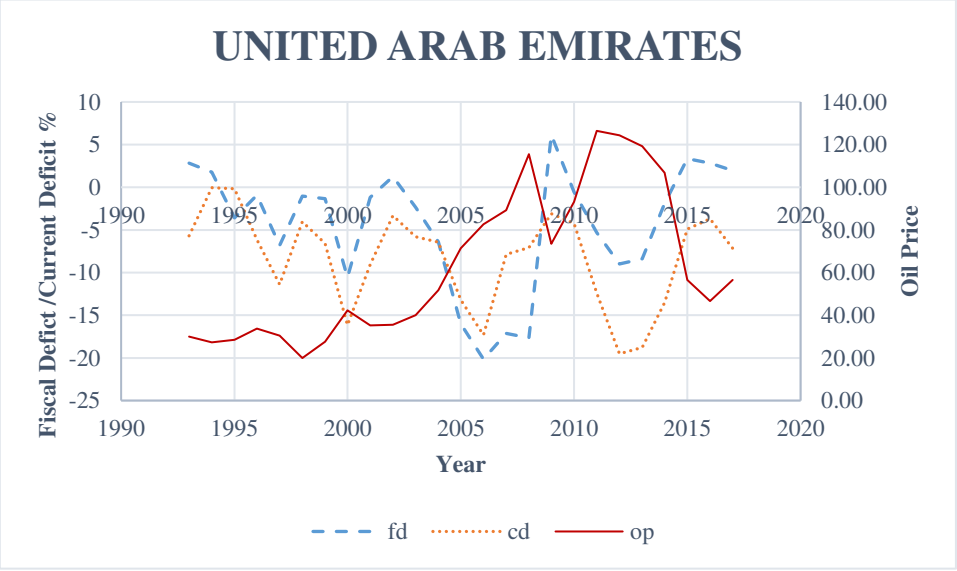





OMAN
Fiscal Defict /Current Deficit %
Oil Price
Year
fd
cd
op


QATAR
Fiscal Defict /Current Deficit %
Oil Price
Year
fd
cd
op


SAUDI ARABIA
Fiscal Defict /Current Deficit %
Oil Price
Year
fd
cd
op


UNITED ARAB EMIRATES
Fiscal Defict /Current Deficit %
Oil Price
Year
fd
cd
op

Appendix C: Homogeneous model unit root test

Test Results			
Non-stationarity tests	**(H_0: All panels contain unit root)**		
Augment Dickey Fuller tests	*Statistic*	*p-value*	*Results*
Fiscal Deficit	-4.9526	0.0000	At least one panel is Stationary
Current Account Deficit	-4.9114	0.0000	At least one panel is Stationary
Oil Prices	-3.7218	0.0001	At least one panel is Stationary
Phillips-Perron tests (Robust)	*Statistic*	*p-value*	*Results*
Fiscal Deficit	-3.9673	0.0000	At least one panel is Stationary
Current Account Deficit	-1.2125	0.1127	All panels contain unit roots
Oil Prices	0.0474	0.5189	All panels contain unit roots
Phillips-Perron tests (Robust)	*Statistic*	*p-value*	*Results*
D1. Current Account Deficit	-9.3771	0.0000	At least one panel is Stationary
D1. Oil Prices	-8.2026	0.0000	At least one panel is Stationary
Stationarity tests	**(H_0: All panels are stationary)**		
Hadri LM test	*Statistic*	*p-value*	*Results*
Fiscal Deficit	19.8756	0.0000	Some panels contain unit roots
Current Account Deficit	9.4461	0.0000	Some panels contain unit roots
Oil Prices	19.8756	0.0000	Some panels contain unit roots
Hadri LM test (Robust)	*Statistic*	*p-value*	*Results*
Fiscal Deficit	5.8490	0.0000	Some panels contain unit roots
Current Account Deficit	6.1811	0.0000	Some panels contain unit roots
Oil Prices	10.1371	0.0000	Some panels contain unit roots
Hadri LM test (Robust)	*Statistic*	*p-value*	*Results*
D1. Fiscal Deficit	-0.5622	0.7130	All panels are stationary
D1. Current Account Deficit	-0.8718	0.8083	All panels are stationary
D1. Oil Prices	-0.2470	0.5975	All panels are stationary

Short Summary: The Fisher-type tests where the null hypothesis is non-stationary show mixed results: whereas the augmented Dickey Fuller test for all the variables are stationary, Phillips-Perron tests using the Newey–West heteroskedasticity - and autocorrelation - consistent covariance matrix estimator indicate that current account and oil prices are non-stationary. The Hadri stationarity test, for which the null is stationary, indicate non-stationarity of all the variables. This is for both robust and non-robust tests.

Appendix D: Panel VAR lag-selection criteria

Lag[17]	Endogenous Variables	Instrumental Variables	Coefficient of Determination	Hansen's *J*	*J* pvalue	MBIC	MAIC	MQIC
1	9	36	.1387558	37.51743	.0858072	-91.5189	-16.48257	-46.95245
2	18	36	.1608248	22.92022	.1936747	-63.10401	-13.07978	-33.39304
3	27	36	.2410057	9.125484	.4257725	-33.88663	-8.874516	-19.03114
4	36	36	.4849616	.	.	.	.	.

Short Summary: Optimal lag order selection is crucial for VAR models. For the GCC homogeneous model, the first-order panel VAR is selected. The choice is based on the three model-selection criteria by Andrews & Lu (2001) with the first four lags of the endogenous variables used as instruments. This outcome has the smallest MBIC, MAIC, and MQIC. While minimizing Hansen's J statistic is also desirable for model selection, it does not correct for the degrees of freedom in the model like the MMSC[18]. Hence**,** the optimal homogeneous model is a bivariate first-order panel VAR-X model using the first four lags of the endogenous variables as instruments.

[17] The regression coefficients in the first three lags are overidentified as the number of instruments are greater than the endogenous variables. In the case of four lags, it is exactly identified.

[18] All variables will have equal lags. This is because a VAR with different lag lengths for its variables could be viewed as a restricted VAR implying different coefficient are set at zero (Sims, 1980)

Appendix E: First-generation and second-generation unit root tests

Test Results

First-Generation	**(H_0: all panels contain unit root)**		
Im-Pesaran-Shin unit root test	*Statistic*	*p-value*	*Results*
Fiscal Deficit	-3.1902	0.0007	Stationary
Current Account Deficit	-1.4113	0.0791	Unit Root
Oil Prices	0.0040	0.5016	Unit Root
Im-Pesaran-Shin unit root test	*Statistic*	*p-value*	*Results*
D1. Current Account Deficit	6.9745	0.0000	Stationary
D1. Oil Prices	-5.9832	0.0000	Stationary
Second-Generation	**(H_0: homogeneous non-stationary)**		
Pesaran Panel Unit Root Test	*Statistic*	*p-value*	*Results*
Fiscal Deficit	-3.421	-2.25	Stationary
Current Account Deficit	-1.974	-2.25	Unit Root
Pesaran Panel Unit Root Test	*Statistic*	*p-value*	*Results*
D1. Current Account Deficit	-4.514	-2.51	Stationary

Short Summary: The two additional unit root tests introduced specifically for the heterogeneous model indicate that fiscal deficit for both tests is stationary. For the Im-Pesaran-Shin unit root test the p-value of 0.0007 rejects the null hypothesis that all panels contain unit root. Pesaran second-generation test[19] also rejects the null hypothesis of a unit root process for the fiscal deficit. It has a statistic value of -3.421, which is below the critical value of -2.25 at the 95 percent significance level. On the other hand, the results for current deficit indicate unit root for both tests, while oil is non-stationary for the Im-Pesaran-Shin unit root test. However, with first differencing, current deficit and oil prices are transformed to stationary variables. It is worth noting that albeit fiscal deficit is stationarity for both tests, the Hadri Lagrange multiplier stationary test conducted earlier was unit root. Hence, all variables require one order of integration to stabilize as indicated in table 3 and table 6 results.

[19] The first generation of panel unit root tests are based on the cross-sectional independency hypothesis where correlations across units constitute nuisance parameters. The second generation of panel unit root tests relaxes the cross-sectional independence assumption allowing in a variety of forms and degrees the dependence across the different units in the panel. (Breitung & Pesaran, 2005; Hurlin & Mignon, 2007)