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Oil rents and fiscal balance in oil dependent economies: do fiscal rules matter?

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ABSTRACT

In this paper, we utilize a panel of oil dependent economies from 2000 to 2015 and attempt to empirically examine the relationship between crude oil rents and fiscal balance, while controlling for other covariates. Our strategy is to highlight the importance of fiscal rules by using an instrumental variable approach based on Dynamic Panel estimators [the General Method of Moment (GMM)]. This is used in comparison with estimations from pooled OLS, LSDV fixed effects, and the IV/2SLS techniques (using each country's share of world output as instrument). Our pre-estimation diagnostics showed that the GMM approach might not be applicable to the small sample, and we suspected that the IV/2SLS method might also be weak in testing our hypothesis for the oil dependent economies; therefore we maintained the LSDV Fixed effects estimations. Our estimation results shows that in countries with fiscal rules, there is insignificant reaction of fiscal balance to changes in oil rents shocks, and the impact is weak. We find also that welfare spending, which was captured by the real GDP per capita, affects fiscal balance, and so does the budgetary variable, i.e. debt-to-GDP ratio, and the ability of the government to curb corruption and mismanagement of funds, which is politically motivated.

Contribution/ Originality
This study contributes to existing literature on natural resource rents and its effects on fiscal balance for natural resource-endowed economies. The paper's primary contribution is to find that the GMM-IV approach is potent in solving endogeneity of crude oil rents, and that the structure of primary fiscal balance differs with natural resource endowments. Also, having fiscal rule matters less with high perception of corruption index and weak political structure.

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1. INTRODUCTION

One of the fundamental macroeconomic objectives of the government is to achieve increased growth of its gross domestic product (GDP), and expand economic activities. However, in recent times, annual percentage growth rate of GDP at market prices has declined in many countries, or at best, remain stable. On the global trend, it has struggled to roam around 3%, as shown in figure 1. The downward trend of growth rates respond to changes in the components of the gross value added by producers of goods and services currently operating in the economy[1]. Among several variables that interact with growth, there is a direct relationship between budget balance (deficits) and economic growth. This relationship derives from high investment costs that is usually not properly optimized or modeled in budget decisions in most countries (Arjomand *et al.,* 2016).

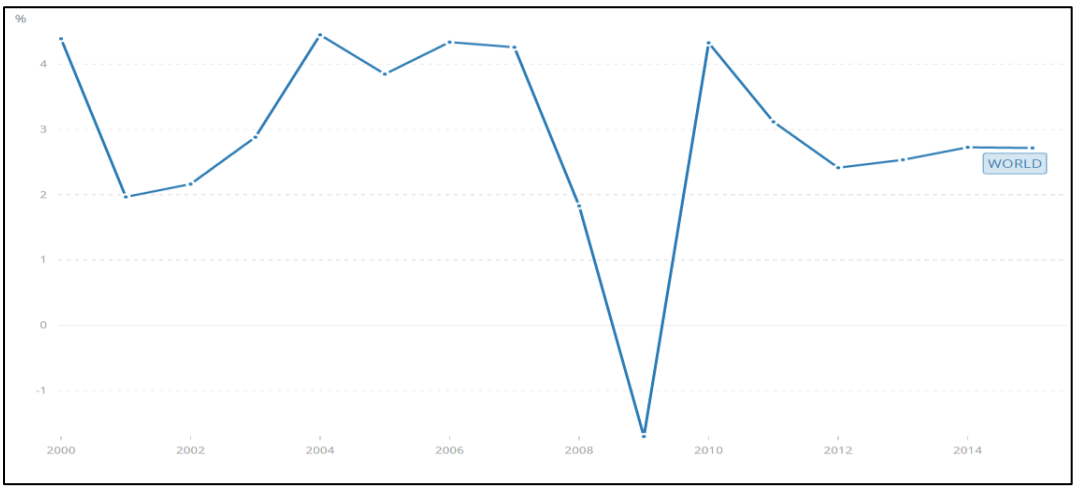


Figure 1: GDP growth (annual %)

In view of the link between investment costs, as correlates of revenue in determining fiscal balance, therefore, one budgetary item that matters for economic growth in oil rich economies is oil rents. Oil rents are basically revenue less costs, and posits a clear picture of an oil dependent country's oil wealth, as compared with oil production volumes. Thus, among several budget items, government's gross revenue is largely sensitive to changes in crude oil price, and attracts consequences for overall economy in the presence of shocks. Past studies have clamored for less dependence on oil-related tax-revenues, and for more investment in high technology, so as to establish an exogenous and genuine driver of economic growth (Azhgaliyeva, 2014; Reyes-Loya and Blanco, 2008).

In addition, irrespective of foreign and domestic debt levels, a country with a drive for favourable fiscal balance, is likely to stand strong in the face of an oil shock, hence such country is referred to as been fiscally sustainable. A favourable fiscal balance is however made possible when there are active fiscal rules. Fiscal rules are used as devices to mitigate against improper behaviour of major fiscal variables, such as revenue, expenditure, and procedures or volumes of new debts. It is usually set for a time frame, and yields potential consequences if not adhered to by fiscal authorities.

Fiscal balance determinants in most countries, and its link with economic growth remains an important area of fiscal policy and public finance, and it requires further study, especially for oil rich countries. This is because oil rich countries tend to borrow for recurrent spending, amazingly during oil peaks, as contrasted to standard expectations. The rising trend in government debt over the last decade is quite alarming. This is because debt is an important component of fiscal balance, and debt-to-GDP

[1] World Bank Database, and OECD National Accounts

ratio has been on increase (Checherita-Westphal and Rother, 2012), which results in rising deficits in turn.

The paradox between international crude oil price peak seasons, rising crude oil revenue and falling fiscal balance (or rising budget deficits) is somewhat established and investigated as not just economically motivated, but also politically motivated. Although, there are several macroeconomic models that incorporate government's optimizing behaviour, these models only explain fiscal balance partially; therefore, it is reasonable to consider the challenges of political management by the government. This is owing to some tendencies for huge deficits, when the government is weak, due to the structure of the government (Roubini and Sachs, 1989).

Since the 2014 to 2015 crude oil price fall, its effects on fiscal sustainability have not been accounted for, given that most oil dependent countries suffered some level of fiscal crisis, ranging from weak fiscal stimulus, increased borrowing, and inability to meet up with very basic public financial obligations, amongst others. This paper thus serves as supportive evidence, and uses recent data to investigate the relationship among these variables vis-à-vis, oil rents, debt-to-GDP, and real GDP per capita. The paper clearly illustrates the effect of oil rents on fiscal balance in oil dependent economies; the effect of oil rents on fiscal balance in oil dependent economies with fiscal rules; the role of rising welfare spending on fiscal balance; and how the effects of oil rents on fiscal balance in oil dependent economies compare with net oil exporting countries.

The effects of oil rents on fiscal balance, in the presence of welfare spending, and no fiscal rule is unknown and varies within oil dependent countries. Such information is critical for understanding the determinants of fiscal balance for a specific class of countries, and to provide group-specific policy recommendations on the use of oil rents in peak periods. It is in line with the above that this study focuses on oil dependent economies, as classified by the World Bank. The study also highlights important effects for countries with fiscal rules, which in this paper we assume as those countries with institutional arrangements that requires prudency in peak periods.

This study will elucidate the effect of oil rents by examining its relationship with welfare spending, and corruption index, among other covariates for selected oil dependent economies. In addition, as discussed in the previous sections, oil dependent economies benefitted from crude oil price peak in late 2014 until mid-2015. These periods also witnessed rising borrowing by many countries, and these were used on recurrent expenditures. As such, it provides an ideal sample for this study.

Furthermore, the study will be vital to policy makers in oil dependent economies by helping them to understand the need for fiscal rules, and to determine appropriate policy interventions during oil boom era, so as to ensure improvement in fiscal balance. Hence, this in future will ultimately safeguard the government purse, and budgetary obligations of oil rich countries.

2. THEORY/LITERATURE REVIEW

2.1. Theoretical framework

Unlike in the private sector where objectives are market driven, and resources are influenced by market demand, many government budgets and activities are constrained by their resources i.e. mostly funded by revenue from tax, or in some cases revenue from natural resources such as crude oil. Activities are politically motivated in the latter, and most funding structures are in line with grants, settlements, and debts. Therefore, decisions are affected differently by different set of agents; in the private sector we have the shareholders, customers, labour force, and the management team; while in the public sector, we identify with the people, who are the users of service, and the political office holders. In line with this also, budget size is usually large in the public sector, resulting in deficits overtime.

In the USA for example, the federal government has sustained high deficits since the 1980s and enjoyed only few years of surpluses, akin to spending on welfare, Medicaid, wars, and other

internal/external spending. The effects of deficit on the economy is however a debate in most countries, but is usually argued against. Therefore, decisions on the choice of method for financing government expenditure, although suggested by the Ricardian equivalence, and other tax smoothening hypotheses, is usually a political issue, and may not be appropriately modelled.

2.1.1. Government budget constraint, budget deficits, and fiscal policy

The basic government budget constraint describes what capacities lie in the government, and this is captured by the government's budget constraint (Romer, 2012). We follow the framework developed by Romer (2012), and highlight some modification to the conclusions of the model. Learning from household's individual budget set up, "the present value of its consumption must be less than or equal to its initial wealth plus the present value of its labour income". We follow a similar trend to construct the government's budget constraint:

$$\int_{t=0}^{\infty} e^{-R(t)} G(t)dt \leq -D(0) + \int_{t=0}^{\infty} e^{-R(t)} T(t)dt \quad \ldots\ldots\ldots\ldots\ldots\ldots (1)$$

$$R(t) = \int_{\tau=0}^{t} r(\tau)d\tau \quad \ldots\ldots\ldots\ldots\ldots\ldots (2)$$

The present value of government's 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), taken as a proxy for total government revenue in this baseline model. G(t) and T(t) denote the government's real purchases and taxes at time t, and D(0) is the initial real debt outstanding. $r(\tau)$ is the real interest rate at time (τ). We refer to D(0) as government's debt rather than wealth, which is negative.

We infer also from the Ramsey-Cass-Koopmans model on the optimal savings for a society, which suggest that household wealth cannot assume a negative value, so is the government debt D(0). Also, since the interest rate maintains a positive value, the government cannot pay off its debt. Hence, the government is motivated to permanently remain indebted, or even increase its borrowing, since the limit of the present value of its debt cannot be positive.

Furthermore, if the government is always borrowing, and uses a fiscal policy where the real interest rate exceeds the rate of growth of debt, equation (1) is satisfied and the fiscal balance (government budget balance) is negative. Thus, we can pose a frontier definition of fiscal balance, or budget deficit as the rate of change of the stock of debt. This rate of change is given as:

$$D(t) = [G(t) - T(t)] + r(t)D(t) \quad \ldots\ldots\ldots\ldots\ldots\ldots (3)$$

Where equation (3) refers to the rate at which the debt stock changes being equal to revenue less expenditure, added to the real interest on the debt stock. Since G(t) – T(t) is usually referred to as the government's primary deficit, we can measure the government's constraint by focusing on performance of fiscal policy.

2.1.2. Modified model

Focusing on the conventional measures of primary deficits and debt stocks, at a point in time may yield misleading measures of actual fiscal performance, therefore it is reasonable to consider the present value of the whole expenditure and revenue paths of the government. We can modify the preceding equations to accommodate macroeconomic variables, such as inflation, a cogent budgetary variable such as oil rents for oil dependent economies, since it accounts for a large portion of revenue, and political variable such as corruption index:

$$B(t) = P(t)[G(t) - T(t) - \mathrm{OR(t)}] + i(t)P(t)D(t) \quad \ldots\ldots\ldots\ldots\ldots\ldots (4)$$

Where P(t) is the price level and i(t) is the nominal interest rate, and if we accommodate nominal and real relationships between nominal interest rate and the inflation rate, we find that:

$$\frac{\dot{B}(t)}{P(t)} = D(t) + \pi(t)D(t) \quad \ldots\ldots\ldots\ldots\ldots\ldots (5)$$

This means that in as much as the debt stock is positive for any country [D(t)], the conventional or nominal primary deficits [B(t)] rises, when the inflation [π(t)] rises, even when it is deflated by the price level [P(t)]. Impliedly, when we interact fiscal rules, or introduce other political or macroeconomic variables in equation 5, we can capture the response of government's budget constraint, to several variables in an economy, and implicitly understand the behaviour of fiscal balance.

2.2. Empirical literature survey

Given that fiscal policy and monetary policy are important macroeconomic policies that shape the economy, and to understand the determinants of budget deficits, and fiscal balance of most countries, several researchers have made efforts to grasp the connection between macroeconomic, political, and budgetary variables, and budget deficits. They have particularly highlighted the relevance of rising debt and falling economic growth performance in determining the fiscal stance of a country.

While some studies showed that interest rates, unemployment rate, economic growth rate, and inflation rates, are major determinants of fiscal performance, others highlighted political variables such as fiscal autonomy of sub-national government, control of corruption index, and transparency of the budget, as significant above all other variables. Consequently, due to consistency and inconsistencies of several findings, this paper proceeds to use case studies of oil exporting countries, while highlighting the presence or absence of fiscal rules, as a strategy to find out significance or causal effects of several class of determinants of fiscal balance.

2.2.1. Literature on determinants of fiscal balance, debt, and growth

Arjomand *et al.* (2016) as well as Afonso and Jalles (2013) found a direct link between economic growth and variables such as inflation, while noting an indirect relationship between budget deficit and debt-to-GDP ratio and also labour productivity. Their findings showed that higher debt maturity leads to higher economic growth, which in turn lead to has effects on government's fiscal performance. In other words, at times of financial crisis, there are adverse growth effects, thus efforts to consolidate fiscal efforts of the government, and improve on basic debt ratios, are capable of improving total factor productivity and also enhance overall growth performance.

In their multivariate regression analysis, covariates such as gross fixed capital formation, public investment, Real GDP per capita, and labor productivity were significant but not with expected effects. In a similar approach, Baum *et al.* (2013) found that the effects of debt on the growth rate of GDP in the short-run is positive, and has very high significance. However, this effect is almost extinct when public debt-to-GDP rises to about 67% of the total debt. Also, other variables such as trade openness measure, and the ratio of gross capital formation to GDP have their individual effects and are statistically significant in determining economic performance.

Tujula and Guido (2004), investigated the variables that affects fiscal balance of OECD countries and found that amongst many variables, long-term nominal interest rates, rate of unemployment, real GDP growth, affects budget deficit. Also, certain political variables were found to be significant, such as election years, government type, whether democratic or military, as well as political stability in the country influences fiscal balance. Thus, the authors found that fiscal balance falls rapidly during election years. Furthermore, during economic recessions, asset prices adversely affects fiscal balance, and can be correlated with economic, political, and institutional set-ups in the country. According to Woo (2003), sociopolitical variables do not greatly affect government's budget balance when there are sound institutional settings.

In addition, Mercan (2014), found that the sustainability of budget deficits matters in overall fiscal performance of a country. Using a sample of 18 OECD countries from 1980 to 2012, the paper found that the ratio of budget deficit to GDP, and government's general expenditure influences budget deficits, and for the sample selected, budget deficits were weakly sustainable over the period covered. Also, a sum up of these determinants of fiscal balance are not unconnected to the leading findings of Roubini and Sachs (1989). Their study gave strong support for both political and economic institutions as major determinants of fiscal balance. However, much emphasis is placed on the structure of the former having more influence. Kontopoulos and Perotti (1999), using a similar methodology for 20 OECD countries, empirically found that 'the number of spending ministers has a strong and very robust effect on expenditure, particularly during the period that includes the large macroeconomic shocks' (p. 100). This means that government size is usually as a result of alliances in the electoral process, and these has potential causal impacts on fiscal performance.

2.2.2. Literature on relationship between fiscal rules and fiscal balance

On the other hand, several other studies have investigated the importance of a number of fiscal rules, such as expenditure or spending rules, revenue rules, as well as debt rules, as they influence fiscal performance of a country. Wijnbergen and Budina (2011), found that due to uncertainty in future flows of revenue and expenditure of the government, stock of debt, and primary deficits are adversely affected. This is particularly worst for natural resource rich countries, therefore, an establishment of "feedback rules" as it interacts with revenue from sale of natural resources, will help reduce the difference, and help alleviate deficits (p. 24). Such feedback rules therefore targets set levels of budgetary components, and can mitigate mismanagement of resources. This finding is consistent with Maliszewski (2009). The author showed that due to inconsistencies and rising production and adjustment costs of crude oil, welfare spending are delicate to models of fiscal rules, thus, revenue from non-oil activities should be distributed carefully given falling crude oil reserves.

Hagen and Harden (1995) by showing an explanation for continually rising government debt, and therefore budget deficits in selected OECD countries, found that the budget process is highly uncertain, hence, the need for fiscal rules. However, their empirical results shows that commitment to rules, based on sound institutions is severely necessary, else, the government is lured into a fiscal illusion. In addition, Bohn and Inman (1996), selected a specific fiscal rule, i.e. balanced-budget rule, and drew evidence from states in the US. Historically, the US has recorded consistent deficit spending, and thus the authors investigated why this is so despite the fiscal rule in place. They found that given the several revenue sources available to the government, deficits can only be ameliorated if there are government spending cuts, rather than increases in taxes. Thus, while using selected economic and political controls, as well as a dummy measure for fiscal rule in their panel regressions, their results and conclusions shows that when a balanced-budget rule is set, the overall performance of such rules are at the mercy of legislative decisions, and in general the political atmosphere.

2.3. Justification

This paper is very important for oil dependent economies, and its findings would significantly contribute to the current literature. This paper is one of the few to interact fiscal rules with oil rents, and present pooled OLS, Fixed effects, and IV estimations in comparison, for two different set of classification of countries.

The essence of this comparison is to comprehend the various under/overestimated causal effects of variables (determinants) on fiscal balance, and to highlight individual significance of macroeconomic variables, budgetary variables, and political variables into one category. Thus, the results of various estimation techniques from this paper will give new insights to the current literature on fiscal balance, welfare spending, debt-to-GDP effects, as well as the essence of fiscal rules in a unified framework, as against the conventional government budget constraint.

3. MATERIAL AND METHODS

Based on the objective of this paper, to test the hypothesis stated, we make use of causal inference models with longitudinal data; linear dynamic panel model and static panel data estimators.

Longitudinal/panel data is a distinct case of pooled time-series cross-section in which the same cross-section such as entities (e.g. states, companies, individuals, and countries) is measured over time. In this study, the cross-section includes a sample of 20 selected oil dependent economies, and yearly observations of a number of variables were collected.

In using panel data, we adjust for *individual heterogeneity*, get more informative data, as well as *variability*, efficiency and good degrees of freedom. Also, we benefit from less collinear relationship among regressors. This leads to the building and testing of more complex behavioral models, and longitudinal unit root tests that possess standard asymptotic distributions.

A problem to overcome with panel data is the homogeneity assumption, and though formal tests exist that would evaluate its validity, there is a possibility of cross-sectional dependence that would complicate the analysis. As such, certain methods and tests need balanced panels and cross-country data consistency.

Pre-Estimation
The study presents the summary statistics of the variables used, scatter plot of these variables, and a correlation matrix. The study proceed to test for heteroskedasticity, and to decide on whether to use the fixed effects of random effects estimation techniques, after conducting the Hausman specification test. Finally, the paper also carried out the test for Instrument Relevance, so as to apply the right and valid instrumental variable

Estimation
This study makes use of Ordinary Least Squares (OLS) with pooled data, proceeds to applying either Fixed Effects (FE) or Random Effects (RE) estimation methods depending on Hausman specification test. The paper finally uses the instrumental variable approach based on two-stage least squares. These three econometric methods helps to confirm the robustness of the findings across distinct techniques. To start with, a simple strategy is to estimate the model in equation (1) and (2) using OLS regression. However, there are problems with this strategy. Two of these problems include; *endogeneity problems* which may be due to the capturing of *reverse causality* issue or the effect of some of the *omitted variables* (e.g., geographical characteristics, culture and so on); and the possibility of *measurement error* of our variables of interest (fiscal deficit and oil rents). This is because such errors will load into other variables.

If not corrected, these two problems will yield OLS estimates that do not correspond to the *causal effect* of oil rents on fiscal balance. Thus, upward or downward biases are possible.

The next strategy is therefore to use either the *fixed effects or random effects panel data model*. This model is reasonably effective to figure out the causes of changes within a sample. Thus, the fixed or random effects model controls for all time-invariant differences between the selected oil dependent economies, so that the estimated coefficients are unbiased because of omitted time-invariant characteristics such as fiscal rule or policy changes, budget structure, amongst others.

As all the variables are time-invariant, this model is appropriate to establish a causal effect of oil rents on fiscal balance in oil dependent economics. The model is specified as follows:

$$FB_{it} = \beta_i + \beta_1 OR_{it} + \gamma_0 Z_{it} + \varepsilon_{it}$$

where the dependent variable FB_{it} stands for fiscal balance of country i in period t. OR_{it} is the main variable of interest, and it is country i's oil rents in period t. B_i represents the country fixed-effect and Z_i is a set of other control variables that includes Debt to GDP ratio, Real GDP per Capita, Government Expenditure (Size), Interest rate, unemployment rate, inflation rate, and control of corruption index ε_{it} stands for the error term.

Despite the fact that the fixed or random effects techniques can solve individual as well as time effects and can adjust for heteroskedasticity, and they seem plausible compared to pooled OLS, they generally need certain assumptions to be fulfilled, for instance, strict exogeneity assumption.

Thus, the shortcomings of RE and FE is that they are centered on country-specific effects and do not consider for stationarity, dynamics and endogeneity.

Oil rents could be potentially endogenous in oil dependent economies' fiscal balance regressions in the existence of omitted variables, measurement errors and reverse causality. For example, economic adjustments, changes in demographic characteristics of oil rigs and political regime changes or upheavals are potential to be omitted variables correlated with oil rents.

Statistical estimation compounded with these challenges may yield inconsistent and biased estimates. In order to handle the *potential endogeneity*, *unobserved heterogeneity* and *country fixed effects problems*, this paper uses the *instrumental variable approach* based on using the *two-stage least squares (2SLS)* with distinct and plausible instrument for oil rents.

This instrument variable is *share of world output*. This is expected to be correlated with oil rents, but uncorrelated with any of the determinants of fiscal balance. It is also orthogonal to any other omitted characteristics (i.e. uncorrelated with the outcomes of interest through any channel other than their effect via the endogenous variables).

A successful instrumental variables approach would correct not only for the simultaneous and omitted variable biases but also for differential measurement error in the two endogenous variables as long as the measurement errors have the classical form (see Wooldridge, 2002) and thus, we can parameters consistently.

The GMM is used to estimate the panel data for the larger data set, where N > T. Since it assumes strict exogeneity and stationarity restrictions, this paper obtains robust estimates from the dynamic linear panel, and also interacts fiscal rules with oil rents to capture the importance of fiscal rules in oil dependent economies. Furthermore, the paper uses two data samples; the first is with 20 countries for 16years, while the second is with 61 countries for 25years. The latter is for selected net oil exporting countries, while the former is for selected oil dependent economies.

Post-estimation diagnostics/robustness checks

In order to confirm robustness, the study carried out the tests of endogeneity (Oil Rents are indeed endogenous or not), the first stage regression statistics, to test for weak instruments, and the tests of overidentifying restrictions, to test for instruments validity.

3.2 Model specification

We specify two models to examine oil rent's effect on fiscal balance. The first model contains oil rents and a set of control variables. The baseline model to investigate oil dependent countries specific oil rent's effect on fiscal balance takes the form:

$$FB_{it} = \beta_0 + \beta_1 OR_{it} + \beta_2 OR_{it} * FR_{it} + \gamma_0 Z_{it} + \varepsilon_{it} \quad \text{…….. (6)}$$

where fiscal balance is the dependent variable defined by country's budget deficit, OR is the oil rents, OR*FR is the interaction of oil rents and oil dependent countries with fiscal rule and Z_i is a vector of

other economic control variables believed to influence fiscal balance. The control variables consist of Debt to GDP ratio, Real GDP per Capita, Government Expenditure (Size), Interest rate, unemployment rate, inflation rate, and control of corruption index. γ_0 is a vector of coefficient estimates of the control variables, i= 1,….., N and t = 1,…..,T are correspondingly the distinct and temporal magnitudes of the panel, β_i is the country fixed effects and ε_{it} is an idiosyncratic error term.

Furthermore, to cater for potential endogeneity of oil rents and all explanatory variables, the study introduce the instrumental variable model. Given the linear regression:

a. Regress OR_{it} on SWO_{it}, and Z_{it} to obtain $OR^{\wedge}_{it}$ estimate ……. (7)

$$OR_{it} = \alpha_0 + \alpha_1 SWO_{it} + \gamma_0 Z_{it} + \varepsilon_{it} \quad \text{…….} \quad (8)$$

where SWO_{it} is the instrumental variable

b. Plug in the fitted values of OR_{it} estimated derived from the equation (1) into the original linear regression equation

$$FB_{it} = \beta_0 + \beta_1 OR^{\wedge}_{it} + \gamma_0 Z_{it} + \varepsilon_{it} \quad \text{…….} \quad (9)$$

where ε_{it} is a composite error term that is uncorrelated with OR_{it} estimated and other regressors.

In applying the dynamic panel (GMM-IV) technique to mitigate potential endogeneity of oil rents, the moment conditions whereby lags of the dependent variable – fiscal balance and the first differences of the exogenous variables – oil rents are instruments for the first-differenced equation. The equation to estimate is given as:

$$FB_{it} = \alpha_i + \beta_1 FB_{it-1} + \beta_2 OR_{it} + \gamma_0 Z_{it} + \varepsilon_{it} \quad \text{…….} \quad (10)$$

Where FB_{it-1} is lagged fiscal balance, which helps yield robustness in the dynamics of adjustment for fiscal balance, and we also specify another model to capture the interaction between oil rents and fiscal rules for all the samples selected.

$$FB_{it} = \alpha_i + \beta_1 FB_{it-1} + \beta_2 OR_{it} + \beta_3 OR_{it} * FR_{it} + \gamma_0 Z_{it} + \varepsilon_{it} \quad \text{…….} \quad (11)$$

$OR_{it} * FR_{it}$ captures the interaction between oil rents and fiscal balance. Also, to gratify for the possibility of cross-sectional dependence and heteroskedasticity, and improve reliability and confidence level of the estimates, we apply the Driscoll-Kraay and the robust standard errors respectively.

3.3. Definition of variables

Table 1: Descriptions of dependent, independent, and policy variables

Category	Measured by	Definition
Outcome Variable (Fiscal Balance)	Budget Balance – BB	General government overall fiscal balance expressed as a percentage of GDP
Policy Variable (Oil Rents)	Oil Rents (OR)	Oil rents are the difference between the value of crude oil production at world prices and total costs of production. Higher oil rents is expected to translate to lower deficits and an improved fiscal balance
Control Variables	Interest Rate	Lending rate is the bank rate that usually meets the short- and medium-term financing needs of the private sector. This rate is normally differentiated according to creditworthiness of borrowers and objectives of financing. The terms and conditions attached to these

		rates differ by country, however, limiting their comparability. A high interest rate leads to low fiscal balance. Debts become expensive and fiscal balance poorly reacts (Eschenbach and Schuknecht, 2002).
	Unemployment Rate/Output growth/Output Gap	Unemployment refers to the share of the labor force that is without work but available for and seeking employment. This captures fiscal response to changes in the macro economy, as well as stabilization policies used during different cyclical fluctuations. Budget deficits would increase, leading to worsening fiscal balance in poor economic times for example. Hence, a negative relationship a priori.
	Debt-to-GDP ratio (DGDP)	The debt-to-GDP ratio measures the fiscal sustainability of the government. It is negatively related to fiscal balance. High DGDP leads to high interest payments and worsens budget balance.
	Share of World Output (SWO)	Oil production, 1000 bbl. per day as a share of total world output.
Welfare level	Real GDP per Capita	In order to finance catching-up expenditure projects, government engage in deficit financing, which negatively affects overall fiscal balance (Woo, 2003)
	Inflation (INF)	Inflation as measured by the consumer price index reflects the annual percentage change in the cost to the average consumer of acquiring a basket of goods and services that may be fixed or changed at specified intervals, such as yearly. The Laspeyres formula is generally used. In the literature, (Kontopoulos and Perotti, 1999), through price-indexation of receipts, inflation may erode competitiveness and risks causing pressures on exchange rates, and also negatively affect investment and growth, which determines fiscal performance in the end.
	Control of corruption (-2.5 weak; 2.5 strong)	The index for Control of Corruption captures perceptions of the extent to which public power is exercised for private gain, including both petty and grand forms of corruption, as well as capture of the state by elites and private interests. A weak index adversely affects fiscal balance.
	Oil reserves, billion barrels	Proved reserves of crude oil are the estimated quantities of all liquids defined as crude oil, which geological and engineering data demonstrate with reasonable certainty to be recoverable in future years from reservoirs under existing economic and operating conditions.
	Oil production, thousand barrels per day	Oil production includes the production of crude oil (including lease condensate), natural gas plant liquids, and other liquids, and refinery processing gain. Negative values indicate a net refinery processing loss.

3.4. Expected results

Hypotheses

i. Oil rents have positive impacts in determining the fiscal balance of an oil dependent economy, with or without fiscal rules

ii. Welfare spending does not affect fiscal balance

iii. There is no significant difference between the effects of oil rents in dependent economies and net oil exporting countries

Of all three variables identified in the literature, we expect Oil Rents to outperform the impact of rising real GDP per capita, control of corruption index, and falling debt-to-GDP on fiscal balance of oil dependent economies. In summary, this study will test the hypothesis that oil rents does affect fiscal rents in oil dependent countries, while observing other proven covariates.

Table 2: Variables and expected signs

Given the models specified in equations above, the variables' expected coefficient results are as follows:

Variable	Expected Sign
Oil Rents	Positive
Interest rate	Negative
Debt-to-GDP ratio	Negative
Share of World Output	Positive
Real GDP	Positive
Government Expenditure (Size)	Negative
Unemployment rate	Negative
Control of corruption	Positive
Inflation rate	Negative

3.5. Data and sources

Data used in the regression model are described in this section. The dependent variable is the fiscal balance measured in constant dollars, from the International Monetary Fund (Fiscal Monitor) 2016. A set of control variables are also included to alleviate the effect of omitted variables bias; these include Debt to GDP ratio, Real GDP per Capita, Government Expenditure (Size), Interest rate, unemployment rate, inflation rate, and control of corruption index. Real GDP and Debt to GDP are specified in Natural logs.

Data of 20 selected oil dependent economies, and 61 net oil exporting economies (all listed in the appendix), as classified by the World Bank; Kuwait, Libya, Saudi Arabia, Iraq, Angola, Oman, Azerbaijan, Venezuela, Chad, Brunei, Kazakhstan, Iran, UAE, Ecuador, Algeria, Nigeria, Russia, Qatar, Norway and Mexico within 2000 – 2015, and 1991 – 2015 respectively. All have annual data for the period under consideration, and all the variables are taken from International Monetary Fund, except Real GDP per capita constant and Oil rents, which are taken from WDI dataset 2015.

4. RESULTS AND DISCUSSIONS

This section provides a detailed account of the pre-estimation tests carried out, findings obtained from employing pooled OLS, FE, IV/2SLS estimations, as well as the GMM-IV results obtained from equations 6 – 11, and robustness checks. The tables below shows general empirical results from regression established on the selected countries included in the sample, and in all regressions there is an interaction variable of oil rents with fiscal rules OR*FR to assess policy-specific effects.

Pre-estimation diagnostics

Summary Statistics

The following table describes the summary of variables used for the various estimations carried out; pooled-OLS, Fixed effects, 2SLS IV, and GMM-IV methods of analysis. Summary statistics like mean, standard deviation, minimum, and maximum are included.

Table 3: Summary statistics

Variables	Obs	Mean	Std. Dev.	Min	Max
Fiscalbalance	1,525	-1.5564	7.92087	-151.3092	43.30262
	320	4.2318	12.0617	-53.54418	43.30262
Oilrents	1,525	9.7456	14.0988	0	67.19
	320	29.9305	15.5642	1.3087	69.55
Fiscalrule	1,525	0.2216	0.4154	0	1
	320	0.2125	0.4097	0	1
Debttogdpratio	1,525	50.4470	39.4886	.35	316.43
	320	28.8846	30.8728	.318164	342.666
Govtsize	1,525	16.2655	7.4090	2.06	83.25
	320	15.0522	5.7363	4.16	42.51
Intrate	1,522	6.9854	13.2696	-94.22	130.78
	320	12.1945	12.2582	3.1	103.16
Ur	1,525	8.2080	5.3079	.16	29.77
	320	7.7609	5.4125	.3	29.9
Realgdppercapita	1,525	16060.21	19246.78	257.11	91593.67
	320	19526.16	23659.15	462.49	91593.6
Infrate	1,525	51.3928	649.0846	-10.6	23773.1
	320	9.8253	24.1002	-10.0675	324.997
Controlofcorruption	1,514	0.0165	1.0816	-2.06	2.55
	320	-0.3582	.97331	-1.69	2.3
Shareofworldoutput	1,525	1.4872	3.7802	.01	27.89
	320	4.0650	5.2230	.07	25.88
Logrgdp	1,525	8.8388	1.4287	5.5495	11.4251
	320	9.1918	1.2221	6.1366	11.4251
Logdgdp	1,525	3.6246	0.8557	-1.0498	5.757102
	320	2.9031	1.0716	-1.1451	5.836756
Oilrents*Fiscalrule	1,525	1.5020	6.322	0	62.17
	320	4.1847	9.1239	0	39.33

Note: The values in italics in table 3 are data of the sample of 20 oil dependent countries employed in the study

From the data, the mean of all net oil exporting countries is negative, and these group of countries have even larger deficits or fiscal balance, compared to the heavily oil dependent countries. In fact, countries in the Middle East, and in Africa have fiscal balance above the country averages. However, no low or middle income country has fiscal balance close to the mean of any of the OECD countries included in the larger sample.

In the case of oil rents, oil dependent countries have country averages larger than selected net oil exporting countries. Thus, the large amount of oil rents for the former can be considered as a justification for their dependency on crude oil revenues in budgetary decisions.

Bin scatter plots

In order to understand the link between fiscal balance and oil rents, the study utilizes the bin scatter plots, which is a non-parametric approach of understanding the link among variables. Since the bin scatter plot first groups oil rents into equal-sized bins, and then computes the averages of fiscal balance and oil rents within each bin, the scatterplot created is representative of the behaviour of the population, not just the selected samples included in this study (Chetty *et al.,* 2013; Stepner, 2014)

Panel A: Fiscal balance and oil rents for net oil exporting countries

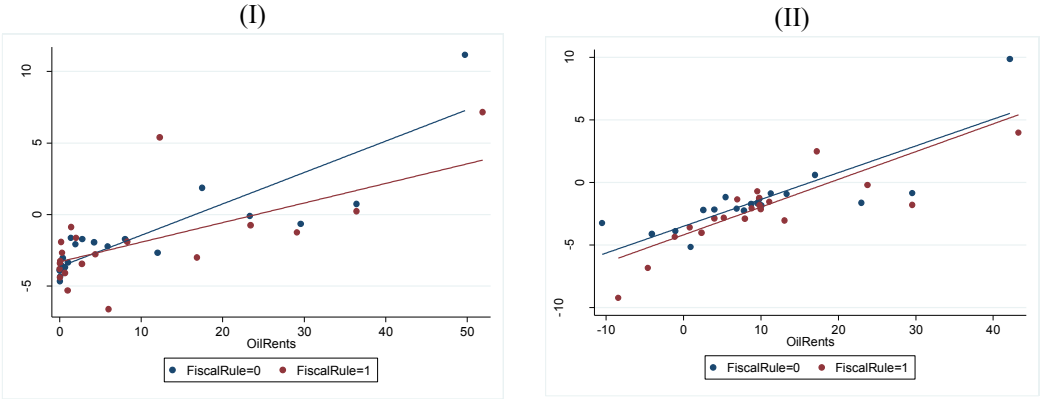
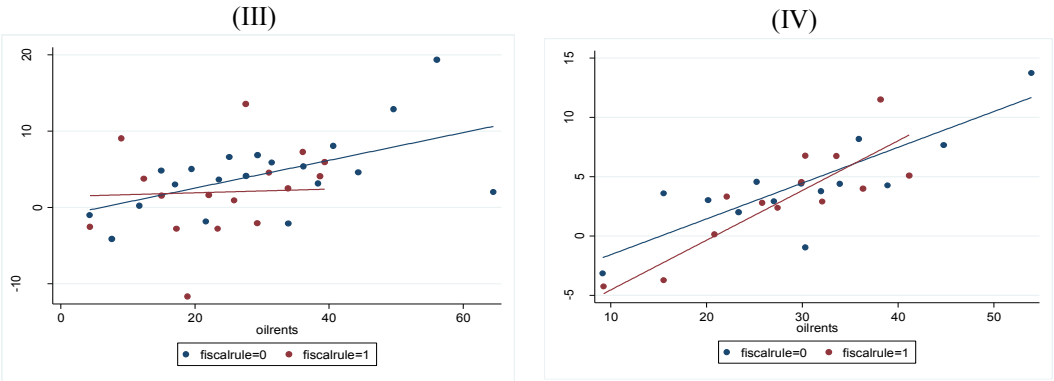


Figure 2: Bin scatter plots of fiscal balance and oil rents

Graph (I) includes a dummy variable i.e. fiscal rules, and plots the bin scatter points, showing that without fiscal rules, the scatter points are dispersed around the regression line, but tight to the regression line when there are fiscal rules. This mean that the slope is imprecisely estimated without fiscal rules, and regression standard error is large, but is otherwise with the presence of fiscal rule.

We include the control of corruption index in Graph (II). This is useful, as it accommodates a control for covariates before plotting the relationship. Thus it shows the relationship between fiscal balance and oil rents, when we control for the corruption index. As shown above, given that the binned scatter points are tight to the regression line, the slope is precisely estimated, whether there is fiscal rule or not, hence, the regression standard error is small, which indicates statistical significance.

Panel B: Fiscal balance and oil rents for oil dependent countries



For Oil dependent economies, graph (III) shows a positive relationship between fiscal balance and oil rents. This positive relationship is however steeper when there is fiscal rules. It is almost constant, and may be statistically insignificant without adding any covariates. However, in graph (IV), the bin scatter points, shows a positive relationship between fiscal balance and oil rents, when we include a covariate. The dispersion of bin scatter points across the line is however uncertain and is shown in several regression estimates that follows in subsequent sections of this paper. One obvious point to note is that the strength and direction of relationship between fiscal balance and oil rents is affected when other covariates are included.

Correlation matrix

Table 4.2 shows Pearson correlations for selected variables. All the independent variables selected are significantly related to fiscal balance in net oil exporting countries. However, in oil dependent economies, government spending is insignificantly related to fiscal balance.

Also, in oil dependent economies, apart from debt-to-GDP ratio, real GDP per capita and control of corruption index, the association with fiscal balance is not very strong, but large sample feature, and control of cross country dependence may induce the statistical significance of each.

The strongest association is between control of corruption index and our selected measure of welfare spending i.e. real GDP per capita. The flow of government spending on welfare to the improvement in life expectancy and general welfare of citizens is mostly hampered by corruption in many oil-rich economies. Thus, as expected, the more corruption is controlled for, the more welfare improvement an economy enjoys.

As expected also, the sign of the association between debt-to-GDP ratio and fiscal balance is negative, and is established in both group of sample countries.

Table 4: Correlation Matrix for selected variables

Panel (A) – For selected net oil exporting countries

	Fiscal Balance	OilRents	GovtSize	logRGDP	logDGDP	Control of Corruption
Fiscal Balance	1.0000					
OilRents	0.3682* 0.0000	1.0000				
GovtSize	-0.1584* 0.0000	0.0088 0.7301	1.0000			
logRGDP	0.1233* 0.0000	-0.0351 0.1712	0.4107* 0.0000	1.0000		
logDGDP	-0.0562* 0.0282	-0.0801* 0.0018	-0.0368 0.1509	-0.0735* 0.0041	1.0000	
Control of Corruption	0.0639* 0.0129	-0.2601* 0.0000	0.2701* 0.0000	0.6878* 0.0000	0.0456 0.0760	1.0000

Note: * indicates significance at the 5% level

Panel (B) – For selected oil dependent countries

	Fiscal Balance	OilRents	GovtSize	logRGDP	logDGDP	Control of Corruption
Fiscal Balance	1.0000					
OilRents	0.2259* 0.0000	1.0000				
GovtSize	0.0774 0.1674	0.1365* 0.0145	1.0000			
logRGDP	0.4574* 0.0000	-0.1348* 0.0158	0.3967* 0.0000	1.0000		
logDGDP	-0.3865* 0.0000	-0.1002 0.0736	-0.0740 0.1868	-0.2874* 0.0000	1.0000	
Control of Corruption	0.4598* 0.0000	-0.2676* 0.0000	0.3014* 0.0000	0.8403* 0.0000	-0.1899* 0.0006	1.0000

Note: * indicates significance at the 5% level

Test for cross-sectional dependence

Given that cross-sectional dependence (CD), and contemporaneous correlation, is usually in macro panels that spans above 15-30 years, we conduct the Pesaran's CD test. This helps us to test whether the residuals are correlated across entities in the samples selected to represent oil dependent countries, so as to avoid bias in tests results (a.k.a. contemporaneous correlation).

Table 5: Tests for cross-sectional dependence

H_0: Residuals are not correlated	Selected oil dependent economies	All Net Exporting Countries
Pesaran's test of cross sectional independence	2.885, Pr. = 0.0039	11.645, Pr. = 0.0000
Average absolute value of the off-diagonal elements	0.303	0.291

Since the P. value < 0.5, we fail to reject the null hypothesis, and conclude that there is cross-sectional dependence among selected oil dependent economies. Hence, we proceed to use the Driscoll and Kraay standard errors, which is a robust standard error for panel regressions with cross-sectional dependence.

Standard hausman test

Here, the null hypothesis of *no fixed effects* has to be rejected at the 10% level. Because of the marginal rejection of the null hypothesis, the regression model in the model specification section of this paper (equation 6) should be estimated by fixed effects regression to ensure consistency of the results.

Table 6: Result of hausman tests

H_0: Difference in coefficients not systemic	Oil Dependent Economies	Net Oil Exporting Countries
Chi^2	16.74	0.0529
Prob > Chi^2	79.10	0.0000

An argument for the RE-FGLS

Although pooled OLS regression yields consistent coefficient estimates when the random effects model is true, its coefficient estimates are inefficient under the null hypothesis of the Hausman test. Therefore, pooled OLS regression should not be used when testing for fixed effects. Because feasible GLS estimation is both consistent and efficient, respectively, under the null hypothesis of the Hausman test, it is more appropriate to compare the coefficient estimates obtained from FGLS with those of the FE estimator (Hoechle, 2009). Due to numerical reasons, Wooldridge (2002) recommends to perform the Hausman test for fixed effects with either the fixed effects or the random effects estimates of the error. Thanks to the Hausman command's option *sigmamore*, Stata makes it simple to perform a standard Hausman test in the way suggested by Wooldridge (2002)

Provided that the Hausman test applied here is valid (which it probably is not), the null hypothesis of no fixed-effects is rejected on the 5% level of significance. Therefore, the standard Hausman test leads to the conclusion that pooled OLS estimation is likely to produce inconsistent coefficient estimates for the regression model in (10). As a result, the regression model in (10) should be estimated by fixed effects (within) regression.

Estimations

Given that the data collated are separated into oil dependent economies, and a larger set to cover for Net oil exporting countries, we present the results in two separate categories, and proceed to compare these estimations, and confirm consistencies, as well as robustness for each class of estimations.

Oil Dependent Countries

Pooled OLS

For the pooled-OLS estimation, we classify the variables as they influence fiscal balance alongside the policy variable, oil rents.

Table 7: Pooled OLS Estimation results

Dependent Variable = Fiscal Balance	(1)	(2)	(3)
VARIABLES	**Model 1 Policy + Macroeconomic Variable**	**Model 2 Macroeconomic + Budgetary Variables**	**Model 3 All Variables + Political Variables**
Oil Rents	0.284***	0.265***	0.305***
	(0.0797)	(0.0624)	(0.0668)
Interest Rate	0.0872	0.156*	0.145**
	(0.0626)	(0.0746)	(0.0596)
Unemployment Rate	-0.581**	-0.462**	-0.312
	(0.221)	(0.203)	(0.226)
Inflation Rate	-0.0913*	-0.0688	-0.0478
	(0.0476)	(0.0526)	(0.0437)
logRGDP	3.843***	4.548***	1.453*
	(0.413)	(0.601)	(0.720)
Govtsize		-0.372***	-0.372***
		(0.0930)	(0.0749)
logDGDP		-2.327***	-2.671***
		(0.289)	(0.261)
Control of Corruption			5.064***
			(1.211)
Oilrents*Fiscalrule	-0.0376	-0.0626	0.0355
	(0.0621)	(0.0559)	(0.0601)
Constant	-35.09***	-30.54***	-2.124
	(4.990)	(5.946)	(6.066)
Observations	320	320	320
R-squared	0.365	0.422	0.457
Number of Countries	20	20	20

Notes: The Drisc/Kraay Standard errors are reported in parentheses and ***, **, and * indicates significance at 1%, 5% and 10% level respectively (i.e. *** p<0.01, ** p<0.05, * p<0.1)

In order to mitigate omitted variables bias, the paper included several relevant control variables that influences fiscal balance in an economy. However, in this paper, we categorize them into macroeconomic variables, budgetary variables, and political variables. These variables are perceived to influence fiscal balance of any economy. Also, in order to highlight the influence of oil rents, it is pertinent to further consider the presence of fiscal rules or not. Hence, we include the interaction term, where fiscal rule – expenditure rule, debt rule, or revenue usage rules according to IMF classifications - is a dummy (1 = presence of at least one form of fiscal rule, and 0 = absence of any form of fiscal rule).

Fixed Effects and IV Estimations

Table 8: Fixed Effects and IV estimation results

	Dependent variable = Fiscal Balance		
	Pooled OLS Estimation All Variables + Political Variables	Fixed effects Estimation	IV/2SLS Estimation
Oil Rents	0.305***	0.395	0.293
	(0.0668)	(4.81)**	(5.41)**
Government Size	0.145**	-0.660	-0.379
	(0.0596)	(1.98)	(3.39)**
Interest Rate	-0.312	0.275	0.147
	(0.226)	(3.56)**	(2.53)*
Unemployment Rate	-0.0478	0.233	-0.309
	(0.0437)	(0.37)	(1.40)
Inflation Rate	1.453*	-0.056	-0.047
	(0.720)	(1.40)	(1.20)
logRGDP	-0.372***	12.747	1.658
	(0.0749)	(2.78)*	(2.04)*
logDGDP	-2.671***	-0.737	-2.662
	(0.261)	(0.93)	(4.24)**
Control of Corruption	5.064***	6.801	4.789
	(1.211)	(1.83)	(4.24)**
Oilrents*Fiscal Rule	0.0355	-0.030	
	(0.0601)	(0.41)	
_cons	-2.124	-102.333	-3.560
	(6.066)	(2.38)*	(0.46)
R^2	0.457	0.59	0.46
Observations	320	320	320
Number of countries	20	20	20

Drisc/Kraay Standard errors in parentheses * $p<0.05$; ** $p<0.01$
Fixed Effects method is preferred for the estimation of the fiscal balance equation based on the Hausman test (Prob>Chi^2 = 0.0529). Time dummies are omitted from the table

In general, the results are consistent with the empirical evidence documented in the literature. Oil rent is highly significant at 1% level in the pooled OLS, fixed effects and IV/2SLS estimations with the inclusion of the interaction term. The coefficient of this variable is 0.305 in the pooled OLS and 0.4 in the fixed effects estimation. This imply that 1% increase in oil rents will increase fiscal balance by +0.305% and +0.4% respectively in oil dependent economies. The interaction term (Oilrents*FiscalRule) is not significant. This means that the presence of fiscal rule does not have any influence on fiscal balance in *oil dependent countries*. Hence, whether rules that curtails spending, borrowings or the use of oil revenue especially during peak periods exists or not, fiscal balance is irresponsive to such changes.

When we consider the endogeneity problem, and estimate using the IV/2SLS approach, the estimate for oil rents decreases to +0.3% increase in fiscal balance for a 1% change in oil rents in *oil dependent economies*, and the interaction term is excluded. We considered country-specific and time-specific effects in the fixed effects model, and note that a 1% increase in oil rents increases the fiscal balance by 0.3%.

In the case of other variables, of interest is the real GDP per capita. This is because it captures the efforts of the government to boost welfare and better the lives of its citizens. Also, another variable of interest is the effects on fiscal balance of the control of corruption index. Government size is only

significant in two regressions, 5% level in pooled OLS and15% level in the IV/2SLS regressions. Interest rate is significant at 5% in both the fixed effects and the IV/2SLS regressions. As expected log RGDP per capita is significant in three regressions, at 1% level in pooled OLS, 5% level in both fixed effects and IV/2SLS estimations with and without the interaction terms respectively.

The control of corruption index is significant at 1% in the pooled OLS and IV/2SLS regressions. The effect of a 1% change in the estimated coefficient of this variable on fiscal balance ranges between +4.8% and +6.8%. Debt-to-GDP ratio is an important budget item, and it is statistically significant in the pooled OLS and IV/2SLS regressions. Thus, a 1% increase in debt-to-GDP ratio, reduces fiscal balance by 2.67% and 2.66% in the pooled OLS and IV/2SLS regressions respectively.

Net Oil Exporting Countries

We estimate all countries first with the famous pooled OLS techniques, and control for country-specific and time-specific effects

Pooled OLS, Fixed Effects, and IV/2SLS estimations

Table 9: Pooled OLS, fixed effects, and IV/2SLS estimation results

	Pooled OLS Estimation All Variables + Political Variables	Fixed effects Estimation	2SLS/IV Estimation
Oil Rents	0.239 (5.36)**	*0.466* (12.12)**	0.181 (4.95)**
Government Size	-0.289 (2.18)*	-0.452 (12.36)**	-0.283 (2.25)*
Interest Rate	-0.031 (1.94)	-0.018 (1.18)	-0.041 (2.95)**
Unemployment Rate	-0.153 (2.00)	0.051 (0.69)	-0.151 (2.85)**
Inflation Rate	-0.000 (0.77)	-0.000 (0.67)	-0.000 (0.43)
logRGDP	0.989 (3.59)**	2.957 (2.86)**	1.092 (3.94)**
logDGDP	-0.242 (0.95)	-0.563 (2.16)*	-0.270 (1.19)
Control of Corruption	0.769 (1.85)	0.740 (2.38)*	0.491 (1.72)
Oilrents*Fiscal Rule	-0.119 (2.90)**	-0.192 (4.49)**	-0.087 (2.13)*
Constant	-5.393 (3.27)**	-25.552 (2.85)**	-5.727 (2.72)**
R^2	0.24	0.44	0.23
Observations	1,511	1,511	1,511
Number of Countries	61	61	61

Drisc/Kraay Standard errors in parentheses
* $p<0.05$; ** $p<0.01$

Given a larger dataset, the results are consistent with the empirical evidence documented in the literature, and the interaction term is significant in all the techniques used. This means that *fiscal rules matter for net oil exporting countries*, and influences fiscal balance through the oil rents. Oil rent is highly significant at 1% level in the pooled OLS, fixed effects and IV/2SLS estimations with the inclusion of the interaction term. The coefficient of this variable is however lower than for the oil dependent economies, but higher in the fixed-effects estimations. The least square dummy variable

(LSDV) approach for fixed effects estimations used showed that an increase in oil rents by 1% increases fiscal balance by 0.47%, but drastically reduces in the IV/2SLS estimations.

The interaction term (Oilrents*FiscalRule) is statistically significant. This means that the presence of fiscal rule does have some influence on fiscal balance in *net oil exporting countries*. Hence, when rules that curtails spending, borrowings or the use of oil revenue especially during peak periods exists, fiscal balance is responsive to such changes.

When we consider the endogeneity problem, and estimate using the IV/2SLS approach, the estimate for oil rents decreases to +0.18% increase in fiscal balance for a 1% change in oil rents in *selected net oil exporting economies*. We considered country-specific and time-specific effects in the fixed effects model, and note that a 1% increase in oil rents increases the fiscal balance by 0.47%.

Government size is significant in all three regressions, a 1% increase in government spending reduces fiscal balance by 0.29%, 0.45%, and 0.28% in the pooled OLS, fixed effects, and IV/2SLS estimations respectively. Interest rate is significant at 5% in the 2SLS estimation, and a 1% increase in the real interest rate *reduces* fiscal balance by 0.04%. For RGDP per capita, a 1% increase, raises the fiscal balance by 0.1%, and is significant at 1% level in all three regressions.

The control of corruption index is significant at 1% only in the fixed effects estimation, and a 1% increase, raises fiscal balance by 0.74%. Unemployment rate is also significant only in the IV/2SLS estimation, and a percent increase in Ur, reduces fiscal balance by 0.15%. Debt-to-GDP ratio is only statistically significant in the fixed-effects estimation, and a percent rise, leads to 0.26% decrease in fiscal balance.

Generalized methods of moment (GMM)

Given our larger dataset, the GMM technique works to eliminate serial correlation, it works to eliminate heteroskedasticity, and it also covers the endogeneity problem. It can be used for all forms of data including panel data, and is efficient when we have less time periods compared with cross sections over time (i.e. T < or = N). The advantages of GMM over the instrumental variables (IV) approach are clear: if heteroskedasticity is present, the GMM estimator is more efficient than the simple IV estimator. Also, GMM dynamic panel estimation is capable to correct for unobserved country heterogeneity, omitted variable bias, measurement error, and endogeneity problems (Bond *et al.,* 2001; Caselli *et al.,* 1996).

Table 10: GMM-IV Estimations

	Dependent Variable = Fiscal Balance	
	GMM-IV without Fiscal rules	**GMM-IV with Fiscal rules**
L.FiscalBalance	0.533 (3.76)**	0.520 (4.27)**
Oil Rents	0.375 (3.69)**	0.410 (2.73)**
Government Size	0.267 (0.48)	0.198 (0.42)
Interest Rate	-0.363 (2.56)*	-0.356 (2.89)**
Unemployment Rate	0.007 (0.01)	0.019 (0.02)
Inflation Rate	0.005 (0.42)	0.003 (0.45)
logRGDP	-0.709 (0.16)	-0.405 (0.10)
logDGDP	0.741	0.765

	(0.31)	(0.31)
Control of Corruption	-3.632	-3.572
	(1.10)	(1.12)
Oilrents*Fiscal Rule		-0.196
		(0.31)
Observations	1,385	1,385
Number of country	61	61

Robust standard errors in parenthesis
* $p<0.05$; ** $p<0.01$

The GMM-IV estimations are conducted for the all net oil exporting countries sample, with the interaction term (OilRents*FiscalRule), and also without the interaction term. In using this approach, we pay a higher cost in terms of the significance of a number of variables. However, as regards the *policy variable* of interest (Oil Rents), it is significant in the presence or absence of fiscal rules, and a rise by 1% increases fiscal balance by 0.38% in the GMM without fiscal rules, while an increase of 1% raises fiscal balance by 0.41% in the presence of fiscal rules using the panel dynamic estimation method with fiscal rules. The lagged dependent variable is statistically significant across fiscal balance in both GMM, suggesting a critical past effect on the present level of fiscal balance in oil exporting countries.

For the test of included covariates, government size is insignificant in both GMM, as well as unemployment rate (UR), inflation rate, real GDP per capita, debt-to-GDP ratio, and the control of corruption index. However, the interest rate is statistically significant in both GMM, and a 1% increase reduces fiscal balance by 0.36% with or without fiscal rules. Lastly, the lagged dependent variable is statistically significant across fiscal balance in both GMM, suggesting an important and critical past effect of fiscal balance on the level of fiscal balance.

GMM-IV Diagnostics Conducted
The Sargan/Hansen test of over-identifying restrictions which tests for overall validity of the instruments and the null hypothesis is that all instruments as a group are exogenous. Therefore, higher p-values are desirable to reject the null, and as it is in this paper, Prob > chi^2 = 0.216.

The second test examines the null hypothesis that error term of the differenced equation is not serially correlated particularly at the second order (AR2). We do not reject the null hypothesis of these tests in this case, since Pr > z = 0.866.

Instruments for first differences equation
Standard
D. (ShareofWorldOutput ShareofWorld)
GMM-type (missing=0, separate instruments for each period unless collapsed)
L (4/24). (FiscalBalance OilRents) collapsed

Arellano-Bond test for AR (1) in first differences: z = -1.47 Pr > z = 0.142
Arellano-Bond test for AR (2) in first differences: z = 0.17 Pr > z = 0.866

Sargan test of overid. Restrictions: chi^2 (34) = 58.50 Prob > chi2 = 0.006
(Not robust, but not weakened by many instruments.)
Hansen test of overid. Restrictions: chi^2 (34) = 40.16 Prob > chi2 = 0.216
(Robust, but weakened by many instruments.)

Difference-in-Hansen tests of exogeneity of instrument subsets:
IV (ShareofWorldOutput ShareofWorld)
Hansen test excluding group: chi^2 (32) = 37.38 Prob > chi2 = 0.236
Difference (null H = exogenous): chi^2 (2) = 2.78 Prob > chi2 = 0.249

Post-estimation tests/robustness checks

Instrumental Variables: Justification

To provisionally accept our instrumental variable (IV) as valid, this paper starts by investigating whether oil rent is indeed endogenous. Thus, it is important to detect variables in the error term that correlates with oil rents. Generally, many variables in the error term may correlate with oil rents, thus it is potentially difficult to identify a good IV. Also, since endogeneity isn't only about such correlations, the concern is if the candidate IV is not correlated with fiscal balance.

The verbal argument for share of world oil reserves as a valid IV is that oil rich economies do not consider amongst other budgetary items, oil reserves, but instead projected oil price. Thus, in the production/drilling/extraction cost of crude oil, and the revenue from the sale of crude oil, which are the determinants of oil rents, the country's share of world reserves is considered in the cost, but export price of crude oil is most significant in the revenue part of oil rents. Thus, the selected IV (i.e. the country's share of world crude oil reserves) has no correlation with other observable characteristics of fiscal balance, but is significantly correlated with oil rents, which is assumed to be potentially endogenous, and affects fiscal balance only through oil rents.

Table 11: IV: Test for instrument relevance

	OilRents
Share of World Output	1.608 (18.65)**
_cons	7.354 (21.00)**
R^2	0.19
N	1,525

* $p<0.05$; ** $p<0.01$

Test of endogeneity (Oil Rents are indeed endogenous or not)

H_0: variables are exogenous: The null hypothesis is that we could have just used regular pooled OLS or the fixed effects regression without necessarily using IV regression.

Table 12: Tests of endogeneity

Selected Oil Dependent economies	***Net Oil Exporting Economies***
Durbin (score) chi2 (1) = .060299 (p = 0.8060)	Durbin (score) chi2(1) = 4.09414 (p = 0.0430)
Wu-Hausman F (1,310) = .058426 (p = 0.8092)	Wu-Hausman F(1,1500) = 4.07538 (p = 0.0437)
Robust score chi2 (1) = .056565 (p = 0.8120)	Robust score chi2(1) = 2.73896 (p = 0.0979)
Robust regression F (1,310) = .054772 (p = 0.8151)	Robust regression F(1,1500) = 3.0852 (p = 0.0792)

Both the Durbin (score) statistics as well as the Wu-Hausman statistic have very large p-values which tells us that *we do not reject the null hypothesis* that Oil rents are exogenous, and not endogenous.

First stage regression statistics (for weak instruments)

Here we report the first-stage regression statistic in order to look for weak instruments, i.e. the correlation between the instruments and the supposed endogenous variable i.e. Oil Rents. We are interested in the Partial R-squared which measures the correlation between oil rents and share of world output after we have partial out the effects of other control variables.

Since the Partial R-squared is 58% and our robust F-statistic is 130.669, which is much larger than any of the critical values shown in our table, we reject the null hypothesis that our instruments are weak. This suggests that we have good instruments in this case.

Table 13: First stage regression statistics

H_0: Instruments are weak Variable: Oil Rents	***Selected Oil Dependent Economies***	***Net Oil Exporting Economies***
R-squared	0.6668	0.3561
Adjusted R-squared	0.6549	0.3518
Partial R-squared	0.5839	0.1966
Robust	F (4, 308)130.669	96.9266
Prob > F	0.0000	0.0000
# of endogenous regressors	1	1
# of excluded instruments	4	2

Test of overidentifying restrictions (for instruments validity)
Here, the p-values for the Sargan as well as the Basmann tests are large which suggests that our instruments are valid and that our models are correctly specified.

Table 14: Test of Overidentifying restrictions

Selected Oil dependent economies	***Net Oil Exporting countries***
Sargan chi^2 (3) = 34.5295 (p = 0.0000)	Sargan chi^2 (1) = 42.9081 (p = 0.0000)
Basmann chi^2 (3) = 37.2546 (p = 0.0000)	Basmann chi^2 (1) = 43.8407 (p = 0.0000)
Score chi^2 (3)= 14.8166 (p = 0.0020)	Score chi^2 (1) = 7.74959 (p = 0.0054)

Connecting the importance of fiscal rules for the effectiveness of oil rents in improving fiscal balance
Inferring from the findings of this study, we can deduce that oil rents is more effective in improving fiscal balance in net oil exporting countries, and fiscal rule is significant, as compared to the category of highly oil dependent economies, where fiscal rule is insignificant in all estimation technique employed to overcome empirical challenges. This ineffectiveness of fiscal rules (Debt, Revenue, and Government expenditure – Size) must have been attributable to overreliance on crude oil, inappropriate application, and untimely adoption of IMF's framework on fiscal policies and strategies by less self-reliant countries. Thus, these countries are largely exposed to external oil price shocks, and suffer from internal fiscal crisis, in the event of rising crude oil exploration costs, alongside falling revenue.

The key decision that underscores the establishment of fiscal rules arises from the trends in fiscal balance/Budget deficits of countries overtime. Deficits maintained a high hand in public finance, and thus necessitated the need for fiscal adjustments in order to standardize fiscal sustainability. Moreover, the rationale behind such reasoning is that government's finances responds to set budget constraints, external shocks – input or output, price shocks, past/lagged fiscal balances of the government, and the political will to support or not to spending for high categories of spending ministries, agencies, or parastatal, such as defense, welfare, education, amongst others.

It is worth noting that the simple view of fiscal rules is that a substantial part of budgetary items, be limited, and a fiscal indicator be used to monitor the reaction of government's finances overtime. Hence, policy makers should reiterate the need for the government to set up, and follow religiously, standardized fiscal balance rules, debt rules, expenditure or government size rules, and revenue usage rules.

5. CONCLUSION

This study achieved its main objective of investigating oil rent's effect on fiscal balance in the presence of fiscal rules for oil dependent economies, and for selected net oil exporting countries, while controlling for the effects of some macroeconomic, budgetary, and political variables, such as government size, interest rate, unemployment rate, inflation rate, real GDP per capita, debt-to-GDP ratio, and control of corruption. The study relied on the strengths of past studies like those of Tujula and Guido (2004) by establishing the specific effects of oil rents for crude oil endowed economies, as one of the *main* determinants of fiscal balance. This establishes the importance of oil rents, amongst other previously identified macroeconomic, budgetary, and political covariates. Thus, we have attempted to overcome the shortcomings of studies that make generalized conclusions for the main determinants of fiscal balance for all countries, without highlighting specific variables that takes a huge chunk of the effects for specific natural resource endowed economies.

Given large macroeconomic panel dataset, our empirical analysis solved the possibility of endogeneity, simultaneity bias and unobserved heterogeneity of oil rents and fiscal balance by the main econometric technique i.e. using an instrumental variable approach based on Dynamic Panel estimators or the General Method of Moment (GMM). This is used in comparison with estimations from pooled OLS, LSDV fixed effects, and the IV/2SLS techniques (using each country's *share of world output* as instrument). Our pre-estimation diagnostics showed that the GMM approach may not be applicable to the small sample, and we suspected that the IV/2SLS method may also be *weak* in testing our hypothesis for the oil dependent economies with N = 20 and T = 16, and therefore we maintained the LSDV Fixed effects estimations as our main result for this category of sample countries selected. We also utilized the Drisc/Kraay standard errors, as well as the robust standard errors, which are standard errors robust to cross-sectional dependence and heteroskedasticity of unknown forms respectively, that exists in large macroeconomic panel data where N > T.

Our estimation results shows that in countries with fiscal rules, there is insignificant reaction of fiscal balance to changes in oil rents shocks, and the impact is weak. We find also that welfare spending, which was captured by the real GDP per capita, affects fiscal balance, and so does the budgetary variable, i.e. debt-to-GDP ratio, and the ability of the government to curb corruption and mismanagement of funds, which is politically motivated.

5.2. Lessons for policy

The findings suggest that oil rents, government spending, welfare related spending, and the level of corruption, have significantly influenced the amount of budget deficits from 1991 – 2015 in countries with at least one form of fiscal rules. The findings have some implications for policymakers, for fiscal management and fiscal sustainability in resource rich countries. First, highlighting the unpredictability of crude oil price shocks, especially the timing, and external economic effects is important, and thus should not be a budgetary variable.

In mid-2015, due to the oil price glut, several countries (including Nigeria, and other oil-rich sub-Saharan African countries) responded negatively with fall in fiscal sustainability, fiscal crisis, and eventually economic recession. Although global growth rate of GDP has been on the decline, in almost oil dependent economies, and investment costs had been on the increase in many countries, oil rents had inevitably improved in the years prior to 2015. This suggests therefore that, had basic macroeconomic, budgetary, and political fundamentals been adequately catered for, fiscal balance would have improved in the period of falling oil rents.

Aside from oil rents, oil dependent economies should pay attention to the use of fiscal rules, to reduce budget deficits. This finding highlights the significance of other variables asides from our policy variable to influence fiscal balance. Accordingly, other policy implications consist of focusing on adequate environment for investors in oil and gas sectors, which includes favourable long-term and

short-term lending rates, and corruption reducing efforts in public and private sector services, as well as improving the overall basics of economic performance indicators.

For recurrent spending, borrowing should not be encouraged, except where such loans are carved for capital projects that yields ripple effects in the overall economy. This will limit the size of the government, and put the primary balance of the government in a reasonable shape.

5.3. Limitations of the study

This study is not without limitations. First, we could not include some of the key determinants of fiscal balance that splits among macroeconomic, budgetary, and political variables due to the absence of complete time-series data for the years under consideration. Second, we certainly acknowledge the fact that some other changes have since taken place in the composition of crude oil reserves and the computation of oil rents in the net oil exporting countries, including the new focus on shale oil and other forms of energy sources that might have influenced our estimates. Nevertheless, we make an effort to control for these changes through the inclusion of country and time fixed effects, our estimates may still show minor biases due to these changes.

Third, the dataset we use is aggregate annual data at the national level. It will be useful to further consider household-level data to examine the disaggregated welfare effects of falling fiscal balance on the unit level. This is a possible extension for future research in oil dependent economies. Despite the above concerns, the present study significantly enhances our understanding of the role of oil rents on fiscal balance in net oil exporting countries.

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Appendices

Appendix 1: List of Net Oil exporting countries included in the study

1	Algeria*	31	Kuwait*
2	Angola*	32	Libya*
3	Argentina	33	Lithuania
4	Australia	34	Malaysia
5	Azerbaijan, Republic of*	35	Mexico*
6	Bangladesh	36	Mongolia
7	Belarus	37	Netherlands
8	Bolivia	38	New Zealand
9	Brazil	39	Nigeria*

10	Cameroon	40	Norway*
11	Canada	41	Oman*
12	Chad*	42	Pakistan
13	China, P.R.: Mainland	43	Papua New Guinea
14	Colombia	44	Peru
15	Cote d'Ivoire	45	Philippines
16	Czech Republic	46	Poland
17	Denmark	47	Qatar*
18	DR Congo	48	Romania
19	Ecuador*	49	Russian Federation*
20	Egypt	50	Saudi Arabia*
21	France	51	Slovak Republic
22	Germany	52	South Africa
23	Ghana	53	Spain
24	Greece	54	Sudan
25	Hungary	55	Thailand
26	Indonesia	56	United Arab Emirates*
27	Iran, Islamic Republic of*	57	United Kingdom
28	Israel	58	United States
29	Italy	59	Venezuela, Republica Bolivariana de*
30	Kazakhstan*	60	Vietnam
		61	Yemen, Republic of

Brunei Darussalam* and Iraq* are also considered among the oil dependent economies II *Oil Dependent Economies