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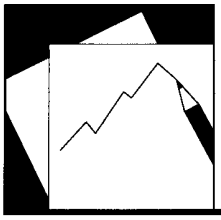

IMF Working Paper

The Linkage between the Oil and the Non-oil Sectors—A Panel VAR Approach

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The Linkage between the Oil and Nonoil Sectors – A Panel VAR Approach

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Abstract

Recent empirical studies have shown an inverse relation between natural resource intensity and long-term growth, implying that the natural resources generally impede economic growth through various channels (the "natural resource curse"). This paper departs from these studies by exploring the inter-sectoral linkages between oil and non-oil sectors in a cross-country perspective. The paper shows that the applicability of "natural resource curse" across oil-based economies should be treated with caution as the externalities of the oil sector highly depend on the countries' degree of oil-intensity. In particular, the results show that, in low oil-intensity economies, the incentives to strengthen both fiscal and private sector institutions lead to positive inter-sectoral externalities. In contrast, weaker incentives in high oil-intensity economies adversely affect fiscal and private sector institutions and consequently lead to negative inter-sectoral externalities.

JEL Classification Numbers: C33, O13, Q32, Q33

Keywords: Panel VAR, natural resources, inter-sectoral linkages, real effective exchange rate.

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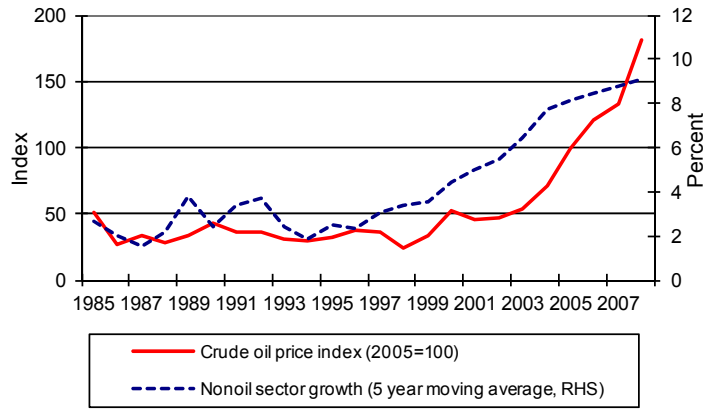
INTRODUCTION[1]

1. **Commodity exporters, particularly oil exporting countries, had largely benefited from the pre-crisis boom in commodity prices.** With the increased global demand for oil and the acceleration of oil prices in recent years, many oil exporters recorded impressive economic growth and substantially strengthened their fiscal and external positions. The improved economic fundamentals reduced the countries' vulnerability to adverse shocks and contributed to increased foreign investment. While in many of these countries, the overall economic growth was led by the prosperity in the oil sector, the non-oil sector growth accelerated as well, taking advantage of the improved economic conditions (Figure 1).

Figure 1 - Crude oil price index and the nonoil sector growth in seleced oil exporters



Source: World Economic Outlook and staff calculations.

2. **In general, the prosperity in the oil sector is likely to have positive externalities on economic activity.** Theoretically, at least, economies that are abundant in natural resources are expected to grow faster than other economies as the increase in wealth should raise investment and promote higher development of human capital. However, much of the recent empirical evidence supports an inverse relation between natural resource intensity and growth, implying that natural resources impede economic growth (the "natural resource curse").[2,3]

3. **The natural resource curse seems to work through several economic channels.** Among others, these channels include the susceptibility to the effects of the Dutch Disease.[4]

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[1] The author thanks Inessa Love and Lea Zicchino for the use of their panel VAR program.

[2] See for instance, Sachs and Warner (1995), Ross (1999), Sala-i-Martin and Subramanian (2003), Murshed (2004), Iimi (2007), Leite and Weidman (1999), Isham et al (2004) and Bhattacharya and Ghura (2006).

[3] One of the most comprehensive studies is the one by Sachs and Warner (1995). By examining 97 countries between 1971 and 1989, they show that states with a high ratio of natural resources exports to GDP in 1971 had abnormally slow growth rates even after controlling for initial per capita income, trade policy, investment rates, region, bureaucratic efficiency, terms of trade volatility and income distribution.

[4] The Dutch disease refers to a situation where the non-natural resource tradable sector is being crowded out by a real exchange rate appreciation and/or by the *resource pull effect* (factor remuneration in the booming natural resource sector lure workers and capital away from the other sectors.

This outcome, combined with the notion that the tradable sector is the one through which the technological innovations are percolating to the economy, leads to the outcome that natural resource ownership puts a drag on the long term growth of the non-oil sector. Additionally, natural richness normally produces a highly concentrated structure of the economy, which exposes countries to volatility in commodity prices and thus may result in lower investment and growth.[5] Another set of arguments suggests that natural resource abundance may lead to poor economic policies resulting from overconfidence in the economy. This leads to lower fiscal discipline and relieves policymakers from taking appropriate but sometimes unpopular economic decisions (Iimi, 2007). In addition to these channels, Ross (1999) attributes part of the natural resource curse to the state's ownership of the resource industries. In particular, he argues that the parastatals tend to soften the budget constrains in addition to their inefficiency in managing and investing natural resource revenues.

4. **Several political-economy channels have been identified as well.** These channels include the tendency for rent-seeking behavior (*Rentier Effect*), which is an important factor in determining a country's level of corruption and the quality of institutions.[6] The adverse effects of corruption on investment and growth are demonstrated in Shleifer and Vishny (1993), Mauro (1995), and Leite and Weidman (1999).[7] Isham et al (2004) also argue that natural resource abundance may lead to lower growth through *Delayed Modernization and Entrenched Inequality Effects*.[8] Related to this line of arguments, Collier and Hoeffler (2005) indicate that countries with an abundance of natural resources are more prone to violent conflicts partly because they often rely on a system of patronage and do not develop a democratic system based on electoral competition, scrutiny and civil rights.[9]

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[5] Manzano and Rigobon (2001) show that the 1980s debt crisis triggered by a significant reduction in commodity prices, can explain a large part of the negative effect of resource abundance on economic growth.

[6] The *Rentier Effect* refers to the adverse impact of resource abundance on institutions' quality. More specifically, it refers to a situation where because of their high earnings from natural resources, resource-dependent countries have less need for tax revenues and are therefore relatively relieved of accountability pressures. Additionally, with the windfall of revenues, the governments can mollify dissents through a variety of mechanisms, including buying off critics, providing the population with benefits, infrastructure project while having the resources to pursue direct repression and violence against dissenters (Isham et al, 2004).

[7] In a theoretical model, Leite and Weidman (1999) demonstrate that the opportunity costs of corruption are higher in labor-intensive industries rather than in capital-intensive sectors, suggesting that corruption is more likely in capital-intensive sectors such as the oil sector.

[8] The *Delayed Modernization* and *Entrenched Inequality* effects refer to a situation where an elite that controls natural resources would resist industrialization or reforms that would diversify the economy because it fears could create several alternative sources of power that would compete over the natural resource revenues.

[9] Auty (1997) argues that the type of the natural resources is what matters for growth. In his view, there is a greater chance of a vicious cycle of mismanagement, rent-seeking and conflict in countries, in which resources are concentrated and hence can be more easily expropriated (such as oil and minerals and unlike agriculture).

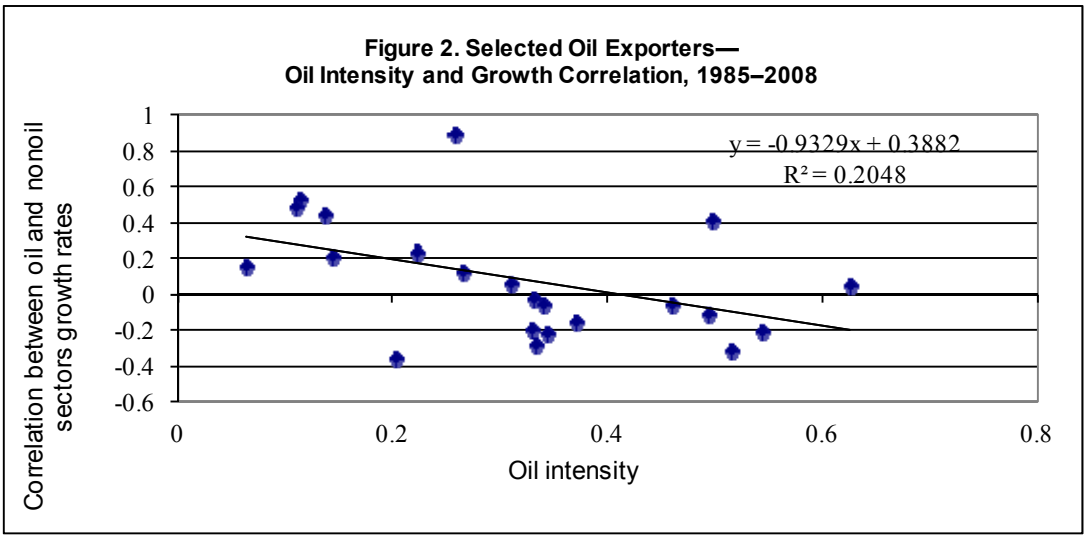
5. **While providing a comprehensive set of channels, most of the empirical studies mainly look at the impact of the natural resource abundance on the overall and long-term economic growth** and not directly at the interactions between the natural resource sector and the other sectors in the economy. Among the few studies that look at the inter-sectoral linkages is the paper of Bhattacharya and Ghura (2006), which focuses exclusively on the Republic of Congo, and finds that while the oil sector does not have a direct impact on the non-oil sector growth it may have had indirect effects through political instability and real exchange rate movements. Fiess and Verner (2003) examined the intersectoral linkages in the Ecuadorian economy and found that the oil sector is co-integrated with the public sector, and the transportation and communication sectors.[10]

6. **The current paper departs from existing studies by looking at the intersectoral linkages between oil and non-oil sectors in a cross-country perspective.** More specifically, the analysis examines to what extent the growth rates of both sectors are linked, taking into account the real exchange rate channel. This study differs from the existing research by focusing solely on oil exporters and by using a methodology of Panel Vector Auto-Regression (PVAR) framework, which allows following the dynamics of the variables without assuming concrete structural economic framework. The estimation results largely support the "natural resource curse", but only in the high oil-intensity countries. In this group of countries, the estimations suggest that a one percent growth of the oil sector leads, on average, to an accumulated decline of 0.15 percent in the non-oil sector within two years. Unlike in high oil-intensity countries, the estimation results show that, in low oil-intensity countries, the oil sector has positive externalities on the non-oil sector, despite the adverse effect of the REER appreciation caused by the oil sector growth. The results also show that in low oil-intensity countries, there is also positive and significant impact of the non-oil sector on the oil sector. The analysis also looks at Angola specifically and finds that, although Angola is among the highest oil-intensity countries in the sample, there is a positive link between the oil and the non-oil sectors, perhaps reflecting the unique circumstances of the country.

[10] In their view, the link of the oil sector with the public sector indicates the capitalization of the public sector through rent from nationalized oil production while the link with the transportation and communication stems from subsidized combustibles.

I. SOME STYLIZED FACTS

7. **The oil intensity among the selected oil exporters[11] is not homogeneous but varies across a fairly wide range.[12]** As it ranges from an average of 6 percent (Chad) to nearly 63 percent (Libya), the interaction between the oil on the non-oil sectors may differ from country to country. Figure 2, which shows how the correlation between oil and non-oil sectors growth rates varies with oil intensity, validates this hypothesis. The negative link between the two variables may suggest that, on average, in countries with relatively low oil intensity, there are positive externalities between the two sectors, while, in countries with higher oil intensity, externalities are negligible or even negative.



8. **The evolution of growth over the sample period (1985-2008) broadly supports this negative relationship.** Figure 3a, which shows the non-oil and oil sectors growth rates among the low oil-intensity countries, demonstrates the high correlation of the two sectors' growth (0.67).[13] This correlation is more than three times higher than the correlation of the non-oil and oil sectors growth in high oil-intensity countries (Figure 3b).

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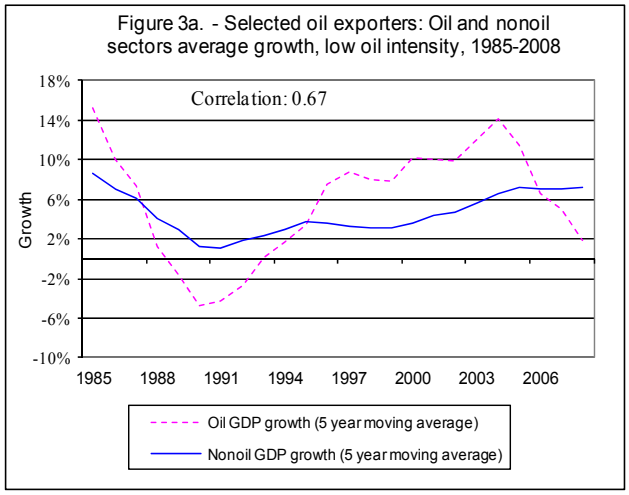
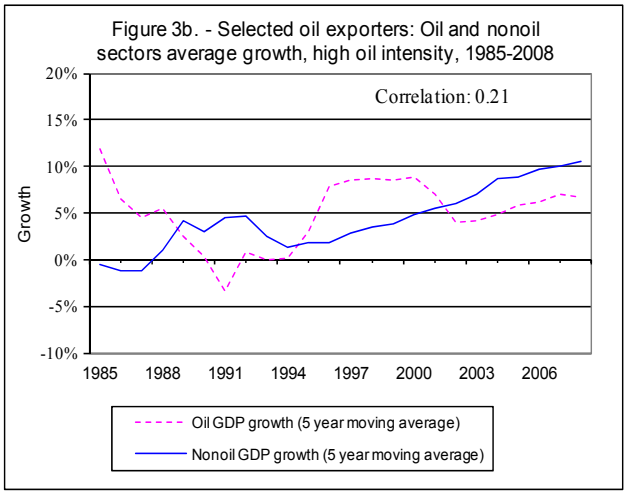
[11] The sample includes 23 oil exporting countries (Algeria, Angola, Azerbaijan, Bahrain, Cameroon, Chad, Congo, Equatorial Guinea, Gabon, Indonesia, Iran, Kazakhstan, Kuwait, Libya, Nigeria, Oman, Qatar, Saudi Arabia, Syria, Turkmenistan, United Arab Emirates, Venezuela and Yemen).

[12] Oil intensity is calculated as the average share of oil GDP in total GDP (constant prices) over a period 1985–2008.

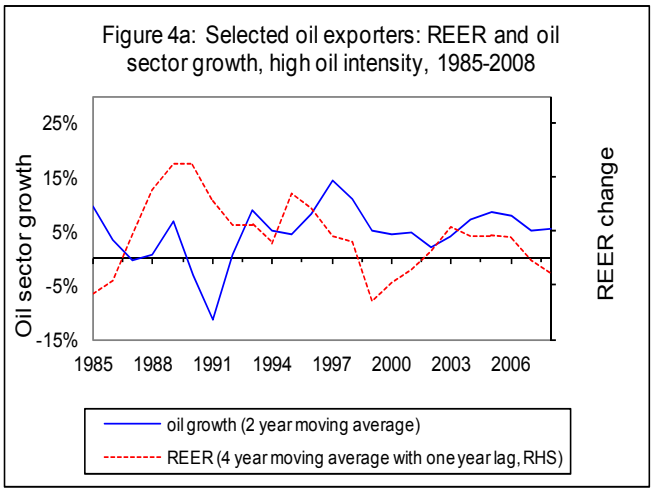
[13] Low oil-intensity countries are defined as countries with an average (over the sample) weight of oil GDP in total GDP (in constant prices) below the sample's median observation (11 countries), while countries with an average weight of oil GDP in total GDP above the sample's median observation are defined as high oil-intensity countries (12 countries).

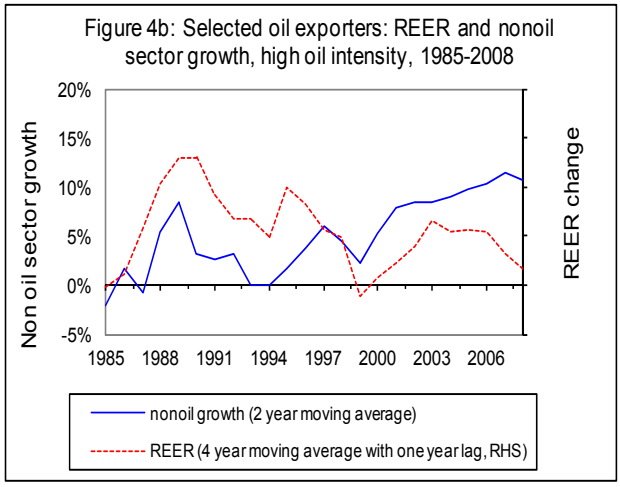




*Sources: WEO and IMF staff calculations.

9. **The difference in the correlations may suggest that the adverse effects of the natural resource curse are taking place mainly in the high oil-intensity countries,** while, in low oil-intensity countries, the positive externalities dominate. As mentioned above, one of the natural resource curse channels is the real exchange rate and its impact on the economic performance of non-oil sector. Figure 4a indeed shows that, in the group of high oil-intensity countries, the real effective exchange rate (REER) cycles and the oil sector growth cycles are moving in opposite directions such that the REER tends to appreciate (depreciate) when the oil sector growth accelerates (decelerates). In contrast, the REER cycles and non-oil sector growth cycles seem to move together (Figure 4b).

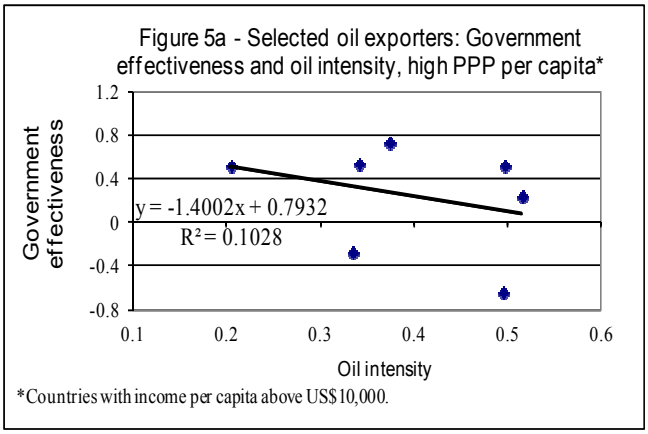


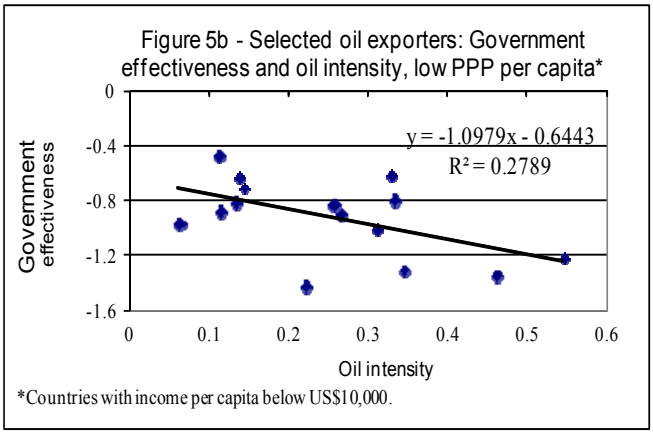


*Sources: WEO and IMF staff calculations.

10. **Given the public sector dominance in many of the selected oil exporters, an important channel through which the oil sector may affect the non-oil sector is the country's fiscal operations.** In this regard, if the windfall of oil revenues is used in a prudential manner, by directing public spending to investment in infrastructure and human capital in line with the economy's absorption capacity, oil revenues can have positive externalities on the non-oil sector. On the other hand, inefficient use of oil revenues, which may lead to increased inflationary pressures if output is close to potential, sharp real exchange rate appreciation, a decline in the marginal efficiency of capital and a non-sustainable fiscal stance, is likely to have adverse effects on the economy as a whole, particularly as it increases the countries' vulnerability to external shocks, impairs external competitiveness and discourages foreign investment.

11. **In an effort to cope with volatility in oil prices and thus reduce the vulnerability to external shocks, many oil exporters have established Special Fiscal Institutions (SFIs)** aimed at enhancing fiscal management and helping to achieve broader fiscal policy objectives. While SFIs include various mechanisms to mange oil revenues (oil funds, fiscal rules, fiscal responsibility legislation and budgetary oil prices), they are not a panacea and their quality and effectiveness vary from country to country (Ossowski et al, 2008). One of the common proxies to measure the quality of government spending is the World Bank's "government effectiveness" indicator (Kauffmann et al, 2008). This indicator measures the public perception about the quality of civil service and the degree of its independence from political pressures, the quality of policy formulation and implementation and the credibility of the government's commitment to such policies. Controlling for the income level, this indicator shows that the government effectiveness tends to be lower in countries with high oil-intensity, implying that the effectiveness of the SFIs and their quality may be higher in low oil-intensity countries (Figure 5a and Figure 5b).[14] Given that in low oil-intensity economies the SFIs



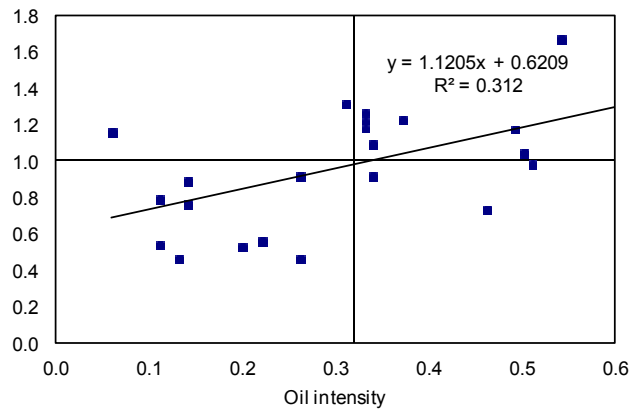


Source: World Bank governance indicators and IMF staff calculation (detailed information appears in Table A.7 in the Appendix).

[14] The indicator is based on 2007 data. It is measured in units ranging from about -2.5 to 2.5, with higher values corresponding to better government effectiveness.

effectiveness is relatively high, these economies have kept their non-oil primary fiscal balances broadly in line with their sustainable levels (Figure 6). One possible explanation for these observations may relates to the government's over-confidence in the economy and the belief that oil revenues windfall will last for a long period. Another explanation could be that, in high oil intensity countries where oil revenues account for the lion share of the government's total revenues and income taxes are generally low, the public is likely to put less pressure on the government to strengthen its fiscal institutions.

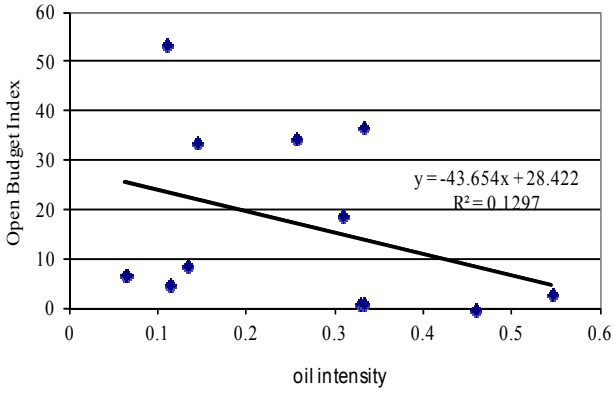
Figure 6. Selected Oil Exporters: Fiscal Sustainability Ratios and Oil Intensity[1]



[1]The sustainability ratios are computed as the ratio of actual primary expenditure relative to sustainable primary expenditure. In the chart, countries with a value more than 1 would have to reach the sustainable benchmark.

12. **Another indicator that may reflect the quality of public finance is budget transparency.** Greater transparency allows stronger public and parliamentary oversight, thus improving accountability and governance, and it enhances public understanding of reforms and support for policies, which helps achieving lower budget deficits, more macroeconomic stability, and higher growth. Additionally, greater transparency improves the environment for investment (domestic and foreign) and confidence of donors in government policies. Although available for only 12 countries in the sample, the open budget index (OBI), calculated by the International Budget Partnership is negatively correlated with oil intensity, suggesting that the lower transparency and the quality of public spending in high oil-intensity countries may have adverse effects on the non-oil sector development (Figure 7).[15]

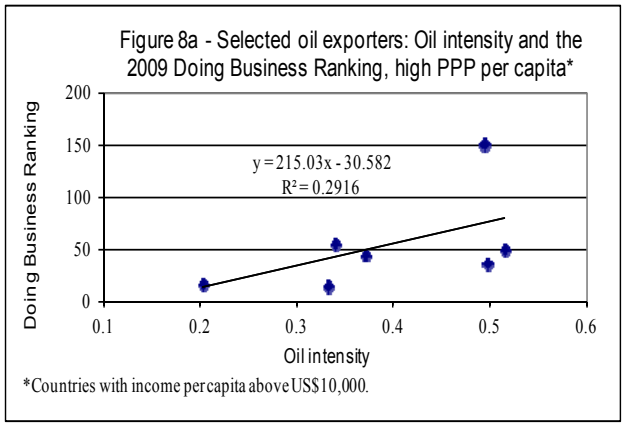
Figure 7 - Selected oil exporters: Budget tranparency and oil intensity

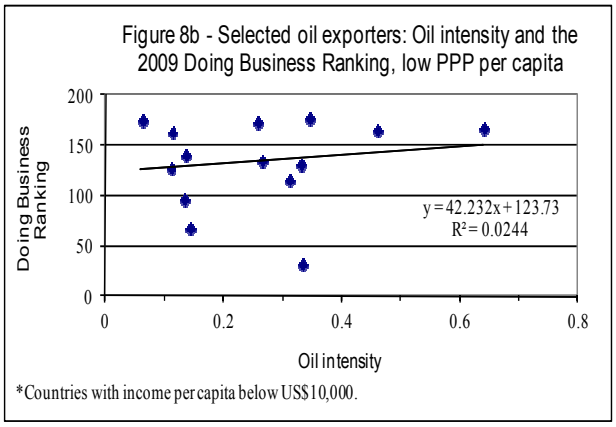


*Sources: International Budget Partnership and IMF staff calculations.

[15] The OBI assigns a score to each country based on the information it makes available to the public throughout the budget process. See http://www.openbudgetindex.org/index.cfm?fa=rankings.

13. **The business climate is an additional channel in which the natural resource curse may adversely affect the non-oil sector.**[16] The latter can be proxied by the Doing Business ranking, although this ranking is mainly focused on the regulatory framework. Figure 8a and 8b, which are used to control for the level of the countries' development,[17] indeed show a positive link between the oil intensity and the countries' ranking suggesting that in high oil intensity countries the incentives to improve the business climate are rather weak.





*Source: World Bank's 2009 Doing Business Report and IMF staff calculations (detailed information appears in Table A.7 of the Appendix).

II. Data and Methodology

14. **The study uses annual data for 1985–2008 for 23 developing countries that are oil exporters,** where for twenty of them, the main export earning stems from oil.[18] Summary statistics, which describe the oil and non-oil sectors growth and the change in the REER, are provided in the Appendix (Table A.1). They show that, on average, the non-oil and oil sectors grew at a similar pace (5.6 percent and 5.8 percent, respectively), although the high standard deviation of the oil sector growth implies that it had changed significantly between countries and over the sample period. The real effective exchange rate depreciated by 2.2 percent on average. The correlation matrix (Table A.2) shows that overall there is a positive correlation between the non-oil and the oil sectors growth and that the non-oil and oil sectors are positively correlated with the REER, although the correlation of the latter and the oil

[16] Based on a cross-country analysis Iimi (2007) concludes that the degree of which natural resources affect growth depends on the level of governance.

[17] It is reasonable to believe that in countries with high level of development, the institutional quality is, on average, higher than in less developed countries, see Isham (2004). The level of development is proxied by the income per capita in PPP terms.

[18] According to the definition of the April 2009 World Economic Outlook (WEO). In addition, the sample includes Indonesia, which was an OPEC member until 2008, Chad and Cameroon. Advanced oil exporters such as Norway, Mexico and Russia were excluded from the sample as they are at different stage of development and policy implications may not be valid for them.

sector growth is small. The alternative tests for unit root unanimously reject the null hypothesis that the variables have a unit root (Table A.3).

	Table 1: Selected oil exporters – Oil intensity statistics[1], 1985-2008				
		Average	Min	Max	2008
High	Libya	0.63	0.57	0.71	0.57
	Angola	0.54	0.24	0.67	0.57
	Kuwait	0.51	0.34	0.67	0.39
	Qatar	0.50	0.40	0.58	0.52
	Gabon	0.49	0.44	0.54	0.44
	Equatorial Guinea	0.46	0.00	0.84	0.64
	United Arab Emirates	0.37	0.24	0.58	0.24
	Congo	0.34	0.28	0.47	0.30
	Oman	0.34	0.24	0.40	0.24
Median	Algeria	0.33	0.29	0.35	0.29
	Azerbaijan	0.33	0.20	0.53	0.53
	Saudi Arabia	0.33	0.23	0.39	0.31
	Nigeria	0.31	0.17	0.46	0.17
	Syria	0.26	0.12	0.36	0.12
	Venezuela	0.26	0.23	0.28	0.23
	Turkmenistan	0.22	0.18	0.25	0.18
	Bahrain	0.20	0.12	0.25	0.12
	Iran	0.14	0.10	0.17	0.10
	Kazakhstan	0.14	0.10	0.18	0.16
Low	Yemen	0.13	0.08	0.16	0.08
	Cameroon	0.11	0.05	0.17	0.05
	Indonesia	0.11	0.07	0.14	0.07
	Chad	0.06	0.00	0.32	0.22

* Source: WEO and IMF staff's calculations.

[1] The countries are sorted according to their average level of oil intensity. Some of the average values are based on a different sample length, depending on data availability.

15. **As the interaction between the non-oil and oil sectors may differ in low and high oil intensity economies, the analysis separates the sample into two sub-samples.** We refer to these two groups as *High* (oil intensity) and *Low* (oil Intensity). The *Low* sub-sample consists of countries in which the oil-intensity is below the sample's median (33 percent), while the *High* sub-sample consists of countries in which the oil intensity is above sample's median. It is worth noting that the composition of countries in the two sub-sample is not fixed but changes over time according to the countries' evolution of oil intensity. Among the twenty-three countries in the sample, nine countries were constantly below the 33 percent threshold and four countries were constantly above the threshold. Other countries shifted between the two samples as the share of oil sector GDP in total GDP changed over the years (Table 1).

16. **For each group, the analysis uses a Panel Vector Auto-Regression (PVAR) methodology**. This technique combines the traditional VAR approach, which treats all the variables in the system as endogenous, with a panel data approach, which allows for unobserved individual heterogeneity. The advantage of the VAR approach is that it does not require any a priori assumptions on the direction of the feedback between variables in the model. The panel VAR is computed from a program written by Inessa Love and is based on the following model incorporating fixed effects:[19]

$$Y_{it}^{j} = \Gamma_0 + \sum_{s=1}^{n} \Gamma_s Y_{i,t-s} + f_i + e_{it} \quad , \quad Y_{it}^{j} = \begin{bmatrix} oy_{it}^{j} \\ noy_{it}^{j} \\ rer_{it}^{j} \end{bmatrix} \quad , \quad j=High,\ Low \qquad (1)$$

where Y_{it} is a vector of the three endogenous variables {*oy, noy, rer*} for country *i* and year *t*. the variable *oy* is the oil sector growth rate (in real terms), *noy* is the non-oil sector growth rate (in real terms), and *rer* is the change in real effective exchange rate. This framework, which allows producing impulse response functions, will be useful to trace the direct effects from the oil to non-oil sectors (and vice versa), and identify the indirect effects that may work through the real exchange rate. The countries' specifics are captured in this framework in the fixed effect variable, denoted in the model by f_i.[20] Since the fixed effects are correlated with the regressors due to lags of the dependent variable, the analysis uses a forward mean-differencing (Helmert procedure), which removes the mean of all forward future observations available for each country-year (Arellano and Bover, 1995).[21]

17. **The dynamic behavior of the model is assessed using impulse response functions,** which describe the reaction of one variable in the system to innovations in another variable in the system while holding all other shocks at zero.[22] The shocks in the VAR were orthogonized using Cholesky decomposition, which implies that variables appearing earlier in the ordering are considered more exogenous, while those appearing later in the ordering are considered more endogenous. In this specification, it is likely that the oil sector growth is the most exogenous variable, with the global markets largely determining the demand (production) and prices. The oil sector is followed by the non-oil sector growth and REER. The assumption here is that companies in the non-oil sector react to REER with some delay, after they realize that the change in the REER has a permanent nature and it is likely to affect their competitiveness for a prolonged period.

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[19] Love, Inessa, and Zicchino, Lea (2006).

[20] One of the main caveats in this approach is that it assumes that the country's special characteristics are fixed over time.

[21] This transformation preserves the orthogonality between the transformed variables and lagged regressors. The estimation uses lagged regressors as instruments and estimate the coefficient by GMM methodology.

[22] Monte Carlo simulations are used to generate the confidence intervals.

III. Estimation Results[23]

A. Low Oil-intensity Countries

18. **The estimation's results show that, in contrast to the "natural resource curse hypothesis", in the *Low oil-intensity* group, the oil sector growth has a significant and positive impact on the non-oil sector growth (Table A.4).** More specifically, the estimated coefficient implies that a one percent growth in the oil sector leads, on average, to a 0.1 percent growth in the non-oil sector within one year. This positive impact is validated by the impulse response functions (IRFs) in Figure 9 below. Although, the fiscal channel is not explicitly modeled in the VAR system, these results suggest that SFIs, which have been generally effective in low oil intensity economies, might be one of the factors that generate positive externalities to the non-oil sector and by extension promote growth in those economies.

19. **Interestingly, the estimation, supported by the IRFs, shows that, in the *Low oil-intensity* group, the non-oil sector has a positive impact on the oil sector.** The estimated coefficient shows that a one percent growth in the non-oil sector leads, on average, to a 0.26 percent growth in the oil sector in the subsequent year. This impact, which implies that the contribution of the non-oil sector to the oil sector is even higher than the contribution of oil sector on the non-oil sector, is in line with the dominance of the non-oil sector in these economies. A possible explanation for this positive link could be greater government investment in the oil sector and/or in infrastructure in general, which may facilitate greater foreign investment. While the IRFs show that a shock in both sectors leads to an appreciation of the REER, there are no indications that REER movements have significant effects on the growth of both oil and non-oil sectors.

20. **The panel VAR dynamics were also assessed by variance decomposition** (Table A.6 in the Appendix). The latter shows the extent of which the forecast error variance of one variable in the system is associated with surprise movement of other endogenous variables. The variance decomposition show that, in the *Low oil-intensity* group, the non-oil sector variance has a greater share of attributed oil sector forecast error variance than the REER forecast error variance. Additionally, the REER has a higher share of the attributed non-oil sector growth forecast compared to the oil sector, which is in line with the non-oil sector's dominance in these economies.

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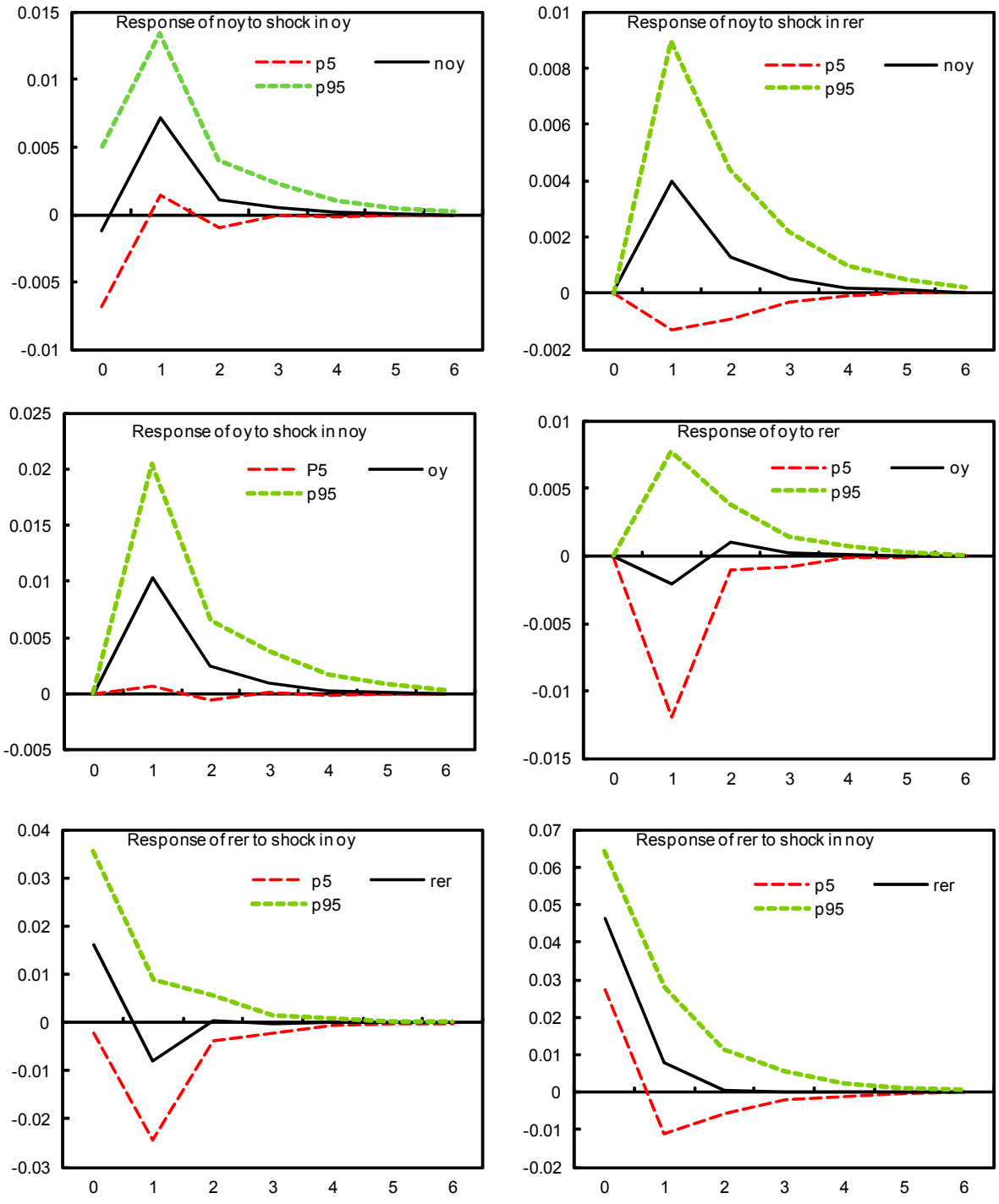
[23] The lag length was selected by using Akaike Information Criterion (AIC). Given the limited observations and the fact that data is annually, one, two and three lags were considered. The AIC results show that in the *Low* group, one-lag specification is slightly superior compared to other specifications while, in the *High* group, the three-lag specification has a significant lower AIC value compared to other specifications.

B. High Oil-intensity Countries

21. **The dynamics in the *High* oil intensity countries are somewhat different from the *Low* oil-intensity countries (Table A.5).** The impact of the oil sector on the non-oil sector is negative, as suggested in the "natural resource curse" hypothesis (Figure 10). More specifically, the estimated coefficients imply that a one percent growth in the oil sector leads, on average, to a decline of 0.15 percentage points in the non-oil sector's growth within two years. Although the non-oil sector is found to be adversely affected by a REER appreciation within two to three years, the estimation does not indicate that such an appreciation is triggered by a shock to the oil sector. Therefore, the adverse impact of the oil sector boom on the non-oil sector is likely to work through other channels that are not explicitly captured in the model. In this context, poor governance and weak fiscal institutions, which deter investment and consumption, may explain this adverse impact. This is also supported by low share of the non-oil sector forecast errors that can be explained by the REER variation (Table A.6 in the Appendix).

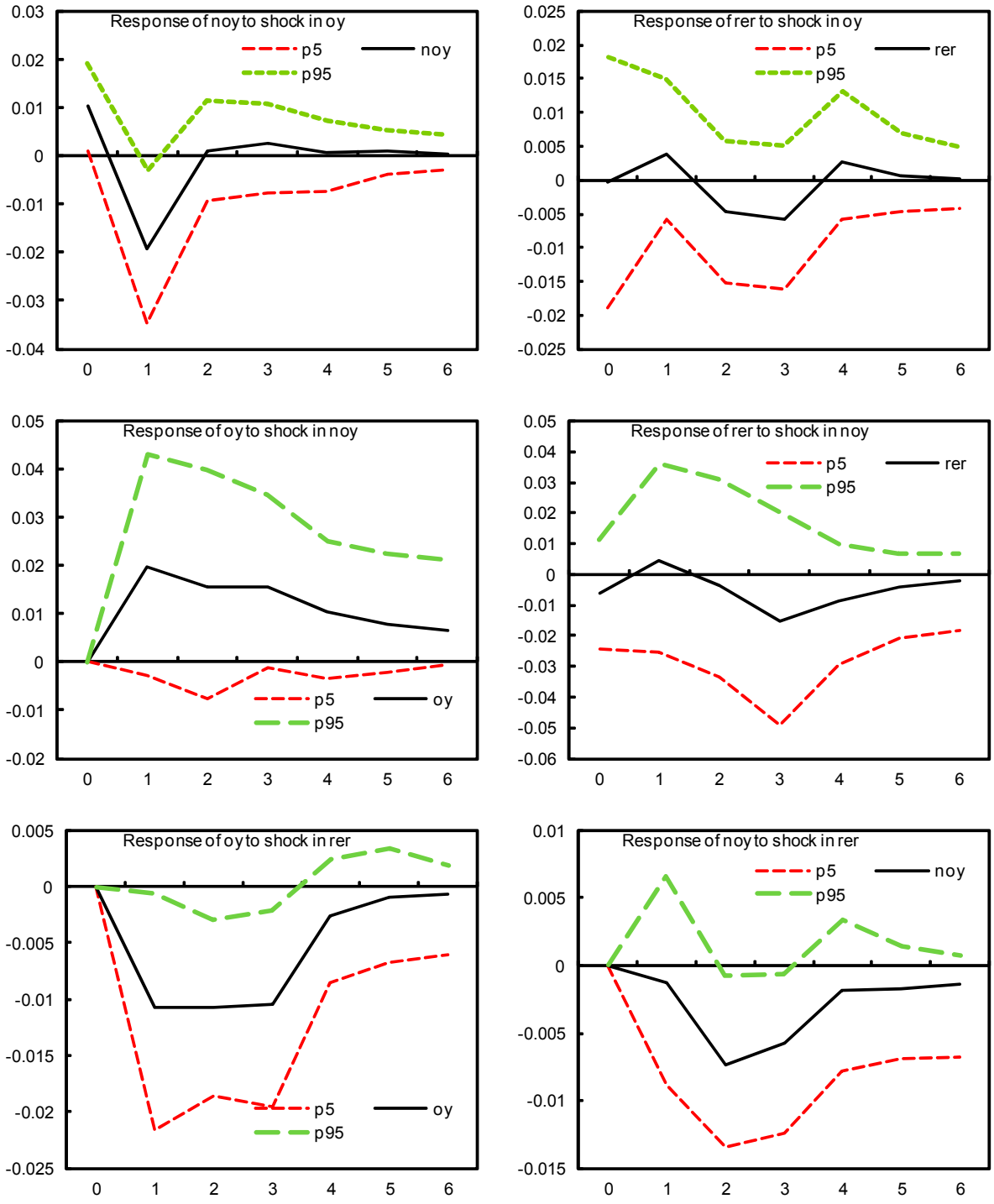
22. **Unlike the results of the Low oil-intensity group, in the High oil-intensity group there is no significant impact of the non-oil sector on the oil sector.** This is not surprising given that in many of these economies the non-oil sector is relatively small and undeveloped with little effect on the overall economic performance. Additionally, like the impact on the non-oil sector, an appreciation of the REER adversely affects on the oil sector within three years. This result can stem from profitability considerations and perhaps the fact that REER appreciation deters foreign investment as domestic assets become more expansive for foreigners.

Figure 9. Low Oil-intensity Countries: Impulse Response of *oy, noy and rer



Source: IMF Staff estimations.
* Errors are 5% on each side generated by Monte-Carlo with 500 repetitions.

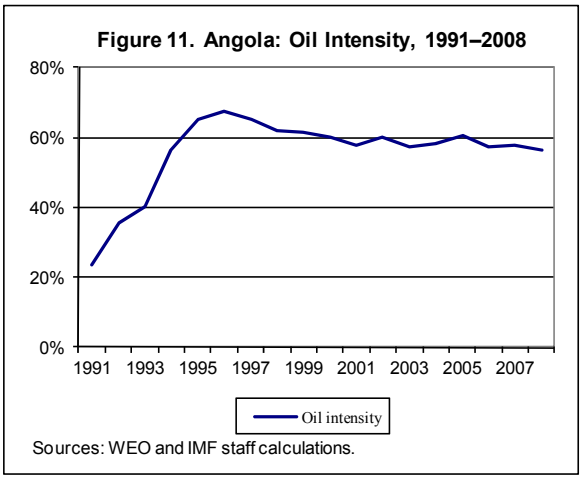
Figure 10. High Oil-intensity Countries: Impulse Response of *oy, noy and rer**



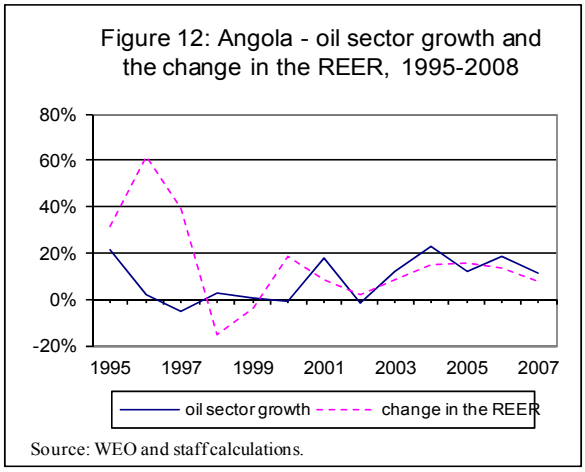
Source: IMF staff estimations.
* Errors are 5% on each side generated by Monte-Carlo with 500 repetitions.

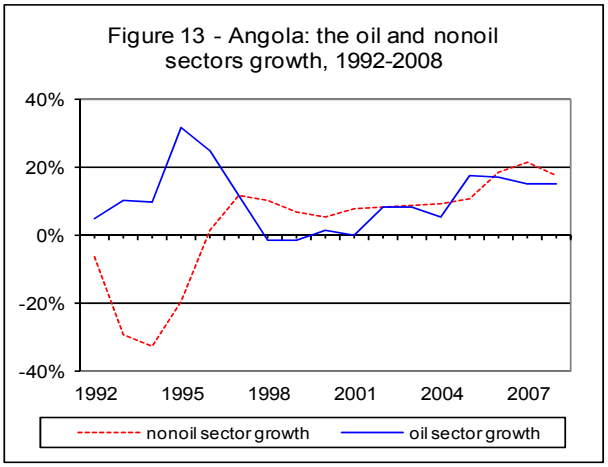
IV. The Case of Angola

23. **Angola is currently among the countries with highest oil-intensity in the sample.** The devastating effects of the prolonged civil war had led to the collapse of the non-oil sector economy and consequently the share of the non-oil sector in the economy declined from 76 percent in 1991 to 32 percent in 1996. Since then, the non-oil sector registered a substantial recovery with an average growth of 11.6 percent annually (1997–2008). However, given that the oil sector has expanded in parallel (7.8 percent), the share of the non-oil sector has been kept stable at around 40 percent in the last eight years (Figure 11).



24. **Since the end-of the 1990s, the oil and the non-oil sectors seem to be moving together.**[24] Between 1992 and 1996, the correlation between the oil and the non-oil growth was positive at 0.26, while from 1997 and 2008, it has almost doubled to 0.46 (Figure 13). Additionally, from 1996 onwards, the oil sector growth appears to move in tandem with the REER, implying that past accelerations of the oil sector growth contributed to the REER appreciation (Figure 12).





25. **Like in the panel analysis, the linkage and interaction between the non-oil and the oil sector are assessed with a VAR methodology.** The VAR system contains the same three endogenous variables as in the panel analysis (*oy, noy and rer*); however, the limited

[24] Due to lack of data, the analysis is focused on a shorter period (1992-2008).

data availability for Angola, which shortens the sample size significantly, together with the volatile period of the conflict, weakens the power of the estimation substantially.[25] With these caveats in mind, the results of the analysis should be viewed with caution.

26. **The estimation results and the IRFs demonstrate the positive and direct impact of the oil sector on the non-oil sector (Table 2, Figure 14).**[26] The estimated coefficients imply that a one percent growth in the oil sector leads to a 0.37 percent growth in the non-oil sector while the impulse response functions reveal that the accumulated impact of such a shock leads to a 0.5 percent growth of the non-oil sector within 4 years. The impulse response functions also show that a shock to the oil sector leads to an REER appreciation; however, given that the sensitivity of the non-oil sector to the REER movements is not significant, there is no adverse impact from this channel on the non-oil sector growth. This is consistent with the fact that the tradable non-oil sector in Angola is very small (oil exports account for 95 percent of total exports), and in line with the assessment that the impediments for Angola's non-oil sector growth are mainly structural (Qureshi, 2008).[27]

Table 2—Angola: VAR Estimation Results, 1994–2008

	OY	*NOY*	*RER*
OY(t-1)	*0.195*	*0.297**	*1.294**
NOY(t-1)	*-0.361*	*0.370**	*-0.094*
RER(t-1)	*-0.027*	*0.045*	*0.182*
C	*0.045*	*0.028*	*0.065*
PEACE	*0.117***	*0.026*	*-0.124*
Dum_94	*0.225*	*-0.175**	*-1.848**
Adj. R-squared	0.506	0.928	0.853

Number of Observations: 15
*Significance level: * significant at 1 percent*
***significant at 5 percent*
****significant at 10 percent.*

27. **While the estimation results support a positive causality from the oil sector to the non-oil sector in Angola,** the presence of a poor business climate, poor infrastructure and low effectiveness of SFI (as reflected by the low transparency of fiscal policy and the currently wide gap between the non-oil primary fiscal balance compared to the sustainable level), provide an hindrance to the development of the non-oil sector. In this context, given that the poor institutional framework is likely to have long-term adverse impact, substantial progress in these indicators is necessary to preserve the currently positive synergies and avoid the negative externalities that are observed in the rest of the high oil-intensity

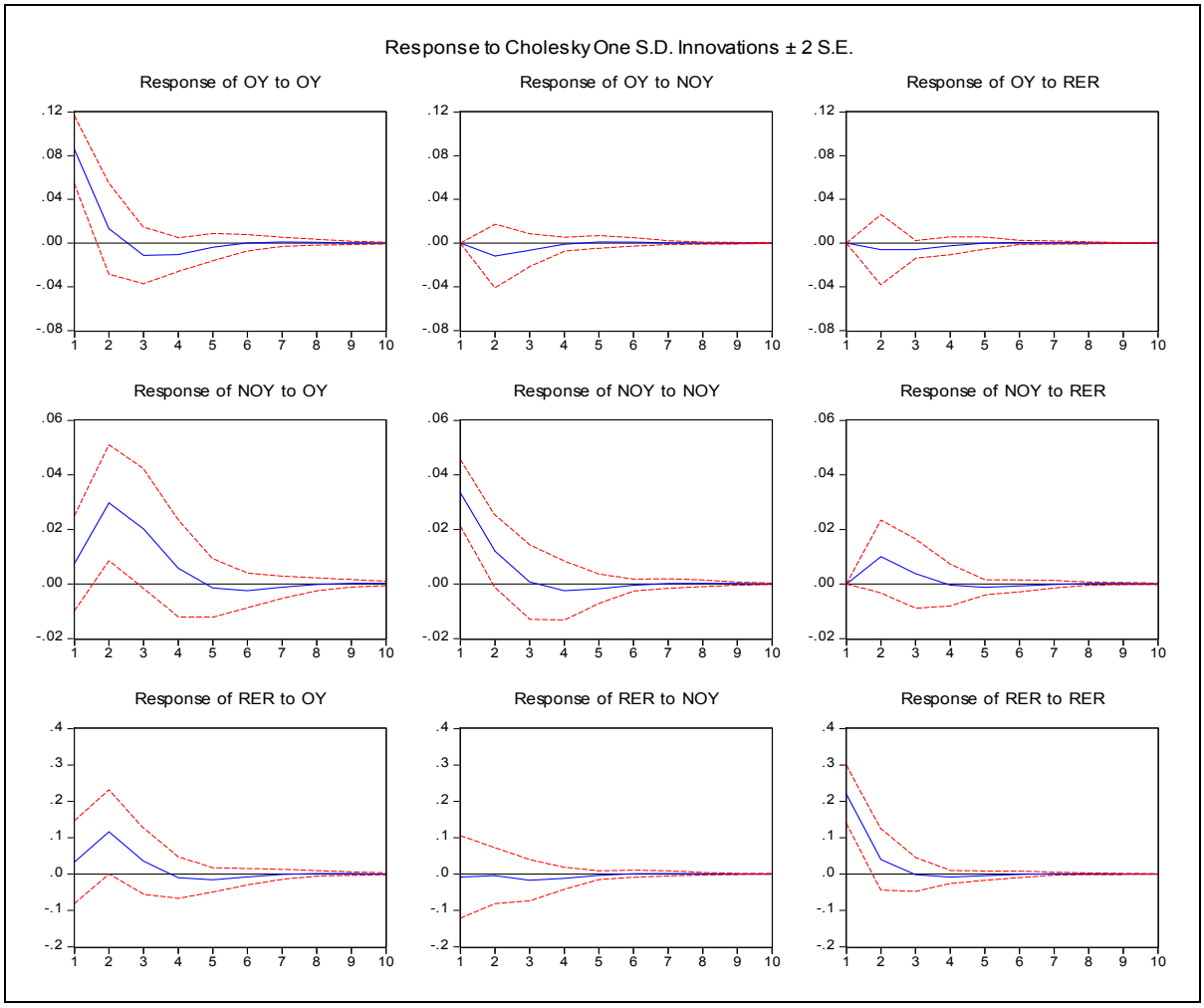
[25] Exchange rate data are available only from 1992.

[26] In addition to the endogenous variables, the estimation also includes two dummies: *PEACE* for the post-conflict period of 2002-08, which is characterized with greater macroeconomic stability; and *Dum_94* to capture the substantial devaluation of the exchange rate in 1994.

[27] Recent assessment of the real effective exchange rate (by CGER methodology) shows that the real exchange rate is broadly in line with its fundamentals.

economies. Moreover, such a progress would allow greater positive spillovers between the two sectors, and consequently will reflect in the acceleration of the overall GDP growth.

Figure 14. Angola: Impulse Response for One-lag VAR of *oy, noy and rer*



V. CONCLUSIONS

28. **The analysis explores the relationship between the oil and non-oil sectors among 23 oil exporters over the last two decades.** It uses a panel VAR approach, which allows for assessing the interaction between the two sectors without a priori assumptions on causation and time length in which the variables affect each other. The estimation results show that the "natural resource curse" effect is dominant only in high oil intensity countries. In this regard, the estimated coefficient implies that a one percent growth of the oil sector leads to a decline of 0.15 percentage points in the non-oil sector's growth in the subsequent two years. While there are indications that the non-oil sector negatively responds to a REER appreciation, the estimation results do not point to the fact that the adverse effect of the oil sector on the non-

oil sector occurs through the REER channel but through other channels, which are not explicitly examined in the analysis. Among others, these channels may reflect the impact of poor governance and the weak fiscal institutions, which increase the vulnerability of the economy to oil prices fluctuations and thus undermine the competitiveness of the non-oil sector.

29. **The dynamics in the low oil-intensity countries seem to be different from the dynamics in the high oil-intensity countries.** The estimation results show that, in the low oil-intensity countries, the oil sector has positive externalities on the non-oil sector and vice versa. More specifically, the estimations show that a one percent growth in the oil sector leads, on average, to a growth of about 0.1 percent in the non-oil sector in the subsequent year while a growth of one percent in the non-oil sector leads to a 0.25 percent growth in the oil sector. This impact, which implies that the contribution of the non-oil sector to the oil sector is even higher than the contribution of oil sector on the non-oil sector, is in line with the dominance of the non-oil sector in these economies.

30. **While the "natural resource curse" dominates in the high oil-intensity countries, the economic developments in Angola appear to behave differently.** In particular, the estimation results for Angola suggest that there is a positive and strong impact of the oil sector on the non-oil sector. The positive link between the sectors perhaps reflects Angola's unique circumstances in which the non-oil sector was almost erased during the prolonged civil war and the fact that the recovery of the oil sector, particularly, at the beginning of this decade, gave the non-oil sector a 'big push". That said, the weak business climate, poor infrastructure and low effectiveness of SFI continue to provide a hindrance to the development of the non-oil sector. Given that the poor institutional framework is likely to have long-term adverse impact, substantial progress in these indicators is necessary to preserve the currently positive synergies and avoid the negative externalities that are observed in the rest of the high oil-intensity economies.

REFERENCES

Arellano, Manuel, and Olympia Bover. 1995. "Another Look at the Instrumental Variable Estimation of Error Component Models", *Journal of Econometrics* 68, 29–51.

Auty, Richard M. 1997. "Natural Resources, the State and Development Strategy", *Journal of International Development*, 9: 651–63.

Bhattacharya, Rina, and Dhaneshwar Ghura. 2006. "Oil and Growth in the Republic of Congo", IMF Working Paper 06/185.

Collier, Paul, and Anke Hoeffler. 2005. "Resource Rents, Governance, and Conflict", *The Journal of Conflict Resolution,* Vol. 49, No. 4.

Feiss, Norbert M., and Dorte Verner. 2003. "Oil, Agriculture, and the Public Sector: Linking Intersector Dynamics in Ecuador", World Bank Policy Research Paper 3094.

Iimi, Atsushi. 2007. "Escaping from the Resource Curse: Evidence from Botswana and the Rest of the World", IMF Staff Papers, Vol. 54, No. 4.

Kauffmann, Daniel, Aart Kraay, and Massimo Mastruzzi. 2008. "Governance Matters VII: Aggregate and Individual Governance Indicators 1996–2007", World Bank Policy Research Working Paper 4654.

Love, Inessa, and Lea Zicchino. 2006. "Financial Development and Dynamic Investment Behavior: evidence from Panel VAR", *The Quarterly Review of Economics and Finance,* 46, 190–210.

Manzano, Osmel, and Roberto Rigobon. 2001. "Resource Curse or Debt Overhang?", NBER Working Paper No. 8390.

Mauro, Paolo. 1995. "Corruption and Growth", *The Quarterly Journal of Economics*, Vol. 110, No. 3, 681–712.

Murshed, Mansoob. 2004. "When Does Natural Resource Abundance lead to a Resource Curse?" Environmental Economics Programme, Discussion Paper 04–01.

Ossowski, Ronaldo, Mauricio Villafuerte, Paulo Medas, and Theo Thomas. 2008. "Managing the Oil Revenue Boom: The Role of Fiscal Institutions", IMF Occasional Paper 260.

Ross, Michael L. 1999. "The political Economy of the Resource Curse", *World Politics*, Vol. 51, No. 2, 297–322.

Sachs, Jeffery, and Andrew Warner. 1995. "Natural Resources Abundance and Economic Growth", NBER Working Paper, No.5398.

Sala-i-Martin, Xavier, and Arvind Subramanian. 2003. "Ad dressing the Natural Resource Curse: An Illustration from Nigeria", IMF Working Paper 03/139.

Shleifer, Andrei, and Robert Vishny. 1993. "Corruption", *Quarterly Journal of Economics,* CIX, 599–617.

Qureshi, Mahvash. 2008. "Competitiveness of Angola's Non-oil Sector: Challenges and Prospects", Angola: Selected Issues.

APPENDIX

Table A.1. Selected Oil Exporters: Summary Statistics, Full Sample, 1985–2008			
	Non-oil sector growth	Oil sector growth	REER
Mean	0.056408	0.058581	-0.02186
Median	0.051853	0.023831	0.000803
Maximum	0.428917	2.38713	0.76793
Minimum	-0.34444	-1.20938	-1.89505
Std. Dev.	0.075256	0.241096	0.190623
Skewness	0.002778	3.855464	-3.38249
Kurtosis	9.55283	38.27444	28.47674
Jarque-Bera	751.4432	22109.34	14215.05
Probability	0	0	0
Sum	23.69137	23.84237	-10.7312
Sum Sq. Dev.	2.373007	23.59959	17.80513
Observations	420	407	491

Table A.2 – Selected Oil Exporters: Correlation Matrix			
	Non-oil sector growth	Oil sector growth	REER
Non-oil sector growth	1	0.101	0.223
Oil sector growth	0.101	1	0.037
REER	0.223	0.037	1

Table A.3 – Selected Oil Exporters, Panel Unit Root Tests, 1985–2008						
Exogenous variables: Individual effects						
Automatic selection of maximum lags						
	Non-oil sector growth		Oil sector growth		REER	
Method	Stat.	Prob.**	Stat.	Prob.**	Stat.	Prob.**
Null: Unit root (assumes common unit root process)						
Levin, Lin & Chu t*	-7.32	0	-6.88	0	-11.03	0
Null: Unit root (assumes individual unit root process)						
Im, Pesaran and Shin W-stat	-5.72	0	-5.84	0	-9.88	0
ADF - Fisher Chi-square	125.0	0	119.4	0	185.62	0
PP - Fisher Chi-square	167.8	0	201.9	0	221.89	0
** Probabilities for Fisher tests are computed using an asymptotic Chi-square distribution. All other tests assume asymptotic normality.						

Table A.4. Estimation Results of the Panel VAR, Low Oil-intensity Countries, 1985–2008			
Dependent variable	*OY*	*NOY*	*RER*
OY(t-1)	*-0.608*	***0.092****	*-0.125*
NOY(t-1)	***0.266****	***0.267****	*0.072*
RER(t-1)	*-0.016*	*0.030*	*0.103*
Number of observations: *151*			
*Significance level: * significant at 1 percent*			
***significant at 5 percent*			
****significant at 10 percent.*			

Table A.5. Estimation Results of the Panel VAR, High Oil-intensity Countries, 1985–2008			
Dependent Variable	*OY*	*NOY*	*RER*
OY(t-1)	*0.050*	***-0.273****	*0.036*
NOY(t-1)	*0.304*	***0.406****	*0.079*
RER(t-1)	*-0.083*	*-0.010*	*0.112*
OY(t-2)	*0.061*	***0.112*****	*-0.031*
NOY(t-2)	*0.108*	*0.120*	*-0.113*
RER(t-2)	***-0.066****	***-0.074****	*-0.057*
OY(t-3)	*-0.318*	*0.033*	*-0.057*
NOY(t-3)	*0.104*	*0.097*	*-0.209*
RER(t-3)	*-0.050*	*-0.025*	*-0.099*
Number of observations: *127*			
*Significance level: * significant at 1 percent*			
***significant at 5 percent*			
****significant at 10 percent.*			

Table A.6. Variance Decomposition				
low oil-intensity				
	periods	*OY*	*NOY*	*RER*
OY	10	0.9802	0.0188	0.0009
NOY	10	0.0279	0.9631	0.0090
RER	10	0.0162	0.1109	0.8729
OY	20	0.9802	0.0188	0.0009
NOY	20	0.0279	0.9631	0.0090
RER	20	0.0162	0.1109	0.8729
High oil intensity				
OY	10	0.8332	0.1273	0.0395
NOY	10	0.0850	0.8980	0.0171
RER	10	0.0046	0.0235	0.9719
OY	20	0.8323	0.1281	0.0395
NOY	20	0.0849	0.8980	0.0171
RER	20	0.0046	0.0237	0.9717

Table A.7. Selected Oil Exporters: Governance, Doing Business and Fiscal Transparency Statistics			
	Government Effectiveness Index*	Open Budget Index 2008**	2009 Doing Business ranking***
High PPP per capita (income per capita above 10,000)			
Bahrain	0.54	-	18
Gabon	-0.62	-	151
Kuwait	0.25	-	52
Oman	0.54	-	57
Qatar	0.52	-	37
Saudi Arabia	-0.26	1	16
United Arab Emirates	0.74	-	46
Low PPP per capita(income per capita below 10,000)			
Algeria	-0.60	1	132
Angola	-1.20	3	168
Azerbaijan	-0.79	37	33
Cameroon	-0.88	5	164
Chad	-0.95	7	175
Congo	-1.30	-	178
Equatorial Guinea	-1.34	0	167
Indonesia	-0.46	54	129
Iran	-0.61	-	142
Kazakhstan	-0.70	34	70
Libya	0.54	-	-
Nigeria	-1.00	19	118
Syria	-0.89	-	137
Turkmenistan	-1.43	-	-
Venezuela	-0.82	35	174
Yemen	-0.81	9	98

* Higher figure implies better government effectiveness.

**Higher figure implies greater budget transparency.

***Lower figure implies better business climate.