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THE EFFECTS OF OIL DEPENDENCE ON GROWTH VOLATILITY

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ABSTRACT

In this thesis, we analyze the relationship between dependence on oil exports and growth volatility, controlling for other determinants. We collect annual data from 1995 to 2015 on a sample of 42 oil net exporting countries and use the standard system generalized methods of moments (GMM) approach developed by Arellano and Bover (1995) and Blundell and Bond (1998). We also investigate the channels that moderate this effect through macroeconomic policies suggested by policymakers and we find evidence that supports the mitigating effect of financial development, institutional quality and human capital on the transmission of oil dependence on growth volatility.

Keywords: oil dependence; macroeconomic volatility; resource curse; system-GMM

JEL Classification: O13; O40

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1. INTRODUCTION

During the last decades, oil exporting economies have been facing large fluctuations in oil prices, and hence higher volatility of output per capita growth since many of these countries depend heavily on oil exports revenues. For these economies, the reasons for the so-called "resource curse" have been widely debated. Firstly, oil countries often experience appreciation of the real exchange rate, which deteriorates non-oil exports sectors and therefore production inputs are reallocated from tradable to non-tradable sectors. Whenever oil revenues create a growing demand in other industries of the economy, it prompts to higher prices in the non-tradable sector and hold profits on the non-oil tradable sector which leads to a fall in competitiveness as proposed by "Dutch Disease"[1] . This leads to a loss of employment on these sectors and the development of a greater economic dependence on oil. Oil dependence leads not only to the reliance on exports but also to unbalanced fiscal dependence on petrodollars and government spending. Oil booms, create the illusion of prosperity and development, but they are in fact destabilizing regimes by reinforcing oil-based interests, which in turn increases rent seeking behavior which involves corruption and probably civil conflicts.

This dissertation analyzes the relationship between oil exports dependence and growth volatility, controlling for other determinants of volatility. It also investigates the channels that mitigate this effect through policies suggested by policymakers. Many studies indicate that the "curse" is worse if economies have low human capital accumulation, poor rule of law and an undeveloped financial system. So, we expect volatility to be positively linked to oil dependence and negatively linked to policies.

[1] Corden and Neary (1982).

Methodologically, we apply a system generalized methods of moments (GMM) approach developed by Arellano and Bover (1995) and Blundell and Bond (1998). We collected annual data from 1995 to 2015 and we build a panel dataset of 42 oil net exporting countries and we also calculate five-year period averages (standard deviations regarding volatility measures) for all variables in the sample.

This thesis contributes to the existing literature by attempting to provide a better understanding of which policies will best reduce the spread of growth volatility on oil exporting economies. More closely related to our dissertation motivation is Moradbeigi and Law (2016) who documents an empirical analysis that confirms a negative link between oil terms of trade volatility, and output volatility, using a sample of 63 oil-producing countries over the period 2000-2010. They also find evidence that a strong financial system has a dampening effect on the transmission of oil terms of trade volatility. Our thesis differs from this paper on several dimensions: first, the effects of oil exports as a share of GDP are investigated instead of oil terms of trade growth. Secondly, our data measurements used are also different, since they use five-year moving sample standard deviation of output growth for the GMM estimation, while we use five-year non-overlapping observations. Lastly, they use both private credit and liquidity as proxies of financial development, whereas we use the principal components analysis of the four main indicators described in the literature to measure this indicator.

The rest of this thesis is organized as follows: Section 2 gives a review of the relevant literature and Section 3 describes the data and presents the methodology. On Section 4 we present the empirical results. Section 5 discusses the policy implications of our findings and, lastly, Section 6 concludes.

2. LITERATURE REVIEW

The negative relationship between growth and volatility was first documented empirically on Ramey and Ramey's paper (1995), controlling for initial income, population growth, human capital, and physical capital. Easterly et al. (2000) concludes that growth volatility is different across economies depending on their level of development, the nature and the magnitude of the shocks that they face, and government's policy regime. Given that, volatility generates significant welfare costs that should be avoided, recent literature has focused on the determinants of volatility in order to lead to better policies, highlighting six categories: i) the size effect, ii) macroeconomic policies, iii) government size, iv) financial sector, v) trade openness and vi) inequality .

First, the way a country reacts to any shocks depends on some basic characteristics such as the level of development or the size of population. Hnatkovska and Loayza (2003) show that volatility of output depends on income levels.

Secondly, output growth volatility has also been associated with macroeconomic policies. Focusing on the role of macroeconomic policies and the structure of governments, Acemoglu et al. (2003) find that differences in institutional quality are an important cause of cross-country differences in volatility, hence they conclude that growth volatility is a negative macroeconomic consequence of poor institutions. Good governance as described in Acemoglu et al. (2005), should reflect a strong rule of law.

Regarding the government size and growth volatility link, Gali (1994) and Fátas and Mihov (2001) show a negative relationship between government spending and volatility. Particularly, they find a positive effect of government size in mitigating growth volatility so that, it acts as

automatic stabilizer. The stabilizer effect of the government expenditure is confirmed in Bejan (2006). The author finds that larger governments decrease volatility in developed countries while this effect is not significant in developing countries.

Concerning the relationship between financial markets and volatility, Easterly et al. (2000) explore the sources of macroeconomic volatility and find that a higher level of financial development is associated with lower volatility. Cecchetti et al. (2006) support this evidence, finding that when the financial system of a country turns out to be more developed and the central bank more independent, output volatility fails. They also determine that there is a greater decrease in volatility when there is an increase in available credit.

The degree of trade openness has an ambiguous effect on volatility since it allows the smoothing of internal shocks through trade but, at the same time, it creates more exposure to external shocks. According to Buch et al. (2006) and Easterly et al. (2000), output volatility is related to the size and frequency of shocks affecting the economy as well as to the way in which these shocks are confronted. Bejan (2006) also discusses the effects of trade openness on output volatility on 111 countries and concludes that developing economies have more openness which prompts higher output volatility. Di Giovanni and Levchenko (2006), in turn, examine the channels through which the degree of openness affects industrial product volatility in a firm-level approach with 61 countries over 30 years using data from 28 industry sectors and a three-dimensional unbalanced panel. Their results indicate that the sectors with a higher opening coefficient are more volatile, that greater specialization is related to greater volatility, and that more open sectors are also less correlated with the rest of the domestic economy. Finally, the three effects together indicate that trade liberalization increases output volatility. However, more recently, Cavallo (2007) presents new evidence that openness has a negative effect on output volatility.

Lastly, some studies have focused on the analysis of the relationship between educational inequality and volatility, concluding that growth volatility reduces the average growth rate and enrollment rates in high school, and that a country with a higher accumulation of human capital can better adjust to new situations and therefore its output is less affected by an internal shock (Ramey and Ramey, 1995; Flug et al., 1998, Mobarak, 2004). Checchi and Garcıa-Penalosa (2006) find evidence on the positive link between output volatility and educational inequality by analyzing variables correlated with educational performance and their distribution, on a sample of 111 countries during the period 1960 to 1995.

However, another candidate to explain growth volatility is the volatility of commodity prices. Why are oil exporting countries more volatile? These economies typically focus their exports in a small number of sectors, mostly tradable sectors where the prices of goods are fixed at international levels, such as oil sector, which exposes them to uncertainty. This kind of concentration takes them to be more susceptible to external shocks and consequently prompts to a larger volatility. Van der Ploeg and Poelhekke (2009) find that growth volatility is the main determinant of the "natural resource curse". They also find that financial development has a dampening impact on volatility on resource based economies.

A few studies also examined the role of governments in mitigating macroeconomic volatility, as many of oil dependent nations have poor government indicators including problems with property rights, high levels of corruption and low transparency. Mehlum et al. (2006) verify that when in the presence of good institutions, a reducing undesired effect of natural resource revenue is less severe. In contrast, Murshed (2004) points out that certain types of natural resources, such as oil and minerals, tend to generate a concentration of revenues, delaying institutional development and promoting rent-seeking behavior. The author estimates a panel model that considers the effects of institutional quality linked to the possession of the natural

resource type over economic growth. Beck et al. (2006), as Van der Ploeg and Poelhekke (2009), also verify weak evidence that financial system diminishes the effects of terms of trade volatility on output volatility.

3. DATA AND METHODOLOGY

3.1. Methodology

This dissertation employs a dynamic panel model estimator as developed by Arellano and Bover (1995) and Blundell and Bond (1998) to examine the relationship between macroeconomic volatility and oil dependence in oil exporting countries. A system-GMM estimator is adequate when the panel is "small T, large N" (Nickell, 1981). In particular, the two-step system GMM estimator is used in this thesis. In order to this, a dynamic panel regression model to capture the link between volatility of output growth per capita (Y) and oil dependence (OIL) is identified as follows:

$$SD(Y)_{i,t} = \beta_1 SD(Y)_{it-1} + \beta_2 OIL_{it} + \alpha POLICY_{it} \qquad (1)$$

$$+\lambda(POLICY_{it} * OIL_{it}) + \gamma X_{it} + \varepsilon_{it}$$

$$i = 1, \dots, n\,; t = 1, \dots, T$$

In equation (1), $SD(Y)_{i,t}$ denotes growth volatility and $\mathrm{OIL_{it}}$ represents oil dependence for country i over period t; X_{it} are the other regressors comprised in the model as control variables: trade openness (TO), government consumption (G), initial level of GDP (GDP), private investment (I), inflation volatility (INFL_VOL) and oil price volatility (OIL_PRICE). $POLICY_{it}$ is the variable that measures policies of interest: financial development (FD), human

capital index (HUMAN) and institutional quality (IQ). The disturbance term is represented as follows:

$$\varepsilon_{it} = u_t + \xi_{it} \qquad (2)$$

Where ε_{it} is the error term, u_t is the country-specific time-invariant or fixed-effects and ξ_{it} idiosyncratic shocks, which is heteroscedastic and correlated in time among countries, but not between countries.

In a dynamic panel, the presence of a lagged dependent variable as an independent variable violates the orthogonality condition. So, as suggested by Arellano and Bond (1991), to eliminate country-specific effect, ξ_{it} is applied in first-differenced,

$$\Delta SD(Y)_{i,t} = \beta_1 \Delta SD(Y)_{it-1} + \beta_2 \Delta OIL_{it} + \alpha \Delta POLICY_{it}$$

$$+\lambda \Delta(POLICY_{it} * OIL_{it}) + \gamma \Delta X_{it} + \Delta \varepsilon_{it} \qquad (3)$$

$$i = 1, \dots, n \; ; t = 3, \dots, T$$

However, the transformed error term $\Delta\varepsilon_{it}$ is correlated with $\Delta SD(Y)_{it-1}$, since both hold ε_{it-1}. One of the problems of this estimation is the possible endogeneity of explanatory variables, since if the economic cycle is not perfectly controlled, its coefficient will be biased, subsequently oil dependence, government consumption, openness trade and private investment are endogenous variables and they change with GDP. To avoid this problem, the model allows us to estimate the transformed equation by instrumenting endogenous variables with the lags of their levels and with the differences of exogenous variables as internal instruments.

The difference GMM estimator uses the following moment conditions[2]:

$$E(SD(Y)_{it-s}, \Delta\varepsilon_{it}) = 0 \text{ for } 2 < s \leq t-1 \; and \; t = 3, \dots, T,$$

$$E(OIL_{it-s}, \Delta\varepsilon_{it}) = 0 \text{ for } \; 2 < s \leq t-1 \; and \; t = 2, \dots, T, \qquad (4)$$

$$E(X_{it-s}, \Delta\varepsilon_{it}) = 0 \text{ for } \; 2 < s \leq t-1 \; and \; t = 2, \dots, T.$$

This method, although consistent, in unbalanced panels generates a great loss of observations, as difference GMM could amplify gaps (Roodman, 2009b). In order to avoid this loss of observations, since in the sample used in the study there are some intervals not observed in the series for some countries, the main estimation was made taking the first differences as instrumental variables of the level equation as suggested by Blundell and Bond (1998). Hence, the further moment conditions for the regressions in levels are:

$$E(\Delta SD(Y)_{it-s}, \varepsilon_{it} + \xi_{it}) = 0 \; for \; s = 1 \; and \; t = 3, \dots, T,$$

$$E(\Delta OIL_{it-s}, \varepsilon_{it} + \xi_{it}) = 0 \; for \; s = 1 \; and \; \; t = 2, \dots, T, \qquad (5)$$

$$E(\Delta X_{it-s}, \varepsilon_{it} + \xi_{it}) = 0 \text{ for } s = 1 \; and \; \; t = 2, \dots, T.$$

The other issue solved by the estimation by System GMM is the capacity that this methodology has to generate a great amount of instruments. However, many instruments may have a perfect correlation with the endogenous variable and therefore will not be good instruments. The Hansen test is performed in an overidentified system: as shown by Roodman (2009) a large number of instruments tends to decrease the Hansen statistic, which is essential for the validation of instruments. In order to test for autocorrelation regardless of the fixed effects, the Arellano-Bond test is applied to the residuals in levels. If autocorrelation of errors occurs, the

2 In GMM estimation, we use only the third lag to control the maximum number of instruments.

result of the estimation is invalid, since the instruments in the transformed equation are not orthogonal to the errors.

Note that in equation (1), OIL_{it} and $OIL_{it} * POLICY_{it}$ are included as separated regressors. The interacted term intends to capture the intuitive fact that economies more dependent on oil exports are naturally more affected by each policy. The oil term by itself seeks to capture an additional effect of oil dependence on output volatility coming from other channels. So, we are interested in

$$\frac{\partial SD(Y)}{\partial OIL} = \beta_2 + \lambda POLICY_{it} \qquad (6)$$

Where β_2 reflects the effect of oil abundance when $POLICY_{it} = 0$ and the sum $\beta_2 + \lambda POLICY_{it}$ reflects the effect of oil dependence at different values of $POLICY_{it}$. Our hypothesis is $\beta_2 > 0$ and $\lambda < 0$ so the direct impact on oil dependence is positive on growth volatility, nevertheless the total effect becomes less positive and possibly negative with appropriate government's strategies.

3.2. Data sources and measurements

Our dataset encompasses an unbalanced panel of 42 oil exporting countries, annual-frequency data that covers all or part of the period 1995-2015, depending on data availability. The sources and summary statistics of variables included in our sample are described in Appendix Table 3. We calculate five-year period averages and standard deviations in the case of volatility measures for all variables in the sample. There are two main reasons for doing this method. Firstly, this filters out business cycle fluctuations in the data (see Aghion et al. (2009)). Second, the GMM system is designed to function with data that includes a short time series and taking

averages of five years leads to a maximum of four observations, which then satisfies the short time series requested.

3.2.1. Growth Volatility

Following Ramey and Ramey (1995) we will use the standard deviation of GDP growth per capita as output volatility. In opposition to most papers in the literature which employ time-invariant variables, we compute the five-year non-overlapping standard deviation of annual log differences in the GDP per capita:

$$Y_{GDP,it} = \ln(GDP_{it}) - \ln(GDP_{it-1}) \quad (7)$$

$$SD(Y)_{GDP,it,t+s} = \sqrt{\frac{1}{S}\sum_{s=0}^{S}\left(Y_{GDP,it} - \frac{1}{S+1}\sum_{s=0}^{S} Y_{GDP,it+s}\right)^2} \quad (8)$$

Since we are working with averages every five years, $S = 4$. The volatility of $Y_{GDP,it}$, specifies the extent to which, at any point in time, output growth differs from a certain average. Figure 1 shows that growth volatility is positively correlated with dependence on oil and negatively correlated with all policies is shown in Figure 3, 4 and 5.

3.2.2 Oil dependence

Oil dependence refers to the degree to which a country relies to oil revenues. As Sachs and Warner (1995) we use oil exports as a share of gross domestic product to measure the oil dependence. It should be noted that our sample is composed of net oil exporters and the value of oil imports is not significant for this study.

3.2.3 Policy Variables

The choice of policy variables[3] is informed by IMF Country Reports and their proxies are supported by literature:

Financial Development: The level of financial development is measured by the principal components analysis of four variables: logarithm of liquid liabilities, money supply, commercial bank credit and domestic credit to private sector, all variables as a ratio of GDP. We interpret higher levels of financial development as an indicator of a more developed financial system, and consequently lower volatility. Given the unavailable data, Turkmenistan and Papua New Guinea are excluded from the set of results of this policy.

Institutional Quality: To capture this indicator instead of using only the variable of rule of law, we computed a principal component analysis of four government indicators: the government efficiency, regulatory quality, corruption and freedom expression. A priori, the indicator is expected to be negatively correlated with output volatility.

Human capital: The index of human capital consists on the average years of schooling and the return to education. Improvement of human capital may lead to an increase in competitiveness tradable sectors, particularly in non-oil sectors, and consequently a progress in value-added that leads to a diminishing in growth volatility. The model excludes Azerbaijan, Chad, Equatorial Guinea, Libya, Oman, Papua New Guinea and Turkmenistan due to lack of data.

3.2.4. Control variables

We include as control variables the main sources of growth volatility that have been more debated in the literature:

[3] Furthermore to these proxies, we have explored different measures of financial development and institutional quality, such as private credit as a share of GDP, rule of law and political rights from Freedom House, respectively. All variables displayed the same results, while some of the control variables decreased the statistical significance level.

Initial GDP per capita: This variable is used to control for convergence effect. We assume a country with lower level of GDP per capita to exhibit higher fluctuations.

Trade Openness: The relationship between trade liberalization and volatility is controversial. It is expected that an increase in trade, especially in non-oil tradable sectors, offsets exogenous shocks. Thus, the relationship between openness and volatility of growth is expected to be negative.

Government Expenditure: The relationship between government spending and output volatility is ambiguous. As we said before, the size of government depends on the level of development of an economy, so government consumption is expected to be positively linked to volatility.

Inflation volatility: This variable is used to reflect monetary shocks and we expect a positive link between inflation volatility and growth volatility.

Finally, all regressions contain time fixed effects and oil price volatility to control for period-specific events that may affect numerous economies simultaneously.

4 EMPIRICAL RESULTS

4.1. Estimation results

The estimations of the model are reported on Table 1. We first investigate whether oil dependence by itself is a determinant of growth volatility, represented on model 1. Then, we look at the role of a set of policies in dampening and potentially offsetting the positive effects of dependency: firstly, the regression results with only the policies (Model 2, 3, 5 and 7); and subsequently with the interaction term of policies and oil dependence (Model 4, 6 and 8).

The first set of results shows that the coefficient of dependence on oil has a positive sign and statistical significance at 1% level. This direct link between oil dependence and growth volatility in oil-exporting countries displays that higher dependence on oil exports would result in an increase on growth volatility.

The lagged dependent variable is negative and individually statistically significant at 1% level while the effect of inflation volatility is always positive, in all specifications. We also note that the results suggest that more open economies and economies with higher levels of GDP suffer lower fluctuations on output growth per capita, as the coefficient of this last variable often looks negative. Results also display that government spending has a positive and significant effect on volatility. Models 2, 3, 5 and 7 on Table 1 suggests a negative effect of all policies on growth volatility, although when tested in simultaneously policies lose significance.

The negative impact of financial development trough oil dependence is in line with Moradbeigi and Law (2016) which suggests that an economy with developed financial markets can diminish a share of the positive effect of oil dependence on growth volatility. Our results suggest that an oil exporting country with a perfect financial system can damp volatility in 7% and deals well with its dependency.

On the other hand, on a country with a particularly weak government like Democratic Republic of Congo, with a low institutional quality index over the last 20 years, to mitigate the positive effect of oil dependency, it has to improve the quality of its institutions. In contrast, an economy with strong institutions like Norway, can mitigate (but not neutralize) the effects of oil exports. The overall positive effect of oil trade on growth volatility is diminished by over 6% compared to Democratic Republic of Congo.

Table 1: Two-step System GMM estimation. Dependent variable: Standard deviation of GDP per capita growth rates

			Different measures of policy					
	Basic Model (1)	Basic Model (2)	FD (3)	(4)	IQ (5)	(6)	HUMAN (7)	(8)
Lagged SD(Y)[4]	-.3915***	-.0859***	-.6157***	-.6274***	-.0747***	-.4616***	-.1084***	-.1471***
OIL	.2582***	.0331***	.2127***	.2764***	.2936***	.2177***	.0466***	.1480***
TO	-.0103	-.0151***	.-0011	-.0167**	-.0453***	-.0029	-.0234***	-.0149***
G	.0194***	.0069	-.0575***	.0463***	.0054	.0356*	.0128***	.0080*
GDP	-.0078***	.0108***	-.0025	-.0017	-.0057***	-.0099***	.0062***	.0042***
INFL VOL	.1485	.1400***	.1923*	.3073***	.0628***	.1282	.1850***	.2326***
OIL PRICE VOL	.0041*	-.0031***	.0056***	.0033***	.0010***	.0064***	-.0012**	-.0022***
FD	-	-.0105	-.0497***	-.0126	-	-	-	-
IQ		-.0076**	-	-	-.0026	.0108	-	-
HUMAN		-.0052	-	-	-	-	-.0118	.0281***
POLICY*OIL	-	-	-	-.0592	-	-.0604*	-	-.1240***
Observations	119	99	114	114	119	119	101	101
Number of countries	42	35	41	41	42	42	35	35
Arellano-Bond test for AR(1)	2.60 (.009)	2.50 (.012)	2.59 (.010)	2.34 (.019)	2.42 (.016)	2.25 (.025)	2.41 (.016)	2.08 (.037)
Arellano-Bond test for AR(2)[5]	2.02 (.043)	.05 (.959)	2.16 (.031)	1.65 (.100)	4.49 (.013)	1.56 (.118)	.52 (.604)	.83 (.408)
Hansen Test of overid. Restrictions	18.45 (.620)	20.08 (.329)	15.68 (.333)	25.06 (.294)	29.98 (.415)	16.74 (.402)	19.90 (.464)	22.46 (.374)

Notes: Time dummies included in all regressions, but not reported. P-values ***p<0.01, p<0.05**, p<0.10*. Estimation was carried out in Stata 14.0 by xtabond2 routine developed by Roodman (2006), we are considering all variables except time dummies as endogenous.

4 All the coefficients of the lagged dependent variable are statistically different from the unit, indicating that the dynamic GMM is an adequate estimator.

5 The results presented in Table 2 must be handled with a reasonable caution because the serial correlation tests are not valid in model 3 and 5. This invalidates the introduction of the lagged dependent variables as an instrument in the model. We use also additional instruments in GMM estimation, such as private credit and rule of law.

Lastly, as expected, the effect of improving human capital has a strong negative and statistically significant impact at 1% level on growth volatility on the most dependent economies. It is noteworthy that public expenditure on education in many of these countries is low and unequal, and it does not reach the entire population.

5 POLICY IMPLICATIONS

This section examines some implications of our findings and other issues that have been set to reduce the volatility of these oil exporting countries.

The results of our thesis have policy implications related to the diversification of exports. Auty (2001) relates volatility to governments' lack of capacity to manage public surpluses as suggested by our model (see model 5 and 6 on Table 1), thereby delaying economic development. This tends to reduce the investment' efficiency, accumulate distortions in the economy and retard diversification. There are significant gains to be made to diversify economies, for example by using oil export revenues to finance technology in order to diversify the production framework in non-oil sectors.

Another important issue regards monetary policy. Cecchetti et al. (2006) finds a positive effect of monetary policy in dampening inflation and growth volatility. The exchange rate policies of these countries are molded by uncertainty regarding the oil price volatility. Countries like oil-exporting countries peg their currency to the dollar because of their oil export revenues in dollars. As a result, they became large owners of dollar in their SWF and these petrodollars are often invested in the US. Alternative monetary regimes have been proposed in previous studies, for instance, floating exchange rate regime allows them to regain control over their monetary policy.

Finally, in line with the previous topic, governments in oil exporting confront the question of how much to consume, invest and save out of oil exports' revenues[6]. A key element for the managing of oil booms is the introduction of oil stabilization and savings funds[7], and possibly the increase of non-oil tax revenues[8]. The government should save or accumulate assets when the price of oil is high and dissave when the price of oil is low. Given the high public revenues derived mainly from oil, oil exporters can finance high public expenditure without resorting to the deficit. So, as several economies have accumulated assets, the use of credit in these countries is low which consequently contributes to low inflation rates. This is consistent with our findings, we verify that inflation and growth volatility have a positive link.

6 CONCLUSION

The results of the estimation for a panel of 42 countries over the period 1995 to 2015 confirm that dependence on oil exports and growth per capita volatility have a positive and statistically significant link. We use a GMM system, since we have short time series and to avoid problems with endogeneity.

This thesis differs from the literature, since we do not focus on the question of whether having large oil resources is good or not for a country, in contrast we concentrate on the policies that oil dependent economies can adopt to reduce the positive effects of oil dependence on the

[6] We will not test the effects of these funds on growth volatility due to the lack of data given the low degree of transparency of these countries. We attempt to test non-oil tax revenues as a policy but given the unavailable data in many of the countries in our sample, the model is not valid.

7 This approach maybe makes sense for advanced countries but can be unsuccessful for developing countries (Venables, 2016; van der Ploeg, 2016).

8 Posch (2011) documents significant effects of several types of taxation on volatility, the link between capital tax and volatility is positive while labor and corporate income tax are negatively linked. Mohtadi, Ross and Ruediger (2016) document that given the ratio of government revenue to GDP, tax revenues are lower as higher is the resource revenues as a share of GDP.

volatility of growth. Furthermore, we find evidence that supports the mitigating effect of financial development, institutional quality and human capital on the transmission of dependence on oil.

The empirical evidence presented in this dissertation has implications and motivated by these, we intend to explore these ideas in future research, when better data are available. One of the future objectives is the construction of an alternative measure of volatility, such as the conditional volatility of gross domestic product growth per capita from a GARCH model. And, subsequently, designing an annual sample to use an enhanced Pooled Mean Group (PMG) estimator.

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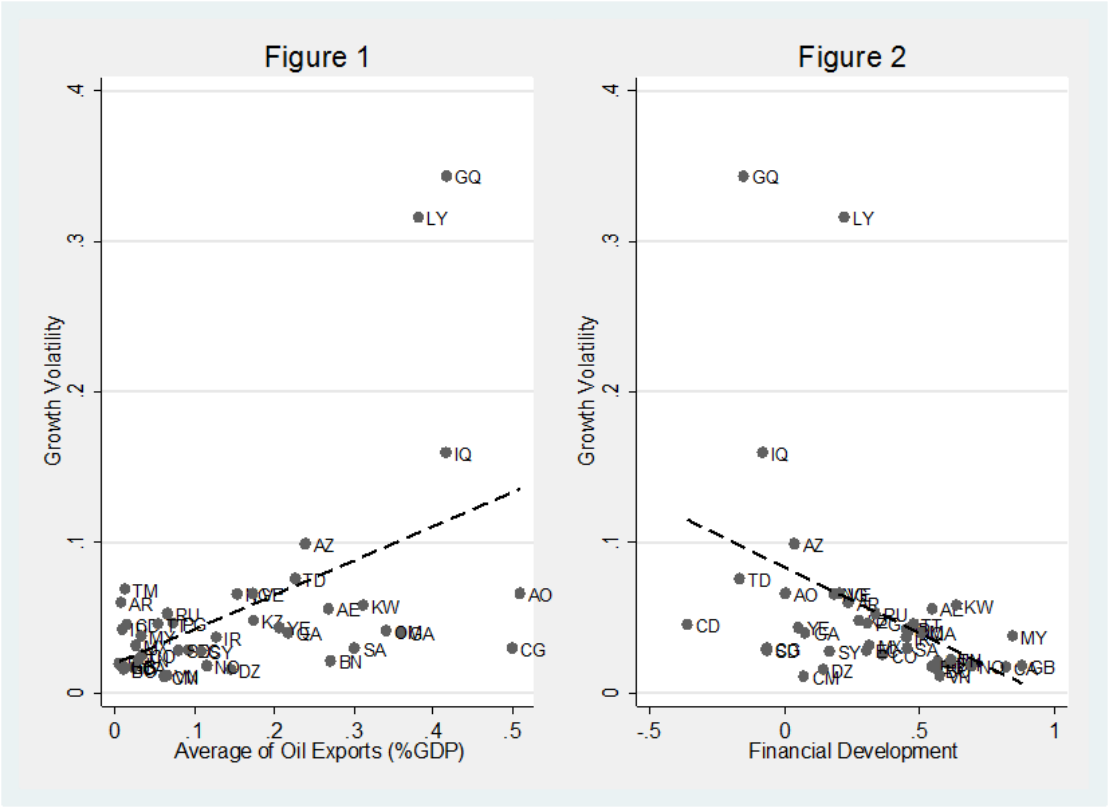
APPENDIX

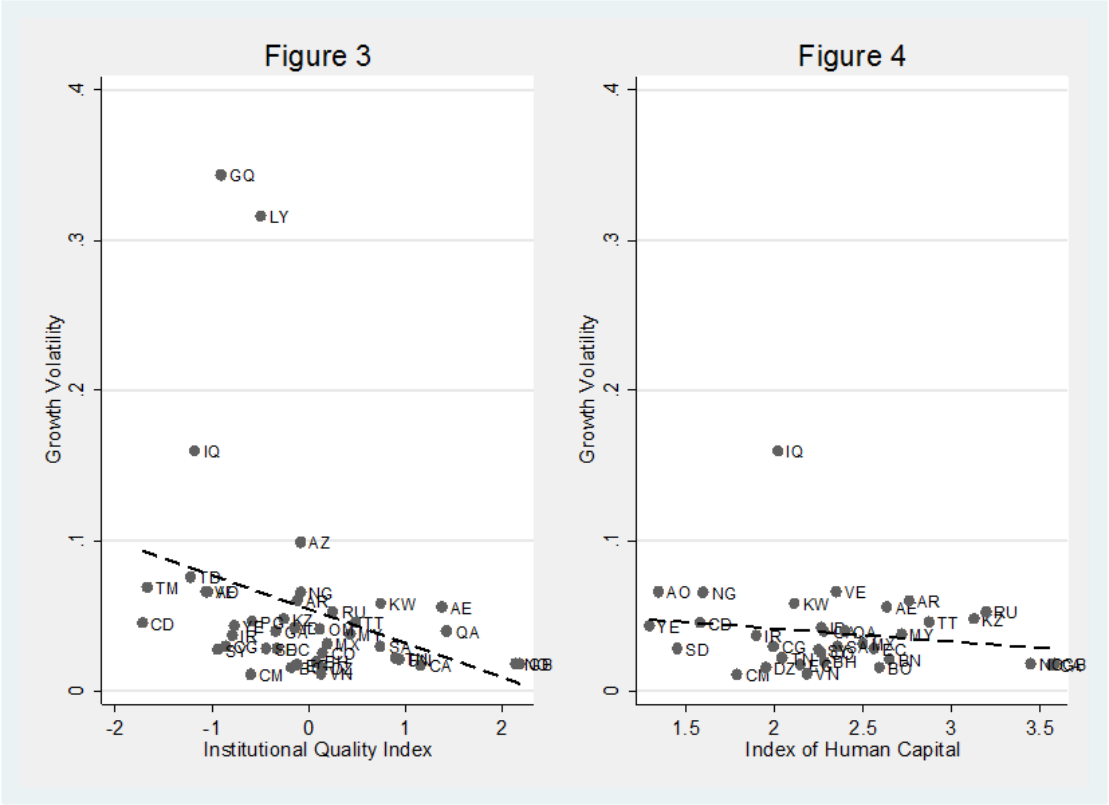
Table 2: Sample of countries

Algeria	Egypt	Papua New Guinea
Angola	Equatorial Guinea	Qatar
Argentina	Gabon	Russia
Azerbaijan	Indonesia	Saudi Arabia
Bahrain	Iran	Sudan
Bolivia	Iraq	Syrian Arab Republic
Brunei	Kazakhstan	Trinidad and Tobago
Cameroon	Kuwait	Tunisia
Canada	Libya	Turkmenistan
Chad	Malaysia	United Arab Emirates
Colombia	Mexico	United Kingdom
Congo	Nigeria	Venezuela
Dem. Rep. Congo	Norway	Vietnam
Ecuador	Oman	Yemen

Table 3: Variable description, sources and summary statistics

Variable	Definition and Construction	Source	Mean (Std. Dev.)	Min (Max)
Dependent variable				
Output volatility	Standard deviation of GDP per capita growth rates.	Author's calculation using data from IMF World Economic Outlook (WEO), October 2016.	4.1 (6.68)	0.271 (56.03)
Independent variables				
Oil dependence	Ratio of crude oil exports to GDP, in current US dollars.	United Nations Conference on Trade and Development, SITC 333.	16.25 (19.67)	0.0007 (298.33)
Policy Variables				
Financial development, in logs	Principal component analysis of: Domestic credit to private sector, money supply, liquidity and bank credit, as share of GDP. Indicator from -1 to 1, with 1 representing developed financial system.	Author's calculation using variables from WDI, World Bank	0.32 (0.32)	-1 (1)
Institutional quality	Principal component analysis of: Estimates of Government Effectiveness, Voice and Accountability, Regulatory Quality, Rule of Law and Control of Corruption, ranging from -2.5 to 2.5, with 2.5 representing strong institutions.	Author's calculation using variables from Worldwide Governance Indicators, World Bank	-0.05 (0.94)	-2.5 (2.5)
Index of Human capital	Average years of schooling and return to education.	Penn World Table 9.0	2.34 (0.59)	1.09 (3.74)
Control variables				
Trade openness, in logs	Ratio of exports plus imports to GDP.	WDI, World Bank	84.83 (50.09)	0.02 (531.74)
Government Consumption, in logs	General government expenditures, Percent of GDP.	IMF World Economic Outlook (WEO), October 2016.	29.38 (11.12)	2.15 (128.29)
Initial GDP, in logs	Initial value of GDP per capita in the beginning of each five-year period, in dollars.	IMF World Economic Outlook (WEO), October 2016.	11099.3 (16664)	151.345 (103605)
Inflation volatility, in logs	Standard deviation of annual percentage change in CPI + 100.	Author's calculation using data from WDI, World Bank	7.21 (17.74)	0.3 (138.46)
Oil price volatility	Standard deviation of the average of three spot prices; Dated Brent, West Texas Intermediate, and the Dubai Fateh, US$ per barrel.	Author's calculation using data from IMF, Commodity Prices	11.57 (7.78)	2.8 (21.54)





Notes: Standard deviation of GDP per capita growth between 1995 and 2015 and is in percent. Oil dependence and policies are the mean defined in Table 3, over 1995 and 2015.