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The Role of Financial Development in Natural Resource Abundant Economies: Does the Nature of the Resource Matter?

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Abstract

The paper evaluates the role played by financial development in oil vis-à-vis non-oil (mining) economies using a panel data set for the period 1984-2003. A novel two-step, variance corrected *system* Generalized Method of Moments (GMM) estimator proposed by Windmeijer (2005) is applied to a dynamic panel of 44 developing economies. The data reveals that financial development plays a crucial role in influencing the efficiency of investment, thus economic performance of these economies. However, the potency of financial institutions is highly dependent on whether the economy is an oil or non-oil (mining) producer.

Keywords: economic growth, financial development, natural resources, system Generalized Method of Moments, dynamic panel, oil vis-à-vis non-oil (mining)

***JEL classification*:** Q32, O11, O13, O16, C32, C33

1. Introduction

Although a vast amount of both theoretical and empirical literature has established a positive link between financial development and economic growth, accounting for the peculiar characteristics of natural resource economies in determining these links has not been studied thoroughly yet. The question of whether natural resource abundance

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has an indirect effect on investment and economic growth through the financial channel needs to be further explored, particularly for developing economies. Thus the paper attempts to shed additional light on this hypothesised indirect link by examining the role of financial development in stimulating investment, and in turn economic growth, of oil vis-à-vis non-oil economies.

Previous studies have established that there is a link between the degree of financial development and natural resource abundance (Nili & Rastad, 2007; Gylfason & Zoega, 2001). Regrettably, the cross sectional data that the Gylfason and Zoega (2001) study uses does not take into consideration endogeneity, heterogeneity and omitted variables bias that is prevalent in growth models. To attempt to overcome this problem and further evaluate the reasons for differing economic performance between oil and non oil economies, Nili and Rastad (2007) applied a *first differenced* GMM estimator to annual data. However, by using annual data Nili and Rastad (2007) are regrettably not appreciating that the output series is highly persistent. To avoid contamination of the results by cyclical dynamics, the majority of growth studies (e.g. Beck & Levine, 2004; Bond, Hoeffler, & Temple, 2001; Levine, Loayza, & Beck, 2000) use time periods based on (for example) five-year averages. Secondly, the *first differenced* GMM approach used has been documented to suffer from potentially biased estimates in small samples. But, by focusing on first differences the approach does away with cross-country relations.

Given such questions over the validity of the results from these studies, the current paper uses a variant of the *system* GMM estimator which has been suggested to offer gains in efficiency and consistency. Also, whilst Nili and Rastad (2007) use a sample group of all developing economies, irrespective of whether they are natural resource abundant economies or not, the current paper only uses natural resource abundant economies.[1]

More broadly the paper makes a contribution to the growth literature in general by using a panel technique that eases the statistical deficiencies associated with previous growth studies. Also a new data set intended to capture the peculiarity of resource economies is used to re-examine the role of financial development on economic growth. Specifically, the paper examines the role of the relationship between financial development and investment on growth in oil vis-à-vis non-oil resource abundant economies (i) averaging data over four years, instead of using annual data, so as to curb business cycle effects (ii) controlling for other growth determinants other than financial development (iii) using a newly modified two step *system* GMM estimator proposed by Windmeijer (2005) that is intended to address the downward bias in standard errors prevalent in Arrelano and Bover (1995)'s original two-step *system* GMM estimator (iv) controlling for omitted variables, simultaneity biases and the small sample biases associated the habitual use of lagged dependent variables common in growth regressions.

2. Literature review

The view that finance plays an important role in the real sector dates back to Schumpeter (1911). In this work, the important role that the banking sector plays in economic growth is emphasised and highlighted. Additionally, situations in which financial institutions are capable of funding as well as identifying productive

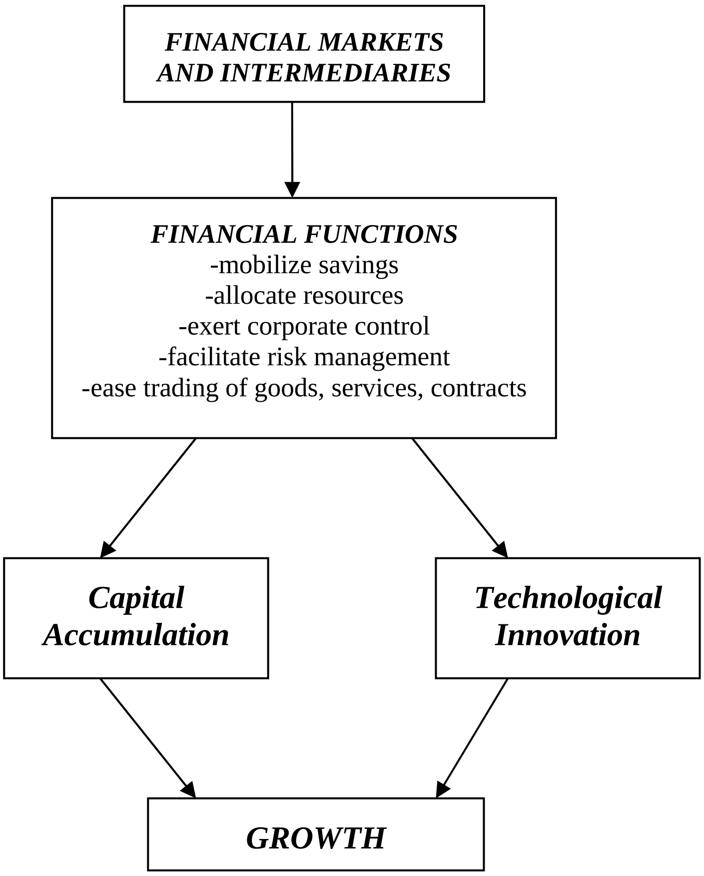
[1] The current paper's focus on natural resource abundant economies only is intended to capture the peculiar characteristic possessed by economies with abundant natural resources.

investments, thus spurring innovation as well as future growth are highlighted. Subsequent literature also suggested that financial development played a pivotal role in economic development. Among these, McKinnon (1973) and Shaw (1973) came to the conclusion that financial development, by raising saving and capital accumulation will raise economic growth. The recent theoretical literature as presented by (King & Levine, 1993a; Pagano, 1993; Saint-Paul, 1992; Bencivenga & Smith, 1991; Greenwood & Jovanovich, 1990) suggests several channels through which finance affects macroeconomic cycles. They concluded that through its function of resource allocation, financial development can enhance economic growth.[2]

Since then, the relationship between finance and growth has been examined from different approaches. Levine (1997) has, by identifying capital accumulation and technological innovation channels from finance to growth provided a sound theoretical approach for most studies. Figure 1 summarises this theoretical approach. The finance-growth literature establishes the role of financial institutions on economic performance by determining whether financial intermediaries are able to carry out their functions (these functions are outlined in figure 1). Similarly, the mainstream growth literature has made use of this theory, for instance, Romer (1986) and Lucas (1988) exploit the capital accumulation channel to argue that the functions carried out by the financial system, will through their influence on the rate of capital formation, affect steady-state growth.

[2] The conclusion for all the studies with the exception of Saint-Paul (1992) is that financial development can have an ambiguous effect on the saving rate and thus economic growth. In most cases, the studies simply ignore cases where financial development has a detrimental effect on the saving rate. Saint-Paul (1992), for instance makes the assumption that financial development raises the saving rate. Bencivenga and Smith (1991) show that increases in the number of banks might reduce the rate of saving but they go further to showcase instances when lower saving rate is outweighed by higher growth enhancing effect of such.

Figure1
A theoretical approach to finance and growth



Source: Levine (1997)

Empirical examinations of the relationship between financial development and economic growth take three broad categories; cross-sectional, panel and time series approaches. The traditionally used approach is cross-sectional data, for instance, King and Levine (1993b; , 1993a) applied the approach to study 80 countries between the period 1960 and 1989. Their results suggested a robust positive relationship between financial development and economic growth. On one hand, Levine and Zervos (1998) extended the focus on only the banking sector development by also considering whether different measures of stock market development had an effect on economic growth. They used cross-sectional data for a sample of 47 countries between the period 1976 and 1993. The problem with these cross sectional studies is their failure to take into consideration endogeneity and omitted variables bias that is prevalent in growth models. For example, most growth equations that examine the role of financial development through its influence on capital accumulation, hence economic growth tend to include investment; however, investment is an endogenous variable. Furthermore the inclusion of financial development indicators as regressors is problematic while high financial development is associated with high output; output is also a determinant of financial development. Because of this possible simultaneity bias, financial development should not be treated as exogenous in growth regressions.[3]

To overcome the problems associated with cross sectional data some of the studies have applied the GMM approach to panel data. GMM is unique because even in the presence of measurement error and endogenous right hand variables it gives consistent estimates. Thus the choice of GMM is intended to deal not only with this possible endogeneity, small sample time series and large cross sectional dimension (typical of most macroeconomic data) and simultaneity bias but also with the omitted variables problem common in growth modelling.

The most extensively used GMM approach in dynamic panel growth models is the *first differenced* GMM estimators.[4] The methodology was first introduced by Caselli, Esquivel and Lefort (1996). Recent studies that examine the role of financial

[3] It could be argued the same for other regressors, e.g. Hoeffler (2001) argued that openness (proxied by trade in our case) was highly correlated with investment.

[4] Dynamic panel models were originally developed by Arrelano and Bond (1991) and Holtz-Eakin, Newey and Rosen (1988).

development in influencing economic growth (e.g. Nili & Rastad, 2007; Beck & Levine, 2004; Benhabib & Spiegel, 2000; Levine et al., 2000) have also made use of this methodology.[5] However, Monte Carlo simulations (e.g. Hayakawa, 2007; Blundell & Bond, 1998) show that the *first differenced* GMM estimations may be imprecise, particularly in small samples (T=5 or 6), and that in such cases a *system* GMM substantially reduces small sample biases and produces more precise estimates.

The problem of small samples is important in our context since it is commonly encountered in growth models because of the need to consider small time periods in growth applications in order to take into account high persistence in output and to avoid having to model cyclical dynamics (Bond et al., 2001). To overcome these problems, Levine et al. (2000) examined the role of financial sector development on economic performance for seventy-four countries with data averaged over seven 5-year interval. Instead of a *first differenced* GMM, they used a *system* GMM. Moreover, they appreciated the fact that the weak instruments they use may lead to finite sample biases; therefore, they limited the instrument count by using the most recent lags as instruments in the level specification. In this study the conclusion was that there is a positive link between financial development and economic growth.

Furthermore, Beck and Levine (2004) examined the relation between stock market, banking development and economic growth using a panel of forty countries with the sample period from 1976 to 1998 averaged over five year intervals. They concluded that generally financial development does not seem to be 'unimportant or harmful for economic growth'. The paper made use of alternative control variables as well as

[5] Beck and Levine (2004) used *system* GMM estimators while Levine et al.(2000) used both *first differenced* and *system* GMM estimators.

three GMM procedures: one-step *system* and a 'novel' two-step *system* procedure with heteroskedasticity consistent standard errors intended to reduce the instrument count, thus avoiding over-fitting[6].

Generally, there seems to be a (positive) link between financial development and economic growth and the relationship is robust to the methodology as well as the control variables used. Previous Monte Carlo studies (e.g. Arellano & Bond, 1991) have revealed that, comparatively, the estimated asymptotic standard errors of the efficient two-step *system* GMM estimator may be biased downwards in small samples while those for one-step *system* GMM estimators are effectively unbiased. This problem arises mainly due to the large number of instruments used by this method.[7] As discussed in Roodman (2007), too many instruments may lead to several ailments, such as downward bias in two-step standard errors thus affect the validity of results, over fitting of endogenous variables and weakened Hansen test of instrument validity. However, these problems do not arise in the (relatively less efficient) one-step *system* estimator, hence its popularity in making inference for growth studies (e.g. Beck & Levine, 2004; Levine et al., 2000).

The current paper uses a novel alternative two-step variance corrected *system* GMM estimator proposed by Windmeijer (2005) that gives more accurate inference in finite samples and the one-step *system* estimator is given for comparison. The instrument set is limited using the technique of 'collapsing' some of the instruments (as in Roodman, 2007) and adding the control variables one at a time (as in Beck & Levine, 2004).

[6] The shortcoming of reducing instruments using this procedure is that a period is lost from the sample.
[7] As a rule of thumb, a researcher should start worrying about the number of instrument used if the instrument count exceeds the number of cross sections.

3. Data and stylized facts

3.1 Data

Indicators[8]

All indicators are from the World Development Indicators (WDI) database, unless it is stated otherwise**.**

Financial indicators

Although several indicators could be used to 'gauge' financial development, one may be more important than the other, depending on the role of financial system that is captured (Denizer, Iyigun, & Owen, 2002). For natural resource abundant economies, we need financial institutions to be able to promote the flow of credit to private investors. Accordingly, the flow of credit to the private sector (PRIVY) is a key variable (thus its use for analysis). The dominant roles of government in acquiring investment as well as the limited role of the private sector have been attributed to the low quality of financial institutions and hence low investment and growth in such economies (Nili & Rastad, 2007). Moreover, in accordance with the natural resource and growth literature, the control of mineral revenues by governments has brought problems of how efficiently to allocate the revenues for development (Auty, 1993). The other financial indicator, M2/GDP (used as a proxy for financial depth) is used for comparison due to its popularity in the literature. Each of the indicators is outlined below.

The traditionally used measure of financial activity is the measure of financial depth (M2/GDP). There is a theoretical literature that argues a positive relationship exists

[8] Following from Beck and Levine (2004) and Levine et al. (2000), all the indicators underwent natural logarithmic transformation because it is possible that the relationship between economic growth and a range of economic indicators is nonlinear.

between financial depth and economic growth. McKinnon (1973)'s model predicts that the positive relationship between these two variables is a result of the relationship between money and capital. The assumption made in this case is that a prerequisite for investment is the accumulation of saving in the form of bank deposits. Likewise, Shaw (1973)'s model predicts that financial intermediation encourages investment thus economic growth through debt intermediation. For both models a positive interest rate is the catalyst through which increased volume of saving mobilization increases financial depth and increased volume and productivity of capital encourages growth. The current endogenous growth models also posit a positive relationship between financial depth and economic growth (King & Levine, 1993a).

Domestic credit to the private sector provides a better measure of financial activity because it accurately characterizes the actual amount of funds routed into the private sector. Hence, it is more related to investment and growth. Financial interaction with the private sector implies that more credit is made available for more productive ventures than if they were made available to the public sector. Therefore, the more credit is made available to the private sector, the higher the level of financial activity.[9]

The limitations associated with financial intermediary indicators goes to show how inadequate they are as measures of how well financial intermediaries carry out their functions of pooling risk, mobilizing saving, etc. There are other different indicators that have been suggested in the literature, such as the share of financial sector to GDP (Graff, 2003; Neusser & Kugler, 1998). This indicator is intended to cover a wide

[9] Graff (2003) begs to differ in the accuracy of this measure by arguing that the domestic credit to the private sector offered by commercial banks creates 'conceptual difficulties' because it lumps together useful credit and non-performing loans.

variety of financial activities and as such, it does not underestimate financial depth. Instead of concentrating on the channels of finance, it is more on to the ‘intensity of financial services,’ by looking at the amount of resources dedicated to manage the financial institutions, which in turn would lower transaction costs (Graff, 2003, p. 51). The limited availability of data on the other alternative indicators of financial depth leads this study to stick to the ‘traditional’ measures.

Indicator for economic growth

The study follows the convention in the literature by using real per capita GDP as an indicator of growth (Y).

The set of explanatory variables, X_{it}, include the logarithm of inflation (GDP deflator), government size, trade and an index for the rule of law. The coefficient of the index of rule of law is intended to provide an estimate of the impacts of political as well as the legal framework on economic growth. The sign of the coefficient is expected to be positive since better-quality political and legal framework is expected to enhance economic growth (Barro, 1997; Barro & Sala-i-Martin, 1995). Government size is measured by the share of government consumption in GDP. Countries with relatively higher government expenditure are more likely to experience lower economic growth. This is the case because higher government spending requires more tax revenue, which leads to less efficient resource allocation. This indicator is particularly important in natural resource abundant economies because of the prominence of the fiscal linkage. The linkage has enabled the mining sector in development countries to provide a large share of taxes and foreign exchange, which can be mismanaged. For instance, Auty (2001) described Saudi Arabia’s government as having taken a ‘paternalistic stance’ in distributing oil rents and this made it difficult for them to adjust in cases of reduced oil revenue. Many of the welfare commitments, e.g. free of charge government services, were difficult to adjust. However, productive spending (such as spending on infrastructure and human capital) encourage growth.

The economies at hand tend to be quite open; they mainly import capital and export their resource. To capture the openness, the indicator TRADE is used. Openness will possibly facilitate economic growth by broadening domestic firms’ markets and by allowing them to acquire inputs at world prices (Shan, 2005). Thus the sign for the coefficient of this variable is expected to be positive. There is a tendency for resource-abundant countries to be high price economies (for instance, Sachs & Warner, 2001), therefore, to capture this aspect inflation is included (and also because of its impact on monetary aggregates (Shan, Morris, & Sun, 2001)). The coefficient of this variable is generally (e.g. Bekaert, Harvey, & Lundblad, 2001; Barro, 1997) expected to be negative. However, this relationship has been documented as being inconsistent (e.g. Levine & Zervos, 1993) and empirically, the harmfulness of inflation on economic growth ‘…is not overwhelming’ (Barro, 1997, p. 90).

A summary of the description of the variables is given in Table 1.

Table 1
Description of variables and their sources

Variable Name	Description	Definition	Source
CREDIT	Domestic credit provided by the banking sector (% GDP)	Domestic credit provided by the banking sector includes all credit to various sectors on a gross basis, with the exception of credit to the central government, which is net. The banking sector includes monetary authorities and deposit money banks, as well as other banking institutions where data are available (including institutions that do not accept transferable deposits but do incur such liabilities as time and savings deposits). Examples of other banking institutions are savings and mortgage loan institutions and building and loan associations.	World Development Indicators(WDI) database
PRIVY	Domestic credit to the private sector (% GDP)	Domestic credit to private sector refers to financial resources provided to the private sector, such as through loans, purchases of nonequity securities, and trade credits and other accounts receivable, that establish a claim for repayment. For some countries these claims include credit to public enterprises.	WDI database
RULE OF LAW	index of the rule of law	An index that ranges between 1 and 6. It is used here as a proxy for the quality of institutions. The higher the index, the better the quality of the institutions.	International Country Risk Guide (ICRG) dataset
OIL	Dummy variable	Oil = 0 mining economy (non-oil) 1 oil	Own coding
INVEST	Gross Fixed capital formation (% GDP)	Gross fixed capital formation (formerly gross domestic fixed investment) includes land improvements (fences, ditches, drains, and so on); plant, machinery, and equipment purchases; and the construction of roads, railways, and the like, including schools, offices, hospitals, private residential dwellings, and commercial and industrial buildings. According to the	WDI database

		1993 SNA, net acquisitions of valuables are also considered capital formation.	
GOVT	Government size	Government expenditure as a share of GDP	WDI database
DEPTH	Money and quasi money as % of GDP	Money and quasi money comprise the sum of currency outside banks, demand deposits other than those of the central government, and the time, savings, and foreign currency deposits of resident sectors other than the central government. This definition of money supply is frequently called M2; it corresponds to lines 34 and 35 in the International Monetary Fund's (IMF) International Financial Statistics (IFS).	WDI database
OPENNESS TO TRADE	Trade (% GDP)	Trade is the sum of exports and imports of goods and services measured as a share of gross domestic product.	WDI database
INFLATION	Inflation, GDP deflator (annual %)	Inflation as measured by the annual growth rate of the GDP implicit deflator shows the rate of price change in the economy as a whole. The GDP implicit deflator is the ratio of GDP in current local currency to GDP in constant local currency.	WDI database
OUTPUT	GDP per capita (constant 2000 US$)	Gross domestic product divided by midyear population. GDP is the sum of gross value added by all resident producers in the economy plus any product taxes and minus any subsidies not included in the value of the products. It is calculated without making deductions for depreciation of fabricated assets or for depletion and degradation of natural resources. Data are in constant U.S. dollars.	WDI database

3.2 Stylized facts

The relatively high investment that is associated with relatively low growth and financial indicators that we find in oil economies (depicted in Table 2) might be due to the efficiency of investment.[10] According to Gylfason and Zoega (2001), for sustainable growth, the quantity of investment on its own is not enough unless the investment is of high quality. The relatively high abundance of natural resources of oil economies could distort the allocation of capital by impeding the development of financial institutions and may retard economic growth via the negative effect of financial underdevelopment on among others, the quality of investment.

Table 2
Mean comparison *t*-tests for average (selected) indicators 1984-2003

Variable	Mean (oil)	Mean (non-oil)	t-statistic	Probability
Credit to the private sector (PRIVY)	32.42	35.07	1.44	0.08
Financial depth (DEPTH)	37.77	53.03	1.10	0.14
Bank credit (CREDIT)	39.01	54.43	6.21	0.00
Investment	22.47	19.92	-5.13	0.00
Economic growth	0.00	1.24	3.21	0.00
Natural resource intensity	1593.21	68.52	-13.48	0.00

Source: Author's calculation based on data from World Development Indicators database
All financial indicators are measured as a % of GDP.

The results are consistent with the finance-growth literature which asserts that financial development indicators predict subsequent growth, capital accumulation and

[10] This stems from Gylfason and Zoega (2001)'s explanation that the high investment rate associated with low economic growth experienced by 11 OPEC countries between 1965 and 1993 was due to efficiency of investment.

improves the efficiency of capital accumulation (Levine, 1997; King & Levine, 1993a). This implies that relative to underdeveloped financial institutions mature financial institutions would have a positive contribution to efficient use of resources.

Tables 3 and 4 are intended to supplement Table 2. They present weighted averages of each of the financial indicators constructed using the share of each country's GDP per capita on the group's total GDP per capita. The weighted averages are used so as to reflect the relative importance of each country to the group's GDP. For all the financial indicators used here, non-oil mining economies tend to outperform oil economies in terms of the development of their financial systems.

Table 3
Financial indicators for non-oil countries 1984-2003

Variable	Mean (%)	S.D. (%)	Minimum (%)	Maximum (%)	Observations
CREDIT	67.15	106.28	-172.74	640.04	658
PRIVY	48.25	82.79	0.00	607.17	658
DEPTH	52.25	59.32	0.82	390.38	659

Source: Author's calculations based on data from World Development Indicators database
All financial indicators are measured as a % of GDP.

Table 4
Financial indicators for oil countries 1984-2003

Variable	Mean (%)	S.D. (%)	Minimum (%)	Maximum (%)	Observations
CREDIT	40.95	48.13	-11.85	203.22	220
PRIVY	41.81	50.52	0.43	203.65	220
DEPTH	46.08	57.94	0.70	234.88	220

Source: Author's calculations based on data from World Development Indicators database
All financial indicators are measured as a % of GDP.

3.3 Sample

In order to provide a comparative analysis, a group of non-oil mining economies is used as a benchmark.[11] Unlike growth models that incorporate natural resources in growth models in a general way, simply lump mining (metals and minerals) and oil (and gas) economies together for analysis, the current paper differentiates between oil and non-oil resource abundant economies. The division is interesting for several reasons: (i) mining and oil production may have 'a different footprint in terms of their environmental, social, and economic effects' in an economy (Weber-Fahr (2002)) (ii) even though oil economies are high investment economies, they typically tend to have a lower quality of investment, which might be an indication of low financial activity, hence generally poor economic performance (Nili & Rastad, 2007). Therefore, it is highly likely that the quality of investment varies according the type of resource extracted.

The sample comprises forty-four developing economies (listed in the appendix). Annual data are obtained for the period between 1984 and 2003. The period is chosen purely on the basis of the availability of a comprehensive set of data for the economies under study. Two financial indicators are used in the study, namely; domestic credit to the private sector (Privy) and for comparison, the paper also uses the commonly used measure of financial depth, M2/GDP (Depth).

[11] The definition of mining is adopted from Weber-Fahr (2002). Mining includes metals and minerals but excludes oil and gas. Furthermore, mining activities encompass underground, open-pit mining, large and small scale operations as well as artisan miners.

4. Methodology

The following general model is commonly used to assess the relationship between financial development and economic growth

$$y_{i,t} = \alpha\, y_{i,t-1} + \beta' x_{it} + \eta_i + \varepsilon_{i,t} \qquad (1)$$

where *y* is real GDP per capita, *x* is a set of explanatory variables, η is an unobserved country-specific effect, ε is the error term and subscripts *i* and *t* are the country and time effects, respectively.

Numerous econometric problems are likely to arise from estimating equation (1): (i) Country characteristics that are time invariant (or fixed effects) such as geography may be correlated with the explanatory variables; (ii) explanatory variables such as investment and financial development are potentially endogenous. Since financial development may cause growth and vice-versa, these regressors are highly likely to be correlated with the error term; (iii) autocorrelation arises because of the presence of a lagged dependent variable (y_{it-1}); (iv) the panel data set consists of a larger country dimension (N=44) and a short time dimension (T=5).

To solve problem (i) (i.e. get rid of country-specific effect) a *first difference* dynamic panel estimator developed by Arellano and Bond (1991) and Holtz-Eakin et al. (1988) is the conventional method used in growth studies (Nili & Rastad, 2007; Caselli et al., 1996). Thus equation (1) becomes

$$y_{i,t} - y_{i,t-1} = \alpha(y_{i,t-1} - y_{i,t-2}) + \beta'(X_{i,t} - X_{i,t-1}) + (\varepsilon_{i,t} - \varepsilon_{i,t-1}) \qquad (2)$$

By taking the first differences, a new problem arises, the lagged explained variable, $y_{it-1} - y_{it-2}$ is correlated with the lagged error term, $\varepsilon_{i,t} - \varepsilon_{i,t-1}$. To deal with this problem (i.e. problem (iii)), an instrumental variables estimator is used; which is also meant to tackle, among other things, the likely endogeneity of explanatory variables (i.e. problem (ii)). Finally the Arellano and Bond (1991) estimators are designed for dynamic panel models with a large N and small T (i.e. they are intended to tackle problem (iv)).

Assuming that the error term, ε, is not serially correlated and that the explanatory variables are weakly exogenous, then the following Arellano and Bond (1991) moment conditions are applied

$$E[y_{i,t-s}(\Delta\varepsilon_{i,t})] = 0 \text{ for } t \geq 2;\ s \geq 2 \quad (4)$$

$$E[X_{i,t-s}(\Delta\varepsilon_{i,t})] = 0 \text{ for } t \geq 2;\ s \geq 2 \quad (5)$$

The *first differenced* GMM estimator is based on these moment conditions. However, the *first differenced* estimator is surrounded by both statistical and theoretical problems. Theoretically, we are concerned with determining the cross-country link between financial development and economic growth, which the *difference* estimator removes. From the statistical point of view, Blundell and Bond (1998) demonstrate that lagged levels of persistent explanatory variables are weak instruments for the differenced regression equation. Monte Carlo simulations (e.g. Hayakawa, 2007; Blundell & Bond, 1998) show that the weakness of instruments in the context of *first differenced* GMM estimations may lead to biased and imprecise for small samples (T=5 or 6).

Consequently, a *system* GMM estimator is used to moderate the potential biases and inaccuracies associated with the *first differenced* estimator. The estimator mixes in a *system*, the regression in levels with the regression in differences (Blundell & Bond, 1998; Arellano & Bover, 1995). The instruments for the latter regression are the same as those in equation (4) and (5) while the former regression uses lagged differences of the corresponding variables as instruments. In addition to the assumptions made under the *first differenced* estimation, it is assumed that country specific effects and explanatory variables are not correlated. Accordingly, the following moment conditions are used for the regression in levels:

$$E[Y_{i,t-s}(\eta_i + \varepsilon_{i,t})] = 0 \qquad (6)$$

$$E[X_{i,t-s}(\eta_i + \varepsilon_{i,t})] = 0 \qquad (7)$$

Therefore, to improve upon the *first differenced* estimator we employ moment conditions given in (4) – (7) to produce efficient and consistent parameter estimates. The validity of the extra moment conditions (6) and (7)(thus the consistency of the *system* GMM estimator) can be determined using a standard Sargan test of over-identifying restrictions or the difference-in-Sargan proposed by Arellano and Bond (1991). Moreover, there is a need to examine whether the error terms exhibit second order serial correlation or not, the *system* estimator is consistent only if the no second order serial correlation assumption is not violated.[12]

For the *first differenced* GMM estimator, the one-step and the two-step GMM estimators are asymptotically equivalent. If not, the two-step estimator is more

[12] Since the test is applied to differenced error terms, the error term will most likely exhibit first order serial correlation even if the original error term does not. This is anticipated since $\Delta\varepsilon_{i,t} = \varepsilon_{i,t} - \varepsilon_{i,t-1}$ and $\Delta\varepsilon_{i,t-1} = \varepsilon_{i,t-1} - \varepsilon_{i,t-2}$ both have $\varepsilon_{i,t-1}$ thus the second order serial correlation in first difference is important in uncovering serial correlation in levels.

efficient, and is always so for the *system* estimator. Disappointingly, Monte Carlo studies have revealed that the efficiency gain is usually small and that the drawback with the two-step GMM estimator is that it converges to its asymptotic distribution comparatively slowly. Moreover, the asymptotic standard errors related to the two-step *system* GMM estimators can be seriously biased downwards for finite samples, hence give unreliable direction for inference. The one-step *system* estimator is not affected by this problem. The difference is mainly due to the matrix used to weight the moment conditions. The weight matrix is independent of the model parameters in the case of the one-step estimator, while the two-step estimator uses a consistent estimate of the moment conditions' covariance matrix (constructed using the residuals from the first step) to weigh them. An initial consistent estimate of the model parameters is used to find the weight matrix.

Windmeijer (2005) revealed that a great deal of the differences among the estimated asymptotic variance and the finite sample that is present in the two-step *system* GMM estimators with moment conditions that are linear in parameters. He estimated this difference, thus leading to 'finite sample corrected estimates of the sample' Windmeijer (2005, p. 26). Subsequently, he conducted a Monte Carlo study that demonstrated that the correction leads to more accurate inference by competently estimating the finite sample variance of the two-step *system* GMM estimator.

The paper uses STATA's 'xtabond2' command that calculates a finite-sample correction to the two-step *system* estimator. The 'corrected' two-step *system* GMM will be used in this paper because of its efficiency, while the relatively less efficient one-step *system* GMM estimators will be reported for comparison.

As mentioned earlier, the issue that often arises when dealing using GMM in the context of small samples is the use of too many instruments (e.g. Roodman, 2007; Beck & Levine, 2004), so the idea here is to contain the instrument set. Roodman (2007) classified the problems of not containing the instrument set into two: (i) the classical problem concerns instrumenting estimators in general. Too many instruments will lead to the problem of 'over fitting of endogenous variables' falling short of eradicating their endogenous component. (ii) The modern problem concerns the use of sample moments to estimate an optimal weighting matrix for the (over) identifying moments between the error terms and the instruments. Taken together, these problems may deceive researchers into believing that their results are valid (due to weakened specification tests), while in actual fact they are invalid. Following from this concern, the paper uses Roodman (2007)'s method 'collapsing' the instrument set and by including one additional control variable at a time as in Beck and Levine (2004).[13] The procedure chosen combines instruments by way of adding them into smaller sets. Therefore, instead of using the standard difference moment conditions in (4) and (5) we impose conditions:

$$E[y_{i,t-s}\Delta\varepsilon_{it}] = 0 \text{ for every } s \geq 2 \tag{8}$$

$$E[x_{i,t-s}\Delta\varepsilon_{it}] = 0 \text{ for every } s \geq 2 \tag{9}$$

The 'collapsed' instrument set contains one instrument for every lag distance and instrumenting variable (second lag of y, third lag of y, and so on), and zeros for missing values.

[13] The other commonly used method of containing the instrument set is limiting the lag length to the second lag. The shortcoming of these alternative methods is that unlike the one used here, which potentially preserves more information, they tend to lose some information.

Specifically, the paper attempts to determine the relationship between financial development and investment and their role in influencing economic performance. To achieve this, a growth regression model similar to Nili and Rastad (2007) is used. The dependent variable is the logarithm of real per capita GDP. The right hand variables include two interaction terms; firstly, the interaction between log of investment and that of financial development indicator to capture the relationship between financial development and investment; secondly, the interaction between the logs of investment, financial development indicator and an oil dummy to capture the potential differences between oil and non-oil economies, as well as a set of variables that act as conditioning variables. Specifically they include, the logarithms of government size, inflation rate, openness to trade, rule of law, these are typically used in finance-growth equations such as Shan (2005).

The first interaction effect serves an important role in that a well developed financial institution has been documented to be linked to the efficiency of investment, thus economic growth. The second interaction effect is intended to account for the differing levels of investment and lower financial development between oil and non-oil economies that the earlier summary statistics revealed. The higher levels of investments found in oil economies are suspected to be financed directly through oil revenues rather than efficiently through financial institutions.

The growth equation for country *i* at period *t* used can be summarized as:

$$Y_{it} = \beta_0 + \beta_1 (I_{it} \times F_{it}) + \beta_2 (I_{it} \times F_{it} \times \text{oil}_i) + \beta_3 \text{ control variables}_{it} + \alpha Y_{it-1} + \varepsilon_{it} \qquad (10)$$

Equation (10) suggests that the level of financial development influences investment, hence economic growth. The more developed financial institutions are, the better the quality of investment and the more effective the latter on economic growth.

$$\begin{aligned}\frac{\partial Y}{\partial F} &= \beta_1 I_{it} + \beta_2 I_{it} \times \text{oil} \\ &= (\beta_1 + \beta_2 \times \text{oil})\, I_{it}\end{aligned} \tag{11}$$

The magnitude of β_1 indicates the significance of investment on economic growth, since it is expected that higher financial development be related to higher capital accumulation, hence economic growth, this coefficient is expected to be positive. β_2 captures the difference of the effect of financial development on investment between oil and non-oil economies, it is expected to have a negative sign since oil economies are expected to have less efficient financial institutions than the control group.

5. Results

Tables 5 and 6 show the results for the two-step variance corrected *system* GMM estimator and the one-step *system* GMM estimator, respectively. In all the regressions the lagged dependent variable is significant, implying that indeed a dynamic model is justified for the analysis at hand. The coefficient of β_1 shows that financial development is capable of effectively transforming capital accumulation into economic growth. Furthermore, β_2 indicates that the effect is lower in oil economies. For instance, regression 1 in table 5 reveals that the impact of a one percent increase in financial development-induced investment leads to a 0.029-0.031=-0.2% decrease in growth of oil economies. While the same change leads to a 0.029=2.9% increase in economic growth of non-oil economies.

Table 5
Two-step variance corrected *system* GMM estimator (PRIVY)

Regressors	(1)	(2)	(3)	(4)	(5)
Constant	-0.200	-0.980	-0.251	-1.813	-0.892
	(0.47)	(0.55)	(0.43)	(0.09)***	(0.40)
Log (per capita GDP) $_{t-1}$	1.010	1.260	1.006	1.061	1.095
	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.00)*
Privy × invest	0.029	0.084	0.018	0.023	0.051
	(0.00)*	(0.01)*	(0.02)**	(0.34)	(0.09)***
Privy × invest × oil	-0.031	-0.084	-0.014	-0.042	-0.039
	(0.06)***	(0.10)***	(0.06)***	(0.07)***	(0.20)
Government size [a]				0.508	
				(0.13)	
Openness to trade [a]		-0.348			
		(0.21)			
Rule of law [a]					-0.158
					(0.40)
Inflation [b]			0.077		
			(0.033)**		
Hansen test of joint validity of instruments (p-value) [c]	0.478	0.854	0.783	0.272	0.501
Serial correlation test (p-value) [d]	0.370	0.445	0.253	0.214	0.483
F-test for joint significance (p-value)	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.00)*
Countries	44	44	44	44	42
Observations	176	176	172	176	168

*Statistically significant at the 1% level
** Statistically significant at the 5% level
*** Statistically significant at the 10% level
P-values are in parenthesis.
The variables used in the interaction term were first converted to logs.
All the regression estimation includes time dummies for the different periods (not reported).
[a] Variable is included as log(variable)
[b] Variable is included as log(1+ variable) to dampen the effects of outliers (Bekaert et al., 2001).
[c] The null hypothesis is that there is no correlation between the instruments used and the residuals.
[d] The null hypothesis is that the errors of the first-difference regression do not exhibit second order serial correlation.

Table 6
One-step *system* GMM estimator (PRIVY)

Regressors	(1)	(2)	(3)	(4)	(5)
Constant	-0.233	-1.201	-0.356	-1.852	-0.246
	(0.42)	(0.33)	(0.39)	(0.09)*	(0.78)
Log (per capita GDP) $_{t-1}$	1.015	1.332	1.005	1.053	1.080
	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.00)*
Privy × invest	0.031	0.065	0.023	0.019	0.022
	(0.02)**	(0.08)***	(0.02)**	(0.33)	(0.61)
Privy × invest × oil	-0.032	-0.132	-0.019	-0.038	-0.089
	(0.22)	(0.10)***	(0.12)	(0.07)***	(0.19)
Government size [a]				0.551	
				(0.14)	
Openness to trade [a]		-0.330			
		(0.37)			
Rule of law [a]					-0.185
					(0.25)
Inflation [b]			0.114		
			(0.26)		
Hansen test of joint validity of instruments (p-value) [c]	0.478	0.854	0.783	0.272	0.501
Serial correlation test (p-value) [d]	0.454	0.435	0.388	0.294	0.503
F-test for joint significance (p-value)	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.00)*
Countries	44	44	44	44	44
Observations	176	176	172	176	172

*Statistically significant at the 1% level
** Statistically significant at the 5% level
*** Statistically significant at the 10% level
P-values are in parenthesis.
The variables used in the interaction term were first converted to logs.
All the regression estimation includes time dummies for the different periods (not reported).
[a] Variable is included as log(variable)
[b] Variable is included as log(1+ variable) to dampen the effects of outliers (Bekaert et al., 2001).
[c] The null hypothesis is that there is no correlation between the instruments used and the residuals.
[d] The null hypothesis is that the errors of the first-difference regression do not exhibit second order serial correlation.

For both cases, the results show stronger evidence that through their link with investment; financial institutions have a statistically and economically positive impact on economic growth, this outcome is consistent with studies such as Beck and

Levine(2004); Levine et al.(2000).[14] Secondly, there is strong evidence (especially on the basis of corrected *system* GMM) to support our assertion that the effectiveness of financial development on investment might be lower for oil economies. This outcome is a plausible explanation as to why these economies have lower economic growth in spite of their relatively higher investment levels, suggesting that the high investment is associated with higher oil revenues rather than high financial development.

The results are consistent with those of Nili and Rastad (2007) and Gylfason and Zoega (2001) theory that the quality rather than quantity of investment is important. The results are not due to possible biases from over fitting, simultaneity, country-specific effects nor omitted variables. Furthermore, the specification tests lead us not to reject the null of no second order serial correlation in the differenced error term and all the instruments used are adequate.

The regressions were also repeated for the commonly used financial indicator that measures financial depth. Regardless of the *system* GMM used, relative to the other financial indicator, regressions involving domestic credit to the private sector produce sharper results (i.e. results in table 5 and 6) implying that domestic credit plays a more important role than financial depth, this result is consistent with theories that emphasize the important role of financial development in economic growth through its effect on capital accumulation. The results are not unexpected since domestic credit to the private sector provides a better measure of financial activity because it accurately characterizes the actual amount of funds routed into the private sector. Hence it is more related to investment and growth.

[14] As a sensitivity test, the equations 1 to 5 of table 5 were re-estimated without the interaction between domestic credit to the private sector, investment and the oil dummy. The estimation of the 'new' equations did not change the conclusions concerning the interaction between investment and domestic credit to the private sector.

Even for this financial indicator, overall financial development can not be dismissed as being irrelevant or even harmful to economic growth via its link to investment.[15] In this case also, the corrected *system* GMM estimator gives sharper results than the other estimator.

Table 7
Two-step variance corrected *system* GMM estimator (DEPTH)

Regressors	(1)[b]	(2)	(3)	(4)	(5)
Constant	-0.791	-0.926	-0.706	-3.352	-2.619
	(0.27)	(0.02)*	(0.17)	(0.01)*	(0.10)***
Log (per capita GDP) $_{t-1}$	1.043	1.030	1.017	1.290	1.236
	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.00)*
Depth × invest	0.063	0.048	0.048	0.061	0.122
	(0.11)	(0.08)***	(0.00)*	(0.11)	(0.09)***
Depth × invest × oil	-0.034	-0.029	-0.005	-0.083	-0.052
	(0.13)	(0.08)*	(0.45)	(0.07)***	(0.33)
Government size [a]				0.342	
				(0.18)	
Openness to trade [a]		0.090			
		(0.14)			
Rule of law [a]					-0.171
					(0.45)
Inflation [b]			0.081		
			(0.14)		
Hansen test of joint validity of instruments (p-value)[c]	0.379	0.426	0.813	0.632	0.925
Serial correlation test (p-value)[d]	0.389	0.340	0.327	0.299	0.435
F-test for joint significance (p-value)	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.00)*
Countries	44	44	44	44	42
Observations	176	176	172	176	168

*Statistically significant at the 1% level
** Statistically significant at the 5% level
*** Statistically significant at the 10% level
P-values are in parenthesis.
The variables used in the interaction term were first converted to logs.
All the regression estimation includes time dummies for the different periods (not reported).
[a] Variable is included as log(variable)
[b] Variable is included as log(1+ variable) to dampen the effects of outliers (Bekaert et al., 2001).
[c] The null hypothesis is that there is no correlation between the instruments used and the residuals.
[d] The null hypothesis is that the errors of the first-difference regression do not exhibit second order serial correlation.

[15] The two equations where this interaction term is insignificant, is only so at the 11% level of significant.

Table 8
One-step *system* GMM estimator (DEPTH)

Regressors	(1)	(2)	(3)	(4)	(5)
Constant	-0.856	-1.126	-0.788	-2.908	-2.380
	(0.22)	(0.31)	(0.24)	(0.01)*	(0.03)*
Log (per capita GDP) $_{t-1}$	1.038	1.027	1.007	1.138	1.229
	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.00)*
Depth × invest	0.073	0.054	0.060	0.070	0.152
	(0.15)	(0.14)	(0.07)***	(0.07)***	(0.11)
Depth × invest × oil	-0.036	-0.033	-0.009	-0.105	-0.104
	(0.20)	(0.20)	(0.27)	(0.05)**	(0.22)
Government size [a]				0.581	
				(0.11)	
Openness to trade [a]		0.131			
		(0.47)			
Rule of law [a]					-0.498
					(0.27)
Inflation [b]			0.106		
			(0.31)		
Hansen test of joint validity of instruments (p-value) [c]	0.379	0.426	0.813	0.632	0.925
Serial correlation test (p-value) [d]	0.453	0.443	0.462	0.169	0.508
F-test for joint significance (p-value)	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.00)*
Countries	44	44	44	44	42
Observations	176	176	172	176	168

*Statistically significant at the 1% level
** Statistically significant at the 5% level
*** Statistically significant at the 10% level
P-values are in parenthesis.
The variables used in the interaction term were first converted to logs.
All the regression estimation includes time dummies for the different periods (not reported).
[a] Variable is included as log(variable)
[b] Variable is included as log(1+ variable) to dampen the effects of outliers (Bekaert et al., 2001).
[c] The null hypothesis is that there is no correlation between the instruments used and the residuals.
[d] The null hypothesis is that the errors of the first-difference regression do not exhibit second order serial correlation.

The inferences are based on the *system* two-step variance corrected GMM and the one-step *system* GMM are given for comparison (as mentioned before, the latter is the most commonly used estimator for inferences. The estimator chosen for making inferences in this paper is documented to give more accurate inference in finite samples by competently estimating the finite sample variance of the two step *system* GMM estimator. Our results support this assertion. The chosen estimator gives sharper results than the one-step *system* GMM results. The one-step *system* results in tables 6 and 8 are consistent with Beck and Levine (2004) in that they give a more 'cautious assessment' of the role of financial development in economic growth. Furthermore, the value of the corrected standard errors lies between those of the system one-step and the two-step *system* GMM estimators.[16]

6. Conclusion

The paper examines the role played by financial development on economic performance of oil vis-à-vis non-oil producers. Two econometric approaches were used. The first is an alternative two-step variance corrected *system* GMM estimator proposed by Windmeijer (2005) that gives more accurate inference in finite samples. The second estimator is the relatively less efficient one-step *system* GMM that is commonly used for making inferences, and is intended only for comparison purposes.

For both estimators, the results support the commonly held theory that financial development will, through its effect on capital accumulation, influence economic performance. Additionally, there is some evidence to support the assertion that the potency of financial development on investment is lower for oil economies. This outcome offers an explanation for their lower economic growth in spite of apparently relatively higher investment, suggesting that the high levels of investment are of lower quality ('lower spillover') types of investment aimed at generating higher oil

[16] The standard errors for the corrected estimator are higher than those of the one-step *system* GMM estimator but lower than those of the two-step *system* GMM estimator. The system two-step estimators were calculated and irrespective of the financial indicator or the regression specification used, the explanatory variables are significant.

revenues. The policy implication is that for natural resource endowments to work for such economies, investment on its own is not enough unless it is accompanied by a well developed financial system that channels the returns from resource abundance into highly productive, long-run drivers of economic growth.

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Appendix

Table A1

System GMM two-step estimator (PRIVY)

Regressors	(1)	(2)	(3)	(4)	(5)
Constant	-0.200	-0.980	-0.251	-1.813	-0.892
	(0.00)*	(0.30)	(0.00)*	(0.00)*	(0.02)*
Log (per capita GDP) $_{t-1}$	1.010	1.260	1.006	1.061	1.095
	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.00)*
Privy × invest	0.029	0.084	0.018	0.023	0.051
	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.01)*
Privy × invest × oil	-0.031	-0.084	-0.014	-0.042	-0.039
	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.02)**
Government size [a]				0.508	
				(0.000)*	
Openness to trade [a]		-0.348			
		(0.06)***			
Rule of law [a]					-0.158
					(0.01)*
Inflation [b]			0.077		
			(0.00)*		
Hansen test of joint validity of instruments (p-value)[c]	0.478	0.854	0.783	0.272	0.501
Serial correlation test (p-value)[d]	0.326	0.418	0.170	0.184	0.384
F-test for joint significance (p-value)	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.00)*
Countries	44	44	44	44	42
Observations	176	176	172	176	168

*Statistically significant at the 1% level
** Statistically significant at the 5% level
*** Statistically significant at the 10% level
P-values are in parenthesis.
The variables used in the interaction term were first converted to logs.
All the regression estimation includes time dummies for the different periods (not reported).
[a] Variable is included as log(variable)
[b] Variable is included as log(1+ variable) to dampen the effects of outliers (Bekaert et al., 2001).
[c] The null hypothesis is that there is no correlation between the instruments used and the residuals.
[d] The null hypothesis is that the errors of the first-difference regression do not exhibit second order serial correlation.

Table A2

System GMM two-step estimator (DEPTH)

Regressors	(1)	(2)	(3)	(4)	(5)
Constant	-0.791	-0.926	-0.706	-3.352	-2.619
	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.00)*
Log (per capita GDP) $_{t-1}$	1.043	1.030	1.017	1.290	1.236
	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.00)*
Depth × invest	0.063	0.048	0.048	0.061	0.122
	(0.00)*	(0.00)*	(0.00)*	(0.01)*	(0.00)*
Depth × invest × oil	-0.034	-0.029	-0.005	-0.083	-0.052
	(0.00)*	(0.00)*	(0.01)*	(0.00)*	(0.02)**
Government size [a]				0.342	
				(0.010)*	
Openness to trade [a]		0.090			
		(0.03)**			
Rule of law [a]					-0.171
					(0.28)
Inflation [b]			0.081		
			(0.00)*		
Hansen test of joint validity of instruments (p-value)[c]	0.379	0.426	0.813	0.632	0.925
Serial correlation test (p-value)[d]	0.317	0.313	0.270	0.255	0.390
F-test for joint significance (p-value)	(0.00)*	(0.00)*	(0.00)*	(0.00)*	(0.00)*
Countries	44	44	44	44	42
Observations	176	176	172	176	168

*Statistically significant at the 1% level
** Statistically significant at the 5% level
*** Statistically significant at the 10% level
P-values are in parenthesis.
The variables used in the interaction term were first converted to logs.
All the regression estimation includes time dummies for the different periods (not reported).
[a] Variable is included as log(variable)
[b] Variable is included as log(1+ variable) to dampen the effects of outliers (Bekaert et al., 2001).
[c] The null hypothesis is that there is no correlation between the instruments used and the residuals.
[d] The null hypothesis is that the errors of the first-difference regression do not exhibit second order serial correlation.

Table A3

List of oil countries

Algeria	Iran	Saudi Arabia	
Congo, Rep.	Nigeria	Trinidad & Tobago	Venezuela
Gabon Iran	Oman	United Arab Emirates	

The countries are a subset (excludes Brunei & Kuwait due to data limitations) of those used by Nili & Rastad (2007)

Table A4

List of non-oil countries

Bahrain	Dominican Rep.	Jordan	Senegal
Bolivia	Ecuador	Madagascar	Sierra Leone
Botswana	Egypt	Malaysia	South Africa
Brazil	Gabon	Mali	Suriname
Burkina Faso	Ghana	Mauritania	Togo
Cameroon	Guyana	Mexico	Tunisia
Central African.	India	Morocco	Zambia
Chile	Indonesia	Niger	Zimbabwe
China	Jamaica	Peru	

The list is heavily drawn from Weber-Fahr (2002)‘s list of mining economies for the period 1990-99. The countries excluded here are those that did not have all the data needed in the analysis