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ABUNDANCIA PETROLERA Y CRECIMIENTO
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RESUMEN

El objeto de este estudio es investigar las siguientes preguntas: ¿La abundancia del petróleo es una maldición o una bendición? ¿Cuáles son los efectos de la abundancia de petróleo sobre el crecimiento y desarrollo económico, considerando el ingreso per cápita? Usando el valor real de la producción petrolera o renta como proxy de las dotaciones de recursos, nuestras estimaciones indican que la abundancia petrolera no pareciera ser una maldición al analizar los efectos en el corto y largo plazo. Que países con abundancia de petróleo pudieran ser más ricos y proveer mejores estándares de vida a la población es un tema diferente, pero la abundancia de petróleo no pareciera apagar el crecimiento económico.

Palabras clave: recursos naturales, crecimiento económico

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ABSTRACT

The aim of this paper is to investigate the following questions: Is an abundance of oil, a curse or a blessing? What are the effects of oil abundance on growth and economic development, as seen in the level of income per capita? Our estimation results, using the real value of oil production or rent as a proxy for resource endowment, indicate that oil abundance does not seem to be a curse, exhibited through both the long-run and the short-run effects. Whether or not oil abundant countries could be richer and provide a better living standard to their population than what is observed is a different issue, but oil abundance does not seem to damper economic growth.

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Oil Abundance and Growth*

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Abstract

The aim of this paper is to investigate the following questions: Is an abundance of oil, a curse or a blessing? What are the effects of oil abundance on growth and economic development, as seen in the level of income per capita? Our estimation results, using the real value of oil production or rent as a proxy for resource endowment, indicate that oil abundance does not seem to be a curse, exhibited through both the long-run and the short-run effects. Whether or not oil abundant countries could be richer and provide a better living standard to their population than what is observed is a different issue, but oil abundance does not seem to damper economic growth.

1 Introduction

Following the influential work by Sachs and Warner (1995), a growing empirical literature on and interest in the resource curse paradox was generated. According to this paradox, resource rich countries perform poorly when compared to countries which are not endowed with oil, natural gas, minerals and other non-renewable resources. Therefore, resource abundance is believed to be an important determinant of economic failure, which implies that oil abundance is a curse and not a blessing.

There are different explanations for why resource rich economies might be subject to this curse. Dutch disease (see Corden and Neary (1982), Neary and van Wijnbergen (1986), and Krugman (1987)) is one of the channels through which the resource curse might make itself felt. Another explanation for the resource curse paradox is based on rent-seeking theories, which argue that natural resource abundance generates an incentive for agents to engage in non-productive activities and for the state to provide fewer public goods than the optimum. See for instance, Lane and Tornell (1996), Leite and Weidmann (1999), and Collier and Hoeffler (2004). Finally, Mehlum et al. (2006) have attempted to show that the impact of natural resources on growth and development depends primarily on institutions, while Boschini et al. (2007) have argued that the type of natural resources possessed is also an

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important factor. It is not our goal to discuss these theories in detail, or to determine their validity. We refer to Sachs and Warner (1995) and Caselli and Cunningham (2009) for an extensive examination of these prominent accounts of the natural resource curse paradox.

1.1 Current Empirical Evidence

The empirical evidence on the resource curse paradox is rather mixed. Most papers in the literature tend to follow Sachs and Warner's cross-sectional specification introducing new explanatory variables for resource dependence/abundance, while others derive theoretical models that are loosely related to their empirical specification. An important drawback of these studies with few exceptions, however, is their measure of resource abundance. Sachs and Warner (1995), for instance, use the ratio of primary-product exports to GDP in the initial period as a measure of resource abundance. This ratio, as clearly pointed out by Brunnschweiler and Bulte (2008), measures resource dependence rather than abundance. The latter should be introduced in the growth regressions as the stock or the flow of natural resources. Moreover, a cross sectional growth regression augmented with this regressor clearly suffers from endogeneity and omitted variable problems.

Brunnschweiler and Bulte (2008) argue that the so-called resource curse does not exist, and that while resource dependence, when instrumented in growth regressions, does not affect growth, resource abundance in fact positively affects economic growth. The positive effect of resource abundance on development and growth is also supported by Esfahani et al. (2009), who develop a long run growth model for a major oil exporting economy and derive conditions under which oil revenues are likely to have a lasting impact. However, this approach contrasts with the standard literature on 'Dutch disease' and the 'resource curse', which primarily focuses on the short run implications of a temporary resource discovery. On the other hand, Stijns (2005), using different measures for resource abundance, indicates that the effect of this variable on growth is ambiguous. Another branch of the literature investigates the channels through which natural resource abundance affects economic growth negatively. Gylfason (2001), for instance, shows that natural resource abundance appears to crowd out human capital investment with negative effects on the pace of economic activity, while Bravo-Ortega et al. (2005) show that higher education levels can in fact offset the negative effects of resource abundance. Therefore, it can be seen that the empirical findings on the resource curse paradox are still not conclusive.

1.2 A Critique of the Current Literature

There are a number of grounds on which the econometric evidence of the effects of resource abundance on growth may be questioned. The literature relies primarily on a cross-sectional approach to test the resource curse hypothesis, and as such does not take into account the time dimension of the data. As noted above, the cross-sectional approach is also subject to endogeneity problems, and this is perhaps the most important reason for being skeptical about the econometric studies suggesting a positive or negative association between resource abundance and growth.

In addition, even when panel data techniques are used most studies make use of homogeneous panel data approaches. While homogeneous panel data models allow the intercepts to differ across groups all other parameters are constrained to be the same. Therefore, a high degree of homogeneity is still imposed. As discussed in Pesaran and Smith (1995), the problem with these dynamic panel data techniques, when applied to testing growth effects, is that they can produce inconsistent and potentially very misleading estimates of the average values of the parameters, since growth models typically exhibit substantial cross-sectional heterogeneity. In fact Lee et al. (1997), using a panel of data on 102 countries, illustrate that there is pervasive heterogeneity in speeds of convergence and in growth rates across countries and show that the conventional method of imposing homogeneity are subject to substantial biases.

More recently Pedroni (2007) shows that there are significant differences in the aggregate production function technologies among countries. Taking into account these differences he argues that it is possible to explain the observed patterns of per capita income divergence across countries. Finally, the current econometric evidence does not address the problem of cross-sectional dependence arising from common factors or shocks. Thus estimations and inference based on models that do not take into account cross-country heterogeneity and dependence, such as the cross-sectional specifications widely used in the literature, can bring about biased and misleading results.

Another one of the major drawbacks of the empirical literature on growth and natural resource abundance, is the lack of theoretical derivation of the econometric model that is being tested. Either an *ad hoc* approach is used, in which output growth is regressed on a number of variables that are arbitrary chosen, or a theoretical model is developed but when it comes to estimation the econometric model is not connected to the theory derived restrictions.

It is clear that given the above shortcomings, the estimated models in the literature can lead to misleading conclusions on whether the resource curse is in fact present for oil abundant countries or not. As part of this paper we put emphasis on using a robust and consistent theory derived econometric model which can be directly tested. We also attempt to rectify some of the econometric shortcomings by adopting a sufficiently general and flexible econometric approach, which is consistent under both cross-section dependence and cross-country heterogeneity.

2 The Econometric Model and Methodology

We base our empirical analysis on the model of **?**, in which the key empirical reduced form equation states that there is an equilibrium relationship between real gross domestic product (GDP) per capita, the share of capital investment in real GDP, and the real value of natural resource (oil) production per capita:

$$\begin{aligned}\ln y_{jt} &= \frac{(1-\alpha_{j1}-\alpha_{j2})}{(1-\alpha_{j1})}\ln A_{j0} - \frac{\alpha_{j1}}{(1-\alpha_{j1})}\ln\left(g_j+n_j+\delta_j\right) \\ &\quad + \frac{(1-\alpha_{j1}-\alpha_{j2})}{(1-\alpha_{j1})}g_j t + \frac{\alpha_{j1}}{(1-\alpha_{j1})}\ln\left(\frac{I^K_{jt}}{Y_{jt}}\right) + \frac{\alpha_{j2}}{(1-\alpha_{j1})}\ln o_{jt} \\ &= a_j + d_j t + \beta_{j1}\ln(I/Y)_{jt} + \beta_{j2}\ln o_{jt} + u_{jt}, \qquad (1)\end{aligned}$$

where α_{j1} (α_{j2}) is the share of capital (oil) in output and $\ln y_{jt}$ is the logarithm of real GDP per capita for countries $j = 1, ..., J$ and time periods $t = 1, ..., T$. Likewise $\ln o_{jt}$ is the logarithm of real value of oil production per capita and $\ln(I/Y)_{jt}$ is log of the investment share of GDP over the same countries and time periods, with a_j denoting country specific fixed effects and $d_j t$ representing heterogeneous country specific deterministic trends.

To eliminate cross sectional dependence (CD) asymptotically we make use of the Common Correlated Effects (CCE) type estimators developed by Pesaran (2006). One of the estimators pools observations over the cross sectional units and is called the CCE pooled (CCEP). The other estimator, CCE mean group (CCEMG) estimator, is just a simple average of the individual country CCE estimators.

Although our econometric specification is simple it is also very general. For instance, using a heterogeneous panel data approach we consider different dynamics for each country, but also account for cross-country dependencies that arise potentially from multiple common factors, while allowing the individual responses to these factors to differ across countries. A possible source of cross-sectional dependency might be due to world-wide common shocks that affect all cross-sectional units. Changes in technology and in the price of oil provide examples of such common shocks that may affect real GDP per capita, but to different degrees across countries.

Moreover, as opposed to the traditional cross-sectional and/or homogenous panel approaches in which one needs to find quantifiable variables that can act as proxies for unobserved factors, in our non-stationary panel approach the country specific deterministic factor captures a broad class of those variables. In addition, the unobserved common components of u_{jt} absorb a number of different factors that drive real income but are at the same time difficult to measure accurately. Moreover, any omitted variables that are either constant or evolve smoothly over time are also absorbed into the country specific fixed effects and the heterogeneous trend components. Furthermore, although our theoretical model does not include human capital, in the form of education, or social capital, in the form of social and political institutions, these unobserved and difficult to measure factors are in fact captured by a_j and $d_j t$ in our cointegrated panel specification. Finally, another advantage of our non-stationary panel approach is that we explicitly estimate the long-run (low-frequency) relationships among the variables, using annual data rather than trying to take 5-year averages to filter out business cycle fluctuations common in the growth literature. This is in contrast to the traditional stationary dynamic and static panel approaches which might inadvertently uncover high-frequency relationships. The estimators are also superconsistent under cointegration and are robust to the omission of variables that are not part of the equilibrium relation defined in equation (1).

3 Empirical Results

Our empirical analysis is based on annual data from 1980 to 2006 on the logarithm of the real gross domestic product per capita, y_{jt}, the logarithm of the investment share of real GDP, $\ln{(I/Y)}_{jt}$, and the logarithm of the real value of oil production per capita, $\ln o_{jt}$. As we also have access to data on oil rent for different countries a further robustness check is performed replacing $\ln o_{jt}$ with the real value of oil rent per capita, $\ln or_{jt}$.[1]

The data set covers 53 countries, see Table 1, of which 10 are Latin American. But our sample also includes 10 OPEC countries, as well 17 out of the 30 OECD countries. As such there is a large degree of heterogeneity across countries. These countries together cover 85 percent of world GDP and 77 percent of world oil production per day, making the sample very comprehensive.

Table 1: Countries Included in the Sample

Latin America	OPEC	OECD		All other Countries	
Argentina	Algeria	Australia	Mexico	Bahrain	Israel
Bolivia	Ecuador	Austria	Netherlands	State of Brunei Darussalam	Malaysia
Brazil	Indonesia	Canada	New Zealand	Cameroon	Morocco
Chile	Iran	Denmark	Norway	China	Oman
Colombia	Kuwait	France	Turkey	Dem. Republic of the Congo	Papua New Guinea
Ecuador	Nigeria	Germany	United Kingdom	Republic of the Congo	Romania
Mexico	Qatar	Greece	United States	Cote d'Ivoire	Syria
Peru	Saudi Arabia	Hungary*		Egypt	Thailand
Trinidad and Tobago	UAE	Italy		Gabon	Tunisia
Venezuela	Venezuela	Japan		India	

OECD refers to the Organization for Economic Cooperation and Development and OPEC to the Organization of the Petroleum Exporting Countries.

3.1 Economic Development and Oil Abundance

Having established that all of our variables are $I(1)$ and that there is a large degree of cross sectional dependence in our data set,[2] we proceed by estimating the following equation:

$$\ln y_{jt} = a_j + d_j t + \beta_{j1} \ln(I/Y)_{jt} + \beta_{j2} \ln o_{jt} + u_{jt}, \tag{2}$$

but we also estimate the above equation by replacing $\ln o_{jt}$ with $\ln or_{jt}$. The results for the two specifications are shown in Table 2. It is clear that the coefficient of oil in all of our specifications is significantly positive implying that oil abundance leads to a positive level effect. The first two columns report the mean group (MG) estimates; not surprisingly there is evidence of cross sectional dependence for the MG estimation errors and as a result they are misleading and so we will not consider these estimates. For the CCEP and CCEMG estimations we augment (2) with the simple cross sectional averages of all of our regressors. From the CD test statistics it is clear that this augmentation has lead to reduction of cross sectional dependence, to such extent that we cannot reject at the 10 percent level the null of no cross sectional dependence for either of the two CCE type estimators. The last two columns report the CCEP estimates which have smaller coefficients on all of the variables as compared to both the MG and CCEMG estimates. We argue that while the countries in our data set all produce oil, there are substantial heterogeneity among them: some countries are net exporters while others are net importers of oil; some are developed others are developing;

[1]All of our data, except for oil prices, which is from the British Petroleum, is from the World Bank (World Development Indicators).

[2]For more details see ?.

in addition, they have different geographical locations. Given this level of heterogeneity across countries we focus on the results of the CCEMG estimates which are reported in the two columns in the middle of Table 2.

Table 2: Estimation Results 1980-2006

$\ln y_{jt}$	MG		CCEMG		CCEP	
$\ln(I/Y)_{jt}$	0.21^{***} (0.024)	0.22^{***} (0.024)	0.21^{***} (0.023)	0.21^{***} (0.023)	0.15^{***} (0.022)	0.15^{***} (0.021)
$\ln o_{jt}$	0.06^{***} (0.015)	–	0.15^{***} (0.031)	–	0.06^{***} (0.014)	–
$\ln or_{jt}$	–	0.05^{***} (0.013)	–	0.14^{***} (0.033)	–	0.06^{***} (0.014)
CD Test Statistics	3.23	3.35	1.59	1.31	−1.70	−1.65

Notes: MG stands for Mean Group estimates and CCEMG and CCEP denote the Common Correlated Effects Mean Group and Pooled estimates respectively. The dependent variable is the logarithm of output per capita, $\ln y_{jt}$. Standard errors are given in parenthesis; for more details see Pesaran (2006). Symbols denote *10%, **5%, ***1% rejections.

The estimated share of capital in output, α_1, and the share of oil in output, α_2, are pretty much the same no matter what measure of oil abundance we use, thus showing the robustness of our results. In addition, it is clear from Table 3 that for the full sample in all cases $\alpha_1 > \alpha_2$, and their sum is about one-third.

To make sure that these results are not driven by a few countries with large coefficients on the oil variables, we look at the individual country CCEMG estimates for each of the three specifications considered.[3] For the full sample, the coefficients of the investment share and the three oil variables all lie in a sensible range. There are only eight countries for which oil production has a negative effect on real income and nine countries for which oil rent has the same effect. However, this effect is only significantly negative for five countries (Chile, France, Netherlands, New Zealand, and Thailand) all of whom are net importers of oil. Thus even at the individual country level there is no evidence that oil abundance, as measured by oil production and rent values, stunts development.

Table 3: Capital and Oil Shares in CCEMG Regressions

	$\ln o_{jt}$				$\ln or_{jt}$			
	All	LA	OPEC	OECD	All	LA	OPEC	OECD
α_1	0.172	0.177	0.138	0.214	0.171	0.176	0.134	0.213
α_2	0.123	0.199	0.210	$0.000^{\dagger}$	0.116	0.204	0.218	$0.002^{\dagger}$
$\alpha_1 + \alpha_2$	0.295	0.376	0.348	0.214	0.287	0.380	0.352	0.215

Notes: † Symbol denotes that the coefficient is not significant in CCEMG regressions. $\ln o_{jt}$ is estimated by augmenting (2) with the simple cross sectional averages of the regressors using $\ln o_{jt}$, whereas $\ln or_{jt}$ is estimated in the same way but by using $\ln or_{jt}$. LA refers to Latin America, OPEC to the Organization of the Petroleum Exporting countries, and OECD to the Organization for Economic Cooperation and Development

We split the sample into three subsets: Latin American (LA) countries, and countries that are members of the Organization of the Petroleum Exporting Countries (OPEC) and the Organization for Economic Cooperation and Development (OECD)[4]. Re-estimating both specifications using these subsets, we report, in Table 3, the CCEMG estimates of the shares

[3] The results for the individual countries are not reported in the paper, but they are available upon request.

[4] Note that some countries belong to more than one group.

of oil and capital in output. For all three subsets, just like in the full sample, the estimates for α_1 and α_2, have the correct signs and are very similar. In addition, while α_1 is significantly positive for all countries in the subsets, α_2 is positive but only significant for the LA and OPEC countries.

Moreover, we can see that while for the OECD countries $\alpha_1 > \alpha_2$, this is not the case for the LA and OPEC countries for which $\alpha_1 < \alpha_2$. These results are perhaps expected for the OPEC countries as the share of oil in output is quite significant because oil production dominates economic activity for these countries. Notice also that the sum of α_1 and α_2 are reasonable and just over one-third. For Latin American countries the estimated values of the shares seem to be sensible, with their total value being around 0.38. Note that while the share of oil in output for LA is similar to that of the OPEC countries, the share of capital in output is around 30 percent larger for the LA countries as compared to the OPEC countries. It is also interesting to note that for the OECD countries as a group the share of oil in output is not significantly different from zero. Again we would have expected α_2 to be significantly smaller for the OECD group as compared to that of the OPEC and LA countries.

To make sure that the results are not driven by a few outliers in the sub-samples, we look at country-specific estimations for the Latin American and the OPEC countries. Overall the coefficients of the oil variables and the share of investment in output are reasonable. The United Arab Emirates is the only country in OPEC for which oil rent and production have a negative effect on income, but this is in fact insignificant. Turning to the results for the Latin American countries we find that Chile is the only country for which oil rent and production have a significant negative effect on real income. However, Chile is a net importer of oil and as such this result does not seem to indicate that resource abundance harms growth. Thus we can conclude that overall the estimates for the Latin American and OPEC countries do not seem to be affected by outliers, suggesting that oil abundance is in fact a blessing and not a curse.

3.2 Growth Effects of Oil Abundance

Having established panel cointegration between real GDP per capita, the share of investment in real GDP, and the real value of oil production per capita (as well as real oil rent per capita), we now estimate the following panel error correction model

$$\begin{aligned} \Delta \ln y_{jt} &= e_j + \psi_j \left[\ln y_{j,t-1} - \chi_{j1} \ln(I/Y)_{j,t-1} - \chi_{j2} \ln o_{j,t-1}\right] \\ &\quad + \kappa_{j1} \Delta \ln (I/Y)_{jt} + \kappa_{j2} \Delta \ln o_{jt} + \kappa_{j3} \Delta \ln y_{jt-1} + \upsilon_{jt}, \end{aligned} \tag{3}$$

to determine the short-run and the long-run effects of oil on real GDP per capita. As before there is considerable cross sectional dependence in the MG regressions, see the first two columns in Table 4. To address this issue, we computed CCEMG and CCEP estimates by augmenting (3) with simple cross sectional averages of the regressors. To check the robustness of our estimates we also estimated (3) by replacing $\ln o_{jt}$ with $\ln or_{jt}$. The coefficients on $\ln y_{j,t-1}$, in all specifications are statistically significant and different from zero indicating that the system reverts to the long-run values following a shock. All other estimated coefficients are correctly signed with the coefficients of the real value of oil production and rent statistically significant and positive in both the short-run and the long-run, indicating that oil abundance has both positive level and growth effects.

Table 4: Panel Error Correction Estimates 1980-2006

$\Delta \ln y_{jt}$	MG		CCEMG		CCEP	
$\ln y_{j,t-1}$	−0.39*** (0.025)	−0.39*** (0.025)	−0.61*** (0.047)	−0.59*** (0.044)	−0.32*** (0.026)	−0.32*** (0.026)
$\ln(I/Y)_{j,t-1}$	0.07*** (0.012)	0.08*** (0.013)	0.13*** (0.021)	0.13*** (0.021)	0.07*** (0.013)	0.07*** (0.013)
$\ln o_{j,t-1}$	0.04*** (0.010)	–	0.10*** (0.027)	–	0.03*** (0.005)	–
$\Delta \ln o_{jt}$	0.04*** (0.011)	–	0.11*** (0.024)	–	0.03** (0.015)	–
$\ln or_{j,t-1}$	–	0.03*** (0.008)	–	0.08*** (0.025)	–	0.03*** (0.005)
$\Delta \ln or_{jt}$	–	0.03*** (0.010)	–	0.11*** (0.025)	–	0.03** (0.015)
$\Delta \ln(I/Y)_{jt}$	0.13*** (0.019)	0.13*** (0.019)	0.15*** (0.021)	0.15*** (0.021)	0.07*** (0.011)	0.07*** (0.011)
$\Delta \ln y_{j,t-1}$	0.17*** (0.032)	0.17*** (0.032)	0.09** (0.038)	0.08** (0.038)	0.10*** (0.050)	0.11** (0.051)
CD Test Statistics	4.97	5.09	−0.84	−0.90	−1.40	−1.39

Notes: The country specific intercepts are estimated but not reported. MG stands for Mean Group estimates while CCEMG and CCEP denote the Common Correlated Effects Mean Group and Pooled estimates respectively. The dependent variable is the change in the logarithm of output per capita, $\Delta \ln y_{jt}$. Standard errors are given in parenthesis. Symbols denote *10%, **5%, ***1% rejections.

As we believe that there is considerable heterogeneity and cross sectional dependence across countries in our sample, we focus on the CCEMG estimates, which generally has significantly larger coefficients on both the investment share of output and the oil variables considered as compared to the MG and CCEP estimates. The estimated share of capital in output, α_1, and the share of oil in output, α_2, vary depending on which oil variable we use in our analysis, but are in line with those reported in Table 3. As before the share of capital in output is larger than the share of oil in output and they sum to less than one-third. The coefficients of the short-run parameters suggest an elasticity of real income with respect to both production and rent per capita of around 11 percent. Our results then seem to confirm that oil abundance has both a positive level (long-run) as well as growth (short-run) effects.

To check the robustness of our results to the choice of natural resource considered, we performed the same estimations with the two measures of real value of production and rent per capita but by using natural gas as well as combining natural gas and oil data and obtained very similar results to the ones reported in Tables 2 and 4. For the sake of space, these results are not reported but are available upon request.

4 Concluding Remarks

This paper has re-visited the resource curse paradox in a panel made up of 53 countries over 27 years. The sample covered 85 percent of world GDP and 77 percent of world oil production per day, and exhibited a substantial degree of cross country heterogeneity. Our results suggested that the effect of oil abundance on both the level as well as the growth rate of real income is significantly positive. We also estimated separate models for the Latin American countries, as well as the OPEC and OECD countries and confirmed that in all three subsets, oil abundance has both short-run growth enhancing as well as positive level effects on real income. Our results thus show that oil abundance by itself does not seem to a curse. Whether or not oil abundant countries could be richer and provide a better living standard to their population than what is observed is a different issue.

What are then the policy implications of this paper? Firstly, one has to be careful when drawing conclusions from most of the empirical work in the literature as the econometric evidence of the effects of oil abundance on growth may be questioned, as described in Section 1.2. Secondly, in the light of our results we believe that the question should not be whether having a large endowment of oil is bad or good for an economy, but instead focus should be put on how much better off these oil abundant economies could be by having (i) a higher degree of financial development, (ii) larger integration with the global economy, (iii) better institutions, and (iv) better macroeconomic policy, among other things. Thirdly, we believe that as opposed to a natural resource curse, there might be a 'volatility curse'. In other words, the large volatility of oil prices contributes to large volatility in oil income for oil exporters and it is this volatility that might dampen growth and development. A policy to overcome this volatility curse might be to establish Sovereign Wealth Funds, like Norway, so that consumption and expenditure can be smoothened over the oil price cycle. Finally, oil is a non-renewable resource and as such at some point in time it will run out (or alternative energy sources might be discovered as the price of oil increases) and with it the large oil revenues that oil exporters are currently enjoying will disappear. Diversification of the economy before all the oil has been extracted should therefore be a key priority for oil abundant economies; as otherwise there will be large implications for future economic growth of these economies.

References

Boschini, A., J. Pettersson, and J. Roine (2007). Resource Curse or Not: A Question of Appropriability. *Scandinavian Journal of Economics 109*(3), 593–617.

Bravo-Ortega, C., J. De Gregorio, and D. Paraguay (2005). The Relative Richness of the Poor? Natural Resources, Human Capital, and Economic Growth. *The World Bank: Policy Research Working Paper Series 3484*.

Brunnschweiler, C. N. and E. H. Bulte (2008). The Resource Curse Revisited and Revised: A Tale of Paradoxes and Red Herrings. *Journal of Environmental Economics and Management 55*(3), 248–264.

Caselli, F. and T. Cunningham (2009). Leader Behaviour and the Natural Resource Curse. *Oxford Economic Papers Forthcoming*.

Collier, P. and A. Hoeffler (2004). Greed and Grievance in Civil War. *Oxford Economic Papers 56*, 563–595.

Corden, W. M. and J. P. Neary (1982). Booming Sector and De-Industrialisation in a Small Open Economy. *The Economic Journal 92*(368), 825–848.

Esfahani, H. S., K. Mohaddes, and M. H. Pesaran (2009). Oil Exports and the Iranian Economy. *Cambridge Working Papers in Economics 0944*.

Gylfason, T. (2001). Natural Resources, Education, and Economic Development. *European Economic Review 45*(4-6), 847–859.

Krugman, P. (1987). The Narrow Moving Band, the Dutch Disease, and the Competitive Consequences of Mrs. Thatcher: Notes on Trade in the Presence of Dynamic Scale Economies. *Journal of Development Economics 27*(1-2), 41–55.

Lane, P. R. and A. Tornell (1996). Power, Growth, and the Voracity Effect. *Journal of Economic Growth 1*, 213–241.

Lee, K., M. H. Pesaran, and R. Smith (1997). Growth and Convergence in a Multi-Country Empirical Stochastic Solow Model. *Journal of Applied Econometrics 12*(4), 357–392.

Leite, C. and M. Weidmann (1999). Does Mother Nature Corrupt? Natural Resources,. Corruption and Economic Growth. *IMF Working Paper 9985*.

Mehlum, H., K. Moene, and R. Torvik (2006). Institutions and the Resource Curse. *The Economic Journal 116*, 1–20.

Neary, J. P. and S. J. G. van Wijnbergen (1986). *Natural Resources and the Macroeconomy*. MIT Press, Cambridge, MA.

Pedroni, P. (2007). Social Capital, Barriers to Production and Capital Shares: Implications for the Importance of Parameter Heterogeneity from a Nonstationary Panel Approach. *Journal of Applied Economics 22*, 429–451.

Pesaran, M. H. (2006). Estimation and Inference in Large Heterogeneous Panels with a Multifactor Error Structure. *Econometrica 74*(4), 967–1012.

Pesaran, M. H. and R. Smith (1995). Estimating Long-run Relationships from Dynamic Heterogeneous Panels. *Journal of Econometrics 68*(1), 79–113.

Sachs, J. D. and A. M. Warner (1995). Natural Resource Abundance and Economic Growth. *National Bureau of Economic Research Working Paper 5398*.

Stijns, J.-P. C. (2005). Natural Resource Abundance and Economic Growth Revisited. *Resources Policy 30*(2), 107–130.