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Oil-shocks and fiscal policy pro-cyclicality in Angola. Assessing the role of asymmetries and institutions.

By

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Abstract

The aim of this paper is to examine pro-cyclicality in Angola, assess whether it behaves asymmetrically over the oil-cycle, and test the hypothesis that institutions and fiscal rules can moderate pro-cyclicality. Received wisdom suggests that in resource-rich economies, fiscal policy tends to be pro-cyclical albeit improvements in the last decades thanks to institutional reforms. Similar evidence is available for oil-rich economies, however, we know little about how pro-cyclicality behaves over the oil-cycle because evidence is scarce and conflicting. Further, evidence on institutions and fiscal rules in oil-exporting economies is still ambiguous. We bridge both gaps by examining fiscal policy pro-cyclicality in Angola, one of the largest oil-producers of Africa, and a country that has experienced an intense process of institutional reforms since the end of its civil war in 2002. Hence, it is an ideal candidate for our study. We use data for the 2004-2014 period to estimate a Threshold Vector Error Correction model (TVECM) that extends existing VAR and VECM methods used up-to-date. Our results indicate that revenue and spending are generally pro-cyclical to oil-shocks, that revenue is more pro-cyclical during booms and that institutional quality, net inflows, financial openness and fiscal rules affect pro-cyclicality.

Keywords: Oil-shocks, Institutions, Fiscal policy cyclicality, Development, ~~Time-varying~~ Threshold Cointegration

JEL codes: C32, H20, H50, O13, O23

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1. Introduction

Government proceeds and spending behave pro-cyclically when they have a positive relationship with the business-cycle or commodity-markets, that is, they increase with the upswings of the economy or when commodity-prices rise, and vice versa. The focus of this paper is to examine fiscal policy pro-cyclicality in Angola, assess whether there are asymmetries on pro-cyclicality and to evaluate the impact of institutions and fiscal rules.

According to available literature, pro-cyclicality is the result of a number of economic and political factors that can be grouped under three broad categories. First, access-to-credit by government and the private sector. Gavin et al (1996) and Kaminsky et al., (2004) show that during downturns, lenders become more wary of the ability of developing economies to meet their existing debt payments, and reduce their credit supply. This limits the ability of fiscal authorities to borrow to counter negative-shocks, making spending more pro-cyclical. See also Gavin and Perotti (1997). This problem can be mitigated by aid-to-development because this is independent of the cycle and makes the budget less sensitive to credit availability (Thorton, 2008). Similarly, a strong foreign net-reserves position can also reduce pro-cyclicality by alleviating Government credit constraints (Zhou, 2009, 2010).

Second, fiscal policy room. Schaechter et al. (2012) and Calderon and Nguyen (2016) argue that indebtedness of the public sector can increase pro-cyclicality, as Governments with greater debt, i.e. less room to borrow, will find external credit constraints more binding and will have less room to adopt counter-cyclical policies. Aid and a positive balance of capital inflows can moderate this problem by freeing resources for counter-cyclical policies (Calderon and Nguyen, 2016).

Third, quality of political institutions. Tornell and Lane (1999) argue that during an export boom, competing political groups can over-spend to distribute gains from the shock to reinforce their political power. They refer to this as the "voracity effect". This would increase pro-cyclicality in developing economies with large resource-revenue and weak or ineffective governments. A more recent version of this model is presented in Cespedes and Velasco (2014). Similarly, Alesina and Talleni (2005), Alesina et al., (2008) and Ilzetzki (2011) find that bad governance, such as, corruption, can increase pro-cyclicality of fiscal policy when systems to monitor politicians are imperfect, because this allows more rent-seeking behaviour during good times[1].

To prevent these problems, a number of fiscal rules aimed at limiting discretionary spending and taxation, imposing deficits and debt rules have been introduced in developing economies. Schaechter et al., (2012) present a survey of these reforms since 1985. However, there is a wide consensus that the implementation of these rules is subject to the strength of institutions, and adoption of rules might not necessarily lead to a reduction of pro-cyclicality (Calderon and Nguyen, 2016, Konuki and Villafuerte, 2016).

Existing empirical evidence for developing economies suggests that fiscal policy is pro-cyclical to both output fluctuations and commodity-markets. Using panels of resource-rich economies Bova et al., (2016) and Calderon and Nguyen (2016) find that revenue and expenditure are pro-cyclical to the business-cycle. Whereas, Spatafora and Samake (2012), Cespedes and Velasco

[1] Dizaji et al., (2016) show that political institutions not only influence the size of government but also the composition of government spending.

(2014) and Bova et al. (2016) find evidence of pro-cyclicality with respect to commodity-markets, as revenue and expenditure increase when commodity-prices rise, and vice versa. Further, on the overall, evidence suggests that pro-cyclicality has improved in the last four or five decades thanks to improvements in the quality of political institutions, while evidence for fiscal rules is mixed (Cespedes and Velasco, 2014, Bova et al., 2016).

In SSA economies we observe similar patterns, although evidence is less abundant and focuses on pro-cyclicality with respect to GDP rather than commodity-shocks. Thorton (2008), Lledo et al (2012), Calderon and Nguyen (2016) find that government spending in SSA has a positive and significant relationship with the business-cycle, i.e. it is pro-cyclical to movements in GDP, although this sensitivity has decreased since the early 2000s. However, in the case of SSA economies, improvements in pro-cyclicality appears to be associated with better political institutions, as well as, with the adoption of fiscal rules that provide room for fiscal policy, and access-to-credit (Lledo et al., 2012, Calderon and Nguyen, 2016).

In oil-exporting economies, fiscal policy also appears to be pro-cyclical to oil-markets, see panel evidence from Husain et al., (2008), Villafuerte and Lopez-Murphy (2010), Erbil (2011), El Anshasy and Bradley (2012) and Koh (2017), or time series studies from the Gulf countries, reported by Fasano and Wang (2002), Farzanegan (2011) and Hamid and Sbia (2013) and for other oil-producers in Gurvich et al., (2009), Medina (2010, 2016) and Bjornland and Thorsrud (2015). We also know that pro-cyclicality appears to be stronger in this group of countries. Konuki and Villafuerte (2016) find that the government budget is pro-cyclical in oil-exporting economies but not in those that export minerals. Similarly, Spatafora and Samake (2012) find that pro-cyclicality of spending, is only significant for economies that export the top-three traded commodities, oil among them.

However, we know little about how pro-cyclicality behaves over the oil-cycle, that is, whether spending (and revenue) grow faster during oil-market booms, than during downturns. This is because there is little evidence available. To the best of our knowledge, only Farzanegan and Markwardt (2009) and Emami and Adibpour (2012) study this phenomenon for Iran, and, Villafuerte and Lopez-Murphy (2009) for an OPC sample. Furthermore, this scarce evidence is conflicting, while the studies for Iran find very little or no evidence of asymmetric fiscal response[2], Villafuerte and Lopez-Murphy (2009) show that spending pro-cyclicality is stronger during upturns than during downturns. The limited scope of this literature call for further research, and contrast with the abundance of evidence on asymmetric effects of oil-shocks on GDP in developed economies (Jimenez-Rodriguez and Sanchez, 2005, Serletis and Istiak, 2013, Bergmann, 2019)[3], as well as, in developing economies (Mehrara, 2008, Nusair, 2016, Gbatu et al., 2017), and the growing literature on asymmetric effects on stock markets (Hu et al., 2018, Xiao et al., 2018, Kumar, 2019, Salisu et al., 2019).

Further, our understanding on whether institutions can mitigate pro-cyclicality in oil-exporting economies also limited because evidence is still ambiguous. El Anshasy and Bradley (2012) and Koh (2017) find support for the hypothesis that institutional quality reduces pro-cyclicality, whereas Konuki and Villafuerte (2016) find no significant effects. Similarly, there is conflicting evidence regarding access-to-credit. El Anshasy and Bradley (2012) find that financial openness increases pro-cyclicality, whereas, Konuki and Villafuerte (2016) results indicate that financial

[2] In contrast with the response of GDP and exchange rates for which they find evidence of asymmetries.
[3] See also the seminal papers by Mork (1989), Hamilton (1996, 2003).

deepening, rather than openness, reduces pro-cyclicality. Evidence on fiscal rules, is also ambiguous, whereas, Koh (2017) find that they can reduce pro-cyclicality, specially, when the country has strong institutions, Bjornland and Thorsrud (2015) find the opposite holds for Norway, a country with highly reputed institutions[4].

In this paper, we aim to contribute to expand our knowledge in these two areas, by examining fiscal policy pro-cyclicality in Angola, evaluating the existence of asymmetric effects to positive and negative oil-shocks, and assessing the role that institutions play in moderating (or no) pro-cyclicality. Angola is one of the largest oil-producers of Africa, and has experienced an intense process of institutional reforms since the end of its civil war in 2002 (UCAN, 2010, IMF, 2015). Hence, it is an ideal candidate to study these issues. For this purpose we use data for the 2004-2014 period to estimate a Threshold Vector Error Correction (TVECM) model that extends existing VECM methods used to evaluate pro-cyclicality in oil-producing economies (Fasano and Wang, 2002, Hamid and Sbia, 2013), and VAR methods used to evaluate asymmetries and the role of institutions (Farzanegan and Markwardt, 2009, and Emami and Adibpour, 2012)

The paper proceeds as follows. Section 2 presents the characteristics of Angola's fiscal policy and the institutional reforms that justify the study of this economy. Section 3, presents our empirical strategy. Section 4, discusses data details. Section 5, presents our empirical results. Section 6 concludes the paper with a summary and policy implications.

2. Fiscal policy setting in Angola

Angola is an excellent subject for our study for four reasons. First, it is one of the largest oil-producers in Africa (BP, 2017). Second, the economy is strongly dependent on the oil-sector that accounts for about 25% of government revenue, 45% of GDP and 95% of exports (IMF, 2015, 2017). Third, there is suggestive evidence that fiscal policy is or has been pro-cyclical to developments in oil-markets. Fig. 1 illustrates this claim. In panel (a), we observe the evolution of Government revenue and spending-to-GDP, which fluctuates between 35 and 50% with contractions in 1998, 2000, 2008 and 2011. These fluctuations seem to mirror the evolution of oil-prices, shown in Panel (b), which fell moderately in 1998 and 2000, and more sharply in 2009 and after 2011. The Government balance, panel (c), also seems to follow the evolution of oil-markets, taking positive values most years that oil-prices grow, and vice versa. Furthermore, the budget relies heavily on oil-revenue, as the Non-Oil deficits, also shown in panel (c), stand around 30% of GDP. This indicates that fiscal policy has a structural bias towards deficits, a common trait of resource-rich economies (Thornton, 2008, IMF, 2015). Government (gross) Debt-to-GDP, Panel (d), also seems influenced by oil-shocks, as it fell from over 100% of GDP to just 20% in the early 2000s, when oil-prices rose, but it grew when oil-prices fell after 2008.

[4] Evidence on fiscal room is only provided by Konuki and Villafuerte (2016), who find that International Reserves reduce pro-cyclicality, while debt-to-GDP has no significant impact.

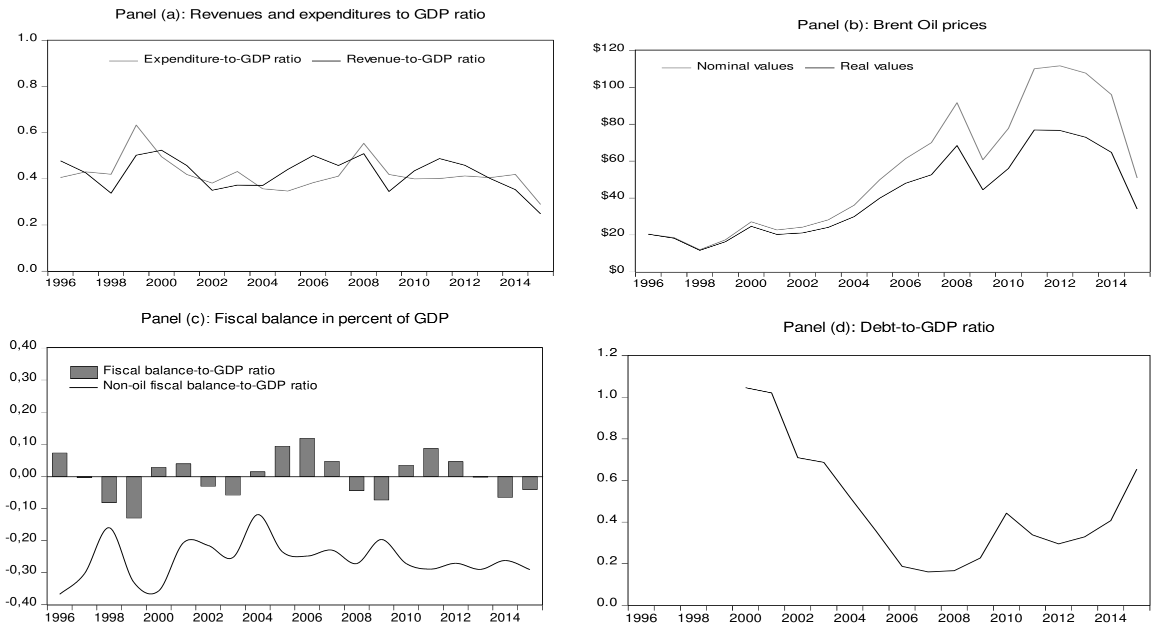

FIGURE 1. Government accounts and oil-prices 1996-2015.
Source: Angola Government of Angola, IMF (2016a) and National Bank of Angola (2018).

Fourth, Angola has undergone an intense programme of political and economic reforms following the end of civil war in 2002 that could have contributed to reduce this fiscal pro-cyclicality (UCAN, 2010, IMF, 2015). To reduce the influence of oil-markets on Government accounts a number of fiscal reforms were introduced from 2009 onwards[5]. Table 1, presents a list of these reforms following the categories proposed in Schaechter et al., (2012). Most reforms have focused on revenue, to expand Non-oil proceeds as the PERT tax-reform in 2010, and to improve management of oil-revenue with the creation of the Special Fiscal Institutions for Oil Income Management[6] (SFIOIM) in 2011, the Sovereign Wealth Fund[7] (SWF) in 2012, and the General Tax Administration in 2014. Deficit and debts rules were also introduced in 2010 and 2013, to improve accountability and government credibility with rules that target Non-oil deficits and avoid arrears. Expenditure has received less attention with only some measures to regulate subsidies in 2009, see also IMF (2009, 2014). The introduction of these rules should have contributed to reduce pro-cyclicality, we evaluate this hypothesis in section 5.5.

[5] Prior to 2009, fiscal policy aimed at creating a structure able to deliver basic social services and restoration of state administration throughout the territory, following the end of the 30 years long civil war. After the end of the Civil war many Angolans faced starvation (about 500,000) and many refugees returned to Angola in a doubtful prospectus (Neto and Jamba, 2006).

[6] This includes the Oil Price Differential Account (OPDA), which aimed to force government to budget with a positive difference between actual and budgetary oil price, and the Strategic Financial Oil Reserve for Infrastructure (SFORI), which aimed to protect infrastructures funding.

[7] The Sovereign Wealth Fund (SWF) was created to deal with intertemporal dependence on oil revenue. The SWF received an initial endowment determined by law of US$5 billion and was stipulated that annual incoming to SWF should be equivalent to 50,000 barrels/day.

Table 1. Major fiscal policies reforms between 2004 and 2014.

		Type of rule			
Year	*Reform package*	*Revenue*	*Spending*	*Deficit*	*Debt*
2009	Creation of Treasury Reserve fund	x			
	New Framework for subsidies policies		x		
2010	De-linking fiscal accounts from short-term oil revenue	x			
	Tax-reform, "Projecto Excutivo da Reforma Tributaria" (PERT)	x			
	Focus on Non-oil balance			x	
	Implementation of routines for financial and budget controls			x	
	Non-accumulation of domestic and external arrears				x
	New Strategy for public indebtedness				x
2011	Special Fiscal Institution for Oil-Income Management (SFIOIM)	x			
2012	Creation of the Sovereign Wealth Fund (SWF)	x			
2013	Creation of the Unit of Debt Management				x
2014	Creation of the General Tax Administration	x			

Source: IMF (2009, 2014, 2015), Ministry Finance of Angola (2018) and UCAN (2010).

3. Empirical strategy

3.1 Core model

To assess if the behaviour of fiscal policy is indeed pro-cyclical, we estimate a Vector Error Correction Mechanism (VECM) model with four variables, namely, (log) real government revenue R_t, (log) real government spending G_t, (log) real money supply M_t, and (log) real Gross Oil Domestic Production Y_t^{oil}. R_t and G_t, are the fiscal policy variables that might follow the cycle of oil-markets, here captured by Y_t^{oil}. M_t, controls for monetary policy and economic activity changes that occur for other reasons than variations in Y_t^{oil}. The use of VECM is common place in the pro-cyclicality literature due to the $I(1)$ properties of fiscal variables, see Fasano and Wang (2002 and Hamid and Sbia (2013). This is also the case of our data and therefore it seems appropriate to follow this approach[8]. The general form of our VECM can be illustrated as follows:

$$\Delta z_t = c_0 + \sum_{i=1}^{n-1} \Gamma_{\mathrm{i}} \Delta z_{t-\mathrm{i}} + \alpha \xi_{t-1} + u_t \qquad (1)$$

Where z_t denotes a vector of variables that have a unit-root, i.e. are $I(1)$ variables. In our case, $z_t = \left(R_t, G_t, M_t, Y_t^{oil}\right)'$, results for unit-root tests are discussed in Section 5.1. c_0 is a vector of constant terms. n denotes the underlying VAR lag-order, we adopt n=3 after carrying the standard selection criteria and after experimenting with several lag structures. The short-run dynamics of the model are captured by the matrix of coefficients Γ_{i} that provide the short-run elasticities of ΔR_t and ΔG_t to oil-shocks, ~~i.e.~~ ΔY_t^{oil}. If there is pro-cyclicality, these elasticities will be positive. The term $\alpha \xi_{t-1}$, is the Error Correction Mechanism (ECM) of the system, with the vector ξ_{t-1} denoting the lagged value of deviations from the long-run relationships, and vector α capturing the influence of these long-run errors on Δz_t, i.e. on the short-run dynamics of the

[8] We also considered using ARDL and the Bound test approach. However, as we explain below, Johansen cointegration results indicate that there are two vectors among our variables. Further, when we experimented with several ARDL specifications they all suffered of persistent diagnostic test problems that our VECM estimations did not present. Thus, a VECM approach seems more adequate to the statistical properties of the data.

model. Finally, u_t is a vector of error terms, normally and Independently Distributed (NID). We can decompose ξ_{t-1} as follows:

$$\xi_{t-1} = \beta' \begin{bmatrix} z_{t-1} \\ k \end{bmatrix} = \begin{pmatrix} \beta_{11} & \beta_{12} & \beta_{13} & \beta_{14} & \beta_{15} \\ \beta_{21} & \beta_{22} & \beta_{23} & \beta_{24} & \beta_{25} \end{pmatrix} \begin{pmatrix} R_{t-1} \\ G_{t-1} \\ M_{t-1} \\ Y_{t-1}^{oil} \\ k \end{pmatrix} \quad (2)$$

Where β' denotes the matrix of long-run parameters that variables z_{t-1} take on the cointegrated vectors of the system and k is the long-run constant term. Considering that z_t contains fiscal and monetary variables we would expect two long-run relationships, one for each set of variables, that is, we expect β' to be a $(2x5)$ matrix. We confirm this in section 5.1. The first long-run relationships will denote cointegration between revenue and spending, that is, the long-run budget restriction, as in Fasano and Wang (2002), which we can write as follow:

$$\beta_{11}R_{t-1} + \beta_{12}G_{t-1} + \beta_{14}M_{t-1} + \beta_{15}k = -\beta_{13}Y_{t-1}^{oil} + \xi_{1,t-1} \quad (3)$$

If the coefficient for Y_t^{oil} is positive, $\beta_{13} > 0$, it will indicate that positive oil-shocks reduce government balance, i.e. the budget is pro-cyclical. Further, equation (3) illustrates that $\xi_{1,t-1}$ captures deviations from the budget on the previous period, hence, its coefficient $\propto$ in equation (1), indicate how ΔR_t and ΔG_t adjust to these budget deviations. For instance, if $\alpha < 0$ for ΔR_t, then revenue fall as a result of a budget surplus, i.e. reacts counter-cyclically, and vice versa. Capturing the influence of budget unbalances over ΔR_t and ΔG_t is another of the advantages of our approach, as this cannot be captured by other VAR methods, as for instance in, Farzanegan (2011) or Medina (2010, 2016).

3.2 Asymmetric effects

To assess asymmetric effects on fiscal policy, that is, if during period of booms in the oil-markets, spending (and revenue) grows more than it contracts during downturns, we use a Threshold-VECM (TVECM), where the threshold is given by changes in oil production, Y_t^{oil}. The following extension of equation (1) illustrates our TVECM:

$$\Delta z_t = c_0 + \sum_{i=1}^{n-1} \Gamma_{\mathrm{i}} \Delta x_{t-\mathrm{i}} + \sum_{i=1}^{n-1} \Gamma_i^{pos} \left\{ \Delta Y_{t-i}^{oil} * I^{pos} \right\} + \sum_{i=1}^{n-1} \Gamma_i^{neg} \left\{ \Delta Y_{t-i}^{oil} * I^{neg} \right\}$$
$$+\alpha^{pos}\{\xi_{t-1} * I^{pos}\} + \alpha^{neg}\{\xi_{t-1} * I^{neg}\} + u_t \quad (4)$$

Where x_t denotes the vector of variables for which we assume a symmetric behaviour in our case, $x_t = (R_t, G_t, M_t)'$, that is, we only allow Y_t^{oil} to affect the system in asymmetric fashion. I^s, is the dummy indicator for the sign of oil-shocks, where s denotes two regimes. $s = pos$, indicates a positive oil-shock, hence, $I^{pos} = 1$ when $\Delta Y_t^{oil} > 0$, and 0 otherwise. $s = neg$, denotes a negative shock, that is, $I^{neg} = 1$ when $\Delta Y_t^{oil} < 0$, and 0 otherwise. Since I^s multiplies ΔY_{t-i}^{oil} and ξ_{t-1}, asymmetry can affect the short-run dynamics of the model and/or the speed of adjustment to deviations from the long-run relationships. When $\Gamma_i^{pos} = \Gamma_i^{neg}$ oil-shocks have symmetrical effects, that is, raises in oil-prices increase spending, as much as, it reduces it when oil-prices go down. However, if $\Gamma_i^{pos} \neq \Gamma_i^{neg}$ then pro-cyclicality during upswings in oil-markets is different to pro-cyclicality during downturns. Further, when $\alpha^{pos} = \alpha^{neg}$, the speed of adjustment is the same during booms in oil-markets than during slumps. However, if for instance, $\alpha^{neg} < \alpha^{pos} < 0$, negative shocks imply greater adjustments than during upswings in oil-markets, hence, pro-cyclicality is weaker during downturns. Note that if $\Gamma_i^{pos} = \Gamma_i^{neg}$ and $\alpha^{pos} = \alpha^{neg}$, equation (4) simplifies to equation(1).

Equation (4) applies the "Equilibrium-threshold" proposed by Balke and Fomby (1997) to our model, as the value of I^s depends on whether ΔY_t^{oil} is above or below a particular equilibrium-value, zero, in our case[9]. To the best of our knowledge, the literature on the asymmetric effects of oil-shocks focuses on effects over GDP and stock markets, see for instance, Xiao et al., (2018) or Bergmann, (2019). Only Farzanegan and Markwardt (2009) and Emami and Adibpour (2012) study asymmetric effects of oil-shocks on fiscal policy[10]. However, their studies do not account for the influence of the budget on spending (or revenue), that our asymmetric speed of adjustment capture with α^{pos} and α^{neg}. Thus, our non-linear approach covers a wider range of possible asymmetries than available literature.

We estimate equation (4) using three definitions of oil-shock, namely, using a month, a quarter, and a year as reference, to account for Hamilton (1996) critique of oil-shock measures. If the critique is accurate our specification of (4) using monthly ($I_{f=1}^s$) and quarterly ($I_{f=2}^s$) definitions could mistakenly discard asymmetry that using an annual measure ($I_{f=3}^s$) could be unveiled. It should be noted that using $I_{f=2}^s$ and $I_{f=3}^s$, turns equation (4) into a "Band-Threshold" (Balke and Fomby, 1997), as these dummies only take values equal to one, when a large change in Y_t^{oil} occurs, in the rest of cases, the middle or "normal times" cases, $I_{f=1}^s$ and $I_{f=2}^s$ take values 0, creating a band where ΔY_t^{oil} could have different effects than under shocks. Accordingly, equation (4) can be written as:

$$\Delta z_t = c_0 + \sum_{i=1}^{n-1} \Gamma_{\mathrm{i}} \Delta x_{t-\mathrm{i}} + \sum_{i=1}^{n-1} \Gamma_i^{pos} \left\{\Delta Y_{t-i}^{oil} * I^{pos}\right\} \sum_{i=1}^{n-1} \Gamma_i^{mid} \left\{\Delta Y_{t-i}^{oil} * I^{mid}\right\} + \sum_{i=1}^{n-1} \Gamma_i^{neg} \left\{\Delta Y_{t-i}^{oil} * I^{neg}\right\}$$
$$+\alpha^{pos}\{\xi_{t-1} * I^{pos}\} + \alpha^{mid}\{\xi_{t-1} * I^{mid}\} + \alpha^{neg}\{\xi_{t-1} * I^{neg}\} + u_t \quad (5)$$

3.3 Institutions effects

Finally, equation (4) can easily be adapted to assess the impact of institutional factors and Fiscal rules, by redefining the dummy indicator, as I_{in}^s, with two regimes denoted by $s = 1$ when institutional factors grow (or fiscal rules are in place), and $s = 2$, when institutional factors decrease (or fiscal rules are not used). That is, by treating changes in the institutional factors (and fiscal rules), rather than ΔY_{t-i}^{oil}, as the transition variable between states or regimes.

Thus, our empirical strategy proceeds in five steps. First, we perform the standard time series test to clarify the properties of our data, that is, unit-root (ADF, DF-GLS) and stationary test[11] (KPSS), as well as, cointegration tests, based on the Johansen approach, which encompasses the

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[9] See also Hansen and Seo (2002), or Krishnakumar and Neto (2015) for further details on TVECM.

[10] These authors define their asymmetric positive-shocks terms as $\sum_{i=1}^{n-1} \max(\Delta Y_{t-i}^{oil}, 0)$, and their negative-shock term as $\sum_{i=1}^{n-1} \min(\Delta Y_{t-i}^{oil}, 0)$. Similar formulation is used in the seminal work of in Mork (1989) and Hamilton (1996). This is equivalent to our formulation because $I^{pos} = 1$ only when $\Delta Y_t^{oil} > 0$, hence, the term $\sum_{i=1}^{n-1} \Delta Y_{t-i}^{oil} * I^{pos} = \sum_{i=1}^{n-1} \max(\Delta Y_{t-i}^{oil}, 0)$. Similarly $\sum_{i=1}^{n-1} \Delta Y_{t-i}^{oil} * I^{neg} = \sum_{i=1}^{n-1} \min(\Delta Y_{t-i}^{oil}, 0)$.

[11] There are two reasons to use KPSS test. First, to cross-check results from ADF, DF-GLS tests, which have a unit-root null hypothesis, against a test with a null of stationarity (Kwiatkowski, et al., 1992). Second, it appears that some of our variables, particularly, G_t and M_t, might not be normally distributed, see Appendix A. As noted by Hadri (2000), KPSS test is not affected by the non-normality of variables when there is a reasonable sample size, as in our case.

Trace (λ_{trace}) and Maximum Eigenvalue (λ_{max}) tests. Second, we proceed to identify the vector of long-run parameters, β' in equation (2), by imposing some form of normalization informed by economic theory (Garrat et al., 2006). Third, we estimate equation (1) for the full-sample and use our estimates of Γ_{i} and α, to assess pro-cyclicality. Fourth, we estimate equation (4) and (5), to assess the existence of asymmetric pro-cyclicality using our three definitions of oil-shocks, i.e. $I^s_{f=1}$, $I^s_{f=2}$ and $I^s_{f=3}$. Fifth, we estimate equation (4), redefining I^s_{in} with institutional change as transition variable, to evaluate the impact of institutional changes and the introduction of fiscal rules on pro-cyclicality.

4. Data

4.1 Core model

Data expands over the period 2004-2014 with monthly frequency. This sample covers the post-civil war years in Angola, and it is well suited to study pro-cyclicality as it contains periods of steady rise (and fall) in oil-prices in the first-half of the 2000s (after 2011), as well as, short but intense positive and negatives shocks after the financial crisis of 2008 and after the Arab Spring in 2011, respectively.

Table 2 provide descriptions and sources details for the core variables of our model, vector z_t in equation (1). This includes, two fiscal policy measures (log) real government revenue R_t and (log) real government spending G_t. Both measures of fiscal policy were unpublished up-to-now, and they were made available to us by the International Affairs Ministry of Finance (IAMF) of Angola. We seasonally adjusted these series to deal with fiscal calendar and seasonal effects using X-12-ARIMA, as proposed by the U.S. Census Bureau (2011)[12]. Our data also includes one monetary variable, (log) real money supply M_t, that controls for changes in economic activity that occur for other reasons than oil-shocks. Finally, (log) real Gross Oil Domestic Production Y_t^{oil} that captures oil-market cycles. This variable is measured in U.S. dollars because the economy is profoundly dollarized and the oil-sector accounts for nearly 95% of country's exports. Further, it also allows to consider the limitations in terms of net foreign reserves that might be used as a buffer mechanism.

Table 2. Data

Variable	*Description*	*Source*
R_t	Real government revenue (in logs): Total revenue in Millions of Angolan Kwanzas (AOA). Deflated by Luanda's CPI. Monthly.	[1]
G_t	Real government expenditure (in logs): Total expenditure in Millions of AOA. Deflated by Luanda's CPI. Monthly.	[1]
M_t	Real money supply (in logs): M3 accounting for currency outside depository corporations, transferable deposits, other deposits, securities other than shares and repurchase agreements. Millions of AOA. Deflated by Luanda's CPI. Monthly.	[2]
Y_t^{oil}	Real Gross oil Domestic Production (in logs): Angola's average monthly oil production (barrels)*US$ Brent/barrel. US$ Millions. Deflated by U.S. CPI. Monthly.	[3]

[1] International Affairs of Ministry Finance (IAMF) of Angola. [2] Department of Economic Studies of National Bank of Angola. [3] U.S. Energy Information Administration – EIA (2016a, 2016b). [AC] Author's calculations

R_t, G_t, M_t, Y_t^{oil} are all expressed in real terms to isolate from (dis-)inflationary movements that might introduce noise in our analysis. The price index that we use to compute G_t, R_t and M_t is the Luanda's Consumer Price Index (CPIL, 2004 = 100) published by IMF (2016b). We use

[12] Appendix A, compares the original series against the seasonally adjustment variables.

Luanda's CPI rather than Angola's overall index, due to availability limitations for the whole country index. Given that Luanda is responsible for the majority of government expenditure and revenue, and that it is economically more dynamic than the rest of the country, we believe this can be done without loss of representativeness[13]. To compute Y_t^{oil}, we use the U.S. CPI available from US. Bureau of Labour Statistics (2016), because this variable is expressed in U.S. dollars and the alternative, taking GDP deflator, was not possible due to lack of monthly data.

Fig 3, presents the evolution of R_t, G_t, M_t, Y_t^{oil} over the sample period. In the top-left panel, R_t seems to follow an upward trend, from which it diverts with wide fluctuations, particularly in 2007 and 2008 coinciding with the large swings in oil-prices of those years. G_t, on the top-right, exhibits an upward-trend with milder fluctuations than revenue, probably reflecting the difficulty of changing spending commitments. M_t, on the bottom-left panel, grows until 2007/8 when it plateaus, reflecting a slow-down in economic activity in Angola[14]. Y_t^{oil}, shown in the bottom-right panel, is relatively stable until 2007/08, when it had several spikes, followed by a downward trend that reflects lower international oil-prices and domestic production (IMF, 2016a).

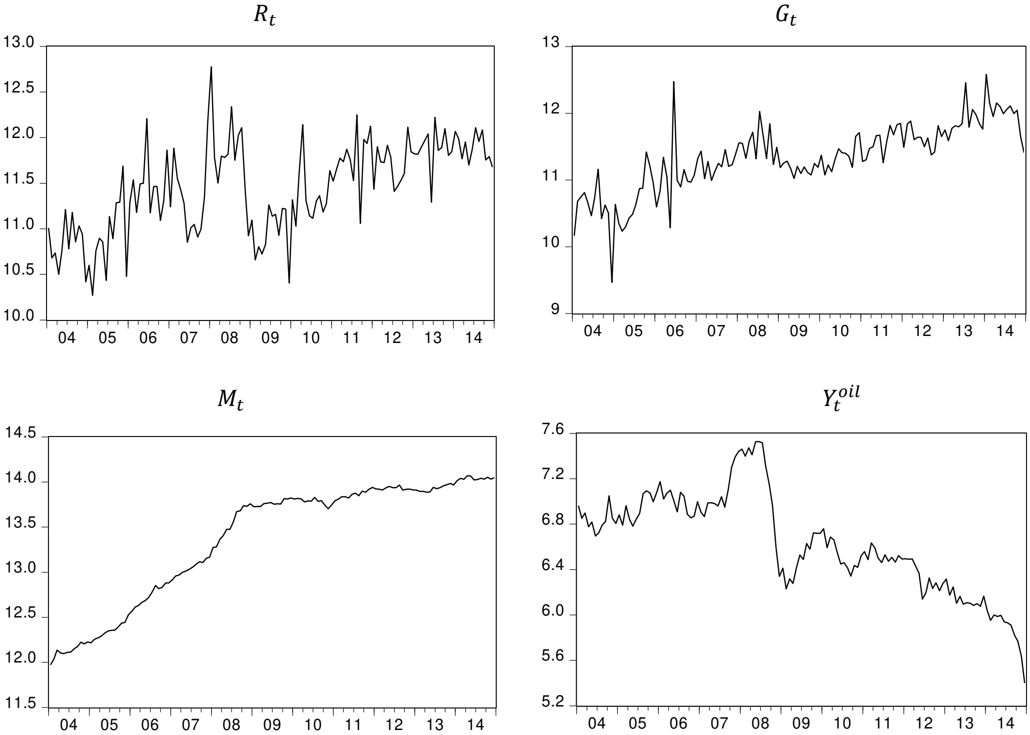

FIGURE 2. Evolution of R_t, G_t, M_t and, Y_t^{oil}, 2004m1-2014m12

4.2 Asymmetries

To test the asymmetric hypothesis we extend our dataset with the following dummy indicators, I_f^{pos} and I_f^{neg} that capture the periods of expansion and contraction in oil-markets. We consider

[13] We use Luanda's CPIL to express G_t, R_t and M_t in real terms, because the Central Bank of Angola used foreign reserves to defend a currency peg with U.S. dollars in a way that any changes in CPI was mostly explained by changes in net foreign reserves.

[14] Obviously, correlation is not causation, but we can agree that money supply trend after 2007/08 is in line with slow-down in the Angolan economy, as happened for instance in Euro area in which the growth of M3 fell significantly after 2010 reflecting economic activity slow-down as stated by ECB (2012).

three frequencies, denoted by f. $I^{s}_{f=1}$ uses monthly data, the frequency of our data. $I^{s}_{f=2}$ uses the previous three months as reference, as in Mork (1989). Third, $I^{s}_{f=3}$ uses the previous twelve months as reference, as in Hamilton (1996). Table 3, provides further details. Defining I^{s}_{f} in this fashion, allows us to control for Hamilton's (1996) critique of oil-shock measures. This author claims that using high frequency data to define oil-shocks can be misleading as many of the short-term movements in oil-markets correspond to corrections to previous movements, which ought not to be considered as shocks[15]. If the critique is accurate our specification of (4) using $I^{s}_{f=1}$ and $I^{s}_{f=2}$ could mistakenly discard asymmetry that using $I^{s}_{f=3}$ could be unveiled.

Table 3. Asymmetric dummies

Variable	*Description*	*Source*
$I^{pos}_{f=1}$	$= 1$ if $\Delta Y^{oil}_{t} > 0$, and 0 otherwise.	[AC]
$I^{neg}_{f=1}$	$= 1$ if $\Delta Y^{oil}_{t} < 0$, and 0 otherwise.	[AC]
$I^{pos}_{f=2}$	$= 1$if $Y^{oil}_{t} - \max\left(Y^{oil}_{t-1}, Y^{oil}_{t-2}, Y^{oil}_{t-3}\right) > 0$, and 0 otherwise.	[AC]
$I^{neg}_{f=2}$	$= 1$ if $Y^{oil}_{t} - \min\left(Y^{oil}_{t-1}, Y^{oil}_{t-2}, Y^{oil}_{t-3}\right) < 0$, and 0 otherwise.	[AC]
$I^{pos}_{f=3}$	$= 1$if $Y^{oil}_{t} - \max\left(Y^{oil}_{t-1}, \dots, Y^{oil}_{t-12}\right) > 0$, and 0 otherwise.	[AC]
$I^{neg}_{f=3}$	$= 1$if $Y^{oil}_{t} - \min\left(Y^{oil}_{t-1}, \dots, Y^{oil}_{t-12}\right) < 0$, and 0 otherwise.	[AC]

[AC] Author's calculations

Figure 4, compares I^{pos}_{f} and I^{neg}_{f} for our three definitions. As we can see in the top panel, where $I^{pos}_{f=1}$, $I^{pos}_{f=2}$and $I^{pos}_{f=3}$ are compared, as we increase the horizon used to create the dummy indicator, the occasions in which the dummy takes value one decreases. This is because, as we move from the monthly definition, or first difference of Y^{oil}_{t}, $I^{pos}_{f=1}$, to taking the last three months, $I^{pos}_{f=2}$, or year as a reference, $I^{pos}_{f=3}$, there are less cases in which Y^{oil}_{t}takes a larger value than the reference period, i.e. our definition of shock becomes more stringent. The same can be said of I^{neg}_{f} in the botoom panel.

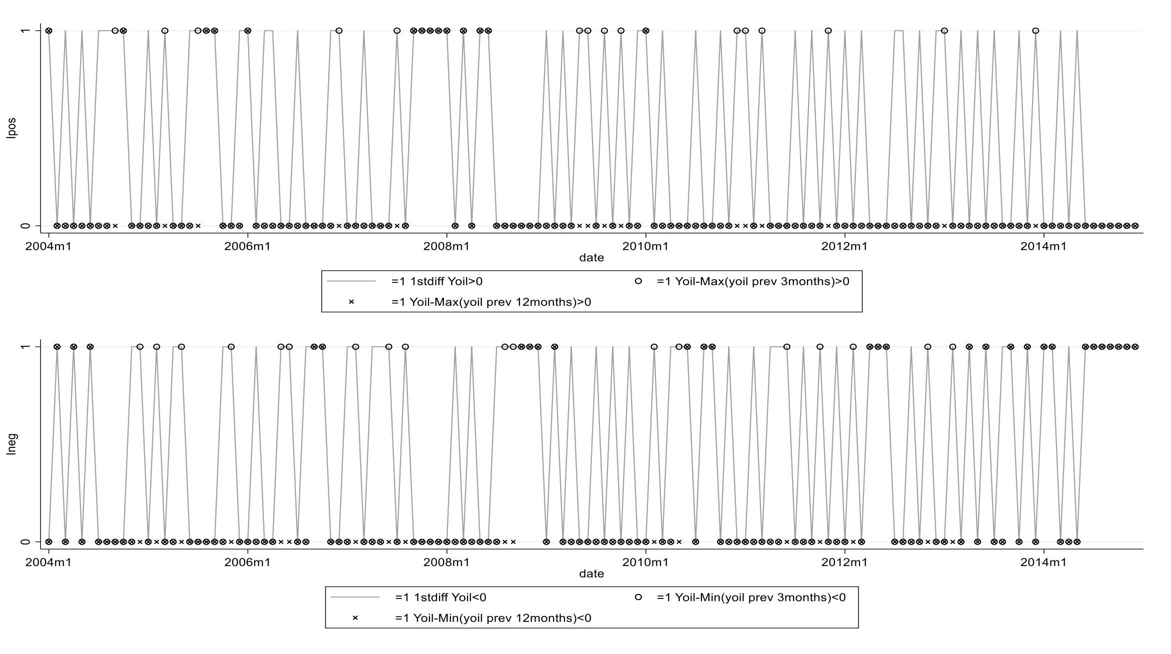

FIGURE 3. *Comparing I^{pos}_{f} and I^{neg}_{f} for different definitions of oil-shock*

[15] We thanks an anonymous referee for this comment.

4.3 Institutions and fiscal rules

To evaluate if the degree of pro-cyclicality can be affected by institutions, we use different measures of institutional quality, fiscal room and access-to-credit usually used in the literature, and use them to construct dummy indicators for institutional change. Similarly, we use the information about Fiscal Rules summarized in Table 1 to create dummy indicators for the adoption of these rules.

Table 4 provide descriptions and sources for institutional variables, as well as, dummy indicators. Institutional quality is measured three variables. First, the corruption index, co_t, provided by International Transparency (2017) measures the public perception of corruption and it ranges from 0-100. Its maximum means that public perceives society as very clean, and 0, otherwise. Hence, we interpret growth in this index as improvements in corruption controls. Second, Rule-of-Law index, ro_t, is published by the World Bank, and ranges from 0 to 1, where 1 achieves the maximum implementation of available law, and 0 otherwise. Third, the Government Effectiveness index, ge_t, also published by the World Bank, measures the quality of bureaucracy, and whether there is an excessive burden on the economy. Fig. 4 shows the evolution of these variables. In panel (a), the corruption index provided, shows a modest growth, or improvement in corruption controls, that is interrupted in 2006 leaving the corruption index barely unchanged over the rest of the sample period. Improvements in the Rule-of-Law index, panel (b), have been more long lasting although it also slowed-down after 2006. The Government Effectiveness index, which measures the quality of bureaucracy, panel (c), also improved by 10pp on the overall, although progress stalled since 2009. These improvements in the quality of institutions, albeit modest, should have helped to reduce pro-cyclicality.

*Table 4***.** Institutional data

Variable	Description	Source
co_t	Corruption index ranges from 0 (highly corrupt) to 100 (very clean).	[6]
ro_t	Rule of Law index. It ranges from 0 to 1, where 0 indicate NO Rule-of-Law.	[5]
ge_t	Government effectiveness measured as quality of bureaucracy and excessive bureaucracy.	[5]
d_t	Debt-to-GDP ratio.	[4]
nf_t	Net capital flows-to-GDP ratio.	[5]
a_t	Development aid-to-GDP ratio.	[5]
fo_t	Financial openness. (0-1), 1=total freedom cross-border capital transactions.	[7]
cr_t	Credit-to-private sector-to-GDP ratio.	[5]
re_t	Gross international reserves-to-GDP ratio.	[8]
I^1_{in}	=1 when $in > 0$, and 0 otherwise. Where $in = \Delta co_t, \Delta ro_t, \Delta ge_t, \Delta d_t, \Delta nf_t, \Delta a_t, \Delta cr_t, \Delta re_t$	[AC]
I^2_{in}	=1 when $in_t < 0$, and 0 otherwise. $in = \Delta co_t, \Delta ro_t, \Delta ge_t, \Delta d_t, \Delta nf_t, \Delta a_t, \Delta cr_t, \Delta re_t$	[AC]
I^1_{fo}	=1 up-to-2006, period when fo_t=0.17, =0 otherwise	[AC]
I^2_{fo}	=1 after 2006, period when fo_t=0, =0 otherwise	[AC]
I^1_{fr1}	=1 from 2009-onwards when fiscal rules were introduced, =0 otherwise.	[AC]
I^2_{fr1}	=1 before 2009, =0 otherwise	[AC]
I^1_{fr2}	=1 from 2012-onwards when SWF was introduced, =0 otherwise	[AC]
I^2_{fr2}	=1 before 2012, =0 otherwise	[AC]

[4] IMF (2016a). [5] World Bank (2017, 2018). [6] Transparency International (2017). [7] Chin and Ito (2017). [8] National Bank of Angola (2018). [AC] Author's calculations.

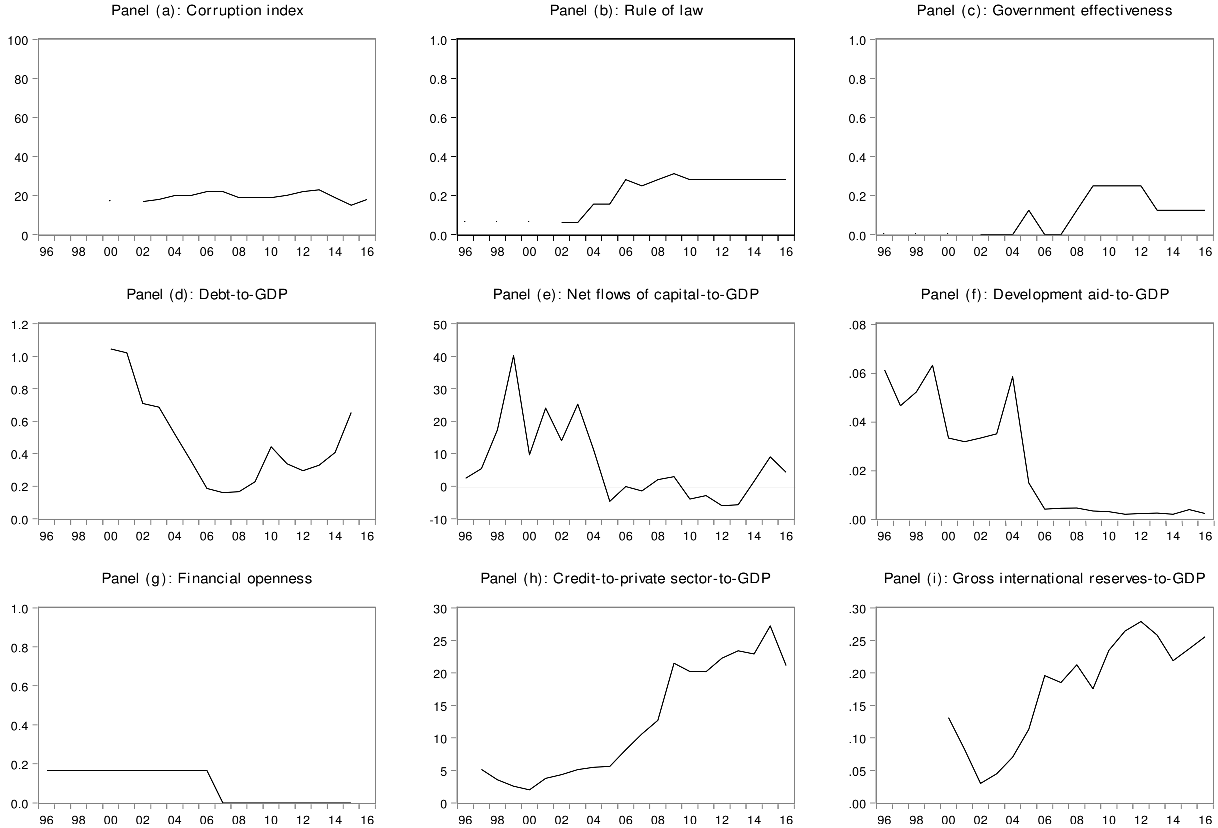

FIGURE 4. Institutions, fiscal room and access-to-credit 1996-2016
Source: IMF (2016a), National Bank of Angola (2018), Chin and Ito (2017), Transparency International (2017), and World Bank (2017, 2018).

Fiscal room is measured by debt-to-GDP, $d_t$net flows, nf_t, and Aid-to-GDP, a_t. This data is obtained from IMF and World Bank sources. As shown in fig 4, panels (d), (e) and (f), fiscal policy room improved up-to-2006 thanks to a sharp reduction in debt-to-GDP, higher net flows and larger Aid-to-GDP. However, thereafter growing debt, the loss of a net-flows surplus of up-to-40% of GDP and falling external aid to negligible levels have squeezed the room for counter-cyclical fiscal policies. Access-to-credit is captured by the following three variables. Financial Openness, fo_t, measured by Chin and Ito (2017) index, that ranges from 0 to 1, where one indicates total freedom of cross-border capital transactions, and 0 otherwise. Credit to the private sector as a share-of-GDP, cr_t, is provided by the World Bank. International reserves, re_t, measures the gross value of reserve held by the National Bank of Angola (2018)[16]. In Fig 4, panel (g), Financial Openness, shows a modest degree of openness up-to-2006 that is reverted thereafter. Credit to the private sector as a share-of-GDP, panel (h), increased five-fold up-to-2009 when it stalled. Similarly, (Gross) international reserves, in panel (i), grew rapidly from 5% to 25% until 2011, when it slowed-down. Rapid growth of credit and reserves up-to-2009 and 2011, respectively, could have reduced pro-cyclicality, whereas, the impact of financial openness is ambiguous as it can increase access to financial markets, but it can also expose the economy to external financial scrutiny (Lledo et al., 2012).

[16] There is some overlap between fiscal room and access-to-credit variables, for instance, international reserves could also affect the fiscal room that authorities have to pursue counter-cyclical policies, as acknowledged by Calderon and Nguyen (2016) and an anonymous referee to whom we are grateful for noting this point.

We use these variables to construct a dummy indicator for institutional change, I_{in}^{s}, where $in = \Delta co_t, \Delta ro_t, \Delta ge_t, \Delta d_t, \Delta nf_t, \Delta a_t, fo_t\ \Delta cr_t, \Delta re_t$ act as transition variables between two regimes (s). $s = 1$ denotes growth, and $s = 2$, reduction. Dummy indicators for $co_t, ro_t, ge_t, d_t, nf_t, a_t$, fo_t, cr_t and, re_t are also reported in Table 4, and can be interpreted as follow. $I_{\Delta co}^{1}$=1 when $\Delta co_t > 0$, and 0 otherwise. Whereas, $I_{\Delta co}^{2}$=1 when $\Delta co_t < 0$, and 0 otherwise. The only dummy indicator that should interpreted differently is the pair I_{fo}^{s}, which only takes two values over the sample period, see fig. 5, in this case, $s = 1$ denotes the period in which the $fo_t = 0.17$, and $s = 2$, the period in which it was zero.

Finally, to evaluate the influence of fiscal rule, presented in Section 2, we created two more dummy indicators. I_{fr1}^{s}, captures the effect of reforms introduced from 2009-onwards, such as, the Treasury Reserve Fund in 2009, the PERT reform in 2010, or the SWF in 2012 among other. In this case, $s = 1$ denotes the period in which the fiscal rules where in place, from 2009-onwards, and $s = 2$, denotes the period prior to these reforms. Some of these rules are thought to be more important than other, for instance, the SWF is supposed to have a greater effect. To evaluate this hypothesis, we create a second dummy indicator, I_{fr1}^{2}, which captures the introduction of SWF from 2012-onwards.

The reason to create these dummy indicators rather than incorporating institutional variables to the core model was due frequency discrepancy between core model variables, which are monthly, and institutional variables, annual.

5. Results

5.1 Preliminary testing

We start our analysis with the standard times series tests to establish the properties of our data. First, we test the existence of unit-roots in the core variables of our model, $z_t = (R_t, G_t, M_t, Y_t^{oil})'$ finding that we should treat these variables as $I(1)$. The ADF and DF-GLS cannot reject the null of a unit-root on the level, but they reject it for the first difference. Similarly KPSS tests rejects stationarity on levels but not in first differences. Further, Zivot-Andrews (1992) and Clemente et al. (1998) tests reject the null of a unit-root controlling for structural breaks. For results details see Table A2, A3 and A4. These results are consistent with evidence for fiscal variables from other oil-producing economies, see for instance, Fasano and Wang (2002) or Hamid and Sbia (2013).

Next, we test if variables in z_t are cointegrated using the Johansen approach, using the Trace (λ_{trace}) and Maximum Eigenvalue (λ_{max}) tests. Results clearly reject the null of no-cointegration in line with available evidence (Fasano and Wang, 2002, Hamid and Sbia, 2013). However, oscillate between two and three cointegrated vectors depending on the test and level of significance. Similar results, are obtained when estimating time-varying Trace (λ_{trace}) and Maximum Eigenvalue (λ_{max}) statistics, to control for structural breaks that could affect tests results. For results details see Table A5 and Figure A2. Considering the split between fiscal and monetary variables in $z_t = (R_t, G_t, M_t, Y_t^{oil})'$, we expect two cointegrated vectors, one for each policy. The first vector should include revenue (R_t) and expenditure (G_t), denoting governments long-run budget constrain, and oil production (Y_t^{oil}) capturing the influence of this variable on the budget. In the second vector, we would expect that money supply (M_t) is cointegrated with spending and oil production. Hence, weighting evidence of two, maybe three, long-run relationships, against theory, it seems reasonable to proceed under the assumption of two cointegrated vectors, $r = 2$.

5.2 Long-run budget relationships

To identify these two long-run relationships, matrix β' in equation (2), we proceed as follows. In the first vector, we impose a unit-restriction to R_t and exclude M_t by restricting its coefficient to zero, i.e. in equation (2) we impose $\beta_{11} = 1$ and $\beta_{13} = 0$. In the second vector, we impose a unit-restriction to M_t and exclude R_t, i.e. $\beta_{23} = 1$ and $\beta_{21} = 0$. [17] This yields the following matrix of long-run elasticities:

$$\hat{\beta}' z_{t-1} = \begin{pmatrix} 1 & -0.731 & 0 & 0.224 & -4.296 \\ 0 & -1.919 & 1 & -2.008 & 19.90 \end{pmatrix} \begin{pmatrix} R_{t-1} \\ G_{t-1} \\ M_{t-1} \\ Y_{t-1}^{oil} \\ k \end{pmatrix} \tag{6}$$

Which we can re-write as the following long-run relationships:

$$R_{t-1} - 0.731 G_{t-1} - 4.296 = -0.224 Y_{t-1}^{oil} + \hat{\xi}_{1,t-1} \tag{7}$$

$$M_{t-1} + 19.90 = 1.919 G_{t-1} + 2.008 Y_{t-1}^{oil} + \hat{\xi}_{2,t-1} \tag{8}$$

Equation (7) denotes a very close relationship between revenue and expenditure that we can interpret as the budget restriction. The coefficient of G_{t-1} is below unity, i.e. one percent raise in spending increases R_{t-1} by only 0.73%, indicating that spending is not fully funded in the long-run. This is in line with the tendency towards deficits noted in Fig. 1. Further, our estimates for Y_{t-1}^{oil} indicate that one percent increase in this variable would reduce the government balance by 0.22% in the long-run, that is, it is pro-cyclical. Fasano and Wang (2002) and Hamid and Sbia (2013) also find support for a long-run relationship that implies a deficit bias in some oil-exporters from the Gulf[18]. Equation (8) denotes the relationship between money supply and government spending, we find that G_{t-1} and Y_{t-1}^{oil} increase money supply in the long-run, suggesting that these variables have an expansive effect on the economy.

5.3 Cyclicality of fiscal policy

Next, we evaluate the degree of cyclicality for the whole sample estimating equation (1). Table 5 presents the results. Our regressions, explain a large proportion of the variation in the data, the adjusted R-squares ($\bar{R}^2$) are in the 30-40% range in all cases, except for ΔY_t^{oil}, where the fitted values only explain a modest 6% of the variation in this variable, we discuss this issue below. All regressions, pass the corresponding serial correlation, homoscedasticity and normality diagnostic tests, at standard 5% significance level[19]. Further, the Eigenvalue stability condition is satisfied suggesting that the model is stable and satisfactorily specified, see Appendix B.

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[17] This amounts to impose the following restricted β'in equation (2): $\beta_R' = \begin{pmatrix} 1 & \beta_{12} & 0 & \beta_{14} & \beta_{15} \\ 0 & \beta_{22} & 1 & \beta_{24} & \beta_{25} \end{pmatrix}$

[18] This also reinforces panel evidence of pro-cyclical budgets in oil-producing economies reported by Erbil (2011) or Konuki and Villafuerte (2016).

[19] Results are provided in Appendix B. The only exception is the normality test for regression ΔG_t. This persisted despite experimenting with several alternatives, e.g. using more lags and correcting outliers with dummies. Hence, given that this issue only invalidates the t-test statistics but does not affect the efficiency of estimates, we decided to proceed acknowledging that we cannot use the t-test for this regression.

Table 5. VECM estimations

	(1) ΔR_t	(2) ΔG_t	(3) ΔM_t	(4) ΔY_t^{oil}
$\hat{\xi}_{1,t-1}$	-0.536***	0.315***	0.014	-0.102***
	(-3.76)	(2.50)	(1.29)	(-2.35)
$\hat{\xi}_{2,t-1}$	-0.119***	0.055	-0.021***	-0.017
	(-2.25)	(1.18)	(-5.12)	(-1.08)
ΔY_{t-1}^{oil}	0.693***	0.375	-0.015	-0.021
	(2.20)	(1.35)	(-0.63)	(-0.22)
ΔY_{t-2}^{oil}	0.553*	0.194	0.009	0.174*
	(1.76)	(0.70)	(0.39)	(1.81)
ΔR_{t-1}	-0.197	-0.167	-0.005	0.028
	(1.49)	(-1.42)	(-0.49)	(0.69)
ΔR_{t-2}	0.009	0.033	-0.004	0.035
	(0.09)	(0.36)	(-0.53)	(1.12)
ΔG_{t-1}	-0.619***	-0.553***	-0.014	-0.021
	(-4.08)	(-4.11)	(-1.17)	(-0.44)
ΔG_{t-2}	-0.349***	-0.402***	0.006	0.017
	(-3.18)	(-4.13)	(0.67)	(0.52)
ΔM_{t-1}	0.299	-1.010	-0.345***	-0.326
	(0.26)	(-0.99)	(-3.90)	(-0.93)
ΔM_{t-2}	-1.345	-0.496	-0.088	-0.163
	(-1.17)	(-0.49)	(-1.00)	(-0.93)
C_0	0.020	0.035	-0.021***	0.001
	(0.27)	(0.54)	(-3.80)	(0.05)
$\bar{R}^2$	0.386	0.425	0.307	0.064
$\hat{\sigma}$	0.325	0.288	0.025	0.099
X^2	89.75	105.69	111.22	20.36
P-value	[0.000]	[0.000]	[0.000]	[0.041]

Note: Error correction terms are given by:

$$\hat{\xi}_{1,t-1} = R_{t-1} - 0.731G_{t-1} + 0.224Y_{t-1}^{oil} - 4.296$$

$$\hat{\xi}_{2,t-1} = M_{t-1} - 1.919G_{t-1} - 2.008Y_{t-1}^{oil} + 19.9$$

Obs=129 in all regressions. ( ) reports t-statistics. * Indicates significance at 10%, ** 5%, *** at 1%.

$\hat{\sigma}$ is standard error of residuals. X^2 is chi-squared statistic from jointly t-test on each regression.

In column (1), we find that government revenue is clearly pro-cyclical to oil production in the short-run, as the elasticity of ΔR_t to the two lags of ΔY_t^{oil} are positive and significant. On the other hand, the coefficient for $\hat{\xi}_{1,t-1}$ is negative and significant, indicating that budget surplus reduce ΔR_t by 54% every month, and vice versa for deficits. This means that ΔR_t acts in a counter-cyclical manner[20]. Deviations from the money-spending long-run relationship ($\hat{\xi}_{2,t-1}$), have the opposite effect, note that Y_{t-1}^{oil} enters equation (8) with the opposite sign than in equation (7), although the size of the coefficient for $\hat{\xi}_{2,t-1}$ is small. Government spending, in Column (2), also reacts positively to oil-shocks in the short-run, i.e. behaves pro-cyclically, although it is less sensitive than revenue, as the elasticity of ΔG_t to lags of ΔY_t^{oil} are smaller than in column (1). Deviations from the long-run budget constrain reinforce this pro-cyclicality, as the coefficients for $\hat{\xi}_{1,t-1}$ is positive. According to our estimate, deviations from the budget

[20] Our estimates of the budget long-run relationship, equation (7) implies: $\hat{\xi}_{1,t-1} = R_{t-1} - 0.731G_{t-1} + 0.224Y_{t-1}^{oil} - 4.296$. Hence, A positive oil-shock (raise in Y_{t-1}^{oil}), implies that $\hat{\xi}_{1,t-1} > 0$, since the coefficient for $\hat{\xi}_{1,t-1}$ is negative (-0.536), it means that ΔR_t needs to fall as a result of raising Y_{t-1}^{oil}, that is, there is a counter-cyclical response on revenue.

relationship increases ΔG_t by 32% a month[21]. The coefficient for $\hat{\xi}_{2,t-1}$, implies a very modest impact of the money-spending relationship on ΔG_t.

It is worth noting, that in column (1) lags of ΔG_t significantly reduce ΔR_t, whereas in column (2) lags of ΔR_t have a small impact on ΔG_t. This suggest that, in the short-run, expenditure pressures revenue making the economy more prone to deliver fiscal deficits, in line with our estimates of $\hat{\beta}'$ in equation (7) and as anticipated by Fig. 1. This finding provides support for the spend-to-revenue hypothesis, in line with evidence from other oil-rich economies (Hamid and Sbia, 2013, Nwosu and Okafor, 2014).

Thus, our results in columns (1) and (2), suggest that both, ΔR_t and ΔG_t, are pro-cyclical to short-run oil-shocks, captured by lags of ΔY_t^{oil}. These findings are consistent with estimates of the impulse response of ΔR_t and ΔG_t to a shock in ΔY_t^{oil}, and variance decomposition shown in Appendix C. Similar results are found for most Gulf-Countries in Fasano and Wang (2002) and Hamid and Sbia (2013), as well as, in panel studies of oil-producers (Erbil, 2011, Konuki and Villafuerte, 2016, Koh, 2017). Further, budget deviations ($\hat{\xi}_{1,t-1}$) force revenue (ΔR_t) to react counter-cyclically but not expenditure (ΔG_t), which reacts in a pro-cyclical manner to these deviations. This contrasts with evidence from Fasano and Wang (2002), who find that spending contributes to correct budget deficits in the Gulf region.

In Column (3), the change in the money supply, seems to depend on its own lags, and the corrections imposed by the money-spending long-run relation ($\hat{\xi}_{2,t-1}$), although the speed-of-adjustment is modest, only 2% of the gap is corrected each month. Gross oil production, in Column (4), is only significantly affected by its own lags and deviations from the long-run relationship that it shares with ΔR_t and ΔG_t. This suggests that ΔY_t^{oil} is more dependent on Global market forces than domestic factors, explaining the low $\bar{R}^2$ for this regression. In order to check the robustness of these findings, we experimented with several lags structure, but on the overall, our results do not seem sensitive to these changes, see Appendix B.

5.4 Asymmetric effects on fiscal policy

To assess if oil-shocks have asymmetric effects on fiscal policy, that is, if during period of booms in the oil-markets, spending (and revenue) grows more than during downturns, we estimate the TVECM illustrated by equation (4) and (5), using changes in oil production, Y_t^{oil}, as our transition variable between regimes. Table 6, present our results for ΔR_t and ΔG_t using our three definitions of oil-shocks. Monthly shocks, $I_{f=1}^s$, columns (1) and (2). Quarterly shocks, $I_{f=2}^s$, columns (3) and (4). Annual shocks, $I_{f=3}^s$, columns (3) and (4) [22].

[21] Our estimates from equation (7) imply: $\hat{\xi}_{1,t-1} = R_{t-1} - 0.731G_{t-1} + 0.224Y_{t-1}^{oil} - 4.296$. Hence, a raise in Y_{t-1}^{oil}, implies that $\hat{\xi}_{1,t-1} > 0$, since the coefficient for $\hat{\xi}_{1,t-1}$ in the regression for ΔG_t is positive (0.315), it means that ΔG_t grows as a result of raising Y_{t-1}^{oil}, that is, there is pro-cyclical behaviour.

[22] Regressions pass the corresponding diagnostic tests, at standard 5% significance level and Eigenvalue stability condition are satisfied for each TVECM, which indicates that the model is stable and satisfactorily specified, see Appendix D. The only exception is the normality of residuals for spending in column (2), and revenue in column (3) although these are corrected in columns (5) and (6).

Table 6. Asymmetric TVECM

	$I^s_{f=1}$		$I^s_{f=2}$		$I^s_{f=3}$	
	ΔR_t	ΔG_t	ΔR_t	ΔG_t	ΔR_t	ΔG_t
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta Y^{oil}_{t-1} * I^{pos}_f$	0.324	-0.298	0.309	0.109	0.379	-0.036
	(0.51)	(0.54)	(0.49)	(0.19)	(0.43)	(0.04)
$\Delta Y^{oil}_{t-2} * I^{pos}_f$	0.573	-0.067	1.020	0.327	0.902	-0.060
	(0.93)	(0.12)	(1.54)	(0.54)	(1.09)	(0.08)
$\Delta Y^{oil}_{t-1} * I^{neg}_f$	0.978	0.852	0.509	0.187	0.907	0.689
	(1.88)*	(1.86)*	(1.09)	(0.44)	(1.77)*	(1.44)
$\Delta Y^{oil}_{t-2} * I^{neg}_f$	0.469	0.265	0.932	0.645	1.329	0.084
	(0.90)	(0.58)	(1.90)*	(1.43)	(2.57)**	(0.17)
$\Delta Y^{oil}_{t-1} * I^{mid}_f$			1.449	0.783	0.152	0.079
			(1.96)*	(1.15)	(0.36)	(0.20)
$\Delta Y^{oil}_{t-2} * I^{mid}_f$			-0.155	-0.465	-0.519	0.011
			(0.25)	(0.81)	(1.25)	(0.03)
$\xi_{1,t-1} * I^{pos}_f$	-0.561	0.276	-0.176	0.301	-0.088	0.394
	(3.49)***	(1.96)*	(0.87)	(1.62)	(0.38)	(1.82)*
$\xi_{1,t-1} * I^{neg}_f$	-0.508	0.357	-0.565	0.355	-0.893	0.006
	(3.10)***	(2.48)**	(3.12)***	(2.14)**	(3.21)***	(0.02)
$\xi_{1,t-1} * I^{mid}_f$			-0.640	0.250	-0.697	0.315
			(3.73)***	(1.59)	(4.76)***	(2.31)**
$\xi_{2,t-1} * I^{pos}_f$	-0.124	0.046	-0.095	0.047	-0.047	0.049
	(2.39)**	(1.01)	(1.76)*	(0.95)	(0.75)	(0.84)
$\xi_{2,t-1} * I^{neg}_f$	-0.108	0.075	-0.112	0.077	-0.113	0.007
	(1.84)*	(1.45)	(1.89)*	(1.41)	(1.38)	(0.09)
$\xi_{2,t-1} * I^{mid}_f$			-0.102	0.048	-0.109	0.055
			(1.71)*	(0.88)	(1.93)*	(1.05)
N	129	129	129	129	129	129
$\bar{R}^2$	0.44	0.49	0.48	0.49	0.50	0.49
Wald tests, $\chi^2(1)$						
$\Delta y^{oil}_{t-1}*I^{pos}_f+\Delta y^{oil}_{t-2}*I^{pos}_f = \Delta y^{oil}_{t-1}*I^{neg}_f+\Delta y^{oil}_{t-2}*I^{neg}_f$	0.20	1.90	0.01	0.14	0.55	0.52
	[0.653]	[0.168]	[0.923]	[0.709]	[0.458]	[0.470]
$\xi_{1,t-1} * I^{pos}_f = \xi_{1,t-1} * I^{neg}_f$	0.10	0.30	2.97	0.07	5.70	1.52
	[0.755]	[0.585]	[0.085]	[0.793]	[0.017]	[0.218]
$\xi_{2,t-1} * I^{pos}_f = \xi_{2,t-1} * I^{neg}_f$	0.16	0.64	0.13	0.44	0.71	0.34
	[0.688]	[0.422]	[0.721]	[0.507]	[0.398]	[0.563]

In all three revenue (ΔR_t) regressions, columns (1), (3) and (5), lags of Y^{oil}_t interacted with I^{pos}_f and I^{neg}_f are positive, in line with our symmetrical estimates reported in Table 5. The coefficients for the interactions of Y^{oil}_t with I^{neg}_f tend to be larger than those interacted with I^{pos}_f, which indicates there is some degree of asymmetry, where negative shocks have a larger impact on revenue. However, the Wald test cannot reject the null of equality of the sum of lags for Y^{oil}_t ($\Delta y^{oil}_{t-1}*I^{pos}_f+\Delta y^{oil}_{t-2}*I^{pos}_f=\Delta y^{oil}_{t-1}*I^{neg}_f+\Delta y^{oil}_{t-2}*I^{neg}_f$), with $\chi^2(1) = 0.20$, 0.01 and 0.55, respectively. Interactions of $\xi_{1,t-1}$, the budget unbalance, with the dummy indicators, I^{pos}_f and I^{neg}_f, are all negative as in Table 5, but their sizes differ depending on the definition of oil-shock. In Column (1), with $I^s_{f=1}$, our estimates present the same sign and similar values, around -0.5, to those reported in Table 5, suggesting that the response to budget unbalances is the same during positive and negative shocks. Whereas, in columns (3) and (5), with $I^{s}_{f=2}$, and $I^{s}_{f=3}$, respectively, interactions with I^{pos}_{f} are smaller in absolute value than for I^{neg}_{f} and I^{mid}_{f}. This implies that revenue responds faster to budget unbalances during slumps and normal times than during positive shocks, where it is more pro-cyclical. In column (3) this asymmetry in the speed of adjustment is significant at 10%, with $\chi^2(1) = 2.97$ and p-value=0.085, and in column (5), at 5% with $\chi^2(1) = 5.70$ and p-value=0.017. Finding stronger effects when we use a longer time-span to define oil-shocks, reinforces Hamilton (1996) claim that high frequency data can hide asymmetric effects[23].

In the spending regressions, columns (2), (4) and (6), interactions of $Y^{oil}_{t-1}$and Y^{oil}_{t-2} with I^{pos}_{f} and I^{neg}_{f}, present mixed signs depending on the regime of dummy indicators. In column (2) and (6), interactions with $I^{pos}_{f}$are negative, whereas interactions with $I^{neg}_{f}$are positive indicating that spending grows more during slumps than during booms, we speculate that to pre-empt political unrest. However, these differences are not significant, as the Wald test cannot reject the null of equality of the sum of lags for Y^{oil}_{t}, with a $\chi^2(1) = 1.90$, 0.14 and 0.52, in columns (2), (4) and (6), respectively. Interactions with $\xi_{1,t-1}$, are all positive, as in Table 5. There are some sizes difference, particularly, in column (6), where the coefficient for $\xi_{1,t-1} * I^{neg}_{f}$is clearly smaller than for I^{pos}_{f} (and for I^{mid}_{f}), but these differences are not significant as the null that $\xi_{1,t-1} * I^{pos}_{f} = \xi_{1,t-1} * I^{neg}_{f}$ cannot be rejected for any of the spending regressions, $\chi^2(1) = 0.30$, 0.07 and 1.52, and implies that spending speed of adjustment is symmetric to budget unbalances. The same happens with $\xi_{2,t-1}$.

Thus, the only significant asymmetry happens in the response of revenue to budget deviations, which tend to be more pro-cyclical during upturns in oil-markets. This is in line with Emami and Adibpour (2012), who find revenue, albeit modestly, more responsive to positive-shocks. Further, our findings for spending are consistent with Farzanegan and Markwardt (2009) and Emami and Adibpour (2012) who find little or no evidence of asymmetric behaviour on spending, contrary to Villafuerte and Lopez-Murphy (2009).

We also asses the asymmetric hypothesis estimating the relevant IRF[24]. Fig 5 presents our results for each definition of oil-shock, that is, $I^{s}_{f=1}$, in panels a) and b), $I^{s}_{f=2}$, in panels c) and d), and $I^{s}_{f=3}$, in panels e) and f). The response of revenue, in a), c) and e), is very similar in all three cases, confidence interval for positive and negative -shocks overlap, which rejects asymmetric behaviour of revenue. The response of spending, in panels b), d) and f), is more pronounced during negative shocks, reflecting differences in estimates anticipated in Table 6, however, confidence intervals also overlap and we conclude that spending does not responds asymmetrically. Overall, IRF rejects the hypothesis of asymmetric behaviour in revenue and spending. Similar results for spending are provided in Farzanegan and Markwardt (2009) and Emami and Adibpour (2012). However, this could also be caused by the fact that in our TVECM, the long-run relationship (ξ_{t-1}) is by construction treated as symmetric. This means that the asymmetric shocks we generate with the IRF are not reflected on this term. This could be

[23] Similarly, interactions of $\xi_{2,t-1}$ with I^{neg}_{f} and I^{mid}_{f} have larger coefficients than its interaction with interaction with I^{pos}_{f} in columns (3) and (5), but the Wald test fails to reject equality of coefficients across states of the oil market with $\chi^2(1) = 0.16$, 0.13 and 0.71.

[24] We thank an anonymous referee for this suggestion.

undervaluing the impact that shocks have, particularly, since the only term that reacts asymmetrically is the speed of adjustment. Thus, we conclude that asymmetric effects concentrate on the response of revenue to budget unbalances highlighted in Table 6.

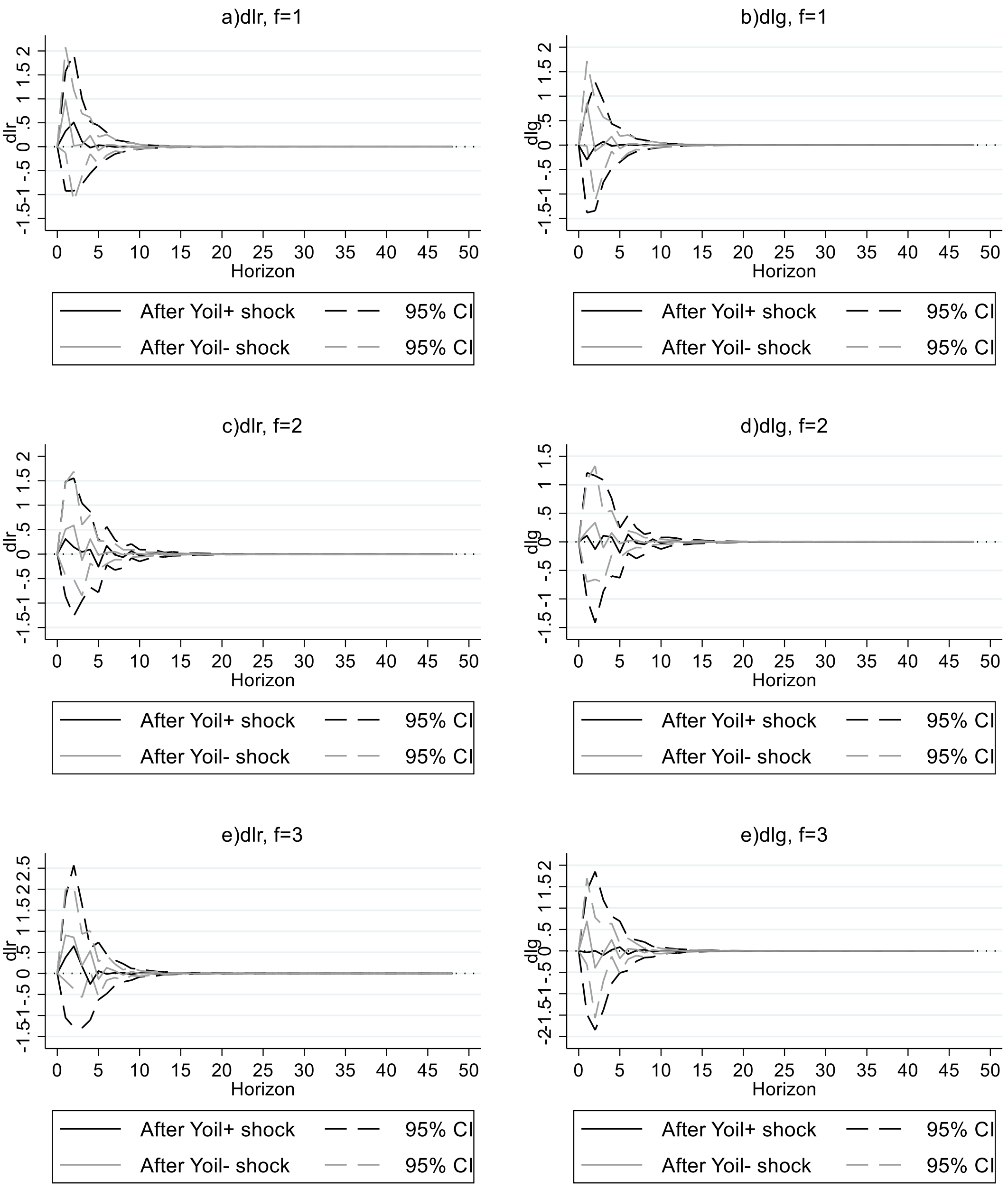

FIGURE 5. IRF for ΔR_t and ΔG_t to positive and negative oil-shocks
Note: CI generated from a bootstrap procedure using 2000 replications.

5.5 *Institutions and fiscal rules*

To assess the impact of institutional factors and Fiscal rules on pro-cyclicality, we estimate the TVECM from equation (4) using I_{in}^{s} to capture changes in institutional factors. We present our results in Tables 7-10 by groups, namely, measures of institutional quality, fiscal room, access-to-credit and fiscal rules[25].

Table 7. Institutional quality TVECM

	$in = \Delta co$		$in = \Delta ro$		$in = \Delta ge$	
	ΔR_t (1)	ΔG_t (2)	ΔR_t (3)	ΔG_t (4)	ΔR_t (5)	ΔG_t (6)
$\Delta Y_{t-1}^{oil} * I_{in}^{1}$	0.381	-0.048	0.803	0.555	0.801	0.370
	(0.75)	(0.12)	(2.04)**	(1.69)*	(1.82)*	(0.97)
$\Delta Y_{t-2}^{oil} * I_{in}^{1}$	0.055	-1.001	0.119	-0.648	0.823	0.676
	(0.11)	(2.38)**	(0.30)	(1.96)*	(1.87)*	(1.76)*
$\Delta Y_{t-1}^{oil} * I_{in}^{2}$	0.708	0.419	0.824	0.387	0.479	0.225
	(1.88)*	(1.34)	(1.84)*	(1.03)	(1.17)	(0.63)
$\Delta Y_{t-2}^{oil} * I_{in}^{2}$	0.811	0.675	0.886	0.724	0.291	-0.164
	(2.15)**	(2.15)**	(2.02)**	(1.97)**	(0.71)	(0.46)
$\xi_{1,t-1} * I_{in}^{1}$	-0.530	0.524	-0.263	0.662	-0.525	0.348
	(2.96)***	(3.53)***	(1.56)	(4.67)***	(2.77)***	(2.11)**
$\xi_{1,t-1} * I_{in}^{2}$	-0.557	0.236	-0.691	0.139	-0.567	0.243
	(3.76)***	(1.92)*	(4.68)***	(1.13)	(3.87)***	(1.90)*
$\xi_{2,t-1} * I_{in}^{1}$	-0.121	0.162	-0.040	0.169	-0.127	0.041
	(2.00)**	(3.22)***	(0.68)	(3.44)***	(1.99)**	(0.73)
$\xi_{2,t-1} * I_{in}^{2}$	-0.117	0.038	-0.108	0.031	-0.127	0.059
	(2.22)**	(0.88)	(1.91)*	(0.66)	(2.39)**	(1.27)
N	129	129	129	129	129	129
$\bar{R}^2$	0.44	0.54	0.47	0.56	0.44	0.50
Wald tests, $\chi^2(1)$						
$\Delta y^{oil}_{t-1} * I_{in}^{1} + \Delta y^{oil}_{t-2} * I_{in}^{1} = \Delta y^{oil}_{t-1} * I_{in}^{2} + \Delta y^{oil}_{t-2} * I_{in}^{2}$	1.33	7.54	0.90	3.01	1.04	1.82
	[0.249]	[0.006]	[0.342]	[0.083]	[0.309]	[0.178]
$\xi_{1,t-1} * I_{in}^{1} = \xi_{1,t-1} * I_{in}^{2}$	0.02	3.95	6.52	13.86	0.05	0.43
	[0.876]	[0.047]	[0.011]	[0.000]	[0.819]	[0.514]
$\xi_{2,t-1} * I_{in}^{1} = \xi_{2,t-1} * I_{in}^{2}$	0.01	12.36	2.82	16.13	0.00	0.23
	[0.925]	[0.000]	[0.093]	[0.000]	[0.995]	[0.630]

Table 7 present results for measures of institutional quality using I_{in}^{s}, where $in = \Delta co_t, \Delta ro_t, \Delta ge_t$, and $s = 1$ means growth of in, and $s = 2$ otherwise. We start discussing revenue estimates in column (1), (3) and (5). In all three regressions, interactions of $Y_{t-1}^{oil}$and Y_{t-2}^{oil} with I_{in}^{1} and I_{in}^{2}, are positive, indicating that growth in Y_t^{oil} increases revenue, in line with our whole-sample estimates from Table 5. There are some small size differences across regime, interactions with I_{in}^{1} take smaller values in columns (1) and (3), than interactions with I_{in}^{2}. This indicates that growth in corruption (controls) and Rule-of-Law index, moderate the response of revenue to Y_t^{oil}, that is, co_t and ro_t make revenue less pro-cyclical. The opposite happens in column (5). However, differences between regimes are not significant as the Wald test cannot reject the null of equality of the sum of Y_t^{oil} lags ($\Delta y^{oil}_{t-1} * I_{in}^{1} + \Delta y^{oil}_{t-2} * I_{in}^{1} = \Delta y^{oil}_{t-1} * I_{in}^{2} + \Delta y^{oil}_{t-2} * I_{in}^{2}$), with $\chi^2(1) = 1.33$, 0.90 and 1.04, respectively.

[25] The corresponding diagnostic tests are passed, at standard 5% and the Eigenvalue stability condition is satisfied for each TVECM, which indicates that models are stable and satisfactorily specified, see Appendix E. Spending regression, as in other specifications does not always pass the normality of residuals, see Table E1-E4, however, this does not affect the unbiasedness of our estimates.

Interactions of $\xi_{1,t-1}$ with the dummy indicators are all negative, as in Table 5. Differences across regimes are only significant for Rule-of-Law, where the null that $\xi_{1,t-1} * I_{in}^{1} = \xi_{1,t-1} * I_{in}^{2}$ is rejected at 5% with the Wald test taking values of $\chi^2(1) = 6.52$ and p-value=0.011. Given that both coefficients are negative, and that it is smaller for $\xi_{1,t-1} * I_{in}^{1}$ in absolute value than for $\xi_{1,t-1} * I_{in}^{2}$, $|-0.263| < |-0.691|$, this indicates that when the Rule-of-Law index increases, , under I_{in}^{1}, revenue responds slower to budget unbalances, i.e. it is more pro-cyclical. Similarly, differences in the interaction of $\xi_{2,t-1}$with I_{in}^{1} and I_{in}^{2}, are only marginally significant for Rule-of-Law at 10%. Hence, only improvements on the Rule-of-Law index have significant effects on revenue pro-cyclicality, albeit with unexpected sign.

For spending, in columns (2), (4) and (6), corruption (controls) significantly reduces spending pro-cyclicality via lags of Y_t^{oil}. Coefficients for interactions with I_{in}^{1}, in column (2) are negative, whereas interactions with I_{in}^{2} are positive, indicating that when the corruption (control) index grows, under $s = 1$, spending does not grow with Y_t^{oil}, i.e. is less pro-cyclical. This difference between regimes is significant as the Wald test rejects the null of equality of the sum of Y_t^{oil} lags, with $\chi^2(1) = 7.54$ and p-value=0.006. It is worth noting that in the case of Rule-of-Law, the interactions with I_{in}^{1}, in column (4) are smaller than for I_{in}^{2}, implying less pro-cyclicality when Rule-of-Law increases, and that we reject the null of equal sum Y_t^{oil} lags marginally, at 10% but not at 5%. Corruption and Rule-of-Law index also affect spending pro-cyclicality via the budget restriction as we reject the null that $\xi_{1,t-1} * I_{in}^{1} = \xi_{1,t-1} * I_{in}^{2}$ for these variables at 5% with $\chi^2(1) = 3.95$ and and 13.86, columns (2) and (4), respectively. Given that coefficients for $\xi_{1,t-1} * I_{in}^{1}$ is positive and larger than for $\xi_{1,t-1} * I_{in}^{2}$, when the Corruption Control and Rule-of-Law index grow, under I_{in}^{1}, spending is more responsive to budget unbalances, that is, is more pro-cyclical. The same happens with $\xi_{2,t-1}$. There is no evidence of Government efficiency affecting spending in column (6).

Thus, according to our results, institutional quality, particularly, Corruption and Rule-of-Law index can reduce spending pro-cyclicality. Previous evidence, is mixed, El Anshasy and Bradley (2012) and Koh (2017), also find significant effects of institutional quality, contrary to Konuki and Villafuerte (2016).

Table 8 presents results for fiscal room variables, using the dummy indicator I_{in}^{s}, where $in = \Delta d_t, \Delta nf_t, \Delta a_t$. We find no evidence of fiscal room affecting revenue pro-cyclicality. First, in columns (1), (3) and (5), lags of Y_t^{oil} interacted with I_{in}^{1} and I_{in}^{2}, are positive, as in Table 5, and the Wald test fails to reject the null that sum of lags of Y_t^{oil} is equal across regimes, with $\chi^2(1) = 0.00$, 0.02 and 0.16 in columns (1), (3) and (5), respectively. Second, the interactions of $\xi_{1,t-1}$ with I_{in}^{1} and I_{in}^{2} have the same sign and similar values, around -0.5, to our estimates from Table 5, and Wald test cannot reject the null that $\xi_{1,t-1} * I_{in}^{1} = \xi_{1,t-1} * I_{in}^{2}$ with $\chi^2(1) = 0.03$, 3.10 and 0.04 in columns (1), (3) and (5), respectively. The same happens with $\xi_{2,t-1}$. Hence, growth in debt, net inflows and Aid, does not have significant effects on revenue.

In spending regressions, columns (2), (4) and (6), there is no evidence of fiscal room affecting pro-cyclicality through lags of Y_t^{oil}. Interactions of $Y_{t-1}^{oil}$and Y_{t-2}^{oil} with dummy indicators present mixed signs across regimes, contray to Table 5, but the Wald test does not reject equality of the sum of Y_t^{oil} lags across regimes ($\Delta y^{oil}_{t-1} * I_{in}^{1} + \Delta y^{oil}_{t-2} * I_{in}^{1} = \Delta y^{oil}_{t-1} * I_{in}^{2} + \Delta y^{oil}_{t-2} * I_{in}^{2}$) with $\chi^2(1) = 1.48$, 1.23 and 0.26, column (2), (4) and (6), respectively. However, Net inflows significantly increases spending pro-cyclicality via the budget restriction, as we reject the null that $\xi_{1,t-1} * I_{in}^1 = \xi_{1,t-1} * I_{in}^2$ for $in = \Delta nf_t$ with $\chi^2(1) = 10.11$, and p-value=0.001. The coefficients for $\xi_{1,t-1} * I_{in}^1$ is positive and larger than for $\xi_{1,t-1} * I_{in}^2$ $(0.538 > 0.092)$, implying that under growing Net Inflows, with I_{in}^1, spending grows faster in response to budget unbalances, i.e. is more pro-cyclical. The same happens with $\xi_{2,t-1}$. For Debt and Aid, interactions of $\xi_{1,t-1}$ and $\xi_{2,t-1}$ with the dummy indicators are not significantly different across regimes.

Thus, according to our findings, the only fiscal room measure that significantly affects pro-cyclicality is net inflows, which increases spending pro-cyclicality. This is partly in line with Konuki and Villafuerte (2016), who also find no effect of debt-to-GDP, but find significant effects of International Reserves contrary to our results.

Table 8. Fiscal Policy room TVECM

	$in = \Delta d$		$in = \Delta nf$		$in = \Delta da$	
	ΔR_t (1)	ΔG_t (2)	ΔR_t (3)	ΔG_t (4)	ΔR_t (5)	ΔG_t (6)
$\Delta Y_{t-1}^{oil} * I_{in}^1$	0.558	0.529	0.672	0.280	0.428	0.595
	(1.34)	(1.45)	(1.79)*	(0.87)	(1.05)	(1.69)*
$\Delta Y_{t-2}^{oil} * I_{in}^1$	0.726	0.444	0.653	0.395	0.905	-0.252
	(1.73)*	(1.21)	(1.70)*	(1.21)	(2.33)**	(0.75)
$\Delta Y_{t-1}^{oil} * I_{in}^2$	0.790	0.243	0.759	0.273	0.837	0.159
	(1.81)*	(0.64)	(1.65)*	(0.69)	(1.92)*	(0.42)
$\Delta Y_{t-2}^{oil} * I_{in}^2$	0.442	-0.173	0.445	-0.400	0.167	0.549
	(1.04)	(0.47)	(0.98)	(1.03)	(0.37)	(1.40)
$\xi_{1,t-1} * I_{in}^1$	-0.524	0.162	-0.429	0.538	-0.545	0.162
	(3.15)***	(1.11)	(2.70)***	(3.97)***	(3.27)***	(1.11)
$\xi_{1,t-1} * I_{in}^2$	-0.555	0.411	-0.718	0.092	-0.511	0.425
	(3.42)***	(2.90)***	(4.44)***	(0.67)	(3.32)***	(3.18)***
$\xi_{2,t-1} * I_{in}^1$	-0.123	-0.005	-0.108	0.113	-0.119	0.024
	(1.96)*	(0.09)	(1.84)*	(2.24)**	(2.20)**	(0.51)
$\xi_{2,t-1} * I_{in}^2$	-0.117	0.055	-0.125	0.010	-0.136	0.058
	(2.26)**	(1.22)	(2.35)**	(0.21)	(2.30)**	(1.14)
N	129	129	129	129	129	129
$\bar{R}^2$	0.44	0.49	0.45	0.53	0.45	0.51
Wald tests, $\chi^2(1)$						
$\Delta y^{oil}_{t-1} * I_{in}^1 + \Delta y^{oil}_{t-2} * I_{in}^1 = \Delta y^{oil}_{t-1} * I_{in}^2 + \Delta y^{oil}_{t-2} * I_{in}^2$	0.00	1.48	0.02	1.23	0.16	0.26
	[0.952]	[0.224]	[0.886]	[0.268]	[0.689]	[0.609]
$\xi_{1,t-1} * I_{in}^1 = \xi_{1,t-1} * I_{in}^2$	0.03	2.45	3.10	10.11	0.04	3.06
	[0.865]	[0.118]	[0.078]	[0.001]	[0.844]	[0.080]
$\xi_{2,t-1} * I_{in}^1 = \xi_{2,t-1} * I_{in}^2$	0.02	2.40	0.16	8.72	0.15	0.86
	[0.899]	[0.121]	[0.686]	[0.003]	[0.700]	[0.355]

Table 9 presents results for measures of access-to-credit. We use the dummy indicator I_{in}^s, where $in = \Delta cr_t, \Delta re_t, fo_t$. Column (1), (3) and (5) present estimates for revenue and show that access-to-credit does not affect revenue pro-cyclicality. $Y_{t-1}^{oil} * I_{in}^s$ and $Y_{t-2}^{oil} * I_{in}^s$ are positive for both regimes in line with estimates from Table 5. There are some size differences, but estimates are not significantly different across regimes, as the Wald test cannot reject the null of equality of the sum of Y_t^{oil} lags, with $\chi^2(1) = 0{,}00$, 0.00 and 0.04 in columns (1), (3) and (5), respectively. Further, estimates for the interactions of $\xi_{1,t-1}$ with the dummy indicators have the same sign and similar values, to those of Table 5, and the Wald test fails to reject the null that $\xi_{1,t-1} * I_{in}^1 = \xi_{1,t-1} * I_{in}^2$ with $\chi^2(1) = 0.77$, 0.02 and 0.00 in columns (1), (3) and (5), respectively. The same happens with $\xi_{2,t-1}$. Hence, there is no evidence that greater private credit, international reserves and financial openness significantly affect revenue.

For spending, columns (2), (4) and (6), we find no evidence of access-to-credit affecting pro-cyclicality via lags of Y_t^{oil}, as we cannot reject the null that sum of lags of Y_t^{oil} is equal across regimes, with $\chi^2(1) = 1.26$, 0.23 and 2.16, column (2), (4) and (6), respectively. However, we find that Financial Openness affects spending pro-cyclicality via the budget restriction, as we reject $\xi_{1,t-1} * I_{in}^1 = \xi_{1,t-1} * I_{in}^2$ for $in = fo_t$, at five percent, with $\chi^2(1) = 10.11$, p-value=0.001. The coefficient for $\xi_{1,t-1} * I_{in}^1$ is positive and larger than for $\xi_{1,t-1} * I_{in}^2$ $(0.742 > 0.204)$, implying that under growing Financial Openness, I_{in}^1, spending grows faster in response to budget unbalances, i.e. is more pro-cyclical. It is worth noting that in the case of Credit and Reserves, we only fail to reject this null marginally, as we reject at 10%, but not at 5%. The same happens with $\xi_{2,t-1}$, differences are only significant for Financial openness at 5%.

Thus, according to our results, Financial Openness is the only access-to-credit measure that significantly affects pro-cyclicality, it increases it through spending. This is consistent with El Anshasy and Bradley (2012) who also find that financial openness increases spending pro-cyclicality, but contrast with Konuki and Villafuerte (2016) who this variable insignificant.

Table 9. Access-to-credit TVECM

	$in = \Delta cr$		$in = \Delta re$		$in = fo$	
	ΔR_t	ΔG_t	ΔR_t	ΔG_t	ΔR_t	ΔG_t
	(1)	(2)	(3)	(4)	(5)	(6)
$\Delta Y_{t-1}^{oil} * I_{in}^1$	0.601	0.395	0.954	0.495	0.773	0.350
	(1.89)*	(1.40)	(2.74)***	(1.59)	(1.36)	(0.73)
$\Delta Y_{t-2}^{oil} * I_{in}^1$	0.653	0.059	0.385	0.059	0.301	-0.701
	(2.07)**	(0.21)	(1.13)	(0.19)	(0.55)	(1.52)
$\Delta Y_{t-1}^{oil} * I_{in}^2$	1.254	0.620	0.306	0.478	0.609	0.453
	(1.75)*	(0.98)	(0.55)	(0.97)	(1.73)*	(1.53)
$\Delta Y_{t-2}^{oil} * I_{in}^2$	0.024	1.011	0.991	0.476	0.671	0.403
	(0.03)	(1.50)	(1.78)*	(0.96)	(1.91)*	(1.36)
$\xi_{1,t-1} * I_{in}^1$	-0.482	0.382	-0.592	0.462	-0.549	0.742
	(3.39)***	(3.03)***	(3.73)***	(3.25)***	(2.64)***	(4.23)***
$\xi_{1,t-1} * I_{in}^2$	-0.638	0.088	-0.620	0.168	-0.536	0.204
	(3.41)***	(0.53)	(3.44)***	(1.04)	(3.78)***	(1.70)*
$\xi_{2,t-1} * I_{in}^1$	-0.120	0.069	-0.139	0.086	-0.122	0.137
	(2.32)**	(1.52)	(2.63)***	(1.82)*	(2.06)**	(2.74)***
$\xi_{2,t-1} * I_{in}^2$	-0.209	-0.017	-0.080	0.023	-0.117	0.032
	(2.70)***	(0.24)	(1.37)	(0.44)	(2.24)**	(0.71)
N	129	129	129	129	129	129
$\bar{R}^2$	0.45	0.49	0.46	0.49	0.44	0.53
Wald tests, $\chi^2(1)$						
$\Delta y^{oil}_{t-1} * I_{in}^1 + \Delta y^{oil}_{t-2} * I_{in}^1 = \Delta y^{oil}_{t-1} * I_{in}^2 + \Delta y^{oil}_{t-2} * I_{in}^2$	0.00	1.26	0.00	0.23	0.04	2.16
	[0.984]	[0.263]	[0.964]	[0.632]	[0.832]	[0.141]
$\xi_{1,t-1} * I_{in}^1 = \xi_{1,t-1} * I_{in}^2$	0.77	3.44	0.02	2.75	0.00	10.36
	[0.382]	[0.064]	[0.888]	[0.097]	[0.947]	[0.001]
$\xi_{2,t-1} * I_{in}^1 = \xi_{2,t-1} * I_{in}^2$	2.44	2.91	1.76	2.50	0.01	7.82
	[0.118]	[0.088]	[0.185]	[0.114]	[0.921]	[0.005]

Table 10 presents results for two fiscal rules indicators, i.e. I_{fr1}^{s} and I_{fr1}^{s}, where $s = 1$ denotes the period in which rules where in place, and $s = 2$, indicates absences of rules. We find no evidence of fiscal rules affecting revenue pro-cyclicality. In revenue regressions, columns (1) and (3), interactions of $Y_{t-1}^{oil}$and Y_{t-2}^{oil} with dummy indicators, are positive as in Table 5, and albeit some size differences across regimes, the Wald test fails to reject the null that sum of lags of Y_t^{oil} is equal across regimes, with $\chi^2(1) = 1.09$, and 0.00 in columns (1) and (3), respectively. Further, the interactions of $\xi_{1,t-1}$ with I_{in}^1 and I_{in}^2 have the same sign and similar values to our estimates from Table 5, and Wald test cannot reject that $\xi_{1,t-1} * I_{in}^1 = \xi_{1,t-1} * I_{in}^2$ with the Wald test taking values of $\chi^2(1) = 0.73$ and 0.34 in columns (1) and (3), respectively. The same happens with $\xi_{2,t-1}$. Hence, the introduction of fiscal rules had significant effects on revenue.

Table 10. Fiscal Rules TVECM

	$in = fr1$		$in = fr2$	
	ΔR_t	ΔG_t	ΔR_t	ΔG_t
	(1)	(2)	(3)	(4)
$\Delta Y_{t-1}^{oil} * I_{in}^1$	0.488	0.587	0.204	0.794
	(1.02)	(1.41)	(0.28)	(1.25)
$\Delta Y_{t-2}^{oil} * I_{in}^1$	0.139	0.389	1.050	0.610
	(0.29)	(0.92)	(1.41)	(0.93)
$\Delta Y_{t-1}^{oil} * I_{in}^2$	0.802	0.502	0.821	0.311
	(2.09)**	(1.50)	(2.55)**	(1.10)
$\Delta Y_{t-2}^{oil} * I_{in}^2$	0.742	0.148	0.411	0.104
	(1.99)**	(0.46)	(1.27)	(0.36)
$\xi_{1,t-1} * I_{in}^1$	-0.605	0.146	-0.675	0.010
	(3.85)***	(1.07)	(2.57)**	(0.04)
$\xi_{1,t-1} * I_{in}^2$	-0.460	0.510	-0.503	0.365
	(2.85)***	(3.62)***	(3.59)***	(2.96)***
$\xi_{2,t-1} * I_{in}^1$	-0.149	0.069	-0.135	0.033
	(1.69)*	(0.90)	(1.59)	(0.44)
$\xi_{2,t-1} * I_{in}^2$	-0.109	0.101	-0.115	0.071
	(1.90)*	(2.04)**	(2.24)**	(1.58)
N	129	129	129	129
$\bar{R}^2$	0.44	0.50	0.44	0.49
Wald tests, $\chi^2(1)$				
$\Delta y^{oil}_{t-1} * I_{in}^1 + \Delta y^{oil}_{t-2} * I_{in}^1 =$ $\Delta y^{oil}_{t-1} * I_{in}^2 + \Delta y^{oil}_{t-2} * I_{in}^2$	1.09	0.18	0.00	0.81
	[0.297]	[0.669]	[0.985]	[0.367]
$\xi_{1,t-1} * I_{in}^1 = \xi_{1,t-1} * I_{in}^2$	0.73	6.07	0.43	2.34
	[0.394]	[0.014]	[0.513]	[0.126]
$\xi_{2,t-1} * I_{in}^1 = \xi_{2,t-1} * I_{in}^2$	0.50	0.41	0.09	0.46
	[0.481]	[0.524]	[0.763]	[0.497]

In spending regressions, columns (2) and (4), there is no evidence of fiscal rules affecting pro-cyclicality through lags of Y_t^{oil}, as the Wald test does not reject the null of equality of the sum of Y_t^{oil} lags across regimes with $\chi^2(1) = 0.18$ and 0.81, columns (2) and (4), respectively. However, Fiscal Rules introduced from 2009-onwards significantly reduce spending pro-cyclicality via the budget restriction, as we reject the null that $\xi_{1,t-1} * I_{in}^1 = \xi_{1,t-1} * I_{in}^2$ for $in = fr1$ at five percent, with $\chi^2(1) = 6.07$, p-value=0.014. The coefficient for $\xi_{1,t-1} * I_{in}^1$ is positive but smaller than for $\xi_{1,t-1} * I_{in}^2$ (0.146<0.510), this implies that the introduction of Fiscal Rules in 2009, under I_{in}^1, made spending less pro-cyclical. In the case of Fiscal Rules introduced in

2012, $fr2$ in column (4), we can only reject equality of coefficients at 10% but not at 5%. Interactions of $\xi_{2,t-1}$ with dummy indicators are not significantly different.

Thus, according to our findings, Fiscal Rules introduced since 2009 and 2012 significantly reduce spending pro-cyclicality, although the effect is stronger for the 2009 dummy. Previous evidence for fiscal rules in oil-producers is mixed, but our results are consistent with Koh (2017) findings and in contrast with Bjornland and Thorsrud (2015).

6. Summary

The purpose of this paper was to examine fiscal policy pro-cyclicality in Angola, evaluate the existence of asymmetric effects to positive and negative oil-shocks, and test the hypothesis that institutions and fiscal rules can moderate pro-cyclicality. This extends the yet scarce literature on asymmetric effects on fiscal and contributes to clarify the still ambiguous role of institutions and fiscals rules in oil-rich economies.

Our results indicate that in short-run, revenue and spending are generally pro-cyclical to oil-shocks. Further, we find that revenue responds asymmetrically to budget unbalances, it is more pro-cyclical during oil-booms than during periods of slows down in oil-markets, but there is no evidence of spending asymmetries. Regarding institutions, we find that not all institutions have a significant effect on pro-cyclicality, and that most of the effect occurs through the spending side. More precisely, our results show that Corruption, Rule-of-Law, Net Inflows, Financial Openness and Fiscal Rules introduced since 2009, significantly affect spending pro-cyclicality via the speed of adjustment to budget unbalances.

The policy implications that arise from these findings are the following. First, based on our results for institutional quality, it seems necessary to impulse legal reforms that reduce corruption in order to reduce spending pro-cyclicality. This needs to be couple by improvements in implementation of law, more legislation without appropriate enforcement will not translate into less corruption, and furthermore, Rule-of-Law in general also helps to reduce pro-cyclicality. Progress on these two categories has stalled since 2006, hence, a new impulse seems necessary. Second, our results for net inflows and financial openness indicate that a greater degree of openness of the economy increases pro-cyclicality, hence, it seems necessary to adopt a cautious fiscal stance and to managed openness with caution to avoid making governments accounts over-relying on external funds. Third, the success of fiscal rules to recue spending pro-cyclicality need to be heralded to protect and extend them. As the IMF (2015) notes, it seems necessary the introduction of further rules to make spending more accountable to make and to increase the tax-base and reduce oil-revenue dependence. The asymmetry of spending to positive shocks, the over-reaction of revenue during booms, compared to slow-downs, provides an opportunity to reinforce Sovereign Wealth Fund and other cautionary savings measures.

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Appendix A. Data

Table A1 reports the summary of descriptive statistics of z_t variables. They are characterized by long left tail, and only Y_t^{oil} and R_t are normally distributed at the 5% level test.

Table A1. Descriptive statistics

Variables	*Mean*	*Std. deviation*	*Min.*	*Max.*	*Skewness*	*Kurtosis*	*Jarque-Bera P-value*
Y_t^{oil}	6.6331	0.4372	5.3997	7.5273	-0.0872	2.6260	[0.6261]
R_t	11.4454	0.4937	10.2711	12.7758	-0.1736	2.4285	[0.2924]
G_t	11.3360	0.5179	9.4649	12.5812	-0.4433	3.6318	[0.0384]
M_t	13.3738	0.6638	11.9726	14.0694	-0.7694	2.0452	[0.0001]

Fig. A1 compares revenue and spending before and after the Seasonal Adjustment, using X-12-ARIMA, was made. As we can see this smooths outs calendar effects of fiscal policy considerably.

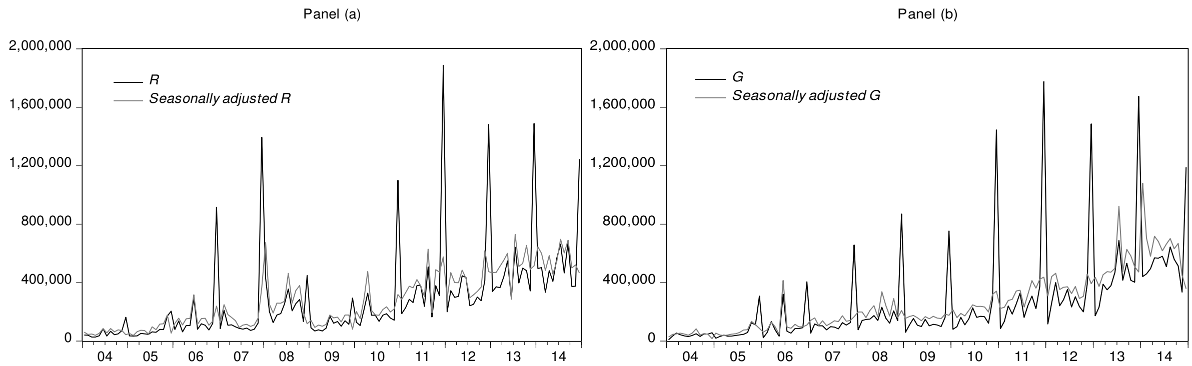

FIGURE A1. Seasonally-Adjusted government revenue and expenditure (millions of AOA)

Table A2. Unit-root tests

Variables	*ADF*		*DF-GLS test*		*KPSS test*	
	Intercept	*Intercept & trend*	*Intercept*	*Intercept & trend*	*Intercept*	*Intercept & trend*
Level						
Y_t^{oil}	-0.05	-2.43	0.32**	-2.02	2.41**	0.34**
R_t	-3.48*	-4.58**	-2.70**	-4.60**	1.67**	0.11
G_t	-2.73	-3.55*	0.01**	-1.85	2.62**	0.17*
M_t	-2.64	-0.80	0.65**	-0.51	3.06**	0.82**
1st differences						
ΔY_t^{oil}	-3.93**	-4.16**	-2.09*	-2.80	0.15	0.04
ΔR_t	-11.58**	-11.54**	-6.22**	-9.01**	0.03	0.03
ΔG_t	-4.03**	-4.05**	-0.33	-2.59	0.15	0.06
ΔM_t	-3.32*	-4.20**	-1.45	-3.69**	1.16**	0.11

Note: Number of lags selected by AIC: 6 (Y_t^{oil}), 1 (R_t), 11 (G_t) and 4 (M_t). ADF critical values at 1% and 5% with intercept: [-3.50/ -2.89], and with intercept and trend: [-4.03/ -3.45]. DF-GLS critical values at 1% and 5% with intercept: [-2.60(all variables)/ -2.04 (Y_t^{oil}), -2.07(R_t), -1.98(G_t), -2.05(M_t)], and with intercept and trend: [-3.54 (all variables)/ -2.91 (Y_t^{oil}), -2.98(R_t), -2.81(G_t), -2.94(M_t)]. KPSS critical values at 1% and 5% with intercept: [0.74/ 0.46], and with intercept and trend: [0.22/ 0.15]. * Rejection of null hypothesis at 5% level and ** at 1%.

Table A3. Unit-root tests with breaks I

Variables	*Zivot-Andrews test*					
	Model A, with break in intercept		*Model B, with break in trend*		*Model C, with break in intercept and trend*	
	Break	*t-statistic*	*Break*	*t-statistic*	*Break*	*t-statistic*
Levels						
Y_t^{oil}	2006m11	-3.63	2007m11	-3.91	2008m8	-5.15*
R_t	2008m11	-6.23**	2006m5	-4.81*	2008m11	-6.50**
G_t	2005m8	-4.19	2006m7	-3.72	2008m11	-4.76
M_t	2005m12	-2.25	2008m10	-5.61**	2008m1	-6.35**
1st Differences						
ΔY_t^{oil}	2009m3	-5.31*	2014m5	-5.04**	2009m3	-5.31*
ΔR_t	2008m2	-11.68**	2014m5	-11.51**	2008m2	-11.67**
ΔG_t	2005m1	-16.24**	2014m3	-16.28**	2005m1	-16.93**
ΔM_t	2008m11	-8.89**	2006m1	-7.87 **	2008m11	-9.73**

Note: Critical values for A at 1%, 5% and 10%: [-5.34/ -4.80/ -4.58]. For B at 1%, 5% and 10%: [-4.93/ -4.42/ -4.11]. For C at 1%, 5% and 10%: [-5.57/ -5.08/ -4.82]. * Rejection of null hypothesis at 5% level and ** at 1%.

Table A4. Unit-root tests with breaks II

Variables	*Clemente et al. test*		
	1st Break	*2nd Break*	*t-statistic*
Levels			
Y_t^{oil}	2007m7	2008m6	-3.07
R_t	2005m5	2010m10	-5.56*
G_t	2005m6	2011m7	-4.35
M_t	2005m10	2007m11	-5.60*
1st Differences			
ΔY_t^{oil}	2008m7	2008m11	-6.40*
ΔR_t	2007m10	2007m12	-13.03*
ΔG_t	2004m11	2005m12	-11.85*
ΔM_t	2007m11	2008m9	-14.57*

Note: Critical value at 5% is -5.49. * Rejection of the null hypothesis at the 5%.

Table A5. Johansen Co-integration test

	λ_{trace} *statistic*	λ_{trace} *critical values*		λ_{max} *statistic*	λ_{max} *critical values*	
H_0		*5%*	*1%*		*5%*	*1%*
$r = 0$	126.26	47.21	54.46	60.31	27.07	32.24
$r \leq 1$	65.95	29.68	35.65	50.14	20.97	25.52
$r \leq 2$	15.82**	15.41	20.04	12.64*	14.07	18.63
$r \leq 3$	3.18*	3.76	6.65	3.18	3.76	6.65
$r \leq 4$						

Note: Underlying VAR lag order=3 with unrestricted constant and 130 observations (2004m3–2014m12). ** No-rejection of null hypothesis ($r \leq n$) at 5% level and * at 1%.

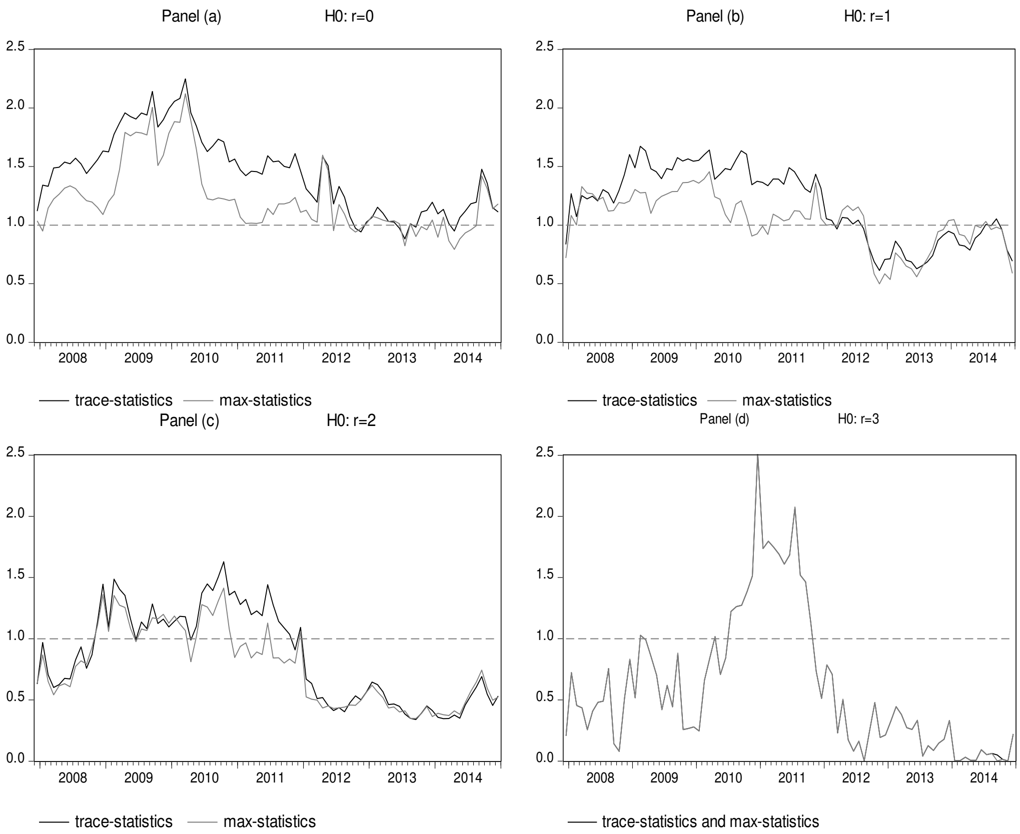

FIGURE. A2. Normalized rolling trace-statistic and max-statistic.
Note: Windows size=48 obs. (85 subsamples). Dates in x-axis denote last month of estimation window.

Appendix B: VECM Post-estimation tests and robustness checks

Table B1. Lagrange-multiplier test for serial correlation

Lag	Chi2	df.	Prob. > chi2
1	22.7549	16	0.1205
2	14.9891	16	0.5254

Table B2. Test for Normality of residuals

Jarque-Bera test

Equation	Chi2	df.	Prob. > chi2
ΔY_t^{oil}	0.134	2	0.9354
ΔR_t	4.809	2	0.0903
ΔG_t	69.613	2	0.0000
ΔM_t	0.827	2	0.6614
All	75.383	8	0.0000

Skewness test

Equation	Skewness	Chi2	df.	Prob. > chi2
ΔY_t^{oil}	-0.0623	0.084	1	0.7726
ΔR_t	0.2251	1.089	1	0.2966
ΔG_t	0.3812	3.124	1	0.0771
ΔM_t	0.1961	0.827	1	0.3632
All		5.124	4	0.2748

Kurtosis test

Equation	Kurtosis	Chi2	df.	Prob. > chi2
ΔY_t^{oil}	3.0965	0.050	1	0.8230
ΔR_t	3.8319	3.720	1	0.0538
ΔG_t	6.5171	66.489	1	0.0000
ΔM_t	3.0064	0.000	1	0.9881
All		70.259	4	0.0000

Table B3. Homoscedasticity of residuals

Joint test:

Chi-sq	df	Prob.
679.2397	650	0.2068

Individual components:

Dependent	R-squared	F(65,63)	Prob.	Chi-sq(65)	Prob.
res1*res1	0.568966	1.279387	0.1639	73.39660	0.2222
res2*res2	0.594297	1.419784	0.0822	76.66429	0.1526
res3*res3	0.682393	2.082441	0.0020	88.02876	0.0302
res4*res4	0.495603	0.952333	0.5777	63.93280	0.5142
res2*res1	0.538978	1.133123	0.3099	69.52820	0.3276
res3*res1	0.404370	0.658006	0.9520	52.16374	0.8750
res3*res2	0.720641	2.500254	0.0002	92.96273	0.0130
res4*res1	0.537296	1.125480	0.3194	69.31121	0.3342
res4*res2	0.499296	0.966506	0.5545	64.40920	0.4974
res4*res3	0.523129	1.063250	0.4040	67.48366	0.3923

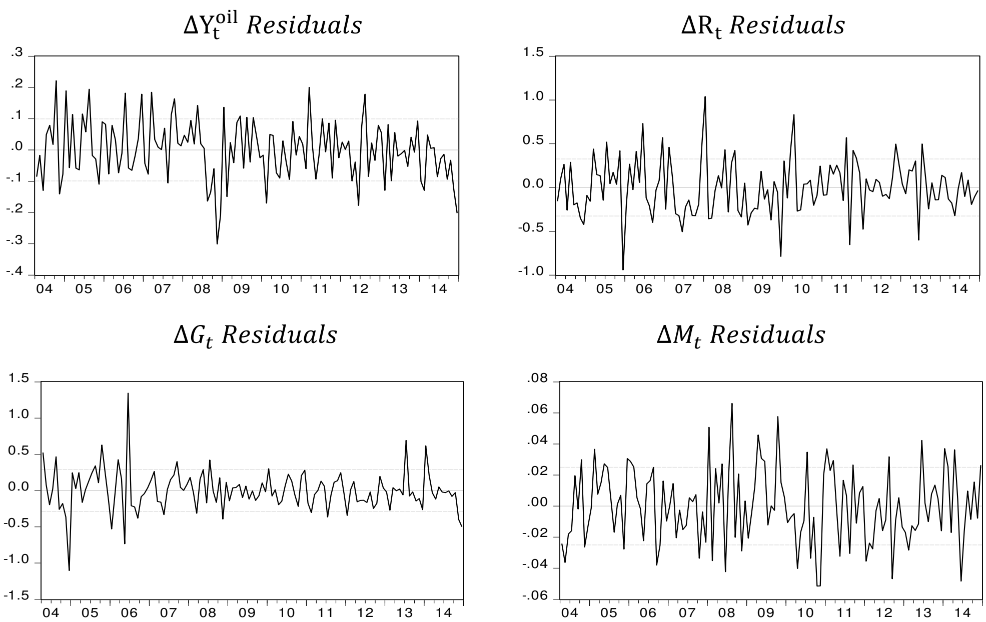

FIGURE B1. Residuals of estimating equation (2)

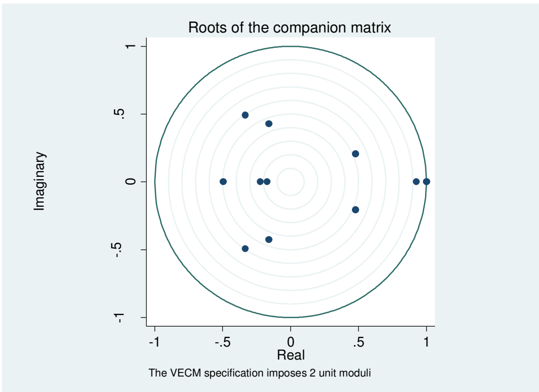

Fig B2. Eigenvalue Stability Condition Test

Table B4. VECM results for lag length n = 1 (SBIC)

	(1) ΔR_t	(2) ΔG_t	(3) ΔM_t	(4) ΔY_t^{oil}
$\hat{\xi}_{1,t}$	-0.527***	0.348***	0.019***	-0.079***
	(-5.45)	(4.23)	(2.56)	(-3.01)
$\hat{\xi}_{2,t}$	0.150***	0.302***	-0.019***	0.002
	(2.82)	(6.64)	(-4.66)	(0.16)
C_0	0.002	-0.000	-0.016***	-0.012
	(0.07)	(-0.00)	(-6.55)	(-1.35)
$\bar{R}^2$	0.222	0.338	0.347	0.079
$\hat{\sigma}$	0.367	0.313	0.028	0.099
X^2	36.32	64.93	67.62	10.96
P-value	[0.000]	[0.000]	[0.000]	[0.012]

Note: The error correction terms are given by:

$$\hat{\xi}_{1,t} = R_t - 0.846G_t - 0.100Y_t^{oil} - 1.183$$

$$\hat{\xi}_{2,t} = M_t - 1.679G_t - 0.618Y_t^{oil} + 9.800$$

Observations=131 in all regressions. ( ) reports *t*-statistics. * Indicates significance at 10%, ** 5% and *** 1%. $\hat{\sigma}$ is standard error of residuals. X^2 is chi-squared statistics from jointly *t*-test on each regression.

Appendix C: Impulse response and Variance decomposition

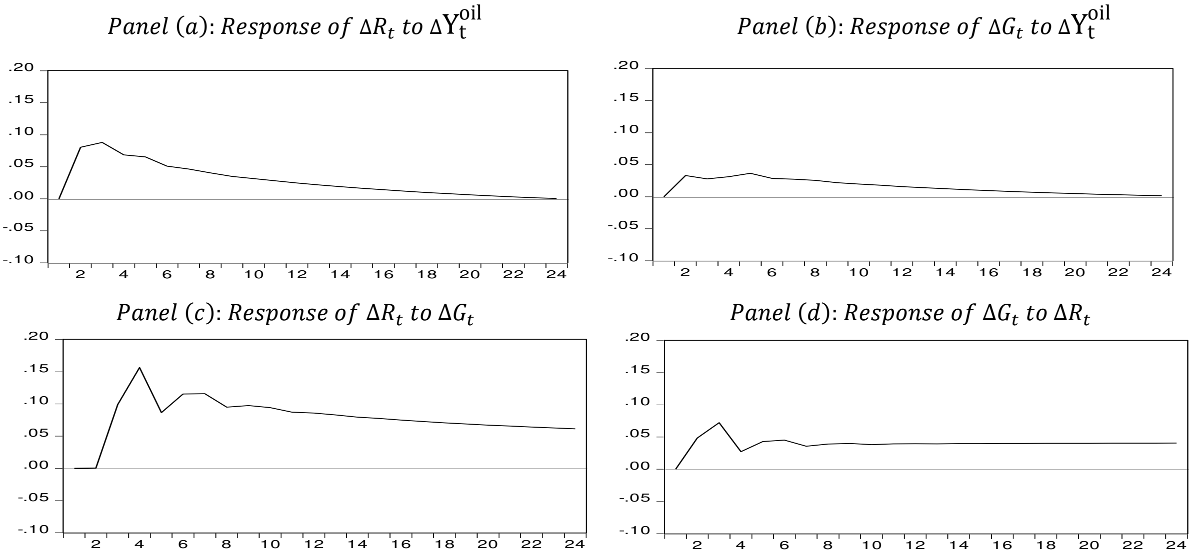

FIGURE C1 - IRF of government revenue and expenditure to a unit shock on ΔY_t^{oil}, ΔR_t and ΔG_t.

Table C1. Forecast error variance decompositions for 20 periods ahead

Error in:	No. of periods	Innovation in:			
		ΔY_t^{oil}	ΔR_t	ΔG_t	ΔM_t
ΔR_t	1	0.0037	0.9963	-	-
	4	0.1365	0.7102	0.1422	0.0111
	8	0.1609	0.5945	0.2304	0.0142
	12	0.1559	0.5554	0.2745	0.0142
	16	0.1473	0.5410	0.2978	0.0139
	20	0.1383	0.5362	0.3119	0.0136
ΔG_t					
	1	0.0177	0.1448	0.8375	-
	4	0.0536	0.2426	0.6988	0.0050
	8	0.0759	0.2922	0.6242	0.0077
	12	0.0772	0.3215	0.5936	0.0077
	16	0.0736	0.3445	0.5744	0.0075
	20	0.0690	0.3637	0.5600	0.0072

Appendix D: TVECM asymmetric effects, Post-estimation tests

Table D1. Asymmetric TVECM

	$I^{s}_{f=1}$		$I^{s}_{f=2}$		$I^{s}_{f=3}$	
	ΔR_t	ΔG_t	ΔR_t	ΔG_t	ΔR_t	ΔG_t
	(1)	(2)	(3)	(4)	(5)	(6)
N	129	129	129	129	129	129
$\bar{R}^2$	0.44	0.49	0.48	0.49	0.50	0.49
χ^2 SC(2)		23.56		41.42		32.46
		[0.545]		[0.246]		[0.638]
χ^2 SC(4)		21.29		33.25		28.15
		[0.676]		[0.600]		[0.822]
χ^2 Norm(1)	4.81	57.02	16.86	0.20	4.29	0.57
	[0.090]	[0.000]	[0.000]	[0.904]	[0.117]	[0.752]

SC tests refer to the system, Norm, refer to the regression on the heading.

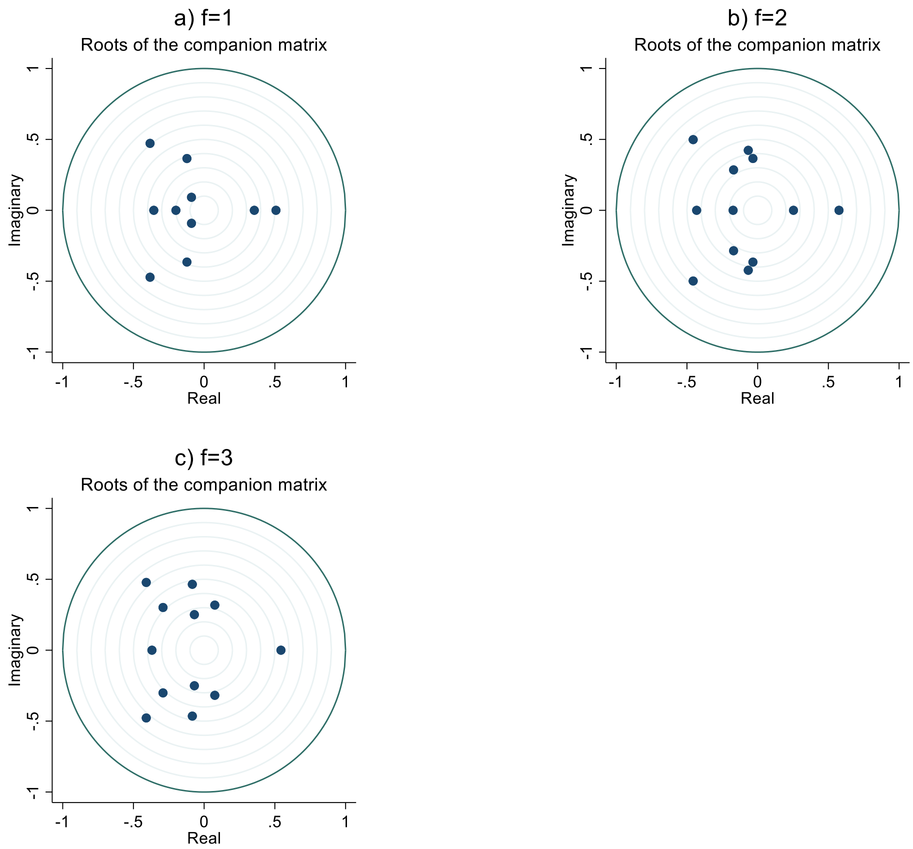

Fig D1. Eigenvalue Stability Condition Test

Appendix E: TVECM institutional effects, Post-estimation tests

Table E1. TVECM Quality of institutions

	$in = \Delta co$		$in = \Delta ro$		$in = \Delta ge$	
	ΔR_t	ΔG_t	ΔR_t	ΔG_t	ΔR_t	ΔG_t
	(1)	(2)	(3)	(4)	(5)	(6)
N	129	129	129	129	129	129
$\bar{R}^2$	0.44	0.54	0.47	0.56	0.44	0.50
χ^2 SC(2)		19.54		28.44		17.65
		[0.771]		[0.288]		[0.857]
χ^2 SC(4)		16.60		14.46		8.48
		[0.896]		[0.953]		[0.999]
χ^2 Norm(2)	6.77	57.02	2.05	31.62	5.86	99.56
	[0.034]	[0.000]	[0.359]	[0.000]	[0.054]	[0.000]

SC tests refer to the system, Norm, refer to the regression on the heading.

Table E2. TVECM Fiscal Policy room

	$in = \Delta d$		$in = \Delta nf$		$in = \Delta da$	
	ΔR_t	ΔG_t	ΔR_t	ΔG_t	ΔR_t	ΔG_t
	(1)	(2)	(3)	(4)	(5)	(6)
N	129	129	129	129	129	129
$\bar{R}^2$	0.44	0.49	0.45	0.53	0.45	0.51
χ^2 SC(2)		22.44		27.05		21.94
		[0.610]		[0.354]		[0.639]
χ^2 SC(4)		15.86		17.31		18.27
		[0.919]		[0.870]		[0.831]
χ^2 Norm(2)	2.26	47.91	3.39	41.32	4.67	26.09
	[0.323]	[0.000]	[0.184]	[0.000]	[0.097]	[0.000]

SC tests refer to the system, Norm, refer to the regression on the heading.

Table E3. TVECM Access-to-credit

	$in = \Delta cr$		$in = \Delta re$		$in = fo$	
	ΔR_t	ΔG_t	ΔR_t	ΔG_t	ΔR_t	ΔG_t
	(1)	(2)	(3)	(4)	(5)	(6)
N	129	129	129	129	129	129
$\bar{R}^2$	0.45	0.49	0.46	0.49	0.44	0.53
χ^2 SC(2)		16.11		24.10		27.86
		[0.911]		[0.514]		[0.314]
χ^2 SC(4)		11.88		11.72		30.83
		[0.987]		[0.989]		[0.195]
χ^2 Norm(2)	3.79	63.23	4.61	59.00	5.10	27.63
	[0.151]	[0.000]	[0.100]	[0.000]	[0.078]	[0.000]

SC tests refer to the system, Norm, refer to the regression on the heading.

Table E4. TVECM Fiscal Rules

	$in = fr1$		$in = fr2$	
	ΔR_t	ΔG_t	ΔR_t	ΔG_t
	(1)	(2)	(3)	(4)
N	129	129	129	129
$\bar{R}^2$	0.44	0.50	0.44	0.49
χ^2 SC(2)		17.92		15.12
		[0.846]		[0.939]
χ^2 SC(4)		9.93		10.21
		[0.997]		[0.996]
χ^2 Norm(2)	2.95	60.45	4.26	73.96
	[0.228]	[0.000]	[0.119]	[0.000]

SC tests refer to the system, Norm, refer to the regression on the heading.

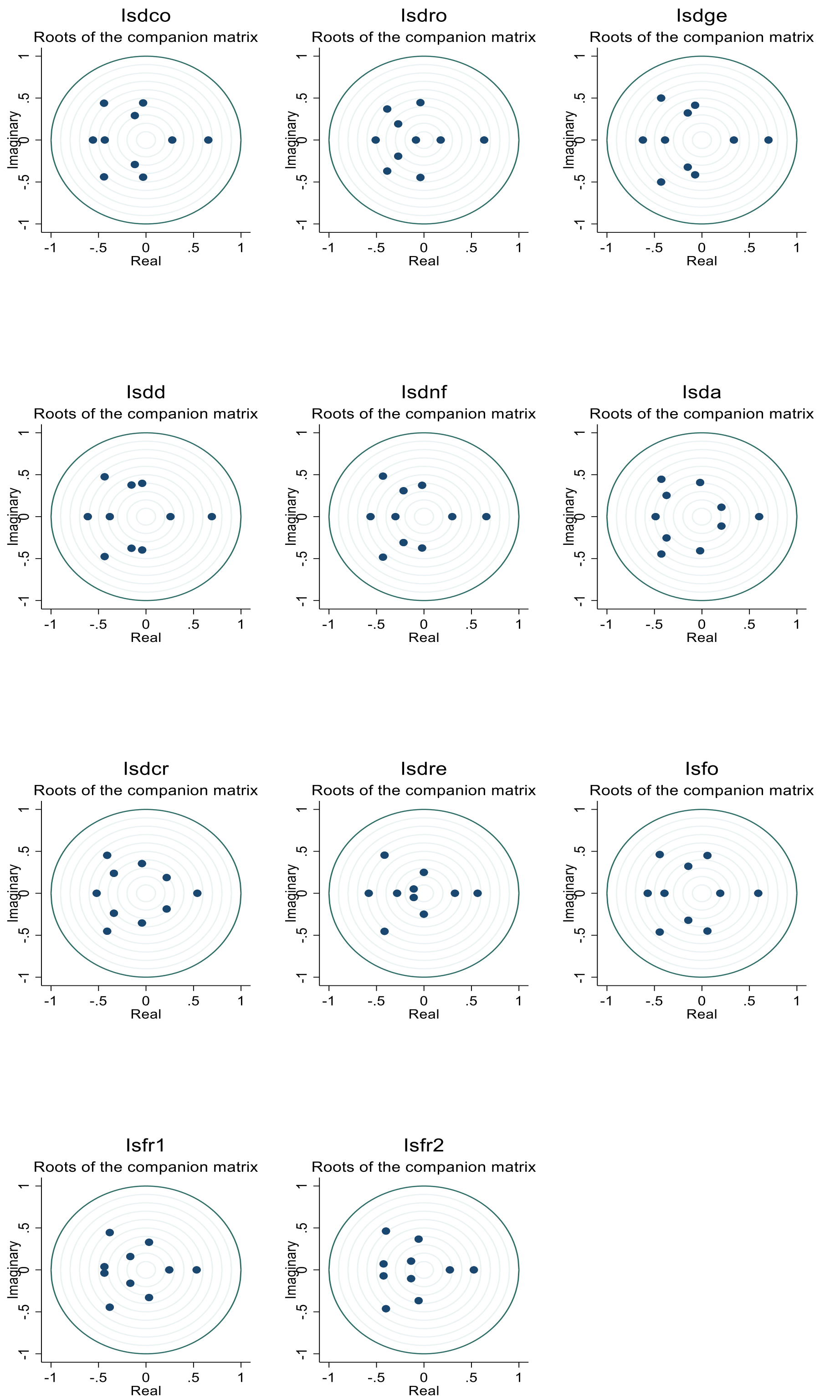

Fig E1. Eigenvalue Stability Condition Test