NATURAL RESOURCES AND HUMAN CAPITAL: THE DILEMMA OF THE RICHES AND DISINCENTIVES*

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ABSTRACT

Do citizens in countries with natural resources enjoy increased opportunities and a better future? Or do natural resources pose the risk of distorting the process of economic development? In this paper we examine the growth and development process of nations that are rich in resources. Our research is devoted to the role of natural resource rents in the incentive to invest in human capital. We consider two types of human capital; professional, and entrepreneurial; along with an unskilled labor pool. Professional human capital is education intensive, while entrepreneurial human capital is experience intensive. We find that lump-sum transfers from resource rents to citizens lower the incentive to invest in professional human capital, decreasing the opportunity to achieve a higher level of schooling. This increases the chance of a low-level equilibrium trap and reduces the chance of converging to a higher income per capita in the long run. As such, this paper posits a new mechanism for the presence of the so called “resource curse” in developing countries and its effect on the growth process. We empirically examine and confirm our theoretical findings.

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1. Introduction

Growth theory suggests that the process of growth consists of several key channels. While economists may not agree on the relative importance (and order) of these channels, most would agree on some of the key channels: rising savings and investments to allow physical capital accumulation; education and health care to promote human capital accumulation; foreign trade to allow accumulation of foreign reserves; democratic and transparency reforms to eliminate rent seeking and enhance income allocation; economic stability and best practice institutions to help build social capital; manufacturing and industrialization to enhance diversification in production (Thorvaldur Gylfason 2007). One would expect that natural resource abundant economies might see acceleration, if any, of the above processes and thus a faster growth as their production possibilities frontiers expand. Yet evidence suggests a more complex picture. On one hand, many resource rich economies experience a lower rate of economic growth, possibly because one or more of the above channels may be distorted. For example, the Middle East and North Africa (MENA) region with its wealth of oil and other natural resources showed negative savings between 1970 and 2005 (Arezki and Nabli, 2012), and a higher resource rent volatility, makes it harder for governments and individuals to invest and save, affecting long-run growth (Ramey and Ramey 1995). On the other hand, countries as diverse as Botswana and Norway both of who possess vast natural resources have experienced high rates of economic growth and prosperity.

Explanations for this diverse experience are equally varied. Under the general rubric of "natural resource curse" some explanations focus on the interaction of institutions and natural resources. In this explanation, countries with poor institutions become subject to the "curse" (e.g., the Middle East economies) while those with good institutions have a greater chance of escaping the curse (e.g., Norway and Botswana) (Mehlum et al. 2006). Yet, a majority of natural resource-rich countries suffer from poor governance, and bad institutions. Indicators of both democracy and corruption in these countries
are found to belong to the lowest range of such indicators. Whether or not resources itself is a *causal* factor in producing poor institutions is a question of great research interest. For example, Gylfason (2010) discusses the decrease in production efficiency and increase in *rent seeking* activities in the presence of resources. This would suggest a resource-to-institution channel for the operation of the natural resource curse. However, this question remains far from settled.

Other explanations focus on the so-called Dutch Disease. Following the economic slowdown in the Netherlands, Corden and Neary (1972), developed the Dutch disease hypothesis to explain the effect of resources on growth, arguing that resource booms induce an appreciation of the exchange rate that lead to lower production of tradable, retarding growth. Historical data show a large shift from manufacturing and agricultural sectors occurred after the discovery of resources, especially in Latin America and the Middle East (Arziki and Nabli 2012), consistent with the Dutch Disease hypothesis.

One channel of resource cruse, related to this paper, is the possibility that resource abundance is inversely related to human capital accumulation. For example, in a cross-country analysis Behbudi et. al. (2010) showed evidence of an inverse relationship between secondary education and resource abundance, especially in oil producing nations. We recast this result for the case of *tertiary* education for a sample of countries that include a majority of oil producing developed and developing countries for the period 1980-2009. Our result also indicates that natural resource rents as a percentage of GDP and tertiary education as a percentage of total population are negatively correlated (Figure 1) in all resource dependent countries. We use tertiary education since *this* form of education is most closely tied to R&D and thus to economic growth via new growth theory. As we shall see, it is also more closely tied to our analysis of economic growth.
Why is this so? This paper is devoted to answering this single question. We argue that natural resource rents, when they dominate national income, result in an adverse incentive problem that retards the optimal desire to invest in one's human capital. This happens as resource revenues enter individual budget constraints via a lump-sum transfer. To do so, we adopt an overlapping generations model, extending a similar model that was initially developed by Iyagen and Own (1997) by incorporating natural resources into it. The model provides meaningful insights on how natural rents reduce optimum schooling and lowers long-run individuals return to human capital when distributed as a lump-sum transfer.

The basic idea is simple, yet intuitive. Transfers from natural resource rents are distributed to society at large. Thus they append each individual's expected income, both in human capital and the unskilled labor sector. Evidence suggests that oil-producing countries do provide this form of lump-sum transfers, possibly to placate society or reduce the risk of social unrest. For example the Kuwaiti authorities spend 4.12 billion dinars in 2008 on lump-sum transfers to national citizens, up to 43% of government aggregate expenditures (Elkatiri et. al. 2011 ).

Given this windfall transfer, we study how the expected return of an individual depends on the size of natural resource rents using two types of human capital,
entrepreneurship and schooling, our findings indicate that natural resources lower the optimum level of schooling that maximizes the individual’s expected utility and that the incentives to invest in optimal schooling is a decreasing function of resource rents. In the long-run citizens choose entrepreneurship and unskilled labor over professional labor. This causes expected income to enter into a low-level equilibrium trap in a multi-equilibria setting. We do find, however, that if the initial level of technology is sufficiently high, countries can still converge to a high level of steady state of expected income, regardless of the level of resource rents.

The remainder of the paper is as follows: section 2 conducts an extensive review of the literature on natural resources and economic growth, stressing on the literature that is most relevant to our study. Section 3 presents the theoretical model, which specifies the behavior of households and resource revenues distribution by the government; it also explains the findings of our model and some concluding remarks. Finally, section 4 will cover a panel data analysis that supports our theoretical findings, and a conclusion.

2. LITERATURE SURVEY

The purpose of this review is to examine prior studies that have been conducted on the effect of natural resources on economic behavior. As mentioned earlier, previous authors have studied the question of natural resource curse from a verity of different angles. This review will highlight their findings in order to lay a clear foundation on how our theoretical approach is different, and where our contribution fall.

2.1. NATURAL RESOURCE ABUNDANCE AND A HISTORICAL OVERVIEW

Economic history over the last two centuries demonstrates conflicting evidence concerning the connection between resource abundance and economic growth (Behbudi, Mamipour & Karami 2010). The development experience in many of today’s industrial economics, observed during the 19th century and during the first half of the 20th century the role of natural resources as an engine to growth. For example Stevens (2003) presented a historical growth review of the United States, Scandinavian countries, Australia, and Canada. Pointing to this positive role, his analysis logically
implies that natural resources should actually boost economic development in the above countries. His argument was that, as natural capital increases, the production possibilities frontiers of the endowed economy should increase. Stevens also argued that at the very least, wealth from natural resources should not deter or impede economic performance.

Yet the second half of the 20th century does not indicate such a successful development experience. In fact Bravo-Ortega & Gregorio (2007), argued that there has been instances when natural resources have to be blamed for slowing down development and growth rates of some countries such as MENA, and Latin America. There have been recurring incidents of resource-poor economies outperforming the resource-endowed economies, for example in the 19th century, some countries that are resource-poor economies eclipsed Spain in spite of the fact that Spain possessed a much gold and silver that came in from its colonies.

The 19th and 20th centuries have those resource-poor nations such as Japan and Switzerland to surge ahead of resource-rich countries such as Russia, and the MENA regions. The world’s star performers over the past three decades are resource-poor economies such as East Asia( Hong King, Korea, Singapore and Taiwan), while many resource-abundant countries including oil producing countries such as Nigeria, Venezuela, and Mexico, have gone bankrupt.

2.2. Natural Resource Abundance and Economic Growth

There is a large empirical and theoretical literature pointing to the adverse impact of resource abundance on economic growth in developing countries over the past four decades (Behbudi, Mamipour & Karami, 2010). The authors argued that natural resources are inversely related to economic growth, and this relationship is referred to as the resource curse. The resource curse demonstrates that economic growth rates fall as natural resources as a percentage of GDP increase. To highlight (Behbudi, Mamipour & Karami) point, the figure below explains this negative relation between natural resources rent and economic growth.
Figure 2: Natural Resources and Economic Growth

This negative association that has been experienced has certainly increased curiosity as researchers have sought to explain it. This poses a puzzle as it was widely acknowledged that possession of natural resources increases economic wealth as well as purchasing power over imports. Hence resource abundance should be expected to increase an economy’s growth rates and investments (Gylfason, Herbertson & Zoega, 1999). For example, many oil-rich countries have sought to use the vast revenues they get from oil to finance diversified investments in order to enhance industrial, and financial development. In addition, when natural resource is characterized by high transport cost, then its availability in the country should prompt introduction of new technology or new industries. Coal deposits, for instance, were the key to economic development of a local steel industry in the 19th century. In that century, countries such as Germany, United States, and Great Britain that at the time rich in resources, were able to experience rapid industrial development and growth. On the other hand, Japan and Korea succeeded in becoming world-class steel manufacturers in spite of the fact that they are virtually dependent on imported iron ore. While natural resources are no longer a key to economic development in the above-developed countries, it is surprising that for other developing nations these resources might actually deter development.

Research has shown that in developing nations that are rich in resources, natural capital tends to crowd out other forms of capital such as physical, human, and foreign
capital, which are considered a key driver of growth. Sachs & Warner (2001) identified the above puzzle by claiming that, if the traded sector is the engine of growth, then a resource shock will lead to change in resources allocation from the traded (manufacturing) to the non-traded sector.

2.3. MECHANISMS LINKING NATURAL RESOURCES AND ECONOMIC GROWTH

Theories seeking to discuss the association between natural resource abundance and economic growth are based on the crowding effect of heavy reliance on resources. Most of these theories are developed from the following four mechanisms that have been identified as the mechanisms of transmission of the detrimental effects of natural resource abundance to economic growth (Gylfason (2001).

2.3.1. NATURAL CAPITAL AND THE DUTCH DISEASE

The Dutch Disease hypothesis was first introduced in the 1970s to explain the economic challenges that Netherlands experienced after its gas discovery within its territorial water in the North Sea (Gylfason, 2001). This theory argues that natural resource abundance may influence price through the overvaluation of the country’s currency that reduce exports of non-resource goods. The industrial sector is the most affected by this disease. A positive natural resource revenue shock reduces the amount of total exports including high-tech and manufacturing that are considered as the engine of economic growth. This argument can best be illustrated by considering the Middle East’s oil-rich, and its oil-poor economies. A positive wealth shocks accruing from natural rent lead to excess demand for non-traded products and causes an increase in their prices. This in turn squeezes profits from traded activities (including manufacturing goods) whose inputs are those non-traded products and have to sell their products at relatively fixed prices on international markets. A comparison between the GDP of oil exporting countries that belong to OPEC such as Iran, Saudi Arabia, and Kuwait with those that do not belong to this block such as Morocco, Egypt, and Jordan. The comparison reveals that on average, non-oil producing nations have attained a significant increase in their total exports over the last five decades while the oil-producing countries have experienced a decline in their total exports implying that
oil exports might be crowding out other exports that are not oil related (Gylfason, 2004). For Example, Saudi Arabia’s non-oil exports up to 1997 are around 12% of total exports (Al-Ali 2007). It is generally believed that the Dutch Disease therefore reduces the level of exports and biases the composition of exports away from services and manufacturing.

The contagious effect of the Dutch Disease spread mainly on the industrial sector, which suffers the most from lower human capital that mainly employs skill intensive labor. As the Industrial sector shrinks, the workers will have almost a negligible bargaining power regarding wages and salary. Only highly skilled workers in the resource sector “which are a small portion of the society”, are able to get a wage premium due to their competition with foreign workers.

2.3.2. Natural Resource Abundance, Saving and Physical Capital

According to Gylfason & Zoega (2001), natural resources endowment has the potential to reduce public as well as private incentives to invest, hence impeding economic growth. The authors argued that natural resource has the tendency to create a false sense of security when there is a rapid rise in the output share that natural resources create. This reduces the demand for physical capital, which in turn results in less long-term growth even if interest rates on investments are very low. Gylfason (2001) also argued that an increase of 10% in natural capital share decreases investment by approximately 2% per GDP.

2.3.3. Natural Capital, Growth and Education Level

Education improves an economy’s ability to use physical capital efficiently, speeds up its technological progress, and enhances economic development. Empirical analysis used years of education, school enrolment, and education expenditures as a share of GDP to measure human capital in different countries.

Figure 3 below illustrates how education interacts with economic growth. It is logical to see that education and economic growth are positively correlated. However, looking at figure 1, it is not the case when one compares education to natural resource rents.
According to the world bank data set for 47 countries, as the level of education increases economic growth will increase as well.

**FIGURE 3: TERTIARY EDUCATION AND GROWTH**

![Graph showing the relationship between Per-Capita growth and education](image)

Source: World Bank Development indicators

Gylfason (2000) emphasizes that education is a prerequisite for rapid economic growth. Education enhances economic development and improves people’s lives in many ways: It can increase efficiency, foster democracy and therefore creates good conditions for quality governance, enhance quality of services provided, and improve the healthcare system. Other findings demonstrate that there is a very strong link between education, individual return, output levels, and productivity (Ramey and Ramey 2004). Studies show that education has benefits not only to the individual’s earnings but also the economy as a whole (Philippot, 2010). Though the presence of natural resource capital has been found to crowd out human and physical capital leading to lower education in the long run. In addition, evidence has also showed that across countries, government expenditures in education as a fraction of GDP, and school enrollments, are both negatively related to the level of natural resources (Gylfason, Herberitson, and Zoaga 1999).

(Brunnshweiler 2006) sought to establish how natural resources, human capital and economic growth are related. With relation to human capital and economic growth, Brunnshweiler observed that countries that do not invest enough in education tend to
rely on one sector to grow. According to Brunnshweiler, lack of human capital prevents entrepreneurship, innovation and creativity, which consequently prevent diversification. Further, over-reliance on natural resource-based industries does not inspire the society to invest in education and training. Under-development of human capital has determinate effects on different sectors of the nation’s economy: such as manufacturing and services that require higher skills. Natural resource crowds out human capital where the manufacturing sector will find it hard to survive, because no qualified people will be able to run these sectors in the long run (Brunnshweiler, 2006).

2.3.4 Natural Resource Abundance and Human Capital Accumulation

Human capital refers to the skills and knowledge of workers. It improves productivity through higher production efficiency and innovation through research and development. A study conducted by the World Bank reveals that human capital has the greatest influence on income as opposed to physical or natural capital (Philippot, 2010). The development of human capital therefore plays a vital role in economic development of all countries.

A few studies analyzed the relationship between natural resource endowment, and human capital accumulation. Among these, Gylfason (2001), Bravo-Ortega & Gregorio (2000), and Stijns (2001) have investigated the effect of natural resource endowment on the development of human capital. Gylfason (2001) argued that government investment on education is inversely proportional to the share of natural capital in most countries. In his empirical analysis, Gylfason concluded that natural capital seems to crowd out human capital hence delaying growth. He also showed that nations that rely heavily on their natural capital as their most vital source of production may unintentionally under-look the development of their human resources, by allocating inadequate attention as well as expenditure to education. He also added that the natural wealth might prevent society from realizing the necessity and importance of education.

Birdsall, Pinckney & Sabot (2001) claimed that although most governments showed interest in education, however governments always stated that investment in education
is always below the optimal level. The author also stated that, if lack of investment in human capital is primarily due to government constrains; resource abundance should encourage additional investment. Birdsal et. al. showed that resource-rich countries invest less in education and training than resource-poor countries. Resource poor countries in Asia showed an average of 60 percent school enrollment in the 1980s, while only 38 percent average enrollment in resource abundant countries. Similarly, poor performance was found in Northern Africa, and Latin America. However, the difference in human capital accumulation in Africa between resource-rich and resource-poor countries was very ambiguous, due to the existence of civil wars and fragility in such countries. Birdsal, Pinckney & Sabot (2001) argued that in the African continent, resource rents are controlled by a small group of political and economic elites, or rebels who are not interested in investing in any type of education. Yet, highly skilled workers in most resource rich developing countries are generally educated in foreign countries and often belong to the political elites (Birdsal, Pinckney & Sabot, 2001). This implies that resource rent may be concentrated with a small portion of the society. This would tend to increase inequality and may lower the interest to invest in improving education for the masses, with the result that it may keep the large segment of society locked in a relative poverty.

Leamer et al (1999) argued that human capital accumulation is the most vital factor that enables resource-rich countries to overcome problems associated with underdevelopment. Under-accumulation of human capital will prevent resource abundant nations from industrial diversification, decreasing the possibility of sectors other than the resource sector to exist. The author explained that resource rich countries invest a big portion of national savings into the natural resource sector itself, which creates very few high-skilled jobs.

In their explanation, Behbudi, Mamipour and Karami (2010) argued that if a developing country is endowed with large natural reserve, it would devote most of its efforts as well as resources towards the exploitation of these resources due to the comparative advantage it possesses. These countries will also tend to engage only in resource production because of the low levels of initial investment required. Resource
production in resource-based industries does not often require high level of knowledge as compared to the manufacturing sector and other industrial sectors. Behbudi, Mamipour and Karami observed that most of these countries promote development of solely resource-based industries, and does not promote the existence of any other type of industries that are human capital intensive.

Resource-deficient economies on the other hand devoted their efforts and resources towards exporting manufactured goods. The manufacturing sector in these countries also characterized by stronger positive externalities, where skilled labor may acquire skills that can be beneficial in different manufacturing sectors as some manufacturing processes mimic each other. According to Mutsuyama (1992), sectors that promote technological advancement and encourage ‘positive externalities’ affect growth positively. Gylfason (2001) also pointed out that manufacturing that requires human capital development, benefits the entire economy through the spillover effects, while resource sector production does have minimal positive externalities associated to it. He also argued that if a nation bases its economy on natural resource, such nations will not invest in developing an extensive education system as a core to build future human capital to work in skill intensive jobs. Hence, the return rate to education in such countries is very low, and citizens do not see any need to pressure their governments into providing better education (Birdsall, Pinckney & Sabot, 2001).

2.4. INCENTIVES TO INVEST IN HUMAN CAPITAL ACCUMULATION

As explained before, natural resource-based industries do not often require high skills; hence investment in education or training in most resource rich countries offers no or minimal returns (Gylfason, 2000). It can therefore be argued that reliance on natural resource-based industries lower the possibility to invest in human capital (Brunnshweiler, 2006).

Resource-poor countries such as Japan, China, Malaysia relies heavily on manufacturing and services that are skill intensive. These nations understood that to remain competitive in international markets, they must deliver efficient products so they always maintain higher profits and return to skills. The above factors inspired citizens
to invest heavily in education (Gylfason, 2004) due to a return incentive. Society also put pressure on their governments to provide quality education so that students can come out with the right skills required for the job market. The focus of resource poor countries on innovations and manufacturing encouraged people to invest in human capital and allow diversification in the manufacturing sectors to exist. One can conclude that accumulating skills is vital to innovation, technology and economic growth as countries increase their chances to produce more of different goods and grow faster (Gylfason, 2004).

As resource poor countries focused on accumulating skills, resource rich nation are trapped with the resource curse. The greatest challenge that these countries face is that talented people that generally seek to start up creative business and innovate avoid manufacturing, and work as rent seekers to obtain faster wealth, thus encouraging corruption and distract the growth process. According to (Murphy, Shleifer and Vishny, 1990) the choice to pursue a certain occupation is dependent on the returns to ability, compensations, and on market size. One can observe that in countries where rent seeking is widespread (especially resource-rich countries), entrepreneurship and innovation is lower where few people will have the incentive to pursue their talents or to sharpen their skills.

Several authors including Gylfason & Zoega (2001), Gylfason (2001), Birdsall, Pinckney & Sabot (2001), and Brunnshweiler (2006), agreed that natural resources in most economies tend to affect education and human capital negatively. These authors also argued that most economic agents tend to ignore the value of education in the presence natural resources. Batswana and Norway were an exception in this case; because they gave a high priority to education and education ability to invest in skills is relatively high.

2.5. Other Mechanisms that link Natural Resources to Human capital
There are other channels through which the presence of natural resources affects human capital accumulation. One such channel provided by Gylfason (2001), is that the volatility in natural rents reduces the certainty of investment into other sources of capital such as physical and human capital. Birdsall, Pinckney & Sabot (2001) linked the lack of human capital accumulation to the behavior of political and economic elites, where human capital accumulation might affect their regimes through increasing the level of think tanks.

Philippot (2010) argues that fluctuations in international resource prices create a high level of uncertainty, as governments are never sure of the exact returns from their resources. This makes it difficult to establish a reliable fiscal policy, where governments might be forced to cut on public spending, during a negative shock to resource prices. Spending on public education is one of the areas that can suffer the most from restrictive fiscal policies in such countries.

Another explanation of the curse is that natural resources encourage corruption. If corruption is at highest levels, then it is possible for civil servants, ministers and bureaucrats to distract money that are meant for building schools, paying salaries, etc. (Sala-I-Martin & Subramanian 2003).

Natural resources also tend to decrease political stability as well as encourage civil conflicts. Philippot (2010) provides an example of the civil war in Ivory Coast, where the central government could not effectively implement its education policy in the Northern side of the country due to low rule of laws, and high militias influence.

The effect of delayed modernization that is a key characteristic in resource-rich nations is also a very important explanation. Elites in these countries tend to resist modernization and education due to the power it offers to majority. The political elite generally fears the well-educated society and think tanks. Education and awareness will increase the demand for more transparency, accountability, and equality in distribution of resources through increasing income taxes on the elites. Further, while elites are reluctant to educate the public, they often send their children to study abroad in good universities so that they return as tomorrow’s elite, (Philippot, 2010).
The above factors are the transmission mechanisms for the determining effect of natural resources on human capital accumulation. Given this background, the following section will introduce a theoretical modeling to show the effect of natural resources on human capital accumulation investment. Specifically, we will show how natural resources influence the optimum level of human capital in the long run, and diminish the possibility of low and middle-income countries to converge to a low level of per-capita income unless they significantly invest in technology.

3. THEORETICAL MODEL

The model adopts an overlapping generations model with a structure similar to Owen and Iyigun’s (1999). However, their paper does not include the role of natural resources and its influence on individual’s choice to accumulate more skills. In our model the level of innate ability to accumulate skills and natural resources rents affect the decision to increase optimum schooling on the growth path. The inclusion of natural resources into an overlapping generations model is an important innovation that allows us to study the resource curse in a dynamic setting, and to show the consequence of natural resource rents for the incentive of citizens to accumulate human capital and therefore for economic growth at large.

Following Owen and Iyigun’s (1999), we present an overlapping generations model, made up of three periods. In the first period, citizens choose either to invest in human capital, or to supply unskilled labor in the labor market. If an individual invests in human capital, she will receive an expected income plus and a resource based lump-sum transfer in the second period, but consumes all accumulated income only in the third period. On the other hand, working as an unskilled worker, she will earn a fixed income $\omega$ and a resource based lump-sum transfer in the first and the second period, and consumes everything in the third period.

Human capital is divided into two types: professional and entrepreneur human capital. In period 2, professional human capital income is certain and dependent on the level of technology, whereas entrepreneur’s income is uncertain a probability of success and
failure. As stated above, we add a rent based lump-sum transfer given out by the government, for both skilled and unskilled sector to see the effect of resource wealth on individual's choice in choosing her profession, and how this influence the growth process in resource rich countries.

A key simplifying assumption of the paper, which allows for a sharper focus on the role of natural resources in incentive to invest in human capital, is to abstract from other channels such as the Dutch Disease. To this end, the paper does not model the production of the resource itself, and instead focuses on its distribution to society. This is captured by considering natural resources to generate a windfall profits, i.e., rent, but does not otherwise contribute to the production process. While an oversimplification, this does allow us to focus on an important and overlooked channel, namely the incentive channel.

3.1. Assumption

Assume a perfectly competitive world where the economy is made up of homogenous consumption goods. Production $Y_t$ in all resource rich countries will follow the following production function:

$$Y_t = A_t H_t + \omega L_t$$

(1)

$H_t$, and $L_t$ is the level of human capital of unskilled laborer respectively. Each factor input earns its marginal productivity, and only the average level of education and entrepreneurship affects the level of technology $A_t$.

$$\frac{\partial Y_t}{\partial H_t} = A_t$$

(2)

$$\frac{\partial Y_t}{\partial L_t} = \omega = 1$$

(3)

where unskilled labor wages are set to one, as a numeraire.
Each individual faces three periods, and the size of the society is normalized to one. We will assume a zero population growth, and each individual is endowed with a certain level of innate ability $a_i$. This innate ability can be drawn from any given distribution supported on a bounded interval. However following Owen and Iyigun's (1999), we will use a uniform distribution for simplicity.

$$\frac{1}{\bar{a} - \underline{a}} \int_{\underline{a}}^{\bar{a}} da_i = 1$$

(4)

$\bar{a}$ and $\underline{a}$, the upper and the lower bound of innate ability, respectively. People will choose to invest in human capital or work as an unskilled labor dependent on their level of innate ability. A relative high level of innate ability above certain threshold will increase the chance of an individual to invest in human capital.

Each period an individual is endowed with one unit of time (t). If she chooses to invest in human capital, then she spend $s_i$ on schooling, and $(1 - s_i)$ on being an entrepreneur, where $(1 - s_i)$ is considered as an entrepreneur's set up cost. Choosing to invest in human capital requires agents to allocate their time optimally between schooling $s_i$, and entrepreneurship $(1 - s_i)$, given a certain level of resource subsidy distributed by the government.

Individuals can invest in either a specific type of human capital or both. The level an individual accumulates of professional human capital $p_{t+1}$ is a function of $s_i$, where $p_{t+1}$ is an increasing function of schooling. Similarly, $e_{t+1}$ is an increasing function in $(1 - s_i)$.

$$e_{t+1} = a_i f(1 - s_i) \quad 0 < s_i < 1$$

(5)

$$p_{t+1} = a_i f(s_i)$$

(6)

$$f'(.) > 0 \quad f''(.) < 0$$

### 3.2. The Role of Natural Resources
Assume that country $i$ accumulates resource revenues $\Omega$ every period. Each individual in society $i$ enjoys a fraction of $\Omega_{\text{net}} = (1 - \gamma)\Omega$ of the resource revenues, where $\gamma \Omega$ is the fraction that the government keeps for itself for budget reasons.

The resource wealth $\Omega_{\text{net}}$ is distributed as lump-sum transfer to each agent in $i$. If an individual chooses to invest in human capital, she will receive $\alpha \Omega_{\text{net}}$, but if she chooses to work in the resource sector she will receive $(1 - \alpha)\Omega_{\text{net}}$ such that $0 < \alpha < 1$

Earlier, we highlighted the role of transfers with respect to an illustration in the case of Kuwait. Further evidence of such transfers in resource rich countries can be found in the case of Saudi Arabia. These transfers show up in the form of wage premia that stem from oil revenue. To indicate the extent of such transfers, one can compare wages of Saudi nationals with those of foreign workers. According to the IMF (International Monetary Fund, 2012), Saudi nationals non-skilled labor income is 4.1 times of that the expatriates.

Assume that the level of technology depends on both professional and entrepreneurial capital, $A(e_t, p_t)$ then,

\[ A^e > 0, \text{ and } A^{ee} < 0 \] \hspace{1cm} (7)

\[ A^p > 0, \text{ and } A^{pp} < 0 \]

And $A^{ep} > 0, \text{ and } A^{pe} > 0$

Given the level of technology, individual's income including the resource transfer, will be as follows:

Human capital income:

\[ (y^h_{t+1})^p = w_{t+1}^h p_{t+1}^i + \alpha \Omega_{\text{net}} = A_{t+1}^p p_{t+1}^i + \alpha \Omega_{\text{net}} \] \hspace{1cm} (8)

\[ (y^h_{t+1})^e = w_{t+1}^h e_{t+1}^i + \alpha \Omega_{\text{net}} = A_{t+1}^e e_{t+1}^i + \alpha \Omega_{\text{net}}, \text{ with probability } q \] \hspace{1cm} (8.1)

\[ (y^h_{t+1})^f = \alpha \Omega_{\text{net}}, \text{ with probability } (1 - q) \]
Where subscripts, $s$ and $f$, represent a successful entrepreneur with probability $q$ and a failure one with probability $(1-q)$ respectively,

Labor Income:

$$y_t^i = 1 + (1 - \alpha)\Omega_{net}$$  \hspace{1cm} (8.2)

the same income is also earned in period $(t+1)$.

3.3. HOUSEHOLDS

We assume a simple log form for the utility function, $U(c) = \ln(c)$. Given unskilled laborer earn income in period $t$ and $t+1$, she maximizes the following utility:

$$U(c_{t+2}) = \ln c_{t+2}$$  \hspace{1cm} (9)

while skilled workers maximize,

$$EU(c_{t+2} | t) = [q \ln(c_{t+2})_s + (1 - q)(c_{t+2})_f]$$  \hspace{1cm} (9.1)

Subject to: \{\begin{align*}
\{1 + (1 - \alpha)\Omega_{net}\} & \text{if working as an unskilled labour} \\
(E(y_{t+1})^e + (y_{t+1})^p) & \text{...human capital}
\end{align*}\}

Substituting the budget constraint into the human capital utility function, then the expected utility will take the following form,

$$EU(c_{t+2} | t) = [q \ln((y_{t+1})^e + (y_{t+1})^p)_s + (1 - q)((y_{t+1})^p)_f]$$  \hspace{1cm} (9.2)

then,

$$EU(c_{t+2} | t) = [q \ln A_{t+1} \cdot [(e_{t+1} + p_{t+1}) + \alpha\Omega_{net}] + (1 - q)\ln [(A_{t+1}p_{t+1} + \alpha\Omega_{net}]$$  \hspace{1cm} (10)

Assume that there is a threshold innate ability $\bar{a}_t$ such that any individual that has $a_i > \bar{a}_t$, will choose to invest in human capital. However, if $a_i < \bar{a}_t$, then she choose to work as an unskilled laborer. Given any threshold ability $\bar{a}_t$, the following equation must hold with equality.
\[
[q \ln \lambda t + f(s_i) + f(1-s_i) + a \Omega_{net} + [(1-q)\ln (A_{t+1} + f(s_i)) + a \Omega_{net}] = \ln [2 + 2(1-\alpha)\Omega_{net}]
\] (11)

A lower threshold value of the innate ability will increase the opportunity of individuals to invest in human capital since more people will have an innate ability higher than the threshold. From equation (11), we see that the threshold level of innate ability decreases with resource portion transferred, \(\alpha\), and the level of entrepreneurship and professional human capital. These results are intuitive; an increase in technology resulting from a higher level of average human capital will increase the return to human capital, yet increasing the incentive to invest more in schooling. Furthermore, an increase in the level of resource rent fraction-distributed \(\alpha\), will lower the threshold innate ability, and push more individuals to invest in human capital due to the increase in human capital’s expected return compared to un-skilled labor return.

Preposition 1: Given any \(t > 0\), and \(a_i > a_t\) the threshold innate ability is a decreasing function of the share of resource rent distributed \(\alpha\), professional, and entrepreneurship human capital.

Proof:

Using equation (11) and the implicit function theorem, it is simple to show that:

\[
\frac{\partial a_t}{\partial e_t} < 0, \frac{\partial a_t}{\partial p_t} < 0, \frac{\partial a_t}{\partial a_t} < 0
\] (11.1)

The above conditions give a nice implication especially for developed countries where \(A_{t+1}\) is high, and human capital accumulation is supported. A resource rent transfer will increase people’s choice to invest in more human capital due to the higher return generated in period two. For example, countries such as USA, Canada, Australia, and Norway, have a very low threshold innate ability compared to other countries. People in such countries have a higher incentive to invest in human capital due to more accessibility to education, and more aid distributed to people investing in human capital accumulation.
Relating to preposition 1 and given the fact that the expected future return from investing in human capital will be higher than being an unskilled laborer, then the optimal amount of schooling accumulated will be as follows,

\[
\frac{q}{1-q} = -\frac{[A_t+a_t(f(s_i^*)+f(1-s_i^*)+\alpha\Omega_{net})]}{[A_t+a_t(f(s_i^*)+\alpha\Omega_{net})]} \times \frac{f'(s_i^*)}{f'(s_i^*)-f'(1-s_i^*)} \tag{12}
\]

The above first order condition indicates that the optimum amount of time each individual spend in school \(s_i\), is dependent on her innate ability level \(a_i\), the level of resource rents, and technology.

The right hand side of equation (12) shows the return ratio of being a successful entrepreneur to a failure one. Given the fact that this equality must hold at the optimum level of schooling \(s_i^*\), then any shock to resource rents will lead the denominator to increase proportionally more than the numerator. Then agents will drop the optimum level of schooling and increase investments in entrepreneurship over time. Given that technology diminishes with excessive investments in entrepreneurship alone, any increase in resource rents will not be very beneficial on the growth path especially in countries with a low level of technology.

Preposition 2:

A: \(\forall \quad q, \quad (0>q>1)\), and an innate threshold ability such that \(\bar{a}_i < a_i < \underline{a}_i\), the optimal amount of schooling \(s_i\) holds if \(s_i > \frac{1}{2}\)

B: The optimal level of schooling \(s^*\) is decreasing in the level of total resource rents \(\Omega_{net}\). However increasing in the average level human capital and innate ability \(a_i\).

Proof:

Part A of preposition 2 holds because any value of \(s^*_i < \frac{1}{2}\) will lead the right hand side of equation (12) to be negative, because \([f'(s_i^*) - f'(1-s_i^*)] > 0\) due to diminishing marginal return
To prove part B of proposition two, we use again the implicit function theorem to find the following:

$$\frac{\partial s^*}{\partial p_t} > 0, \text{ And } \frac{\partial s^*}{\partial e_t} > 0, \frac{\partial s^*}{\partial \Omega_{net}} < 0, \frac{\partial s^*}{\partial a_i} > 0$$  \hspace{1cm} (12.1)

### 3.4. Model Dynamics:

Assume that there exist a situation where $\bar{a}_t > \bar{a}$, then each individual will choose to be an unskilled labor supply. For a given average level of professional and entrepreneurial capital, even people with the highest level of ability will not choose to invest in human capital accumulation. This is justified in equation (14),

$$\mu = (e_t, p_t, \Omega_{net})\{(q \ln A_{t+1} a_i(f(s_i) + f(1 - s_i)) + a \Omega_{net}) + [(1 - q) \ln(A_{t+1} a_i f(s_i) + a \Omega_{net})] \leq \ln[2 + (1 - a) \Omega_{net}] \} \hspace{1cm} (14)$$

$\mu$ represents the set of all agents that choose to remain unskilled given $\bar{a}_t > \bar{a}$. This is represented as the shaded area in figure one and two. However, in case $\bar{a}_t < a_i < \bar{a}$, then the dynamics of the model will be illustrated by equation (15) and (16) to show the motion of human capital in the long run.

$$e_{t+1} = \begin{cases} \frac{\pi}{a_i(\pi - a_i)} f(1 - s_i) da_i & \text{if } a_i > \bar{a} \\ f(1 - s_i) & \text{if } a_i \leq \bar{a} \end{cases}$$ \hspace{1cm} (15)

$$p_{t+1} = \begin{cases} \frac{\pi}{a_i(\pi - a_i)} f(s_i) da_i & \text{if } a_i > \bar{a} \\ f(s_i) & \text{if } a_i \leq \bar{a} \end{cases}$$ \hspace{1cm} (16)

From equation (11), and (12) $s_t^*$ and $a_t$ are functions of $A_{t+1}(e_t, p_t)$, and $\Omega_{net},$ then

$$e_{t+1} = \Sigma(e_t, p_t, \Omega_{net}), \text{ And } p_{t+1} = B(e_t, p_t, \Omega_{net}).$$ \hspace{1cm} (17)

**Preposition 3:** For any $q$, such that $\bar{q} < q < 1$, an initial level of professional and entrepreneurship human capital, and a given resource rent $\Omega_{net}$:

A-There exist a stable steady state equilibrium in the space of $e_t$ and $p_t$, given equation (15) and (16), if the initial level of average human capital is high, and a given resource rent $\Omega_{net}$. 

22
B- An exogenous shock to resource rent $\Omega_{net}$ reduces the possibility of income to converge to a higher steady state given an initial level of technology $A$ ($e_0, p_0$).

Proof:

Point A in proposition 3 is intuitive, if technology is high enough, people will have the motivation to invest in more human capital, since human capital’s expected return increases with the level of technology, $A_{t+1}$. Point A can be justified graphically showing that at a given level of $\bar{e}$ and $\bar{p}$, and $A (\bar{e}, \bar{p})$ There exist an $e_{t+1} = p_{t+1} = \bar{e} = \bar{p}$

FIGURE 4: GRAPHICAL INTERPRETATION OF THE MODEL’S DYNAMIC

The above graph stipulates that only a high enough average level of initial professional and entrepreneurship human capital will lead to a high non-trivial steady state represented by point y, where $\hat{P}$ and $\hat{E}$ loci intersect (See Appendix for Proof). Point x is not a stable steady state because any point outside $\hat{E}$ and $\hat{P}$, then the long term income will converge back to the shaded area. However the presence of resource rent will distort the convergence process. Countries with a sufficient enough initial technology
A_h(e_0, p_o)^1 falling inside the locus will converge to point y in the long-run regardless of any level of resource rents. However countries with A_i(e_0, p_o), that falls outside the loci, leads the long-run income to converge back to the shaded area, where resource rent will increase the convergence process.

3.4.1. The effect of resource rents on human capital accumulation
This model shows that regardless of how much a country generates resource rents, these resources behave as a curse rather than a blessing, since it will distort the efficient allocation of talent, and lowers the optimum level of schooling. As per point B in preposition 3, any increase in the level of resource rent distributed will lowers the possibility to invest in more schooling and long-run income will converge to a low steady state level. As resource rent Ω_net increases, the professional human capital loci Ȣ will shift downward and Ȣ will shift to the right leading the area between x and y to diminish over time, and increasing the possibility to move back to an unskilled economy that is represented by the shaded area. Our findings can be shown from equation (12):

\[
\frac{q}{1-q} = - \frac{[A_{t+1}a_i(f(s_i^*) + f(1-s_i^*)) + \alpha \Omega_{net}]}{[A_{t+1}a_if(s_i^*) + \alpha \Omega_{net}]} \frac{f'(s_i^*)}{f'(s_i^*) - f'(1 - s_i^*)}
\]

The right hand side of the equation represents the return ratio of being a successful entrepreneur to being a failure. The ratio clarifies that as the resource rent increases then the ratio will be smaller. This will decrease s_i^* and increase f'(s_i^*) to hold the equality. Since this equation represents the optimum amount of schooling after self selecting to invest in human capital, then s_i^* is the level of schooling that sets equation (14) to zero. Any increase in schooling will not be optimal and leads to a negative marginal return. Thus, a positive resource rent shock will create an over accumulation of entrepreneurship compared to schooling. Yet, an exogenous shock to technology is capable to increase the optimum level of schooling again. One can say that natural resources and technology works in opposite directions. This might justify how

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^1 A_h(e_0, p_o) represents a sufficiently high level of initial technology, while A_i(e_0, p_o) represents a sufficiently low level.
developed nations with resources escaped the curse, and developing countries got stuck in a development trap in the long run.

FIGURE 5: THE EFFECT OF NATURAL RESOURCE ON SCHOOLING AND ENTREPRENEURSHIP

Figure 5 shows the effect of natural resources on human capital accumulation after a positive shock in resource rent. As resource rent increases, professional capital will decrease, and overinvestment in entrepreneurship will take place leading the curves to move in the opposite direction, and lowering the possibility to converge to the stable steady state level y.

The figure demonstrates that due to their higher level of overall technology, higher income countries would have a higher prospect to converge to a high steady state regardless of the level of natural capital, Whereas low-income countries will converge back to a low or no skilled labor economy being caught in a development trap, regardless of how much they give out resource capital to the society. The graph gives an insight on how the level of natural resources might not affect countries such as USA, Canada, Australia, and Norway, since their level of technology is high enough to balance out the negative effect of the resource curse. These countries enjoy a steady and higher growth than countries such as Saudi Arabia, Kuwait, Nigeria, and the rest of MENA
countries that are resource rich and poor in innovation and technological advancements.

3.5. Final Theoretical Implication

The aim of our theoretical model is to contribute to the role of natural resources in hampering investments in human capital accumulation. Including natural capital in our overlapping generation model clarifies how incentives are distorted when it comes to the decision of choosing what skills to acquire. In developing countries that are rich in resources, natural resources play a negative role in investing in human capital especially schooling. However resources have a minimal effect on developed countries especially if they invested enough in technology and innovation.

Our main finding is that natural resource countries have low levels of human capital, innovation and technology, and have high level of unskilled industries due to the inefficient allocation of their rents. This economical structure will lead these countries to be trapped in poverty in the long run. Regardless of how rich in natural capital these countries are, they will converge back to a relatively low level of GDP per-capita if resource rent is distributes as a lump-sum transfer payment. This finding can be also connected to that the initial level of technology such that it is not capable to put these countries on a positive human capital growth path even if resource revenues are tremendously high. Our research filled a gap that was not been discovered by previous literature hence giving a better understanding of one of the most important issue that resource rich countries are facing.

Government policy that depends on distributing generated resource rents, will discourage investments in human capital and technology accumulation, and keep agents wellbeing almost under the mercy of government transfers fluctuations. As shown in our model, technology is a key driver to increase average schooling, and entrepreneurship due to its positive effect on individual's return. Any given positive shock to technology, motivates people's incentive, promotes faster growth, and diminish the adverse effect of positive resource revenue shocks.
As a conclusion, government policies that direct resource rent to technology and innovation create a better chance for individuals to invest in human capital. Technologies will motivate more advanced non-oil manufacturing products to exist, where this type of production, demands a high level of skills and in turn increases people’s incentives to invest in more human capital.

4. **EMPIRICAL ANALYSIS**

This part will examine how natural resources, human capital and economic growth interact. As was discovered in previous sections the effect of natural resource rents on human capital and economic growth is negative. The key lesson from the theoretical model was that the effect of lump-sum transfer as a proportion of resource rents, $\alpha \Omega_{net}$, was to reduce the incentive to accumulate human capital. In this section we will examine this result empirically. We will do so by studying the effect of lump-sum transfers and resource capital on human capital and by using tertiary education as a proxy for human capital accumulation. The implication of our analysis will be determined by using a panel data of 47 countries between 1980-2009. The countries in our data set are resource rich as well as resource poor nations from all regions around the world taken from the World Development Indicators 2012.

4.1. **Panel Data**

blamed to the wastes and corruption from oil rather than the Dutch disease. Bravo-Ortega and De Gregorio (2005) showed that resource curse can be offset by having a large level of human capital. They used a panel data model between 1970 and 1990. They studied the interaction between human capital and natural resources, showing that high levels of human capital may outweigh the negative effects of the natural resource abundance on growth

However, two factors distinguish this study from the earlier ones. First, given the theoretical structure of our model, our hypothesis is not that resources have a positive or negative effect on human capital accumulation, nor that transfer have a positive or negative effect on human capital accumulation; rather that the interaction of lump-sum transfer and resources have a deleterious impact on the incentive to accumulate human capital. This says that, countries that have high level of natural rents, government transfers have a negative effect on human capital accumulation. This is captured by the term \( \alpha \Omega_{\text{net}} \) in the theoretical model discussed earlier. This unique aspect, especially derived from the model, has not been examined before.

Second, the above studies focus on secondary education as a measure for human capital, while we focus on tertiary education in our analysis. This is because not only this measure has been somewhat neglected in the literature; such a measure is more pertinent to the notion of specialization and skills so crucial to technological innovation and the process of economic growth.

The model employed in our analysis follows the fixed effect panel data general form

\[
y_{it} = \alpha_i + Z_{it} + X_{it} + \epsilon_{it}
\]

Given the hypothesis above, our benchmark equation to focus on the interaction of resources and transfers as follows

\[
Tertiary\ Edu_{it} = \alpha_i + \text{Resource Rents}_{it} + \text{Gov. Transfers}_{it} + \text{Gov. Transfers} \times \text{Res.} + X_{it} + \epsilon_{it}
\]
Here, "Tertiary Edu" is defined as the tertiary education enrollment as a percentage of total population. The flow estimates are estimated using tertiary education enrollment as a percentage of total population between 1980 and 2009. Annual Data is collected from the World Bank Data Set, including both sexes;

Resource Rents: is the measure of rents as a percentage of GDP. According to the World Bank Development Indicators, natural resources rents are the sum of oil rents, natural gas rents, coal rents (hard and soft), mineral rents, and forest rents. In our analysis, we use this variable divided by GDP, because it reflects the dependence of a given country on its resource sector.

Gov. Transfers represents government transfers as a percentage of total government expenses. We examine the effect of government transfers on tertiary education, where mainly these transfers stem from resource rents in resource rich countries. Including government transfers in our model was justified based on the theoretical findings especially in proposition 2. This says that, oil rents that are distributed as a lump-sum exogenous transfer will lower human capital investments in the long run especially in countries with low levels of technology. Hence, we will also have the interaction variable, below, added:

Gov. Transfers * Resources: Captures the combined effect of natural resources and government transfers on tertiary education over time and across countries. This variable is an estimate of the $a\Omega$ in our theoretical model. Including the interaction between government transfers and natural resources in our model examines our theoretical findings especially in proposition 2. The purpose of including this variable is to show the effect of, lump-sum exogenous transfers on human capital investments, especially in countries with natural resource reserves.

$X_{it}$ is a set of control variables including, savings per capita, public expenditures on education as a percentage of total expenses, GDP per capita growth, foreign direct investments as a percentage of GDP, manufacturing as a percentage of GDP, trade as a percentage of GDP, and democracy index. A list of all the countries and variables is provided in Appendix B.
4.2. **Model estimation**

Table 1 presents results from six regressions. It is seen that government transfers have a positive effect on tertiary education in all regressions. However the key result is that the *combined* effect of transfers and natural resources is negative and significant at a 1% and 5% levels. In countries with higher natural resource rents, higher government transfers will lower tertiary education enrollment. Moreover, the results are quite robust to variation in model specification. If the product of resource rents and government transfers increases by one unit, tertiary education will decrease by 0.4 units on average, across all regressions. This is a strong support for the theoretical analysis of previous sections of this paper. The adverse role of resources *via lump sum transfers* is brought home further, when we note that either variable *alone* exhibits a positive effect.

Additional observations are as follows: Savings and foreign direct investments have a negative effect but the significance level varies among all the six regressions (pointing possibly to a substitution effect between investments in physical and human capital). Trade as a percentage of GDP has a positive and significant effect on tertiary education at a 1% level: An increase in trade by 1 percent will lead to a increase in human capital by 0.01 percent on average. The role of trade in investing in human capital is therefore likely to be more important than generally considered. Democracy has a positive effect on tertiary education, It is obvious for countries such as Canada, USA, and western European countries that are relatively more democratic, tend to have a high level of human capital and have a higher growth level in the long run (Wacziarg 2001). However, even in democratic nations, a higher level of natural resources will exert a negative influence on tertiary education, an effect that is significant at a 5% level of confidence. This relation is examined by the coefficient of *(Democracy* Resources) in table 1. As the product of natural resources and democracy increases by one unit, tertiary education will decrease by 0.03 units.
### TABLE 1: THE EFFECT OF GOVERNMENT TRANSFERS ON EDUCATION IN RESOURCE RICH COUNTRIES

<table>
<thead>
<tr>
<th>Tertiary Education</th>
<th>(2.1)</th>
<th>(2.2)</th>
<th>(2.3)</th>
<th>(2.4)</th>
<th>(2.5)</th>
<th>(2.6)</th>
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<tr>
<td>Transfer*Resources</td>
<td>-0.415</td>
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<td>-0.328</td>
<td>-0.341</td>
<td>-0.374</td>
<td>-0.323</td>
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<td>(0.151)***</td>
<td>(0.151)**</td>
<td>(0.153)**</td>
<td>(0.155)***</td>
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<td>Gov. Transfers</td>
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<td>0.353</td>
<td>0.318</td>
<td>0.318</td>
<td>0.321</td>
<td>0.318</td>
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<tr>
<td></td>
<td>(0.018)***</td>
<td>(0.018)**</td>
<td>(0.019)**</td>
<td>(0.019)***</td>
<td>(0.00)***</td>
<td>(16.14)***</td>
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<tr>
<td>Per Capita Growth</td>
<td>0.052</td>
<td>0.050</td>
<td>0.617</td>
<td>0.060</td>
<td>-0.057</td>
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<tr>
<td></td>
<td>(0.876)</td>
<td>(0.0876)</td>
<td>(0.88)</td>
<td>(0.094)</td>
<td>(0.092)</td>
<td>(0.45)</td>
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<td>Savings</td>
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<tr>
<td></td>
<td>(0.0417)</td>
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<td>(0.049)**</td>
<td>(1.96)**</td>
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<td>0.050</td>
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<td>(0.071)</td>
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<tr>
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<td>(0.0189)***</td>
<td>(0.00)***</td>
<td>(0.003)***</td>
<td>(5.51)**</td>
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<td></td>
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<td>(0.004)</td>
<td>(1.47)</td>
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<tr>
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<td>(1.34)</td>
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<td>Natural Resources</td>
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<tr>
<td></td>
<td>(0.051)</td>
<td>(2.22)*</td>
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<tr>
<td>Democracy* Resources</td>
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<td>-0.035</td>
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<tr>
<td></td>
<td>(1.99)**</td>
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<td></td>
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<tr>
<td>Constant</td>
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<td>0.140</td>
<td>0.131</td>
<td>0.132</td>
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</tr>
<tr>
<td></td>
<td>(0.003)***</td>
<td>(0.103)***</td>
<td>(0.014)***</td>
<td>(0.023)**</td>
<td>(0.0236)***</td>
<td>(3.85)***</td>
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<td>1,379</td>
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<td>47</td>
<td>47</td>
<td>47</td>
<td>47</td>
</tr>
</tbody>
</table>

*Notes: The numbers in parentheses are t-statistics. These variables were taken from the World Bank dataset. Further, democracy is measured on the following scale, from low to high (0-6). Note that the significance level is: * p<0.1; ** p<0.05; *** p<0.01.*

### 4.3. Conclusion

The theoretical and empirical models presented above show why natural resources impede the incentives of individuals to invest in human capital. The theoretical model is developed around the private incentives for an individual to choose her profession. It is well known that in low and middle-income countries that have a relatively low level of technology, agents choose to invest in more entrepreneurial human capital, as well as staying as an unskilled labor supplier for any given positive shock to resource rents. Once windfall revenues from resources are introduced in such a economy, resource rents negatively interfere in the allocation of human capital itself; increasing the accumulation of one type of human capital on the disadvantage of the other. Thus the presence of resources in these countries increases the likelihood of being unskilled in the long run.

Our theoretical findings justify why resource rich countries such as the MENA region or parts of Latin America, that distribute resource rents as lump-sum transfers, have a low level of technology and human capital, relative to others. According to the model explained above the inefficient distribution of resources made it more difficult to invest in human capital over time. If resource rents are distributed as a lump-sum transfer, the negative effect of these rents will lead these countries to be trapped in a long-term low growth trap since they do not invest enough in technology over time. It is thus obvious that cash transfers to the human capital sector are an ineffective policy especially in countries that have a low level of technology and innovation.

Given the fact that technology level determines the return to human capital, then the initial average level of professional and entrepreneurial human capital is very crucial for long-term growth in the presence of resource rents. A high initial level of technology lowers the adverse effect of resource revenues on human capital investment, especially
when more non-resource sectors exist in a given nation, and this leads the nation’s income to converge to a high stable equilibrium in the long run.

Our empirical model supports the theoretical findings. The panel data results show that as natural resource rents increase, investments in human capital accumulation will decrease. Specifically we find that government transfers that stems from resource rents distort human capital investments over time. The empirics strongly supported this finding and showed a negative and significant relationship between a variable created from the interaction of government transfers with natural resource rent and human capital, for a sample of 47 countries over 29 years.

In both, the theoretical and empirical models, our results present a thorough understanding of an economic development gap especially in resource rich countries, from an angle that yet has not been discussed. These findings could facilitate effectively formulation and implementation of efficient and successful government policies in resource abundant countries, especially in countries that are not able to avoid the resource curse yet.
APPENDIX A:

Assume the following:

1- $\dot{E} = 0$ And $\dot{P} = 0$ do not fall inside the shaded area i.e:
$$
\mu = \{e_t, p_t, \Omega_{net}\} [q \ln(A_{t+1}a) + f(s_i) + \ln(1-s_i) + a\Omega_{net}] + [(1-q)\ln(A_{t+1}a) + a\Omega_{net}] \geq \ln2[\omega + (1-a)\Omega_{net}]
$$

2- For a given value of $q$, the $\dot{E} = 0$ and $\dot{P} = 0$ intersect given $f(\frac{1}{2})$is large, and converge to a high steady state. Especially when the level of technology is sufficiently high, regardless of the level of resource revenues.

3- An increase in the level of resource revenue will decrease the possibility to converge to a high steady state, and get stuck in poverty trap.

1- $\dot{P} = 0 = \{(e_t, p_t, \Omega_{net})|p_{t+1} - p_t = 0
$$
$$
\dot{E} = 0 = \{(e_t, p_t, \Omega_{net})|e_{t+1} - e_t = 0
$$

Given $a \leq \bar{a}_t \leq \bar{a}$, and using the implicit function theorem:

$$
\frac{\partial p_t}{\partial e_t} |\dot{E} = -\frac{\Sigma_{e-1}}{e_p}, \text{The following} \ -\frac{\Sigma_{e-1}}{e_p} \text{will be negative given } \Sigma_{e} > 1.
$$

$$
\frac{\partial p_t}{\partial e_t} |\dot{P} = -\frac{b_e}{b_p-1}, \text{Similarly,} \frac{\partial p_t}{\partial e_t} |\dot{P} < 0, \text{when } B_p > 1
$$

A- For a given small value of “$e$” $\frac{\partial p_t}{\partial e_t} |\dot{E} < 0$, and as “$e$” goes to $\infty$, $\frac{\partial p_t}{\partial e_t} |\dot{E} > 0$

B- For a given small value of “$p$” $\frac{\partial p_t}{\partial e_t} |\dot{P} < 0$, and as “$p$” goes to $\infty$, $\frac{\partial p_t}{\partial e_t} |\dot{P} > 0$

c- Given that $s_t, and \bar{a}_t$ are continuous on $e_t, and p_t$, there exist a value of $p', and e'$ such that $\frac{\partial p_t}{\partial e_t} |\dot{P} = 0$

e- Given that $s_t, and \bar{a}_t$ are continuous on $e_t, and p_t$, there exist a value of $p", and e"$ such that $\frac{\partial p_t}{\partial e_t} |\dot{E} = 0$.

The above A,B,C,D represent the shape of $\dot{E}$ and $\dot{P}$ loci figures.

2- We will show that there exist a non-trivial stable steady state to exist for a given value of $e_t$ and $p_t$. 

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For a value of $q = 1$, Equation (14) will hold only if, $f'(s^*) = f'(1 - s^*) = f'(\frac{1}{2})$. Then,

$$e_{t+1} = p_{t+1} = f(s^*) \int_{a_t}^{\bar{a}} \frac{1}{a-\bar{a}} \, da$$

if $\bar{a} > a_t > \underline{a}$.

Then if there is a steady state it should satisfy an $e^*$, $p^*$, along the $\hat{P}$, and $\hat{E}$ loci, such that $e^* = p^*$, where the above equality holds in both loci. And both loci must intersect exactly at a 45° straight line from the origin.

3- Given the optimum level of Schooling,

$$q = \frac{[A_{t+1} a_t(f(s_i^*) + f(1-s_i^*) + \alpha \Omega_{net})]}{[A_{t+1} a_t(f(s_i^*) + \alpha \Omega_{net})]} \frac{f'(s_i^*)}{f'(s_i^*) - f'(1-s_i^*)},$$

And using the implicit function theorem, then $\frac{\partial s^*}{\partial \Omega_{net}} < 0$. This will shift the $\hat{E}$, and $\hat{P}$, and loci in opposite direction since $\hat{E}$, and $\hat{P}$, are continuous on $s^*$.
### APPENDIX B:

<table>
<thead>
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<th>Variable</th>
<th>Explanation</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>Per-Capita Growth</td>
<td>Gross Domestic Product Per-capita Growth</td>
<td>World Bank</td>
</tr>
<tr>
<td>Natural Resource</td>
<td>Resource Rents as a Percentage Of GDP</td>
<td>World Bank</td>
</tr>
<tr>
<td>Savings</td>
<td>Total Savings as a Percentage of GDP</td>
<td>World Bank</td>
</tr>
<tr>
<td>Edu-Exp/Capita</td>
<td>Government Expenditures on Education Per Capita</td>
<td>World Bank</td>
</tr>
<tr>
<td>Trade</td>
<td>Terms of Trade As a percentage of GDP</td>
<td>World Bank</td>
</tr>
<tr>
<td>Manu-Per-GDP</td>
<td>Manufacturing Products as a Percentage of GDP</td>
<td>World Bank</td>
</tr>
<tr>
<td>FDI-inflows</td>
<td>Foreign Direct Investments as a Percentage of GDP</td>
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</tr>
<tr>
<td>Institution</td>
<td>Countries with Bad institution Multiplied by Oil Rents</td>
<td>World Bank</td>
</tr>
<tr>
<td>Government Transfers</td>
<td>Government transfers and subsidies of total expenses</td>
<td>World Bank</td>
</tr>
<tr>
<td>Democracy</td>
<td>Democracy level going from (0,6)</td>
<td>ICRG</td>
</tr>
<tr>
<td>Resources*Democracy</td>
<td>The combined effect of democracy and resources.</td>
<td>World Bank</td>
</tr>
<tr>
<td>Transfer*Res.</td>
<td>The combination of transfers and resources</td>
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#### Country Set

<table>
<thead>
<tr>
<th>Australia</th>
<th>Greece</th>
<th>Egypt</th>
<th>Algeria</th>
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<tbody>
<tr>
<td>Canada</td>
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<td>Switzerland</td>
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<td>Israel</td>
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<td>Indonesia</td>
<td>Yemen</td>
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<td>Luxembourg</td>
<td>Denmark</td>
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<td>France</td>
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<td>Russia</td>
<td>Argentina</td>
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</tbody>
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*Source: World Bank Development indicators*
REFERENCES:


European Economic Review, 50 (6), 1367-1386.


