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NATURAL RESOURCE ABUNDANCE, HUMAN CAPITAL AND ECONOMIC GROWTH IN THE PETROLEUM EXPORTING COUNTRIES

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Growth literatures indicate that human capital, education and technology progress are effective factors on economic growth. Empirical studies present that natural resource abundance have an important role on economic growth in natural-resource-rich countries. This paper investigates the relationship natural resource abundance, human capital and economic growth in two groups of petroleum exporting countries: namely A) Major petroleum exporters B) Other petroleum exporters. The paper first, investigated the relationships between related variables by cross section method and then the proposed model is tested by panel data for the period 1970-2004. Findings showed that physical investment and openness have positive impact on economic growth, and resource abundant and government expenditure inversely related with economic growth, but human capital have a different impact in two sample of the paper; so that in first group of countries, human capital have a negative relationship with economic growth while it has a positive relation with economic growth in second group. It is concluded that human capital can be main factor to explain slow growth of resource-rich countries. Abundant of natural resource in this countries and bad usage of natural resource can be cause of negative relationship between human capital and economic growth. In other hands, countries that are rich in mineral and oil neglect the developing of their human resources by devoting inadequate attention and expenditure to education. So these countries have lower growth rate with respect to others.

Keywords: Economic Growth, Natural Resource Abundance, Human Capital, Petroleum Exporting Countries, Panel Data
JEL classification: C33, O57, Q32, I29

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1. INTRODUCTION

The economic history of the last two centuries shows mixed evidence about relationship of resource abundance with economic growth. During the nineteenth and first half of the twentieth centuries there were several experiences of development where natural resources seem to have been the engine of economic growth (Wright, 1990; and Blomstrom and Meller, 1990). However, it is hard to find successful experiences of development in the second half of the twentieth century. In fact, it is easy to find experiences where this sector has been blamed for the underdevelopment or low growth rates of some economies (Bravo-Ortega and Gregorio, 2005). For example in most countries that are rich in oil, minerals, and other natural resources, economic growth over the long haul tends to be slower than in other countries that are less well endowed. According to the resource curse, natural resources and economic growth vary inversely. As the amount of natural resources increases, the rate of economic growth falls. This pattern is counter-intuitive, because economic theory predicts, ceteris paribus, that natural resources enhance an economy's production possibilities, thus augmenting the potential for economic growth. The mere presence of natural resources does not cause economic stagnation. Rather, natural resource abundance induces certain distortions in the economy, which then serve as transmission mechanisms, which, in turn, affect economic growth. These transmission mechanisms directly influence economic growth whereas natural resources only exert an indirect impact via the transmission mechanisms. Some transmission mechanisms include: the Dutch Disease, rent seeking, government mismanagement, and low levels of human capital (Gylfason, 2001).

This paper examines the relationship between natural resources abundance, human capital, and economic growth in exporting petroleum countries. This research emphasizes the interaction between natural resources and human capital, and their effects on the economic growth. This paper develops as follows: Section 2 encompasses a review of relevant past literature regarding the natural resources, human capital and economic growth. Section 3 provides empirical evidences about the subject. The methodology of the paper is discussed in section 4. Finally, section 5 summarizes results and discusses policy implications of these results.

2. LITERATURE REVIEW

Logically, natural resources should promote economic development, because natural capital expands the production possibilities of an economy. Historically, natural resources have played an integral role in the development of currently wealthy, industrialized nations, including Australia, Canada, Scandinavian countries, and the United States (Stevens, 2003). At the very least, natural resource wealth should not impede or hinder economic performance. Yet many developing nations view their resource endowment as an ambiguous blessing. A large body of empirical evidence supports a clear negative correlation between economic growth and resource

abundance-known as the resource curse-in regards to developing nations during the past forty years. Clearly, natural resources themselves are not inherently detrimental to economic development as evidenced by basic economic theory, common sense, and historically based counter examples. Rather, resource abundance often causes distortions or certain tendencies in an economy, and these distortions then undermine economic performance (Ross, 1999). These distortions serve as "transmission mechanisms," which create and explain the negative correlation between natural resource abundance and economic growth.

Just as there is lack of a universally accepted theory of economic growth in general, we lack a universally accepted theory of the curse of natural resources. It can be assumed that natural resources crowd-out activity *x*.[1] Activity *x* drives grow. Therefore Natural Resources harm growth. Since there is a diversity of views regarding the second of these statements (what exactly drives growth), we have a similar diversity of views on the natural resource question (Sachs and Warner, 2001). Sachs and Warner (1995, 1999), and Sachs (1996) identify *x* with traded manufacturing activities. The mechanism is familiar. Positive wealth shocks from the natural resource sector (along with consumer preferences that translate this into higher demand for non-traded goods) creates excess demand for non-traded products and drives up non-traded prices, including particularly non-traded input costs and wages. This in turn squeezes profits in traded activities such as manufacturing that use those non-traded products as inputs yet sell their products on international markets at relatively fixed international prices. The decline in manufacturing then has ramifications that grind the growth process to a halt. In Gylfason *et al*. (1999), and Gylfason (2000) in this issue the culprit '*x*' is education. Furthermore, the basic logic could be extended to other variables relevant to growth. Natural resource abundance could crowd-out entrepreneurial activity or innovation, if wages in the natural resource sector raise high enough to encourage potential innovators and entrepreneurs to work in the resource sector. Human capital represents the skills and knowledge of workers. Human capital improves worker productivity, which then causes economic growth. An economy develops human capital primarily through education and other forms of training. According to the World Bank, human capital as opposed to natural or physical capital exerts the greatest influence on income (Auty, 2001). Thus, the development of education, which generates human capital, plays an integral role in economic growth. Large natural resource endowments often create distortions in the economy that result in low levels of human capital. If a developing country possesses a large natural resource endowment, this country will devote its efforts and resources to the exploitation of the natural resource, because it possesses a comparative advantage. Also, primary production appears particularly attractive, because it requires lower levels of initial investment. Primary production and natural-resource-based industries do not

[1] Activity *x* is the transmission mechanisms which create and explain the negative correlation between natural resource abundance and economic growth.

require high levels of human capital compared to the manufacturing sector. In addition, few positive externalities exist in natural resource-based industries. Thus, a resource-abundant economy develops a very limited sector of the economy-the natural resource based industry, and this sector does not require or promote the development of human capital.

On the contrary, it has been argued (Matsuyama, 1992) that resource-deficient countries do not possess the option of natural resource reliance. Therefore, these countries devote their resources to the exportation of manufactured goods. Manufactured goods require comparatively high levels of skill, thus creating a high demand on education. In addition, the manufacturing sector creates stronger positive externalities. The manufacturing sector encourages the development of technology and promotes "learning by doing" benefits (Matsuyama, 1992). Manufacturing demands the development of human capital, which, in turn benefits, the entire economy whereas primary production does not require high levels of human capital (Gylfason, 2001). If a country centers its economy on a natural resource, this country will not develop an extensive educational system, because the core of the economy-the natural resource sector-does not necessitate high levels of education. People do not pressure the government to provide better education, because the return rate of education is very low. The resource-based economy cannot utilize these new skills, and therefore, additional education does not increase income (Birdsall, 1997)

Sachs and Warner, in a series of papers, have produced the most persuasive recent empirical evidence connecting economic growth and relative abundance of natural resources (Sachs and Warner, 1995). Subsequent works include Lane and Tornell (1996), Feenstra, Madani, Yang and Liang (1997), Gylfason *et al*. (1999), Rodriguez and Sachs (1999), Sachs and Warner (1999, 2001), and Asea and Lahiri (1999). However, the main empirical results can be found in Sachs and Warner (1995), Feenstra *et al*. (1997) and Gylfason *et al*. (1999). The main finding of Sachs and Warner (1995) is the robust negative relationship between economic growth and natural resources, using cross-section regressions. They corroborate this relationship with different measures of resource abundance, such as: the share of mining production in GDP, land per capita, and share of natural resource exports in GDP. Finally, they find that an increment in one standard deviation in the participation of natural resources exports in the GDP would imply a lower rate of growth on the order of 1% per year. Gylfason *et al*. (1999) postulate that the natural resources sector creates and needs less human capital than other productive sectors, which is similar to the assumption of this paper. A larger primary sector induces an appreciated currency which makes the development of a skill intensive sector difficult. Thus, the model they develop predicts an inverse relation between real exchange rate volatility and human capital accumulation and hence growth. Similarly, they predict a positive relationship between external debt and profitability in the secondary sector and also growth. However, the evidence they provide regarding these two explanatory variables is mixed; exchange rate volatility is not statistically significant and external debt is statistically significant but with the wrong sign. Table 1

illustrates the findings of the major studies in natural resource abundance and economic growth.[2]

Table 1. Empirical Studies for Natural Resource Abundance and Economic Growth

Empirical Studies	Method	Period of time	The number of countries	The Useful Indicators for Natural Resource	Result
Sachs & Warner (1995a)	Cross Section	1971-1989	95	Share of primary exports in GDP	negative
Sachs & Warner (1997)	Cross Section	1970-1990	87	Share of primary exports in GDP and total merchandise exports	negative
Gylfason (1999)	Cross Section	1960-1997	125	Share of primary exports in merchandise exports	negative
Gylfason (2001,2002)	Cross Section	1965-1998	85	Share of natural capital in national wealth	negative
Sachs & Warner (2001)	Cross Section	1970-1989	97	Share of exports of the natural resource in GDP	negative
Atkinson & Hamilton (2003)	Cross Section	1980-1995	91	Resource rent	negative
Lederman & Melony(2003)	Cross Section - Panel Data	1980-1999	65	Share of primary exports in total exports and total labor force	positive
Sala-i-Martin, & Subramanian (2003)	Cross Section	1960-1998	71	Share of exports of food and agricultural raw materials in total merchandise exports and GDP Share of exports fuel and natural gas and ores and minerals in total merchandise exports and GDP	negative positive
Salmani & Yavari (2004)	Panel Data	1960-1999	127	Share of fuel exports in merchandise exports and GDP Share of primary exports in merchandise exports	negative
Bravo-Orega & Gregorio (2001,2002,2005)	Panel Data	1970-1990	19	Share of fuels and non-fuel primary exports in GDP	negative
Papyrakis and Gerlagh(2007)	Panel Data	1986-2000	49 states of US	Share of resource rents, primary production and primary exports in GDP Share of natural capital in total capital	negative

[2] In table 1, there are two empirical studies that find a positive relationship between natural resource abundance and economic growth. These studies showed that the effect of natural resource on economic growth is sensitive to methodology and natural resource indicator. See Lederman and Melony (2003) and Sala-i-Martin and Subramanian (2003).

As noted earlier, the explicit consideration of various transmission channels of the effects of natural resource abundance on economic growth has lead to more differentiated and ambiguous results. For example, Gylfason (2001) and Bravo-Ortega and De Gregorio (2005) concentrate on human capital. The first study shows that the negative growth effects of natural resources stem from lower education spending and less schooling in resource-rich countries; the latter find that the negative effects can in fact be offset by higher education levels (Brunnshweiler, 2006). Torvik (2001) discusses that natural resource abundance increases rent-seeking behavior and lowers income, while Manzano and Rigobon (2001) believe that the real problem for growth is the debt overhang in resource-rich countries. Stijns (2003) examines the Dutch disease explanation and finds little evidence for overall negative resource effects on growth though he confirms the sectoral change pattern typical of the "disease". Stijns (2006) shows that the negative association between resource abundance and human capital accumulation is not robust to reasonable, indeed arguably desirable, changes in the way resource abundance and human capital accumulation can be measured. And Hausmann and Rigobon (2002) consider trade structure and show that (export) diversified economies are less likely to suffer negative effects of natural resource wealth. Birdsall, Pinckney and Sabot (2001) start by observing that the most governments around the world are extolling the benefits of education while claiming their investment in education that has limited because of lack of money. As these authors admit, if limits on human capital investment primarily result from binding government constraints, resource abundance should induce additional investment, all else equal. Yet, these authors argue that statistics tell another story: resource abundant countries, on average, invest less in education than other countries extol.

3. METHODOLOGY AND EMPIRICAL RESULTS

In this research the relationships between natural resource, human capital and economic growth by two methods of panel data and cross section has been investigated. First the relationship of natural resource abundance, human capital and economic growth is studied by cross section method and then we estimate the main empirical implications of the model using panel data for the period 1970-2004. The data used in the figures and regressions are from the Penn World Tables (2006), the Barro and Lee Educational Data Set (2000) and World Tables from World Bank (2005). Appendix B describes the variables and their sources in more details. The sample of paper is petroleum exporting countries that are chosen from UNCTAD classification in 2005. The selected countries have been classified in to two groups as: First group) major petroleum exporters that the share of petroleum and petroleum products is not less than 50 percent of their total exporters and Second group) other petroleum exporters that export petroleum but their petroleum exports are a little (See Appendix A for the list of the studied countries).

3.1. Cross Section Method

First, Figure 1 shows a scatter plot of real per capita economic growth from 1970 to 2004 and natural resource abundance as measured by the share of fuel exports in total merchandise exports. The countries in the figure are represented by one dot each. The figure shows that the natural resource abundance has a negative relationship with economic growth and the countries which have great fuel exports (first group) have a low economic growth with respect to the countries have a little fuel exports (second group). All of first group of countries are developing countries while the most of second group countries are developed countries. Figure 2 and 3 show that when human capital increases, economic growth of countries improves. In other words, the countries with high human capital have a high economic growth. So when we attend for location of countries in these figures, it can be seen that in the first group of countries, human capital is less than the second countries and the presence of developed countries can be cause of positive relationship between human capital and economic growth. So we find out that study of developing and developed countries as aggregative can have a biased finding rather than fact. Then in this paper, we try to investigate these countries individually.

Figures 4 and 5 illustrate that when we investigate relationship of human capital and economic growth in the first group of countries, human capital can not increase the economic growth of major petroleum exporting countries. Now this question is raised that, can natural resource abundance be the cause of negative relationship between human capital and economic growth in the first group? Figures 6 and 7 answer to this question and show the negative relationship between natural resource abundance and human capital. In other hand, the countries with the large share of petroleum exports (first group) have a lower human capital and neglect the most factor of economic growth (human capital).

The all of the findings of this section can be seen in Table 2. This table shows data of economic growth, natural resource abundance and human capital in two groups of studied countries.

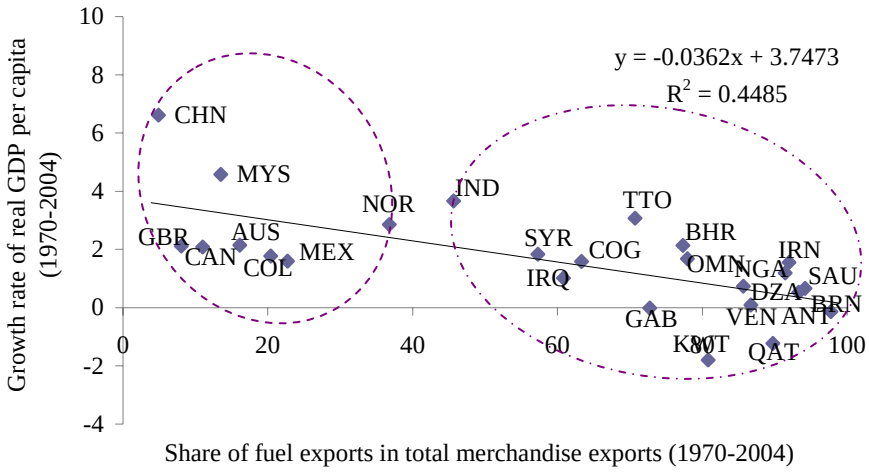

Figure 1. Natural Resource Abundance and Economic Growth

Table 2. Economic Growth, Natural Resource Abundant and Human Capital in Two Sets of Countries

The Period of Time	First Group of Countries: Major Petroleum Exporters (Oil Countries)				Second Group of Countries: Other Petroleum Exporters (Non-Oil Countries)			
	Economic Growth*	Natural Resource Abundance**	Human Capital***		Economic Growth	Natural Resource Abundance	Human Capital	
			LSM	LS			LSM	LS
1966-1970	3.199	68.849	9.8	7.8	2.712	5.286	24.4	25.0
1971-1975	3.803	78.939	12.8	9.9	3.631	7.053	26.9	26.3
1976-1980	1.752	85.691	16.9	14.2	3.505	17.023	29.0	28.4
1981-1985	-2.316	85.527	20.0	17.2	2.381	30.879	30.8	30.3
1986-1990	-0.450	77.124	23.2	20.2	2.704	21.448	37.8	36.8
1991-1995	1.314	80.641	26.6	24.0	3.200	18.237	39.5	38.6
1996-2000	1.276	78.021	28.5	26.3	3.615	18.170	38.5	37.6
2001-2004	0.569	79.417	-	-	2.084	20.400	-	-
1966-2004	1.390	79.300	16.8	14.5	2.962	17.317	29.9	29.5

Notes: *: Growth rate of real GDP per capita. **: Share of fuel exports in total merchandise exports. ***: LS: Percentage of “secondary school attained” in the male population. LSM: Percentage of “secondary school attained” in the total population.

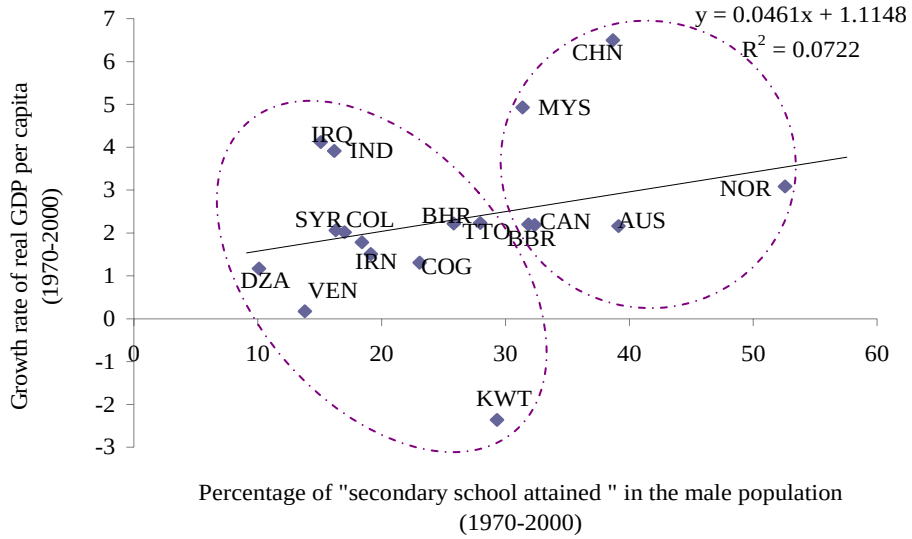

Figure 2. Human Capital and Economic Growth

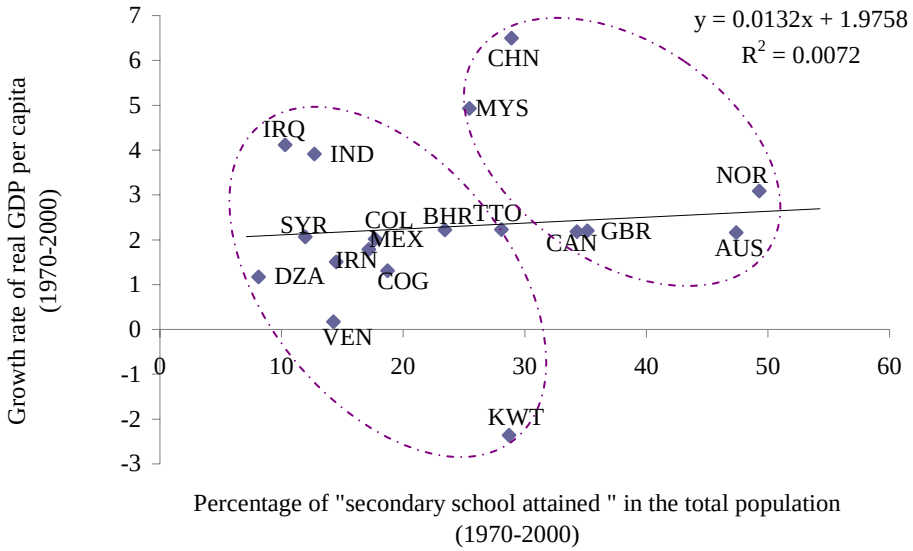

Figure 3. Human Capital and Economic Growth

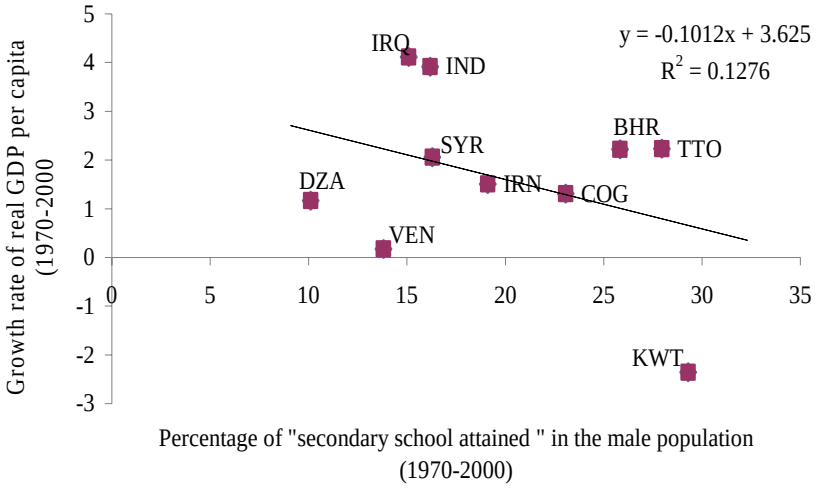

Figure 4. Human Capital and Economic Growth in Oil Countries

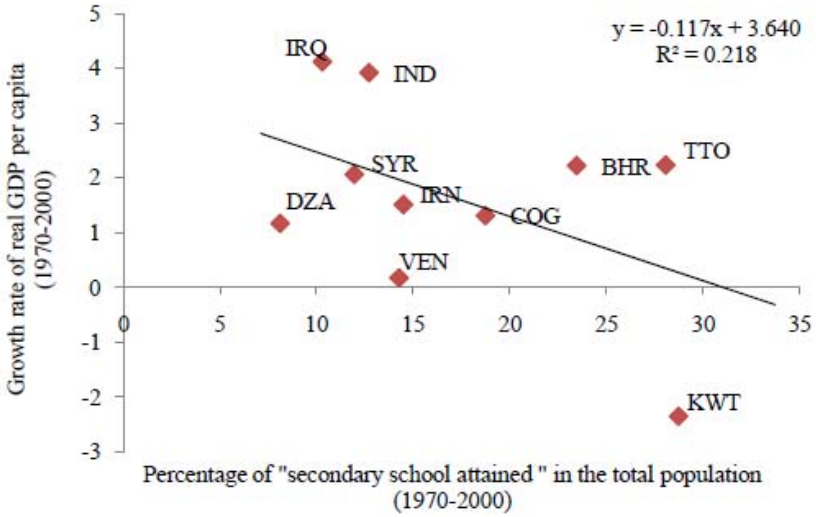

Figure 5. Human Capital and Economic Growth in Oil Countries

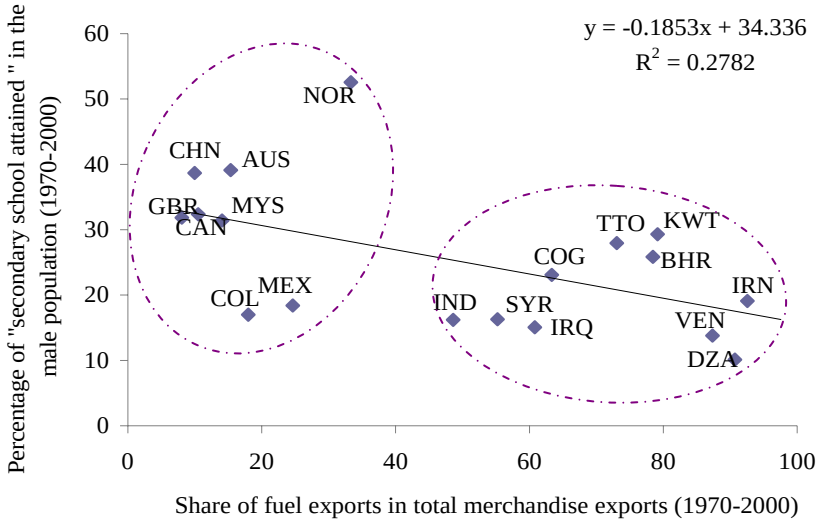

Figure 6. Natural Resource Abundance and Human Capital

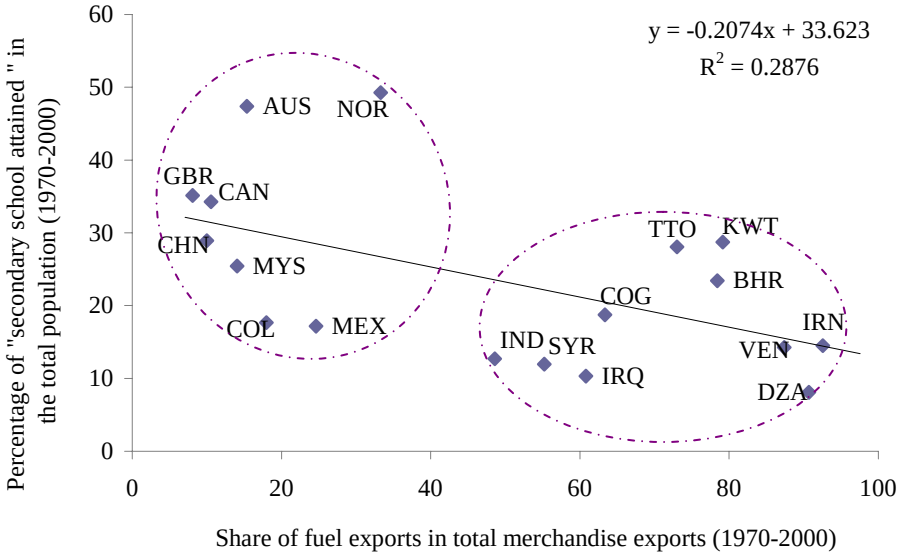

Figure 7. Natural Resource Abundance and Human Capital

3.2. Panel data method

The model that has been employed in this research has been developed based on the previous works on the growth field. They include cross country studies e.g., Barro (1991) and Barro and Sala-i-Martin (1995); studies of economics with natural resource abundance base e.g., Gelb (1988) and Auty (1990, 2001); useful models in empirical studies e.g., Sachs and Warner (1995a, 1997, 1999, 2001), Gylfason (2001), Sala-i-Martin and Subramanian (2003) and Bravo-Ortega and Gregorio (2005).

We estimate the main empirical implications of the model using panel data for the period 1970-2004. In this framework, the growth equations have the following general form:

$$g_{it} = \beta_1 + \mathrm{B}_2 \ln(GDP_0) + \beta_3 Z + \varepsilon_{it} . \quad (1)$$

The general form of Equation (1) has been derived by several authors. While the derivations differ across studies, the core hypothesis is that cross-sectional growth rates can be explained by transitional dynamics, and that countries adjust to their steady state income with a speed that is less than infinite. The sign of β_2 provides a crucial test of this hypothesis. If β_2 is negative, the adjustment path to the steady state is concave, with the speed of transition faster at the beginning, when the country is furthest from its steady state income level. *Z* is a vector of economic characteristics that determine a country's steady state income level, and thus its growth rate.

In the first stage, we regress the growth rate of GDP per capita on explanatory variables, using panel data with seven sub-periods.[3] Given that we are interested in determining the possible effect of natural resource abundance on economic growth, we extend traditional growth regressions incorporating the share of fuel exports in the total merchandise exports as a proxy of resource abundance (*N*). As control variables we use human capital (*H*) measured by the Percentage of "secondary school attained" in the total population (H_1), Literacy rate of total adult population (H_2), government expenditure as fraction of GDP (*KG*), openness measured by the fraction of exports and imports over GDP (*OPEN*), terms of trade (*TOT*), investment as fraction of GDP (*KI*) and initial GDP *(LNIGDP*). All the variables are measured at the average of each period of the panel.

The benchmark regression for the rate of growth can be expressed as:

$$g_{it} = \beta_{01} + \beta_2 LNIGDP_{i0} + \beta_3 KI_{it} + \beta_4 OPEN_{it} + \beta_5 H_{it} + \beta_6 N_{it} + \beta_7 TOT_{it} + \beta_8 KG_{it} + \varepsilon_{it} , \quad (2)$$

[3] In this paper, period 1970-2004 is divided to seven sub-period and is considered the average of each sub-period; that is, 1970-1974, 1975-1979, 1980-1984- … -2000-2004.

where *i* is a country index and *t* indicates the number of the cross section regression of the panel.

In the second stage, including interaction effects between human capital and natural resources, we estimate the following regression:

$$g_{it} = \beta_{01} + \beta_2 LNIGDP_{i0} + \beta_3 KI_{it} + \beta_4 OPEN_{it} + \beta_5 H_{it} + \beta_6 N_{it} + \beta_7 H_{it} * N_{it} + \beta_8 TOT_{it} + \beta_9 KG_{it} + \varepsilon_{it}. \quad (3)$$

Equation (3) incorporates the interaction term between natural resources and human capital. This term allows us to test whether the negative effect of natural resources on the rate of growth decreases with human capital. The analysis of panel data is the subject of one of the most active and innovative bodies of literature in econometrics, partly because panel data provide such a rich environment for the development of estimation techniques and theoretical results. The fundamental advantage of a panel data set over a cross section is that it will allow the researcher great flexibility in modeling differences in behavior across individuals.

The basic framework for this discussion is a regression model of the form:

$$y_{it} = X_{it}^{'}\beta + Z_i^{'}\alpha + \varepsilon_{it}\,. \quad (4)$$

There are *K* regressors in X_{it}, not including a constant term. The heterogeneity, or individual effect is $Z_i'\alpha$ where Z_i constant term and a set of individual or group specific variables. Thus if we are interested in differences across group, we can test the hypothesis that the constant terms are all equal with an *F* test. Under the null hypothesis of equality, the efficient estimator is pooled least squares. The *F* ratio used for this test is:

$$F_{(n-1,nT-n-K)} = \frac{(R^2{}_{LSDV} - R^2{}_{Pooled})/(n-1)}{(1-R^2{}_{LSDV})/(nT-n-K)}\,, \quad (5)$$

where *LSDV* indicates the dummy variable model and Pooled indicates the pooled or restricted model with only a single overall constant term. If the null hypothesis was rejected, we have made the distinction between fixed end random effects models. The specification test devised by Hausman (1978) is used to test for orthogonality of the random effects and the regressors. The test is based on the idea that under the hypothesis oh no correlation, both OLS in the *LSDV* model and *GLS* are consistent, but *OLS* is inefficient, whereas under the alternative, *OLS* is consistent, but *GLS* is not. The chi-square test is based on the Wald criterion:

$$W = \chi^2[K-1] = [b-\hat{\beta}]'\psi^{-1}[b-\hat{\beta}], \quad (6)$$

$$\psi = Var[b-\hat{\beta}] = Var[b] - Var[\hat{\beta}]. \quad (7)$$

b is the slope estimator in LSDV model (fixed effect) and β is the slope estimator in the random effect model (Greene, 2004, pp 284-302).

The result of these tests that were shown in the tables of estimation models indicate null hypothesis of *F* test for first group of countries is rejected while this test for second group of countries can not reject. In other hand the result of *F* test show in first group, *LSDV* model is better model but in second group *F* test show pooled least square is better model and individual effects is not considered for second group. As previously attended, If the null hypothesis in *F* test was rejected, we have made the distinction between fixed end random effects models by Hausman test. The results of Hausman test that applied only for first group show the null hypothesis is rejected and fixed effect is efficient and consistent.

3.2.1. Estimation of the Models for First Group of Countries

Table 3 reports the results of our estimations using fixed effect method for first group countries according to Equation (2). Findings show that there is a negative relation between natural resources and economic growth. In this table we use the percentage of "secondary school attained" in the total population (H_1) and in the male population (H_{1m}), literacy rate of youth total (% of people ages 15 and above) (H_{2y}) and literacy rate of adult total (% of people ages 15-24) (H_2) as a measure of human capital. The result of estimation show there is a negative relation between human capital and economic growth. Other variable such as investment fraction of real GDP and openness had a positive and expected effect on economic growth, but government expenditure as fraction of GDP and terms of trade have a negative effect on economic growth of first group countries. The sign of initial GDP is a negative and conditional convergence is not consistent for this countries.

Table 4 shows the effect of the interaction between natural resources and human capital. As we previously mentioned, it is expected that higher levels of human capital reduce the negative effect of natural resources on growth but equations 2.6 to 2.9 that include the interaction between natural resources and human capital show interaction term has a negative effect on economic growth. Thus the result indicates natural resource abundance first impedes increasing human capital and then it has a negative effect on growth by human capital. In other words, in major petroleum exporting countries natural resource (oil) not only has a negative effect directly but it also has a negative effect via human capital. Because these countries depend on their fuel exporters, human capital is very low in these countries. So, lower human capital couldn't reduce the negative effects of natural resources on growth.

Table 3. Estimation of the Model (2) for First Group of Countries by Fixed Effect Method

	1.1	1.2	1.3	1.4	1.5	1.6	1.7	1.8	1.9
C	-49.56***	-60.92***	-63.64***	-86.92***	-83.96***	-73.86***	-74.92***	-105.44***	-43.95***
	(-7.82)	(-10.38)	(-5.60)	(-6.00)	(-5.71)	(-6.08)	(-5.77)	(-10.24)	(-6.68)
LNI	6.19***	7.75***	7.05***	10.76***	10.45***	9.02***	8.91***	13.40***	6.33***
GDP	(7.71)	(10.93)	(5.41)	(5.76)	(5.53)	(6.01)	(5.48)	(8.97)	(5.95)
KI	0.16***	0.178***	0.15***	0.11***	0.12***	0.04*	0.09***	0.13***	0.12***
	(5.57)	(6.05)	(4.97)	(3.91)	(3.98)	(1.34)	(3.58)	(9.18)	(6.44)
OPEN	0.016	0.007	0.05***	0.03*	0.02*	0.05***	0.05***	0.07**	0.01*
	(0.67)	(0.37)	(4.35)	(1.45)	(1.23)	(3.80)	(3.99)	(2.85)	(1.02)
N			-0.07***	-0.06***	-0.05**	-0.06***	-0.06***	-0.09***	-0.02***
			(-5.26)	(2.77)	(-2.47)	(-3.90)	(-3.64)	(-4.29)	(-2.75)
H1	-0.32***			-0.24***				-0.19***	-0.29***
	(-6.32)			(-4.05)				(-4.84)	(-6.18)
H1 (M)		-0.35***			-0.24***				
		(-7.27)			(-3.88)				
H2						-0.09***			
						(-5.66)			
H2 (y)							-0.06***		
							(-4.18)		
TOT								-0.01***	
								(-3.26)	
KG									-0.24**
									(-2.51)
R^2	0.73	0.79	0.43	0.55	0.54	0.49	0.46	0.75	0.59
Obser-vations	67	67	120	60	63	106	106	45	63
Coun-tries	10	10	17	10	10	15	15	7	10
F statistic	12.96	18.80	3.84	4.97	4.75	4.94	4.44	12.37	5.86
Hausman statistic	3.06	3.03	7.53	2.69	2.68	7.87	6.79	3.95	2.72

Notes: t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

3.2.2. Estimation of the Models for Second Group of Countries

Table 5 report the result of estimation model for the second group countries by using pooled least square method. Finding in this table show that natural resource abundance has a negative relation with economic growth, but human capital, that measured by the percentage of "secondary school attained" in the total population (H_1) and in the male

population (H_{1m}), and (the cause of lack data for Literacy rate of youth total) the average schooling years in the total population too (H_s), has a positive effect on growth. Other variables like investment and openness and term of trade improve growth and government expenditure has a negative relation with growth. In this group of countries (second group), the sign of initial GDP is expected and confirm conditional convergence in this countries.

Table 4. Estimation of the Model (3) for First Group of Countries by Fixed Effect Method

	2.1	2.2	2.3	2.4	2.5	2.6	2.7	2.8	2.9
C	-49.56***	-60.92***	-63.64***	-86.92***	-83.96***	-93.39***	-99.26***	-98.31***	-78.21***
	(-7.82)	(-10.38)	(-5.60)	(-6.004)	(-5.71)	(-5.84)	(-7.34)	(-7.22)	(-7.70)
LNI GDP	6.19***	7.75***	7.05***	10.76***	10.45***	11.34***	12.30***	12.16***	9.79***
	(7.71)	(10.93)	(5.41)	(5.76)	(5.53)	(5.65)	(6.46)	(6.44)	(6.92)
KI	0.16***	0.178***	0.15***	0.11***	0.12***	0.11***	0.13***	0.13***	0.11***
	(5.57)	(6.05)	(4.97)	(3.91)	(3.98)	(3.20)	(8.05)	(7.46)	(4.79)
OPEN	0.016	0.007	0.05***	0.03*	0.02*	0.03*	0.06**	0.06**	0.02*
	(0.67)	(0.37)	(4.35)	(1.45)	(1.23)	(1.36)	(2.49)	(2.34)	(1.40)
N			-0.07***	-0.06***	-0.05**	-0.046***	-0.05**	-0.04***	-0.016
			(-5.26)	(-2.77)	(-2.47)	(-1.78)	(-2.11)	(-1.71)	(-0.18)
H1	-0.32***			-0.24***		-0.104*			
	(-6.32)			(-4.05)		(-1.56)			
H1 (M)		-0.35***			-0.24***				
		(-7.27)			(-3.88)				
*H1*N*						-0.0015*	-0.002***		-0.0028***
						(-1.44)	(-4.38)		(-3.92)
*H1M*N*								-0.002***	
								(-4.58)	
TOT							-0.012***	-0.014***	
							(-3.08)	(-3.60)	
KG									-0.16*
									(-1.52)
R^2	0.73	0.79	0.43	0.55	0.54	0.57	0.77	0.76	0.57
Obser-vation	67	67	120	60	63	63	45	45	63
Coun-tries	10	10	17	10	10	10	7	7	10

Notes: t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 5. Estimation of the Model (2) for Second Group of Countries by Pooled Least Square Method

	3.1	3.2	3.3	3.4	3.5	3.6
C	8.18***	7.09***	7.55**	10.09***	6.16**	8.24**
	(2.93)	(3.14)	(2.72)	(3.98)	(2.36)	(2.51)
LIRGDP	-0.89**	-0.75***	-0.76**	-1.14***	-0.66**	-0.66*
	(-2.59)	(-2.92)	(-2.24)	(-3.26)	(-2.29)	(-1.49)
KI	0.11**	0.06***	0.06***	0.06***	0.05**	0.04**
	(2.69)	(3.64)	(4.33)	(4.37)	(2.31)	(2.47)
OPEN	0.02**	0.02***	0.01**	0.01**	0.02**	0.01***
	(2.43)	(13.35)	(2.68)	(2.27)	(2.84)	(5.06)
N	-0.02*	-0.02**	-0.026***	-0.017*	-0.015**	-0.018*
	(-1.75)	(-2.10)	(-3.09)	(-1.61)	(-2.04)	(-1.87)
H1		0.012*			0.012*	0.023*
		(1.30)			(1.42)	(1.61)
H1(M)			0.02*			
			(1.75)			
H(S)				0.188**		
				(2.32)		
TOT					0.001	
					(0.25)	
KG						-0.08***
						(-4.09)
R^2	0.34	0.38	0.66	0.76	0.45	0.84
Observation	56	49	49	49	49	49
Countries	7	7	7	7	7	7
F	1.5	1.60	0.38	0.54	1.5	0.85

Notes: t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

Table 6 shows the effect of the interaction between natural resources and human capital on economic growth for the second group of countries. The value of interaction variable that was shown in regressions 4.3 to 4.6 indicate that negative effect of natural resource on growth can reduce by human capital. As we previously mentioned (Table 2), human capital in the second group of countries is pretty high in respect with the first group and this high human capital can offset negative effect of natural resource abundance.

Table 6. Estimation of the Model (3) for Second Group of Countries by Pooled Least Square Method

	4.1	4.2	4.3	4.4	4.5	4.6
C	7.09***	7.55**	7.48**	7.16**	6.86**	6.12*
	(3.14)	(2.72)	(2.38)	(1.96)	(1.90)	(1.74)
LIRGDP	-0.75***	-0.76**	-0.74**	-0.72**	-0.51*	-0.46*
	(-2.92)	(-2.24)	(-2.14)	(-1.95)	(-1.17)	(-1.23)
KI	0.06***	0.06***	0.06**	0.058*	0.04*	0.028
	(3.64)	(4.33)	(2.05)	(1.41)	(1.42)	(0.66)
OPEN	0.02***	0.01**	0.02**	0.019**	0.02***	0.023***
	(13.35)	(2.68)	(2.82)	(2.77)	(3.12)	(3.00)
N	-0.02**	-0.026***	-0.042*	-0.043*	-0.039***	-0.039*
	(-2.10)	(-3.09)	(-1.83)	(-1.79)	(-3.29)	(-1.70)
H1	0.012*					
	(1.30)					
H1(M)		0.02*				
		(1.75)				
*H1*N*			0.0006*	0.0006*		0.00055*
			(1.43)	(1.42)		(1.25)
*H1M*N*					0.0005*	
					(1.34)	
TOT				0.002		0.005
				(0.16)		(0.42)
KG					-0.07*	-0.076*
					(-1.99)	(-1.47)
R^2	0.38	0.66	0.44	0.44	0.49	0.50
Observations	49	49	49	49	49	49
Countries	7	7	7	7	7	7

Notes: t-statistics are reported in parentheses. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

4. CONCLUSION

An inverse relationship between economic growth and the relative abundance of natural resources in both groups of petroleum exporting countries has been found. These findings agree with the main predictions of our model. Moreover, and as a main difference with previous work in this topic, we find statistical evidence of natural resource curse by emphasis on human capital. Based on the model's predictions, we also extend the usual specifications for economic growth regressions by incorporating an interaction term between human capital and natural resources. This exercise allows us to recover a list of countries that were in the past, or are in the present relatively rich in

natural resources and human capital, and whose levels of human capital more than offset the negative effect of the natural resource abundance on growth.

The results seem to indicate that natural resources are damaging for economic growth in countries (first group) with low levels of human capital, and countries with rich natural resource neglect human capital. While, in the second group of countries that have high level of human capital this high level of human capital can offset the negative effect of natural resource on economic growth. In addition, this study provides evidence, though not particularly strong, of a negative relationship between human capital and natural resources. So this study shows that human capital serves as a transmission mechanism of the resource curse.

Finally, it can be conclude that given that natural resources are not inherently detrimental to economic growth, rather they create distortions in the economy, which undermine economic performance, governments of resource rich countries should not view slow economic growth as an unfortunate but inevitable reality. These resource-rich developing countries (first group) should look to countries, such as Norway and Canada who have high human capital and good economic growth. The governments of resource-rich countries should consider promoting the manufacturing sector of the economy in addition to the natural resource sector, for which they have a comparative advantage. Economic theory indicates that lack of manufacturing is a principal cause underlying their poor economic performance. Natural resources possess the potential to promote, not impede, economic growth in developing countries.

Appendix

A. The List of Countries

First group of countries: Major petroleum exporters (oil countries)		
BHR: Bahrain	AGO: Angola	DZA: Algeria
GAB: Gabon	COG: Congo, Rep	BRN: Brunei
IRQ: Iraq	IRN: Iran, Islamic Rep	IND: Indonesia
ANT: Netherlands Antilles	LYB: Libya	KWT: Kuwait
QAT: Qatar	OMN: Oman	NGA: Nigeria
TTO: Trinidad and Tobago	SYR: Syrian Arab Republic	AUS: Saudi Arabia
YEM: Yemen	VEN: Venezuela, RB	AMT: United Arab Emirates
Second group of countries: Other petroleum exporters (non - oil countries)		
AUS: Australia	GBR:United Kingdom	CAN: Canada
MYS : Malaysia	COL: Colombia	NOR: Norway
	CHN: China	MEX: Mexico

B. Variables and Sources

Variable	Definition & Source
g	growth rate of Real GDP per capita (Constant Prices: Chain series) Unit: % in 2000 Constant Prices {source: Penn World Tables 6.1}
LNIRGDP	logarithm of initial Real GDP per capita (Constant Prices: Chain Series) unit: % in 2000 Constant Prices {source: Penn World Tables 6.1}
KI	Investment Share of RGDPL unit: % in 2000 Constant Prices {source: Penn World Tables 6.1}
OPEN	Openness in Current Prices unit: % in Current Prices {source: Penn World Tables 6.1}
N	Fuel exports (% of merchandise exports) {source: WDI 2005}
KG	Government Share of RGDPL unit: % in 2000 Constant Prices {source: Penn World Tables 6.1}
H_1	Percentage of "secondary school attained" in the total population {source: Barro & Lee 2000}
H_{1M}	Percentage of "secondary school attained" in the male population {source: Barro & Lee 2000}
H_2	Literacy rate, adult total (% of people ages 15 and above**)** {source: WDI 2005}
H_{2y}	Literacy rate, youth total (% of people ages 15-24) {source: WDI 2005}
H_s	Average schooling years in the total population. {Source: Barro & Lee 2000}

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