

## **Making Abundant Natural Resources Work for Developing Economies: The Role of Financial Institutions**

**Malebogo Bakwena, Philip Bodman<sup>†</sup> and Sandy Suardi\***

### **Abstract**

Can financial development play a role in abating the *natural resource curse*?<sup>1</sup> What are the channels via which financial development may negate the potential detrimental effects of natural resources on economic growth? To attempt to answer these questions, the paper employs panel unit root, cointegration and error correction models to fourteen natural resource abundant economies.<sup>2</sup> The empirical results suggest a long run cointegrating relationship between finance, growth and ancillary variables. A fully modified OLS (FMOLS) is then used to estimate the long run relationship. A panel error correction model favors a unidirectional long run causal relationship from financial development to growth. The results do indeed imply that development of financial institutions may help in abating the *natural resource curse*.

**Keywords:** economic growth, financial development, natural resource curse, panel data, cointegration, error correction, fully modified OLS

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

---

<sup>†</sup> Corresponding author [p.bodman@economics.uq.edu.au](mailto:p.bodman@economics.uq.edu.au)

\* M. Bakwena and P. Bodman, School of Economics, University of Queensland, Brisbane, QLD, S.Suardi, School of Economics, LaTrobe University, Melbourne, VIC.

<sup>1</sup> Contrary to conventional wisdom, a growing body of evidence indicates that natural resource dependence may be harmful to development in low and middle income level countries. This counter-intuitive result forms the basis of the *resource curse thesis* (Sachs & Warner, 2001; Nankani, 1979).

<sup>2</sup> The most commonly used terms in the literature are natural resource intensity or dependence. Natural resource abundance is synonymous to these terms. Natural resource abundant economies are defined as those whose resource production account for at least 40% of GDP and/or at least 8% of exports.

## 1. Introduction

This study is related to two strands of literature. The first significant line of work concerns natural resources and economic growth, which typically conjectures that economies with low levels of investment tend to be plagued by the *natural resource curse*. The second significant line of work relates to the interaction between financial development and growth. It has been documented that a well-developed financial system is, among other things, able to efficiently allocate resources and thus boost investment (McKinnon, 1973; Shaw, 1973).

A vast amount of both theoretical and empirical literature has established a positive impact of financial development on economic growth. Authors such as Levine (1997) have linked financial development and economic growth through two main channels. The first is by facilitating an increasing savings, therefore resources, which can be channeled towards investment. The second is by improving resource allocation and hence the efficiency of investment. On this basis, finance is potentially one factor that could explain the differences in capital accumulation hence economic performance.

However, the effect of financial development on growth, taking into account the possible dampening effect of natural resource abundance, has not been studied thoroughly yet. Among the few studies, Nili and Rastad (2007) concluded that contrary to the general consensus, financial development had a net dampening effect on investment and growth in oil exporting economies. Furthermore, they observed that these economies were characterised by weak financial institutions which contributed to the poor performance in terms of economic growth. Based on a sample of eighty-five countries, faced with differing natural resource intensities, Gylfason

and Zoega (2001) found that high natural resource dependence was associated with low financial development. The low/weak financial institutions documented by such studies clearly has the potential to detract from economic performance by hindering capital accumulation.<sup>3</sup>

To further explain the role financial development plays in the presence of abundant natural resources, this paper uses recently developed time series panel unit root, cointegration and causality tests. The paper makes a contribution to both the finance-growth and natural resource-growth literatures in several ways. Firstly, by appreciating the possible detrimental effect of natural resource abundance, it is intended to complement a handful of studies (such as Apergis, Filippidis, & Economidou, 2007; Christopoulos & Tsionas, 2004) that employ similar panel techniques (and time series) to examine the relationship between financial development and economic growth. Secondly, with regard to the natural resource-growth literature, it intends to complement (Nili & Rastad, 2007) by examining both oil and non-oil abundant economies and more importantly in terms of the methodology used.<sup>4</sup>

The set up here allows us to firstly determine whether there is a structural long run relationship (without which short run dynamics can be misleading) between financial development and economic growth. This enables us to confidently determine the short run dynamics. The commonly used Generalized Method of Moments (GMM) dynamic estimators are designed to, among other things; deal with the issue of simultaneity at the expense of not appreciating the integration and cointegration

---

<sup>3</sup> The finding is consistent with the new growth literature (e.g. Romer, 2006) that views capital accumulation as a key determinant of differences in output performances.

<sup>4</sup> Nili and Rastad (2007) uses the commonly used first difference GMM estimation procedure.

properties of the data.<sup>5</sup> Consequently, one cannot tell whether the estimated panel models are representative of a structural long run relationship or a spurious one (Apergis et al., 2007; Christopoulos & Tsionas, 2004). The paper also appreciates that correlation among variables does not imply causation. Gylfason & Zoega (2001) determined that high natural resource dependence was correlated with a low degree of financial development. Carrying out formal causality tests and taking into account possible simultaneity biases sheds additional light on this issue, and among other things, the existence or non-existence of the highly debated *natural resource curse*.

## **2. Literature review**

Natural resources (usually comprising primary commodities) have, in the history of economic thought, been treated as less important than labour and capital. Before the twentieth century, they played a pivotal role in world trade with many countries, such as Australia, US and Canada enjoying the strong support from primary commodity exports in the early stages of their economic development (Auty & Mikesell, 1998; North & Thomas, 1973). In the twentieth century, primary exports were treated differently as a result of their failing to deliver satisfactory growth outcomes. Contrary to conventional wisdom, a growing body of evidence indicates that natural resource abundance may be harmful to development in low and middle income level countries. This counter-intuitive result forms the basis of the *resource curse thesis* (Sachs & Warner, 2001; Nankani, 1979).

There is an established body of empirical literature that shows that mineral economies tend to under-perform relative to their non-mineral counterparts (Auty & Mikesell,

---

<sup>5</sup> For example in Nili & Rastad, 2007; Beck, Lundberg, & Majnoni, 2006; Levine, Loayza, & Beck, 2000.

1998; Auty, 1993; Gelb & Associates, 1988). One of the commonly cited reasons is that the contributions of the mineral sector to economic growth take ‘the form of a series of booms and downswings’ (Auty, 1993). The impact of the mineral sector on economic growth is closely linked to the government’s budget through the taxation and royalties generated.<sup>6</sup> The repeated occurrence of revenues that are in excess of normal return on capital and production costs often bring about instability in the economy. In the absence of measures to ‘smooth out’ volatile revenue inflows generated by natural resources, taxes that accrue to the government are cyclical. The unpredictability of these cycles tends to create considerable misallocation of resources that impact negatively on the non-mineral tradable sectors. Thus the effectiveness of using these large revenues for development has been severely hampered by increases in revenue volatility (Auty, 1993).

There are other channels through which natural resource dependence could reduce economic growth (e.g. rent seeking, Dutch disease, over optimism of governments etc.). Two of the often neglected channels are savings and investments. Gylfason & Zoega (2006) show that there is a positive correlation between low growth and natural resource dependence in countries with relatively low saving and investment levels. The roles of savings and investment are undoubtedly intricately linked to the sophistication of the financial system. Earlier studies done by McKinnon (1973) and Shaw (1973) have documented that low savings and investment are related to an underdeveloped financial system. Given that the financial system is influential in alleviating the levels of savings and investment in an economy, the problem of low

---

<sup>6</sup> Tax revenue is the dominant form of economic linkage in mineral economies because of extensive use of capital.

growth rates due to natural resource abundance could be avoided provided that there is a relatively well developed financial system.

The prominence of the view that finance plays an important role in the real sector dates back to Schumpeter (1911). In this early work, the important role that the banking sector plays in economic growth is emphasised. Also, situations in which financial institutions are capable of funding as well as identifying productive investments, thus spurring innovation and future growth, are highlighted. The literature following Schumpeter (1911) also suggested that a developed financial system played a pivotal role in economic development. Among these, McKinnon (1973) and Shaw (1973) came to the conclusion that finance, by raising saving and capital accumulation will raise economic growth. The recent theoretical literature as presented in Bencivenga, Smith and Starr (1995), Saint-Paul (1992), King and Levine(1993b), Bencivenga and Smith (1991), Greenwood and Jovanovich (1990) suggested several channels through which finance can affect macroeconomic cycles. They concluded that through its function of resource allocation, particularly its effect on the saving rate, financial development can enhance economic growth.<sup>7</sup>

Of course financial reform *per se* does not always deliver rosy outcomes. Even after undertaking financial reforms, some OECD countries did not experience acceleration in their savings, investment and growth (Shan, Morris, & Sun, 2001). Furthermore, Bodman (1995) noted for eight OECD countries between 1960 and 1993 that in cases

---

<sup>7</sup> 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.

where saving had gone up subsequent to financial deregulation, there was not much empirical evidence relating a long run connection between saving and domestic investment. Moving away from OECD countries, Reinhart & Tokatlidis (2003) concluded that for twenty-nine Sub-Saharan economies, following financial development the saving and investment levels were generally lower, with no reduction in economic growth. They further observed that these results were more prevalent in low income economies. Moreover, the 1980s rapid growth of the ‘Asian tigers’ decreased following ‘considerable, and perhaps excessive, development of their financial sector’ (Shan, 2005, p. 1353). This shows that an expansion in the financial sector can bring about grave distraction to emerging market economies.

However, whilst such studies cast doubt as to the importance of finance in promoting saving, investment and economic growth it seems likely that the multi-faceted benefits that financial development can have on broader economic development are substantial in the longer term. One of the lessons learnt from the 1990’s financial crises is that access for developing countries to international capital does not exist in ‘worst times’ and is weak in the ‘best of times’ (Reinhart & Tokatlidis, 2003).<sup>8</sup> International capital flows are unstable and are more so in Asia, especially following rapid development in the financial sector (Lawrence, 2003). But clearly, countries that ought to import capital overseas need a well functioning financial sector, otherwise they are excluded from accessing international markets, even in the good times. Levine (1998) presented evidence to show that comprehension of the role of finance in growth may possibly aid governments in less developed countries (LDCs) to establish whether they should give priority to reforms in the financial sector. Through

---

<sup>8</sup> Access to international capital is especially important for developing economies because it improves their business opportunities (Lawrence, 2003).

its function of resource allocation it is envisaged that the financial system would be able to redirect mineral revenues to viable investment opportunities in the non-mineral sectors of the economy that would lead to a sustainable growth.

In seeking to understand the relationship between finance and growth, two schools of thought have emerged. There is the 'supply-leading' view and the 'demand following' view. According to the former view, a developed financial sector is necessary for attaining high rates of economic growth.<sup>9</sup> A growing economy is able to generate new and additional demands for financial services, which in turn prompts a 'supply response in the growth of the financial system' (Patrick (1966)). If this holds true, then this implies that the lack of well developed financial systems in less developed countries is an indication of lack of demand for such.

Conversely, the 'demand-following' view asserts that growth in the real sector leads to the development of the financial sector. A rapid growth in real national income will tend to prompt a higher demand for external funding (what others have saved), thus a need for financial intermediation. Financial intermediation will be important for transferring saving between individuals and from slow growing sectors to fast growing ones. Thus the intermediation can be used to sustain and support leading sectors in the growth process.

On the basis of these two views, the question of whether a developed financial system precedes economic growth has led to more empirical examination of the issue.

---

<sup>9</sup> Even though it is necessary to have a developed financial market to attain high economic growth rates, the supply-leading finance cannot be said to be a precondition for achieving 'self-sustained economic development' (Patrick, 1966, p. 176). The view rather presents a way of inducing real growth through finance.



Empirical examination of the causal relationship between financial development and economic growth take three broad econometric approaches. The traditionally used approach is cross sectional data, which assumes that causality is unidirectional from financial development to growth. Cross sectional studies include, Levine and Zervos (1998); Levine (1997); (King & Levine, 1993b, 1993a) who found that the ‘supply leading’ view held for their respective samples. Unfortunately, the cross-sectional studies do not take into consideration heterogeneity of sample members or reverse causality, which is likely to introduce simultaneity bias (Shan et al., 2001), and thus may give misleading results.

Subsequently, time series modelling frameworks were utilised to deal with the possibility of reverse causality, and to take into account heterogeneity that is present in countries. For instance, based on unit root tests and cointegration analysis, the ‘supply leading’ view is supported by Bhattacharya & Sivasubramanian (2003), for the case of India for the period between 1970/1971 and 1998/1999. Making use of manufacturing data from thirteen OECD countries for the period 1970 to 1991, Neusser and Kugler (1998) found support for the supply view in ten of the thirteen countries (the other three supported the ‘demand following’ view). Chang & Caudill (2005) observed that for the period 1962 to 1998 the supply leading view was supported by Taiwanese data. Other studies, such as those of Shan & Morris (2002) and Hondroyannis, Lolos & Papapetrous (2005) concluded that both views held for their samples (i.e. the relationship between financial development and economic growth is bi-directional).

Overall the empirical results seem to be more mixed for developed economies although they seem to suggest that Patrick's 'supply leading' view is more prominent in developing economies. A plausible explanation of the differences in results might be attributed to the differences in countries and time periods examined, statistical methods and variables measured. To improve upon the validity of the results, recent studies have moved to combining the time series and cross sectional properties of the data (i.e. panel data studies). This overcomes potential problems of too few observations, that may lead to small sample biases faced by time series studies, and the problem of not taking into account heterogeneity and simultaneity biases prevalent in cross sectional studies.

As noted earlier, recent empirical studies (e.g. Nili & Rastad, 2007; Beck et al., 2006; Christopoulos & Tsionas, 2004; Levine et al., 2000) on the role of financial development in different aspects of economic growth have extensively used panel data. Levine, Loazya & Beck (2000) uses a panel of seventy- four developing and developed countries over the period 1960-1995 to explain the finance-growth nexus while taking into account potential biases due to unobserved country-specific effects, omitted variables as well as simultaneity bias. To deal with these problems, they used Generalized Methods of Moments (GMM) estimators developed for dynamic models of panel data as introduced by Holtz-Eakin, Newey & Rosen (1988) and Arrelano and Bond (1991). The results were consistent with the growth enhancing hypothesis of financial development. Furthermore, Levine (1998) used GMM estimators to account for simultaneity bias for a sample of forty-four developed and developing countries during 1975-1993 to examine the link between long run growth and banking development. Similarly Nili and Rastad (2007) use GMM estimators to go about

solving problems of omitted variables and endogeneity to examine the role of financial development in the context of oil exporting economies.

### 3. The Econometric model and Causality Tests

To examine the role of financial development on natural resource abundant economies, we estimate the empirical model

$$Y_{it} = \beta_{0i} + \beta_{1i}F_{it} + \beta_{2i}I_{it} + \beta_{3i}N_{it} + u_{it} \quad (1)$$

where  $Y_{it}$  is real output in country  $i$  and year  $t$ ,  $I_{it}$  is investment,  $N_{it}$  is natural resource intensity,  $F_{it}$  is a financial development indicator and  $u_{it}$  is the error term. Since the direction of causality between economic growth and finance is not clear, the model can also be represented as

$$F_{it} = \beta_{0i} + \beta_{1i}Y_{it} + \beta_{2i}I_{it} + \beta_{3i}N_{it} + v_{it} \quad (2)$$

The determination of the relationship and causality between the variables involves carrying out the following procedures:

1. A determination of the order of integration for the variables in regressions (1) and (2). This preliminary data analysis is essential since, if the variables are found to be I (1) series, then we need to test for possible long run relationships.
2. An examination of the long run relationship among the variables by way of panel cointegration tests. If the variables are not cointegrated, we will estimate the system in first differences, otherwise a system of panel error correction model will be estimated.
3. An evaluation of the direction of causality through the use of dynamic panel error correction model.

Each of these procedures is discussed more thoroughly as follows:

### 3.1 Determining the order of integration

To identify a possible long run relationship between the variables, they need to be integrated of order one, I (1), in levels. This is determined through the use of panel unit root tests which have better power than ADF tests, especially with a short time span ( $t=20$ ) as in our sample. The panel unit root tests used are those proposed by Im, Pesaran and Smith (IPS) (1997, 2003) and Hadri (2000). The use of more than one test is motivated by the fact that the commonly used test, IPS, has low power if the deterministic regressors are misspecified leading to a failure to reject the null hypothesis of a unit root.

For the IPS test, the null hypothesis is that of a unit root and it is reversed for the Hadri test. The panel regression is

$$y_{it} = \rho_i y_{it-1} + \sum_{j=1}^{p_i} \phi_{ij} \Delta y_{it-j} + z'_{it} \gamma_i + \varepsilon_{it}, \quad (3)$$

and we test the null hypothesis of  $H_0 : \rho_i = 1$  (there is a unit root, for all  $i$ ) against an alternative hypothesis  $H_1 : \rho_i < 1$  (there is no unit root for at least one  $i$ , the test assumes a heterogeneous alternative). The IPS test statistic is

$$t_{IPS} = \frac{\sqrt{n}[\bar{t} - E(t_i / \rho_i = 0)]}{\sqrt{Var(t_i / \rho_i = 0)}} \sim N(0,1) \quad (4)$$

where the moments  $E(t_i / \rho_i = 0)$  and  $Var(t_i / \rho_i = 0)$  are tabulated in IPS (1997) and

$\bar{t} = N^{-1} \sum_{i=1}^N t_i$  is a simple average of the individual series Augmented Dickey

Fuller(ADF) test statistic.

As mentioned earlier, the Hadri test statistic reverses the null hypothesis to a stationary hypothesis, i.e. have a null of no unit root in any of the series in the panel.

The test is based on a residual based Lagrange Multiplier (LM) statistic given as

$$LM = \frac{\frac{1}{N} \sum_{i=1}^N \frac{1}{T^2} \sum_{t=1}^T s_{it}^2}{\hat{\sigma}^2}, \quad (5)$$

Where  $s_{it} = \sum_{j=1}^t \hat{e}_{ij}$  and  $\hat{\sigma}^2$  is the error variance estimate.

### 3.2 Panel Cointegration

Should the variables of interest be found to be integrated of order one, I (1), the next step is to determine whether a long run relationship exists between the variables by way of a panel cointegration test. To establish the (non-) existence of panel cointegration, we will use the method developed by Pedroni (1999). The method involves an estimation of a hypothesised cointegration relationship for each panel member followed by a pooling of the resulting residuals. To test the null hypothesis of no cointegration, the method requires the computation of the regression residuals from the following hypothesised cointegrating regressions

$$Y_{it} = \alpha_i + \delta_i t + \beta_{1i} I_{it} + \beta_{2i} F_{it} + \beta_{3i} N_{it} + \varepsilon_{it} \quad (6)$$

$$F_{it} = \gamma_i + \lambda_i t + \theta_{1i} Y_{it} + \theta_{2i} I_{it} + \theta_{3i} N_{it} + \varepsilon_{it} \quad (7)$$

where the  $\beta$  ( $\theta$ )'s are allowed to vary across individual panel members,  $\alpha$  ( $\gamma$ ) and  $\delta$  ( $\lambda$ ) represent country and time effects, respectively. A time trend dummy  $t$  is included in the regression (6) and (7) to capture possible deterministic trend in the average output growth. Based on equation (6) and (7), Pedroni (1999) suggested two

types of statistics, the within-based (or panel cointegrating) statistics and the between-based (or the group mean panel) statistics. The first sets of statistics are based on pooling the autoregressive coefficients across different members for the unit root tests on the estimated residuals. The second sets of statistics are based on estimators that take a simple average of the individually estimated coefficients for each member.

Following Pedroni (1999), the statistics are calculated as:

Panel  $\nu$  statistic:

$$Z_\nu = \left( \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{it-1}^2 \right)^{-1}$$

Panel  $\rho$  statistic

$$Z_\rho = \left( \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{it-1}^2 \right)^{-1} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} (\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_i)$$

Panel PP-statistic

$$Z_t = \left( \hat{\sigma}^2 \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{it-1}^2 \right)^{-\frac{1}{2}} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} (\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_i)$$

Panel ADF-statistic

$$Z_t^* = \left( \hat{s}^{*2} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{it-1}^{*2} \right)^{-\frac{1}{2}} \sum_{i=1}^N \sum_{t=1}^T \hat{L}_{11i}^{-2} \hat{e}_{it}^{*2} \Delta \hat{e}_{it}^*$$

Group  $\rho$  statistic

$$\tilde{Z}_\rho = \sum_{i=1}^N \left( \sum_{t=1}^T \hat{e}_{it-1}^2 \right)^{-1} \sum_{t=1}^T (\hat{e}_{it-1} \Delta \hat{e}_{it} - \hat{\lambda}_i)$$

Group PP statistic

$$\tilde{Z}_t = \sum_{i=1}^N \left( \hat{\sigma}^2 \sum_{t=1}^T \hat{e}_{it-1}^2 \right)^{-\frac{1}{2}} \sum_{t=1}^T (\hat{e}_{it-1} \Delta \hat{e}_{it-1} - \hat{\lambda}_i)$$

Group ADF-statistic

$$\tilde{Z}_t^* = \sum_{i=1}^N \left( \sum_{t=1}^T \hat{s}_i^{*2} \hat{e}_{it-1}^{*2} \right)^{-\frac{1}{2}} \sum_{t=1}^T (\hat{e}_{it-1}^* \Delta \hat{e}_{it}^*)$$

Where  $\hat{e}_{it}$  is the estimated residual from equations (6) and (7),  $L_{11i}^2$  is the estimated long run covariance matrix for  $\Delta\hat{e}_{it}$ ,  $\hat{L}_i$  is used to adjust for correlation in the panel ADF model.  $\hat{\sigma}_i^2$  and  $\hat{s}_i^2(\hat{s}_i^{*2})$  are the long run and variances for country  $i$ , respectively. The decision rule is to reject the null hypothesis if the absolute value of test is greater than the critical value that is provided by Pedroni (1999).

### 3.3 Fully Modified Ordinary Least Squares (FMOLS)

If the cointegration relation exists (thus a long run relationship exists between the variables), then equations (1) and (2) will be estimated using the Pedroni's (2000) method of FMOLS designed for heterogeneous cointegrated panels. This type of least squares is used because in cases where the variables are I (1), OLS estimation yield biased estimators. Furthermore, the method is intended to address the issue of endogeneity, simultaneity bias and the non-stationarity of the regressors that is the main concern in panel studies (e.g. Christopoulos & Tsionas, 2004; Levine, 2003)

A cointegrated system for a panel of  $i=1, \dots, N$  members is represented as,

$$\begin{aligned} y_{it} &= \alpha_i + \beta x_{it} + \mu_{it} \\ x_{it} &= x_{it-1} + \varepsilon_{it} \end{aligned} \quad (8)$$

Where  $\xi_{it} = (\mu_{it}, \varepsilon_{it})'$  is a stationary vector error process with covariance matrix  $\Omega_i$ .

Taking into account heterogeneity that exists in fixed effects and in the short run dynamics, a panel FMOLS estimator for the coefficient of the  $\beta$  in (8) is

$$\hat{\beta}_{FM} - \beta = \frac{\sum_{i=1}^N \hat{\Omega}_{11i}^{-1} \hat{\Omega}_{22i}^{-1} \left( \sum_{t=1}^T (x_{it} - \bar{x}_t) \mu_{it}^* - T \hat{\gamma}_i \right)}{\left( \sum_{i=1}^N \hat{\Omega}_{22i}^{-2} \sum_{t=1}^T (x_{it} - \bar{x}_t)^2 \right)}$$

where

$$\mu_{it}^* = \mu_{it} - \frac{\hat{\Omega}_{21i}}{\hat{\Omega}_{22i}} \Delta x_{it}, \quad \hat{\gamma}_i \equiv \hat{\Gamma}_{21i} + \hat{\Omega}_{21i}^0 - \frac{\hat{\Omega}_{21i}}{\hat{\Omega}_{22i}} (\hat{\Gamma}_{22i} + \hat{\Omega}_{22i}^0)$$

Should the test fail to identify the presence of a cointegrating relationship, FMOLS will not be estimated and the causality tests will be carried out using first-differenced of the variables in a vector autoregression framework.

### 3.4 Testing for causality

Having established that the variables are cointegrated, the next step is to test for a causal relationship. A causal relationship is established using Pesaran, Shin and Smith (1999)'s Pooled Mean Group (PMG).<sup>10</sup> It is informative to examine how PMG differs from alternative panel estimators. Standard fixed effects estimator calculates a variance weighted averages; however, it is not appropriate for dynamic models. Moreover, the GMM and other pooled estimation models such as the fixed effects and instrumental variables are intended to address potential misspecifications and achieve consistent estimates in the presence of endogeneity.<sup>11</sup> The estimation procedures assume homogeneity in the slope coefficients. Then again, these estimation procedures are likely to produce inconsistent and misleading long run coefficients unless the slope coefficients are indeed identical (Pesaran et al., 1999). The PMG estimator assumes long run homogeneity of coefficients but short run heterogeneity of coefficients and error variances. It is not a bad idea to expect the long run equilibrium relationship between variables to be similar for the economies under study since they have a common characteristic (have abundant natural resources) which influences

---

<sup>10</sup> For comparison with previous studies a GMM estimator is also used. The results of this exercise are provided in the appendix.

<sup>11</sup> These estimators are commonly used in the finance-growth literature, e.g. Levine, Loayza & Beck (2000) use a GMM; Christopoulos & Tsionas (2004) use an instrumental variable estimator.



them in a similar fashion. They generally undergo similar structural changes, due to similar experiences, such as the Dutch disease (Davis, 1995), over optimism of governments (Gelb & Associates, 1988). Furthermore, the estimator permits the estimation of the common long run coefficient without making the less credible assumption of identical dynamics in each economy (Pesaran et al., 1999).

The error correction VAR used here is specified as:

$$\Delta Y_{i,t} = \alpha_0 + \alpha_1 t + \phi_1 y_{t-1} + \phi_2 x_{t-1} + \sum_{k=1}^{m-1} \theta_{ik} \Delta Y_{i,t-k} + \sum_{k=1}^{m-1} \beta'_{i,k} \Delta X_{i,t-k} + \varepsilon_{it}$$

Where  $t = 1, \dots, T$ ;  $i = 1, \dots, N$ ,  $k$  is the optimal lag length<sup>i</sup>,  $\Delta$  represents first differencing. The  $\phi$ 's represent the long run multipliers, while  $\theta$  and  $\beta$  are the respective short-run dynamic coefficients. An explanatory variable will, in the short run, Granger cause growth if its coefficient is statistically significant (as determined by the Wald F-test). The long run causality is established by determining the significance of the  $\phi$ 's

Finally, the PMG estimator is more desirable because it assumes fixed effects. A fixed effects based model is particularly useful in this paper since the focus is on a specific set of economies and the inference made is restricted to the behavior of that set (random effects used for making inference about a population). The fixed effects assumption used in the paper is a common choice for macroeconomists (e.g. Judson & Owen, 1999). A typical macroeconomic panel will typically contain countries that are of interest and not randomly sampled from a 'much larger universe of countries,' (Judson & Owen, 1999, p. 11). Second, the individual effect may represent an omitted variable, in such cases there is a likely correlation between the country-specific

characteristics and other regressors. The use of random effects in such a case, would lead to inconsistent estimators as the correlation is ignored.

#### **4 Data**

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

**Natural resource rents:** The indicator used here, per capita resource rents is intended to measure resource intensity. The advantage of using this measure is that it excludes renewable resources and is free from effects of previous structural change and economic growth (Rambaldi, Brown, & Hall, 2005). Most of the studies (e.g. Sachs & Warner, 2001; Davis, 1995) measure resource intensity in terms of GDP or exports. Davis (1995) reported that the share of minerals to exports and GDP tend to change over time, this implies that countries that used to be classified as resource-intensive might end up being classified otherwise. This poses a problem because if resource intensity is affected by historical changes in economic growth then 'circularity and bias are inevitable' (Rambaldi et al., 2005).

**Financial indicators :** The study uses three measures of financial activity ( $F$ ), namely: M2/GDP ( $F_1$ ), credit provided by the banking sector ( $F_2$ ) and domestic credit to the private sector ( $F_3$ ) to determine the financial development categories. It should be noted that although the three indicators used here are commonly used in the literature 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 the private investors. Accordingly, the flow

of credit to the private sector ( $F_3$ ) is a key variable (thus its use for analysis).<sup>12</sup> 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). Furthermore, 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 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 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).

Another measure of financial activity is the domestic credit provided by the banking sector. This index is intended to improve upon the existing financial depth indicator as it isolates credit issued by banks from that provided by the central bank or other

---

<sup>12</sup> Bank credit is used for comparison only.

intermediaries (Levine & Zervos, 1998). (King & Levine, 1993a) argue that besides the central bank, commercial banks are the major financial intermediary.

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.<sup>13</sup>

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 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.

---

<sup>13</sup> 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.

**Financial development index :** Following Ndikumana (2000) a composite index of financial development is calculated for country  $i$  in year  $t$  as follows:

$$FINDEX_{it} = \frac{1}{m} \sum_{j=1}^m [100 * (\frac{F_{j,it}}{\bar{F}_j})]$$

Where:  $m (=3)$  is the number of financial indicators used in the computation of the index. The index used here combines credit to the private sector, credit provided by banks and money and quasi-money (%GDP) (or M2/GDP).

$F_{j,it}$  a financial development indicator under consideration

$\bar{F}_j$  is the sample average of financial indicator  $j$

**Indicator for growth (Y) and investment (I) :** The study follows the convention in the literature by using real per capita GDP as a proxy for economic growth ( $Y$ ).

**Investment share of real GDP per capita (Laspeyres).** RGDPL is obtained by summing investment, consumption, government and exports, and subtracting imports in any given year. The indicator is a fixed base index with 1996 as the reference year, hence the “L” for Laspeyres.

## 5. Stylized facts

*Table 1: Summary statistics by financial development category 1984-2003*

Variable	Full sample	Financial development <sup>b</sup>		
		Low	Medium	High
Bank credit (% GDP)	60.80	11.79	60.03	101.96
Credit to private sector (% GDP)	50.38	20.42	43.14	91.21
Natural resource intensity	232.06	410.06	196.32	107.67
Real GDP per capita growth (annual %)	2.07	1.51	1.99	2.74
Investment share in real GDP (%)	13.82	11.63	12.66	17.74

<sup>a</sup> Source: Author's calculations from data from the sources cited

<sup>b</sup> The financial development categories are determined based on the financial development index (defined under data description). A country is classified in the low, medium or high category if its financial development index belongs to the lower 25<sup>th</sup> percentile, between the 25<sup>th</sup> and 75<sup>th</sup> percentiles and in the upper 75<sup>th</sup> percentile, respectively.

Table 1 provides a summary of the statistics according to the level of financial development. According to the statistics, high levels of financial development (irrespective of the indicator used) are associated with high levels of investment and output growth. For instance, average credit to the private sector is 91% of GDP in the high development category, compared to just 20% in the low category. Additionally, the annual percentage (%) of real GDP per capita is below the full sample average in the low development category and above average for the high development category. The share of investment in real GDP is about 6% higher in the high development category than the low development category. In term of all the averages, the middle category lies in between the low and high category financial development categories.

The statistics also illustrate a negative relationship between natural resource intensity and financial development, output growth and investment levels. The low development category is four times more natural resource intense than the high development category. The summary statistics generally suggest that the level of financial development is important in the sample under study.

## 6. The Empirical results

### 6.1 Panel unit root tests

Table 2: Panel unit root results

Variables	IPS		Hadri	
	trend +intercept	intercept	trend +intercept	intercept
Y	<b>1.95421</b> ( <b>0.9747</b> )	<b>5.27219</b> ( <b>1.0000</b> )	<b>6.65162</b> ( <b>0.0000</b> )	<b>10.2768</b> ( <b>0.0000</b> )
I	-2.37214 (0.0088)	-2.56424 (0.0052)	<b>4.74431</b> ( <b>0.0000</b> )	<b>3.67482</b> ( <b>0.0001</b> )
F <sub>2</sub>	<b>-0.80565</b> ( <b>0.2102</b> )	<b>-0.84358</b> ( <b>0.1995</b> )	<b>3.70304</b> ( <b>0.0001</b> )	<b>6.76554</b> ( <b>0.0000</b> )
F <sub>3</sub>	<b>0.26705</b> ( <b>0.6053</b> )	<b>0.37305</b> ( <b>0.6454</b> )	<b>4.82791</b> ( <b>0.0000</b> )	<b>7.65519</b> ( <b>0.0000</b> )
N	<b>-0.51060</b> ( <b>0.3048</b> )	<b>0.76025</b> ( <b>0.7764</b> )	<b>5.75403</b> ( <b>0.0000</b> )	<b>3.47477</b> ( <b>0.0003</b> )
ΔY	-7.47700 (0.0000)*		<b>5.43646</b> ( <b>0.0000</b> )	2.02262 (0.0216)*
ΔI	-10.1504 (0.0000)*		<b>2.48397</b> ( <b>0.0065</b> )	-0.65239 (0.7429)*
ΔF <sub>2</sub>	-9.73564 (0.0000)*		<b>9.35564</b> ( <b>0.0000</b> )	2.37972 (0.0087)*
ΔF <sub>3</sub>	-7.91735 (0.0000)*		<b>7.89545</b> ( <b>0.0000</b> )	2.06057 (0.0197)*
ΔN	-10.9812 (0.0000)*		<b>14.3261</b> ( <b>0.0000</b> )	<b>5.50905</b> ( <b>0.0000</b> )

Notes: lag lengths chosen using Schwarz criteria. Figures in parentheses are the corresponding p-values. If the p-value is greater than 0.05(for 5% significant level) or 0.10(for 10% significant level) or 0.01(for 1% significant level) we do not reject the null hypothesis of a unit root, otherwise we reject it. Note that the null hypothesis for the Hadri test differs from the other tests (Ho: no unit root). Boldface values denote evidence in favour of a unit root.

\* Signifies rejection of a unit root.

Karlsson and Löthgren (2000) suggested that to fully assess the stationarity property of a panel, a careful analysis of both individual and panel unit root tests should be carried out. On this basis, all the series were subjected to this form of testing (this also made it possible to come up with a conclusion in cases where the two tests give contradictory results, such as with the natural resource and investment series). The individual and panel results generally suggest that the variables are I (1).

## **6.2 Cointegration tests**

To answer the question of whether financial development plays a role in abating the resource curse, output (financial development)<sup>14</sup> was regressed with financial development (output), investment and natural resource intensity so as to determine the existence or non-existence of a long run relationship.

The section reports statistics for models with both a linear trend and time dummies. The model preferred in this paper is the one with time dummies. The time dummies are included so as to allow for the possibility of correlated residuals across the countries. Regressions without time dummies are only given for purposes of comparison as time dummies are vital to maintain the standard estimation assumption of cross-section independence (Perman & Stern, 2003; Pedroni, 2001). In cases where a sample is short (as is our case), the group ADF generally performs best followed by panel ADF and panel rho (Cameron & Tamarit, 2002). On the basis of this (and Lee, 2005), the results are considered reliable if the group ADF test rejects the null hypothesis of no cointegration, the other tests are given for comparison only.

---

<sup>14</sup> Of the two financial indicators (i.e. domestic credit to the private sector and bank credit) used in the paper, domestic credit to the private sector is the one used for analysis, the other indicator is only given for comparison.



Tables 3 and 4 present panel cointegration results for domestic credit to the private sector. There is no evidence of a long run relationship in the case where this financial indicator is the dependent variable. However, there is evidence to suggest otherwise when output is the dependent variable. The results imply that it is highly unlikely that as far as credit to the private sector is concerned, the ‘demand-following’ view holds.

*Table 3: Panel cointegration results (dependent variable is output)*

	No time effects	Time effects
panel v-stat	4.84609*	<b>3.34114*</b>
panel rho-stat	1.92912***	<b>1.84855***</b>
panel pp-stat	-1.49626	<b>-1.15492</b>
panel adf-stat	0.25785	<b>-0.85878</b>
group rho-stat	2.63498**	<b>2.72026*</b>
group pp-stat	-3.40966*	<b>-2.33766**</b>
group adf-stat	-1.90318***	<b>-2.04420**</b>

The figures in parentheses are the t-values

Financial indicator used here is domestic credit to the private sector

\* rejects the null hypothesis of no cointegration at the 1% level of significance

\*\* rejects the null hypothesis of no cointegration at the 5% level of significance

\*\*\* rejects the null hypothesis of no cointegration at the 10% level of significance

*Table 4: Panel cointegration results (dependent variable is credit to the private sector)*

	No time effects	Time effects
panel v-stat	0.51698	<b>-0.30713</b>
panel rho-stat	0.08551	<b>1.53884</b>
panel pp-stat	-5.48967*	<b>-2.00539**</b>
panel adf-stat	-4.93744*	<b>-1.22356</b>
group rho-stat	1.60562	<b>2.70002*</b>
group pp-stat	-5.32405*	<b>-2.28493**</b>
group adf-stat	-4.79786*	<b>-1.28637</b>

The figures in parentheses are the t-values

Financial indicator used here is domestic credit to the private sector

\* rejects the null hypothesis of no cointegration at the 1% level of significance

\*\* rejects the null hypothesis of no cointegration at the 5% level of significance

\*\*\* rejects the null hypothesis of no cointegration at the 10% level of significance

The results in table 3 reveal that a long run relationship exists among some of the variables (resource intensity, finance, output and investment). The group FMOLS results for the cointegrating relationships are given in table 5.

*Table 5: Fully modified OLS estimates (dependent variable is output)*

Specification	Finance	Investment	Resource
<b>Time effects</b>	<b>1.79 (2.79)*</b>	<b>33.51 (11.00)*</b>	<b>0.19 (0.53)</b>
No time effects	25.84 (21.38)*	22.62 (3.69)*	1.00 (8.41)*

The figures in parentheses are the t-values

Financial indicator used here is domestic credit to the private sector

\* denotes statistical significance at the 1% level of significance

The panel FMOLS results in table 5 show that both investment and credit to private sector have a positive and a highly statistically significant relationship with output. Conversely, natural resource intensity has a weak, positively insignificant relationship with output. The results are consistent with Patrick (1966) ‘*supply leading*’ view, but contradict the *natural resource curse thesis* (Sachs & Warner, 2001; Nankani, 1979). The latter might be attributed to the measure used for measuring natural resource intensity which has been shown to produce results that do not support the *curse* (Rambaldi et al., 2005).

Tables 6 and 7 give panel cointegration results for equations where the dependent variables are output and bank credit, respectively. When output is the dependent variable, there is not enough evidence to suggest that the variables are cointegrated. However, if bank credit is the dependent variable, there is enough evidence to suggest that the variables are cointegrated. Overall, the results suggest a long run relationship between output, bank credit, resource intensity and investment only when bank credit

is the dependent variable. Thus, it is likely that the causality runs from output to bank credit (i.e. the ‘demand-following’ view holds) and not the other way round.

Table 6: Panel cointegration results (dependent variable is output)

	No time effects	Time effects
panel v-stat	3.29062*	<b>2.32362**</b>
panel rho-stat	2.99823**	<b>2.07107**</b>
panel pp-stat	1.78481***	<b>-0.15133</b>
panel adf-stat	-0.06330	<b>-0.76715</b>
group rho-stat	3.28265*	<b>2.94134*</b>
group pp-stat	-0.17588	<b>-1.89151***</b>
group adf-stat	-2.06033**	<b>-1.43575</b>

The figures in parentheses are the t-statistics

Financial indicator used here is bank credit

\* rejects the null hypothesis of no cointegration at the 1% level of significance

\*\* rejects the null hypothesis of no cointegration at the 5% level of significance

\*\*\* rejects the null hypothesis of no cointegration at the 10% level of significance

Table 7: Panel cointegration results (dependent variable is bank credit)

	No time effects	Time effects
panel v-stat	0.07442	<b>-0.76400</b>
panel rho-stat	1.04770	<b>0.93788</b>
panel pp-stat	-3.03874*	<b>-3.29792*</b>
panel adf-stat	-2.13464**	<b>-4.33891*</b>
group rho-stat	2.44831**	<b>2.43490**</b>
group pp-stat	-3.35229*	<b>-3.01468*</b>
group adf-stat	-2.67426**	<b>-3.24600*</b>

The figures in parentheses are the t-statistics

Financial indicator used here is bank credit

\* rejects the null hypothesis of no cointegration at the 1% level of significance

\*\* rejects the null hypothesis of no cointegration at the 5% level of significance

\*\*\* rejects the null hypothesis of no cointegration at the 10% level of significance

Table 8 presents the fully modified OLS estimates (FMOLS) of the cointegrating relationship. The results show that there is a statistically significant negative association between bank credit and the intensity of natural resources.

Table 8: Fully modified OLS estimates (dependent variable is bank credit)

Specification	Output	Investment	Resource
<b>Time effects</b>	0.01( 1.06 )	0.02( 0.46 )	-0.04( -4.64 )*
No time effects	0.05( 15.76 )*	0.16( -0.87 )	-0.11( -8.71 )*

The figures in parentheses are the t-statistics

Financial indicator used here is bank credit

\* denotes statistical significance at the 1% level of significance

The results presented in tables 2 to 8 imply that the type of financial indicator used for analysis matters in terms of which of Patrick(1966)'s view on the relationship between financial development and economic growth holds.

To answer the question of the channels via which financial development may negate the detrimental effects of natural resource on economic growth, investment is regressed on the three other variables.<sup>15</sup>

Table 9: Panel cointegration results (dependent variable is investment)

	No time effects	Time effects
panel v-stat	0.89679	<b>-0.28545</b>
panel rho-stat	0.06178	<b>0.46511</b>
panel pp-stat	-5.43401*	<b>-4.77890*</b>
panel adf-stat	-4.79882*	<b>-5.41380*</b>
group rho-stat	1.20344	<b>1.65297***</b>
group pp-stat	-5.74936*	<b>-4.88575*</b>
group adf-stat	-4.90881*	<b>-4.45301*</b>

The figures in parentheses are the t-statistics

Financial indicator used here is domestic credit to the private sector

\* rejects the null hypothesis of no cointegration at the 1% level of significance

\*\* rejects the null hypothesis of no cointegration at the 5% level of significance

\*\*\* rejects the null hypothesis of no cointegration at the 10% level of significance

<sup>15</sup> Since our chosen financial indicator is domestic credit to the private sector, this exercise is only done for this estimator.

The results from table 9 show that there is evidence to suggest that there is a long run relationship between the four variables. Thus the FMOLS results are presented in table 10 below:

*Table 10: Fully modified OLS estimates (dependent variable is investment)*

Specification	Finance	Output	Resource
Time effects	<b>0.05 (2.70)*</b>	<b>0.01 (12.81)*</b>	<b>-0.00 (1.79)***</b>
No time effects	0.04(4.00)*	0.01(3.09)*	0.01(3.68)*

The figures in parentheses are the t-statistics

Financial indicator used here is domestic credit to the private sector

\* denotes statistical significance at the 1% level of significance

\*\*\* denotes statistical significance at the 10% level of significance

The FMOLS results show that all the relationships are statistically significant at the conventional levels of significance.

## 7 Causality results

The Granger causality results are presented in table 11.<sup>16</sup> The growth equation shows that financial development causes economic growth in the long run but not in the short run. This implies that long run policies that improve financial institutions will be effective in terms of economic performance. This result coincides with earlier studies (e.g. Chang & Caudill, 2005; Christopoulos & Tsionas, 2004; Darrat, 1999) that found a long run (but not short run) causal relationship from financial development to economic growth. Moreover the results show that investment and natural resource both cause growth in the short and long run. This implies that both short and long run policies that promote capital accumulation are important in influencing economic performance.

<sup>16</sup> For bank credit the paper is investigating whether there is causality running from financial development to economic growth, while for domestic credit to the private sector, causality is explored from financial development to economic growth.

Table 11: Panel causality results

Dependent Variable	Source of causation (independent variables)							
	Long run (error correction equations)				Short run			
	<b>Domestic credit to the private sector</b>							
	Y	F	N	I	$\Delta Y$	$\Delta F$	$\Delta N$	$\Delta I$
$\Delta Y$	—	12.264 (0.004)*	9.604 (0.002)*	52.105 (0.000)*	—	-2.260 (0.302)	0.257 (0.03)**	28.383 (0.02)**
$\Delta I$	0.001 (0.578)	0.010 (0.473)	0.009 (0.000)*	—	0.020 (0.001)*	0.160 (0.093)***	-0.011 (0.183)	—
	<b>Bank credit</b>							
$\Delta F$	-0.013 (0.009)*	—	-0.006 (0.069)***	3.481 (0.000)*	0.016 (0.557)	—	-0.009 (0.798)	-1.594 (0.004)*
$\Delta I$	0.001 (0.581)	0.004 (0.812)	0.011 (0.000)*	—	0.025 (0.000)*	0.009 (0.519)	-0.015 (0.065)***	—

For all equations a time trend was included.

The figures in parentheses are the p-values.

\* rejects the null hypothesis of no causality at the 1% level of significance

\*\* rejects the null hypothesis of no causality at the 5% level of significance

\*\*\* rejects the null hypothesis of no causality at the 10% level of significance

Previous FMOLS estimates show a positive relationship between natural resource intensity and economic growth, taken with the causality results here; natural resource intensity does not have a detrimental effect on growth. The result implies it is the policies of governments, not resource endowment that determines growth. For instance, natural resource wealth may bring about conflict and discord, as well as corruption among stake-holders. In extreme cases they may lead to civil wars, as has been the case in Africa's 'diamond wars'. In turn the wars bring about destruction to 'societal institutions and rule of law' as well as diverting factors of production from productive uses.<sup>17</sup>

As for the investment equation, an interesting result is that in the short run, financial development Granger causes investment. The result is consistent with the view that investment is one of the channels through which financial development affects economic performance (e.g. Levine, 1997; McKinnon, 1973). Furthermore, consistent with Gylfason and Zoega(2006), natural resource intensity Granger cause investment in the long run.

To test for the robustness of the results, the models were re-estimated using the second lag of the variables and this did not fundamentally change the results.<sup>18</sup> Furthermore a GMM estimator with robust standard errors and that provides correct estimates of the coefficient covariance in the presence of heteroskedasticity of unknown form was used (the results are given in the appendix (table A.3)). Taken together with the PMG results, both estimators strongly support the view that

---

<sup>17</sup> See the discussion in (Gylfason & Zoega, 2006) for example.

<sup>18</sup> Similar to other previous studies (such as Nair-Reichert & Weinhold, 2001) a lag length of one is considered appropriate due to a relatively short time series for each cross section and several explanatory variables.

financial development will have a long run impact on economic performance and the channel through which this works is capital accumulation.

The general policy implication is that in order to abate the *natural resource curse*, long run policies that improve financial institutions and promote capital accumulation will be effective in terms of aiding economic performance. The results are not due to potential biases such as omitted variables, endogeneity, simultaneity or the panel estimation method used.

## **8. Conclusion**

The research undertaken in this paper does not claim that the financial sector is a direct major source of economic growth. If anything, through its function of resource allocation, it ‘plays an auxiliary role in the process of economic growth and development. A failure to fulfill these functions, however, could clearly reduce the rate of economic growth below the otherwise feasible’ (Graff, 2003:65).

A panel of fourteen developing, natural resource abundant economies for the period between 1983 and 2004 is used. Panel unit root and cointegration techniques were utilized to conclude that there exists a long run significant relationship between financial development and economic growth. Subsequently, an estimator that is robust to the exclusions of the variables that are not part of the cointegrating relation and allows for endogeneity of the explanatory variables was used to estimate the cointegrating relationship (Pedroni, 2000). Finally a panel error correction model is used to determine the causal relationship between our variables. Our results are consistent with other empirical studies (e.g. Chang & Caudill, 2005; Christopoulos &



Tsionas, 2004; Darrat, 1999) that the causality from financial development to economic growth is confined to the long run. Furthermore, financial development can impact on economic growth via its function of resource allocation, thus raising capital accumulation. The implication is that financial development is one policy that can be used to promote capital accumulation with the potential to abate the *natural resource curse*.

The results from the paper also illustrate that the choice of financial indicator matters. Therefore, it is important for researchers to determine the role of the financial system that is captured by each different indicator (Denizer et al., 2002). For instance, in the case of bank credit, there is a unidirectional causality from output to financial development (i.e. the direction of causality is reversed in this case). An interesting result is that investment still plays an important role in an economy by directly causing output and indirectly through financial development. For natural resource abundant economies financial institutions need to be able to promote the flow of credit to private investors. Hence the use of domestic credit to the private sector for our analysis.

## 7.1 Appendix

*Table A.1 List of selected countries according to financial development category*

HIGH	MIDDLE	LOW
China	Algeria	Botswana
Malaysia	Bolivia	Dominican Republic
South Africa	Chile	Gabon
Zimbabwe	Indonesia	Venezuela
	Iran	
	Tunisia	

Table A.2 Definition of variables

<b>Variable name</b>	<b>Description</b>	<b>Definition</b>	<b>Source</b>
<b>CREDIT</b>	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.	WDI website
<b>PRIVY</b>	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 website
<b>RESOURCE</b>	Natural resource rents	Non-renewable resource rents per capita (defined in Rambaldi et al., 2000; Bolt et al., 2002)	World Bank (2006)
<b>M2/GDP</b>	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

<b>FINDEX</b>	Financial development index	Composite financial development index	Ndikumana (2000)
<b>GROWTH</b>	GDP per capita growth (annual %)	Annual percentage growth rate of GDP per capita based on constant local currency. GDP per capita is gross domestic product divided by midyear population. GDP at purchaser's prices 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.	Demirguc-Kunt and Levine(1996) WDI database
<b>OUTPUT</b>	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
<b>INVESTMENT</b>	Investment share of real GDP per capita (Laspeyres) (RGDPL)	RGDPL is obtained by summing investment, consumption, government and exports, and subtracting imports in any given year. The indicator is a fixed base index with 1996 as the reference year, hence the "L" for Laspeyres.	Penn World tables

### *Alternative causality tests*

Table A.3 reports the causality results from the panel error correction model based on GMM estimation. The Wald hypothesis test rejected the null hypothesis that the second lag is insignificant. Having established that a lag length of two years is sufficient, values of the dependent variable with higher lags are used as instruments.<sup>19</sup> The instruments used are valid if there is no correlation between the error terms and the instruments. To ascertain this, the Sargan's test for over-identification (not reported here) was used. For all the equations, we do not reject the null hypothesis that the over-identifying restrictions are valid (or population moment conditions are correct) and conclude that the population moment conditions are correct.

*Table A.3: Wald F-test statistic from Panel ECM estimation*

Dependent variable	Source of causation (independent variable)				
	Short run				Long run
	$\Delta Y$	$\Delta F$	$\Delta N$	$\Delta I$	$ECT_{t-1}$
$\Delta Y$	—	3.13 (0.05)**	202.26 (0.00)*	84.59 (0.00)*	16.28 (0.00)*
$\Delta I$	13.61 (0.00)*	0.04 (0.84)	22.02 (0.00)*	—	284.21 (0.00)*

Notes: Time dummies were included in all estimations. Figures in parenthesis are the  $p$ -values. The other relationships are not reported because they do not add to the discussion. For the case where F was a dependent variable, the results show no cointegration among the variables and this implies that a causal relationship from output to financial development is unlikely. Finally, we do not expect natural resource intensity to be caused by any of the variables (i.e. it is exogenously determined).

\*Statistically significant at the 1% level

\*\* Statistically significant at the 5% level

<sup>19</sup> Second lag was significant for the growth equation but not the investment equation.

## 9. References

- Apergis, N., Filippidis, I., & Economidou, C. (2007). Financial deepening and economic growth linkages: A panel data analysis. *Review of World Economics*, 143(1), 179-198.
- Arellano, M., & Bond, S. (1991). Some tests of specification for panel data: Monte Carlo evidence and an application to employment equations. *Review of Economic Studies*, 58, 277-297.
- Auty, R. M. (1993). *Sustaining development in mineral economies: The resource curse thesis*. London: Routledge.
- Auty, R. M. (Ed.). (2003). *Macroeconomic policy for mineral economies*: United Nations Conference on Trade and Development (UNCTAD).
- Auty, R. M., & Mikesell, R. F. (1998). *Sustainable development in mineral economies*. New York: Oxford University Press.
- Beck, T., Lundberg, M., & Majnoni, G. (2006). Financial intermediary development and growth volatility: Do intermediaries dampen or magnify shocks? *Journal of International Money and Finance*, doi:10.1016/j.jimonfin.2006.08.004, 1-22.
- Bencivenga, V. R., & Smith, B. D. (1991). Financial intermediation and endogenous growth. *Review of Economic Studies*, 58, 195-209.
- Bencivenga, V. R., Smith, B. D., & Starr, R. M. (1995). Transactions costs, technological choice and endogenous growth. *Journal of Economic Theory*, 67, 153-177.
- Bhattacharya, P. C., & Sivasubramanian, M. N. (2003). Financial development and economic growth in India: 1970-1971 to 1998-1999. *Applied Financial Economics*, 13, 925-929.
- Bodman, P. (1995). National savings and domestic investment in the long term: some time series evidence from the OECD. *International Economic Journal*, 9(2), 37-60.
- Camerero, M., & Tamarit, C. (2002). A panel cointegration approach to the estimation of the peseta real exchange rate. *Journal of Macroeconomics*, 24, 371-393.

- Chang, T., & Caudill, S. B. (2005). Financial development and economic growth: The case of Taiwan. *Applied Economics*, 37, 1329-1335.
- Christopoulos, D. K., & Tsionas, E. G. (2004). Financial development and economic growth: Evidence from panel unit root and cointegration tests. *Journal of Development Economics*, 73, 55-74.
- Darrat, A. F. (1999). Are financial deepening and economic growth causally related? Another look at the evidence. *International Economic Journal*, 13(3), 19 - 35.
- Davis, G. A. (1995). Learning to love the Dutch disease: Evidence from the mineral economies. *World Development*, 23(10), 1765-1779.
- Demirguc-Kunt, A., & Levine, R. (1996). Stock market development and financial intermediaries: Stylized facts. *World Bank Economic Review*, 10(2), 291-321.
- Denizer, C. A., Iyigun, M. F., & Owen, A. (2002). Finance and macroeconomic volatility. *Contributions to Macroeconomics*, 2(1), 1-30.
- Gelb, A., & Associates. (1988). *Oil windfalls: Blessing or curse?* Washington D.C.: Oxford University Press.
- Graff, M. (2003). Financial development and economic growth in corporatist and liberal market economies. *Emerging Markets Finance and Trade*, 39(2), 47-69.
- Greenwood, J., & Jovanovich, B. (1990). Financial development, growth, and the distribution of income. *The Journal of Political Economy*, 98(5), 1076-1107.
- Gylfason, T., & Zoega, G. (2001). Natural resources and economic growth: The role of investment. Retrieved August 2006, from <http://www.ems.bbk.ac.uk/faculty/Zoega/pdf/Natinvest31.pdf>
- Gylfason, T., & Zoega, G. (2006). Natural resources and economic growth: The role of investment. *The World Economy*, 29(8), 1091-1115.
- Hadri, K. (2000). Testing for stationarity in heterogeneous panel application. *Econometric Journal*, 3, 148-161.
- Holtz-Eakin, D., Newey, W., & Rosen, H. S. (1988). Estimating vector autoregressions with panel data. *Econometrica*, 56(6), 1371-1395.

- Hondroyannis, G., Lolos, S., & Papapetrous, E. (2005). Financial markets and economic growth in Greece, 1986-1999. *Journal of International Financial Markets, Institutions and Money*, 15, 173-188.
- Iimi, A. (2006). Did Botswana escape the resource curse? *IMF Working Paper*(WP/06/138).
- Im, K. S., Pesaran, M. H., & Shin, Y. (2003). Testing for unit roots in heterogeneous panels. *Journal of Econometrics*, 115, 53-74.
- Judson, R. A., & Owen, A. L. (1999). Estimating dynamic panel data models: A guide for macroeconomists. *Economics Letters*, 65, 9-15.
- Karlsson, S., & Lothgren, M. (2000). On the power and interpretation of panel unit root tests. *Economics Letters*, 66(3), 249-255.
- King, R. G., & Levine, R. (1993a). Finance and growth: Schumpeter might be right. *The Quarterly Journal of Economics*(August), 717-737.
- King, R. G., & Levine, R. (1993b). Finance, entrepreneurship, and growth. *Journal of Monetary Economics*, 32, 513-542.
- Lawrence, P. (2003). Fifty years of finance and development: Does causation matter? *Keele Economics Research Papers, KERP 2003/07*.
- Lee, C. (2005). Energy consumption and GDP in developing countries: A cointegrated panel analysis. *Energy Economics*, 27, 415-427.
- Levine, R. (1997). Financial development and economic growth: Views and agenda. *Journal of Economic Literature*, 35(2), 688-726.
- Levine, R. (1998). The legal environment, banks, and the long-run economic growth. *Journal of Money, Credit and Banking*, 30(3), 596-613.
- Levine, R. (2003). More of finance and growth: More finance, more growth? *The Federal Reserve Bank of St. Louis*, 31-46.
- Levine, R., Loayza, N., & Beck, T. (2000). Financial intermediation and growth: Causality and causes. *Journal of Monetary Economics*, 46, 31-77.



- Levine, R., & Zervos, S. (1998). Stock markets, banks and economic growth. *American Economic Review*, 88(3), 537-558.
- McKinnon, R. I. (1973). *Money and capital in economic development*. Washington, D.C.: The Brookings Institution.
- Nair-Reichert, U., & Weinhold, D. (2001). Causality tests for cross-country panels: A new look at FDI and economic growth in developing countries. *Oxford Bulletin of Economics and Statistics*, 63(2), 153-171.
- Nankani, G. (1979). Development problems of mineral-exporting countries. *World Bank Staff Working Paper*, 354(SWP354).
- Ndikumana, L. (2000). Financial determinants of domestic investment in Sub-Saharan Africa: Evidence from panel data. *World Development*, 28(2), 381-400.
- Neusser, K., & Kugler, M. (1998). Manufacturing growth and financial development : Evidence from OECD countries. *The Review of Economics and Statistics*, 80(4), 638-646.
- Nili, M., & Rastad, M. (2007). Addressing the growth failure of the oil economies: The role of financial development. *The Quarterly Journal of Economics and Finance*, 46, 726-740.
- North, D. C., & Thomas, R. P. (1973). *The rise of the western world: A new economic history*. Cambridge: Syndics of the Cambridge University Press.
- Patrick, H. T. (1966). Financial development and economic growth in underdeveloped countries. *Economic Development and Cultural Change*, 14, 174-189.
- Pedroni, P. (1999). Critical values for cointegration tests in heterogeneous panels with multiple regressors. *Oxford Bulletin of Economics and Statistics*, 61, 653-678.
- Pedroni, P. (2000). Fully modified OLS for heterogeneous cointegrated panels. In B. Baltagi (Ed.), *Nonstationary panels, panel cointegration and dynamic panels* (Vol. 15). New York: Elsevier Science Inc.
- Pedroni, P. (2001). Purchasing power parity tests in cointegrated panels. *The Review of Economics and Statistics*, 83(4), 727-731.

- Perman, R., & Stern, D. I. (2003). Evidence from panel unit root and cointegration tests that the environmental Kuznets curve doesn't exist. *The Australian Journal of Agricultural and Resource Economics*, 47(3), 325-347.
- Pesaran, M. H., Shin, Y., & Smith, R. P. (1999). Pooled mean group estimation of dynamic heterogeneous panels. *Journal of the American Statistical Association*, 94(446), 621(621).
- Rambaldi, A. N., Brown, R. P. C., & Hall, G. (2005). How valid are previous tests of the resource curse hypothesis? A comparison of results using different measures of resource intensity with panel data (pp. 1-20): School of Economics, University of Queensland.
- Reinhart, M., & Tokatlidis, I. (2003). Financial liberalisation: The African experience. *Journal of African Economies*, 12(AERC supplement 2).
- Romer, D. (2006). *Advanced Macroeconomics* (3rd ed.). New York: Mc Graw-Hill/Irwin.
- Sachs, J. D., & Warner, A. M. (2001). Natural resources and economic development: The curse of natural resources. *European Economic Review*, 45, 827-838.
- Saint-Paul, G. (1992). Technological choice, financial markets and economic development. *European Economic Review*, 36, 763-781.
- Schumpeter, J. A. (1911). *The theory of economic development: An inquiry into profits, capital, credit, interest and the business cycle* (R. Opie, Trans. Vol. XLVI). Cambridge, Massachusetts: Harvard University Press.
- Shan, J. (2005). Does financial development 'lead' economic growth? A vector auto-regression appraisal. *Applied Economics*, 37, 1353-1367.
- Shan, J., & Morris, A. (2002). Does financial development 'lead' economic growth? *International Review of Applied Economics*, 16(2), 153-168.
- Shan, J., Morris, A. G., & Sun, F. (2001). Financial development and economic growth: An egg-and-chicken problem? *Review of International Economics*, 9(3), 443-454.
- Shaw, E. S. (1973). *Financial deepening in economic development*. New York: Oxford University Press.